**Engineered Controls Solutions Inc.**
**London, Ontario, Canada**

**Nucleation System**
**Operational manual**
**rev 2.0**
**October 2010**

## 1- Introduction:

ECS nucleation system, rev 2.0 is designed to be used as a dry air/nitrogen nucleation system. It is intended to reduce the density of polyol or other resins by nucleating air or nitrogen into a poly stream. It is a stand alone system capable of running independently of any other online systems or processes.

## 2- Principle of operation:

The system is made up of the following:

1- Inlet, outlet valves
2- Day tank pressure regulator
3- Density meter
4- Static mixers
5- Electric Pump
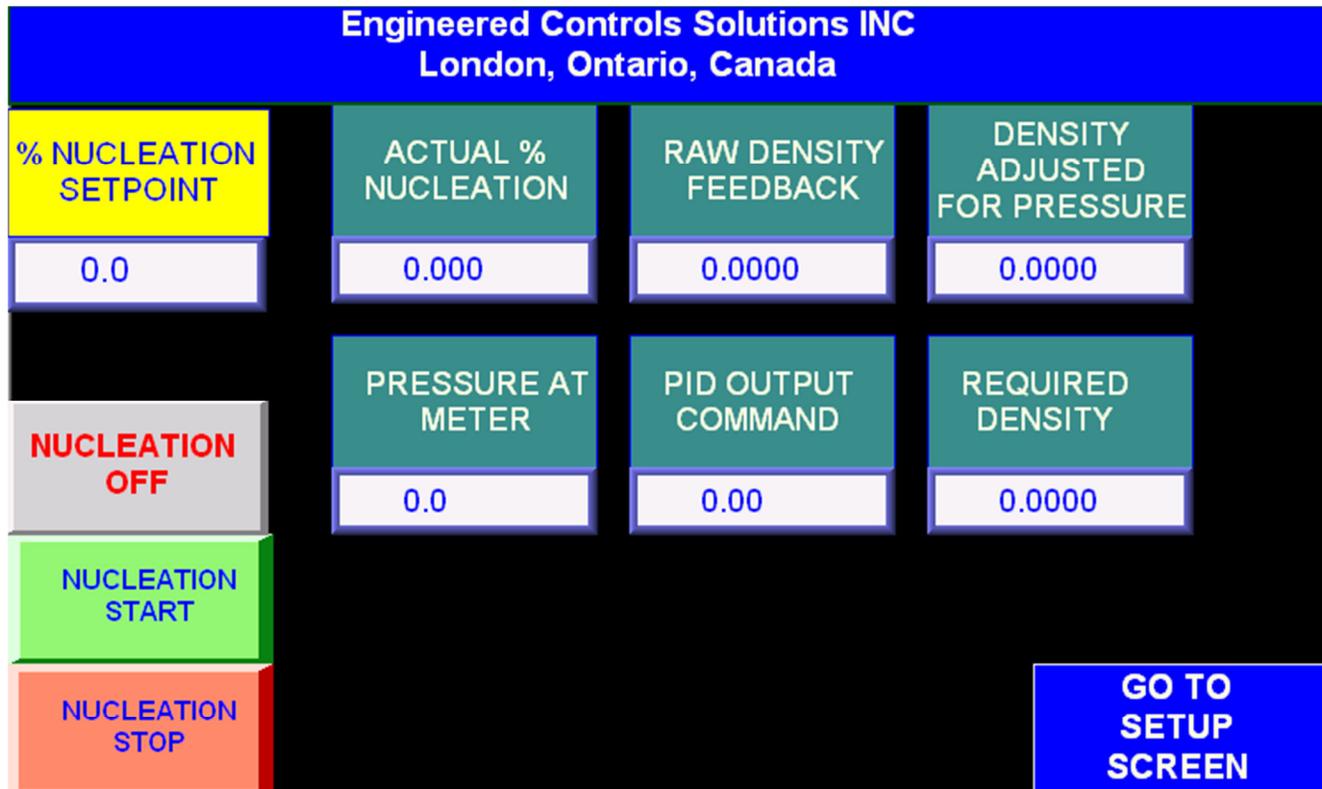6- Air injection ports
7- Mixer bypass circuit

The Polyol storage tank is retrofitted with a precision pressure regulator used to keep the Poly tank pressure constant at all time. Out of the pressure regulated tank, the Polyol enters the nucleation system via the inlet valve, passes through a density meter then to the system pump. A stream of dry air / nitrogen is added to the pump inlet. The air-liquid mixture is then pushed through a series of static mixers back to the storage tank.

The system density is continuously monitored and adjusted via a PID control loop running in the on board PLC system.

## 3- Setup and operation:

The user-machine interface is through a 7" color operator interface unit

### Main Screen:



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| % NUCLEATION SETPOINT | ACTUAL % NUCLEATION | RAW DENSITY FEEDBACK | DENSITY ADJUSTED FOR PRESSURE |
|---|---|---|---|
| 0.0 | 0.000 | 0.0000 | 0.0000 |

| | PRESSURE AT METER | PID OUTPUT COMMAND | REQUIRED DENSITY |
|---|---|---|---|
| NUCLEATION OFF | 0.0 | 0.00 | 0.0000 |

NUCLEATION START

NUCLEATION STOP

GO TO SETUP SCREEN

     **- Nucleation set-point**: Data Entry, touch field to activate
enter the percentage nucleation set-point, for example, 10.0 corresponds to 10 % reduction in density, therefore, if the raw material density is 1/0 g/cc, the target density will be 0.9 g/cc

–     **Nucleation start:** Push button
Touch the button to activate the nucleation system.

–     **Nucleation stop**: Push button
Touch the button to deactivate the nucleation system

–     **Actual % nucleation:** Displays the actual nucleation percentage
–     **Raw density feedback:** displays the density feedback as derived from the density meter
–     **Density adjusted for pressure:** Displays the density feedback after compensation for pressure is performed
–     **Pressure at meter:** The fluid pressure at the system inlet
–     **PID output command:** The output of the PID controller applied to the air supply valve
–     **Required density:** The system density target in g/cc
–     **Go to setup screen:** navigation button, go to system setup screen

**Setup screen:**



–      **Raw Material density:** Data Entry, touch field to activate
Enter the raw material density in g/cc
–      **Control mode select:** Toggle push button
       a) MODE IS PRESSURE ADJ: The system density feedback is derived from the density meter and the system pressure as read from the pressure transducer mounted at the exit side of the density meter. No manual calibration is active.
       b) MODE IS DENSITY TABLE: The system density feedback is derived from the density meter and interpolated using the density table build during manual calibration.

–      **Go to density table:** navigation button, go to density table screen
–      **Go to main:** navigation button, go to main screen

       **Density table screen:**

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| RAW DENSITY FEEDBACK | 0.0000 |
|---|---|

| | MEASURED DENSITY | METER DENSITY | | MEASURED DENSITY | METER DENSITY |
|---|---|---|---|---|---|
| 01 | 0.0000 | 0.0000 | 06 | 0.0000 | 0.0000 |
| 02 | 0.0000 | 0.0000 | 07 | 0.0000 | 0.0000 |
| 03 | 0.0000 | 0.0000 | 08 | 0.0000 | 0.0000 |
| 04 | 0.0000 | 0.0000 | 09 | 0.0000 | 0.0000 |
| 05 | 0.0000 | 0.0000 | 10 | 0.0000 | 0.0000 |

**Data should be entered from highest to lowest**
**VALUE 1= BASE DENSITY**
**VALUE 10 = LOWEST DENSITY**

| GO TO SETUP SCREEN | GO TO MAIN |
|---|---|

– **Raw density feedback:** Display field, displays density feedback from density meter
– **01 Measured Density:** Enter the density as measured from a test sample using a hydrometer or a graduated cylinder
– **01 Meter Density:** enter the density as read from the density meter and displayed in the "raw density feedback" field
– 02, 03, …, 10 same as above.

*Note: Very important !*
*The data collected should be a decrementing series, IE, the data in filed 01 should be greater than that in field 2, and in field 2 should be greater then that in filed 3 and so on.*
*When collecting the data, one should start with a clean system, no nucleation, record the data for the clean system as points 01 for measured density and meter density. Start the nucleation system, and record the data is small decrements of density. Make sure to exceed 20 % of the lowest nucleation set-point required.*
*Make a note of the tank pressure when the data is collected, and make sure you always run at that pressure with a particular table.* ***Changing the tank pressure requires a new calibration table.***