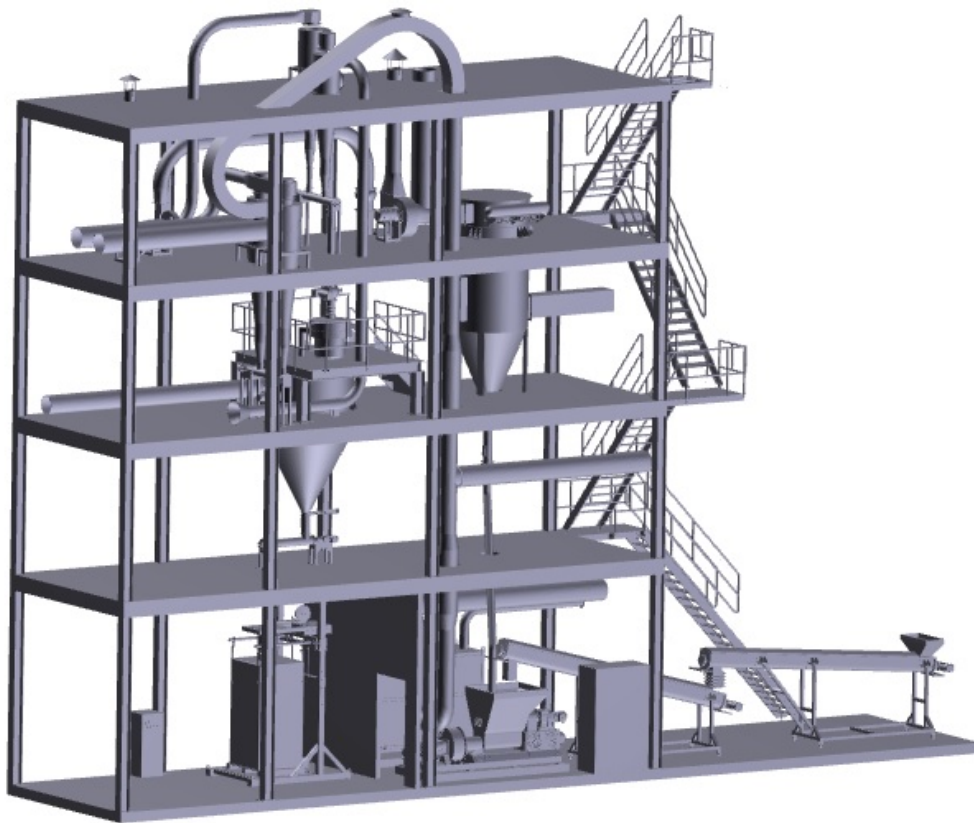




# **DRYER PLANT**

## **INSTRUCTION MANUAL**



## 1. Preface

This user manual contains operating and maintenance information for the MICROTEC Dryer plant and should be considered a permanent part of this unit. **The manual must remain with the equipment at time of transfer or release.** These instructions should be followed to ensure dependable performance.

The warranty applies only if the equipments are operated within the rating and service condition for which it was specifically sold and use of originally spare parts that are supplied by MICROTEC. The purchaser must prevent the existence of any destructive external conditions, which typically include:

- Operation close to critical condition
- Serve extra and shock loading
- Mechanical or thermal overload
- Other conditions of which the seller was not fully advise

The unit must be installed, operate, and maintained in accordance with the instructions in this manual.

Adequate installation, maintenance, and safety instructions should be provided to personal directly responsible for operation of the equipment.

Please remember that when service is required, MICROTEC process equipment and systems knows your equipment best. Consult MICROTEC for assistance.

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## 2. Safety

### 2.1 Overview

#### Introduction:

Employers are responsible for meeting safety and health regulations. MICROTEC equipment is designed and built to meet safety and health standards in effect at the time of manufacture. However, industrial equipment neither lasts forever nor is it designed to be self-restoring. MICROTEC expects that its equipment, when properly installed, operated, and maintained, will enable employers to comply with applicable safety regulations.

#### User Manual:

This manual should be a permanent part of the equipment and must remain with the equipment in case of transfer or resale. Read the manual carefully before the dryer is installed or used.

### 2.2 Safety Symbols:

Some of safety symbols are used in this manual for Important Information, Warning, and Danger:



Important  
Information



Hot surface warning



Warning that might cause  
damage or personal injury

## 2.3 Dryer Plant Safety Labels:

Safety Labels provide a direct and efficient method of displaying your information. Microtec ANSI Caution, Warning, and Danger labels allow operators to properly identify and display the level of hazard for each situation. In conjunction these labels can convey important information for a variety of hazards including, Sound noise, Heat or Hot Surfaces, Electric Shock and High Voltages, Heavy Lifting, Mechanical Crushes or Pinch Points, as well as protective gear situations.



## 2.4 Safety Devices:

Guards, alarms, interlocks, isolating valves, explosion vents, explosion relief, burst sensors, and other safety devices furnished by MICROTEC must be installed. Procedure in the operating instructions must be carefully followed. The user also is responsible for furnishing and installing guards or other safety equipment needed to protect operating personnel, even though such safety equipment might not have been furnished by MICROTEC.

### 2.4.1 Explosion Vent:

Explosion vents combine safety and shorter opening times. Explosion vents are specially designed for relief of dust explosion. When specifying explosion vents, the immense impact of pressure waves and flame propagation in the outside area need to be considered. Explosion vent must therefore be directed to a safe area.



**Never stand near or in front of explosion vent device or explosion vent duct.**

### 2.4.2 Burst Sensor:

The sensor signals the opening of the explosion vent so that equipment such as fan or air lock rotary valves can be switched off. Sensors are installed separately and just above the explosion vent. This enables sensors to be easily adapted to existing installations.





### 2.4.3 Explosion Relief:

Explosion pressure relief without blast flames or explosion vent duct. Responds and opens at low pressure setting. Uninterrupted operation after an explosion, reduced danger of fires and subsequent explosions due to immediate resealing.



**Never stand near or in front of explosion relief device.**

### 2.4.4 Isolating Valve:

Isolating valve provides explosion protection in flow direction without requiring external energy. In case of an explosion, the pressure wave pushes the closing device seal. The valve is locked in this closed state, preventing the spread of flames and pressure waves. Isolating valve is suitable for explosion in both directions.



## 2.5 Safety Guidelines

### General Guideline:

Below recommendation provided by Indian company who has done HAC study for this plant. The study report provided to PepsiCo (Saudi) and it is expected that all PepsiCo staff who are involved in this dryer plant, read that report carefully to know all hazardous area. Also we have brought recommendation of that report below and it is to be read and understood before installation and operating the dryer plant.

Specific recommendations for the Starch Drying have been described in the HAC Worksheets in section 7 of the report. Following general recommendations have been listed in addition to area specific recommendations:



- Compliance with applicable safety regulations and codes
- Personal protection of employers and use of hard hats, safety glasses, ear protection, etc.
- Protection of employees from exposure to hazard (hot surfaces, etc.)
- Clearly visible safety signs
- Regular housekeeping, in combination with regular scheduled inspections, should maintain the thickness of any dust deposit to less than one millimeter while the underlying surface color must be discernible. This requirement also applies for inaccessible locations such as on top of equipment and on overhead structures. Limited area where thicker dust deposits cannot be avoided should be cleaned at least once per shift. Housekeeping methods should avoid the generation of dust clouds and rising the dust that may settle again at higher elevations. The preferred methods for housekeeping is the use of vacuum cleaner either mobile units or central vacuum cleaning systems. The use of scoops, brooms and brushes for housekeeping both are acceptable according the NFPA 652 section 8.4.2.3, but care must be taken to prevent the formation of dust clouds.
- The use of air compressor air for cleaning ("blow down") is not allowed. An exception can be made for the cleaning of inaccessible area where there are no other alternatives, but this should be done under the restrictions outlined in NFPA 652, section 8.4.2.6.2.
- Ideally the antistatic floor is recommended in the production building. Alternatively, installed an earthed antistatic mat or metal floor plate where the operator stands while in contact with a flammable atmosphere.
- It should be ensured that all metal plant items involved in powder handling and processing operations are earthed with a resistance to earth less than 10 ohms. In addition, it is also important that the resistance to earth of metal

plant items is reliable, stable and checked on yearly basis or following maintenance.

- Ensure that all electrical apparatus used in hazardous area are of suitable zone rating.
- Alarm systems to alert employees that equipment is being started
- Venting of equipment away from work areas
- Emergency response instructions for operators

### Before Starting:

Check the following:



- Operator has received adequate instruction for safe operation.
- All access openings are closed and properly secured.
- Area is free of slipping and tripping hazards.
- No starch dust in the area.

### Additional Cautions:



- Keep clear of moving parts when stopping equipment. Rotating parts continue rotating after power has shut off.
- Lock out equipment to prevent accidental restarting during maintenance.
- Replace any guard, shield, or barrier before resuming operation.
- Do not operate equipment with interlocks, guards, shields, barriers, chains, and similar devices removed or alerted.



- Provide adequate installation, maintenance, and safety instructions to personnel operating the equipment.
- Keep unauthorized personnel at a safe distance from operating equipment.
- Make sure that the safety breakers are switched off and locked.
- Ear protection shall always be used when working on or by the machine.
- Maintenance shall be done according to instruction manual and only by authorized technician.
- Transport and handling has to be carried out by authorized personnel.
- Before doing any maintenance, switch off all electrical apparatus via the main switch and lock the installation to prevent it from being accidentally switched on.



**Never stand in front or behind the rotary equipments during start up**

## 2.6 Lockout / Tag out:

### Introduction:

Lockout-tagout (LOTO) or lock and tag is a safety procedure which is used in industry and research settings to ensure that dangerous machines are properly shut off and not able to be started up again prior to the completion of maintenance or servicing work. It requires that hazardous energy sources be "isolated and rendered inoperative" before work is started on the equipment in question. The isolated power sources are then locked and a tag is placed on the lock identifying the worker who has placed it. The worker then holds the key for the lock ensuring that only he or she can start the machine. This prevents accidental startup of a machine while it is in a hazardous state or while a worker is in direct contact with it

### Lockout Procedure:

The following lockout procedure contains the minimum information necessary to help you develop an energy control procedure that meets the requirements of Lockout/Tagout (Control of Hazardous Energy).



- The persons are authorized to lock out the machine or equipment using this procedure.
- The authorized employee will identify the type and magnitude of the energy that the machine or equipment uses, understand the hazards of the energy, and the methods to control the energy before using this procedure.
- Notify all affected employees that the machine or equipment is to be shut down and locked out for service or maintenance.
- Shut down the machine or equipment by the normal stopping procedure (such as depressing a stop button, opening switches, or closing valves).
- Completely isolate the machine or equipment from its energy sources by using the appropriate energy-isolating devices.
- Lock out the energy isolating devices with assigned individual locks if any, if not provided, it has to be provided by PepsiCo' personnel and operators.



- Dissipate or restrain stored and residual energy, such as that in capacitors, springs, elevated machine members, rotating flywheels, hydraulic systems, and air, gas, steam, or water pressure, using methods such as grounding, repositioning, blocking, or bleeding down.
- Make sure the equipment is disconnected from the energy sources and stored and residual energy has been made safe. Check that no personnel are exposed, and then verify the isolation of the equipment.



**Return the operating controls to the safe, neutral, or off position, after verifying the equipment is isolated from its energy sources.**

Restore the machine or equipment to service after the service or maintenance is completed and the machine or equipment is ready to return to its normal operating condition by doing the following steps:



- Check the machine or equipment and the immediate area around it to make sure all nonessential items have been removed and that the machine or equipment is in operating condition and ready to energize.
- Make sure all employees are safely positioned for starting or energizing the machine or equipment.
- Verify that the controls are in neutral.
- Remove the lockout devices and reenergize the machine or equipment.
- Notify affected employees that the servicing or maintenance is completed and the machine or equipment is ready to use.

### **Group Lockout:**

When two or more people are working on the same or different parts of a larger overall system, there must be multiple holes to lock the device. To expand the number of available holes, the locked-out device is secured with a folding scissors clamp that has many pairs of padlock holes capable of keeping it closed. Each worker applies their own padlock to the clamp. The locked-out device cannot be activated until all workers have removed their padlocks from the clamp.



### Out-of-service tags:

Out-of-service tags are used to identify equipment or machinery that has been taken out of service due to a fault, damage or malfunction.



## 3. System Description

### 3.1 Introduction:

The MICROTEC Dryer plant is widely used in starch production and can reach a high drying efficiency. Conventional drying consists of mixing and heating the solids to achieve even drying, and simultaneously transporting the vapors away from the surface of solids so as to maintain a high rate of mass transfer. Although these two stages can be achieved simultaneously by contacting the solids with a hot gas stream, heat-sensitive materials, such as foods and pharmaceuticals, may suffer thermal degradation, and other solids may lose some of their water of hydration when subjected to high temperatures. This problem may often be overcome by using flash drying technique to ensure that the solids are in contact with hot gas in a highly turbulent environment for only a very short time, perhaps for a few seconds. Flash-Drying process consists of a modified feeder in which the wet solids are introduced into a pipe through which they are transported in a high velocity hot gas stream.

### 3.2 Components and Principle:

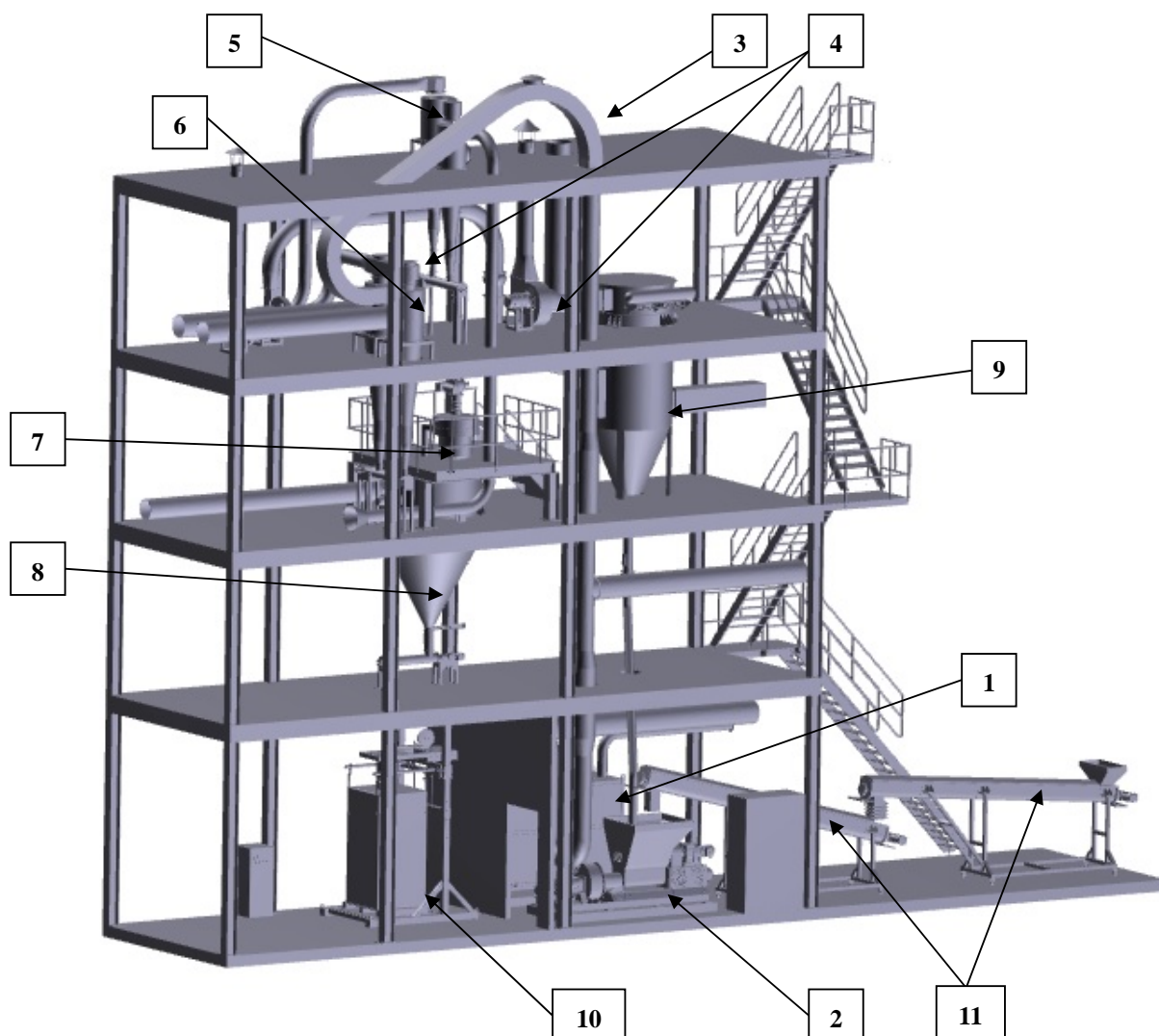
The Dryer Plant Project is designed to dry 350 kilograms of starch cake per hours and produce 260 kilograms dried starch per hours with 11-13% moisture. The Dryer Plant mainly consists of screw feeders, starch disintegrator and feeder, air heater, air fans, dryer main ducts, cyclones, screw conveyors, airlocks, sieve, silo, bag filter and packing machine. The disintegrator and feeder are together to be as a single machine.

Surface area of a wet lump increases as the size of the lump decreases. The disintegrator acts like a hammer mill that breaks up any lumps of concentrate and throws the concentrate into the feeder. Starch feeder conveys wet starch up into the drying column, where it travels concurrent with the hot air. Air heater increases the inlet air temperature to set point. The outlet-air temperature from air heater is controlled by regulating the starch cake feed rate and temperature to the dryer 1st fan. In drying process, heat is conducted to wet starch particulate through the dryer column, the water inside and outside of particles will be transformed into hot air stream in a short span time, usually 0.5 to 3 seconds, then mix with air flow in dryer tube. The pulverized material with hot air is conveyed through the drying duct to the cyclone separator by the suction force that created by the centrifugal fan and air locker to separate starch from air and water vapor. The material loses moisture during drying process. The temperature of air is reduced while its humidity increases. Fine particle that escaped from the cyclone are trapped by a bag filter. The air coming out of bag filter has minor dust of around 25mg/m<sup>3</sup>. The dried material is conveyed to vibrating screen sieve and then storage at silo. When starch in silo is reached to specified level; air knife valve is opened and discharged dried starch to packing machine by screw feeder with frequency

control speed.

### 3.2.1 Dryer major components:

1. Air Heater ( EQ-510)
2. Disintegrator (EQ-501) and Feeder (EQ-502)
3. Dryer column
4. Air Fans (P-501,P-502,P-503)
5. Separation Cyclones (EQ-503)
6. Cooling Cyclones (EQ-505)
7. Starch Sieve (EQ-507)
8. Starch Silo (V-501)
9. De-dusting Bag Filter (EQ-508)
10. Packing Machine (EQ-509)
11. Screw Conveyor (EQ-6002 , EQ-6003)





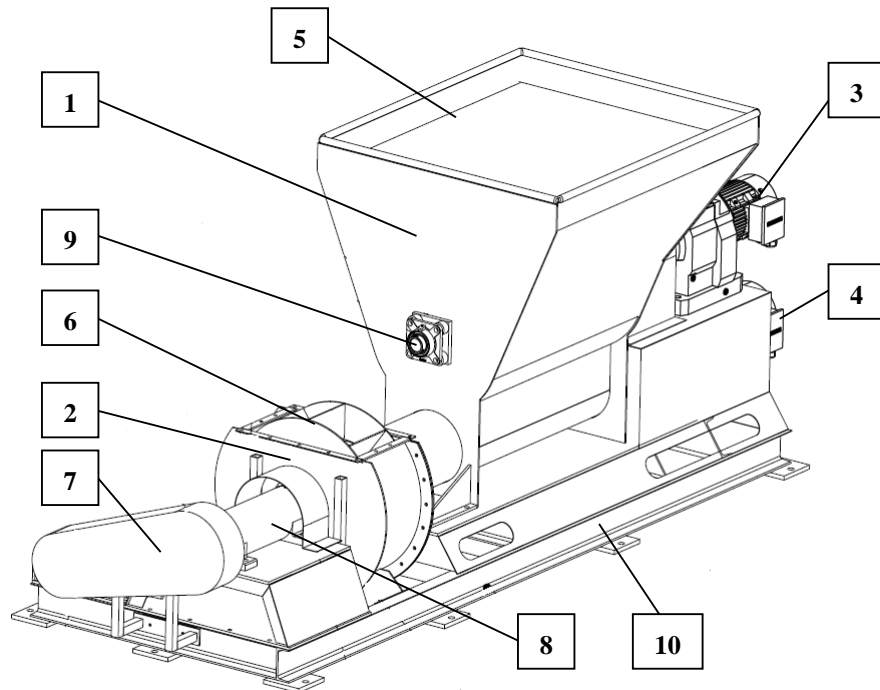
### 3.3 Dryer Temperature Control:

Traditional flash-dryer control system includes controlling the exhaust-air temperature by varying the inlet drying-air temperature. This control system performs adequately in the absence of process disturbances, but poor control and over drying or under drying occur in the case of load changes (starch feed moisture content) because of the short residence times of both solids and gases. For preventing from over or under drying, MICROTEC-based control in which the outlet-air temperature is controlled by regulating the starch feed rate, with feedback from outlet and inlet air temperature in closed loop control by PLC- base system.

## 4. Dryer Components

### 4.1. Disintegrator & Starch Feeder

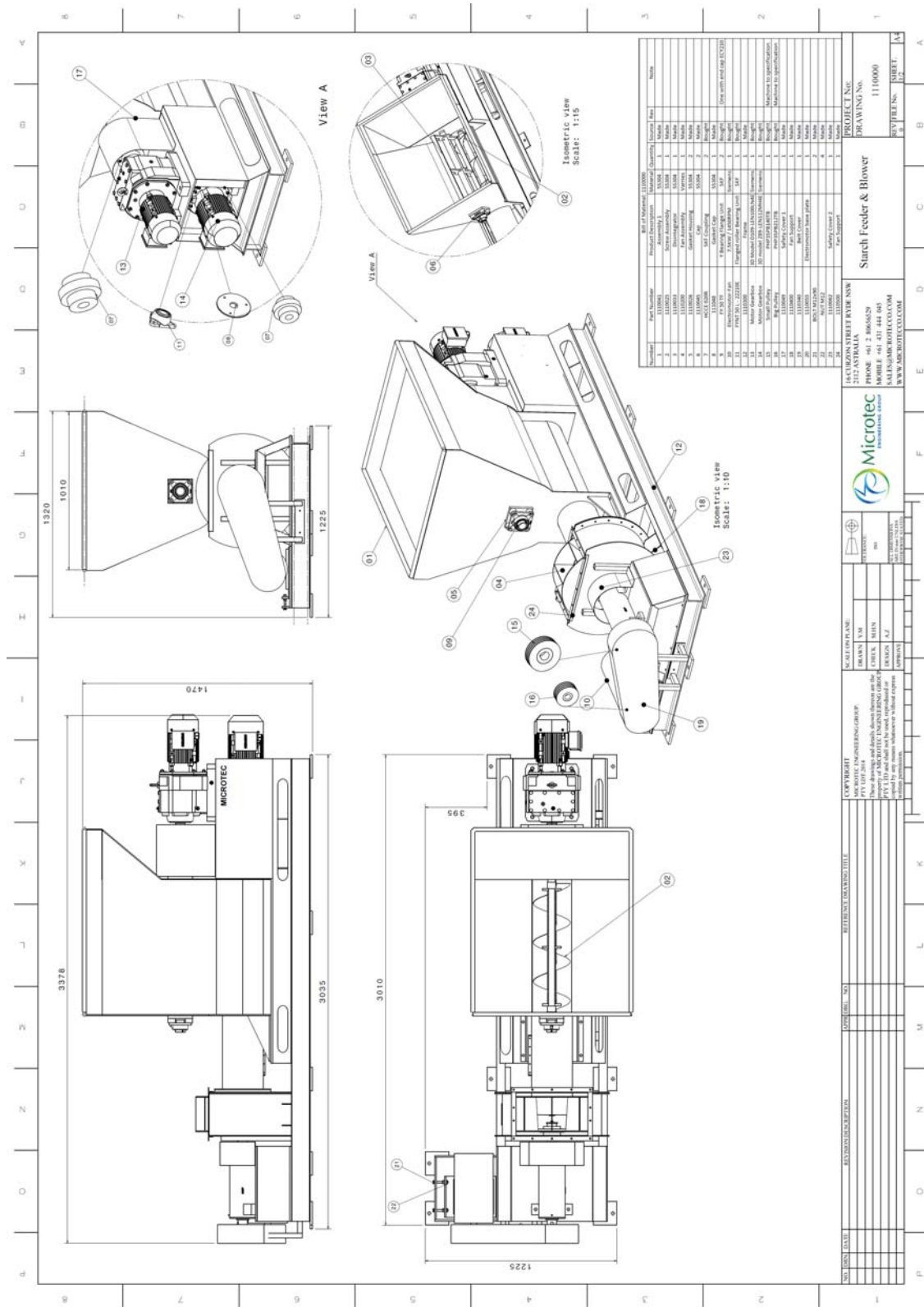
The disintegrator acts like a hammer mill that breaks up any lumps of concentrate and throws the concentrate into the drying feeder. Drying feeder conveys wet starch up into the drying column, where it travels concurrent with the hot air. The disintegrator and starch feeder are combined all together as a single machine. Starch feeder motor speed specifies starch feed rate. Outlet-air temperature going to main fan is measured by temperature sensor and controlled by regulating the starch feeder motor speed (starch feed rate) and temperature controller. Disintegrator and starch feeder arrangement:



1. Disintegrator
2. Starch Feeder
3. Disintegrator Impeller Drive
4. Screw Drive
5. Hopper
6. Feeder Rotor
7. Feeder Drive Unit
8. Feeder Bearing Housing
9. Impeller Bearing
10. Base Frame

## Reference Document

This document has been developed using information:



#### **4.1.1. General Safety Instruction**

The disintegrator and starch feeder operates reliably and safely if this operation manual is observed. Inexpert use can cause both malfunctions and danger to people. Therefore, this operation manual is binding for any person in charge of installation, start-up, operation and maintenance at the purchaser's works. The machine must be used for the purpose defined in the contract only. The machine must be used, maintained and repaired by authorized and well-trained personnel only. The operating personnel must be informed about possible dangers by reading this operation manual. It is necessary to observe the shut-off procedures described in the operation manual of the system into which the machine is integrated. It is not allowed to carry out any work which impairs the reliability of the machine and associated system components.

The operator has to make sure that no unauthorized person works at the machine. Operator is obliged to run the disintegrator and starch feeder always in perfect condition. The manufacturer declines liability for unauthorized changes which impair the function and safety of the machine. Lock out power before servicing this equipment. Work on the machine must always be carried out during shutdowns. This applies especially to the removal of safety guards. In this case the drive must be secured against being switched on inadvertently. It is not allowed to remove information, mandatory, and prohibitive signs. If the machine is started up again after a shutdown, make sure that all safety guards have been mounted properly.

### 4.1.2. Transportation and Storage

During transport the disintegrator and starch feeder must be handled with care in order to avoid damage due to harsh treatment or careless loading and unloading.



**The machine must be attached only at the intended points (eye bolts or openings). For loading and transport it is prohibited to use motor mounting eyes in any case.**

Complete machine must be loaded in such a way that their position corresponds to their installation position. Inclined positions or similar deviations must be avoided at any rate. The devices have to be loaded in such a way that they cannot move, tilt or get in contact with each other. The transporting agent and his loading expert are responsible for transport safety devices which are suitable for the duration of the transport.

The machine should be stored in roofed rooms. Close openings in the housing of the machine which are not shut with covers in order to prevent water from penetrating. During the storage period a minimum amount of maintenance work is necessary to maintain inoperative.

- The impellers must be spun in regular intervals (once per month). For this purpose the impellers or the shaft should be marked in such a way that the runner's idle position is offset by 90°. If the bearings are relieved it is not required to spin the impeller.
  
- If storage last for more than 3 months, the bearings must be opened before start-up and checked for corrosion damage caused by condensate. If required, the old grease has to be removed; the bearings must be cleaned and provided with new grease.

The storage of the motors must not affect their inoperative. Therefore, they should not be subjected to moisture or heat. In this connection, please refer to the operating instructions of the motor manufacturer. Depending on the order, machine are primed, and then coated with a basic or covering varnish. Bright parts are treated with rust preventing grease or preservative oil. If the machine is stored for longer than 9 months it must be preserved once more.

### 4.1.3. Installation

With regard to plant engineering, make sure that the machine is freely accessible for installation and maintenance work. Adjacent plant sections or machines have to be arranged correspondingly. The machine can be installed either on a concrete foundation or a steel structure. The main drawing and the dimensional sheet contain the necessary dimensions. During transport the machine and components must be handled with care in order to avoid damage due to harsh treatment or careless loading and unloading. The foundation, framed, alignment and heights must be checked. Machine is placed on the concrete base after its hardened and checked with water gauge.



**Machine must be leveled carefully before initial startup.**

The machine must be installed according to technical documents by doing following steps:

- Set and clean foundations which are capable of bearing or stable framings with plane horizontal surfaces corresponding to the dimensions of the machine to be installed.
- The foundations and frames must be checked.
- The alignments and height must be measured.
- Free access and local freedom of motion in the area of assembly.
- Mobile or stationary hoists.
- Work side current 10A/220V for manual electric devices.
- The machine has to be suspended by the lifting eyes.
- Afterward the machine is placed on the foundation shall be aligned and leveled exactly by means of water level or similar measuring tools.

#### 4.1.4. Operation

Before the machine is started up, the following steps must be implemented:

##### Checking:



- Check all visible screwed unions for tightness and retighten them, if necessary.
- All lubrication points for bearings must be provided with grease.
- Check the fastening elements for the safety devices for correct installation.
- Removal all foreign matters (parts for assembly, tools) from the disintegrator hopper and feeder housing. The same applies to connecting ducts.
- The machine must not be subjected to static stress caused by connected piping.
- Check attached compensators/elastic expansion joints for function and correct installation.
- Check all the electric system for compliance with the EN standard.
- Check and adjust the protective devices (relays for motors, relay for power switches, counter, grounding, etc).
- Under normal condition, the ambient temperature of the motors must not exceed 45°C.
- Check the direction of rotation of the motors.

##### Start up:



- Keep out of the machine's danger zone!
- Switch on machine.
- Special attention should be paid to the temperature of the bearing.
- The power consumption of the motor shall be checked.
- After 2 hours of operation check the machine vibration, noise, bearing temperature, motors current, motors temperature and impellers and screw speed.
- After 12 hours operation check all screws tightness, bearing temperature, fan vibration, noise, motor current and impeller speed.



**Keep out of the machine's danger zone!**

### Shutdown:



- Make sure no starch is left inside the machine.
- Switch off machine
- Switch off main switch.
- Make sure that the motors cannot switch on again by unauthorized persons. The valid regulations for prevention of accidents must be observed.

### 4.1.5. Maintenance

#### General:

Expert and regular maintenance is a prerequisite for trouble free operation. To prevent long periods of repair and downtimes, the following recommendation should be strictly observed. Check all screwed union, especially foundation bolt, at intervals of six months for tightness and retightens them, if required. Also check the impellers every six month by visual inspection. Pay special attention to the condition of the weld seams and irregular deposits of dirt. If starches which contain dust are conveyed through the hopper, monthly checks are necessary. The results of these visual inspections should be recorded. The bearing temperatures must be permanently observed during start up. Bearing temperature must not exceed 80°C. The temperature becomes stable after three hours of operation at the earliest.



**Vibrations represent a very high stress to the entire mechanical system of the machine! Therefore, measurements are required at regular intervals. Instructions for vibration measurements are given in section 4.1.8. If the results of the measurements exceed the admissible values although the machine has been maintained according to the instructions, please inform the manufacturer.**



## Bearing and Lubricants:

The antifriction bearings installed are subject to the manufacturer's lubrication instruction. Bearing were originally filled with the lubricant **contain a synthetic base fluid in lithium complex soap thickener and NL GI of grease shall be Grade 2 for operating above 150°C** (or equivalent grease ). Other lubricants can also be used, of course, if they have comparable characteristics. When cleaning the housing, completely remove old grease, possibly clean the bearing and fill with new grease. The lubricants must be stored in clean, closed containers to prevent dust and moisture from penetrating. The storing place should be dry and cool. Lubrication interval depends on the rotational speed, the bearing structure and the shaft diameter. The recommended schedule for greasing is clearly showed in following table:

APPROXIMATE GREASE RELUBRICATION SCHEDULE

Shaft Dia. (mm)	Speed (RPM)				Grease Added At Each Interval (gr.)	
	100-900	1200	1800	3600	Roller Bearing	Ball Bearing
35	2140	1715	980	515	10	2
40	2000	1600	900	460	11	3
50	1880	1495	830	410	12.5	3.5
55	1670	1320	705	320	19	5
60	1495	1170	600	320	20	6
70	1420	1105	550	320	24	6.5
75	1345	1040	505		27	7
80	1280	980	460		32	7.5
90	1155	875	380		42	11
100	1045	775	300		53.5	
105	940	680			68	
115	845	595			74	
125	755	515			85.5	
130	670	440			99	
140	590	365			117	
150	515	265			134	

## Impellers:

In case of long shutdowns spin the impellers once per week. Here the final position should be offset by 90° compared to the previous idle position. Apart from the regular visual inspections (at least once a year) the impeller must be cleaned whenever it is dirty. The cleaning intervals depend on the fluid conveyed.

## Motors:

Under standard condition the motors are maintenance free. Permanently lubricated bearings do not require re greasing. Apart from this, the motor manufacturer's maintenance instructions are valid.

### 4.1.6. Repair

#### General:

This section contains Instructions for repair which only includes the exchange of original components. In case of problems which are not mentioned in this section, please contact MICROTEC. Make sure for every repair that the machine cannot be switched on inadvertently.

#### Exchange of disintegrator Impeller:



- Switch off motors.
- Switch off main switch.
- Make sure that the motor cannot switch on again by unauthorized persons. The valid regulations for prevention of accidents must be observed.
- Dismount gearbox coupling.
- Loosen all bolts and nuts.
- Strike impeller withdraws impeller.
- The new impeller must be treated carefully in order to prevent any unbalance caused by an impact.
- The impeller is assembled in reverse order.

#### Exchange of Starch Feeder Impeller:



- Switch off motor.
- Switch off main switch.
- Make sure that the motor cannot switch on again by unauthorized persons. The valid regulations for prevention of accidents must be observed.
- Remove piping for free access to the impeller.
- Remove v-belts.
- Dismount pulley.
- Dismount bearing housing with shaft.
- Strike impeller; loosen safety bolt and nut and withdraw impeller.
- The new impeller must be treated carefully in order to prevent any unbalance caused by an impact.
- The impeller is assembled in reverse order.

### Exchange of Disintegrator Bearings:



- Switch off motor.
- Switch off main switch.
- Make sure that the motor cannot switch on again by unauthorized persons. The valid regulations for prevention of accidents must be observed.
- Dismount motor and gearbox.
- Remove coupling, if one exists.
- Dismount bearing according to the manufacturer's instructions.
- The bearings are mounted in reverse order.

### Exchange of Starch Feeder Bearings:



- Switch off motor.
- Switch off main switch.
- Make sure that the motor cannot switch on again by unauthorized persons. The valid regulations for prevention of accidents must be observed.
- Dismount shaft guard.
- Dismount motor and gearbox.
- Remove belts and pulley.
- Dismount bearing according to the manufacturer's instructions.
- The bearings are mounted in reverse order.

#### 4.1.7. Machine Troubleshooting

Malfunction	Possible cause	Solutions
<b>Machine Excessive Vibration</b>	<ol style="list-style-type: none"> <li>1. Loose base fastening.</li> <li>2. Moving balance of the starch feeder impeller.</li> <li>3. Rotor does not work. Impeller are worn out, or broken</li> <li>4. Bearing worn out or broken.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check the base.</li> <li>2. Check the moving balance of the Impeller.</li> <li>3. Change impeller and check all rotating parts.</li> <li>4. Check and replace bearing.</li> </ol>
<b>Machine Higher Motors Amper</b>	<ol style="list-style-type: none"> <li>1. Bearing are not adjusted properly</li> <li>2. A hard material (stone, metal or ..) is dropped into the machine</li> <li>3. Alignment of drive unit and impeller shaft.</li> </ol>	<ol style="list-style-type: none"> <li>1. Bearings in both sides of the disintegrator need adjustment.</li> <li>2. Stop the machine immediately and take out any foreign material</li> <li>3. Check alignment.</li> </ol>
<b>Feeder Output and are too low</b>	<ol style="list-style-type: none"> <li>1. Speed too low</li> <li>2. Wrong direction of rotation.</li> <li>3. Plant resistance larger than calculated.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check power transmission, bearing, motor, electrical circuit.</li> <li>2. Check direction of rotation.</li> <li>3. Check process calculation and piping.</li> </ol>
<b>Machine Excessive Noise</b>	<ol style="list-style-type: none"> <li>1. Lubrication fault. Different types of grease have been mixed.</li> <li>2. Bearings are not adjusted properly.</li> </ol>	<ol style="list-style-type: none"> <li>1. Relubricate according to instruction.</li> <li>2. Check alignment Bearing sin both sides of the Fan need adjustment.</li> </ol>
<b>Impeller dose not move although motor is running</b>	<ol style="list-style-type: none"> <li>1. Fracture of the impeller key.</li> <li>2. Hub detached from impeller.</li> </ol>	<ol style="list-style-type: none"> <li>1. Withdraw impeller, exchange key, check shaft and hub.</li> <li>2. Exchange impeller completely.</li> </ol>
<b>Motors too Hot</b>	<ol style="list-style-type: none"> <li>1. Cooling air temperature above 40°C.</li> <li>2. Flow of cooling air is impeded.</li> <li>3. Motor over load.</li> </ol>	<ol style="list-style-type: none"> <li>1. Improve supply of fresh air; install forced-air cooling system.</li> <li>2. Improve air supply.</li> <li>3. Check process line.</li> </ol>
<b>Bearing temperature too high</b>	<ol style="list-style-type: none"> <li>1. Unacceptable operating temperature.</li> <li>2. Wrong lubricant.</li> </ol>	<ol style="list-style-type: none"> <li>1. Change operating mode.</li> <li>2. Lubricant as per instruction.</li> </ol>

#### 4.1.8. Feeder Vibration Measurement

A variety of mechanical defects can be traced back to one of the three main causes of increased machine vibrations: loose fastening elements, poor alignment and unbalances. Changes in the operating performance have a direct influence on the vibration behavior of a machine. The measuring method recommended by the internationally accepted regulations (VDI 2056, ISO 2372) is so easy that it can be carried out the maintenance personnel without special training in vibration measurement.

The regulations subdivide industrial machines into six vibration classes. Only the effective value  $V_{eff}$  of the vibration speed is measured. By comparison with the specified limit values for the corresponding vibration class, the vibration behavior of machine can be immediately evaluated as good, acceptable, still acceptable or unacceptable.

A certain amount of vibration is unavoidable and must be tolerated. Only if this standard vibration level is exceeded, the conditions have deteriorated. The manufacturer's specifications in the inspection protocol serve as reference values. Experience has shown that one gets the best idea of the vibration behavior of machine by measuring the vibration intensity. The vibration intensity is defined as the effective value of the vibration speed in the frequency range between 10 and 1000 Hz. The vibration intensity is measured in mm/s with the supplement  $V_{eff}$ . It is a direct measure for the energy content of the vibrations and therefore a good parameter for the destructive forces which possibly occur at a machine.

##### Selection of Measuring Point:

The vibration at the selected measuring point should be represented for the vibration behavior of the machine. The forces which occur are usually transmitted via the bearings and the bearing housings to the housing and the foundation of the machine. Therefore vibration should be measured at bearing housings or at a point immediately next to the bearings. Light attachment parts such as covers or duct connections as well as other components which are much less stiff than the machine are not suitable for the measurements. The more measuring points, the easier mechanical disturbances can be located. The measuring results at the bearing on impeller side mainly provide information about unbalances of the impeller. To get an idea of the state of the complete machine, the bearings on the drive side of impeller and motor have to be measured. The direction of vibration is important, too. Unbalances rotate with the shaft and cause radial vibrations, i.e. vibrations in all directions, at right angles of the shaft. Axial vibrations along the shaft are often caused by poor alignment, poor coupling or bent shafts. Therefore, at a measuring point measurements are usually taken in three directions: vertical, horizontal and axial. The two radial values permit an additional evaluation: Increased vertical values point to insufficient or damaged fixtures or foundations, whereas it is possible to draw conclusions from the horizontal measuring value to unbalances. The exact measuring point at which the sensing element is fixed should

be clearly marked and also used for future measurements. Otherwise, the measured values cannot be compared.

### Evaluation of Vibration Behavior:

According to VDI 2056 the machines are subdivided into six groups, depending on

- machine size and mode of operation
- erection/foundation

For each group the limit values for good, acceptable, still acceptable and unacceptable vibrations have been defined to serve as a basis for comparing of the measured values. Most machines belong to groups M, G and T. Group K comprises smaller machines which are only rarely measured. Driving power, type of drive, machine size and stiffness of foundation are characteristics for assigning the individual disintegrator to the machine groups. A machine with a driving power of approx. 100 kW on a concrete foundation belongs to group G. If mounted on another foundation, e.g. on the rather elastic deck of a ship, the same machine would however be allocated to group T.

Limit values	Group				mm/s	RMS	
	M	G	T	D			
28							Unacceptable range
18						20	Still acceptable range
11							Acceptable range
7,1							Good
4,5						5	
2,8							
1,8							
1,1						1	

Group M: Medium-size machines without special foundations; also firmly mounted driving mechanisms and machines (up to approx. 300 kW) with rotating parts on special foundations only.

Group G: Large machines on high-tuned, rigid or heavy foundations, large power engines and machines with circulating masses.

Group T: Large machines and power engines on low-tuned foundations with circulating masses, e.g. turbo groups.

Group D: High-tuned installed machines and driving mechanisms with mass effects which cannot be compensated.

#### 4.1.9. Technical Specification

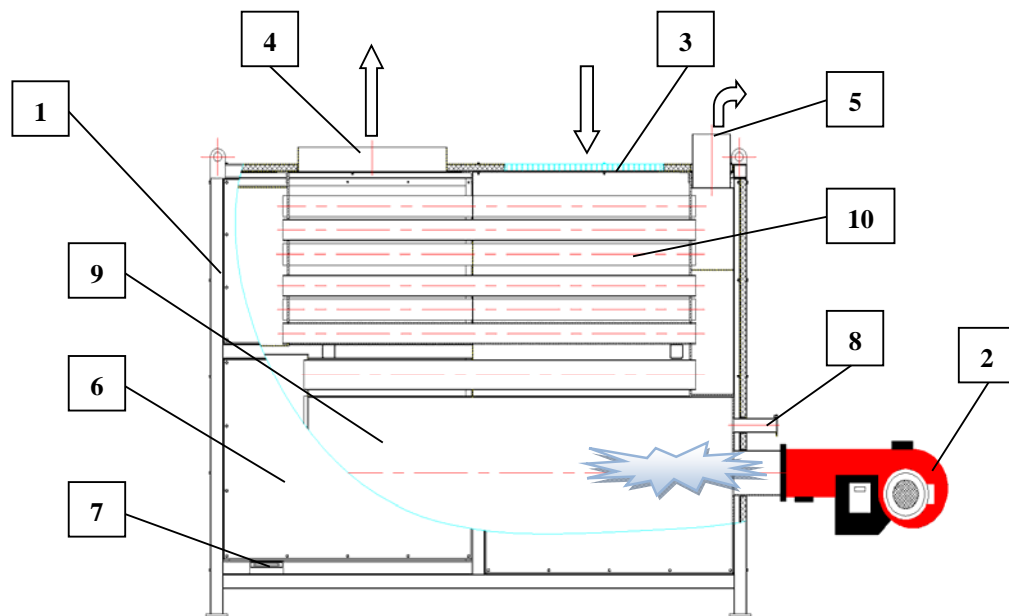
Technical Item	Unit	Quantity
Capacity	<i>Kg/h</i>	
Feeder Rotation speed	<i>RPM</i>	
Power	<i>KW</i>	
Total Weight	<i>Kg</i>	
Overall Dimension	<i>mm</i>	
Material		Food Grade Stain less Steel

#### 4.1.10. Spare Parts

Name	Model	Specification	Remark
Bearing			
Bearing block			
Shaft Seal			
impeller			
O-shape gasket ring			
V-shape gasket ring			
Gasket			
Vibrating Isolator			
Shaft			
belts			
pulley			

## 4.2. Air Heater

In the air heater, fresh air heated up from room temperature to .... °C by help burner which is using natural gas. Air heater is in indirect air heat exchanger. Ambient air going to the air heater which has several heating pipes via an air filter. Fresh air temperature increases while touching hot pipes of air heater. The air heater outlet temperature is measured by temperature sensor and controlled by TIC. TIC is controlled air temperature according to set point and heater outlet air temperature feedback from temperature sensor TI by regulating inlet natural gas to burner.



1. Air Heater
2. Gas Burner
3. Air Intake Filter
4. Air Outlet
5. Exhaust (to outdoor)
6. Insulated Cover
7. Safety Opening
8. Inspection Drawbridge
9. Furnace
10. Fire tubes



## Reference Document

This document has been developed using information from the following sources:

- 1- Air Heater Drawing: 5053-ME-DW-0000000
- 2- Gas Burner Manual –WM10 – Weishaupt monarch

### 4.2.1. General Safety Instruction

The air heater operates reliably and safely if this operation manual is observed. Inexpert use can cause both malfunctions and danger to people. Therefore, this operation manual is binding for any person in charge of installation, start-up, operation and maintenance at the purchaser's works. The air heater must be used for the purpose defined in the contract only. The air heater must be used, maintained and repaired by authorized and well-trained personnel only. The operating Personnel must be informed about possible dangers by reading this operation manual. It is necessary to observe the shut-off procedures described in the operation manual of the system into which the fan is integrated. It is not allowed to carry out any work which impairs the reliability of the air heater and associated system components. The operator has to make sure that no unauthorized person works at the machine. Operator is obliged to run the air heater always in perfect condition. The manufacturer declines liability for unauthorized changes which impair the function and safety of the air heater. Lock out power before servicing this equipment. Work on the air heater must always be carried out during shutdowns and cool downs. This applies especially to the removal of safety guards. In this case the gas burner and main fan must be secured against being switched on inadvertently. It is not allowed to remove information, mandatory, and prohibitive signs. If the air heater is started up again after a shutdown, make sure that all safety guards have been mounted properly.



- The work on the system and on electrical voltage components represents considerable danger to life and limb in the event in proper handling.
- Do not work on live electrical components and elements (electric motors, cabinets, etc) if you are not sure that these are indeed disconnected electrical shock represent a danger to life.
- Do not use the system if parts of the system are faulty, missing or damaged. Don't operate the system without intake filter elements.

- Explosion vents on heater outlet duct combine safety and shorter opening times. When specifying explosion vents, the immense impact of pressure waves and flame propagation in the outside area need to be considered. Explosion vent must therefore be directed to a safe area.
- In case of explosion the burst sensor on heater outlet duct signals the opening of the explosion vent so that equipment such as fan or burner can be switched off. Sensors are installed separately and just near the air heater.



**Never stand near or in front of explosion vent device or explosion vent duct.**

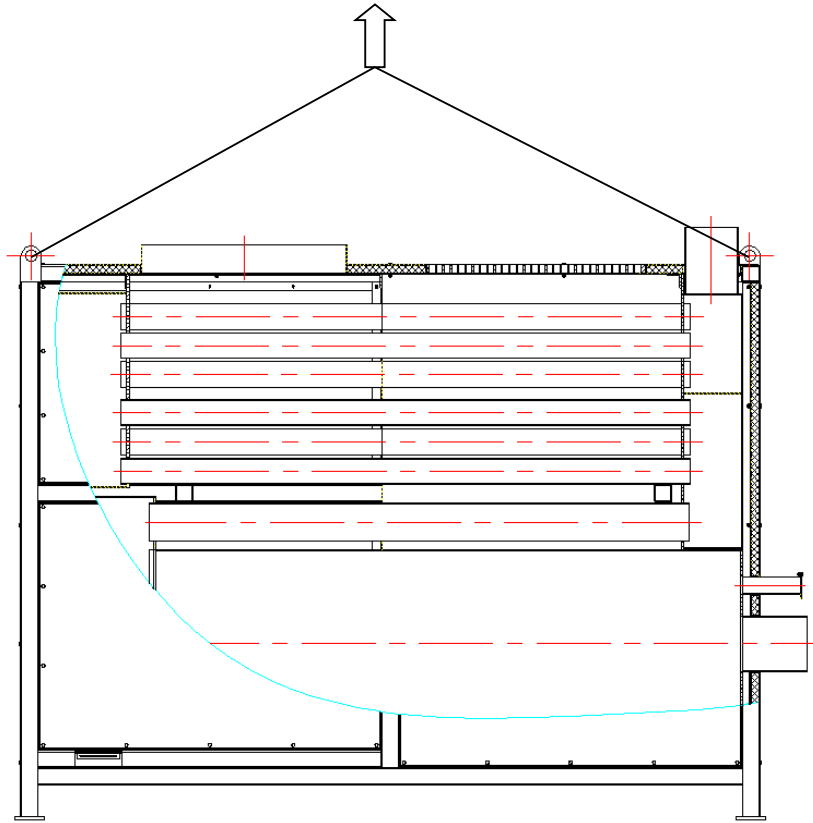
#### **4.2.2. Storage, Transportation and Installation**

Overturning or not permanently fixed equipment may represent a danger to life and limb. The system must be secured against overturning and sliding during the storage and transport. Do not stand under or next to the load when lifting and lowering. Lift trucks or forklift trucks or transport cranes must have sufficient minimum loading. The system may only be installed on suitable flooring. Falling over or functional impairments may otherwise represent a danger to life and limb. The substrate must be vibration free and horizontally aligned. The operator has to verify the viability of the ground. The system must be secured to the substrate, e.g. using lag bolts or heavy - duty anchors. The system must be protected from the weather. Otherwise, the system functions may be impaired. The system must be stored in a dry place and protected from moisture during transport.



**The air heater must be attached only at the intended points (eye bolts or openings). For loading and transport it is prohibited to use burner mounting eyes in any case.**

General schematic of lifting centrifugal fans:



- Improper work on the system and on electrical voltage components represents considerable danger to life and limb in the event of improper handling. The operator is responsible for ensuring that all work is carried out by authorized and qualified personnel. The operator must ensure that their authorized personnel are familiar with all the safety indications in this manual in advance.
- The connecting piping leading from the air heater must be fixed to the air inlet and outlet flanges.
- The air intake filter is manually cleaned. Cleaning is carried out pneumatically.
- The external gas fuel supply for gas burner must be provided by the customer with an approved system.



- The operating gas pressure must be according to burner manufacturer instruction
- Connect the control cable of the gas burner.
- Connect the gas fuel hose to gas burner.
- The device may only be operated if all necessary measuring cables and hoses are connected.
- The housing of the external control must be firmly and reliably mounted close to the unit on the wall or at any other appropriate mounting point.
- Connect the control and gas burner to the power supply.
- Pay attention to the admissible supply voltage. An incorrect power supply may result in an electrical malfunction of the system.

With incorrect motor rotation direction, the fan of burner must be disconnected from the power supply and two phase at the inlet inverted. For all detail installation of burner please go to burner manufacturer operation and maintenance manual and use this manual as a general guide only.

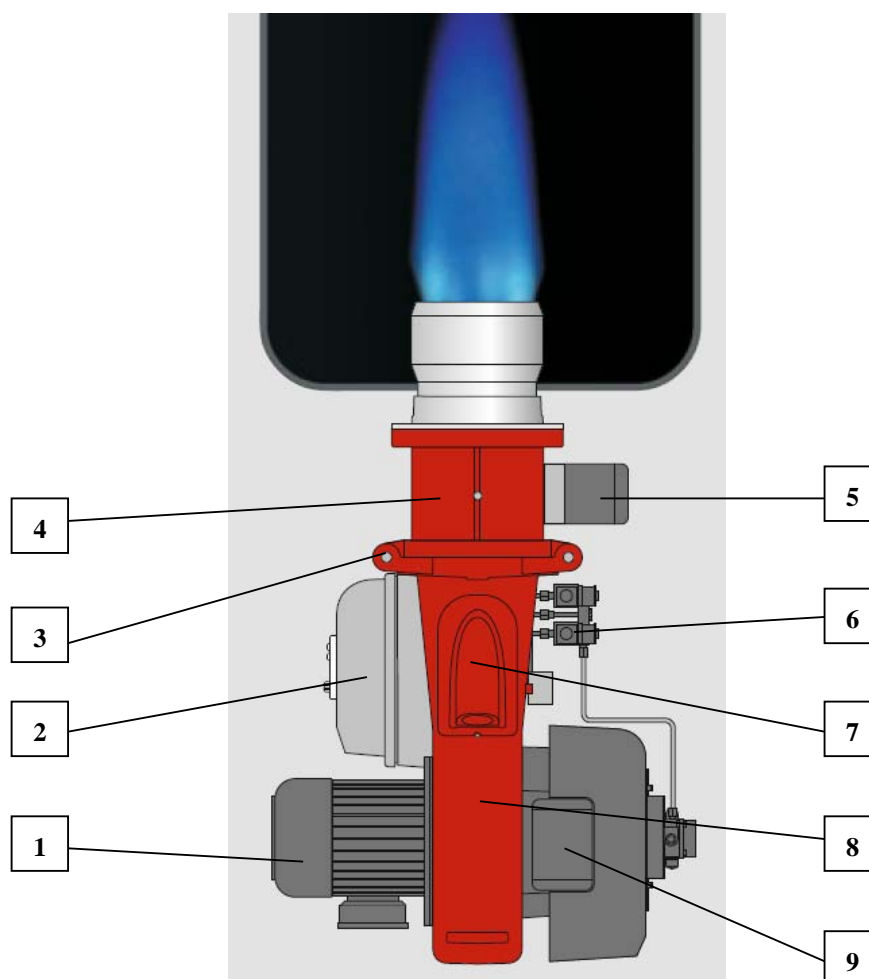
#### **4.2.3. Gas Burner**

Use all information below as reference only. For all detail installation of burner please go to burner manufacturer operation and maintenance manual and use this manual as a general guide only.

Gas fuel burner is equipped with electronic fuel air ratio controller and digital combustion as standard. Modern heating applications require precise and always repeatable correct mixture of fuel and air. Only this way, optimum combustion values can be guaranteed for a long period of time. The programming of burner function is performed via the display and control unit is connected to the combustion manager via a BUS system.

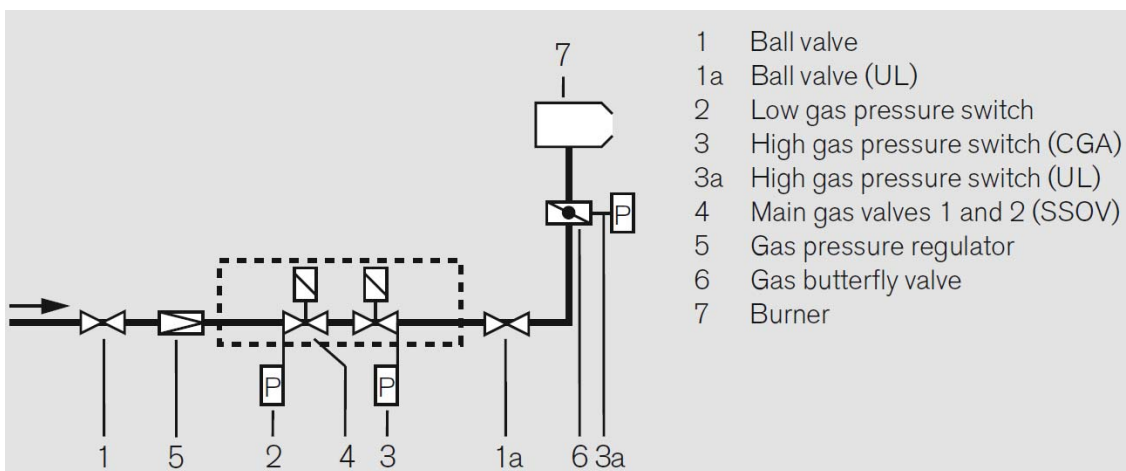
- Suitable fuel : natural gas
- Operating Temperature : -15 to +40°C gas
- Air humidity: ax. 80% relative humidity, no condensation.
- For indoor operation only
- Digital combustion manager for all firing rates
- Burner is equipped with adjustable flame tube

## Gas Burner Components:



1. Burner Motor
2. Digital Combustion manager with flame sensor
3. Burner Casing
4. Mixing head
5. Actuator for gas butterfly
6. Solenoid Valves
7. Electronic Ignition unit
8. Blower Casing
9. Actuator for air damper

### Gas train schematic:



- Gas train must be mounted tension free.
- Do not compensate for misalignment by over tightening.
- Distance between burner and gas valve should be as small as possible.
- Pay attention to the correct gas flow direction.
- The gas train must be fixed and supported securely. They must not be allowed to vibrate during operation.
- Support suitable for the site should be fitted during installation.
- For commissioning a gas meter is required to verify exact gas consumption.

#### 4.2.4. Maintenance

For the Burner use all information below as reference only. For all detail installation of burner please go to burner manufacturer operation and maintenance manual and use this manual as a general guide only.

Correct and regular use and maintenance of the unit heater will determine rational and efficient operation, minimum consumption as well as long life. The maintenance must be done with the device cold, with the gas and electricity supplies cut off.

- Check the correct functioning of all safety devices and verify that all the screws are correctly tightened.
- Burner: Disassemble the burner, check their condition and clean them.
- Gas Filter: Disassemble.
- Exhaust: Disassemble the duct and sweep it out.
- Air Intake Filter: Disassemble the filter and clean it with air or replace.

#### 4.2.5. Air Heater Troubleshooting

Malfunction	Possible cause	Solutions
<b>Air heater dose not start</b>	1. Incorrect wiring. 2. Lack of voltage.	1. Check the wiring. 2. Verify the electrical supply.
<b>The air heater does not heat sufficiently</b>	1. Incorrect temperature set point. 2. Insufficient gas pressure.	1. Check the set point. 2. Check the gas supply pressure.
<b>The air heater never stop</b>	1. The TIC set point is too high or is defective. 2. Incorrect wiring.	1. Check the set point. 2. Check the wiring.
<b>The air heater never stop</b>	1. The TIC set point is too high or is defective. 2. Incorrect wiring.	1. Check the TIC and set point. 2. Check the wiring.
<b>The ignition electrode is making spark</b>	1. Gas solenoid valve defective. 2. Combustion manager defective. 3. No gas. 4. Air in the piping.	1. Replace it. 2. Replace it. 3. Check the pressure. 4. Bleed the piping

#### 4.2.6. Technical Specification

Technical Item	Unit	Quantity
Air Intake Filtering Area	M2	
Air Intake Filter Material		
Filter Dimension	mm	
Maximum Air outlet Temperature	°C	
Operating Air outlet temperature	°C	
Gas Burner catalog number		
Burner Heat Capacity	Kcal/h	
Maximum Gas Pressure	Pa.	
Fuel Gas consumption	M3/h	
Total Installed Power	KW	
Air Heater Weight	Kg	
Overall Dimension	mm	
Air Heater Material		

#### 4.2.7. Spare Parts

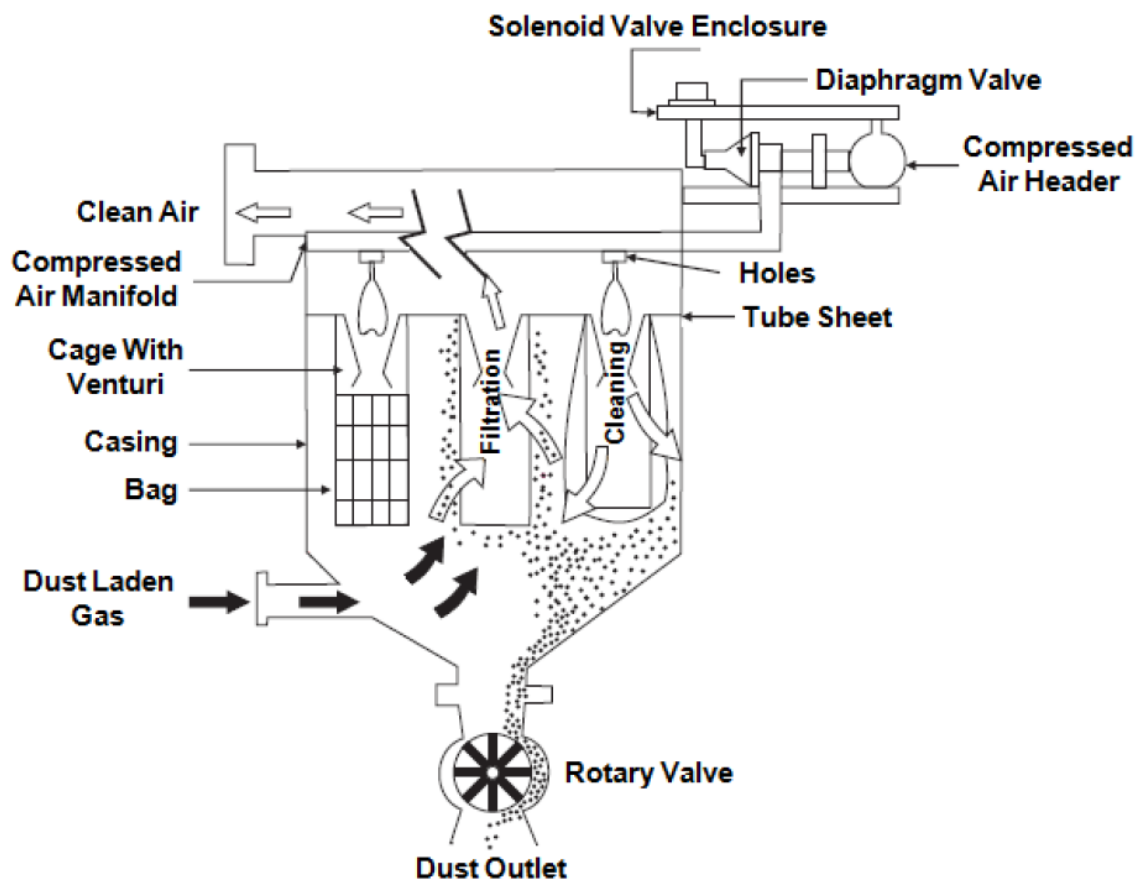
Name	Model	Specification	Remark
Air filter			



### 4.3. Bag Filter

In pneumatic conveying systems handling fine or dusty material, the method of filtration that has become almost universally adopted is a bag type fabric filter. These filters are commonly called baghouses. Most bag houses use long, cylindrical bags (or tubes) made of woven or felted fabric as a filter medium. Dust laden air enters the bag house through hoppers by suction or positive pressure tangentially at the middle of the casing; it gives the dust laden gas a circular motion which helps in removing the heavy and coarser particles that are present in the gas stream in a manner similar to a cyclonic collector. These collected particles are directly discharged. It is only the very fine particles that get carried to and collected by the bags. Thus the total dust load on bags is reduced. The gas is drawn through the bags, either on the inside or the outside depending on cleaning method, and dust accumulates on the filter media which increases the resistance to gas flow. Due to this, the filter must be cleaned periodically when sufficient pressure drop occurs. The bags are cleaned by introducing a high-pressure pulse of compressed air at the top of each bag.

Pulse jet bag filter components and process:



### 4.3.1. General Safety Instruction

The bag filter operates reliably and safely if this operation manual is observed. Inexpert use can cause both malfunctions and danger to people. Therefore, this operation manual is binding for any person in charge of installation, start-up, operation and maintenance at the purchaser's works. The bag filter must be used for the purpose defined in the contract only. The bag filter must be used, maintained and repaired by authorized and well-trained personnel only. The operating Personnel must be informed about possible dangers by reading this operation manual. It is necessary to observe the shut-off procedures described in the operation manual of the system into which the fan is integrated. It is not allowed to carry out any work which impairs the reliability of the bag filter and associated system components. The operator has to make sure that no unauthorized person works at the machine. Operator is obliged to run the bag filter always in perfect condition. The manufacturer declines liability for unauthorized changes which impair the function and safety of the bag filter. Lock out power before servicing this equipment. Work on the bag filter must always be carried out during shutdowns. This applies especially to the removal of safety guards. In this case the drive must be secured against being switched on inadvertently. It is not allowed to remove information, mandatory, and prohibitive signs. If the bag filter is started up again after a shutdown, make sure that all safety guards have been mounted properly.



- The work on the system and on electrical voltage components represents considerable danger to life and limb in the event in proper handling.
- Do not work on live electrical components and elements (electric motors, cabinets, etc) if you are not sure that these are indeed disconnected electrical shock represent a danger to life.
- Do not use the system if parts of the system are faulty, missing or damaged. Don't operate the system without filter elements. A defective condition of the system could represent hazards to health.



- In case of fire Isolating valve in bag filter air intake provides explosion protection in flow direction without requiring external energy. The valve is locked in this closed state, preventing the spread of flames and pressure waves.

- Explosion vents on bag filter combine safety and shorter opening times. Explosion vents are specially designed for relief of dust explosion. When specifying explosion vents, the immense impact of pressure waves and flame propagation in the outside area need to be considered. Explosion vent must therefore be directed to a safe area.
- In case of explosion the burst sensor on bag filter signals the opening of the explosion vent so that equipment such as fan or air lock rotary valves can be switched off. Sensors are installed separately and just above the explosion vent.



**Never stand near or in front of explosion vent device or explosion vent duct.**

#### 4.3.2. Storage, Transportation and Installation

Overturning or not permanently fixed equipment may represent a danger to life and limb. The system must be secured against overturning and sliding during the storage and transport. Do not stand under or next to the load when lifting and lowering. Lift trucks or forklift trucks or transport cranes must have sufficient minimum loading. The system may only be installed on suitable flooring. Falling over or functional impairments may otherwise represent a danger to life and limb. The substrate must be vibration free and horizontally aligned. The operator has to verify the viability of the ground. The system must be secured to the substrate, e.g. using lag bolts or heavy - duty anchors. The system must be protected from the weather. Otherwise, the system functions may be impaired. The system must be stored in a dry place and protected from moisture during transport.



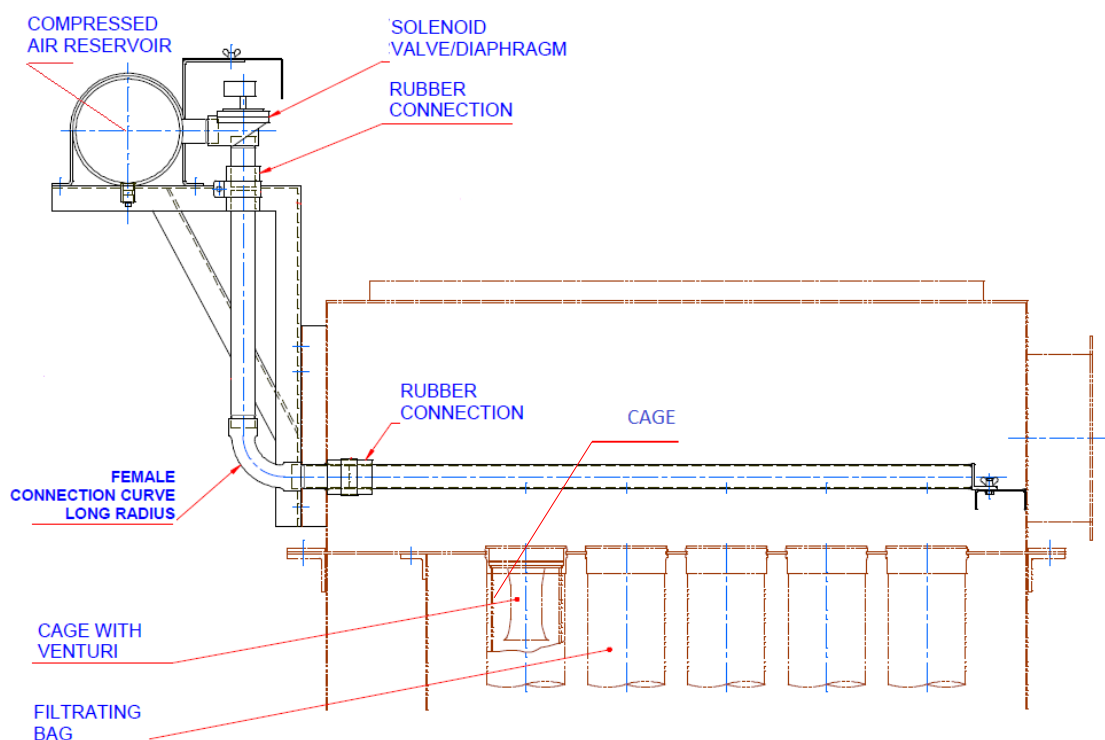
- Improper work on the system and on electrical voltage components represents considerable danger to life and limb in the event of improper handling. The operator is responsible for ensuring that all work is carried out by authorized and qualified personnel. The operator must ensure that their authorized personnel are familiar with all the safety indications in this manual in advance.
- The connecting piping leading from the bag filter must be fixed to the air inlet and outlet flanges.



- The filter bags are automatically cleaned. Cleaning is carried out pneumatically. Without compressed air supply the filter cartridges will become dirty very quickly.
- The external compressed air supply must be provided by the customer with an approved compressed air hose.
- The compressed air must be dry and oil free.
- The operating pressure must be minimum of 4.5 bar and maximum 6.5 bar so that the compressed air tank returns promptly to the required operating pressure after a cleaning cycle ready for the next cleaning time.
- Connect the control cable of the magnet valve.
- Connect the compressed air hose to the nipple of the magnet valve with the help of hose coupling.
- The device may only be operated if all necessary measuring cables and hoses are connected.
- The housing of the external control must be firmly and reliably mounted close to the unit on the wall or at any other appropriate mounting point.
- Connect the control, fan and airlock to the power supply.
- Pay attention to the admissible supply voltage. An incorrect power supply may result in an electrical malfunction of the system.
- With incorrect motor rotation direction, the fan must be disconnected from the power supply and two phase at the inlet inverted.

### 4.3.3. Description of Components

Bag filter main components view:



### Filtering Bags

These are filtering elements made in needle felt through which the air and dust separation takes place, as the air goes through the filtering elements, solid particles are retained in their external wall. After period, the bags get impregnated with dust and need to be cleaned. Such cleaning is performed with compressed air pulse.



**Filtering Bag**

## Cages

Cages are frameworks used to support the filtering bags by forming a rigid cylindrical assembly. The inner part is closed while the top part is open, containing a venture ejector.



**Cages**

## Venturis

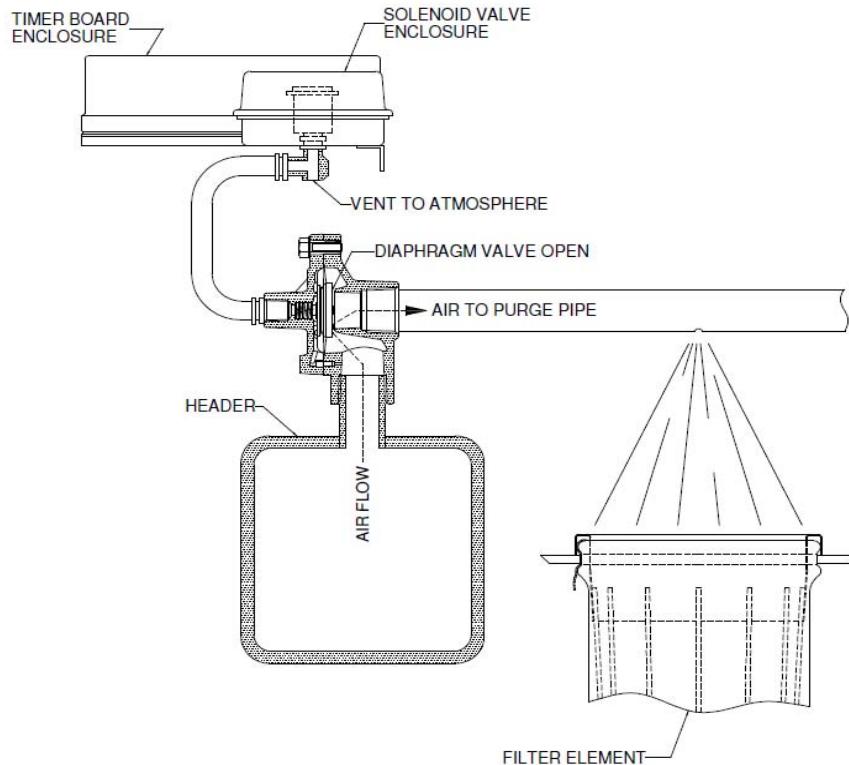
Venturis are accelerator metallic tubes that change the energy from injected compressed air into pressure energy, inducing the air through the filtering bag and, as a result from its magnitude to standard air flow, it sends a chock wave to the bag cleaning it and dislodging impregnated material. The compressed air pressure is established as a function of the geometry or configuration of the venturi ejector, as well as the permeability of the bag to be cleaned.



**Venturis**

## Pulse Jet System

Cleaning air passes from the header through a large diaphragm valve, through the purge pipe, then into the filter element. This diaphragm valve is controlled by the timer board with a normally closed solenoid valve (see illustration below).



- Solenoids are elements designed to change electric impulses generated in the electronic temporized sequencer programmer into pneumatic impulses, which will act on the diaphragm valves.
- Also known as quick escape, these are valves that allow the passage of a compressed air flow that cleans the bags. These valves are opened through pneumatic impulses produced by the solenoids.
- Header (air reservoir) needed to accumulate the compressed air used to clean the bags. This reservoir has enough air capacity so that throughout cleaning air blowing time the air gush is kept continuous.

Air passes through the filter media while solids are retained on the media's surface. A signal from the timer actuates the opening of the normally closed solenoid valve. Opening of the solenoid valve releases the air pressure in the tube connecting the solenoid valve to the diaphragm valve, causing the valve to open. A momentary pulse of compressed air flows from the air header down the purge pipe and out into each filter bag. This momentary pulse takes all bags in one row off line through pressure reversal. Solid are released to fall into the filter hopper. Filtered air exits through the clean air plenum exhaust.

#### **4.3.4. Operation**

Before the fan is started up, the following steps must be implemented:

##### **Checking**

- Check bags attachment. There should be no twisted or unattached bags.
- Ensure that the bags are attached vertically and the bottom parts do not touch another bag or another internal surface of the central body.
- There should be no cracks, splits or holes inside of the filter.
- Blowing air holes in the compressed air injector tube need to be centralized on the venturis with a tolerance of  $\pm 5$  mm in this centralization.
- Check if all collars and venturis are well adjusted.
- Open the solenoids protection boxes and check if all electric contacts are insulated, as well as if the nuts and bolts are appropriately attached.
- Run the compressed air system and eliminate all leakages.
- Open the compressed air reservoir drain and check if there is no water accumulated or other debris from assembly operations.
- Check if the differential manometer is currently set up and has water.
- Check if the access doors are perfectly assembled to avoid any leakage.
- All the bolts need to be appropriately tightened to avoid leakage.
- Turn on the fan, the rotating valve and check if they are operating in the appropriate rotation direction.



- 1- Keep out of the suction range of fans with free air intake with in a distance of two times of nominal diameter under any condition.**
- 2- Never stand in front or behind the rotary equipments during start up.**
- 3- Never stand near or in front of explosion vent device or explosion vent duct.**



### Start up:

- The compressed air supplying system needs to be the first to operate.
- When the manometer (by client) of the compressed air reservoir indicates that the system is operating under full pressure (manometer pressure between 6.5 and 7 bar), the cyclic electronic programmer may be started. The programmer time interval may be set at 30 seconds initially. Check if all the valves have been started. After a pulse, the reservoir needs to recover its pressure and reach a value of 6.5 to bar before the next pulse.
- Then, the air lock valve may be started (V1002).
- Check if all the access doors, passages and other openings are closed, locked and screwed.
- Turn the fan on (P503). There will be a small drop in the pressure through the clean bags and the fan needs to begin operation with its meter partially closed so that the motor is not overloaded during the first few hours of operation.
- Turn the dust filled air. The filter can be operated under partial load to allow the bags to slowly absorb dust particulates, thus preventing that fine particulates pass through the pores of new bags. **For this purpose, regulate the opening of the fan meter.**
- Bag cleaning sequence and time, through the diaphragm valves with solenoids, will be scheduled by the cyclic electronic programmer, the "timer".
- Cleaning action goes from one row to the other, while the air flow filled with dust enters the filter continuously. Each row of bags is cleaned with a short blow of 1/20 seconds or less, and the cleaning interval from one row to another may be adjusted **from 3 to 30 seconds** with the timer mounted on an electronic control panel. This way, nearly all filtering area in the bag filter is in continuous operation. If pressure loss continues to increase until reaching approximately **15 mbar** (project pressure of the bag filter) and does not stabilize, it is required to reduce the sequence interval from one bag row to another in the cyclic electronic programmer.
- If the programmer adjustment **with 3 seconds** is not enough for dropping and stabilizing **in 15 mbar**, shut down the System (Ventilator/Bag Filter) and contact MICROTEC.

- When the Bag Filter is stabilized, the interval time may be increased in the programmer, slowly, until getting closer to the project pressure for the equipment (15 mbar), thus providing for a saving in the compressed air used for cleaning. When the interval time is increased, the differential pressure is also increased.
- Readings above 150 mbar are acceptable. However, we recommend the operation to be at 100 mbar or less to increase the useful life of the filtering bags. The proper interval time may be reduced when you want to have lower differential pressure readings. When adjusting time interval, go in small steps, so that the differential pressure stabilizes throughout many service hours.
- Check the main air tube with the pilot tube or equivalent measuring equipment to establish the initial conditions. If the air flow needs to be adjusted to higher or lower flow, according to process needs, repeat the preceding step.

#### **Shutdown:**

- Switch off the air lock valve (V1002).
- Wait for the passages to be cleaned.
- Switch off the fan (P503).
- Shut down the source of dust.
- Turn off the bag cleaning system.

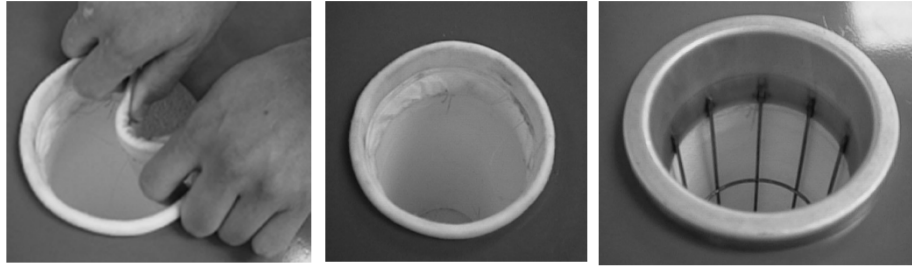
#### **4.3.5. Maintenance**

During the operation, the following points need to be checked:

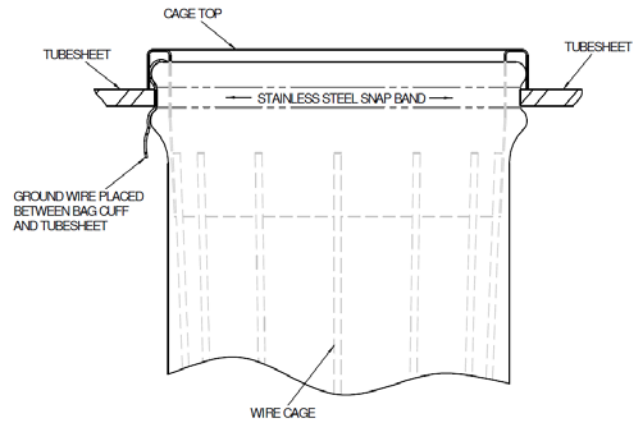
- Lubricating conditions for air lock valve.
- Noise and abnormal vibration in rotating parts.
- Check if there are loose screws in all the assembly.
- Check if there is good seal between bolted parts, especially access covers used for bag maintenance at the top of the Bag Filter.
- Check equipment bearing temperature, such as: ventilator, conveyor screw thread and rotating valve.
- Check tear & wear in general. (Especially for rotating equipment).
- Bag Filter that operate with toxic gases or explosive materials, if the operation requires their access for maintenance, it is required to operate for a few hours with clean air to ensure complete purge of such gases from the inner area.

- Every manhole needs to be completely sealed. Eventual leakages need to be immediately repaired.
- For good functioning of your Bag Filter, it is important to ensure that dust extracting parts are operating in perfect conditions. The conveyor threaded screw and the rotating valve need to be checked frequently, especially if there is any air leakage.
- On a monthly basis, inspect all cleaning system parts, including: Diaphragm Valves, Solenoid Valves and Bags.
- Filtering bags need to be treated as carefully as possible.
- It is advisable to periodical check the bags for damages (holes or tears). They should be immediately changed if any damage is found. We recommend that such checking is carried out at least on a weekly basis.
- Wet bags need to be immediately replaced by clean/dry bags.
- Air oil-water separator, filter, air receiver and air bag for compressed air should be drained and decontaminated on certain time.
- Normally six months, the filter material of oil-water separator should be replaced once.
- Check the inlet and out let pressure difference. If excess or lower regulate range, we must find reasons, usually regulating injection period with pulse controller to resolve.
- The solenoid valve shall be cleaned every three months, and their spares rubber sealing should be replaced on certain time.
- Check filter bags damaged or not if smoke flows from outlet. Smoke from outlet is found after each filtering air, which belongs to excess filtering air. The period should be regulated, and repair them if cages, rubber rings are found damaged.
- Each kind of rubber rings are found damaged.
- The filter bags should be checked whether good or not every six months.

### Bag and Cage Replacement:



- Lower the bottom of the bag through the hole in the tube sheet.
- Fold the snap band (bag top) to insert it into the tube sheet hole.
- Fit the groove of the snap band to the edge of the tube sheet and allow the band to snap into place.
- Check the fit of the snap band. It should fit securely all around with no wrinkles in the snap band. The top of the bag should be above the tube sheet.



### 4.3.6. Bag Filter Troubleshooting

Malfunction	Possible cause	Solutions
<b>Dust In Exhaust Air</b>	<ol style="list-style-type: none"> <li>1. Start up period.</li> <li>2. Holes in Bags.</li> <li>3. Bag and Cage installation.</li> <li>Impeller are worn out, or broken</li> <li>4. Blank-Out Plugs.</li> </ol>	<ol style="list-style-type: none"> <li>1. Allow the filter to run for 48 to 96 hours to establish a dust cake.</li> <li>2. Check and replace bags.</li> <li>3. Bags may be missing or may not be properly installed in the tube sheet. Check and correct installation.</li> <li>4. Plugs may be missing or improperly installed. Check and correct installation.</li> </ol>
<b>Poor Bag Life</b>	<ol style="list-style-type: none"> <li>1. Abrasion.</li> <li>2. Damaged Cages.</li> <li>3. High Air Volumes.</li> <li>4. Media Blinding. (High Humidity)</li> <li>5. Incorrect Filter Media.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check air flow direction and velocity</li> <li>2. Check and replace.</li> <li>3. Check design criteria and consult MICROTEC.</li> <li>4. Check ambient moisture, air temperature for dew point. Check Ducts for leak.</li> <li>5. Consult MICROTEC for alternative media.</li> </ol>
<b>High Differential Pressure</b>	<ol style="list-style-type: none"> <li>1. Bad or Leaking Gauge Lines.</li> <li>2. Low Header Pressure.</li> <li>3. Air Pulse Jet.</li> <li>4. Media Blinding.</li> <li>5. Bag Fit on Cages.</li> <li>6. High Dust Load.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check the gauge and replace it if the needle does not move, check both lines for cracks.</li> <li>2. Check Air Compressor pressure and air regulator, check for leaks in the supply line and other equipment. Check pneumatic valves and solenoids.</li> <li>3. Check timer function and pulse frequency. Set or replace timer.</li> <li>4. Check ambient moisture, air temperature for dew point. Check Ducts for leak.</li> <li>5. Replace the bags if they are too tight.</li> <li>6. Check Design criteria. Air flow rate. It may be necessary to install a larger filter or reduce air flow to the original design.</li> </ol>
<b>Low Differential Pressure</b>	<ol style="list-style-type: none"> <li>1. Bad or Leaking Gauge Lines.</li> <li>2. Holes in Bags.</li> <li>3. Air volume too low</li> <li>4. Bag and Cage installation.</li> <li>5. Blank-Out Plugs.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check the gauge and replace it if the needle does not move, check both lines for cracks.</li> <li>2. Replace the bags.</li> <li>3. Check the duct system for plugs. Check fan for correct RPM.</li> <li>4. Bags may be missing or may not be properly installed in the tube sheet. Check and correct installation.</li> <li>5. Plugs may be missing or improperly installed. Check and correct installation.</li> </ol>

## 4.3.7. Technical Specification

Technical Item	Unit	Quantity
Maximum Gas (air) Pressure	<i>Pa.</i>	
Gas (air) Flow Rate	<i>M3/h</i>	
Filtering Area	<i>M2</i>	
Filter Bag Material		Acrylic Fiber
Acid resistance-Alkali Resistance- Oxidation Resistance		General-General-Good
Bag Dimension	<i>mm</i>	
Bags Quantity		
Continuous Operating Temperature	<i>°C</i>	130
Instantaneous operating temperature	<i>°C</i>	150
Filter Maximum Differential Pressure (Dirty)	<i>mbar</i>	
Filter Minimum Differential Pressure(Clean)	<i>mbar</i>	
Air Pulse Jet Minimum Pressure	<i>bar</i>	5-7
Air Pulse Jet Cleaning Interval	<i>s</i>	
Total Installed Power	<i>KW</i>	
Filter Weight	<i>g/m2</i>	500
Overall Dimension	<i>mm</i>	
Filter Housing Material		Food Grade Stain less Steel

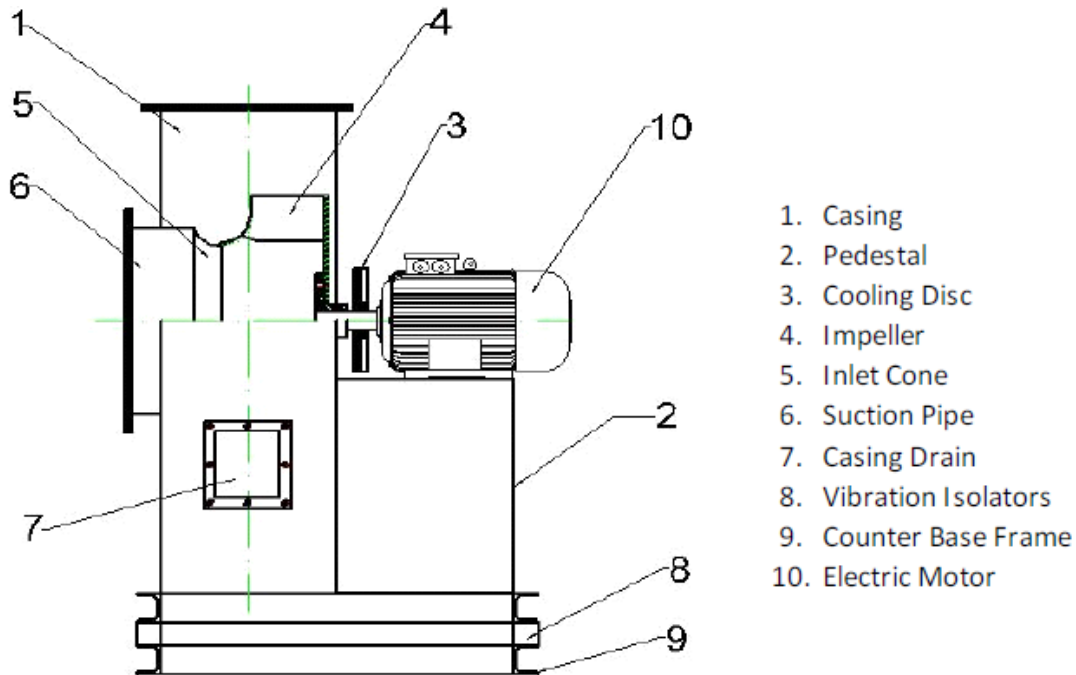
#### 4.3.8. Spare Parts

Name	Model	Specification	Remark
Bags			
Solenoid			
Pneumatic Valve			
Cages			
Venturis			
Airlock Valve Bearing			
Airlock Valve Sealing			

## 4.4. Air Centrifugal Fan

In Centrifugal fans the air enters in the impeller with axial direction and leaves with tangent to blades plan direction. Fans are intended to move clean air volumes or air mixed with dusts or particles of variable.

Air centrifugal fan direct drive components:



### 4.4.1. General Safety Instruction

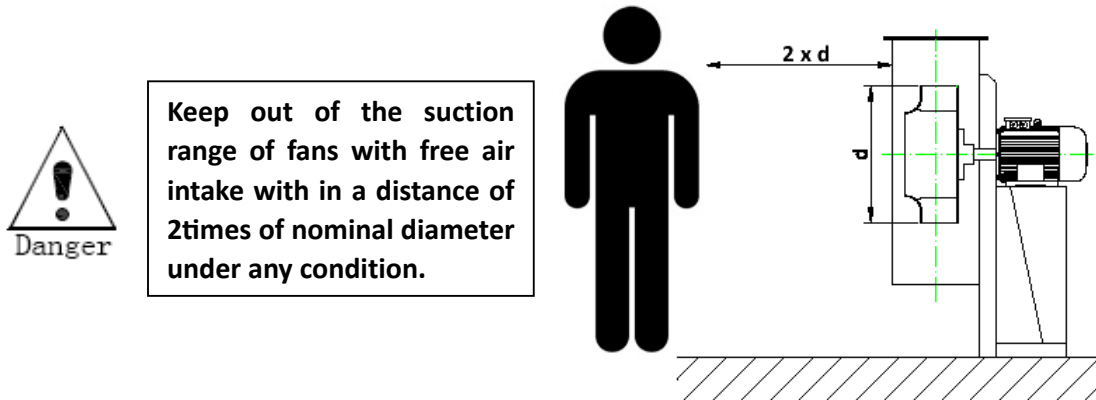
The fan operates reliably and safely if this operation manual is observed. Inexpert use can cause both malfunctions and danger to people. Therefore, this operation manual is binding for any person in charge of installation, start-up, operation and maintenance at the purchaser's works. The fan must be used for the purpose defined in the contract only. The fan must be used, maintained and repaired by authorized and well-trained personnel only. The operating Personnel must be informed about possible dangers by reading this operation manual. It is necessary to observe the shut-off procedures described in the operation manual of the system into which the fan is integrated. It is not allowed to carry out any work which impairs the reliability of the fan and associated system components.

The operator has to make sure that no unauthorized person works at the machine. Operator is obliged to run the fan always in perfect condition. The manufacturer



declines liability for unauthorized changes which impair the function and safety of the fan. Lock out power before servicing this equipment. Work on the fan must always be carried out during shutdowns. This applies especially to the removal of safety guards. In this case the drive must be secured against being switched on inadvertently. It is not allowed to remove information, mandatory, and prohibitive signs. If the fan is started up again after a shutdown, make sure that all safety guards have been mounted properly.

Minimum approach distance to free intake centrifugal fans:



#### 4.4.2. Transportation and Storage

The During transport the fan and fan components must be handled with care in order to avoid damage due to harsh treatment or careless loading and unloading.



**The fan must be attached only at the intended points (eye bolts or openings). For loading and transport it is prohibited to use motor mounting eyes in any case**

Complete fans must be loaded in such a way that their position corresponds to their installation position. Inclined positions or similar deviations must be avoided at any rate. The only exceptions are small axial fans. The devices have to be loaded in such a way that they cannot move, tilt or get in contact with each other. The transporting agent and his loading expert are responsible for transport safety devices which are suitable for the duration of the transport.

The fans should be stored in roofed rooms. Close openings in the housing of the fan which are not shut with covers in order to prevent water from penetrating. During the storage period a minimum amount of maintenance work is necessary to maintain inoperative.

- The impeller must be spun in regular intervals (once per month). For this purpose the impeller or the shaft should be marked in such a way that the runner's idle position is offset by 90°. If the bearings are relieved it is not required to spin the impeller.
- If storage last for more than 3 months, the bearings must be opened before start-up and checked for corrosion damage caused by condensate. If required, the old grease has to be removed; the bearings must be cleaned and provided with new grease.

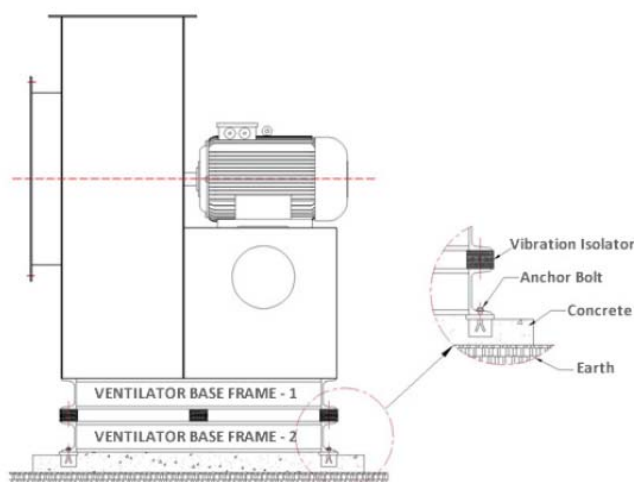
The storage of the motors must not affect their inoperative. Therefore, they should not be subjected to moisture or heat. In this connection, please refer to the operating instructions of the motor manufacturer. Depending on the order, fans are primed, and then coated with a basic or covering varnish. Bright parts are treated with rust preventing grease or preservative oil. If the fan is stored for longer than 9 months it must be preserved once more.

### 4.4.3. Installation

With regard to plant engineering, make sure that the fan is freely accessible for installation and maintenance work. Adjacent plant sections or machines have to be arranged correspondingly. The fan can be installed either on a concrete foundation or a steel structure. The main drawing and the dimensional sheet contain the necessary dimensions. During transport the fan and fan components must be handled with care in order to avoid damage due to harsh treatment or careless loading and unloading. The foundation, framed, alignment and heights must be checked. Fan is placed on the concrete base after its hardened and checked with water gauge.



**Fan must be leveled carefully before initial startup.**



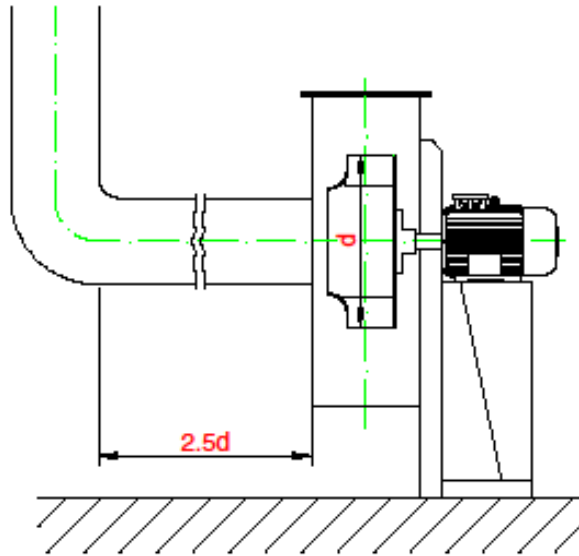
The fan must be installed according to technical documents by doing following steps:

- Set and clean foundations which are capable of bearing or stable framings with plane horizontal surfaces corresponding to the dimensions of the fan to be installed.
- The foundations and frames must be checked.
- The alignments and height must be measured.
- Free access and local freedom of motion in the area of assembly.
- Mobile or stationary hoists.
- Work side current 10A/220V for manual electric devices.
- The fan has to be suspended by the lifting eyes.
- Afterward the fan is placed on the foundation shall be aligned and leveled exactly by means of water level or similar measuring tools.

- If possible in the available space, to guarantee correct entry of the fluid in to the intake opening it is advisable on fans connected to ducting to leave a straight section of duct with length about 2.5 times rotor diameter.



**Minimum installation distance with intake pipe bends.**



#### 4.4.4. Operation

Before the fan is started up, the following steps must be implemented:

##### Checking:



- Check all visible screwed unions for tightness and retighten them, if necessary.
- All lubrication points for bearings must be provided with grease.
- Check the fastening elements for the safety devices for correct installation.
- Removal all foreign matters (parts for assembly, tools) from the fan housing. The same applies to connecting ducts.
- The fan must not be subjected to static stress caused by connected piping.
- Check attached compensators/elastic expansion joints for function and correct installation.
- When using explosion-proof motors measure the gap between impeller and inlet nozzle and record it.
- Check all the electric system for compliance with the EN standard.
- Check and adjust the protective devices (relays for motor, relay for power switches, counter, grounding, etc).
- Under normal condition, the ambient temperature of the motor must not exceed 45°C.
- Check the direction of rotation of the motor.

##### Start up:



- Keep out of the fan's danger zone!
- Switch on fan motor.
- Special attention should be paid to the temperature of the bearing.
- The power consumption of the motor shall be checked.
- After 2 hours of operation check the fan vibration, noise, bearing temperature, motor current, motor temperature and impeller speed.
- After 12 hours operation check all screws tightness, bearing temperature, fan vibration, noise, motor current and impeller speed.



**Keep out of the fan's danger zone!**

### Shutdown:



- Switch off motor.
- Switch off main switch.
- Before switch of fan the temperature in the fan should be reduced to approx. 100°C first in order to avoid thermal stress.
- Make sure that the motor cannot switch on again by unauthorized persons. The valid regulations for prevention of accidents must be observed.

#### 4.4.5. Maintenance

##### General:

Expert and regular maintenance is a prerequisite for trouble free operation. To prevent long periods of repair and downtimes, the following recommendation should be strictly observed. Check all screwed union, especially foundation bolt, at intervals of six months for tightness and retightens them, if required. Also check the impeller every six month by visual inspection. Pay special attention to the condition of the weld seams and irregular deposits of dirt. If fluids which contain dust are conveyed through the fan, monthly checks are necessary. The results of these visual inspections should be recorded. The bearing temperatures must be permanently observed during start up. Bearing temperature must not exceed 80°C. In case of hot gas fans they should not exceed 100°C. The temperature becomes stable after three hours of operation at the earliest.



**Vibrations represent a very high stress to the entire mechanical system of the fan! Therefore, measurements are required at regular intervals. Instructions for vibration measurements are given in the chapter "Vibration measurements". If the results of the measurements exceed the admissible values according to VDI 2056 although the fan has been maintained according to the instructions, please inform the manufacturer.**

##### Bearing and Lubricants:

The antifriction bearings installed are subject to the manufacturer's lubrication instruction. Bearing were originally filled with the lubricant **Mobilith SCH220 contain a synthetic base fluid in lithium complex soap thickener and NL GI of grease shall be Grade 2 for operating above 150°C** (or equivalent grease ). Other lubricants can also be used, of course, if they have comparable characteristics. When cleaning the housing, completely remove old grease, possibly clean the bearing and fill with new grease. The lubricants must be stored in clean, closed containers to prevent dust and moisture from penetrating. The storing place should be dry and cool. Lubrication interval depends on the rotational speed, the bearing structure and the shaft diameter. The recommended schedule for greasing is clearly showed in following table:

APPROXIMATE GREASE RELUBRICATION SCHEDULE

Shaft Dia. (mm)	Speed (RPM)				Grease Added At Each Interval (gr.)	
	900	1200	1800	3600	Roller Bearing	Ball Bearing
35	2140	1715	980	515	10	2
40	2000	1600	900	460	11	3
50	1880	1495	830	410	12.5	3.5
55	1670	1320	705	320	19	5
60	1495	1170	600	320	20	6
70	1420	1105	550	320	24	6.5
75	1345	1040	505		27	7
80	1280	980	460		32	7.5
90	1155	875	380		42	11
100	1045	775	300		53.5	
105	940	680			68	
115	845	595			74	
125	755	515			85.5	
130	670	440			99	
140	590	365			117	
150	515	265			134	

### Impeller:

In case of long shutdowns spin the impeller once per week. Here the final position should be offset by 90° compared to the previous idle position. Apart from the regular visual inspections (at least once a year) the impeller must be cleaned whenever it is dirty. The cleaning intervals depend on the fluid conveyed.

### Motor:

Under standard condition the motors are maintenance free. Permanently lubricated bearings do not require regreasing. Apart from this, the motor manufacturer's maintenance instructions are valid.

## 4.4.6. Repair

### General:

This section contains Instructions for repair which only includes the exchange of original components. In case of problems which are not mentioned in this section, please contact the manufacturer. Make sure for every repair that the fan cannot be switched on inadvertently.

### Exchange of Impeller:

- Switch off motor.
- Switch off main switch.





- Make sure that the motor cannot switch on again by unauthorized persons. The valid regulations for prevention of accidents must be observed.
- Remove suction piping for free access to the impeller.
- Dismount motor coupling.
- Dismount inlet nozzle.
- Strike impeller; loosen safety bolt and nut and withdraw impeller.
- The new impeller must be treated carefully in order to prevent any unbalance caused by an impact.
- The impeller is assembled in reverse order.

### Exchange of Bearings:



- Switch off motor.
- Switch off main switch.
- Make sure that the motor cannot switch on again by unauthorized persons. The valid regulations for prevention of accidents must be observed.
- Dismount shaft guard.
- Dismount motor.
- Remove coupling, if one exists.
- Dismount top halves of bearing housings according to the manufacturer's instructions.
- Lift shaft.
- Detach bottom halves of bearing housings from bearings pedestals.
- Detach adapter sleeve and dismount antifriction bearing according to the manufacturer's instructions.
- The bearings are mounted in reverse order.

### Exchange of Cooling Disc:



- Switch off motor.
- Switch off main switch.
- Make sure that the motor cannot switch on again by unauthorized persons. The valid regulations for prevention of accidents must be observed.
- Remove cooling disc guard.
- Loosen connecting bolts of the disc halves.
- Remove disc halves.
- Mount the new cooling disc in reverse order - make sure that they are mounted correctly (blades in direction of bearing).

#### 4.4.7. Centrifugal Fan Troubleshooting

Malfunction	Possible cause	Solutions
<b>Fan Excessive Vibration</b>	<ol style="list-style-type: none"> <li>1. Loose base fastening.</li> <li>2. Moving balance of the impeller.</li> <li>3. Rotor does not work.</li> </ol> Impeller are worn out, or broken 4. Bearing worn out or broken.	<ol style="list-style-type: none"> <li>1. Check the base.</li> <li>2. Check the moving balance of the Impeller.</li> <li>3. Change fan impeller and check all rotating parts.</li> <li>4. Check and replace bearing.</li> </ol>
<b>Fan Higher Motor Amper</b>	<ol style="list-style-type: none"> <li>1. Bearing are not adjusted properly</li> <li>2. A hard material (stone, metal or ..) is dropped into the Fan</li> <li>3. Alignment of drive unit and impeller shaft.</li> </ol>	<ol style="list-style-type: none"> <li>1. Bearing sin both sides of the Fan need adjustment.</li> <li>2. Stop the Fan immediately and take out any foreign material</li> <li>3. Cheek alignment.</li> </ol>
<b>Fan Output and total pressure are too low</b>	<ol style="list-style-type: none"> <li>1. Speed too low</li> <li>2. Wrong direction of rotation.</li> <li>3. Plant resistance larger than calculated.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check power transmission, bearing, motor, electrical circuit.</li> <li>2. Check direction of rotation.</li> <li>3. Check process calculation and piping.</li> </ol>
<b>Fan Excessive Noise</b>	<ol style="list-style-type: none"> <li>1. Cover disc of impeller touches the inlet nozzle.</li> <li>2. Lubrication fault. Different types of grease have been mixed.</li> <li>3. Bearings are not adjusted properly.</li> </ol>	<ol style="list-style-type: none"> <li>1. Realign nozzle; check compensators for static load.</li> <li>2. Relubricate according to instruction.</li> <li>3. Cheek alignment Bearing sin both sides of the Fan need adjustment.</li> </ol>
<b>Impeller dose not move although motor is running</b>	<ol style="list-style-type: none"> <li>1. Fracture of the impeller key.</li> <li>2. Hub detached from impeller.</li> </ol>	<ol style="list-style-type: none"> <li>1. Withdraw impeller, exchange key, check shaft and hub.</li> <li>2. Exchange impeller completely.</li> </ol>
<b>Motor too Hot</b>	<ol style="list-style-type: none"> <li>1. Cooling air temperature above 40°C.</li> <li>2. Flow of cooling air is impeded.</li> <li>3. Motor over load.</li> </ol>	<ol style="list-style-type: none"> <li>1. Improve supply of fresh air; install forced-air cooling system.</li> <li>2. Improve air supply.</li> <li>3. Check process line.</li> </ol>
<b>Bearing temperature too high</b>	<ol style="list-style-type: none"> <li>1. Cooling wheel not installed.</li> <li>2. Unacceptable operating temperature.</li> <li>3. Wrong lubricant.</li> </ol>	<ol style="list-style-type: none"> <li>1. Install cooling wheel.</li> <li>2. Change operating mode.</li> <li>3. Lubricant as per instruction.</li> </ol>

#### **4.4.8. Vibration Measurement**

A variety of mechanical defects can be traced back to one of the three main causes of increased machine vibrations: loose fastening elements, poor alignment and unbalances. Changes in the operating performance have a direct influence on the vibration behavior of a fan. The measuring method recommended by the internationally accepted regulations (VDI 2056, ISO 2372) is so easy that it can be carried out the maintenance personnel without special training in vibration measurement.

The regulations subdivide industrial machines into six vibration classes. Only the effective value  $V_{eff}$  of the vibration speed is measured. By comparison with the specified limit values for the corresponding vibration class, the vibration behavior of a fan can be immediately evaluated as good, acceptable, still acceptable or unacceptable.

A certain amount of vibration is unavoidable and must be tolerated. Each fan has been designed for a certain vibration level. Only if this standard vibration level is exceeded, the conditions have deteriorated. The manufacturer's specifications in the inspection protocol serve as reference values. Experience has shown that one gets the best idea of the vibration behavior of a fan by measuring the vibration intensity. The vibration intensity is defined as the effective value of the vibration speed in the frequency range between 10 and 1000 Hz. The vibration intensity is measured in mm/s with the supplement  $V_{eff}$ . It is a direct measure for the energy content of the vibrations and therefore a good parameter for the destructive forces which possibly occur at a machine.

##### **Selection of Measuring Point:**

The vibration at the selected measuring point should be representative for the vibration behavior of the machine. The forces which occur are usually transmitted via the bearings and the bearing housings to the housing and the foundation of the fan. Therefore vibration should be measured at bearing housings or at a point immediately next to the bearings. Light attachment parts such as covers or duct connections as well as other components which are much less stiff than the fan are not suitable for the measurements. The more measuring points, the easier mechanical disturbances can be located. The measuring results at the bearing on impeller side mainly provide information about unbalances of the impeller. To get an idea of the state of the complete fan, the bearings on the drive side of impeller and motor have to be measured. The direction of vibration is important, too. Unbalances rotate with the shaft and cause radial vibrations, i.e. vibrations in all directions, at right angles of the shaft. Axial vibrations along the shaft are often caused by poor alignment, poor coupling or bent shafts. Therefore, at a measuring point measurements are usually taken in three directions: vertical, horizontal and axial. The two radial values permit an additional evaluation: Increased vertical values point to insufficient or damaged fixtures or foundations, whereas it is possible to draw conclusions from the horizontal measuring value to unbalances.

The exact measuring point at which the sensing element is fixed should be clearly marked and also used for future measurements. Otherwise, the measured values cannot be compared.

### Evaluation of Vibration Behavior:

According to VDI 2056 the machines are subdivided into six groups, depending on

- machine size and mode of operation
- erection/foundation

For each group the limit values for good, acceptable, still acceptable and unacceptable vibrations have been defined to serve as a basis for comparing of the measured values. Most fans belong to groups M, G and T. Group K comprises smaller machines which are only rarely measured. Driving power, type of drive, machine size and stiffness of foundation are characteristics for assigning the individual fans to the machine groups. A fan with a driving power of approx. 100 kW on a concrete foundation belongs to group G. If mounted on another foundation, e.g. on the rather elastic deck of a ship, the same fan would however be allocated to group T.

Limit values	Group				mm/s RMS	
	M	G	T	D		
28						Unacceptable range
18					20	Still acceptable range
11						Acceptable range
7,1						Good
4,5					5	
2,8						
1,8						
1,1					1	

Group M: Medium-size machines without special foundations; also firmly mounted driving mechanisms and machines (up to approx. 300 kW) with rotating parts on special foundations only.

Group G: Large machines on high-tuned, rigid or heavy foundations, large power engines and machines with circulating masses.

Group T: Large machines and power engines on low-tuned foundations with circulating masses, e.g. turbo groups.

Group D: High-tuned installed machines and driving mechanisms with mass effects which cannot be compensated.

#### 4.4.9. Technical Specification

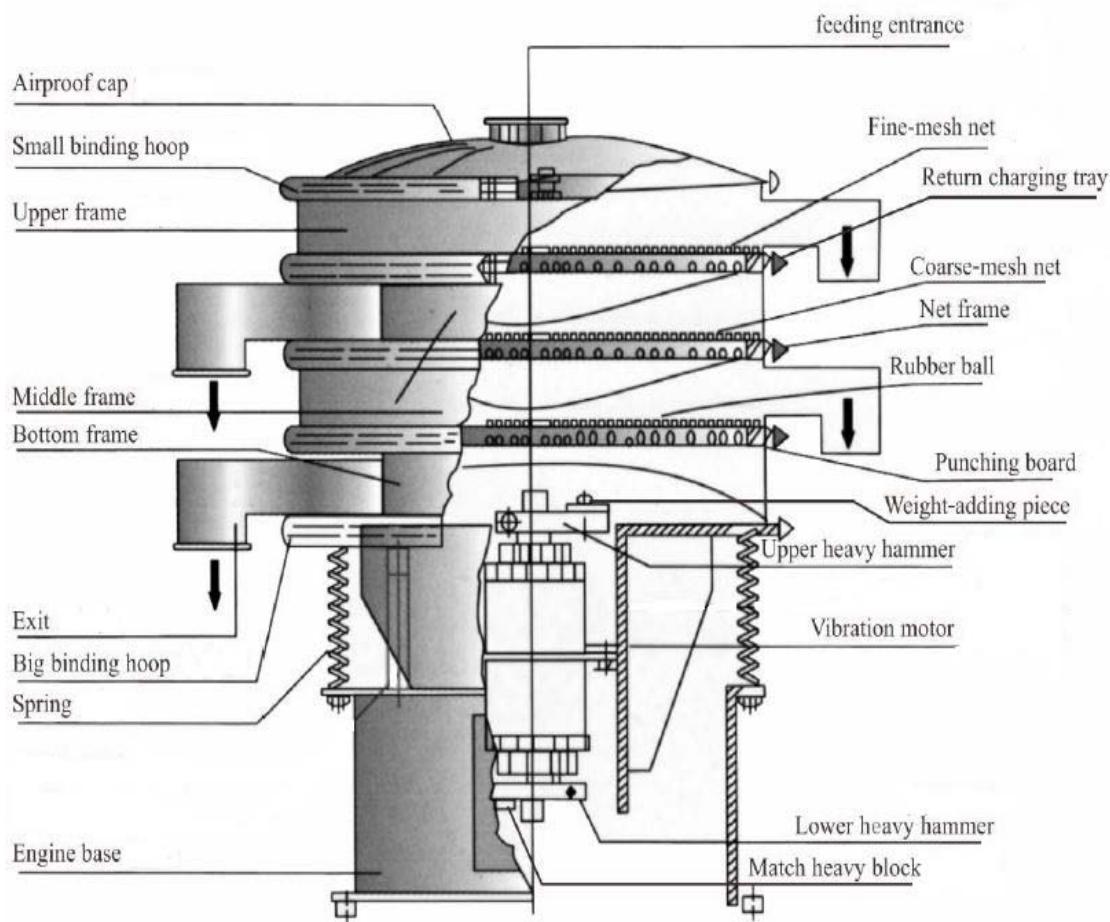
Technical Item	Unit	Quantity
Maximum Air Pressure	<i>Pa.</i>	
Air Flow Rate	<i>M3/h</i>	
Power	<i>KW</i>	
Total Weight	<i>Kg</i>	
Overall Dimension	<i>mm</i>	
Material		Food Grade Stain less Steel

#### 4.4.10. Spare Parts

Name	Model	Specification	Remark
Bearing			
Bearing block			
Inlet Cone			
Shaft Seal			
Cooling Disc			
impeller			
O-shape gasket ring			
V-shape gasket ring			
Gasket			
Vibrating Isolator			
Shaft			
Suction Pipe			

## 4.5. Sieve (Vibrating Sifter)

The MICROTEC separator is a screening device that vibrates about its center of mass. Vibration is accomplished by eccentric weights on the upper and lower ends of the motion-generator shaft. Rotation of the top weight creates vibration in the horizontal plane, which causes material to move across the screen cloth to the periphery. The lower weight acts to tilt the machine, causing vibration in the vertical and tangential planes. Speed and spiral pattern of material travel over the screen cloth can be set by the operator for maximum throughput and screening efficiency of any screenable product ... wet or dry... heavy or light... coarse or fine... hot or cold.



**Sieve Components**

### 4.5.1. General Safety Instruction

The Sieve operates reliably and safely if this operation manual is observed. Inexpert use can cause both malfunctions and danger to people. Therefore, this operation manual is binding for any person in charge of installation, start-up, operation and maintenance at the purchaser's works. The sieve must be used for the purpose defined in the contract only. The sieve must be used, maintained and repaired by authorized and well-trained personnel only. The operating Personnel must be informed about possible dangers by reading this operation manual. It is not allowed to carry out any work which impairs the reliability of the sieve and associated system components. The operator has to make sure that no unauthorized person works at the machine. Operator is obliged to run the sieve always in perfect condition. The manufacturer declines liability for unauthorized changes which impair the function and safety of the sieve. Lock out power before servicing this equipment. Work on the sieve must always be carried out during shutdowns. This applies especially to the removal of safety guards. In this case the drive must be secured against being switched on inadvertently. It is not allowed to remove information, mandatory, and prohibitive signs. If the sieve is started up again after a shutdown, make sure that all safety guards have been mounted properly.



- The work on the system and on electrical voltage components represents considerable danger to life and limb in the event in proper handling.
- Do not work on live electrical components and elements (electric motors, cabinets, etc) if you are not sure that these are indeed disconnected electrical shock represent a danger to life.
- Do not use the system if parts of the system are faulty, missing or damaged. Don't operate the system without mesh screen.
- Before starting work, make sure nobody is exposed to hazardous situation.
- Keep clear of moving parts when stopping equipment. Rotating parts continue rotating after power has shut off.
- Lock out equipment to prevent accidental restarting during maintenance.
- Replace any guard, shield, or barrier before resuming operation.
- Do not operate equipment with interlocks, guards, shields, barriers, chains, and similar devices removed or alerted.
- Provide adequate installation, maintenance, and safety instructions to personnel operating the equipment.



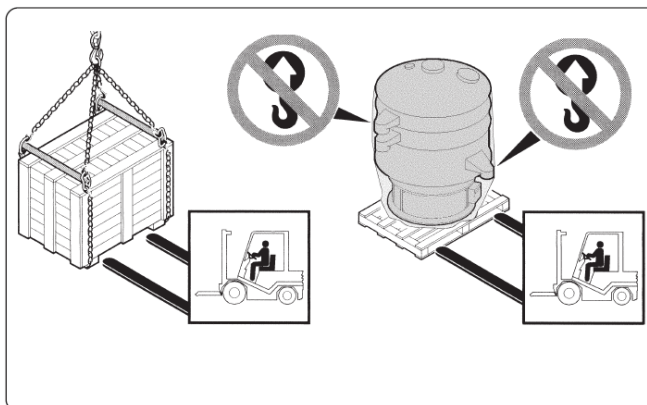
- Keep unauthorized personnel at a safe distance from operating equipment.
- Make sure that the safety breakers are switched off and locked.
- Ear protection shall always be used when working on or by the machine.
- Maintenance shall be done according to instruction manual and only by authorized technician.
- Transport and handling has to be carried out by authorized personnel.

#### 4.5.2. Storage, Transportation and Installation

Overturning or not permanently fixed equipment may represent a danger to life and limb. The system must be secured against overturning and sliding during the storage and transport. Do not stand under or next to the load when lifting and lowering. Lift trucks or forklift trucks or transport cranes must have sufficient minimum loading. The system may only be installed on suitable flooring. Falling over or functional impairments may otherwise represent a danger to life and limb. The substrate must be vibration free and horizontally aligned. The operator has to verify the viability of the ground. The system must be secured to the substrate, e.g. using lag bolts or heavy - duty anchors. The system must be protected from the weather. Otherwise, the system functions may be impaired. The system must be stored in a dry place and protected from moisture during transport.



- Improper work on the system and on electrical voltage components represents considerable danger to life and limb in the event of improper handling. The operator is responsible for ensuring that all work is carried out by authorized and qualified personnel. The operator must ensure that their authorized personnel are familiar with all the safety indications in this manual in advance.
- Use the forklift truck to unload the machine.

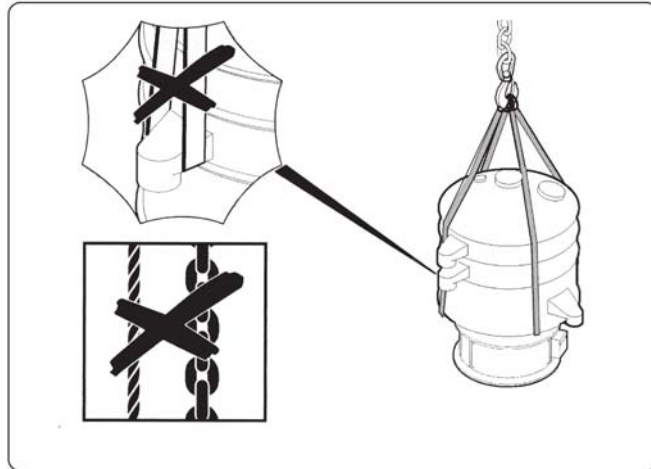




- Lift the machine with an overhead or standard crane using slings made of a material which is strong enough to bear the load in question. Place the machine in the area where it is to be used.



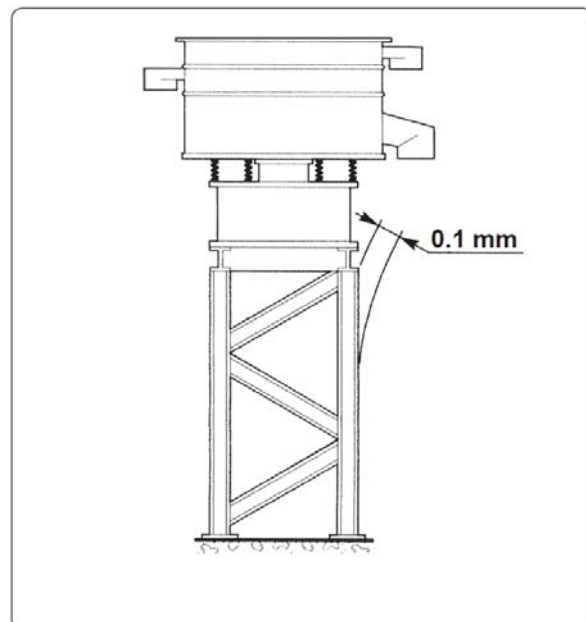
**All lifting and handling operation must be performed by fully trained and qualified personnel using adequate lifting equipment.**



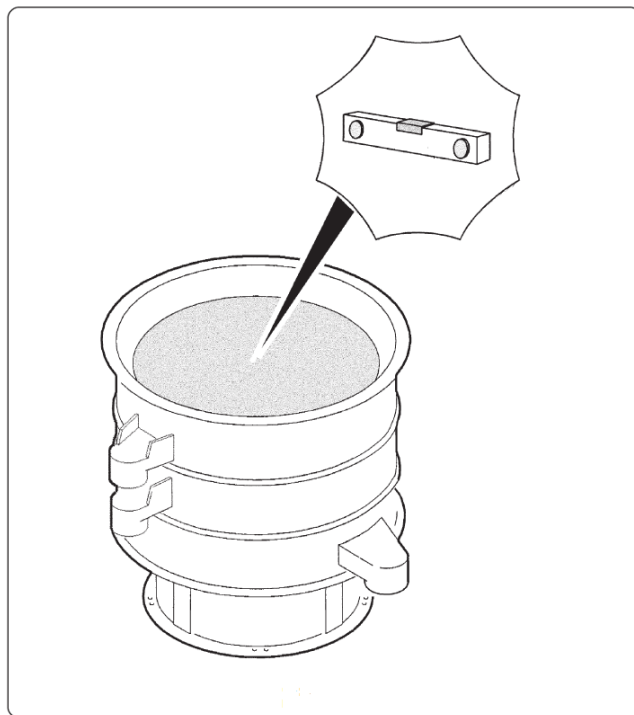
- Check that the support structure is rigid and sturdy taking into account the dynamic loads in order to avoid vibrations.



**Please note; the structure shall not move more than 0.1 mm**



- Demount transportation under prop. The upper part of sieve must be under propped during transportation because the sieve base is connected to the sieve net with spring. The transportation under prop should be loaded after arrival of installation place.
- The machine must be placed on the level floor. If the floor is not hard enough, an anti-vibration rubber board should be fixed between the work desk and the base.
- Place spirit level on the net (mesh screen), correct machine leveling guarantees trouble-free operation.











- The connecting piping leading from the sieve must be flexible to the inlet and outlet flanges.
- The device may only be operated if all necessary measuring cables and hoses are connected.
- The housing of the external control must be firmly and reliably mounted close to the unit on the wall or at any other appropriate mounting point.
- Pay attention to the admissible supply voltage. An incorrect power supply may result in an electrical malfunction of the system.

- The standard cables must be connected between the electromotor and the cables built in sieve machine because of exquisite vibration.
- Each layer of the machine can revolve 360°. Loosen the bolts of locknut and adjust the mouth of each layer. Remember to screw the bolt down.

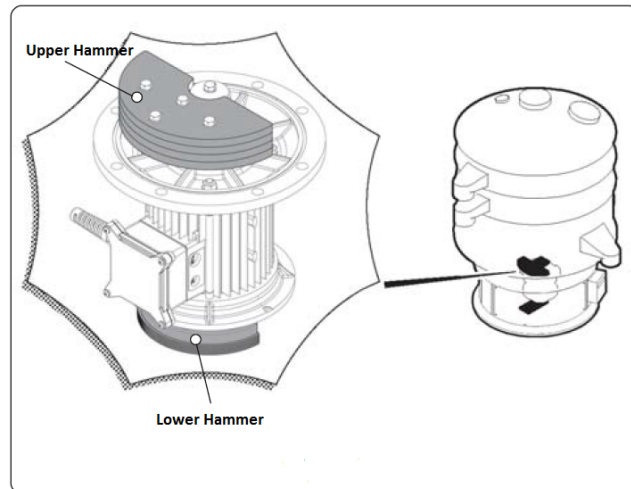
#### 4.5.3. Adjustment of Upper and Lower Heavy Hammers

Flow pattern of material can be fine tuned for screening efficiency by repositioning the lower hammers relative to upper hammers.

	0° 	Material is thrown straight and gives insufficient separation
	15° 	Material begins to spiral
	85° 	Gives material maximum efficient screening pattern
	95° 	Keeps over size material from being discharged and assists in receiving maximum through put

- Adjusting phase angle can alter motion orbit and staying time of materials on the net. In order to adjust machine to various filtration state, such as material distribution, disposal quantum, filtration efficiency and filtration rate, it should be adjusted to the best state.

- Upper and lower hammer cannot be adjusted in angle. The lower can be down in revolution angle after unloosing the bolts. The fixed bolts down before adjusting the scale lines to proper scale from 0°, which are on both sides of corresponding lower hammers with a scale circle under it.



- Adjustment of additional blocks on one side of the upper and lower heavy hammers are used to adjust vibration strength according to the number of layers and proportion of materials for the best result.

#### 4.5.4. Operation

- Check carefully if the fixed bolts are loose or not. If so, if so, continued racing may damage the machine.
- Check the electrical cabinet and motor cables.
- Turn the switch on for 20-30 minutes of racing. Generally, counter clockwise rotation may take place.
- Check motor current. At first, especially in low temperature, the current may be grater. But in 20-30 minutes, it will be normal.
- The machine dose not vibrates in such way as to affect the stability or precision of and equipment located nearby.
- The sound pressure level emitted by a standard machine is less than 85dB. As a result, it is advisable to use hearing protection if working for working for long periods nearby.
- The machine must not make any abnormal noise which is due to loosing of the fixed parts. Otherwise, it should be checked carefully before stop it. Pay more attention to unloosing every part especially after transportation and restarting. It's normal that the machine has resonance when starting

and stopping. And so the swing becomes stronger and the noise becomes higher.

- After racing, feed a bit of materials to the machine through the mouth and then increase the materials it needs. At the same time, adjust the heavy hammers according to the materials on the net face in order to achieve the highest efficiency.
- Generally, the machine is not equipped with bouncing balls but it can satisfy filtration. The balls should install if special materials need them. Thus the racing noise may be a little harder.

#### 4.5.5. Maintenance



- All maintenance operations should be performed with the machine turned off.
- Check if the electromotor produces much abnormal noise and heat. The temperature of the bearing is 40°C higher than that of surroundings. If something is abnormal, lubricating oil (Shell, Aiwanli or RL3) should be added or the bearings be replaced. Check if the nets are tense or the net faces are broken. If so, they should be immediately replaced.
- The inner facet must be cleared after work.
- Lubrication oil should be added twice a week when the machine works.
- Check if the fixed parts are loosened or not every one month.
- Detach the vibrator to check the bearings and oil envelop. If necessary, they should be replaced at once.

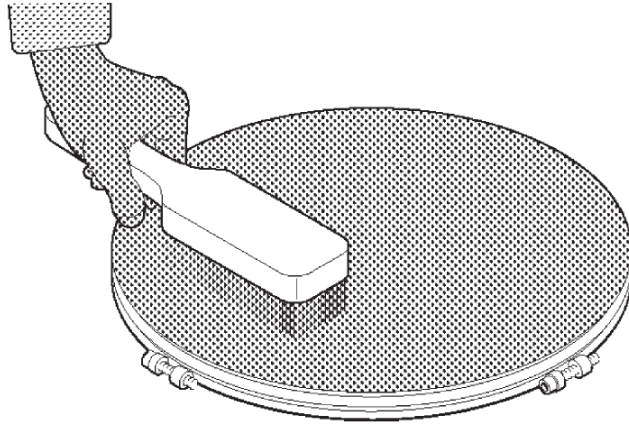


- After the first 8 hours clean the nets (grids or mesh screen), Check the condition of nets. If the nets needs to be replaced, follow the instruction given in paragraph 4.5.6 during this operation also check the state of the seal. Make sure all screw and lock nuts are fully tightened. In particular check: the fixing bolts of the motor-driven vibrator, the net clamps and check the condition of the electric cables connected to the motor.



- Every 24 hours clean the nets (grids or mesh screen), Check the condition of nets. If the nets needs to be replaced, follow the instruction given in paragraph 4.5.6 during this operation also check the state of the seal.
- Every 200 hours Make sure all screw and lock nuts are fully tightened. In particular check: the fixing bolts of the motor-driven vibrator, the net clamps and check the condition of the electric cables connected to the motor.

- The nets (grids or mesh screen) are manually cleaned. To clean the net use a brush, if powder is being handled.



#### **4.5.6. Replacement of the Nets (Grids or Mesh Screens)**

- For replacement of the nets, loosen the bolts of the outer circle, offload the sifter lattice, take out the sifter frame, take away the plastic airproof circle, screw the bolts and loosen the sifter frame when operator use new nets if the former ones are broken.
- Install the new net again according to reverse order in loosing instruction.
- The nets must be leveled off, thus, the lower and upper bolts must be screwed to ensure that both of the bolts should be screwed down.

**4.5.7. Sieve Troubleshooting**

<b>Malfunction</b>	<b>Possible cause</b>	<b>Solutions</b>
<b>Abnormal racing of vibration motor</b>	<ol style="list-style-type: none"> <li>1. Affirm the power.</li> <li>2. Wires are broken.</li> <li>3. Motor is burned out.</li> <li>4. Bearing worn out or broken.</li> <li>5. Redundant lubricating oil.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check and repair the power system.</li> <li>2. Change wires.</li> <li>3. Replace motor.</li> <li>4. Check and replace bearing.</li> <li>5. Keep the motor on.</li> </ol>
<b>Excessive Noise</b>	<ol style="list-style-type: none"> <li>1. Circle is loose.</li> <li>2. Base is not level or something abnormal is on it.</li> <li>3. Springs are broken or dislocated.</li> <li>4. Upper or lower hammer are loose.</li> <li>5. Bouncing –ball board is not level or broken.</li> </ol>	<ol style="list-style-type: none"> <li>1. Screw the copper bolt down.</li> <li>2. Level off the base or take it away.</li> <li>3. Replace or relocate them.</li> <li>4. Screw them down.</li> <li>5. Level It off or replace it.</li> </ol>
<b>Material cannot discharge automatically</b>	<ol style="list-style-type: none"> <li>1. Circumvolution direction is wrong.</li> <li>2. The angle of upper and lower hammer is too broad.</li> <li>3. The net is clogged.</li> <li>4. The net is not tense enough.</li> <li>5. Too much residue is left on the net.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check and adjust motor direction.</li> <li>2. Check and adjust it.</li> <li>3. Clean the net.</li> <li>4. Make sure the net is properly taut and if necessary replace it.</li> <li>5. Adjust the vibrator in order to increase the speed at which the residue flows towards the discharge port.</li> </ol>
<b>The product accumulates in middle of the net.</b>	<ol style="list-style-type: none"> <li>1. Too much product is being supplied.</li> <li>2. The net is not tense.</li> <li>3. The motor runs in the opposite direction.</li> <li>4. The motor is not adjusted correctly.</li> </ol>	<ol style="list-style-type: none"> <li>1. Reduce the product feed rate.</li> <li>2. Tense it when replacing.</li> <li>3. Check and reverse two of three wires connected to the terminal block..</li> <li>4. Adjust the lower hammer.</li> </ol>
<b>The net (Mesh screen) break too frequently.</b>	<ol style="list-style-type: none"> <li>1. Material strikes the net faces directly.</li> <li>2. The net is not tense.</li> <li>3. Propping net is damaged.</li> <li>4. Plastic air proof circle is destroyed.</li> </ol>	<ol style="list-style-type: none"> <li>1. Use the buffer.</li> <li>2. Tense it when replacing.</li> <li>3. Use a new one.</li> <li>4. Stick it tightly or replace it.</li> </ol>
<b>The bearing of motor break frequently</b>	<ol style="list-style-type: none"> <li>1. Too much centrifugal force is applied to the vibrator.</li> </ol>	<ol style="list-style-type: none"> <li>1. Contact to MICROTEC</li> </ol>

#### 4.5.8. Technical Specification

Technical Item	Unit	Quantity
Centrifugal Force	<i>Kg</i>	
Screening Decks		
Net (Mesh) Surface	<i>M2</i>	
Electrical Power	<i>KW</i>	
Total Weight	<i>Kg</i>	
Overall Dimension	<i>mm</i>	
Material		Food Grade Stain less Steel

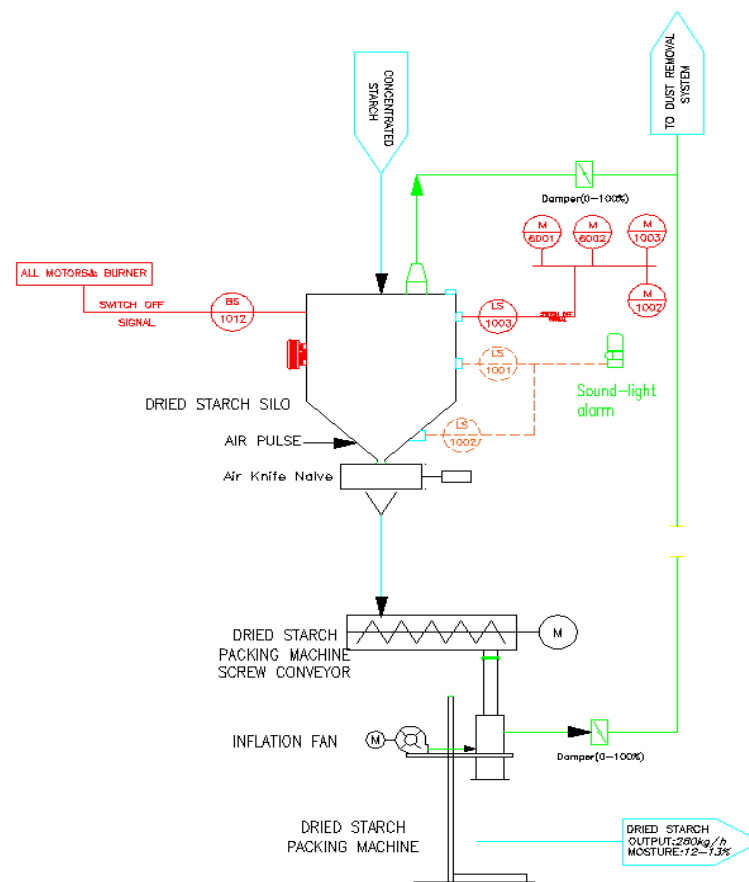
#### 4.5.9. Spare Parts

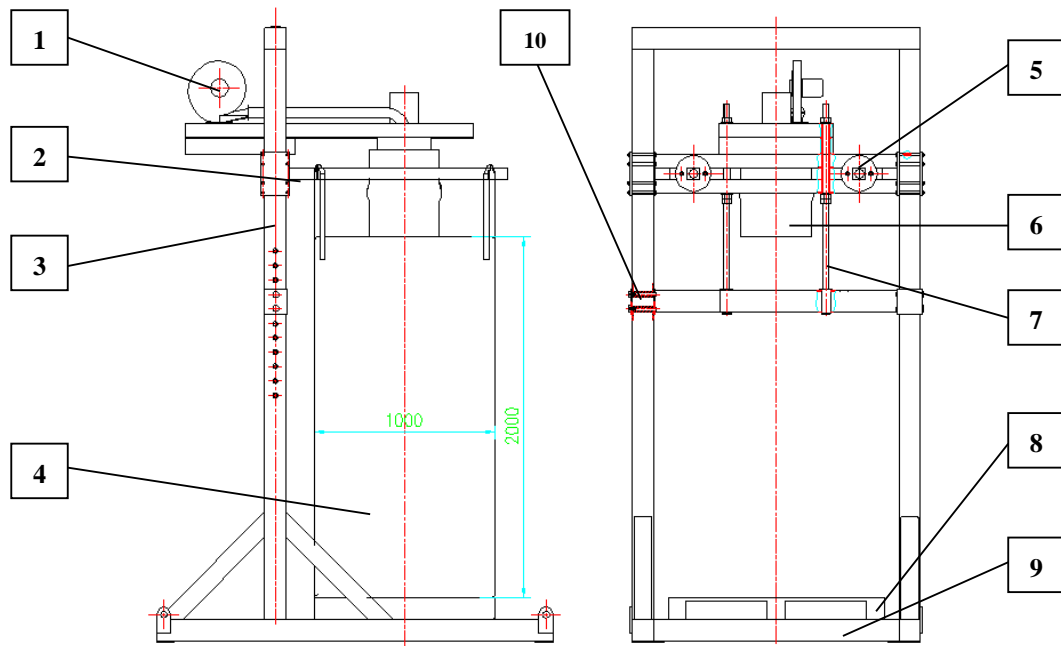
Name	Model	Specification	Remark
Bearing			
Plastic Circle			
Airproof Circle			
Plastic Balls			



## 4.6. Packing Machine

Concentrated starch transferred from screw feeder to the vibrating screen sieve and then dry starch concentrate feed to silo. A screw feeder transferred dry starch concentrate from silo to packing machine with weighing system. Fine starch is conveyed from sieve to silo and stored to specified level. Air knife valve could be closed and opened proportionally by control system. When starch elevation reaches to high elevation switch, sound alarm and flash light is turned on and operator shall hang bag and pushed start button of packing machine. Horn and flash light is turned off automatically. Bag throat is tightened by seal. Bag is then inflated by blower. After inflation of bag, blower is stopped. Screw feeder is started. Air knife valve is opened. Starch would be discharged to bag until the weight of bag reaches to 960 kilograms. Then air knife valve proportionally closed but not completely and at the same time speed of screw feeder decreased by frequency convertor. When weight of bag reaches to 995 kilograms, Air knife valve more closed and screw feeder fed more slowly by decreasing screw motor speed, finally when the weight of bag is reached to 1000 kilograms air knife valve completely closed and at same time screw feeder shall be stopped. Pneumatic clamp shall be released bag throat. Inside packing machine there is a weighing platform. This weighing platform sending weight signals and showing bag weight.



**Bag filling machine components:**

- 1. Inflator Fan**
- 2. Fill Head**
- 3. Structure Column**
- 4. Big Bag**
- 5. Hanger Arm**
- 6. Spout Seal**
- 7. Fill Head Screw**
- 8. Pallet**
- 9. Deck - Weighing Platform**
- 10. Location Pins**

### 4.6.1. General Safety Instruction

The packing machine operates reliably and safely if this operation manual is observed. Inexpert use can cause both malfunctions and danger to people. Therefore, this operation manual is binding for any person in charge of installation, start-up, operation and maintenance at the purchaser's works. The packing machine must be used for the purpose defined in the contract only. The packing machine must be used, maintained and repaired by authorized and well-trained personnel only. The operating Personnel must be informed about possible dangers by reading this operation manual. It is not allowed to carry out any work which impairs the reliability of the packing machine and associated system components. The operator has to make sure that no unauthorized person works at the machine. Operator is obliged to run the filling machine always in perfect condition. The manufacturer declines liability for unauthorized changes which impair the function and safety of the machine. Lock out power before servicing this equipment. Work on the packing machine must always be carried out during shutdowns. This applies especially to the removal of safety guards. In this case the drive must be secured against being switched on inadvertently. It is not allowed to remove information, mandatory, and prohibitive signs. If the machine is started up again after a shutdown, make sure that all safety guards have been mounted properly.



- The work on the system and on electrical voltage components represents considerable danger to life and limb in the event in proper handling.
- Do not work on live electrical components and elements (electric motors, cabinets, etc) if you are not sure that these are indeed disconnected electrical shock represent a danger to life.
- Do not use the system if parts of the system are faulty, missing or damaged.
- Before starting work, make sure nobody is exposed to hazardous situation.
- Keep clear of moving parts when stopping equipment.
- Lock out equipment to prevent accidental restarting during maintenance.
- Replace any guard, shield, or barrier before resuming operation.
- Do not operate equipment with interlocks, guards, shields, barriers, chains, and similar devices removed or alerted.
- Provide adequate installation, maintenance, and safety instructions to personnel operating the equipment.



- Keep unauthorized personnel at a safe distance from operating equipment.
- Make sure that the safety breakers are switched offed and locked.
- Ear protection and safety glasses shall always be used when working on or by the machine.
- Maintenance shall be done according to instruction manual and only by authorized technician.
- Transport and handling has to be carried out by authorized personnel.
- Protect winging platform from shock loads.
- On operation ensure that the bag earth clamp provided is attached at this time before the filling operation commences.
- Do not open the pneumatic valve and let product into the fill head if the bag inflator running.
- Never start machine without first checking for loose objects, trash, dropped nuts and bolts, or other foreign items.
- High pressure air system is dangerous. Do not service or trouble shoot systems with air supply on. Be sure to bleed off any trapped air before working on components since it is possible to have high pressure trapped in airlines and cylinders, etc.

### 4.6.2. Transportation and Storage

During transport the packing machine must be handled with care in order to avoid damage due to harsh treatment or careless loading and unloading.



**The machine must be attached only at the intended points (eye bolts or openings).**

Complete machine must be loaded in such a way that their position corresponds to their installation position. Inclined positions or similar deviations must be avoided at any rate. The devices have to be loaded in such a way that they cannot move, tilt or get in contact with each other. The transporting agent and his loading expert are responsible for transport safety devices which are suitable for the duration of the transport.

The machine should be stored in roofed rooms. Close openings in the housing of the machine which are not shut with covers in order to prevent water from penetrating. During the storage period a minimum amount of maintenance work is necessary to maintain inoperative.

- The rotary parts must be spun in regular intervals (once per month). For this purpose they should be marked in such a way that the runner's idle position is offset by 90°.
- If storage last for more than 3 months, the partss must be opened before start-up and checked for corrosion damage caused by condensate. If required, the old grease has to be removed; the bearings must be cleaned and provided with new grease.

The storage of the motors must not affect their inoperative. Therefore, they should not be subjected to moisture or heat. In this connection, please refer to the operating instructions of the motor manufacturer. Depending on the order, machine are primed, and then coated with a basic or covering varnish. Bright parts are treated with rust preventing grease or preservative oil. If the machine is stored for longer than 9 months it must be preserved once more.

### 4.6.3. Installation

With regard to plant engineering, make sure that the machine is freely accessible for installation and maintenance work. Adjacent plant sections or machines have to be arranged correspondingly. The machine can be installed either on a concrete foundation or a steel structure. The main drawing and the dimensional sheet contain the necessary dimensions. During transport the machine and components must be handled with care in order to avoid damage due to harsh treatment or careless loading and unloading. The foundation, framed, alignment and heights must be checked. Machine is placed on the concrete base after its hardened and checked with water gauge.



**Machine must be leveled carefully before initial startup.**

The machine must be installed according to technical documents by doing following steps:

- Set and clean foundations which are capable stable framings with plane horizontal surfaces corresponding to the dimensions of the machine to be installed.
- The foundations and frames must be checked.
- The alignments and height must be measured.
- Free access and local freedom of motion in the area of assembly.
- Mobile or stationary hoists.
- Work side current 10A/220V for manual electric devices.
- The machine has to be suspended by the lifting eyes.
- Afterward the machine is placed on the foundation shall be aligned and leveled exactly by means of water level or similar measuring tools.
- Connect plant air supply.
- Connect electrical components if applicable. Electrical power and control connection are required if a bag inflator fan, weighing platform, pneumatic valve and air regulator are supplied.
- Test spout seal, weighing platform, bag inflator fan, air supply system.
- Connect plant air supply.



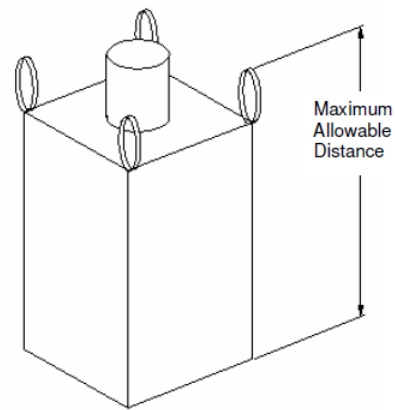
**Protect weighing system from shock loads while installing. Out of specification load s or shock loads may damage the load cells.**

- Set air pressure to 6 bar.
- Connect electrical components if applicable. Electrical power and control connection are required if a bag inflator fan, weighing platform, pneumatic valve and air regulator are supplied.
- Connect the dust collection system.
- Weighing system shall be calibrated after installation.

#### 4.6.4. Operation

Packing machine include an inflatable inlet seal, which is used to provide dust tight connection between the bulk bag inlet spout and the fill head. The starch flows through the inner tube, while the outer tube allows displaced air to be vented through a port connected to dust collector.

- Position fill head to the correct height as specified by the fill container or bulk bag dimensions.
  - Measure the distance from the bottom sew seam of the bag to the top of the bag loop hook on the fill head to the supporting surface for the bulk bag.



- Place any pallet or other equipment that would normally be under the filled bulk bag on the filler deck.
- Put the fill head at a position that places the hooks at a height above the bag support surface that is close to, but less than the maximum allowable distance.
- Hang an empty bag from the loop hooks on the filler head.
- Pull the bag taught from the bottom sew seam.
- The bottom seam should rest on the deck, pallet or other supporting surface. If not, lower the pin location and re-rest.

- Spout Seal: the seal will inflate or deflate when this function is used. The inflate position will cause the seal to expand against a bag spot and the deflate position will cause the seal to release the bag.
- Bag Inflation is used to fully open the receiving bulk bag.
- Weigh batch control manages the flow of product through the filler and administers preset fill points and feed rates.
- During the filling period the air springs will inflate.
- Hang bag on hooks. Pull bag taught.
- Slide the bag spout over the inflatable seal.
- Press and hold the bag inflate button.
- Fill the bag.
- Release the bag inflate button.
- Release the bag with fork lift.





### 4.6.5. Maintenance

#### General:

Expert and regular maintenance is a prerequisite for trouble free operation. To prevent long periods of repair and downtimes, the following recommendation should be strictly observed. Check all screwed union, especially foundation bolt, at intervals of six months for tightness and retightens them, if required. Also check the inflator fan every month by visual inspection. Pay special attention to the condition of the weld seams and irregular deposits of dirt. The motor and inflator fan bearing temperatures must be permanently observed during start up. Bearing temperature must not exceed 80°C. The weighing system accuracy and function shall be check every day. The results of these visual inspections should be recorded.



- All maintenance operations should be performed with the machine turned off.
- Check if the inflator fan and motor produces much abnormal noise and heat. The temperature of the bearing is 40°C higher than that of surroundings. If something is abnormal, lubricating oil (Shell, Aiwali or RL3) should be added or the bearings be replaced.
- Lubrication grease for inflator fan should be added twice a week when the machine works.
- Check if the fixed parts are loosened or not every one month.
- After the first 8 hours check the weighing system and calibrate it by authorized person, if required.
- Every 24 hours clean the machine and Check the dust collector connection.
- Every 200 hours Make sure all screw and lock nuts are fully tightened. In particular check: the fixing bolts of fan and check the condition of the electric cables connected to the motor.
- Every day check air pressure and drain condensate water every three months.



#### 4.6.6. Packing Machine Troubleshooting

Malfunction	Possible cause	Solutions
<b>Motors too Hot</b>	1. Cooling air temperature above 40°C. 2. Flow of cooling air is impeded. 3. Motor over load.	1. Improve supply of fresh air; install forced-air cooling system. 2. Improve air supply. 3. Check process line.
<b>Fan Bearing temperature too high</b>	1. Unacceptable operating temperature. 2. Wrong lubricant.	1. Change operating mode. 2. Lubricant as per instruction.
<b>Low material throughput</b>	1. Inadequate feed 2. Bridging of material in screw feeder. 3. Bridging of material in air knife valve.	1. Check feed from previous equipment. 2. Check inlet and outlet of screw. 3. Check inlet and outlet of silo valve.

#### 4.6.7. Technical Specification

Technical Item	Unit	Quantity
Packing Capacity	<i>Kg/h</i>	
Bulk Bag max. Dimension	<i>mm</i>	
Bulk Bag Min. Dimension	<i>mm</i>	
Electrical Power	<i>KW</i>	
Total Weight	<i>Kg</i>	
Overall Dimension	<i>mm</i>	
Material		Food Grade Stain less Steel

#### 4.6.8. Spare Parts

Name	Model	Specification	Remark
Fan Bearings			

## 5. Dryer Operation

### 5.1 Introduction

The dryer plant mainly consists of starch disintegrator and feeder, air heater, air fans, dryer main ducts, cyclones, screw conveyors, airlocks, sieve, silo, bag filter and packing machine. The disintegrator and feeder is match together to a compact machine. Surface area of a wet lump increases as the size of the lump decreases. The disintegrator acts like a hammer mill that breaks up any lumps of concentrate and throws the concentrate into the feeder. Drying feeder conveys wet starch up into the drying column, where it travels concurrent with the hot air. Air heater increases the inlet air temperature to set point. Outlet-air temperature is controlled by regulating the starch feed rate, with feedback from outlet and inlet air temperature in closed loop control system. In drying process, heat is conducted to wet starch particulate through the dryer column, the water inside and outside of particles will be transformed into hot air stream in a short span time, usually 0.5 to 3 seconds, then mix with air flow in dryer tube. The pulverized material with hot air is conveyed through the drying duct to the cyclone separator by the suction force that created by the centrifugal fan and air locker to separate starch from air and water vapor. The material loses moisture and this is absorbed by the hot air. The temperature of air is reduced while its humidity increases. Fine particle that escaped from the cyclone are trapped by a bag filter. The air coming out of bag filter is dust free and conforms to pollution control norms. The dried material is conveyed to vibrating screen sieve and then storage at silo when starch in silo is reached to specified level; air knife valve is opened and discharged dried starch to packing machine by screw feeder with frequency control speed.

### 5.2 Dryer Checking and Start-up

The dryer plant control system consists of two modes, manual and automatic. In both systems, outlet/ inlet air temperature and packing machine controlled automatically. Before starting, dryer plant shall be checked by authorized personal according to procedure 5.2.1 section of this manual. Operator can select manual or automatic control system. In manual mode control system each machine was able to start and stop separately but in automatic mode dryer plant is controlled by PLC. It is very important note that manual or automatic dryer start up shall be done according to following related procedure.

### **5.2.1. Checking**

1. Checking the disintegrator (EQ-501) turning direction of the main axis is the same as that of lined out on the cover of the drive system.
2. Check the feeder (EQ-502) shaft alignment of the pulleys and check the tension of the V-belts. The tension of the V-belts should be adjusted so, that each belt can be pushed down in the middle for 10mm with a weight of 3.7kg.
3. Take care no hard and rigid parts can enter into the disintegrator (EQ-501) and feeder (EQ-502), as this can cause serious damage.
4. Foreign items inside must be removed and separated from those accessories.
5. Checking if the all screws are fastened enough.
6. Check there is no foreign parts inside the disintegrator and feeder.
7. Check there is no foreign parts inside the screw feeders (EQ-504, EQ-506, EQ-512).
8. Check all access openings for disintegrator (EQ-501, EQ-502), heater (EQ-510) and screw feeders (EQ-504, EQ-506, EQ-512) are closed and properly secured.
9. Check the burner electrical connection and burner (EQ-511) natural gas inlet pressure.
10. Check the burner (EQ-511) gas piping.
11. Check the intake filter of heater (EQ-510). Filter shall be connected to air heater without any clearance and firmly.
12. Checking if there is any block on the heater air intake, air outlet.
13. Check the temperature sensors mechanical and electrical connection after air heater on the air outlet duct (TI-501) and before main suction fan (TI-502).
14. Check Explosion Venting of equipment and ducts away from work area.
15. Check all access openings for cyclones (EQ-503, EQ-505) and bag filter (EQ-508) are closed and properly secured.
16. Check all ducting and piping fittings and flanges properly connected together without leakage.
17. Check the electrical equipment is connected according to the diagrams.
18. Checking if there is any block on the dryer ducts and vents.
19. Checking the lubrication condition of the all bearing, appropriate better lubrication the bearing two times per week.
20. Checking the Motivating the belts for driving system of rotary equipments to see the conveying system is under good condition.
21. Check if all the V-belt for rotary equipment drive system with cleaning agent and let it run for about 1-8 hour.
22. Checking if there is any block on the fresh air inlet filter (F-501) and correctly connected to duct without any clearance and damage.
23. Checking the airlock rotary valves (V-1001, V-1002, V-1003) and all screws turning

direction of the main axis is the same as that of lined out on the cover of the drive system.

24. Checking the air fans (P-501, P-502, P-503) turning direction of the main axis is the same as that of lined out on the cover of the drive system.
25. Checking sieve (EQ-507) connections and structure. Checking if the all screws are fastened enough. Check the sieve alignment and vibrating motor.
26. Check the pneumatic connections for silo (V-501) air pulse and air knife valve (V-1004).
27. Check positioning air knife valve (V-1004), shall be normally closed.
28. Check the level sensor connection for silo (V-501).
29. Check the pneumatic connection for bag filter (EQ-508) air pulse jet.
30. Checking the packing machine (EQ-509) inflation fan (F-1004) turning direction of the main axis is the same as that of lined out on the cover of the drive system.
31. Set the height of packing machine (EQ-509) arms to floor according to bag height.
32. Check dust suction air damper for packing machine shall be normally closed.
33. Check the electrical connection of packing machine weighing system.

### 5.2.2. Manual Mode

1. On the control panel, select manual control mode.
2. Start the main suction fan P-501 drive motor (M1006).



**Never stand in front or behind the rotary equipments during start up**

3. Allow fan P-501 to run for 1-2 minutes. Check if maximum amp. Of fan motor is not **exceeded! (.....)**.
4. Make sure that burner natural gas supply valves are opened.
5. Start the air heater burner EQ-511.



**Never run the heater burner EQ-511 before starting of main suction fan P-501**

6. Allow the temperature in the outlet (TI-502) to rise to 120°C.
7. Switch on bag filter air lock valve V-1002.
8. Switch on dust removal fan P-503.
9. Switch on sieve EQ-507.
10. Switch on air lock valve cooling cyclone V-1003.
11. Switch on screw conveyor cooling cyclone EQ-506.

12. Switch on exhaust fan P-502.
13. Switch on separation cyclone sir lock valve V-1001.
14. Switch on screw conveyor separation cyclone EQ-504.
15. Switch on starch dryer feeder EQ-502.
16. Switch on starch cake disintegrator EQ-501 (M1002, M1003).
17. Feed the starch cake into disintegrator hopper.
18. Inlet air temperature is controlled by TIC-501.
  
19. Outlet-air temperature is controlled by regulating the starch feed rate, with feedback from outlet and inlet air temperature in closed loop control TIC-502.
20. Set the starch bag filling weight on packing machine weighing system.
21. Silo de-dusting shall be done by air damper regulating very smoothly.
22. If starch elevation in the silo (V-501) reached to specified level (LS-1001), silo light-sound alarm turn on.
23. Put starch bag on packing machine EQ-509.
24. Switch on packing machine; electromagnetic valve (V-1005) switches on automatically for sealing bag throat. Inflation fan (F-1004) switched on and after few second switched off automatically, air knife valve (V-1004) opened and packing machine screw feeder EQ-512 switched on automatically, bag is filled by dried starch.
25. **Open manually the de-dusting packing machine damper very slowly for collecting starch dust by bag filter fan suction.**
26. If weight of bag reached to set point or starch elevation reached to low level sensor, air knife valve (V-1004) closed and screw feeder (EQ-512) turned off automatically and electromagnetic valve (V-1005) released bag clamping.
27. Close manually the de-dusting packing machine damper.
28. Release the bag hangers from packing machine arms.
29. Remove filled bag with pallet by fork lift.

### **5.2.3. Automatic Mode**

1. **On the control panel, select automatic control mode. And push start.**
2. After 2 minute feed the starch cake into disintegrator hopper.
3. Inlet air temperature is controlled by TIC-501.
4. Outlet-air temperature is controlled by regulating the starch feed rate, with feedback from outlet and inlet air temperature in closed loop control TIC-502.
5. Set the starch bag filling weight on packing machine weighing system.
6. Silo de-dusting shall be done by air damper regulating manually very smoothly.
7. If starch elevation in the silo (V-501) reached to specified level (LS-1001), silo light-sound alarm turn on.
8. Put starch bag on packing machine EQ-509.

9. Switch on packing machine; electromagnetic valve (V-1005) switches on automatically for sealing bag throat. Inflation fan (F-1004) switched on and after few second switched off automatically, air knife valve (V-1004) opened and packing machine screw feeder EQ-512 switched on automatically, bag is filled by dried starch.
10. Open manually the de-dusting packing machine damper slowly for collecting starch dust by bag filter fan suction.
11. If weight of bag reached to set point or starch elevation reached to low level sensor, air knife valve (V-1004) closed and screw feeder (EQ-512) turned off automatically and electromagnetic valve (V-1005) released bag clamping.
12. Close manually the de-dusting packing machine damper.
13. Release the bag hangers from packing machine arms.
14. Remove filled bag with pallet by fork lift.

### 5.3 Dryer shut-down

Shut-down shall be down inverse of start-up sequence.

#### 5.3.1. Manual Mode

1. Close manually the de-dusting packing machine damper.
2. Close manually the de-dusting silo damper.
3. Close air knife valve (V-1004).
4. Switch off screw feeder EQ-512.
5. Switch off starch cake disintegrator EQ-501 (M1002, M1003).
6. Switch off starch dryer feeder EQ-502.
7. Switch off screw conveyor separation cyclone EQ-504.
8. Switch off exhaust fan P-502.
9. Switch off screw conveyor cooling cyclone EQ-506.
10. Switch off air lock valve cooling cyclone V-1003.
11. Switch off sieve EQ-507.
12. Switch off dust removal fan P-503.
13. Switch on bag filter air lock valve V-1002.
14. Turn off the air heater burner EQ-511.
15. Switch off the main suction fan P-501 drive motor (M1006) when the temperature in the fan should be reduced to approx. 100°C first in order to avoid thermal stress. .



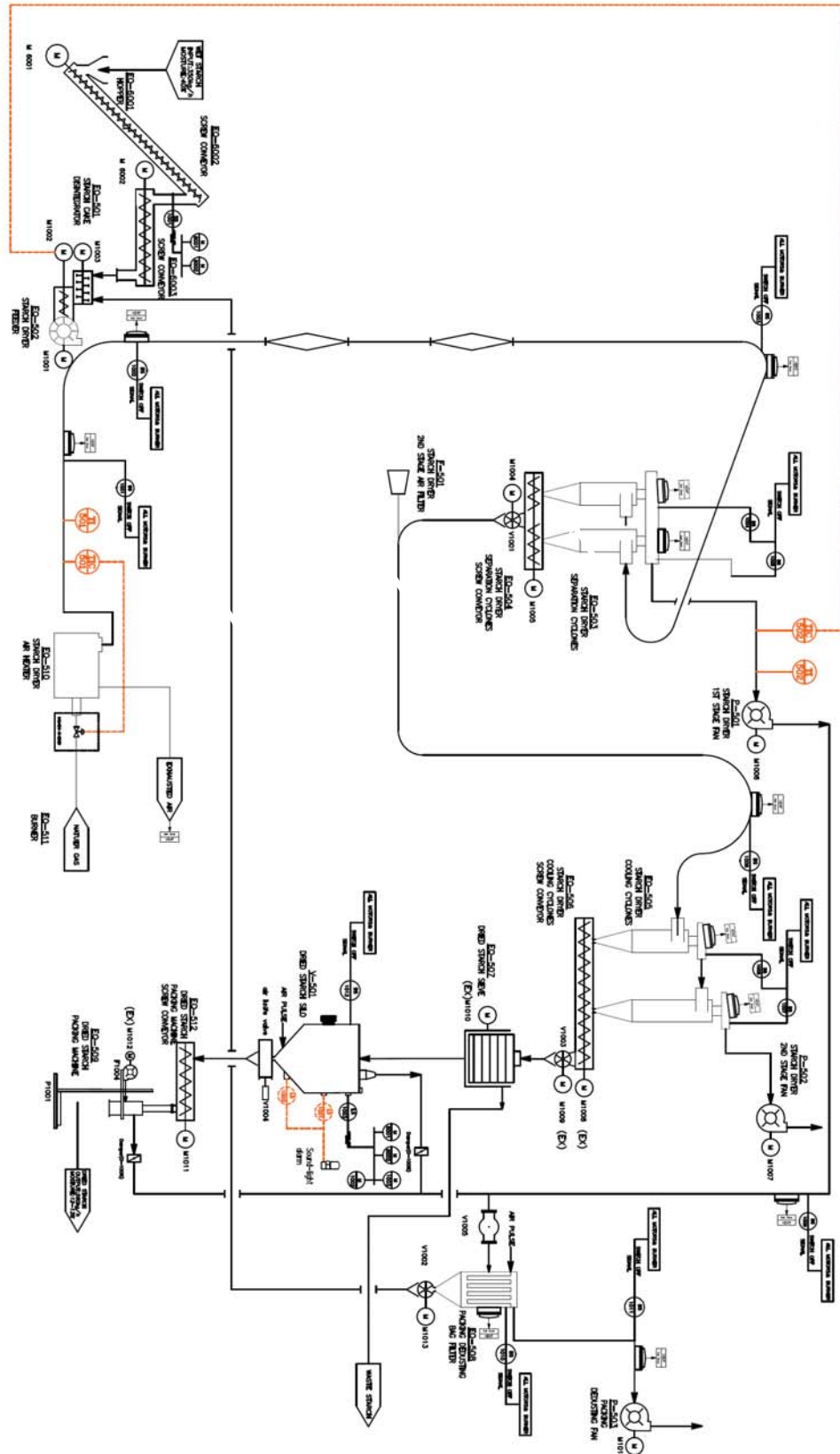
**Never turn off main suction fan P-501 before turning off the heater burner EQ-511. The temperature in the fan should be reduced to approx. 100°C**



### **5.3.2. Automatic Mode**

- 1. On the control panel, select automatic control mode.**
2. Close manually the de-dusting packing machine damper.
3. Close manually the de-dusting silo damper
4. Push stop.

## 6. Process Flow Diagram



## 7. FUNCTIONAL DESCRIPTION

This section describes the operation and process controls that would be applied in each unit or equipment of the Plant.

### 7.1 STARCH FEED UNIT – SCREW FEEDERS EQ-6002, EQ-6003

Wet starch cake would be fed at a rate (350 kilograms per hours) from existing decanter to hopper **EQ-6001**. Wet starch cake continuously would discharge from hopper EQ-6001 into screw feeder **EQ-6002**. Screw feeders EQ-6002 and **EQ-6003** would be connected together with flange which is equipped by safety interlock switch in case the flanges are open for any reason, motors of both EQ-6002 and EQ-6003 automatically stopped. The screw feeder EQ-6003 discharges wet starch onto the disintegrator EQ-501.

### 7.2 STARCH DISINTEGRATION AND RAISER UNIT- EQ-501, EQ-502

The disintegrator **EQ-501** acts like a hammer mill that breaks up any starch lumps of concentrate and throws the concentrate into the drying raiser via starch feeder **EQ-502**. Drying raiser conveys wet starch up into the drying column and starch dryer separation cyclone EQ-503. The disintegrator, starch feeder and raiser are combined all together as a single machine. Starch feeder **EQ-502** motor speed is controlled by frequency convertor from zero to hundred percent. Starch feeder motor speed specifies starch feed rate. Outlet-air temperature going to fan P-501 is measured by temperature sensor **TI 502** and controlled by regulating the starch feeder EQ-502 motor speed (starch feed rate) and **TIC 502**.

### 7.3 AIR HEATING UNIT- EQ-510, EQ-511

In the air heater **EQ-510**, fresh air heated up from room temperature to ..... °C **burner EQ-511 which is using natural gas**. Air heater is in indirect air heat exchanger. Ambient air going to the air heater which has several heating pipes via an air filter. Fresh air temperature increases while touching hot pipes of air heater. The air heater outlet temperature is measured by temperature sensor **TI 501** and controlled by **TIC 501**. TIC 501 is controlled air temperature according to set point and heater outlet air temperature feedback from temperature sensor TI 501 by regulating inlet natural gas to burner EQ-511. Air heater EQ-510 and gas burner EQ-511 manually or automatically could be started only after starting of fan P-501.

#### **7.4 FLUIDIZATION UNIT- CENTRIFUGAL FAN P-501**

The pulverized starch with hot air is fluidized and conveyed through the drying column to the cyclone separator EQ-503 by the suction force that created by the centrifugal fan **P-501**. The wet starch loses moisture and this is absorbed by the hot air. The temperature of air is reduced while its humidity increases. Solid particles are separated from gas flow by cyclone separator EQ-503. If centrifugal fan **P-501** manually or automatically is switched off then air heater **EQ-510,511** shall be switched off immediately by control system or by operator in manual mode.

#### **7.5 AIR-SOLID SEPARATION UNIT- EQ-503, EQ-504, V-1001**

The starch with hot air is conveyed through the drying duct to the cyclone separator **EQ-503** by the suction force that created by the centrifugal fan P-501. The wet starch loses moisture and this is absorbed by the hot air. Dried starch particles are separated from gas flow by cyclone EQ-503 and air locker **V-1001** to separate starch from air and water vapor. Fine particle that escaped from the cyclone EQ-503 are trapped by a bag filter EQ-508. Dried starch conveyed by screw conveyor **EQ-504** through the pipes into cooling cyclones EQ-505. The suction force that created by the centrifugal fan P-502.

#### **7.6 DRIED STARCH COOLING UNIT- P-502, EQ-505, EQ-506, V-1003**

Dried and hot starch shall be cooled to specified temperature, therefore separated starch from cyclone EQ-503 conveyed by screw conveyor EQ-504 through the pipes into cooling cyclones **EQ-505** and suction force that created by the centrifugal fan **P-502**. Then is separated from air by cooling cyclone EQ-505. Separated cooled starch leaves cooling cyclone via air locker **V-1003** and screw conveyor **EQ-506** to EQ-507 for screening. Cooling process is done by mixing fresh air coming to the cooling cyclone via air filter F-501. Hot starch and fresh air are mixing and going to cooling cyclone, in this process starch releases some of it heat to fresh ambient air ant getting cooled down.

#### **7.7 DRIED STARCH SCREENING UNIT- EQ-507**

The dried & cooled down starch is conveyed by screw conveyor EQ-506 to vibrating screen sieve **EQ-507** for screening and separation of coarse and fine starch. Fine screened starch then conveyed to silo V-501 for storage and coarse starch to be collected manually in a bag.

## **7.8 PRODUCT STORAGE UNIT- V-501, V-1004**

Fine starch is conveyed from sieve EQ-507 to silo **V-501** and stored to specified level. Air knife valve **V-1004** could be closed and opened proportionally by control system. Silo V-501 equipped with three level switches:

1. **Low level switch LS-1002**, if the starch elevation reaches to low elevation then air knife valve V-1004 shall be closed automatically by control system and at the same time sound alarm and light alarm shall be turned on indicating low level switch is activated.
2. **High level switch LS-1001**, if the starch elevation reaches to high elevation then the sound alarm and flash light alarm shall be turned on indicating High Level Switch is activated.
3. **High high level switch LS-1003**, if the starch elevation reaches to high high elevation then M6001, M6002, M1002, shall be switched off and has to be indicating high high level switch is activated.

**NOTE:** In all three above cases when alarm is on or the motors are stop, shall be make it clear what action to be taken by operator and how to stop alarm and light.

## **7.9 STARCH PACKING UNIT- EQ-509, EQ-512**

When starch elevation reaches to high elevation switch **LS-1001**, sound alarm and flash light is turned on and operator shall hang bag and pushed start button of packing machine **EQ-509**. Horn and flash light is turned off automatically. Bag throat is tightened by seal **V-1005**. Bag is then inflated by blower **F-1004**. After inflation of bag, blower **F-1004** is stopped. Screw feeder **EQ-512** is started. Air knife valve **V-1004** is opened. Starch would be discharged to bag until the weight of bag reaches to 960 kilograms. Then air knife valve **V-1004** proportionally closed but not completely and at the same time speed of screw feeder **EQ-512** decreased by frequency convertor. When weight of bag reaches to 995 kilograms, Air knife valve **V-1004** more closed and screw feeder **EQ-512** is fed more slowly by decreasing screw motor speed, finally when the weight of bag is reached to 1000 kilograms air knife valve V-1004 completely closed and at same time screw feeder EQ-512 shall be stopped. Pneumatic clamp **V-1005** shall be released bag throat. Inside packing machine there is a weighing platform. This weighing platform sending weight signals and showing bag weight.

### **7.10 DEDUSTING UNIT- EQ-508**

Fine particles that escaped from the cyclone EQ-503 are trapped by a bag filter **EQ-508**. Air lock valve **V1002** shall be started. Exhaust fan **P-503** shall be started. De dusting of silo and packing machine would be done by suction force that created by the centrifugal fan **P-503**. Operator shall be regulated manually air suction damper for packing machine and silo. These dampers are designed to remove starch dust from packing machine as well as starch silo.

### **7.11 DRYER TEMPERATURE CONTROL- TIC-502, TI-501, TI-502**

The air heater EQ-510 outlet temperature is measured by temperature sensor **TI 501** and controlled by **TIC 501**. TIC 501 controls flow rate of inlet natural gas to burner EQ-511 burner control system. Outlet-air temperature is controlled by regulating the starch feeder EQ-502 motor speed (starch feed rate), with feedback from outlet air temperature sensor **TI 502** in closed loop control PID system by **TIC 502**.

### **7.12 EXPLOSION BURST SWITCHES- BS-1001 TO BS-1012**

When the pressure of equipment increase and reaches to certain value due to any problem, then there would be possibility of explosion and any of vents may burst. When this happens, the related burst switches is activated any from **BS-1001 to BS-1012** is activated and sends signal to control system and all Dryer Plant motors and air heater burner shall be switched off automatically and alarm (light and sound) must be activated and an indicator to show burst switches is activated.

#### **IMPORTANT POINTS:**

- All safety related points are automatic like explosion vent burst, alarm and etc, either in manual mode or automatic mode must be done automatically. For example even if Plant is in manual mode, when any burst switch is activated, all must be stopped automatically.
- Either in manual or automatic mode of operation of the plant , when operator presses packing machine start button, all must be done automatically for packing

## 8. Technical Specification

Technical Item	Unit	Quantity
Wet Starch Feed Rate	<i>Kg/h</i>	350
Feed Moisture Content		40%
Dried Starch Output	<i>Kg/h</i>	260
Product Moisture Content		12%-13%
Flash Tube Length	<i>M</i>	23
Maximum Air Flow Rate	<i>M3/h</i>	
Minimum Air Flow Rate	<i>M3/h</i>	
Max. Temp. in Flash Tube	°C	180
Min. Temp. in Flash Tube	°C	Ambient
Air Heater Burner Fuel		Natural Gas
Max. Starch Packing Weight	<i>Kg</i>	1000
Total Installed Power	<i>KW</i>	
Total Weight	<i>Kg</i>	12,920
Overall Dimension	<i>M</i>	13 x 12 x 4
Material		Food Grade Stain less Steel

## 9. Dryer Process Troubleshooting

Malfunction	Possible cause	Solutions
<b>Under Drying (Product moisture more than 15% )</b>	<ol style="list-style-type: none"> <li>1. Excessive much wet starch moisture.</li> <li>2. Wet starch feed rate is high.</li> <li>3. Ambient air moisture is too high.</li> <li>4. Air intake temperature is very low.</li> <li>5. Air temperature controller function.</li> <li>6. Temperature sensors function (TI-501, TI-502).</li> </ol>	<ol style="list-style-type: none"> <li>1. Check, feed starch moisture shall not to be more than 40%.</li> <li>2. Check, temperature control system and Feeder EQ-502 speed controller.</li> <li>3. Increase outlet air temperature set point.</li> <li>4. Check controller TIC-501, TIC-502 and PLC.</li> <li>5. Check temperature sensors electrical circuit and calibration.</li> </ol>
<b>Over Drying (Product moisture less than 8% )</b>	<ol style="list-style-type: none"> <li>1. Wet starch feed rate is low.</li> <li>2. Dryer air temperature is too high.</li> <li>3. Air temperature controller function.</li> <li>4. Temperature sensors function (TI-501, TI-502).</li> </ol>	<ol style="list-style-type: none"> <li>1. Check, temperature control system and Feeder EQ-502 speed controller.</li> <li>2. Check, temperature control system, check temp. Sensors check air heater function.</li> <li>3. Check controller TIC-501, TIC-502 and PLC.</li> <li>4. Check temperature sensors electrical circuit and calibration (TI-501, TI-502).</li> </ol>
<b>Dried Starch output rate is low (lower than 220Kg/hr)</b>	<ol style="list-style-type: none"> <li>1. Starch feed rate is low (lower than 310 Kg/hr).</li> <li>2. Feeder speed.</li> <li>3. Starch particles size is bigger than design criteria.</li> <li>4. Bag filter of de-dusting unit (EQ-508) is damaged.</li> <li>5. Sieve (EQ-507) is blocked.</li> <li>6. Rotary air locks (V-1003, V-1001) are blocked.</li> <li>7. Screw conveyor EQ-506 and EQ-504 is blocked.</li> <li>8. Screw Feeder Packing Machine (EQ-512) is blocked.</li> <li>9. Manually de-dusting damper packing machine (EQ-509) and silo (V-501) are fully opened.</li> <li>10. Air knife valve (V-1004) is blocked.</li> </ol>	<ol style="list-style-type: none"> <li>1. Increase starch feed rate to 350 Kg/hr.</li> <li>2. Check Feeder EQ-502 speed and speed controller.</li> <li>3. Check disintegrator function.</li> <li>4. Check bag filter and replace.</li> <li>5. Check sieve mesh screens and operation.</li> <li>6. Check drive, rotation, impeller, sealing, inlet and outlet of V-1004.</li> <li>7. Check screw inlet and outlet, Drive, smooth rotation and screw flight.</li> <li>8. Check screw inlet and outlet, Drive, smooth rotation and screw flight.</li> <li>9. Check damper flap position. According to start up and shut down procedure.</li> <li>10. Check air knife valve pneumatic actuator, air line connections, air pressure (at least 5 bars) and operation.</li> </ol>



<b>Malfunction</b>	<b>Possible cause</b>	<b>Solutions</b>
<b>Air Flow Rate is not enough for starch fluidizing into dryer column.</b>	<ol style="list-style-type: none"> <li>1. Block of the heater air intake filter.</li> <li>2. Block of the ducts.</li> <li>3. 1 ST stage fan (P-501) impeller revolution (speed) is decreased.</li> <li>4. Block of the Fan(P-501)</li> <li>5. Block of the isolating valve (V-?) Before inlet of de-dusting bag filter.</li> <li>6. Bags of de-dusting filter (EQ-508) are dirty.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check heater air intake filter, clean or replace air filter.</li> <li>2. Stop the machine, and check.</li> <li>3. Check Drive and coupling or pulley, motor Amper, belt tension (if applicable), bearings, shaft, noise and vibration.</li> <li>4. Stop the machine, check inlet and outlet and inside the fan.</li> <li>5. Check isolating valve. It must be normally open.</li> <li>6. Check bag filter pulse jet system, pneumatic valves, air pressure (at least 5 bar) and air nozzles. Bag filter shall be cleaned by air or replaced.</li> </ol>
<b>Screw Conveyor Excessive Noise</b>	<ol style="list-style-type: none"> <li>1. Foreign materials in conveyor</li> <li>2. Alignment of drive unit and shaft screw.</li> <li>3. Gearbox or bearing worn out or broken.</li> <li>4. Screw rubbing on casing.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check inside of screw.</li> <li>2. Stop the screw and check alignment.</li> <li>3. Check and Replace.</li> <li>4. Check shaft alignment, bearing position, screw flight.</li> </ol>
<b>Screw Conveyor Excessive Vibration</b>	<ol style="list-style-type: none"> <li>1. Drive unit vibration.</li> <li>2. Screw mounting.</li> <li>3. Bearing worn out or broken.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check alignment of drive and shaft screw.</li> <li>2. Check framework mounting</li> <li>3. Check and replace bearing.</li> </ol>
<b>Low material throughput by screw</b>	<ol style="list-style-type: none"> <li>1. Inadequate feed</li> <li>2. Bridging of material.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check feed from previous equipment.</li> <li>2. Check inlet and outlet of screw.</li> </ol>
<b>Air Lock Rotary Valve Excessive Noise</b>	<ol style="list-style-type: none"> <li>1. Foreign materials in valve</li> <li>2. Alignment of drive unit and impeller shaft.</li> <li>3. Gearbox or bearing worn out or broken.</li> <li>4. Impeller rubbing on casing.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check inside of valve.</li> <li>2. Stop the valve and check alignment.</li> <li>3. Check and Replace.</li> <li>4. Check shaft alignment, bearing position, impeller.</li> </ol>
<b>Low material throughput by Air Lock Rotary Valve</b>	<ol style="list-style-type: none"> <li>1. Inadequate feed</li> <li>2. Bridging of material.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check feed from previous equipment.</li> <li>2. Check inlet and outlet of valve.</li> </ol>

[illegible]

