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1. Limits of Supply for Electrical Control Options:

Refer to Drawing No. 011797/D

The drawing shows a typical P&ID of a fully instrumented Horizontal Axis Basket Centrifuge for a Class I, Division 1, Group D installation.

Instrumentation colored **BLACK** is included as part of ROBATEL's base limit of supply or is included when the customer selects a given option. Example: XOV-700 is included in ROBATEL's supply only when the "blanket option" is chosen.

Instrumentation components are intrinsically safe and pre-wired to a numbered terminal strip within the machine mounted NEMA 4X junction box (20" x 20" x 8"). If the customer's control system (or DCS) is able to accept namur proximity sensor inputs, a pulse string for speed indication and analog signals, the machine could be directly wired to that control system. If the machine is located in a Hazardous Area, the DCS must provide the necessary Intrinsically Safe isolation for the applicable Hazardous Area. All motors must be powered by the customer. However, ROBATEL's base limit of supply also includes the AC drive in a NEMA 1 enclosure to control the speed of the main motor. Refer to the technical description **Section 2.1 and 2.2**.

The instrumentation colored in **RED** is included in addition to components colored in **BLACK** when the customer requires control by DCS using only discrete I/O and 4-20 mA signals. These devices provide isolation (intrinsically safe barriers) and/or monitoring such that the DCS can monitor "dry contacts" and 4-20mA signals. This instrumentation would be mounted in a NEMA 12 enclosure (24" x 36" x 12") and pre-wired to a numbered terminal strip. The enclosure must be mounted in the field (outside of the hazardous area) or within the control room. Refer to the technical description **Section 2.3**.

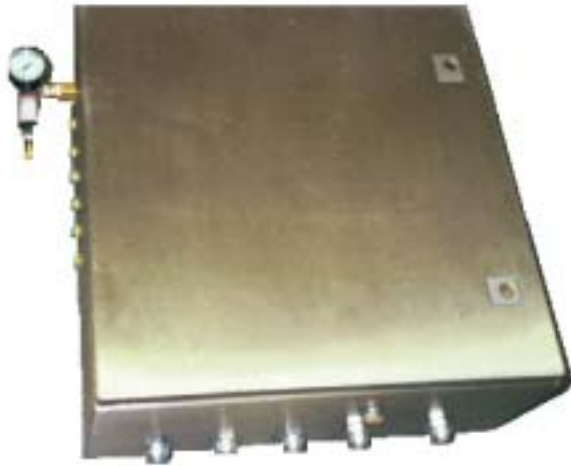
The instrumentation colored in **BLUE** is included in addition to components colored in **RED** and **BLACK** when the Fully Automatic Control System is chosen. In this case, the intrinsically safe barriers, relays, power supply, circuit breakers, communication card and PLC would be pre-wired to a numbered terminal strip within the NEMA 12 enclosure (79" x 24" x 16"). Refer to the technical description **Section 2.4 and 2.5**. In addition, the AC drive components would be installed within the NEMA 12 enclosure (79" x 24" x 16") and be pre-wired to a corresponding numbered terminal strip. Refer to the technical description **Section 2.6**.

The components colored in **GREEN** are to be supplied by the customer. These components include field mounted piping, valving and instrumentation.



2. Description of Main Components:

2.1 *Machine Mounted Components, JB-30:*



All machine mounted control wiring is pre-wired to a local junction box. This electrical enclosure is rated NEMA 4X and contains the terminal strip for the machine mounted low voltage electrical devices. In most cases, this is mounted to the side of the machine and machine wiring is done by ROBATEL. The customer would then connect the field wiring to the terminal blocks provided. The numbering on the terminal blocks is identical to the corresponding terminal block within the control cabinet.

The enclosure also houses the solenoid pilot valves and the temperature transmitters for the bearing RTDs.

If this enclosure is not mounted to the machine, it may still be used as an intermediate junction box or the field wiring can be taken directly from the machine mounted electrical devices.

2.2 Basic A.C. Drive and Braking Unit:



The drive and brake enclosures are rated NEMA 1 and should be mounted in the customer's MCC or near the machine (if the area classification permits). Terminal blocks are provided for field wiring.

High voltage wiring should be kept separate from the low voltage control wiring. Since the AC drive utilizes PWM technology, it is important that the motor's lead wires be shielded or enclosed within metallic grounded conduit to reduce electrical interference.

The AC drive contains parameters which are necessary for its safe operation.

The AC drive is sized to control the speed of the main centrifuge motor.

A **Regenerative** drive or a **separate** braking unit (dynamic or regenerative) is provided to give rapid deceleration of the centrifuge such that the operating speed can be changed as a function of the process step.



2.3 Optional DCS Interface Panel, FP-20:



This enclosure is rated NEMA 4X or 12 and contains the additional interface between the machine mounted electricals and the customer's DCS, which controls the centrifuge operation. Specifically, it houses the necessary components such as vibration monitor, speed monitor and intrinsically safe barriers for Class II, Div. 2 systems (shown) or Class I, Div. 1 systems,.

Dry contacts are provided such that the customer could hardwire the safety interlocks or program the DCS to handle these inputs. Refer to the detailed component description listing for actual device outputs.

Although ROBATEL is not responsible for the programming or wiring of the customer's control system, ROBATEL provides a detailed listing of typical interlocks and sequencing.

This enclosure should be mounted in the customer's instrument room, MCC or near the machine (if the area classification permits). Terminal blocks are provided for field wiring to connect the enclosures listed above. Be certain to separate the intrinsically safe wiring (blue terminal blocks) from the standard wiring.

2.4 Main Control Panel, CP-30:



ROBATEL's Electrical control system is designed for outstanding performance and optimum flexibility. The heart of the control system is the Allen Bradley SLC-503 Programmable Logic Controller. The PLC is housed in a NEMA 12 enclosure having a power disconnect handle and "Power On" lamp on the front face. Other components within the control cabinet include: Intrinsically safe barriers (for Class I, Division 1 systems), output relays, 24 volt power supply, speed monitoring equipment and terminal blocks for convenient customer connection.

The control system handles all the necessary sequencing and safety interlocks. Hardwired interlocks are included for the Emergency Stop push button and the High oxygen level (if monitoring is provided).

ROBATEL provides dry contacts to open the customer's process valves such that the client has flexibility to power these valves with either 24 VDC or 120VAC. ROBATEL requires dry contacts (rated 24 VDC) on the customer's valves to indicate valve position.



The control system has four modes of operation:

- A) Manual Mode.** In this mode, all functions of centrifuge operation can be performed under the direct control of the operator. All necessary safety interlocks are still performed through the control system. This mode of operation is helpful when starting with a new product and offers the most flexibility.
- B) Automatic.** In this mode, the cycle will loop through one of the ten recipes programmed for centrifuge operation. After the completion of one cycle, the next cycle will start automatically. This mode of operation is usually used for production machines.
- C) Cycle-by-cycle.** In this mode, the program will perform one complete cycle. After the completion of one cycle, the program will be stopped.
- D) Step-by-step.** In this mode, the cycle will progress through one step of the automatic cycle. It is necessary for the operator to push the Cycle Start push button to proceed to the next step.

This enclosure should be mounted in the customer's instrument room, MCC or near the machine (if the area classification permits). Terminal blocks are provided for field wiring to connect the associated enclosures. Be certain to separate the intrinsically safe wiring (blue terminal blocks) from the standard wiring.

2.5 Local Operator Interface, FP-30:



The operator interface display may be mounted near the machine since it is mounted within a NEMA 4X enclosure and rated for Class I, Group D, Division 2 Operation (Class I, Group C&D, Division 1 Operation when a purging system is provided). It comprises a graphic display, membrane keypad, emergency stop button, power on indication lamp and fault lamp (with Push-to-test feature). Since this enclosure contains the operator interface, it should be mounted away from direct sunlight and in a relatively clean area. The field wiring to this enclosure should come directly from the main control panel (CP-30).

The enclosure is fitted with the Allen Bradley PanelView 900 Operator Interface which has 16 pre-programmed push buttons, number keypad and graphic display. The Operator Interface allows programming of the 10 cycle recipes, adjustment of various set-points, fault diagnosis and complete control of the machine in all modes of operation.

For Class I, Div. 1 systems, a Bebcos purge and pressurization unit is mounted to the side of the enclosure. The panel must be purged and pressurized before power is applied to the enclosure. During centrifuge operation, loss of pressure would initiate a fault.



2.6 A.C. Drive Panel, DP-30:



When ROBATEL provides the control system, the AC Drive and the associated electrical devices to control the hydraulic unit motor and screw conveyor discharge motor (if provided) are mounted within a NEMA 12 enclosure. The drive package is carefully selected to work in conjunction with the equipment to achieve rapid acceleration, deceleration and speed control. By utilizing PWM technology, efficient control of the motor is obtained. Regenerative or dynamic braking may be provided based on motor size and duty cycle.

This enclosure should be mounted in the customer's MCC or near the machine (if the area classification permits). Terminal blocks are provided for field wiring to the main control panel (CP-30). Distance between the machine and the AC drive is limited to 200 feet unless optional line reactors are provided.

High voltage wiring should be kept separate from the low voltage control wiring. Since the AC drive utilizes PWM technology, it is important that the motor's lead wires be shielded or enclosed within metallic grounded conduit to reduce electrical interference.

The AC drive contains parameters which are necessary for its safe operation.



2.7 Optional Inertization Cabinet, FP-31:



This enclosure is rated NEMA 4X and should be mounted as close to the machine as possible (within 10 meters) in an area above the associated connections on the machine. If the enclosure is mounted in a location lower than the connections on the machine, the risk of condensation and process liquids entering the cabinet and damaging the internal components is likely. The front face of the enclosure must be mounted vertically and preferably in a direction facing the operator. The enclosure contains the necessary nitrogen regulation equipment to blanket the centrifuge. In addition, it contains the electrical instrumentation necessary to control the pressure within the centrifuge and give necessary feedback to the main control system (CP-30). This unit is not an Oxygen Monitor but a nitrogen pressure regulation system.

The nitrogen supply must be clean and dry. The nitrogen feed piping should have a manual shut off valve in a convenient location near the machine.

Compression fittings are provided on the bottom of the enclosure for field connection. The bearing purge flow should be set for a minimum of 30 SCFH. The devices within the enclosure are adjusted and set during factory testing.

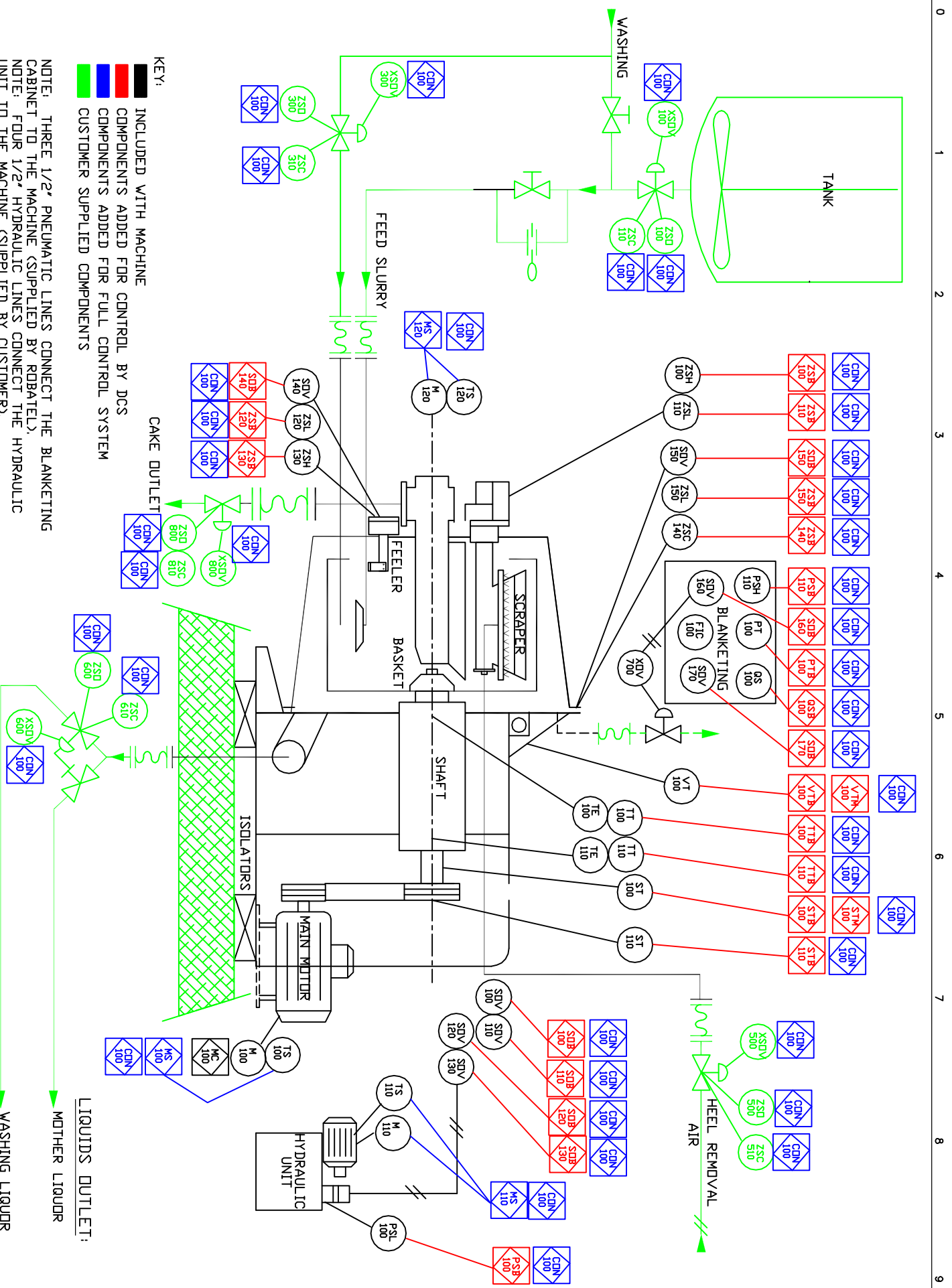
The machine vent must be connected to a venting system with a pressure of less than 10" WC in order for the inertization package to work properly.

Since the logic and sequencing of the blanketing is performed by the controller, the blanketing panel and associated valves do not comprise a stand-alone system. The blanketing panel requires control from the customer's DCS or from ROBATEL's PLC.

SIMPLIFIED P&I DIAGRAM
EHLB-DRV

By: _____
 Machine: _____
 Project No.: _____
 Customer: _____

TER Date: 05-10-96
 011797



KEY:
 INCLUDED WITH MACHINE
 COMPONENTS ADDED FOR CONTROL BY DCS
 COMPONENTS ADDED FOR FULL CONTROL SYSTEM
 CUSTOMER SUPPLIED COMPONENTS

NOTE: THREE 1/2" PNEUMATIC LINES CONNECT THE BLANKETING CABINET TO THE MACHINE (SUPPLIED BY ROBATTEL).
 NOTE: FOUR 1/2" HYDRAULIC LINES CONNECT THE HYDRAULIC UNIT TO THE MACHINE (SUPPLIED BY CUSTOMER).

LIQUIDS OUTLET:
 MOTHER LIQUOR
 WASHING LIQUOR

CAKE OUTLET

HEEL REMOVAL AIR

WASHING

FEED SLURRY

BLANKETING

ISOLATORS

MAIN MOTOR

HYDRAULIC UNIT