Blown Film Extrusion

Line Control

3 Layers with CD

USER MANUAL

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1. Introduction

1.1. Blown Film Extrusion

Blown film extrusion is the process of extruding plastic through a circular die and blowing the melted plastic into a bubble-like expansion. The bubble is pulled upwards until it passes through a nip-roll where it is flattened to create what is known as lay-flat of blown film. At the end of this process the lay-flat is winded on reels.
Extruding the plastic through the die can be done using several extruders in order to manufacture multi-layer films with each layer being made from different materials with different properties.
The bubble size, in the blown film extrusion, is depended on the amount of air introduced into the bubble and the position of a calibration cage (if exists). The air inside the bubble can be continuously exchanged by what is known as IBC (Internal Bubble Cooling) system. Cooling the air inside the bubble helps cooling the plastic faster and, by this, enables increasing the production throughput.

Manufacturing film by this process gives the ability to regulate the film's width and thickness by controlling the volume of air inside the bubble, the output of the extruder and the speed of the nip-roll.

1.2. Line Control

Sysmetric's *Line Control* systems are designed to control the different sub-systems which involve the blown film production line in order to manufacture the film with the desired properties. The different sub-systems and controls are:

- Raw material handling – can be done by one of two systems:
  - *Graviman* – loss-in-weight follow-up on the extruder throughput.
  - *CD Series* – batch type gravimetric dosing units for preparing defined mixtures of raw material. The extruder's throughput is determined and monitored by the batch preparation rate.

  Material handling can also include conveying the raw material to the *Graviman*/*CD* and to the extruder.
- Extruder – controlling the extruder speed.
- IBC and calibrator cage – controlling the air exchange inside the bubble and the calibrator position to form the desired width of lay-flat.
- Nip-roll – tuning the nip-roll speed for the desired Meter/Minute.
- Tension and Winder – adjusting the tension rolls and winder speed to tense the lay-flat and wind it on the reels.
- Temperature – controlling the temperature of the extruder, the die and the tension rolls.
- Remote control – setting parameters to the production line and data acquisition from a remote PC (***Minuman*** software).

By controlling and monitoring those sub-systems, the *Line Control* can ensure a film production with specified properties of:

- Width
- Thickness (gram-per-mater)
- Layers Ratio (in multi-layer production lines)

The different models of Sysmetric's *Line Control* systems involve different combinations of the above mentioned sub-systems of the production line and can control part or all the parameters of the blown film.

1.3. 3 Layers with CD

The *3 Layers with CD* is Sysmetric's system for blown film production lines with 3 extruders for manufacturing 3 layers film. This system involves the following:

- 3 *CD Series* gravimetric dosing units (the CD model is selected to fit the production line throughput).
- Control on the speeds of the 3 extruders.
- Layers ratio – adjusting the relative speeds of the extruders to receive the desired layers ratio.
- Thickness – adjusting the extruders speed to receive the desired film's thickness defined by gram-per-meter.

1.3.1. CD Series Gravimetric Dosing Units

The *CD Series* gravimetric dosing units are Sysmetric's solution to raw material dosing for extrusion and injection molding processes. The CD doser reduces material cost, utilizing its high accuracy to lower the amount of expensive additives in the product. The batch weighing nature of the doser offers calibration-free operation and up-to-the-gram accumulation of raw material flowing through the system. The mechanical simplicity of the CD series units, and its practical design, ensures easy maintenance-free operation. The control unit of the CD doser combines automatic adaptive tuning and noise filtering algorithms with the ruggedness, open architecture, and extensibility of an industry-standard PLC.

The CD Series dosing units are divided to 5 models for different capacities:

- CD100 for up to 100Kg/h
- CD400 for up to 400Kg/h
- CD800 for up to 800Kg/h
    - CD800HD200 for up to 1000Kg/h
    - CD800HD400 for up to 1200Kg/h

Note: the stated capacities refer granulated material with 0.5 Liter/Kg density and may vary with different materials.

The *Line Control* operation principles are the same with all CD models and this manual refers all models. For detailed information on the *CD Series* dosing units, operation and maintenance, please refer to Sysmetric's *CD Series* user manual.

2. System Overview

2.1. Control Panel

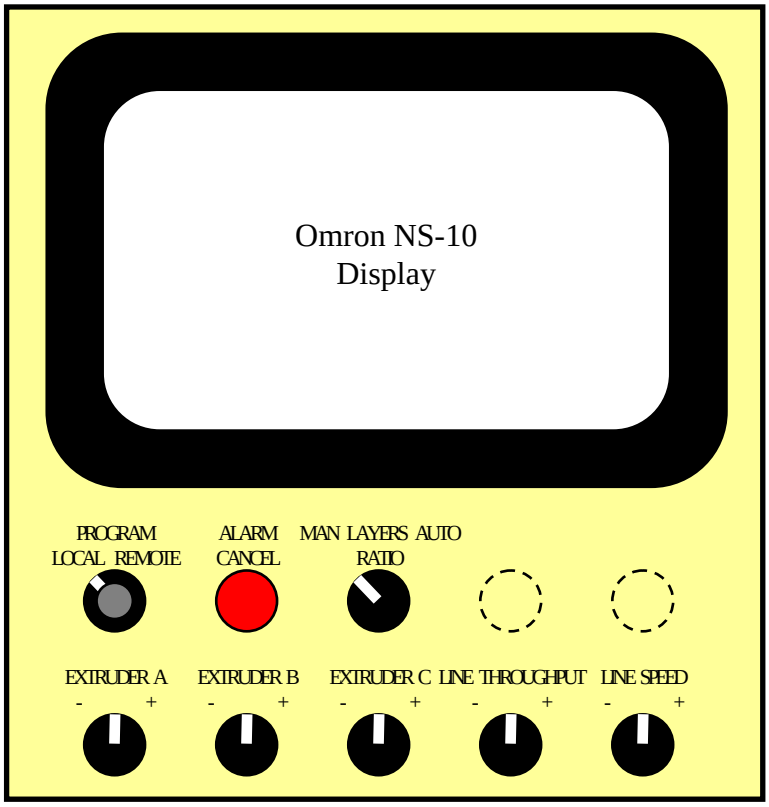

Figure 2.1-1 – Control panel

The control panel of the system consists of the following:

- Program key switch – select local control or remote PC control
- Alarm cancel push-button – mute alarms
- Layers control switch – select between manual or automatic control on the layers ratio and the extruders speed
- Extruder switch A, B, C – manual control on the extruders speed
- Line throughput switch – increase/decrease line throughput
- Line speed switch – increase/decrease line speed
- Touch screen display for programming and monitoring

2.1.1. Layers Control

The layers control switch button selects between 3 modes of operation:

1. *MANUAL (MAN)* – this mode is used for maintenance and for testing the operation of the extruders and the nip-roll. In this mode the speed of the extruders and nip-roll are controlled manually from the corresponding switch buttons on the control panel. To manually test the extruders press the start switch button of each extruder and increase/decrease the R.P.M using the corresponding *EXTRUDER #* switch on the control panel. To manually test the nip-roll, press the nip-roll start push-button and increase/decrease its speed using the *LINE SPEED* switch button. (When the extruders and nip-roll are on, their corresponding label in the control display changes to green).
2. *LAYERS RATIO* – in this mode the system controls the extruders speed in order to maintain the set layers ratio. This mode is used mainly when starting the production in the line before switching to automatic mode. When working in layers ratio mode turn the *LINE THROUGHPUT* switch to increase/decrease the throughput or enter a value to the *SET Kg/hr* variable in the control display and use the *LINE SPEED* switch to increase/decrease the nip-roll speed or enter a value to the *SET M/Min* variable in the control display.
3. *AUTOMATIC (AUTO)* – in this mode the system has full control on the line and it maintains the set gram-per-meter (*gr/M*) with the set layers ratio. This mode is used for normal operation of the line. When the system is in automatic mode use the *LINE SPEED* switch to increase/decrease the nip-roll speed or enter a value to the *SET M/Min* variable in the control display. The system will automatically adjust the extruders speed to maintain the set gram-per-meter (*gr/M*) and layers ratio.

2.1.2. Program

This *PROGRAM* switch selects between *LOCAL* control and *REMOTE* control.

1. *LOACL* – in local mode all the line settings are done using the control panel and the control display on the system's control cabinet.
2. *REMOTE* – remote mode is used when the system is connected to a remote PC with the ***Minuman*** software for remote control on the production parameters and for data acquisition. When the system is set to remote mode the line formula (layers ratio and gram-per-meter) can not be replaced locally at the control display and the material accumulators can not be reset. Changing formula and resetting the material accumulators in remote mode can be done only through the ***Minuman*** software on remote PC.

2.1.3. Alarm Cancel

The *ALARM CANCEL* push-button has two functions:

1. Inhibiting system alarm (R11 potential free contact).
2. Display and toggle unresolved alarms on the control display.

2.2. Control Display

Figure 2.2-1 – Control display

The control display is a color touch-screen panel. Every operation on the display is done by pressing gently on the display. Activating a button is done be pressing gently on the display where the button is drawn. Changing numeric values is done by pressing gently on the display where the value is written.

2.2.1. Entering Numeric Values

Several screens (e.g. *LINE* screen) have one or more editable numeric items (e.g. the percentage of each layer). To modify the value of an item, follow these steps:

1. Select the item that you want to edit by pressing gently on the display where that item is written. A pop-up screen with numeric keypad will appear on the display.
2. Enter the new value using the numeric keypad. If the item has a decimal point, use the '.' key to move to the fractional part. For example, to enter 12.3, push '1', '2', '.' followed by '3'.
3. Press the *Enter* key to confirm the change. The keypad screen will close and the item will get the new value.

You can cancel editing by pressing the *X* button in the keypad screen.

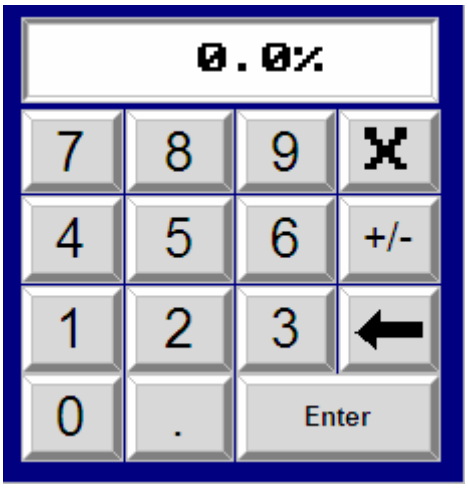

Figure 2.2-2 – Numeric keypad

2.2.2. Line Screen

The line screen is the main screen of the system. This screen shows the extruders status and the production parameters. Press the *LINE* button to switch the display to the line screen.

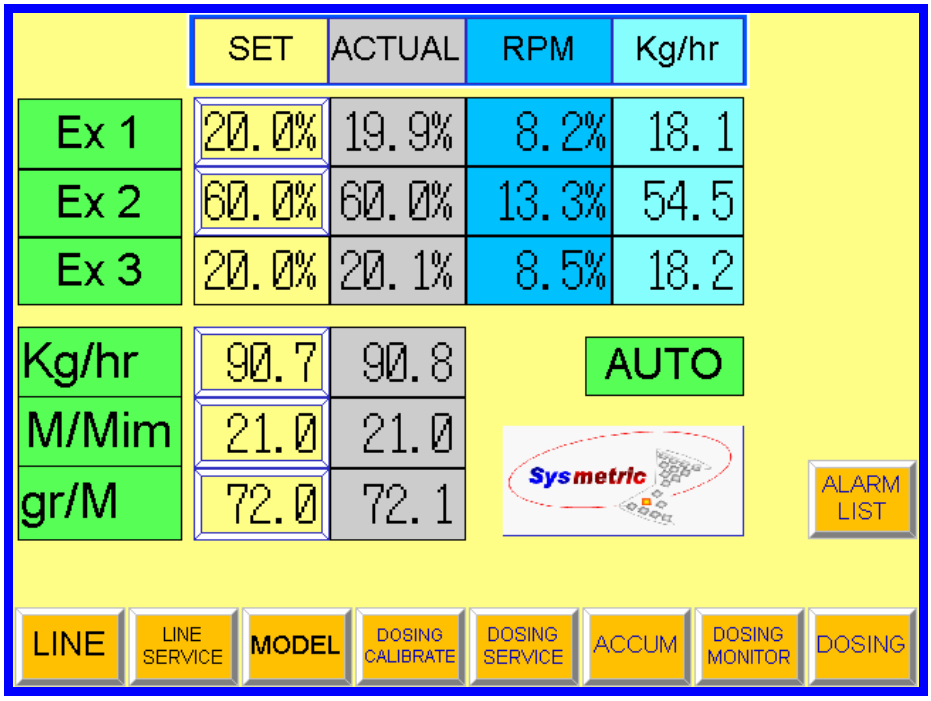

Figure 2.2-3 – Line screen

The line screen shows the following data:

- For each extruder (*Ex 1*, *Ex 2*, *Ex 3*) – *SET* and *ACTUAL* percentage of the total line throughput, current *RPM* and the actual extruder output in *Kg/hr*.
- *Kg/hr* – the *SET* and *ACTUAL* line throughput.
- *M/Min* – the *SET* and *ACTUAL* line speed.
- *gr/M* – the *SET* and *ACTUAL* gram-per-meter.

2.2.3. Line Service Screen

The line service screen is used for setting and monitoring parameters of the line's speed, selecting manual or automatic speed calibration mode and it shows the total working hours of the extruders and the line. Press the *LINE SERVICE* button on the control display to switch to the line service screen. The system will request to enter the access password. The password is 4321.

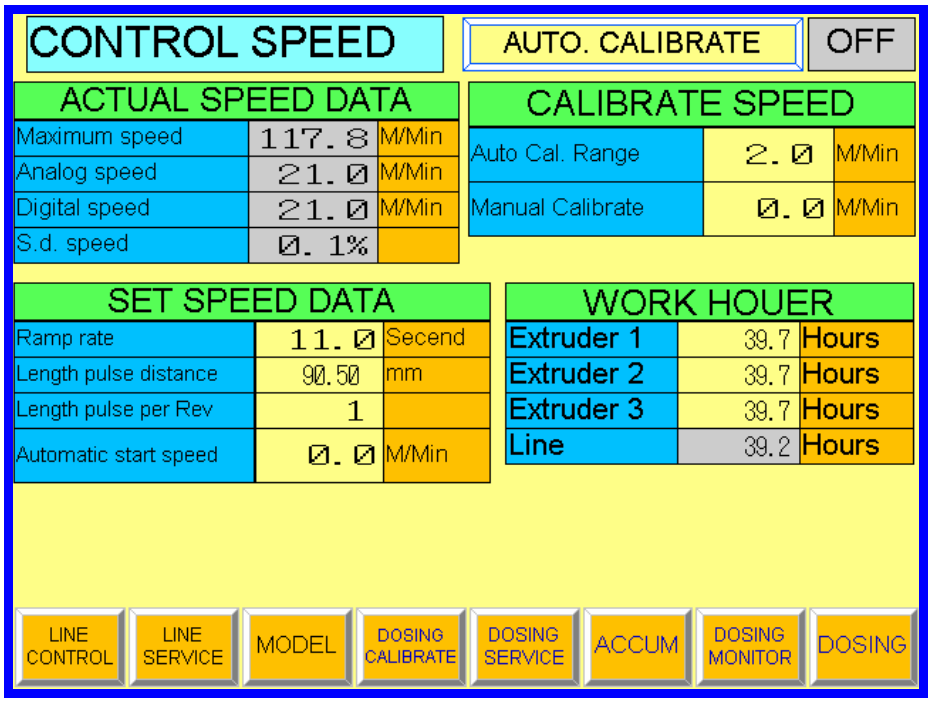

Figure 2.2-4 – Line service screen

See section 4.1 for complete details on the line service screen.

2.2.4. Model Screen

The system is using a control technique called “modeling”. The modeling is a special control technique that enables stable and accurate control. It is based on the actual terms involved in the process, not like the general control techniques (PID etc.). The idea of the modeling technique is to evaluate the mass per revolution that the extruder screw pumps. The model evaluation is capable of handling the screw nonlinearity as well. All calculations are done in natural control numbers rather then physical terms in order to obtain full accuracy (for that reason some of the values will use “z” units). To enter the model screen, press the *MODEL* button on the control display.

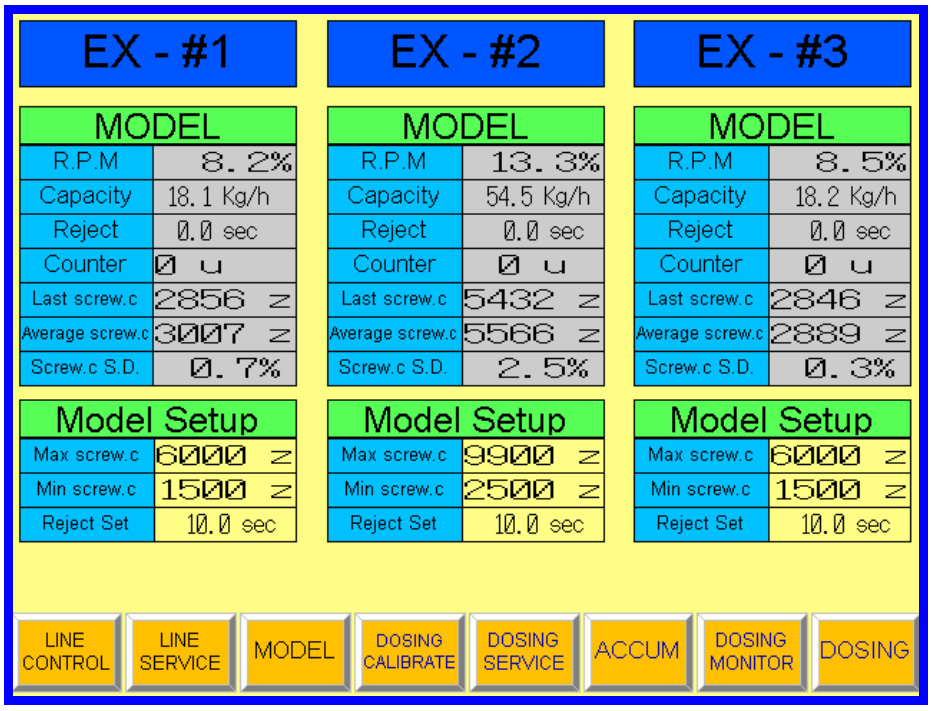

Figure 2.2-5 – Model screen

The model screen holds all the parameters needed for the model operation. Refer to section 4.2 for full details on the model screen and the model parameters.

2.2.5. Dosing Calibration Screen

The dosing calibration screen is used for calibrating the weighing of the CD dosing units. To enter this screen press the *DOSING CALIBRATE* button on the control panel and enter the access password 4321.

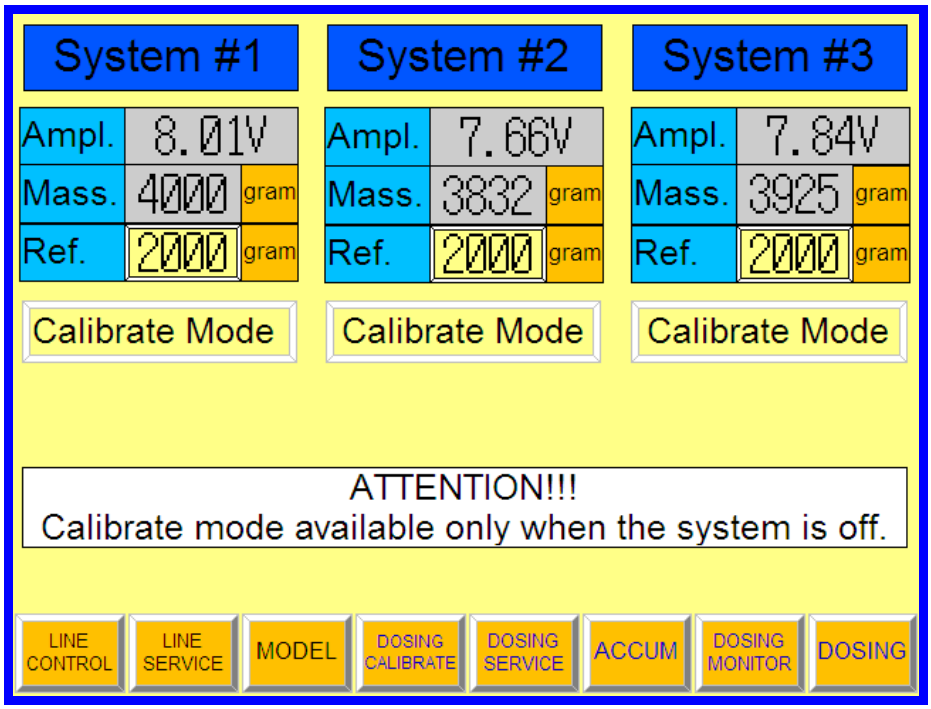

Figure 2.2-6 – Dosing calibration screen

See the *CD Series* user manual for details on the calibrating the dosing units.

2.2.6. Dosing Service Screen

The dosing service screen is holding the parameters needed for the operation of the CD dosing units. To enter this screen press the *DOSING SERVICE* button on the control panel and enter the access password 4321.

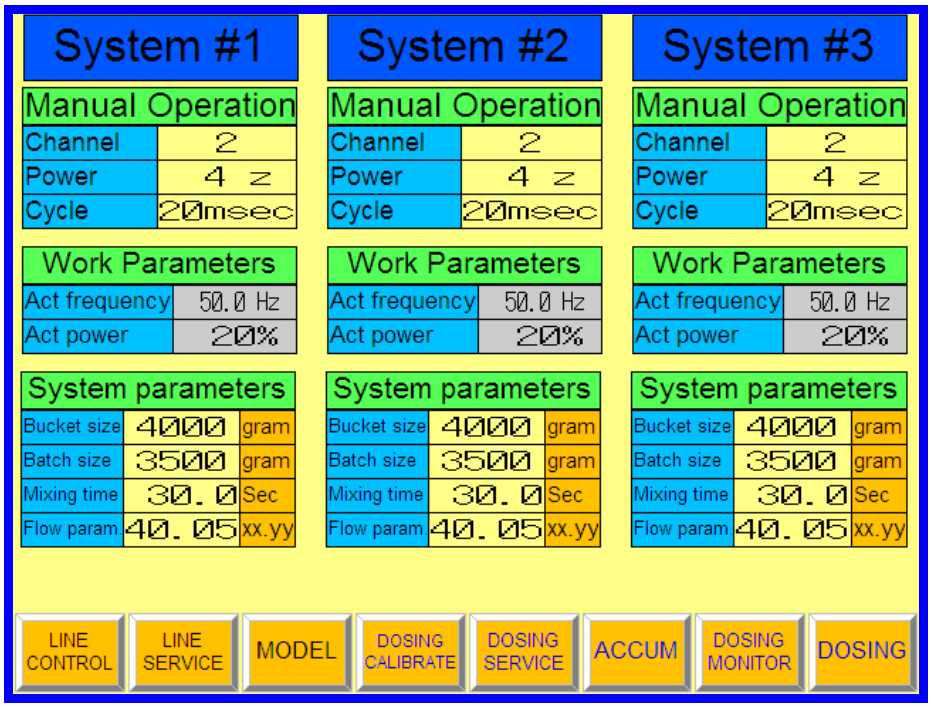

Figure 2.2-7 – Dosing calibration screen

See the *CD Series* user manual for details on the dosing parameters.

2.2.7. Accumulators Screen

The accumulators screen shows the total amount of raw material that was dispensed at each channel of each dosing units. To enter this screen, press the *ACCUM* button on the control panel.

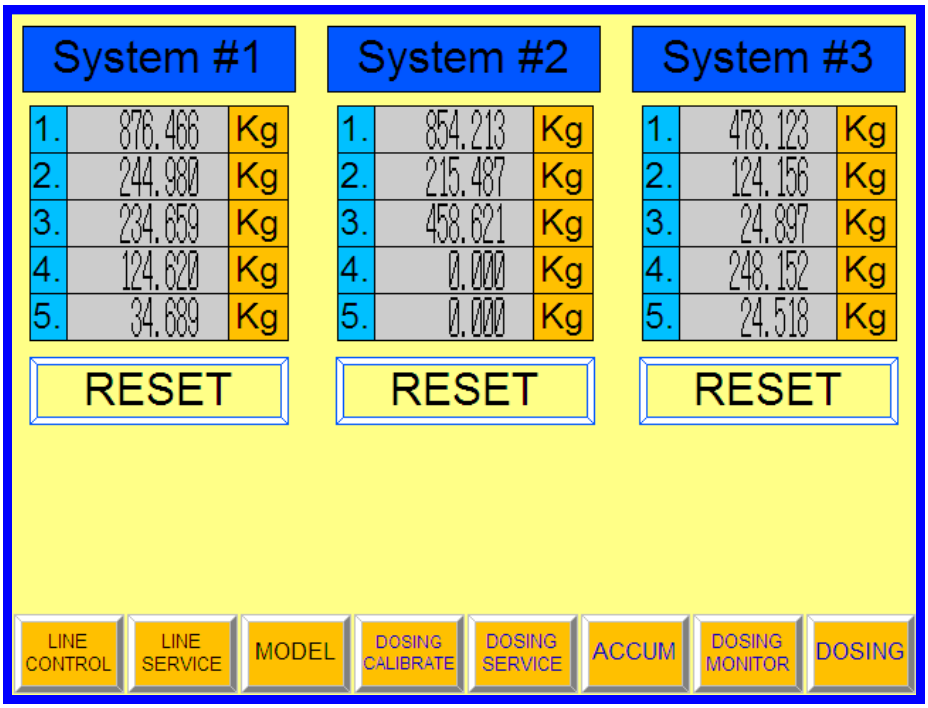

Figure 2.2-8 – Accumulators screen

Press the *RESET* button to reset the accumulators.

2.2.8. Dosing Monitor Screen

The dosing monitor screen shows the actual working performance of the dosing units. Through this screen it is easy to follow the batch preparation cycle of the dosing unit when searching for some malfunction in the systems. To enter this screen, press the *DOSING MONITOR* button on the control panel.

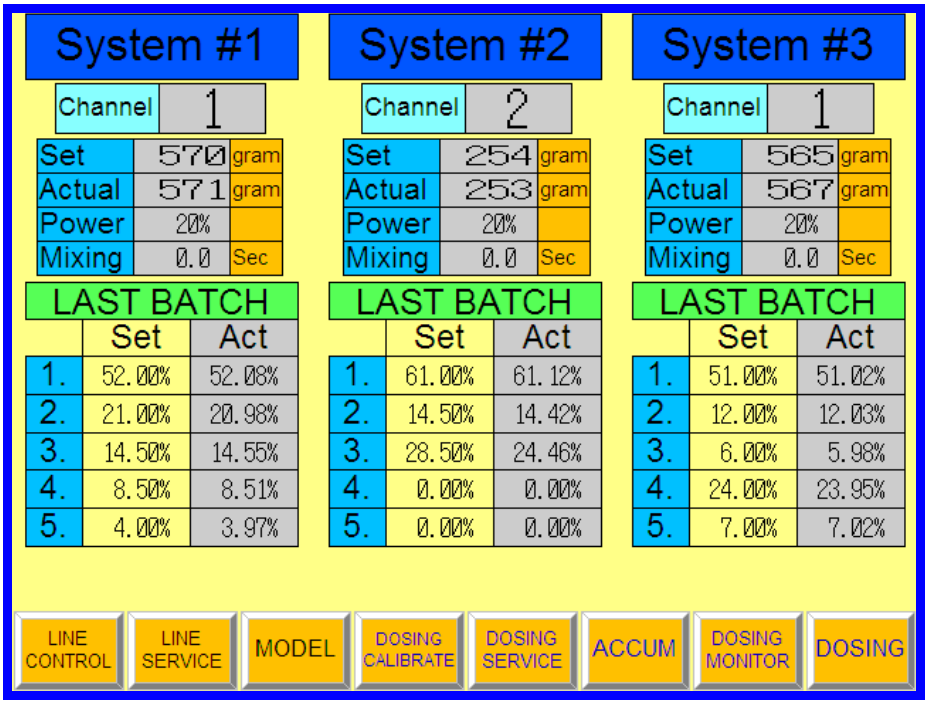

Figure 2.2-9 – Dosing monitor screen

See the *CD Series* user manual for details on monitoring the dosing units and the batch preparation cycle.

2.2.9. Dosing Screen

The dosing screen is used for entering the *SET* dosing formula for each dosing unit and it shows the *ACTUAL* formula according to the last batch that the system prepared. To enter this screen, press the *DOSING* button on the control panel.

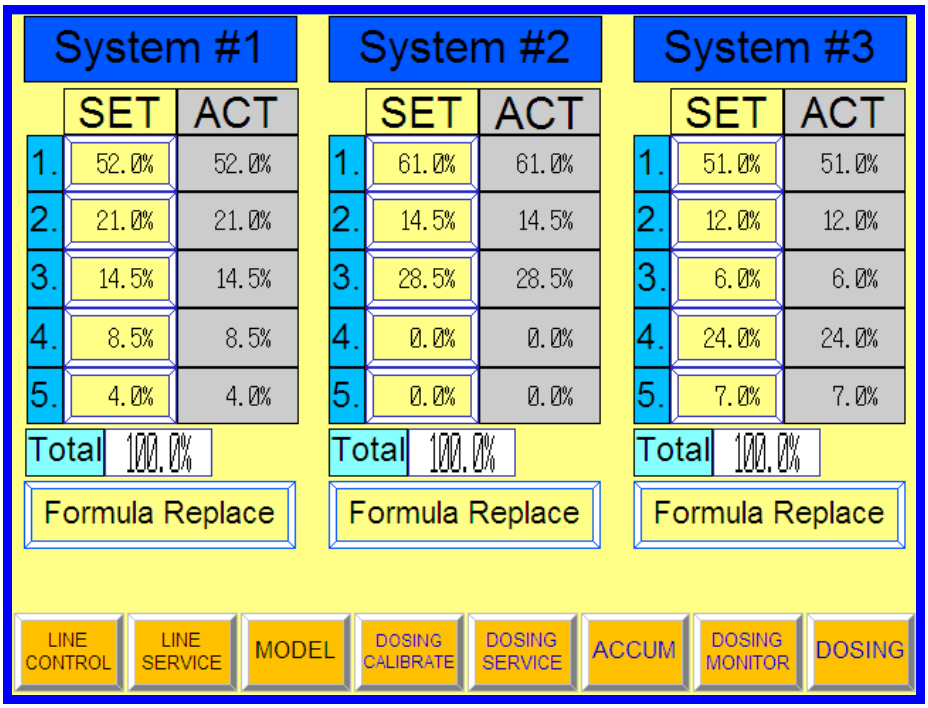

Figure 2.2-10 – Dosing screen

See the *CD Series* user manual for details on the dosing formula.

3. System Operation

Normal production should always start with the layers control in *LAYERS RATIO* mode or *AUTO* mode. If the line is started in *LAYERS RATIO* the system controls only the layers ratio and the gram-per-meter must be adjusted manually. If the layers control is in *AUTO* mode the system controls both the layers ratio and the gram-per-meter.

Starting the production is dune by the following steps:

1. Press *DOSING* on the control display to switch to the dosing screen. Check that each CD unit is set with the correct dosing formula. If not, enter the correct formula and press *Formula Replace* to set the new formula.
2. Turn on the CD dosing unit of each layer.
3. Turn layers control switch to *LAYER RATIO* mode or *AUTO* mode.
4. Press *LINE* on the control display to switch to the line control screen and set the layers ratio. Enter the *SET* percentage for extruder 1 (*Ex 1*) and extruder 2 (*Ex 2*). Extruder 3 (*Ex 3*) percentage is calculated and added automatically to sum 100% layer ratio.
5. Activate the extruders by pressing the start push button of each extruder.
6. Adjust the *SET Kg/hr*. Turn *LINE THROUGHPUT* switch to increase/decrease the *Kg/hr* or enter the desired value to the *SET Kg/hr* variable in the control display.
7. Press the nip-roll's start push button to activate the roll.
8. Pull the plastic film to the nip-roll and to the winder.
9. Adjust the line speed. Turn *LINE SPEED* switch to increase/decrease the line speed or enter a value to the *SET M/Min* variable in the control display.
10. Set the desired gram-per-meter by entering a value to the *SET gr/M* variable in the control display.

If the system is in *LAYERS RATIO* mode proceed with the following steps:

11. Using the *LINE THROUGHPUT* and the *LINE SPEED* switches, change the extruders R.P.M and the nip-roll speed and bring the line production close to the desired gram-per-meter (as in the *SET gr/M*).
12. Turn the layers control switch to *AUTO*. The system will take full control on the line production and maintain the set gram-per-meter and layers ratio.

During automatic production the line speed can be changed using the *LINE SPEED* switch or by changing the *SET M/Min* variable in the control display. The system will automatically adjust the extruders R.P.M to maintain the set layers ratio and gram-per-meter.

4. Service and Maintenance

4.1. Line Service Screen

The line service screen is used for setting and monitoring parameters of the line's speed, selecting manual or automatic speed calibration mode and it shows the total working hours of the extruders and the line. Press the *LINE SERVICE* button on the control display to switch to the line service screen. The system will request to enter the access password. The password is 4321.

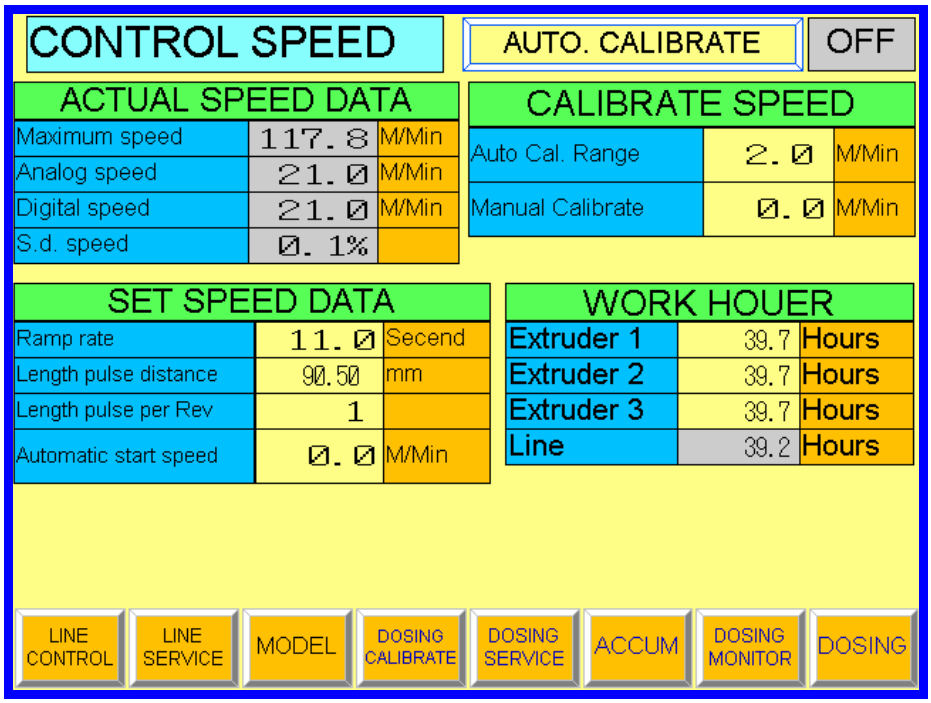

Figure 4.1-1 – Line service screen

4.1.1. Actual Speed Data

1. *Maximum speed* – is the calculated maximum line speed. This value is calculated based on the speed calibration.
2. *Analog speed* – the current line speed according to the analog input.
3. *Digital speed* – is the calculated line speed according to the digital pulses. This value is averaged over 30 seconds and thus it is accurate only when the line speed has not been changed for at least 30 seconds.
4. *S.d. speed* – the standard deviation of the line speed in percentage units. This value is calculated when the line is in automatic calibration.

4.1.2. Set Speed Data

1. *Ramp rate* – defines the time in seconds for ramping the production throughput from 0 to 100%.
2. *Length pulse distance* – the circumference in millimeters of the roll where the digital speed proximity switch is installed.
3. *Length pulse per Rev* – the number of pulses that the digital speed proximity switch generates per one revolution of the roll where it is installed.

4. *Automatic start speed* – the minimum start speed of the nip-roll. This value is used by the control to start the nip-roll when the production is in automatic mode.

4.1.3. Auto Calibrate

The control system uses the analog speed for calculating the extruders speed in order to maintain the desired film's Kg/M. The analog speed, calculated from the nip-roll's motor driver reference voltage, tends to vary with time and does not maintain stability. When the system is set to automatic calibration mode it uses the digital speed sensor to continuously calibrate the analog speed and, by that, maintaining the correct extruders speed and correct Kg/M.
To enable automatic mode press the *AUTO CALIBRATE* push button in the control display. The label next to the push button will display *ON* to indicate automatic mode. Pressing the button again will disable the automatic mode.

4.1.4. Calibrate Speed

1. *Auto Cal. Range* – defines the allowed range of automatic calibration.
2. *Manual Calibrate* – manually calibrating the line speed. This calibration can be done only when the automatic calibration is disabled. There are two ways to manually calibrate the line speed:
    a. Measure the actual line speed with a measuring device and enter that value in the *Manual Calibrate* field.
    b. Copy the *Digital speed* value to the *Manual Calibrate* value.

4.1.5. Work Hour

1. *Extruder 1, Extruder 2, Extruder 3* – extruders total working hours. To reset the totals enter 0 in the *Hours* value of each extruder.
2. *Line* – extruders + nip-roll total working hours. This value can not be reset.

4.2. Model Screen

The system is using a control technique called “modeling”. The modeling is a special control technique that enables stable and accurate control. It is based on the actual terms involved in the process, not like the general control techniques (PID etc.). The idea of the modeling technique is to evaluate the mass per revolution that the extruder screw pumps. The model evaluation is capable of handling the screw nonlinearity as well. All calculations are done in natural controller numbers rather then physical terms in order to obtain full accuracy (for that reason some of the values will use “z” units). To enter the model screen, press the *MODEL* button on the control display.

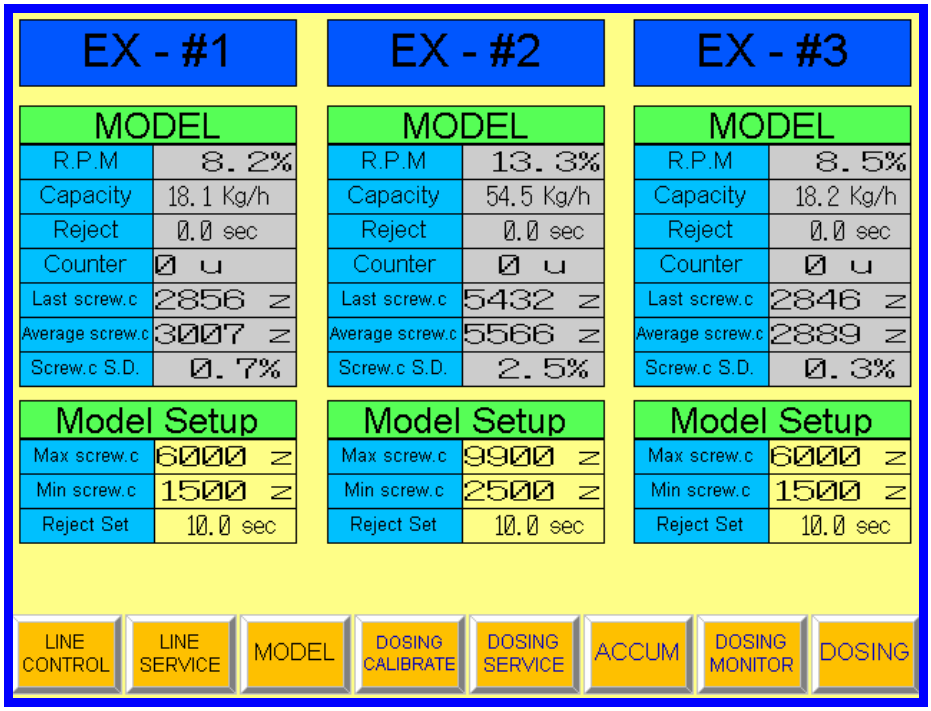

Figure 4.2-1 – Model screen

4.2.1. Model

1. *R.P.M* – the actual R.P.M. of the extruder in percentage.
2. *Capacity* – the actual throughput of the extruder in Kg/h.
3. *Reject* – minimum time delay between adjacent batches. If a second batch is processed before this time has elapsed the system will temporarily disable the control and will preset the batch counter (*Counter*) to 4u.
4. *Counter* – batch counter that represents the system stability. The system is considered stable when the counter is at zero.
5. *Last screw.c* – the last estimated extruder’s capacity in gram per revolution. It is calculated in relative units, denoted by z. The *Last screw.c* is compared to the min and max levels, after every batch, and if exceeds the *Counter* is preset to 4u. Such an event occurs usually after interference in the material flow and it stops the values updating until the line stabilizes again.
6. *Average screw.c* – the final filtered value of the extruder’s capacity.
7. *Screw.c S.D.* – the standard deviation of the screw capacity values in percentage units.

4.2.2. Model Setup

1. *Max screw.c* – the maximum allowed value for the *Last screw.c* parameter.
2. *Min screw.c* – the minimum allowed value for the *Last screw.c* parameter.
3. *Reject Set* – the set value for the *Reject* timer.

4.3. Production Stability and Accuracy

The control on the extruder throughput relies on the known size batches of raw material supplied to the extruder continuously by the CD dosing unit. During operation, every time a batch of raw material is supplied to the extruder the *Last screw.c* is updated. In normal operation, the *Last screw.c* parameter should be stable, it should be about twice the *Min screw.c* value and about half the *Max screw.c* value and it should be close to the *Average screw.c* value. In addition, the *Screw.c S.D.* should be lower then 4%. Monitoring these values for several consecutive batches will provide all the data necessary to locate any problem.
If the *Last screw.c* value is jumpy and/or the *Screw.c S.D.* is relatively high (more then 4%) check the following:

4.3.1. CD Weighing Bucket Loadcell

1. Clean the loadcell of the weighing bucket of the CD dosing unit.
2. Check if the loadcell is connected tightly to the housing.
3. Check if the weighing bucket is calibrated. See Calibration chapter in *CD Series* user manual for more details.

4.3.2. CD Mixer Inlet Proximity Switch

1. Stop the CD dosing unit.
2. Open the weighing bucket service door on the CD mixer chamber and check that the proximity switch is free of dirt.
3. Define the type of proximity switch installed in the system by checking its color and act accordingly.
   - For orange Proximity Switch:
     i. Turn the sensitivity screw located at the back of the proximity switch clockwise until the indicator LED turns off.
     ii. Turn the sensitivity screw counterclockwise slowly until the indicator LED turns on.
     iii. Turn the screw counterclockwise half a turn more.
   - For yellow Proximity Switch:
     i. Turn the sensitivity screw located at the back of the proximity switch clockwise until the indicator LED turns on.
     ii. Turn the sensitivity screw counterclockwise slowly until the indicator LED turns off.
     iii. Turn the screw counterclockwise one more turn.

4.3.3. CD Mixer Rotation Proximity Switch

Monitor the CD mixer rotation proximity switch to verify it works properly:

1. While the production line and the CD unit are on, verify that when the mixer rotates the sensor's indication light is blinking.
2. Verify that the mixer is constantly stopping at the same angle.

4.3.4. Row Material Supply

Check if the row material supply to the CD unit is ok. There should always be material in the hopper loaders of the CD when batches are prepared, otherwise the batch preparation process can become too long and the supply continuity can be

damaged. However, one row material supply problem in 10 minutes is still acceptable and will not disturb the stability and the accuracy.

4.3.5. Batch Preparation Process Time

Batch preparation process in the CD unit should always be shorter than 1 minute. If the process is longer then 1 minute monitor the CD unit and identify the cause of delay.

4.3.6. Batch Size

If the batch size of the CD unit is too small it causes the batches to be supplied, from the dosing unit to the extruder, in pairs and that can disturb the control process. When it happens the interruption counter (*Counter*) of the system is preset to the value 4u, standard deviation (*Screw.c S.D.*) will be relatively high (more then 4%) and the gram per revolution value (*Last screw.c*) will be jumpy.

4.3.7. Screw Capacity Out of Range

If the value of *Last screw.c* is out of range or close to the minimum or maximum levels please consult Sysmetric support.

5. Alarms

An alarm condition exists whenever the system recognizes that something has gone wrong. When an alarm condition occurs the unit does the following:

- The alarm relay (potential free contact) is closed, thereby, allowing any siren or main alarm indicator to be activated. Consult the wiring list for details on how to connect this contact. Pressing the *ALARM CANCEL* button opens the relay but, if the alarm condition continues, the contact is closing again after 1 minute.
- While the alarm is active, a corresponding alarm message is displayed on the display. Pressing the *ALAMR CANCEL* button also deletes this message. Further pressing the *ALARM CANCEL* button toggles the alarm messages of all active alarms.
- The alarm indicator on the operator panel keeps blinking until the alarm is resolved.
- The system keeps trying to make batches and the correct line production as if an alarm never occurred.

5.1. Alarms Screen

The system creates an alarm log. Press the *ALARM* button on the display to switch to the alarm log screen.

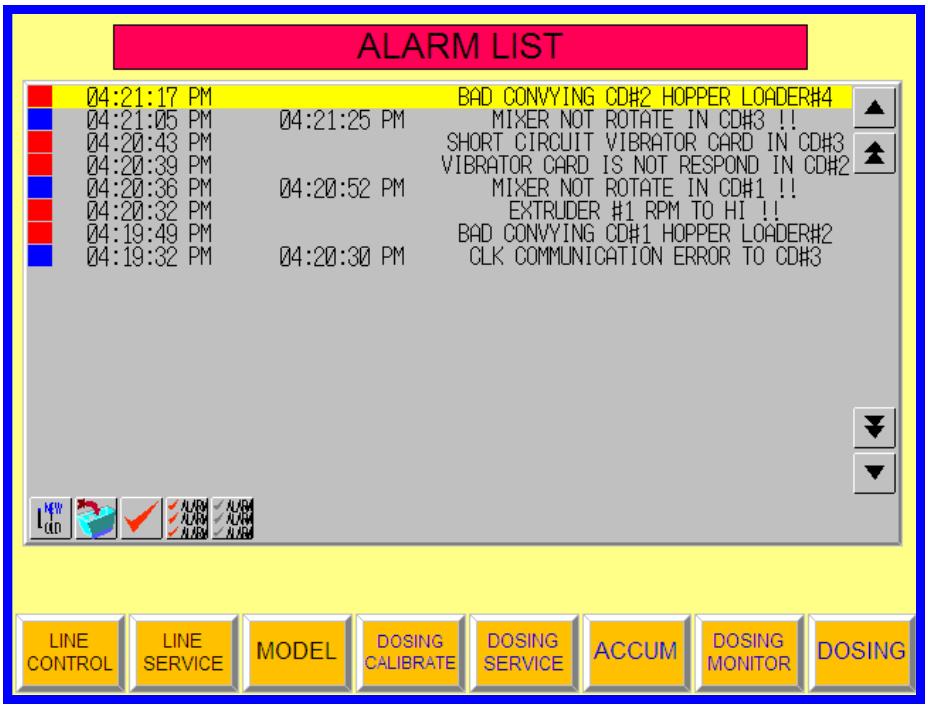

Figure 5.1-1 – Alarms screen

The alarm log shows which alarms where active with start and end time of each alarm.

5.2. Alarms List

The following is a list of alarm messages that can appear on the display according to the active alarm, the possible causes for the alarm and what actions to take.

Note: the following alarms list does not detail alarms messages which regard the *CD Series* dosing units. See the *CD Series* user manual for details on these alarms.

5.2.1. "Total Layers Ratio is Not 100%"

Meaning:

The set layers ratio percentage is not 100%.

Action:

Fix the percentages of the extruders so that the layers ratio will be 100%.

5.2.2. "Low Battery in Line PLC – Replace Soon"

Meaning:

The backup battery of the line controller is running low.

Action:

Replace the backup battery of the PLC.
Note: use only Omron's original battery (3G2A9-BAT08).

5.2.3. "Automatic Speed Calibration Out of Range"

Meaning:

This alarm appears when the system is in automatic speed calibration mode and the difference between the analog and the digital speed exceeds the *Auto Cal. Range*.

Action:

1. Disable the automatic speed calibration mode.
2. Manually calibrate the line speed.
3. Enable again the automatic mode.

5.2.4. "Automatic Speed Calibration – Unstable Speed"

Meaning:

The digital speed sensor indicates unstable line speed when the system is in automatic speed calibration mode.

Action:

1. Disable the automatic speed calibration mode.
2. Search and fix the cause of the line speed instability. Usually the line speed instability is a consequence of unstable nip-roll speed or unstable tension rolls speed.
3. Enable again the automatic mode.

5.2.5. "No Digital Speed Pulses"

Meaning:

The systems does not receive signals from the digital speed sensor when the system in automatic speed calibration.

Action:

1. Disable the automatic speed calibration mode.
2. Check intactness of the digital speed sensor and the wiring from the sensor to the controller.
3. Enable again the automatic mode.

5.2.6. "CLK Communication Error to CD#"

Meaning:

The *Line Control* PLC can not complete CLK communication with the specified CD dosing unit.

Action:

1. Check that the PLC in the specified CD unit is powered and in RUN mode.
2. Check that the CLK card in the specified CD unit is working (RUN, INS SD, RD, LNK and M/A LEDs should be on, ERC and ERH LEDs should be off and if the unit is the end point of the CLK network the termination switch should be on and the TER LED should be on).
3. Check the wiring of the CLK network. If any change or reconnection is made in the CLK wiring, all the PLCs connected to the CLK network should be powered off and back on to ensure restore of the CLK communication.

5.2.7. "Extruder # RPM Too High"

Meaning:

The specified extruder, although running at full speed, does not reach the throughput needed for maintaining the correct layers ratio and/or line throughput.

Action:

Decrease the line throughput or lower the percentage of the specified extruder in the layers ratio to decrease the needed throughput from that extruder.

5.2.8. "Exception Output Ex#"

Meaning:

Indicates an unstable throughput in the specified extruder. The stability of the extruder's throughput is determined by the batch preparation rate in the CD dosing unit of the extruder. Thus, this alarm can indicate malfunction either at the extruder or at the CD dosing unit.

Action:

1. Check the temperature at the rear side of the extruder where the CD dosing unit is feeding raw material. If the temperature is too high it will disturb the stability of material flow.

2. Check correct operation of the CD dosing unit:
   - Verify at least 10 seconds off time between consequent batch preparation cycles.
   - Verify correct operation of the mixer proximity switch.
   - Verify correct operation of the mixer angle proximity switch.

Note: See the *CD Series* user manual for details on the operation and maintenance of the CD dosing unit.