

SEQUENCE OF OPERATIONS

Conventional Concept™

JOB #5452-100

**LEVER BROTHERS
WEST INDIES LIMITED**

TRINIDAD, WEST INDIES
JANUARY 2, 2004

CERTIFIED

DATE: 4/22/04 BY: NAB

DYNAMIC AIR
Conveying Systems

1. GENERAL INFORMATION

- 1.1. This Sequence of Operations describes the operations of system 100.
- 1.2. The Dynamic Air Conventional Concept™ pneumatic conveying system transports material (stpp, sodium sulphate, sodium carbonate) from the BulkBuster™ bulk bag unloader to one of four receiving day bins (bins) via the transporter.
- 1.3. The Allen Bradley MicroLogix 1200 controls the system. The operator interfaces the system through the PanelView 550 operator interface located on the front of the control enclosure. The MicroLogix 1200 communicates to the PanelView 550 via Ethernet communication. The operator adjustable parameters throughout this sequence are written in *Italics*.
- 1.4. The customer is responsible for all Ethernet connections, providing the HUB, and ensuring proper communication.
- 1.5. The system Automatic operation (section 2) sequences between: loading (section 2.2) the material into the transporter from the BulkBuster™, and transporting (section 2.3) the material to the selected bin.
- 1.6. The manual bin selection (section 3.1) allows for selecting the receiving bin. Other system manual operations are available for maintenance purposes. The manual load cycle (section 3.2) allows for filling the transporter with material from the BulkBuster™. The manual transport cycle (section 3.3) allows for transporting material to the selected bin.
- 1.7. The scale calibration procedure is listed in section 4. The scale must be calibrated before any system operations are allowed. The operator adjustable parameters are listed in section 5. The alarms are listed in section 6.
- 1.8. The day bin material weight is monitored using load cells. While the day bin material weight is below the *High Weight* setpoint, the bin is calling for material (calling). Because the transport cycle continues until completion, the day bins *High Weight* setpoint must be set low enough to allow for a full transporter of material to be transported to the bin after the calling signal is lost. This prevents overfilling the bin.
- 1.9. The day bin discharging is controlled by the customer. To discharge a bin, first open the bin outlet valve. While the receiving bin outlet valve is open, energize the Vibra-Jet® timer PCB. The Vibra-Jet® timer PCB pulses the solenoids sequentially.
- 1.10. The transporter pressure is monitored using an analog pressure transducer (4-20 mA output representing 0-100 psi). If the pressure transducer value is outside the -3 to 100 range, the Transporter Pressure Transducer Out Of Range critical alarm condition exists. The transporter depressurizes, and the system automatic operation terminates.

- 1.11. The air control module (ACM) supplies regulated air to the transporter and the convey line booster fittings during the transport cycle. The ACM uses an electronic pressure controller to regulate the air pressure. The pressure controller inputs a 4-20 mA analog signal representing 0-100 psi pressure setting. The pressure controller applies the pressure setting to the pilot regulator, thus regulating the downstream air.
- 1.12. If the BulkBuster™ exhauster is switched to “auto”, the BulkBuster™ exhauster operates as described in this sequence of operations. If the exhauster is switched to “on”, the exhauster runs continuously. The exhauster mode is changed by pressing the Exhauster key. The exhauster running proof consists of the motor starter energized and the motor running contact closed. If the exhauster running proof is lost when the exhauster is to be running, the BulkBuster Exhauster Failed To Start critical alarm exists.
- 1.13. The BulkBuster™ dust filter is manually cleaned by pressing the Filter key. The operator should clean the dust filter periodically as necessary. The dust filter timer PCB sequentially pulses the dust filter solenoid valves to clean the filters.
- 1.14. If the BulkBuster™ Jostler is switched to “auto”, the jostlers operate as described in this sequence of operations. If the Jostler is switched to “off”, the jostlers do not operate at all.

NOTE: Do not change the bulk bag while the system is in Automatic mode. If it is desired to switch the bulk bag in Automatic mode, the operator can disable (enable) the jostlers from the system Control screen.

- 1.15. It is the Operator’s responsibility to ensure that the bulk bags are properly in place and contain material. If the above conditions are not met, the system rate will be affected.
- 1.16. The receiving bin dust filter cleaning is controlled by the timer PCB and the differential pressure switch. While the dust filter differential pressure switch is actuated (6” W.C.), the dust filter timer PCB sequentially pulses the dust filter solenoid valves to clean the filter.
- 1.17. The valve closed proof consists of the following: the valve open solenoid is de-energized, the valve open limit switch is open, and the valve closed limit switch and sealed pressure switch are closed. The valve open proof consists of the valve I/O in the opposite states. The valve fail to position timer (15 seconds) starts when a valve has neither the closed proof nor the open proof. If the valve fail to position timer expires, the Valve Failed To Open/Close non-critical alarm exists.

2. AUTOMATIC OPERATION

2.1. INITIATING THE AUTOMATIC SEQUENCE

CAUTION: If the transporter remains pressurized after start-up or as the result of an emergency condition, it must be manually depressurized via the top air bleed-off valve before troubleshooting is attempted. Working on a pressurized system could result in severe personnel injury or equipment damage.

- 2.1.1. Turn the control enclosure keyed power selector switch clockwise. The BulkBuster™ outlet valve, the transporter inlet valve and the transporter vent valve (pneumatically slaved to the transporter inlet valve) are closed. All operations remain idle.
- 2.1.2. Select the receiving bin as described in section 3.1. If the downstream equipment is using different materials, the weight of selected bin should be low enough to accept the entire bulk bag. This allows for the system to be purged before changing materials.
- 2.1.3. From the system Control screen, select automatic mode by pressing the Start Auto key. For manual operation, see section 3.
- 2.1.4. When the system is in automatic operation the BulkBuster™ exhaustor runs continuously while the transporter continuously sequences between loading and transporting to the selected bin.
- 2.1.5. The automatic operation cancels when the operator presses the Stop Auto key or the system has a critical alarm.

NOTE: Upon pressing the Stop Auto key, the Tuffer® motor starter turns off immediately. If the Stop Auto key is pressed during the load cycle, the load cycle halts immediately. If the Stop Auto key is pressed during the transport cycle (automatic or manual), the transport cycle continues to completion. If the *Transporting Too Long* timer has expired, pressing the Stop Auto key cancels the transport cycle.

2.2. AUTOMATIC LOAD CYCLE

The following conditions must exist before the automatic load cycle initiates:

- The transporter is not full
- The transporter is depressurized
- The selected bin is calling

- 2.2.1. The transporter inlet valve and vent valve open, and the Tuffer® starts.

NOTE: If the Tuffer® motor running proof is lost while the Tuffer® is running, the Tuffer Failed To Start critical alarm exists.

- 2.2.2. When the transporter inlet valve is open and the Tuffer® is running; the BulkBuster™ outlet valve opens, and the *Loading Too Long* timer (set approximately to twice the normal loading time) starts.
- 2.2.3. While the Tuffer® inlet valve is open, the BulkBuster™ jostler timer PCB and the BulkBuster™ Vibra-Jet® timer PCB energize. The jostler timer PCB continuously extends and retracts the jostlers sequentially. The Vibra-Jet® timer PCB continuously pulses the solenoids sequentially.
- 2.2.4. Material gravity feeds from the BulkBuster™ into the transporter.
- 2.2.5. When the transporter material level reaches the high level switch or the operator presses the Load Complete key; the BulkBuster™ outlet valve closes, and the *Inlet Valve Close Delay* timer starts.
- 2.2.6. When the *Inlet Valve Close Delay* timer expires, the transporter inlet valve closes and the Tuffer® stops.

NOTE: If the *Loading Too Long* timer expires before the transporter is full, the Transporter Loading Too Long non-critical alarm condition exists. The transporter continues loading until full or the Stop Auto key is pressed.

- 2.2.7. When the transporter inlet valve and vent valve are closed, the load cycle is complete.

2.3. AUTOMATIC TRANSPORT CYCLE

The following conditions must exist before the automatic transport cycle initiates:

- The transporter is full or the Load Complete key was pressed
- The transporter inlet valve is closed
- The transporter is depressurized
- The selected bin is calling

- 2.3.1. The valves in position timer (2 seconds) starts. The transporter inlet valve, the 2-way switch, and the switch receiver's position proofs must be present for the duration of the valves in position timer.
- 2.3.2. When the valves in position timer expires; the ACM pressure controller sets to the selected bin *Convey Pressure*, the *Pressure Up* timer starts, and the *Transporting Too Long* timer (set to approximately twice the normal transporting time) starts.

NOTE: The *Pressure Up* timer holds the transporter in the pressurizing state until the transporter pressure reaches *PS2*. If the pressure fails to reach *PS2* before the *Pressure Up* timer expires, the Transporter Failed To Reach *PS2* non-critical alarm condition exists. The transporter depressurizes.

- 2.3.3. Material transports from the transporter to the selected bin.

2.3.4. While the ACM pressure controller is set greater than zero, and the transporter pressure is at or below the selected bin *Convey Pressure* minus the *Offset Pressure*; the transporter air injection nozzle solenoid pulses using the *Aeration On* timer and *Aeration Off* timer.

NOTE: If the transporter inlet valve closed proof is lost during the transport cycle, the Transporter Inlet Valve Close Failure During Transport critical alarm condition exists. If a switch receiver's position proof is lost during the transport cycle, the Switch Receiver Thru/Divert Position Failure During Transport critical alarm condition exists. If the 2-way switch position proof is lost during the transport cycle, the 2-Way Switch Thru/Divert Position Failure During Transport critical alarm condition exists. In either case, the transporter depressurizes immediately, and the system automatic operation terminates.

2.3.5. As the material clears the transporter and convey line, the transporter pressure drops rapidly. When the pressure falls below *PS2*; the ACM pressure controller resets to zero, the *Depress Too Long* timer starts, and the transporter depressurizes through the convey line.

NOTE: If the *Transporting Too Long* timer expires before the transporter pressure falls below *PS2*, the Transporter Transporting Too Long non-critical alarm condition exists. The transporter continues transporting until the pressure falls below *PS2* or the Stop Auto key is pressed.

2.3.6. When the transporter pressure falls to *PS1* (3 psi), the pressure down timer (5 seconds) starts.

NOTE: If the *Depress Too Long* timer expires before the pressure down timer expires, the Transporter Pressure Above *PS1* non-critical alarm condition exists. The transporter continues to depressurize.

2.3.7. When the pressure down timer expires, the transporter is depressurized and the transport cycle is complete.

NOTE: If the operator pressed the Load Complete key to initiate the automatic transport cycle, the automatic mode cancels after the automatic transport cycle completes. When the automatic cycle ends, the Panelview screen displays "Load Complete", and the operator can now load another bulk bag.

3. MANUAL OPERATIONS (Not Automatic)

3.1. MANUAL BIN SELECTION

The following conditions must exist before the manual bin selection can initiate:

- The transporter is depressurized

3.1.1. From the Manual Mode screen, press the Select Bin key.

3.1.2. Use the up (↑) and down (↓) keys to select the desired bin, then press the Enter (↵) key.

NOTE: If the desired bin is not *Enabled*, the bin selection does not change.

3.1.3. The 2-way switch and switch receivers position to direct material to the selected bin. The booster header solenoid valves open or close to allow air flow along the material path.

NOTE: The switch receiver on the unselected convey line defaults to the thru position.

3.2. MANUAL LOAD CYCLE

The following conditions must exist before the manual load cycle can initiate:

- The transporter is not full
- The transporter is depressurized
- The selected bin is calling

3.2.1. From the Manual Mode screen, press and **hold** the Manual Load key.

NOTE: If the BulkBuster™ exhauster is in the “auto” position, the exhauster turns on while manually loading.

3.2.2. The system performs the same operations as described in section 2.2. The load cycle also ends if the Manual Load key is released.

3.3. MANUAL TRANSPORT CYCLE

The following conditions must exist before the manual transport cycle can initiate:

- The transporter inlet valve is closed
- The transporter is depressurized
- The selected bin is calling

3.3.1. From the Manual Mode screen, press and release the Manual Transport key.

3.3.2. The system performs the same operations as described in section 2.3 for one transport cycle.

4. SCALE CALIBRATION PROCEDURE

- 4.1. From the Main Menu, go to the Scale Setup screen.
- 4.2. Press the Calibrate key to enter the configuration screen.
- 4.3. Enter the desired *Scale Calibration Weight*.
- 4.4. Press the scale Reset key. The zero value, span value, and the tare weights are cleared.
- 4.5. When the day bin is empty, press the Zero key.
- 4.6. Add the *Scale Calibration Weight* to the day bin and press the Span key.
- 4.7. Press the Accept key to accept the current calibration or press the Reset key to recalibrate the scale.
- 4.8. The scale is now calibrated.
- 4.9. Press the Exit key to return to the scale setup screen.
- 4.10. If the Tare key is pressed, the net weight is zeroed, but the gross weight remains the same. I.e. If the weigh hopper was empty but your net and gross weight read 5 lbs, pressing the Tare key would set the net weight to 0 lbs and the gross weight would remain at 5lbs.

5. OPERATOR ADJUSTABLE PARAMETERS

- 5.1. *PS2 Pressure* (0-99 psi)
- 5.2. *Pressure Up Time* (0-999 sec)
- 5.3. *Offset Pressure* (0-99 psi)
- 5.4. *Aeration On Time* (0-9.9 sec)
- 5.5. *Aeration Off Time* (0-99.9 sec)
- 5.6. *Loading Too Long Time* (0-999 sec)
- 5.7. *Transporting Too Long Time* (0-999 sec)
- 5.8. *Depress Too Long Time* (0-999 sec)
- 5.9. *Convey Pressure* (0-99 psi; set specific to each bin)
- 5.10. *Enabled* (On/Off; set specific to each bin)
- 5.11. *High Weight* (STPP 310 cu. ft. bin: 0-15,500 lbs.
Sodium Sulphate 310 cu.ft. bin: 0-21,000 lbs
Sodium Sulphate 70 cu. ft. bin: 4,800 lbs
Sodium Carbonate 70 cu. ft. bin: 3,500 lbs)

6. ALARM SUMMARY

- 6.1. Valve Fail To Open/Close (non-critical)
The valve has taken too long to position correctly. The valve continues trying to position.
- 6.2. Transporter Transport Cycle Canceled (critical)
An error has occurred during the transport cycle. The transporter depressurizes, and the system automatic operation terminates.
- 6.3. Valve Open/Close Failure During Transport (critical)
The valve position proof is lost during the transport cycle. The transport cycle is canceled. The transporter depressurizes, and the system automatic operation terminates.
- 6.4. Switch Receiver Thru/Divert Position Failure During Transport (critical)
The switch receiver position proof is lost during the transport cycle. The transport cycle is canceled. The transporter depressurizes, and the system automatic operation terminates.
- 6.5. 2-Way Switch Thru/Divert Position Failure During Transport (critical)
The 2-way switch position proof is lost during the transport cycle. The transport cycle is canceled. The transporter depressurizes, and the system automatic operation terminates.
- 6.6. Transporter Failed To Reach PS2 (non-critical)
The transporter has failed to pressurize at the beginning of the transport cycle. The transporter depressurizes.
- 6.7. Transporter Loading Too Long (non-critical)
The material has taken too long to fill the transporter. The system remains loading until the transporter is full or the Stop Auto key is pressed.
- 6.8. Transporter Transporting Too Long (non-critical)
The material has taken too long to empty the transporter. The system remains transporting until the transporter is empty or the Stop Auto key is pressed.
- 6.9. Transporter Pressure Above PS1 (non-critical)
The transporter has taken too long to depressurize at the end of the transport cycle. The transporter continues trying to depressurize.
- 6.10. Transporter Pressure Transducer Out Of Range (critical)
The pressure transducer is reading a value outside the range of -3 to 100 psi. The transporter depressurizes, and the system automatic operation terminates.
- 6.11. BulkBuster Exhauster Failed To Start (critical)
The Exhauster motor is not running during normal operation. The cycle ends immediately and the system automatic operation terminates.

6.12. Tuffer Failed To Start (critical)

The Tuffer motor is not running during the load cycle. The cycle ends immediately and the system automatic operation terminates.