

P.R.D.C.T. CALIBRATION DOCUMENT

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This document outlines a reliable and repeatable procedure to calibrate the PRDCT test apparatus for dry bulk materials testing.

TESTING MATERIALS

- P.R.D.C.T. Test Apparatus (PRDCT-TA)
- P.R.D.C.T. Electrical System (PRDCT-ES)
- Computer with PuTTY software
- Calibrated Weights(0.02kg-1kg)
- 10lb metal weights
- 5lb sand-filled weights
- Dry Bulk Materials requiring testing
- Agitator requiring testing
- Appropriate P.R.D.C.T. Calibration Drum (CAL-D) (based on agitator type)
- P.R.D.C.T. Calibration Stand (CAL-S)
- 80 lb rated fishing line tied to a hex nut
- Humidity detector
- Temperature detector

CALIBRATION PROCEDURE

ASSEMBLE COMPONENTS:

- Log all testing conditions (temperature, humidity and pressure).
- Make sure PRDCT-TA is assembled with agitator

Image of PRDCT-TA assembled with agitator

- Place PRDCT-TA, PRDCT-ES, CAL-D, CAL-S and computer on a test bench.

Image of PRDCT-TA, PRDCT-ES, CAL-D, CAL-S and computer on a test bench.

- Fasten the CAL-D to the agitator tines inside the PRDCT-TA.

Image of CAL-D fastened to the agitator tines inside the PRDCT-TA.

- Fasten the CAL-S to the mounting holes and clip to the walls of the PRDCT-TA.

Image of CAL-S fastened to the mounting holes and clipped to the walls of the PRDCT-TA..

CONNECT ELECTRICAL SYSTEM

- Plug wires from PRDCT-ES to PRDCT-TA

Image of CAL-S fastened to the mounting holes and clipped to the walls of the PRDCT-TA..

- Plug USB-A from PRDCT-ES to Computer

Image of CAL-S fastened to the mounting holes and clipped to the walls of the PRDCT-TA..

- Plug computer and motor into power.

Image of CAL-S fastened to the mounting holes and clipped to the walls of the PRDCT-TA..

- Open PuTTY software on Computer.

Image of CAL-S fastened to the mounting holes and clipped to the walls of the PRDCT-TA..

OBTAINING PARASITIC TORQUE:

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System Ready

=====
Select Mode:
1 = Regular Test
2 = Parasitic Torque Calibration Run
3 = Toggle Motor Enable

Load cell will tare upon a selection.
=====
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PuTTY Serial Monitor.

- Select option "3 = Toggle Motor Enable" to disable the motor.
- Select option "3 = Toggle Motor Enable" to enable the motor.
- Select option "2 = Parasitic Torque Calibration Test" to capture the parasitic torque.
- Enter Calibration speed. 15 rpm is recommended.
- This value will be saved to the default parasitic torque.

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Motor stopped

===== CALIBRATION RESULT =====
Average parasitic torque (lb-in): 0.4828
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Parasitic Torque Output

RUNNING CALIBRATION:

- Select option "3 = Toggle Motor Enable" to disable the motor.
- Wind the fishing line around the CAL-D in a counterclockwise motion when looking from the motor end to the hopper of the PRDCT-TA. Secure the hex nut in the pocket of the CAL-D.
- Select the weight to test and hook it on the free end of the fishing line.
- Let the weight fall below the bench and ensure the line is taut. Check that the fishing line is still in-line with the groove of the CAL-D.
- Create slack in the line by lifting the weight, then in PuTTY select option "1 = Regular Test".
- Enter speed (rpm) and duration (seconds) you want to run the test at. To ensure the test can be run without running out of fishing line, use equation 1 to validate speed of test, time of test and test bench height. After entering these values, Taring occurs.
- In a controlled manner, let the weight fall once more. Make sure the weight is not swinging before continuing the test.
- The test then requests parasitic torque be entered. The obtained parasitic torque can be used by entering "D", however for calibration tests enter "0" so that the obtained data includes the parasitic torque. The test will begin shortly after entering the parasitic torque.
- Data comes up on the serial monitor, closing the serial monitor saves the data into a csv.

Notes: To develop a calibration curve, run calibration tests with various size weights at the same speed (RPM). Then once a curve is created, validate it with a couple tests using a different speed (RPM).

Clarifications:

- Run parasitic torque tests to get an initial parasitic torque value. This value can then be validated by the calibration curve. The curve is plotted on a time vs torque graph and the parasitic torque will be the intercept of the slope on the torque axis. This intercept value should match the one obtained in the parasitic torque test run.

EQUATION 1:

$$x = 0.105 * w * t * r$$

x = Distance the fishing line will travel (inches) (minimum distance between the test bench and the floor)

w = Speed of test (RPM)

t = duration of test (seconds)

r = radius of attached CAL-D (inches)

[Current CAL-D has a r = 3.37 inches]

Minimum clearance distance is $x(\text{inches}) = [((\text{Angular velocity input in RPM})/60) * (\text{Time input in seconds})] * 2 * (\text{radius of calibration drum in inches}) * \pi$