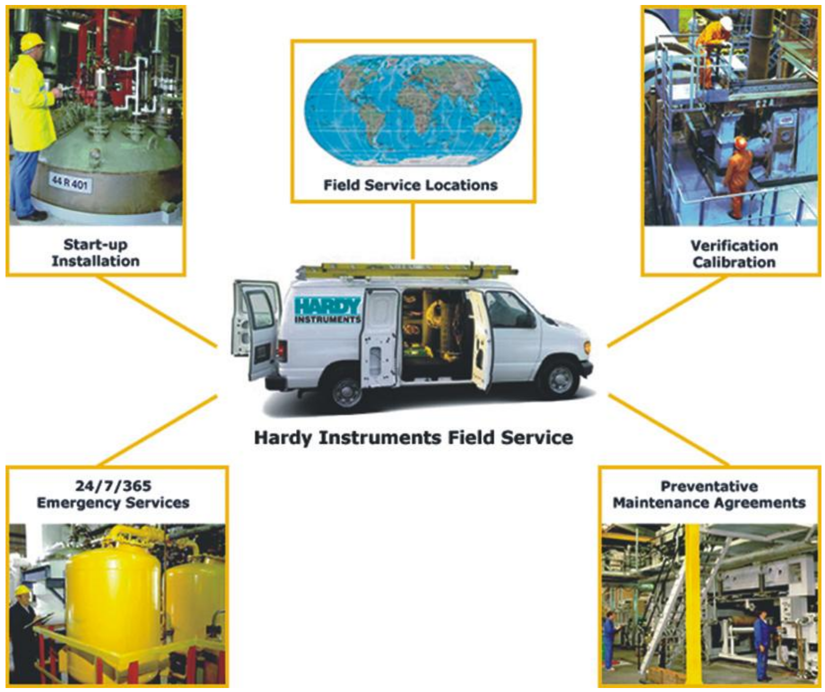
HI 1756-1DF and HI 1756-2DF
Dispenser Filler Control Module
User's Guide

Corporate Headquarters
9440 Carroll Park Drive, Suite 150
San Diego, CA 92121
Phone: 1-800- 821-5831
FAX: (858) 278-6700
Web-site: http://www.hardysolutions.com

Hardy Process Solutions Document Number: 0596-0322-01 Revision B



Local Field Service

Hardy has over 200 field technicians in the U.S., and more positioned throughout the world to assist you in your support needs. We also have factory engineers who will travel to your facility anywhere in the world to help you solve challenging applications. We're ready to support you with:

- Installation and start-up
- Routine maintenance and certification
- Plant audits and performance measurement
- Emergency troubleshooting and repair

To request Emergency Service and Troubleshooting, Start-up, Installation, Calibration, Verification or to discuss a Maintenance Agreement please call 800-821-5831 (Standard Hours 6:30 AM to 5:00 PM Pacific Standard Time).

Outside the U.S

Hardy Process Solutions has built a network of support throughout the globe. For specific field service options available in your area please contact your local sales agent or our U.S. factory at +1 858-292-2710.

Contents

Chapter 1 Overview

This manual provides users and service personnel with specifications and procedures for installing, configuring, operating, maintaining, and troubleshooting the Hardy Process Solutions HI 1756 nDF Dispenser Filler with WAVERSAVER®, C2®, and INTEGRATED TECHNICIAN™ (IT®) diagnostics.

NOTE *WAVERSAVER, C2, and IT are registered trademarks of Hardy Process Solutions, Inc.*

To ensure good performance and maximum service life, follow all guidelines described in this manual. Be sure you understand all cautions, warnings, and safety procedures. If you find that the information in this manual does not provide the help you need, contact the HI Customer Service Department at:

Phone: (858) 278-2900

FAX: (858) 278-6700

Web Site: www.hardysolutions.com

Support e-mail address: support@hardysolutions.com

About Hardy Manuals

An overview of each chapter's contents is listed below:

- Chapter One - Provides an overview of HI 1756 nDF capabilities and features
- Chapter Two - Provides a overview of HI 1756 nDF specifications
- Chapter Three - Describes the steps for installing both the standard and optional HI 1756 nDF equipment, and the HI 215IT series junction box
- Chapter Four - Explains how to configure the HI 1756 nDF
- Chapter Five - Provides calibration instructions
- Chapter Six – Provides troubleshooting procedures for repair of the HI 1756 nDF

HI 1756 nDF Overview

The HI 1756 nDF is a ControlLogix I/O module, which is designed to operate in a local rack or a remote rack that is connected to the local chassis via a network link.

The module can be inserted and removed under power without disruption of any other modules in the system (racks). This makes it possible to replace a failed module while keeping the rest of the system running. Status indicators will be provided on the front of the module for fault status. A status block will provide information to the processor for alarming and troubleshooting (IT).

The HI 1756 nDF can be purchased as a single channel (1756 1DF) or dual channel (1756 2DF) module; enabling up to two separate single or multi-cell weight scales to be monitored at one time. Two relays are assigned to each weigh scale input, and can be triggered by programmable target weight and preact weight values.

The analog-to-digital converter in the weigh module controller is capable of 8,388,608 counts of resolution which allows the instrument to tolerate large "dead" loads, over sizing of load cells/sensors, and still have sufficient resolution to provide accurate weight measurement and control. The analog-to-digital converter can be configured to provide either 95 or 145 updates per second. The 95 updates per second mode is recommended for nosier environments while the 145 updates per second mode provides a faster response time to changes in the flow rate.

The module supports both C2 electronic calibration and hard calibration (i.e., traditional calibration with weights).

Typical Applications

Dispenser filler control can be used in a variety of material-flow applications.

The 1756 nDF Controller can control up to two ingredients per weigh scale channel, in a filler mode, using two integrated DC or AC relays which can be independently controlled automatically through programmable set point values or manually. The setpoint values can be adjusted throughout the fill cycle, however once a relay is OPENED (external valve is closed) it cannot be CLOSED again until the next fill cycle is started.

Features and Capabilities

C2® Calibration

Traditional calibration uses certified test weights. C2® Electronic Calibration allows a scale to be calibrated without the need for test weights. A C2® weighing system consists of up to eight load cell sensors per channel, a junction box, interconnect cable, and an instrument with C2® capabilities (e.g., the HI 1756 nDF). Each Hardy Process Solutions C2-certified load sensor outputs digital information used for calculating the calibration. When the HI 1756 nDF reads the signals from the load sensors, it calibrates the scale based on the load sensor's output plus a user-supplied reference point value (from 0 to any known weight on the scale).

NOTE *C2® is registered trademarks of Hardy Process Solutions Inc.*

WAVERSAVER®

When measuring small weight changes, the affects of mechanical vibration and noise from the feeders and plant environment can introduce substantial interference. WAVERSAVER factors out vibration, noise, and other interference-related signals from the load cell so the rate controller can better decipher the actual weight data.

While WAVERSAVER can factor out noise with frequencies as low as 0.25 Hz, five cut-off frequencies can be selected, with higher frequencies providing a faster response time. The default factory setting is 1 Hz vibration frequency immunity.

Integrated Technician™

The HI 1756 nDF Integrated Technician™ (IT®) is built-in system diagnostics that makes it possible to diagnose weighing system problems. IT allows the reading of individual load sensor voltages and weights and isolates individual system components for quick and easy troubleshooting.

Digital Volt Meter (DVM) - Option

DVM requires the HI 215IT Series Junction Box to monitor mV/V readings for each load sensor and the total system. When the operator detects a problem, the DVM readings help to isolate the faulty component. Further, the DVM readings can be used to level a system and to make corner adjustments to platform scales. Accuracy is +/- 2% or better of full scale.

NOTE *If you do not have the HI 215IT Junction Box connected to the module, the reading is the total for all load cells on the system.*

Weighing System Tests - Optional

This test is used to diagnose drifting or unstable weight reading problems. It requires the HI 215IT Series Junction Box for full utilization. The ability to read the weight seen by the individual load sensors allows you to use this test for making cornering, leveling and load sharing adjustments to the weighing system.

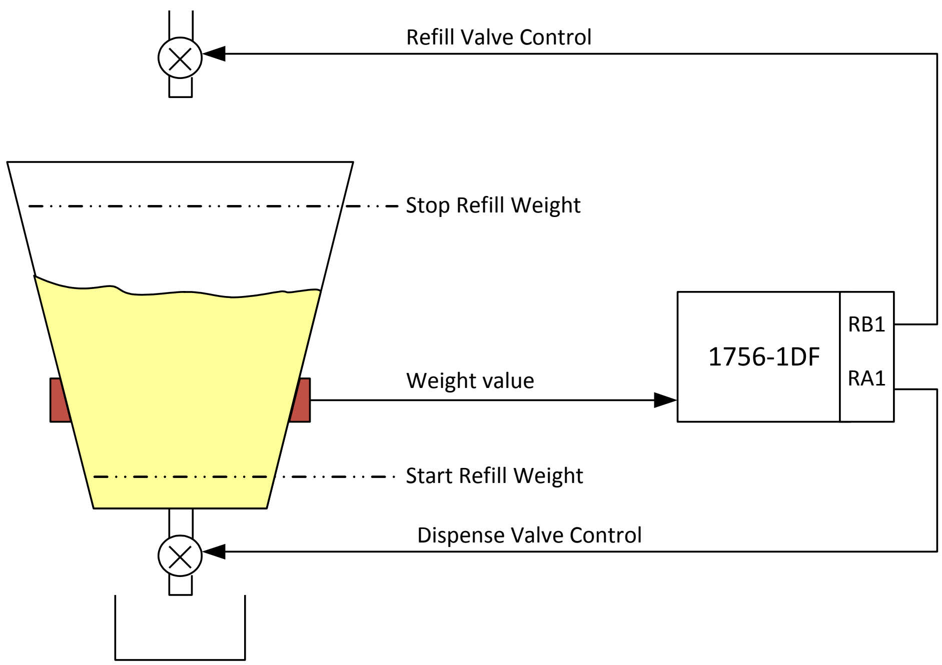
The Weighing System Test provides the following problem detection support:

1. Disconnects the controller and engages an internal reference signal to see if the problem is inside of the instrument.
2. Disconnects the load sensors and engages an internal (in the junction box) reference signal to see if the cable between the instrument and the Junction Box is causing the problem.
3. Reads the weight of each load sensor to see if the load sensor might be causing the problem.

Automatic or Manual Refill

Automatic refill uses user-selectable refill points to start and stop the refill process between dispense cycles. Automatic refill is only set for Dispense single speed mode. The relay B is the default refill relay in single mode and dribble feed in the dual mode. A command status of -1 will be set when the automatic refill is incorrectly configured. Automatic refill is not usable in the filler mode as the refill source vessel weight is not monitored by the HI 1756 nDF.

In the automatic refill mode, if weight at the end of a single speed dispense cycle is equal to or below the **start refill weight** parameter value, then the dispense cycle is disabled and the refill cycle started automatically; once the weight reaches the **stop refill weight** parameter value the refill cycle is stopped. Once the refill cycle is complete the dispense cycle is once again enabled. In this mode relay RA on the weigh scale channel would be used for the dispense cycle and relay RB on the same weigh scale channel would be used for the refill cycle.



An Automatic Refill Example

The Manual Refill option allows for manual refill at any time, via the STARTREFILL command; the refill cycle will automatically stop when the weight reaches the **stop refill weight** parameter value. The STOP command will set both relays to their default (OPEN) state.

The SETRELAY command can also be used to directly control the relay states regardless of weight value.

In the filler mode the PLC will need to remotely detect the level in the dispensing vessel and implement a manual refill operation.

Chapter 2 Specifications

Chapter 2 provides specifications for the HI 1756 nDF Dispenser-Filler and other equipment that may come with the package. The specifications listed are designed to assist in the installation, operation and troubleshooting of the instrument. All service personnel should be familiar with this section before installing or repairing the instrument.

Basic Specifications

General

Resolution

Internal:1:8,388,608

Input

Up to four 350-ohm Full Wheatstone Bridge, Strain Gauge Load Sensor/Cells (5 volt excitation) can be connected to each weigh scale channel

Non-Linearity

0.0015% of Full Scale

Common-Mode Rejection

110dB at or below 60 Hz

Common-Mode Voltage Range

2.5VDC maximum (with respect to earth ground)

Backplane Input Voltage

5 VDC and 24 VDC

Backplane Current Load

<1 Amp at 5 VDC
0.0125 Amps at 24 VDC (with 4-350 Ohm Load Cells)

Backplane Power Load

< 5W at 5 VDC
< .3W at 24 VDC with 4-350 Ohm Load Cells

C2 Calibration Input

Isolation from digital section 1000 VDC minimum.

Cable lengths

1000 feet maximum of C2 authorized cable
250 feet maximum of C2 authorized cable (Maximum of 4 load sensors) with IT Junction box.

Load Cell Excitation

5 VDC +/- 1.15 VDC maximum.
Isolation from digital section 1000 VDC minimum

C2 Calibration Output

Isolation from digital section 1000 VDC minimum

Number of Channels

HI 1756 1DF 1 Weigh Scale Channel
HI 1756 2DF 2 Weigh Scale Channels

Update Rate

95(10.5ms) or 145(6.9ms) Updates per Second

Averages

1-255 User-selectable in Single Increments

WAVERSAVER®

User Selectable

OFF
7.50 Hz
3.50 Hz
1.00 Hz (Default)
0.50 Hz
0.25 Hz

Digital Voltmeter (Integrated Technician – Diagnostic Mode Only)

Accuracy ± 2% of full scale

Relay

Two integrated solid state DC or AC relays per weigh scale channel
Default state of relays will be OPEN (Form A - NO).
For resistive loads only. Cannot mix AC and DC relays on same module.

DC Relay

Capable of switching 5 to 30 VDC
Maximum current rating 3A @ 25°C, 2A @ 40°C, and 1A @ 60°C
Minimum load current 2mA

AC Relay

Capable of switching 24-280 (47-63Hz) VAC
Maximum current rating 0.5A @ 60°C
Minimum load current 70mA

Environmental Requirements

Operating Temperature Range

0 to 60° C (32° F to 140° F)

Temperature Coefficient

Less than 0.005% of full scale per degree C for Cal-LO and Cal-HI reference points

Storage Temperature Range

-40 to 85° C (-40 to 185° F)

Humidity Range

0-90% (non-condensing)

Pending Approvals

UL, CUL, and CE

Chapter 3 Installation

Chapter 3 covers unpacking, cabling, interconnecting, configuring, and installing the Weigh Scale Module. User and service personnel should read this chapter before installing or operating the Weigh Scale module.

Unpacking

Step 1. Before signing the packing slip, inspect the packing and contents for damage of any kind. Report any damage to the carrier company immediately.

Step 2. Verify that everything in the package matches the bill of lading.

Step 3. Write down the Model and Serial number of the module. Store this information in a convenient location for reference when contacting The Customer Support Department for parts or service.

Step 4. Be sure to complete the warranty registration on the Hardy web site.

Installing the HI 1756 nDF

Allen-Bradley ControlLogix Processor or Remote Rack

WARNING *Electrostatic discharge may damage semiconductor components in the module. DO NOT TOUCH THE CONNECTOR PINS, and observe the following handling precautions:*

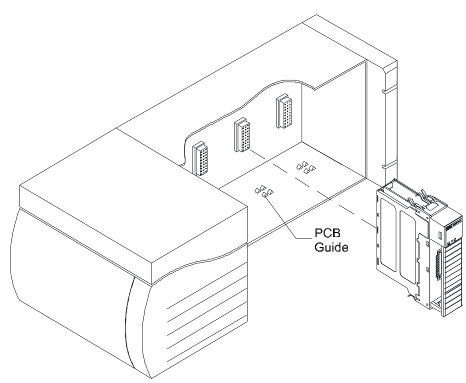
- Wear an approved wrist-strap grounding device when handling the module.
- Touch a grounded object or surface to rid yourself of any electrostatic discharged prior to handling the module.
- Handle the module from the bezel in front away from the connector. Do not touch the connector pins.
- Do not install the module right next to an AC or high voltage DC module.
- Route all the load voltage cables away from high voltage cables.

A ControlLogix Chassis

Step 1. Make sure that the module is oriented correctly for installation.

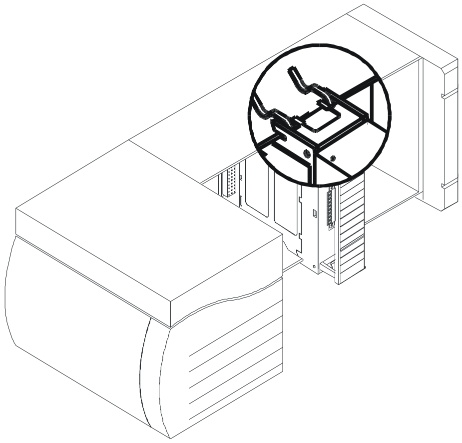
Step 2. Gently slide the module into the Chassis.

Step 3. Slide the digital board between the PCB Guides on the top plate and bottom plate of the chassis to line up the module connector with the backplane connector

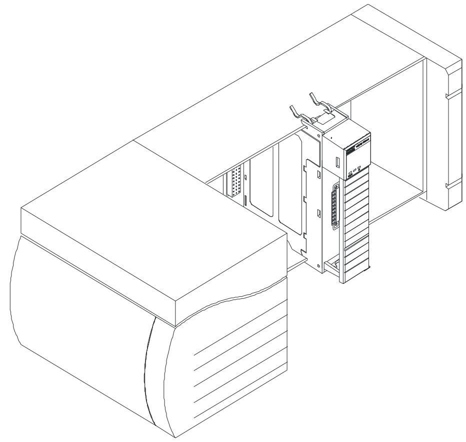


Inserting the module

Step 4. When the module connector is touching the backplane connector, firmly but carefully push toward the chassis until the pins are plugged in and the top and bottom module releases are snapped into place.



Module release(s)



Module installed in chassis

Removing the Module from the Chassis

Step 1. Press down on the top and bottom module releases simultaneously until the module can be pulled away from the chassis. (See Figure above.)

Step 2. Pull the module out of the chassis.

Step 3. Store in a safe, secure location in an anti-static bag or the original enclosure.

Installing the Module I/O Connector

The I/O connector at the front of the module connects the module to a load sensor, or the HI 215IT Series Junction Box, depending on how many load sensors are installed in the weighing system. (See the pin-out diagram below.) A pin-out diagram is also located on the inside of the module door.

Open the module door to access to the I/O connector.

Step 1. Install the cable and connector so it allows the module door to be shut.

Step 2. With the plug oriented correctly (See the pin-out diagram below), plug the I/O male connector into the I/O connector at the front of the module.

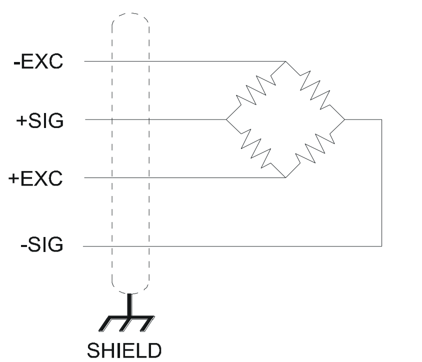
HI 1756 1DF with door open

	Check to be sure that the connector is completely plugged in before operating the module.
NOTE	***Most module-related problems are due to loose connections. Be sure to check the I/O connection first in the event you have a problem receiving information from the load cells or if the relays do not operate correctly.***

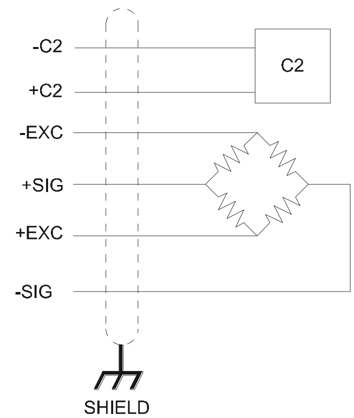
Single Channel
Pin 1 Exc+
Pin 2 Sense+
Pin 3 Sig+
Pin 4 Sig-
Pin 5 Sense-
Pin 6 Exc-
Pin 7 C2+
Pin 8 C2-
Pin 9 Shield

Load Cell Wiring Diagrams

The diagrams below show how Hardy Load Sensor with C2 wiring differs from standard Load Cell wiring. C2 wiring is required when using a Integrated Technician summing junction box. The C2 wires are used fro communicating IT and C2 commands.

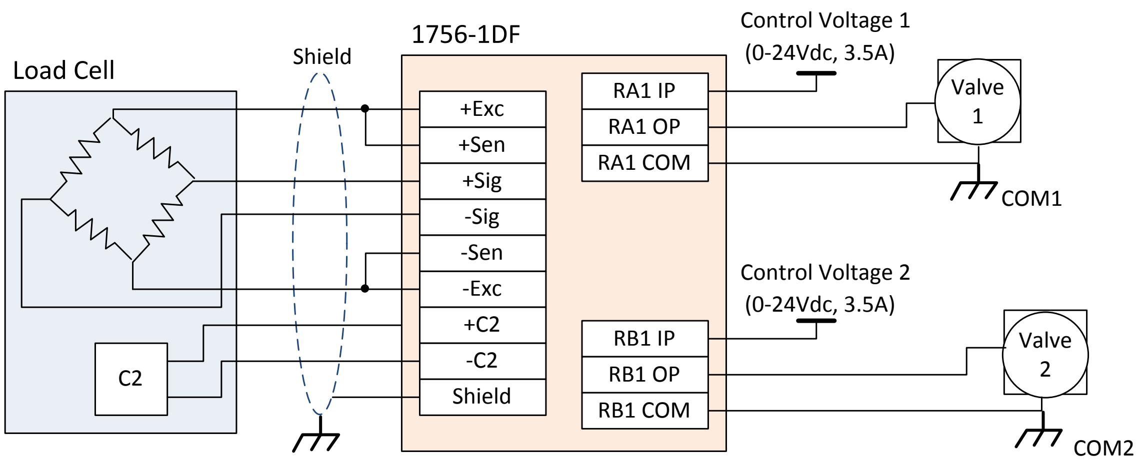


Industry standard load cells wiring



Hardy load sensor/c2 wiring

HI 1756 1DF Valve wiring diagram

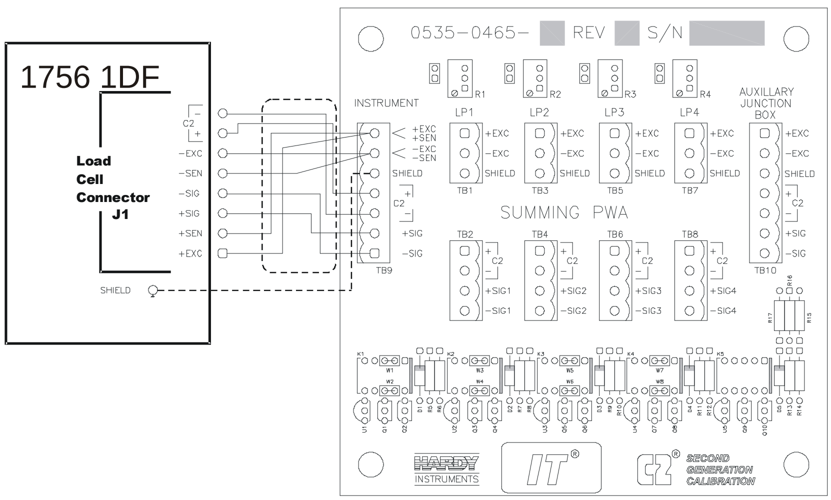


The simple wiring diagram above shows how to connect a single load cell to a single channel 1756 1DF module. Note, when connecting the 1756 1DF to a junction box, the sense lines would be connected to +Sen and –Sen Connections in the diagram.

The solid state relays used in the 1756 nDF require a 2mA minimum load. When switching a light load with a solid state relay across the line, you must look at the rated dropout current of the load. If it is less than 2mA it may not turn off. The solution is to put a loading resistor in parallel with the light load, to be sure leakage current is sufficient to the solid state relay is turned off.

CAUTION: *INSTRUMENT POWER AND RELAY WIRES SHOULD BE ROUTED AWAY FROM ALL OTHER SIGNAL CABLES TO AVOID ELECTRICAL INTERFERENCE.*

Hardy HI 215IT Junction Box



Hardy HI 215IT Junction Box Wiring Diagram

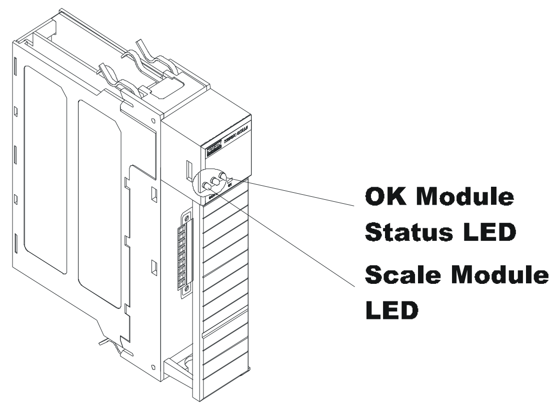
NOTE *When connecting the Hardy HI 215IT Junction Box, you must remove the two factory installed jumpers on pins 1&2 and on pins 5&6 on the module and install C2 and sense wires. C2 wires carry the commands for Integrated Technician and the C2 calibration information.*

Chapter 4 Configuration

Chapter 4 covers the settings used to prepare the controller for calibration and operation. The Setup procedures require Allen-Bradley's RS Logix 5000, Allen-Bradley RSLinx™ or RSLinx™ Lite.

Power Check

To make or change settings, there must be power to both the PLC and the module. Verify that the LEDs are lit for normal operation.



Module LEDs

LEDs

Scale Data LEDs	
Flashing Green	Dispenser/Filler is active (on)
Steady Green Running	(Normal)
Steady Red	Device Failure. Contact HI Customer Support
Flashing Red	Read Convert Error.
LED is Off	Channel is Inactive
OK Module Status LED	
Brief Steady	During power up the LED lights Red for about one second.
Flashing Green	In Program mode. (Normal)
Steady Green	In Run Mode. (Normal)
Steady Red	Device Failure. Contact HI Customer Support.
Flashing Red	Communication Error.

At power-up, the module runs through an initial self-diagnostic check. If the module does not have valid calibration data the scale data LED will flash green at a rate of about once a second.

The door will open to the right revealing two groups of connectors and one red button for C2 calibration at the "cal low weight" parameter value. The number of pins in the connector will depend on the number of channel options obtained. The left group of connectors will be for weigh scale inputs and the group of connectors on the right will be for relay I/O.

Dot Matrix Display

Four 3x7 dot matrix displays provide individual status on the relays assigned to each weigh scale channel.

The three operational states are defined in the following table.

Display	Comment
_	Not Active, OPEN
A	Active, CLOSED
X	Not being used

Setting Up Communications

Configuring the HI 1756-nDF Dispenser Filler Module in the RSLogix 5000 for ControlLogix with the HI 1756-nDF Module Add on Profile

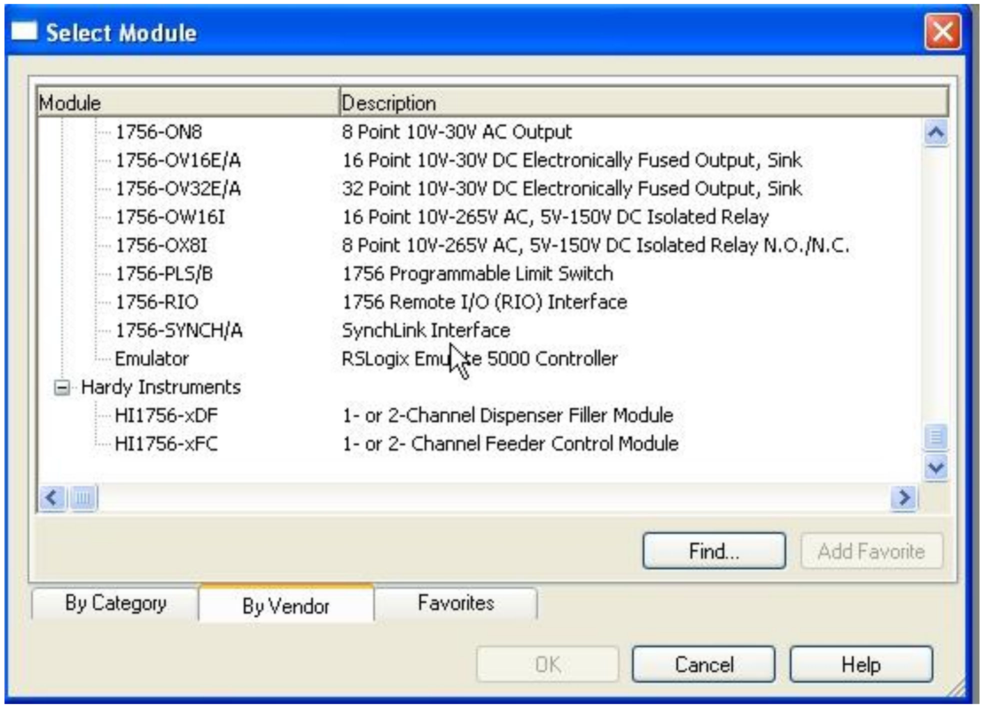
To set up communications between the ControlLogix processor and the dispenser/Filler Control module using the Add on Profile (AOP), you will need to do the following in RSLogix 5000.

Step 1. Download the AOP files from the Hardy Process Solutions web site, hardysolutions.com and install.

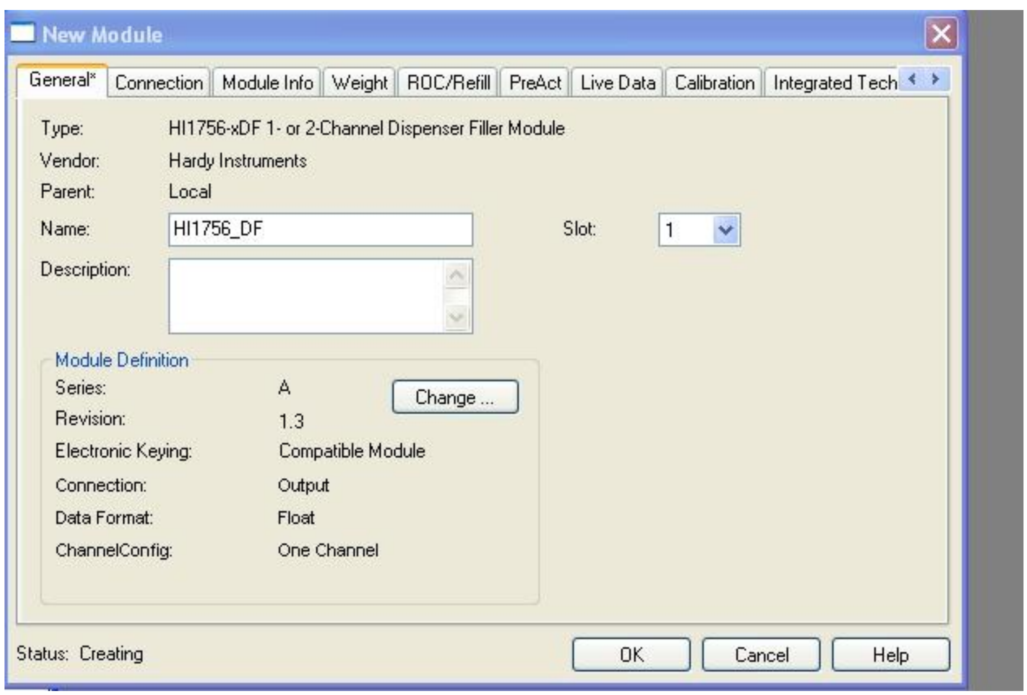
Note: *If a password is requested use hi1756 (all lower case).*

Step 2. Under the project, right click on the I/O Configuration and from the list box select "New Module". The "Select Module Type" dialog box appears.

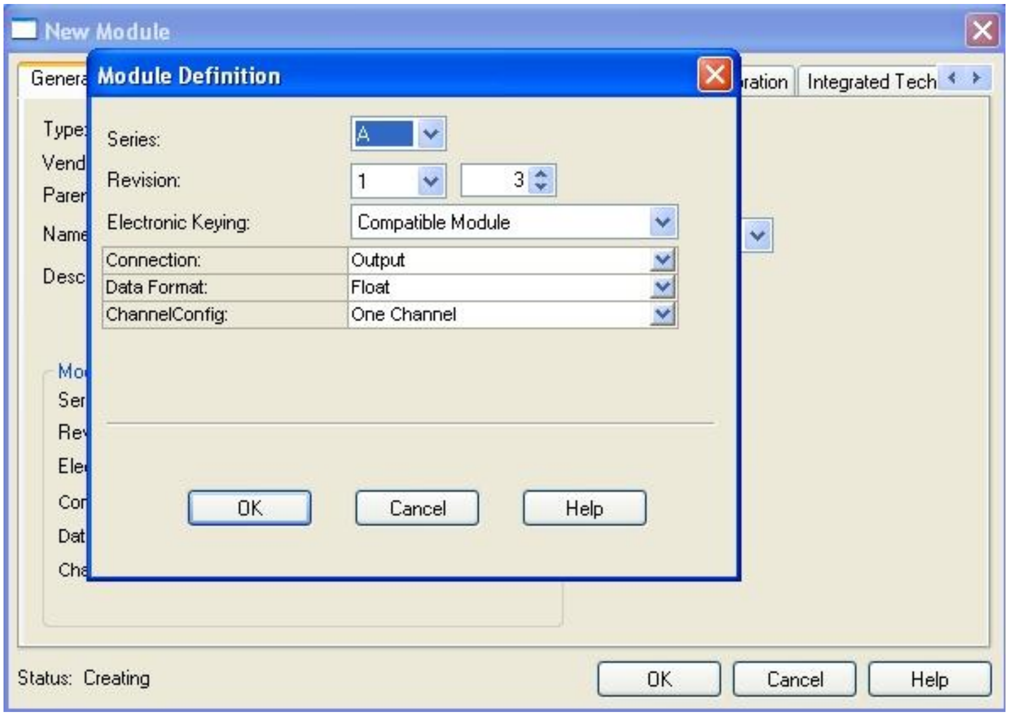
Step 3. Scroll down and find the "Hardy" modules and expand this category. Select the HI 1756-nDF module and click on the OK button. The module properties dialog box appears.



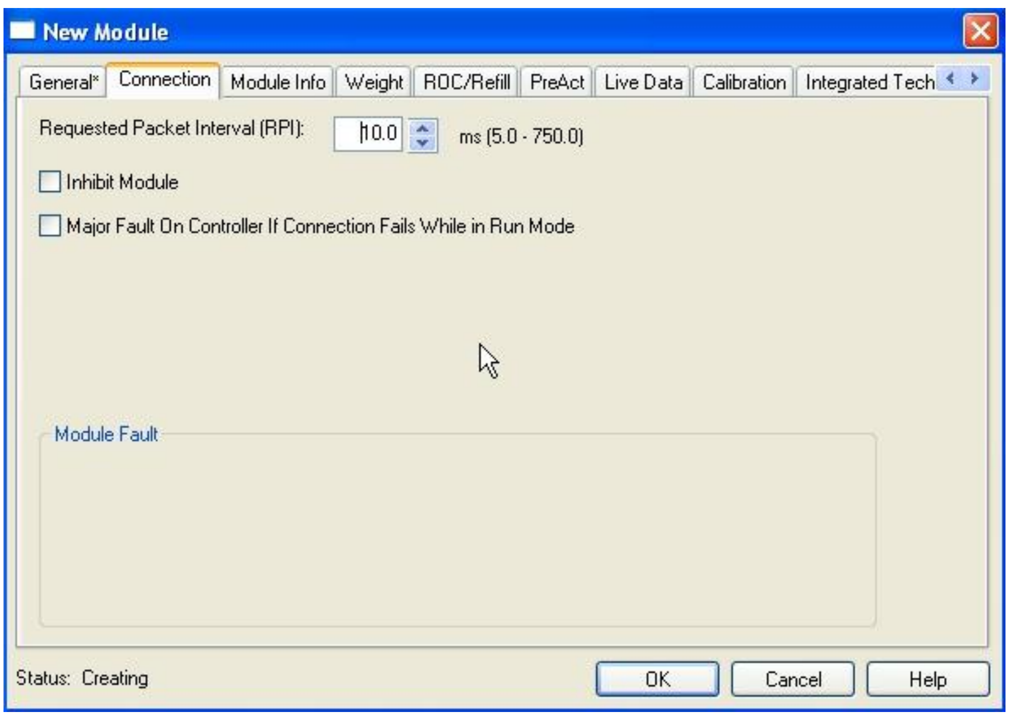
Step 4. Click in the Name text field. Enter a descriptive name for the module. We used HI1756DF for example. Click in the Description box and enter a description if desired. Insure the slot selection is correct.



Step 5. If you have a dual channel module, you should click on the “Change” button and select “Two Channel”.



Step 6. On the Connection tab, set the RPI time to 10.0 ms.



The remaining tabs will allow the user to fill out the parameter settings for the module.

Linking the PLC with the HI 1756-nDF Dispenser Filler Control Module

To set parameters for the weigh scale module, you must establish communications with a ControlLogix PLC. Follow the steps below to set up the communication link without using the AOP. You will need a new or open RS Logix® 5000 project. For instructions, see your RS LOGIX 5000 manual.

Step 1. Look for a list of folders on the left side of the screen. Scroll to and select the I/O Config folder, which will open a menu.

Step 2. Select New Module to display a list of modules.

Step 3. Select the Generic 1756 module to open the Module Properties form.

Step 4. Enter the following connection parameters in the appropriate fields:

- Name of Module
- Description of Module (Optional)
- Slot ID
- Input Assembly Instance:101 Size = 16
- Output Assembly Instance: 100 Size = 16
- Configuration Assembly Instance: 102 Size = 200 for a single channel (1756 1DF) or 400 for a dual channel (1756 2DF)

Step 5. Select DATA REAL from the Comm Format pull-down list.

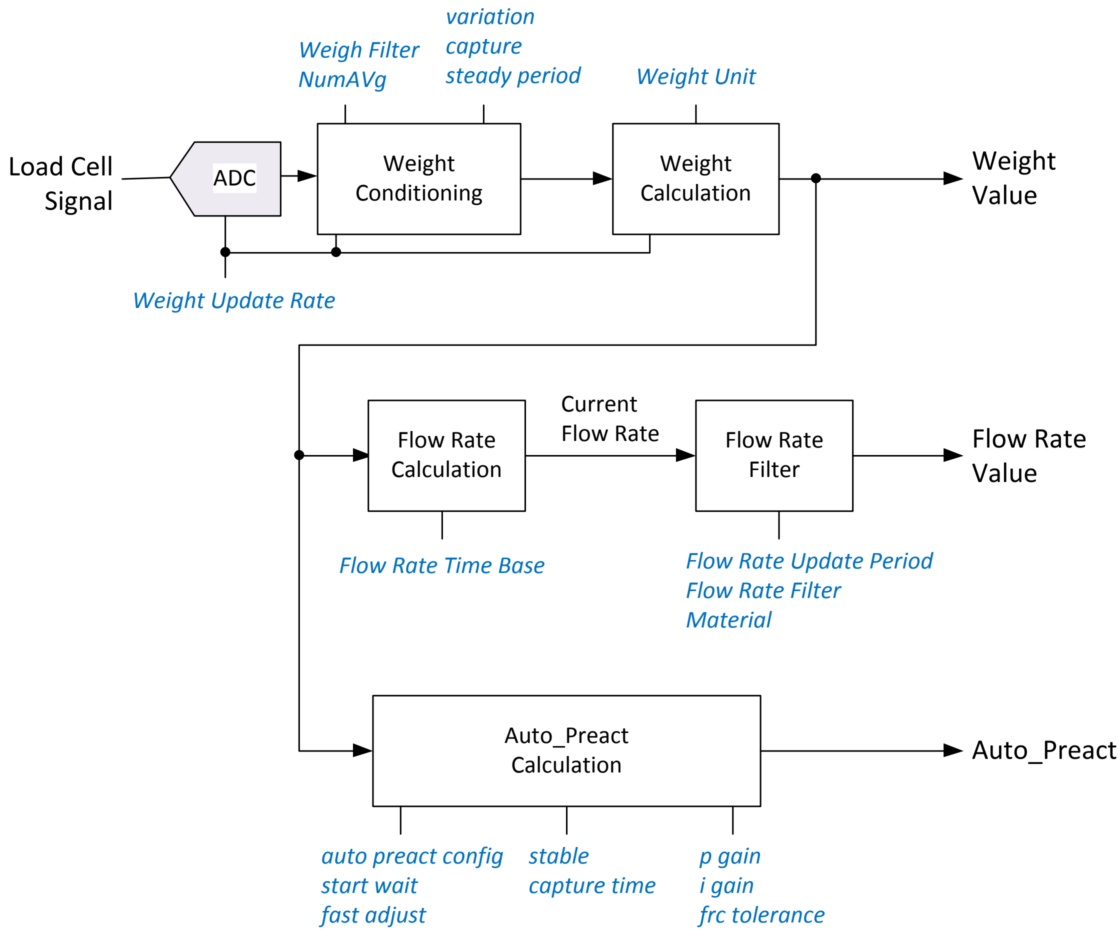
Step 6. Open the Connection Tab.

Step 7. Set the RPI to 5 milliseconds or greater Do not set this parameter lower than 5 milliseconds.

Step 8. Click Finish.

Overview of Operation

The HI 1756 nDF will calculate Gross weight, Net weight, & Flow Rate (FR) outputs simultaneously, as shown in the simplified block diagram below.



Simplified block diagram for the 1756-1DF

Overview of Weight Calculation

The ADC data can be filtered to reduce short term disturbances caused by system noise, vibration noise, and local short term disturbances that could affect the weigh measurement.

The most robust method to reduce these system disturbances is Waversaver®, but this mode has the longest delay which is directly proportional to the bandwidth selected as the algorithm requires at least one full cycle of the lowest frequency to be able to remove the noise and harmonics from the weight measurement. On the other hand the raw data sample mode provides the fastest response with no additional delay but does not filter out any noise from the sampled data. As a compromise a low pass filter can be selected to provide noise shaping across multiple samples centered on the current weigh value; this mode has a fixed delay of 100mS.

The filter selection will depend upon the environment and the desired response time to changes in weight.

Weight Filter	Delay (ms)	Quality Comment
0	0	Poor, no filtering
1	100	Fair, narrow filter window
2	270 – 2000	Excellent, Waversaver® filter selection

Note: ADC delay in not included in delay calculation as this delay is consistent regardless of filter mode selected.

In addition a second filtering stage can be enabled which averages the current and preceding ADC samples. This is a simple method to remove harmonics from the data stream without introducing delay into the data path. For example, if NumAverages parameter is set to 10 (default) and the weight update rate is 100Hz, a frequency notch will occur every 10Hz in the sampled spectrum. This simple but effective filter is ideal for removing harmonics at known frequencies within the sampled spectrum.

To calculate the preact value to compensate for in flight material, it is necessary to set tolerances so that the weight processing algorithm can detect when amount of inflight material falls within a user specified tolerance over a set number of samples. The required parameters are shown in the following table. This processing does not add delay into the signal processing path.

Parameter	Default	Description
steady period	128	Sets the number of samples used to calculate the steady weight value used in the auto-preact function.
variation	*1	Sets the peak to peak variation in weight values which will be processed
capture	*2	Sets the peak to peak variation in processed weight values that will be used to calculate the weight value on the scale after in flight material has settled.

- *1: Default value set to 1/2,500 of maximum capacity of the load cell.
- *2: Default value set to 1/10,000 of maximum capacity of the load cell

Overview of Flow Rate Control

The default setting for the flow rate will be kilograms per second (kg/sec); however the time interval will be programmable to also include kilograms per minute (kg/min) and kilograms per hour (kg/hr) and the weight value can be programmed to be in pounds enabling lbs/sec, lbs/min, and lbs/hr flow rate to be generated.

The flow rate calculation is a filtering operation tailored to provide an accurate measurement of the material flow rate over the specified period of time. As the update period is typically faster than the flow rate unit of time, the HI-1756 nDF will scale the current calculation to match the programmed flow rate unit of time, albeit hours, minutes, or seconds.

The time base value sets the number of samples that will be reviewed each time a flow rate calculation is made.

The flow rate is affected by the composition of the material, for example liquids will provide a linear flow rate as they are dispensed compared to “lumpy” material which due to product binding and asymmetric shape will cause short term disturbances in the weigh reading and subsequent flow rate calculations.

To provide a reliable flow rate reading with a range of materials the following four flows rate filters are provided, see the “flow Rate Filter” parameter in the table below.

Parameters for configuring the flow rate calculation are detailed in the following tables:

DINT Configuration Parameters used in Flow Rate Control

<table>
<tr><th>Parameter</th><th>Default</th><th>Description</th></tr>
<tr><td>Weight Unit</td><td>3</td><td>Weight unit selection
<table>
<tr><th>Value</th><th>Frequency (Hz)</th></tr>
<tr><td>0</td><td>Pounds(lb)</td></tr>
<tr><td>1</td><td>Ounces(oz)</td></tr>
<tr><td>2</td><td>Ton(ton) short ton</td></tr>
<tr><td>3</td><td>Kilograms(kg)</td></tr>
<tr><td>4</td><td>Grams(g)</td></tr>
<tr><td>5</td><td>Metric Tonnes (t) long ton</td></tr>
</table></td></tr>
<tr><td>Flow Rate Period</td><td>0</td><td>Flow Rate options
<table>
<tr><th>Ref#</th><th>FR unit of time</th></tr>
<tr><td>0</td><td>seconds</td></tr>
<tr><td>1</td><td>minutes</td></tr>
<tr><td>2</td><td>hours</td></tr>
</table></td></tr>
<tr><td>Weight Filter</td><td>2</td><td>The weigh scale data used in the weight calculation can be derived from one of three filters. The selection is based on a compromise between the response time required and the inherent noise within the measured value.
<table>
<tr><th>FILT</th><th>Function</th></tr>
<tr><td>0</td><td>Raw ADC data samples</td></tr>
<tr><td>1</td><td>Low Pass filter</td></tr>
<tr><td>2</td><td>Waversaver output data</td></tr>
</table></td></tr>
<tr><td>Material</td><td>0</td><td>The material texture can cause fluctuations in the instantaneous weight readings. To compensate for these periodic fluctuations set to 0 for liquids and fine materials and 1 for coarse materials.</td></tr>
</table>

<table>
<tr><th>Parameter</th><th>Default</th><th>Description</th></tr>
<tr><td>Flow Rate Filter</td><td>1</td><td>The weight data used in the flow rate calculation can be derived from one of four filters. The selection is based on a compromise between the response time required and the inherent noise within the measured value.
<table>
<tr><th>FRF</th><th>Quality Comment</th></tr>
<tr><td>0</td><td>No suppression of flow rate fluctuations caused by system noise, fast response time to step change in flow rate</td></tr>
<tr><td>1</td><td>Adaptive Flow Rate Filter (default)
Very good at suppressing flow rate fluctuations caused by system noise, and has a fast response time to step change in flow rate</td></tr>
<tr><td>2</td><td>Long Term Non-Adaptive Filter
Excellent at suppressing flow rate fluctuations caused by system noise, but has a long response time to step changes in flow rate</td></tr>
<tr><td>3</td><td>Short Term Non-Adaptive Filter
Very Good at suppressing flow rate fluctuations caused by system noise, and has a short response time to step changes in flow rate</td></tr>
</table>
</td></tr>
</table>

REAL Configuration Parameters used in Flow Rate Control

Parameter	Default	Description
Flow Rate Timebase	4.0	Period of time over which changes in weight are used to calculate the flow rate. The smallest increment is 100ms. Unit of time is in seconds.

Overview of Relay Operation

After power up all relay outputs are in the OPEN state, which is assumed to indicate that the external valves are CLOSED, and will remain in the OPEN state until the unit is programmed via the output table.

There are two programmable set points per weigh scale channel; each set point is associated with a relay output. As the 1756 nDF can be a single or dual channel and the operation of each channel is independent, the relays, target weight and preact values used on each channel will be referenced as relay RA, target TA, preact PA, relay RB, target TB, and preact PB.

The HI 1756 nDF implements a change in weight (CIW) algorithm, which requires that the external system controls if the weight will increase (fill) or decrease (dispense) and the HI 1756 nDF simply treats the net weight as an absolute value with respect to the zero point. The preact value can be positive or negative, to compensate for in flight material, to ensure the set point operates at the correct absolute net weight value.

The relay's initial state, OPEN or CLOSED, is determined by mode of operation. The dynamic state of the relay during a fill cycle depends on the comparison of the current net weight to the calculated set point value. The set point value is based on three parameters the target weight, the preact weight, and the mode of operation. These parameters are defined below:

1. The "target weight"

The target weight is a floating point number indicating the nominal weight value that should OPEN or CLOSE the relay depending on the mode of operation.

Regardless of mode it is recommended that each fill cycle should start with a TARE command to set the net weight to zero.

2. The "preact" value

In order to compensate for delays caused by sensor reaction time or in flight material, there is a preact parameter. The preact value is subtracted from the target weight so negative preact values will increase the set point weight value with respect to the target weight value, and positive values will decrease the set point weight value with respect to the target weight value.

3. The "mode of operation"

In the following description when the relay is OPEN the external valve will be CLOSED, and when the relay is CLOSED the external valve will be OPEN.

The initial state of each relay and the set point calculation depends upon the mode of operation. Once a relay has been closed it will not be opened until the next start or restart of a fill cycle.

The sequential mode is defined as the two relays working sequentially; with relay RA being active before relay RB. In this mode the two relays cannot be CLOSED at the same time. This mode could be used to select between two different flow rates into one hopper.

The parallel mode enables each relay to operate independently enabling two feeders at different speeds to be used to fill a single hopper with the same ingredient.

The different modes of operation, for each weigh scale input, are detailed in the following table; where the Ref# value refers to the mode value used to select the desired mode of operation.

Ref#	Relay Mode	Description of Relay Operation
0	Single Relay Operation	Relay RA is set to the CLOSED state at the beginning of the fill cycle. Relay RB is held in the OPEN state. When the absolute net weight value is greater than or equal to the SPA value relay RA is set to the OPEN state. RB is the refill relay. SPA = target weight TA – preact PA SPB = 0.0

Ref#	Relay Mode	Description of Relay Operation
1	Sequential Relay Operation	Relay RA is set to the CLOSED state, and relay RB set to the OPEN state at the beginning of the fill cycle. When the absolute net weight value is greater than or equal to the set point SPA relay RA is OPEN and relay RB is CLOSED, when the absolute net weight value is greater than or equal to set point SPB both relays are OPEN. Automatic refill not allowed. SPA = target weight TA – preact PA SPB = target weight TB – preact PB
2	Parallel Relay Operation	[***Default Mode of Operation for each weigh scale***] Relay RA and relay RB are both set to the CLOSED state at the beginning of the fill cycle. When the absolute net weight value is greater or equal to set point SPA relay RA is OPEN or when the absolute net weight value is greater or equal to set point SPB relay RB is OPEN. Automatic refill not allowed. SPA = target weight TA – preact PA SPB = target weight TB – preact PB

2 Speed (Fast/Slow) Mode Considerations

The 1756-nDF can be purchased with two relays per weigh scale channel. The architecture can be configured so both relays start at the same time (simultaneous feed) and have different target weights so the "fast" feed is closed before the "slow" feed; or the two relays can start sequentially (sequential feed) with the "fast" relay (relay A) being closed when it reaches its target weight and the 'slow" relay (relay B) opening as soon as the "fast" relay is closed. Automatic refill not allowed.

In both situations the "fast" relay will never see a stable weight on the scale before the "slow" relay allows additional material onto the scale. Therefore the "fast" relay will be treated as a coarse adjustment and will be set to provide a maximum percentage of the final target weight value, and the auto-preact algorithm will run only on the slow relay to provide the accurate final dispense cycle to reach the desired target weight.

When setting up the process for the first time the "fast" relay should be run on its own with the "slow" relay initially disabled; the target weight for the "fast" relay will be set by running several test dispense cycles. Once the "fast" relay target is set, the slow relay will be enabled and tests repeated to verify that the vessel does not overfill. If this occurs, one of two actions can occur:

1. If the auto-preact is at zero or below the "fast adjust" percentage of the target weight then the fast relay target has been programmed too high. If the "fast adjust" value is not 0.0% then the target weight set for the "fast" relay will be reduced by the percentage programmed into the "fast adjust" parameter and the auto-preact reduced by the same percentage or reset to zero if the residual value in the auto-preact output is below the "fast adjust" percentage times the target weight value. This repeats until the unit hits the desired target weight.

2. If the "fast adjust" bit is set 0.0%, then the control system is expected to monitor the error between the final weight and the desired target weight and should reduce the fast relays target value. Any change in the fast relay target value resets the auto-preact value to zero.

Overview of Auto-Preact Function

The auto_preact function predicts the required preact weight to ensure that the weight on the scale at the end of a fill cycle is equal to the desired target weight, after all the inflight material has cleared the physical pathways and settled on to the scale. The setpoint weight is the weight at which the relay is closed, and is calculated by subtracting the preact weight from the desired target weight.

Setpoint weight = target weight – auto_preact weight

At the beginning of the fill cycle the material flow rate is not linear and the start wait parameter is used to ignore the flow rate during this time. Once the calculated setpoint has been reached the relay will close the valve and any in flight material will continue to accumulate on the scale for a short period of time. The update time parameter is used to set the predicted time for the inflight material to settle onto the scale so a reliable weight reading can be taken.

This weight value is used in the auto-preact function to continually modify the setpoint value so the correct target weight is reached.

The auto-preact function combines a proportional plus integral filter based on historical differences between the target weight and the weight measured on the scale at the end of each fill cycle; and a predictive function based on the current flow rate.

The following parameters are used to configure the auto-preact function.

DINT Configuration Parameters used in Auto-Preact

Parameter	Default	Description
capture averages	3	Sets the number of fill/dispense cycles to average the target error values and flow rate values to provide the auto_preact value.
auto preact enable	0	Selects between the internally calculated auto-preact value and the external preact value in the output table.

REAL Configuration Parameters used in Auto-Preact

Parameter	Default	Description
start wait	2.0	Period of time that the flow rate is ignored in the auto-preact calculation
update time	2.0	Period of time after the setpoint value has been reached that a new weight input can be taken to update the auto-preact function.
stable	1.0	The maximum peak to peak percentage difference in flow rate used to detect a stable flow rate.

Parameter	Default	Description
p gain	0.05	Proportional error term gain value. Additional percentage of the error added to the amount of correction the module is making.
i gain	0.65	Integral error term gain value. The percentage of the error being applied to the auto preact.
frc tolerance	2.0	The minimum peak to peak percentage difference in flow rate used to detect a stable flow rate. Values below this are ignored
fast adjust	1.0	If the channel is being used in a simultaneous or sequential feed mode this sets the percentage of target weight that can be adjusted on the fast channel if the final measured weight exceeds the target weight.

Status Values used in Auto-Preact function

Parameter	Description
fast setpoint time	Actual time from the start of the fill cycle to when the relay on the fast channel changes state.
slow setpoint time	Actual time from the start of the fill cycle to when the relay on the slow channel changes state.
stable time	Time from the start of the fill cycle to the flow rate becoming stable. Unit of time is in seconds.
steady time	Time from when the target weight is reached (relay triggered) to when the weight first remains within the **capture** tolerance for the programmed number of **steady periods**. Unit of time is in seconds.
not stable	A value of ONE indicates that the flow rate did not become stable during the fill cycle; otherwise this status value is ZERO.
not steady	A value of ONE indicates that the weight did not remain within the **capture** tolerance on the scale for the specified number of update periods, **update time,** before the **capture time** was reached; otherwise this status value is ZERO.

Use of Auto-Preact Status Values

The minimum time to complete an auto_preact cycle is the sum of the slow setpoint time and capture time values. The slow setpoint time value is the time from the start of the fill cycle to when the relay changes state, and the capture time is the time from when the relay changes state to when a weight value is taken (assumed to be available) to update the auto_preact function. The following status values help to ensure the system timing is configured correctly. A full picture of the cycle can be calculated by externally monitoring the time from the start of the fill cycle to when the cycle ends.

Flow Rate Status

The flow rate compensation portion of the algorithm requires a constant, stable, flow rate to be able to calculate the required value to compensate for in-flight material after the relay changes state. If the not stable status value is a one, then the flow rate never became stable before the relay changed state. This could be caused by one of the following reasons:

1. The stable tolerance is too tight and the material is unable to meet the specified percentage variation during the fill cycle.
2. The start wait value is too long and the period left to calculate a stable flow is too short. This can be verified by reading the stable time and slow setpoint time values. If the stable time is shorter than the start wait period, and is also less than the setpoint time then the start wait time needs to be adjusted to provide at least 2 timebase periods between the measured stable time and slow setpoint time values. If the slow setpoint time is less than the stable time then either the stable tolerance or the material flow rate needs to be adjusted.
3. The flow rate for numerous reasons was changing throughout the fill cycle. This may be by design and once identified the user can set the frc tolerance parameter to zero, to disable this portion of the algorithm.

If the not stable status value is a zero, then the slow setpoint time provides a time reference for stable time value, if the stable time value is multiple timebase periods long, then adjustments to the flow rate could be considered to increase throughput.

Auto_preact Status

The programmed capture time value represents the time from when the relay state is changed to when a weight value on the scale can be taken and used to adjust the auto_preact function.

If the AP_NOT_STEADY status is a one, then the weight did not remain within the capture tolerance on the scale for the specified steady period before the update time, programmed time from relay changing state, was reached. To determine possible causes, the programmed update time should be compared to the steady time status value which represents the time from when the relay changes state to the first time the weight on the scale remains within the capture tolerance for the programmed steady period. If the update time is less than the steady time status duration, then either the update time needs to be increased so that it exceeds the steady time status duration by at least 0.3 seconds to allow a stable weight value to be calculated; or the update time needs to be increased so a reliable weight value is available sooner. While the not steady status is a one, the auto_preact value is not being updated. When adjusting the update time the auto_preact values should be reset.

If the update time is greater than the steady time and the not steady value is zero, then the system will stabilize and the correct auto_preact value will be generated to optimize the process.

Assembly Object Instances

1. Input Assembly (from 1756 nDF to PLC).

An area where the 1756 nDF module writes its data such as Net, Gross, FR to the PLC.

The input assembly is an array of 16 floats, with 8 devoted to the 1st channel and the next 8 devoted to the 2nd channel.

The rate of change and the gross and net weights are always visible in the input table, for each weigh scale.

Input table offset	Content
0	Command (echoes the command given in the Output Table. See below)
1	Command Status (see below)
2	Parameter value, in read and write commands
3	Target Value for relay A (TA)
4	Gross weight
5	Net weight
6	Rate of change
7	STATUSWORD

Input Assembly for Weigh Scale 1

Input table offset	Content
8	Command (echoes the command given in the Output Table. See below)
9	Command Status (see below)
10	Parameter value, in read and write commands
11	Target Value for relay A (TA)
12	Gross weight
13	Net weight
14	Rate of change
15	STATUSWORD

Input Assembly for Weigh Scale 2 (for HI 1756 2DF only)

2. Output Assembly (from PLC to 1756 nDF)

Dedicated area where PLC writes parameters to the 1756 nDF; these values are read by the 1756 nDF as scheduled by the RPI. The output assembly defaults to an array of floats.

The output table consists of 16 float values, of which the first 8 float values apply to the 1st channel, and the next 8 float values apply to the 2nd channel.

The first float value of the 8 is the "command" value. The interpretation of the next 7 values depends on the command being given.

Default Output Table Description

These commands are zero, tare, write nonvolatile, reload nonvolatile, cal low, cal high, C2 cal. These commands do not require any of the 7 other float values. These commands will use the default output table format.

Default output table formats

Output table offset	Content
0	Command
1	Parameter Number (used by read and write commands)
2	Parameter Value (used by write command and set relay command)
3	*spare*
4	
5	
6	
7	

Output Assembly for Weigh Scale 1

Output table offset	Content
8	Command
9	Parameter Number (used by read and write commands)
10	Parameter Value (used by write command and set relay command)
11	*spare*
12	
13	
14	
15	

Output Assembly for Weigh Scale 2 (for HI 1756 2DF only)

Commands to the PLC related to weigh scale 2, input table offset 8 – 15, are only valid for HI 1756 2DF modules. For the HI 1756 1DF modules this portion of the input table will be set and held in its default NOCMD state.

First Word – 0: Command Number

The default output table enables single parameters and functions to be modified.

The majority of the commands are intended to be used once and require a NOCMD or a different command to be sent if the same command is to be repeated. However, there are special function commands which can be repeated and each time the command is read the appropriate action is taken. These special commands are denoted using a “**” in the following table. For example the SET command enables the user to continually adjust the target weight throughout a fill or dispense cycle.

The first word in the output table is a command, the possible commands are:

<table>
<tr><th>command</th><th>Number</th><th>description</th></tr>
<tr><td>NOCMD</td><td>0.0</td><td>No command</td></tr>
<tr><td>STARTANDTARE</td><td>1.0</td><td>This command causes an automatic TARE of the weigh scale, sets the relays based on the mode of operation, and calculates the two set points for relay RA and relay RB before starting the fill cycle.

<table><tr><th>Relay Mode</th><th>Description</th></tr><tr><td>0</td><td>Single Relay Mode</td></tr><tr><td>1</td><td>Sequential Relay Operation</td></tr><tr><td>2</td><td>Parallel Relay Operation</td></tr></table>
See “Overview of Relay Operation” for a detailed description on the different modes of operation.</td></tr>
<tr><td>STARTNOTARE</td><td>2.0</td><td>This command sets the relays based on the mode of operation and updates the two set points for both relay RA and relay RB before continuing to run fill cycle.

The RESTART command does not cause an automatic TARE of the weigh scale.

<table><tr><th>Relay Mode</th><th>Description</th></tr><tr><td>0</td><td>Single Relay Mode</td></tr><tr><td>1</td><td>Sequential Relay Operation</td></tr><tr><td>2</td><td>Parallel Relay Operation</td></tr></table>
See “Overview of Relay Operation” for a detailed description on the different modes of operation.</td></tr>
<tr><td>SET**</td><td>3.0</td><td>The SET command updates the two set points for relay RA and relay RB while continuing to run the fill cycle.

The SET command does not cause an automatic TARE of the weigh scale and does not set the relays based on the mode of operation. This is used to change the target and preact values only.

** Repeatable Command</td></tr>
<tr><td>STOP</td><td>4.0</td><td>The relays are set to their default OPEN state, and the unit continues to monitor the weight readings but ignores weight readings to ensure relays remain OPEN.</td></tr>
</table>

command	Number	description
SETRELAY**	7.0	***Default setting is 0, both relays OPEN*** **Manual mode** for testing relay operation. 0 = both relays RB and RA are OPEN 1 = relay RB is OPEN, and relay RA is CLOSED 2 = relay RB is CLOSED, and relay RA is OPEN 3 = both relays RB and RA are CLOSED The manual relay setting can be overridden by the STARTANDTARE and the STARTNOTARE commands. **WARNING: Forcing the relay may cause damage or personal injury. Make absolutely sure that you know what the relay is connected to before activating.** ***** Repeatable Command***
RELOADNV	16.0	Reload Non-Volatile Recall all parameters from non volatile memory.
WRITENNV	17.0	Write Non-Volatile Save all parameters to non volatile memory.
STARTREFILL	18.0	Starts a manual refill cycle
TARECMD	98.0	TARE: zero the net weight
ZEROCMD	99.0	Zero the gross weight
CALLOWCMD	100.0	Hard calibration, low step.
CALHIGHCMD	101.0	Hard calibration, high step.
C2CALCMD	102.0	C2 calibration.
WRITEPARAM	103.0	Write a single parameter. To write a single parameter, send the command 103.0. Specify the parameter to be changed by putting the parameter number in float number 1, and put the new parameter value in float number 2 of the output table.
READPARAM**	105.0	Read a single parameter. To read a single parameter, send the command 105.0. Specify the parameter to read by putting the parameter number in float number 1. The parameter value will appear in word 2 of the input table. ***** Repeatable Command***
RESETFR	112.0	Clear all old data from the flow rate (FR) weight buffer. This has the effect of zeroing the flow rate value.
RESETAPCMD	113.0	Reset Auto Preact Command Resets all stored values in the auto preact function to their factory default values.
SETDEFAULT	148.0	Replaces all parameter values with the factory default parameters values.

Command Return or Error Codes

Commands always return the command word and command status. The command status word may include the following codes:

return codes	#Value	description
SUCCESS	0.0	Pass
NOTALLOWED	-1.0	Bad state for command, tried to run to start a cycle while refilling or trying to refill while running a dispense/fill cycle.
OUTOFTOLERANCE	-3.0	Out of tolerance
INDEXOUTOFRANGE	-4.0	Out of Range
NOSUCHCMD	-5.0	Command bad
C2FAILNODEVS	-6.0	No C2 devices
C2FAILCAPEQ	-7.0	Failure, C2 capacities not equal
HARDCALFAILCOUNTS	-8.0	Fails, too few ADC counts between high - low
NOSUCHPARAM	-9.0	Parameter ID incorrect

Second and Third Words - 1, 2: Parameter Number and Value

The second and third words in the output table, Parameter Number and Parameter Value, are used by the WRITEPARAM command. For details see the Parameter Table below. Expanded descriptions are listed below the table by parameter number.

Notes *When set by a command, all parameters are saved to non-volatile memory. The scale calibrations are saved automatically when completed successfully*

DINT Configuration Parameters

<table>
<tr><th>Parameter Name</th><th>Parameter Number</th><th>Parameter Default</th><th>Description</th></tr>
<tr><td>Channel Active</td><td>1.0</td><td>1</td><td>Boolean, 1 = ON, 0 = OFF</td></tr>
<tr><td>Weight Units</td><td>2.0</td><td>3</td><td><table>
<tr><th>Value</th><th>Frequency (Hz)</th></tr>
<tr><td>0</td><td>Pounds(lb)</td></tr>
<tr><td>1</td><td>Ounces(oz)</td></tr>
<tr><td>2</td><td>Ton(ton) short ton</td></tr>
<tr><td>3</td><td>Kilograms(kg)</td></tr>
<tr><td>4</td><td>Grams(g)</td></tr>
<tr><td>5</td><td>Metric Tonnes (t) long ton</td></tr>
</table></td></tr>
<tr><td>NumAverages</td><td>3.0</td><td>10</td><td>1 -255
Averages the current sample and previous N samples to provide the current weight value.</td></tr>
</table>

<table>
<tr><th>Parameter Name</th><th>Parameter Number</th><th>Parameter Default</th><th>Description</th></tr>
<tr><td>Waversaver</td><td>4.0</td><td>3</td><td>Waversaver Options
<table>
<tr><th>Ref#</th><th>Frequency (Hz)</th></tr>
<tr><td>0</td><td>OFF</td></tr>
<tr><td>1</td><td>7.50</td></tr>
<tr><td>2</td><td>3.50</td></tr>
<tr><td>3</td><td>1.00</td></tr>
<tr><td>4</td><td>0.50</td></tr>
<tr><td>5</td><td>0.25</td></tr>
</table></td></tr>
<tr><td>Zero Track enable</td><td>5.0</td><td>0</td><td>Enables the auto zero tolerance function when 1.</td></tr>
<tr><td>Weight Filter</td><td>6.0</td><td>2</td><td>Weight filter selections
See Overview of Weight Calculation for selection details.
<table>
<tr><th>Ref#</th><th>Filter</th></tr>
<tr><td>0</td><td>Raw ADC data samples</td></tr>
<tr><td>1</td><td>Filtered data samples</td></tr>
<tr><td>2</td><td>Waversaver output data</td></tr>
</table></td></tr>
<tr><td>Refill mode</td><td>7.0</td><td>0</td><td>Setting to 1 the automatic refill mode is enabled and the unit automatically starts a refill cycle if the next dispense cycle will lower the weight below the programmed start refill weight value. The automatic refill cycle is stopped when the weight reaches the programmed stop refill weight value. This is only available in single relay mode.
When set to 0 the manual refill mode is enabled and a STARTREFILL command is required to start the refill cycle.</td></tr>
<tr><td>Weight Update Rate</td><td>8.0</td><td>0</td><td>Sets the rate at which weight readings are taken. Set to 0 for 145Hz mode and to 1 for 95Hz mode.</td></tr>
<tr><td>Material</td><td>9.0</td><td>0</td><td>To compensate for material flow rate, set to 0 for liquids or fine materials and 1 for coarse or “lumpy” materials.</td></tr>
<tr><td>Flow Rate filter</td><td>10.0</td><td>1</td><td>Flow rate filter.
See Overview of Flow Rate Calculation for selection details.
<table>
<tr><th>Ref#</th><th>Filter</th></tr>
<tr><td>0</td><td>Raw ADC data samples</td></tr>
<tr><td>1</td><td>Adaptive running avg</td></tr>
<tr><td>2</td><td>Short term running avg</td></tr>
<tr><td>3</td><td>Long term running avg</td></tr>
</table></td></tr>
</table>

<table>
<tr><th>Parameter Name</th><th>Parameter Number</th><th>Parameter Default</th><th>Description</th></tr>
<tr><td>Flow Rate Units</td><td>11.0</td><td>0</td><td>Flow Rate options<table><tr><th>Ref#</th><th>FR unit of time</th></tr><tr><td>0</td><td>seconds</td></tr><tr><td>1</td><td>minutes</td></tr><tr><td>2</td><td>hours</td></tr></table></td></tr>
<tr><td>Flow Rate Period</td><td>12.0</td><td>0</td><td>Used to set when the flow rate calculation is active. When set to 0 (default), the flow rate calculation continuously runs, and when set to 1 the flow rate calculation is run only during a fill cycle.</td></tr>
<tr><td>steady period</td><td>13.0</td><td>128</td><td>When this value is set to zero the steady weight algorithm is bypassed and the weight data value is used directly.

The steady weight algorithm is enabled when a non-zero value is entered. The non-zero value sets the maximum period used to generate the steady weight output.

The valid array sizes are 16, 32, 64, and 128 (default).</td></tr>
<tr><td>auto preact enable</td><td>14.0</td><td>0</td><td>Configures the auto preact function.
When set to 0 (default) the auto_preact is disabled and the preact value must be entered through the output table.
If this value is set to 1the auto_preact function is enabled and the preact value from the output table is ignored; and any changes to the target weight during a feed cycle are also ignored. This ensures that the auto_preact can converge towards a fixed target weight.
Any transition to 0 causes the current state of the auto_preact function to be held. If the auto_preact is not reset through the command interface, and this value is set high the auto_preact function continues as if there was no interruption. It is therefore strongly recommended that this value is only changed between filler/dispense cycles.</td></tr>
</table>

Parameter Name	Parameter Number	Parameter Default	Description
capture averages	15.0	3	This sets the number of fill/dispense cycles to average the target error values and flow rate values to provide the auto_preact value. The minimum value = 1, and the maximum value = 100

Parameter 1 Channel Active
Enables or disables the weigh channel.

Parameter 2 Weight Units (Unit of Measure)
The Unit parameter sets the scale and related displays to one of the following options:

0: Pounds (lb)
1: Ounces (oz)
2: Ton (ton) short ton
3: Kilograms (kg) - Default
4: Grams (g)
5: Metric Tonnes (t) long ton
Range: LB, OZ, TON, KG, G, T (default Kg)

Note *The weigh scale module does not need to be recalibrated after changing the metric value.*

Parameter 3 NumAverages
This is the number of samples to average when determining a value to reduce the effect of material impact and/or vibration as material moves on and off the scale. The dispenser/filler takes 95 or 145 readings per second. If you average enough weight readings, the weight loss or gain remains smooth and the displayed value shows little or no fluctuation, although it is actually recalculated (by sliding average) with each reading. If a weight reading fluctuates too much, increase the number of readings in the average, but for applications that require a very quick weight reading, do not set this value too high.

The averaging parameter is most often set when using any device that outputs an erratic signal (e.g. a flow meter). Using the averaging function comes at the expense of response time. A setting of one average takes 10 milliseconds at 95sps or 6.67milliseconds at 145sps; or at a setting of 95 the average takes 1 second at 95sps or 0.67 seconds at 145sps. The averaging function is a running average, where the input signals are totaled and the total is divided by the averaging number. The instrument reads one new signal plus the last number of averages signals and repeats the averaging process again.

For example: With a setting of 20 averages, the instrument reads the 20 most current input signals, totals the signals, divides by 20, drops the oldest one, reads one new signal along with 19 old readings, totals the signals, divides by 20, drops the oldest one, etc. The NumAverages filter is included in all weight filter modes.

Range: 1-255 (default 1)

See also WAVERSAVER for information on filtering unstable weight readings.

Parameter 4 Waversaver

Chapter one provides a detailed description of WAVERSAVER's function and purpose. In short, WAVERSAVER helps to mitigate the effects of vibratory forces, allowing the HI 1756 nDF to distinguish between actual weight data and mechanical noise in the signals the load cell sends. WAVERSAVER can be configured to ignore noise with frequencies as low as 0.25 Hz. High values allow faster readings, while the lower values raise the degree of filtration. 7.5 Hz provides the least vibration immunity with the fastest response time. 0.25 Hz provides the most vibration immunity with the slowest response time. The function is user selectable and can be turned off. Waversaver is not used when the Weight filter is set to RAW, or Low pass filter mode.

Range: OFF, 7.50 Hz, 3.50 Hz, 1.00 Hz (Default), 0.50 Hz, 0.25 Hz

Parameter 5 Zero Track enable

Enables the auto zero tolerance function

Parameter 6 Weight filter

Selects the filter used after the analog to digital conversion stage to remove noise and harmonics from the weight value.

Parameter 7 Refill mode

This is only available in the single relay mode of operation. Relay B is used for the refill relay.

Enables the automatic refill mode so the unit automatically starts a refill cycle if the next dispense cycle will lower the weight below the programmed start refill weight value. The automatic refill cycle is stopped when the weight reaches the programmed stop refill weight value. The STOP command will set both relays to their default (OPEN) state.

In the manual refill mode a STARTREFILL command is required to start the refill cycle, however the refill cycle will automatically stop when the weight reaches the programmed stop refill weight value.

In automatic or manual mode the STOP command will set both relays to their default (OPEN) state.

Parameter 8 Weight Update Rate

This parameter sets the update rate of the analog to digital converter, and any subsequent weight filtering calculations.

Parameter 9 Material

Defines the type of material being measured; liquids and materials that flow easily are defined as fine material, and materials that may bind together or are lumpy in texture are defined as coarse material.

This selection helps to configure the flow rate calculation to remove short term disturbances in the flow rate.

Parameter 10 Flow rate filter

The type of material and the process environment may require different filtering to ensure a stable flow rate. This parameter enables one of four possible flow rate filters to be selected.

Parameter 11 Flow rate units

The units of time (seconds, minutes or hours) you want for the flow rate. The Flow Rate display on the summary display will read in these units.

Range: 0=sec, 1=min, 2=hr (default Seconds)

Parameter 12 Flow Rate Period
Used to set when the flow rate calculation is active. When set to 0 (default), the flow rate calculation continuously runs, and when set to 1 the flow rate calculation is run only during a fill/dispense cycle

Parameter 13 steady period
This parameter sets the number of samples that are processed to provide the weight output.

The valid array sizes are 0, 16, 32, 64, and 128 (default).

When this value is set to zero the steady weight algorithm is bypassed and the weight data value is used directly.

Parameter 14 auto preact enable
Enables the auto-preact function

Parameter 15 capture averages

Sets the number of fill/dispense cycles to average the target error values and flow rate values to provide the auto_preact value.

REAL Configuration Parameters

Parameter Name	Parameter Number	Parameter Default	Description
Span Weight	16.0	4,000	The total amount of weight, in selected weight units, placed on the scale for the high point when performing a "Traditional Calibration".
Cal low weight	17.0	0.0	Amount of test weigh, in selected weight units, used, normally zero, for the low point during hard calibration or reference point during C2 calibration.
Auto Zero tolerance	18.0	4.0	If used, the gross weight measurement value will be set to zero whenever the gross weight is within the auto zero tolerance and the scale is not in motion.
Motion tolerance	19.0	2.0	Value, in selected weight units, used to determine if the scale is in motion.
Zero tolerance	20.0	4.0	Sets the weight range, in selected weight units, around zero that will be accepted as zero by the instrument.
Tare weight	21.0	0.0	The weight value, in selected weight units, removed by the TARE function.
Start refill weight	22.0	0.0	Weight reference which will cause a refill cycle to automatically start
Stop refill weight	23.0	4,000.0	Weight at which a refill cycle will automatically stop

Parameter Name	Parameter Number	Parameter Default	Description
Capacity	24.0	5000.0	When the gross weight is greater than the programmed capacity value the ERROROVERCAPACITY status bit is set. This status bit is reset whenever the gross weight is below programmed capacity value.
Flow Rate Time Base	25.0	4.0	Period of time over which changes in weight are used to calculate the flow rate. Unit of time is in seconds.
	26.0		Reserved
Variation	27.0	*1	Sets the peak to peak variation in weight values which will be processed
Capture	28.0	*2	Sets the peak to peak variation in processed weight values that will be used to calculate the weight value on the scale after in flight material has settled.
Start Wait	29.0	2.0	Period of time, from the start of the fill cycle, during which the flow rate is not calculated. The smallest increment is 0.1 seconds. Unit of time is in seconds.
Update Time	30.0	2.0	Period of time, after the target weight has been reached before the measured weight value is taken. The smallest increment is 0.1 seconds. Unit of time is in seconds.
Stable	31.0	1.0	The maximum peak to peak percentage difference in flow rate once the "stable wait' period is reached. Values outside of this range reset the calculation. If a stable flow rate is not measured the flow rate portion of the auto-preact algorithm is not updated.
P gain	32.0	0.05	Gain value used to scale the proportional error term. Setting this value to 0.0 disables the proportional portion of the P+I filter. Maximum value is 1.0
I gain	33.0	0.65	Gain value used to scale the integral error term. Setting this value to 0.0 disables the integral portion of the P+I filter; and forces the integral term to 0.0. Maximum value is 1.0

Parameter Name	Parameter Number	Parameter Default	Description
FRC Tolerance	34.0	2.0	Percentage changes in the flow rate changes below this value are ignored. Setting this value to 0.0 disables portions of the auto_preact calculation related to flow rate, and resets all the flow rate terms.
Fast Adjust	35.0	1.0	If the channel is being used in a simultaneous or sequential feed mode, then this sets the percentage the fast relay is adjusted by if the auto-preact algorithm exceeds the target weight when the auto-preact values are zero.

- *1: Default value set to 1/2,500 of maximum capacity of the load cell.
- *2: Default value set to 1/10,000 of maximum capacity of the load cell

Parameter 16 Span Weight
The Span Weight is a reference point derived from an actual measured weight. This should not be confused with the Scale Capacity. If you have a 100 pound weight and you place it on the scale, the Span Weight would be 100 pounds.

Parameter 17 Cal low weight
This reference weight is the weight of any product on the scale that is not removed during calibration (derived from actual measured weight used at cal low or C2 cal). Normally, you would remove all “live load” weight from the scale to obtain a Cal low weight of 0.0.

Range: Must be > or = 0.

Parameter 18 Auto Zero tolerance
If enabled the gross weight measurement value will be set to zero whenever the gross weight is within the auto zero tolerance and the scale is not in motion

Parameter 19 Motion Tolerance
A value, based on the Weight Units parameter, used to determine if the scale is in motion

Parameter 20 Zero tolerance
This parameter sets the weight range, depending on the Weight Units parameter, around zero that will be accepted as zero by the instrument.

Parameter 21 Tare weight
The weight value based on the Weight Units parameter, below which will be removed by the TARE function.

Parameter 22 Start refill weight
If the current weight, after a dispense cycle, is equal to or below this weight reference value then the refill cycle to automatically start. In situations where the weight at the end of a dispense cycle will be equal to or below the **start refill weight** parameter value, the dispense cycle is disabled and the refill cycle started automatically
Value must be equal to or greater than 0.0 (default) and less than the stop refill weight 4000.0 (default)

Parameter 23 Stop refill weight
Weight at which a refill cycle will automatically stop
Value must be greater than 0.0 (default) and equal to or less than the stop refill weight 4000.0 (default)

Parameter 24 Capacity
When the gross weight is greater than the programmed capacity value the ERROROVERCAPACITY status bit is set. This status bit is reset whenever the gross weight is below programmed capacity value.

Parameter 25 Flow rate time base
The Time Base is the length of time in seconds between two weight readings that are subtracted to determine the initial flow rate. By increasing the time base, you increase the time between weight readings. This allows more material to be dispensed during the time base period. Low flow rates require a longer time base than high flow rates. The controller measures weight to about 1 part in 10,000. The formula below provides a minimum.

TIME BASE > (SCALE CAPACITY/10000)/LOW SETPOINT (units per sec.)

SCALE CAPACITY/5000 = determines minimum weight increment

Parameter 26 Reserved.

Parameter 27 variation
Sets the peak to peak variance value below which samples are filtered.

Parameter 28 capture
Sets the peak to peak variance value used to select which filter is used to provide the output value.

Parameter 29 start wait
Period of time, from the start of the fill cycle, during which the flow rate is not calculated.

Parameter 30 Update Time
Period of time, after the target weight has been reached before the measured weight value is taken.

Parameter 31 stable
Sets the maximum peak to peak percentage difference in flow rate, once the “stable wait’ period is reached. Values outside of this range reset the calculation.

Parameter 32 p gain

Gain value used to scale the proportional error term.

The proportional error term is generated by scaling the difference between the programmed target weight and the final weight value measured on the scale at the end of the last fill/dispense cycle. The larger the p_gain value, the faster the loop will compensate for a constant step change in the process but the larger the error will be for random fluctuations in the process.

The p_gain value can be programmed to a maximum value of 1.0, which represent 100% of the measured error or to 0.0 which disables the proportional compensation in the P+I calculation.

Parameter 33 i gain

Gain value used to scale the integral error term.

The integral error term measures the difference between the programmed target weight and the final weight value measured on the scale at the end of the last cycle, but instead of making a single change to the auto_preact value this error is integrated over multiple fill/dispense cycles. In cases where a step change in the process are encountered the integral term will eventually reach the desired weight value and the target error will diminish to zero. In this situation as the target error value tends towards zero the impact on the preact value is also reduced so the response of the system is directly proportional to the i_gain value used.

The i_gain value can be programmed to a maximum value of 1.0, which represent 100% of the measured error or to 0.0 which disables the integral compensation in the P+I calculation.

Parameter 34 frc tolerance

Percentage changes in the flow rate changes below this value are ignored and no changes to the auto_preact value are made.

Parameter 35 fast adjust

If the channel is being used in a simultaneous or sequential feed mode, then this sets the percentage the fast relay is adjusted by if the auto preact algorithm exceeds the target weight.

REAL Status Values

Parameter Name	Parameter Number	Description
Historical Flow Rate	55.0	The averaged flow rate value. The period over which this value is calculated is set by the capture averages parameter.
Preact A	56.0	The current preact value for relay A
Preact B	57.0	The current preact value for relay B
Last Flow Rate	58.0	The flow rate from the last fill/dispense cycle
Last Fill Weight	59.0	The measured weight at the end of the last fill/dispense cycle

Parameter Name	Parameter Number	Description
Steady Time	60.0	Time from when the target weight is reached (relay triggered) to when the weight first remains within the **capture** tolerance for the programmed number of update periods, **update time**. Unit of time is in seconds.
Cycle Time	61.0	Time form the start to the end of the fill/dispense cycle Unit of time is in seconds.
Stable Time	62.0	Time from the start of the fill cycle to the flow rate becoming stable. Unit of time is in seconds.
Fast Setpoint Time	63.0	Time from the start of the fill cycle to when the relay on the fast channel (relay A) changes state.
SlowSetpoint Time	64.0	Time from the start of the fill cycle to when the relay on the slow channel (relay B) changes state.
Averaged preact value	65.0	Averaged preact value

Dynamic Output Table Description

The following commands will enable the user to read and write the parameters of the 1756 nDF during a fill cycle. These commands allow multiple parameter values and associated functions to be modified within a single command.

See the "overview of Relay Operation" section to determine the correct Mode of Operation value listed in the dynamic output table.

Dynamic output table format

Output table offset	Content
0	Command – START, RESTART, SET, and STOP
1	Mode of operation (weigh scale 1)
2	Target weight TA for relay RA
3	Preact value PA for relay RA
4	Target weight for relay RB
5	Preact value for relay RB
6	
7	
8	Command – START, RESTART, SET, and STOP
9	Mode of operation (weigh scale 2)
10	Target weight TA for relay RA
11	Preact value PA for relay RA
12	Target weight for relay RB
13	Preact value for relay RB
14	
15	

Commands for weigh scale 2 from the PLC, output table offset 8 – 15, are only valid for HI 1756 2DF modules. For the HI 1756 1DF modules this portion of the dynamic output table will be ignored.

Status Word

The "status word" is a bit encoded value within the integer number.

Status Word	Value	Definition
STATUSCHANENABLED	0x00800000	Set if channel enabled
STATUSINMOTION	0x00400000	Variations in weight exceed the motion tolerance parameter
ERRORADCONVERT	0x00200000	Millivolt return from the load cell system is out of range for the unit
ERRORADFAILURE	0x00100000	Unit's A/D converter not responding.
ERROROVERCAPACITY	0x00080000	Out of range value
ERROR_EPROM	0x00000400	EPROM hardware error
STATUS_AP_WT_NOT_STEADY	0x00000100	Indicates if the current sample is within tolerance.
STATUS_AP_NOT_STABLE	0x00000080	Set if flow rate was not stable. Remains set until the start of the next fill cycle
STATUS_AP_NOT_STEADY	0x00000040	Set if weight on the scale was not within tolerance at the end of the fill cycle. Remains set until the start of the next fill cycle
STATUS_AP_WAITING	0x00000020	Set after the last relay closes and remains set until the weight sample is taken
STATUS_AP_ACTIVE	0x00000010	Set during the entire fill cycle, if auto preact enabled
STATUS_REFIL	0x00000008	Refill process active
STATUS_ON	0x00000004	System ON or OFF
RELAYB_ASSERTED	0x00000002	Relay B is asserted
REALYA_ASSERTED	0x00000001	Relay A is asserted

*Dual Mode and auto refill ON, or in the auto refill mode where the target weight greater than the difference between refill low and refill high or trying to start while the scale is in motion.

Integrated Technician

If there is **NO** IT JBOX, the instrument can still measure the sense voltage, the overall load cell millivolts per volt, and the internal reference weight value. If the user has an IT JBOX, the instrument can also read the weights and voltages of the individual sensors attached to the IT JBOX.

To initiate an IT test; do a WRITEPARAM command, with parameter number 0x0036, and a parameter value equal to the number of sensors, which should be 1-4 if you have an IT JBOX. If you do not have an IT JBOX, the parameter value does not matter.

To read back the results, do a READPARAM command, with parameter numbers 0x0036, 0x1036, 0xB036. The return values are listed below.

Integrated Technician Return Values Table

These numbers are floating point equivalent to hex numbers.

Return Value	REAL	Description
INSTANCE_VSENSE {XE "INSTANCE IT Return Values}	54.0	Sense voltage, 2 decimal places
INSTANCE_DVM_COMBINED	4150.0	millivolts per volt, 4 decimal places
INSTANCE_IREF_WEIGHT	8246.0	internal reference weight, weight decimal point
INSTANCE_JBOX_MV/V1	12342.0	Load cell 1 millivolts per volt, 4 decimal places
INSTANCE_JBOX_MV/V2	16438.0	Load cell 2 millivolts per volt, 4 decimal places
INSTANCE_JBOX_MV/V3	20534.0	Load cell 3 millivolts per volt, 4 decimal places
INSTANCE_JBOX_MV/V4	24630.0	Load cell 4 millivolts per volt, 4 decimal places
INSTANCE_JBOX_REF_WEIGHT	28726.0	reference weight on IT JBOX
INSTANCE_JBOX_WEIGHT1	32822.0	Sensor 1 on JBOX
INSTANCE_JBOX_WEIGHT2	36918.0	Sensor 2 on JBOX
INSTANCE_JBOX_WEIGHT3	41014.0	Sensor 3 on JBOX
INSTANCE_JBOX_WEIGHT4	45110.0	Sensor 4 on JBOX

NOTE: The Integrated Technician can also be run through the AOP dialog box.

CIP Messages

The weight calibration values can be read and written by CIP messages.

- Message Type: CIP generic (Common Industrial Protocol)
- Service Code: 4C (hex)
- Class Name: 4
- Instance Name: 254
- Object Attribute: none, leave this blank

It is possible and convenient to configure the MSG instruction to use the same tag for both source and destination.

There are two read and write calibration commands, each consisting of 6 float values (24 bytes) as follows:

- Command (see the list of commands below)
- Channel (0 or 1)
- Reserved
- CalZeroCounts
- CalLowCounts
- CalibK

1. Command 1.0: Read calibration values. Use this command to read the rate and weight calibration values.
2. Command 129.0: Write weight calibration. Use this command to set the 3 weight calibration values: zero counts, low counts, and CalibK (weight per A/D count).

The two commands below read and write configuration data. Each return 52 float values, which are the command, the channel, and the reserved word, followed by 49 parameter values, which are listed in the order of the parameter IDs.

3. Command 15.0: Read configuration data.
4. Command 143.0: Write configuration data.

Note *The values written via these commands are NOT saved automatically to the non-volatile memory and are lost on power down if no save to non-volatile command is given.*

There is a command #4 to read the auto preact status values, consisting of 14 REAL values (56 bytes) as follows:

- Command #4.0
- Channel (0 or 1)
- Status parameter 55: Average flow rate at end of fill
- Status parameter 56: Preact A (Fast relay)
- Status parameter 57: Preact B (Slow relay)
- Status parameter 58: Flow rate at end of last fill.
- Status parameter 59: Sampled amount of last fill
- Status parameter 60: Motion time. Time in seconds after relay close for weight to come out of motion
- Status parameter 61: Fill time. Total time from opening of relays to sampling weight
- Status parameter 62: Velocity stable time. Time after start of fill for flow rate to become stable.
- Status parameter 63: Setpoint A time: time from start of fill to closure of first relay
- Status parameter 64: Setpoint B time: time from start of fill to closure of second relay
- Status parameter 65: Averaged preact value
- Status Word (bit encoded integer)

Chapter 5 Calibration

The Dispenser-Filler Module should be calibrated before use. We also recommend that you verify the calibration periodically or when not in use for extended periods of time. Users and service personnel should be familiar with the procedures in this chapter before installing or operating the Dispenser-Filler Module.

NOTE ***Do not perform a calibration on either channel while an application is in operation.***

Pre-Calibration Procedures

Verify that the load cells have been properly installed.

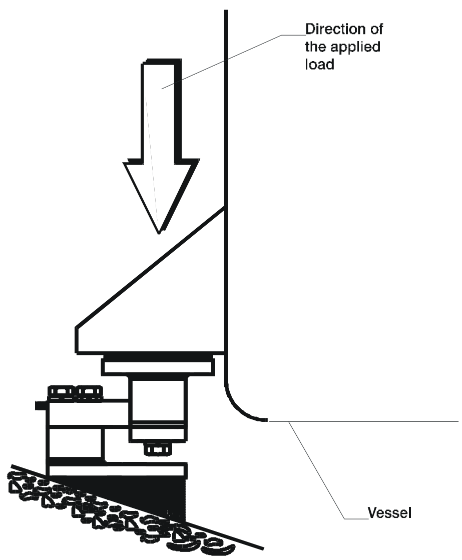
- Refer to your load cell operations and installation manual for proper installation instructions.
- On some sensors and cells an arrow indicates the direction of the applied load. If the arrow is pointing in the wrong direction, change the position of the load cell so that it is mounted in the direction of the applied load.
- Check for binding on the Load Cell or other parts of the weighing system.

CAUTION: *Binding on a scale/vessel or load cell does not allow the load cell free vertical movement and may prevent the instrument from returning to the original zero reference point.*

A load cell must be mounted so that 100% of the load (Vessel w/Contents) passes vertically through the load cell.

Verify that nothing is binding the load cell. This means that nothing is draped across the scale/vessel or the load cell, such as a hose, electrical cord, tubes, or other objects.

Verify that nothing is in contact with the scale/vessel other than service wires and piping that have been properly mounted with flexible connections.



Properly Installed Load Cell

Electrical Check Procedures

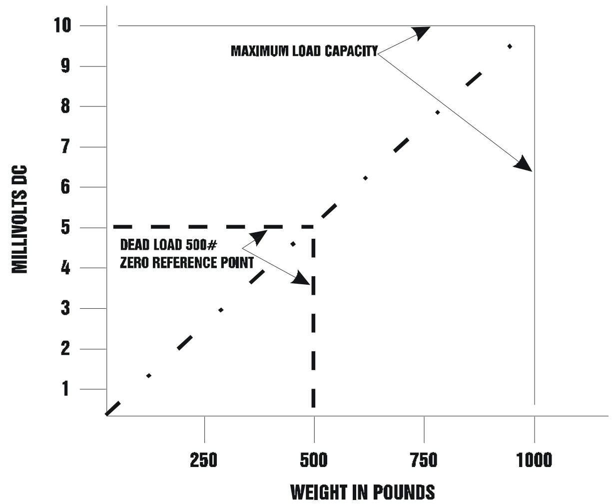
Load Cell/Point Input/Output Measurements

The Dispenser-Filler Module is designed to supply 5 VDC excitation to as many as four 350-Ohm load cells/points per channel. The expected output from each load cell/point will depend on the mV/V rating of the load cell/point and the weight.

For example, a 2mV/V load cell/point will respond with a maximum of 10 mVDC at the load sensor's full weight capacity, which includes the weight of the vessel and the weight of the product as measured by the load cell/point. Thus, if the load cell/point weight capacity is rated at 1000 pounds, the load cell/point will be 10 mVDC at 1000 pounds, 7.5 mVDC at 750 pounds, 5 mVDC at 500 pounds and so on.

A zero reference point will vary from system to system depending on the "Dead Load" of the vessel. "Dead Load" is the weight of the vessel and appurtenances only, with no product loaded. In our example we will assume the dead load to be 500 pounds.

The operating range for the scale in this example is 5-10 mVDC with a 500 pound weight range. Note that after zeroing the instrument, the 0 reading refers to the zero reference point and not absolute 0 mVDC or absolute 0 weight.



Millivolts/Weight Scale

NOTE *Load cell/point measurements are checked with a digital volt meter at the J1 connector on the front of the module or by using INTEGRATED TECHNICIAN with the HI 215IT Junction Box.*

Load Check

Place a load (weight) on the scale or vessel, and check to see if the weight reading on the input table changes in the proper direction.

For example: If the input table display reads 100 pounds and a 20-pound weight is placed on the vessel or scale, the ladder logic display should read 120 or some value over 100. With the input table display reading 100 pounds, if a 20-pound load is placed on the vessel or scale and the reading is 80 pounds, the reading is going in the wrong direction and indicates some problem with the system.

If the input table reads improperly or shows no change, something is wrong with the setup. If the input table changes weight in the proper direction, remove the weight and proceed to calibrate the module. Refer to chapter 6 troubleshooting for additional help to determine the cause of the poor weight reading.

AOP Calibration

Both C2 and Hard calibrations are available in the AOP dialog box under the Calibration Tab.

C2 Calibration

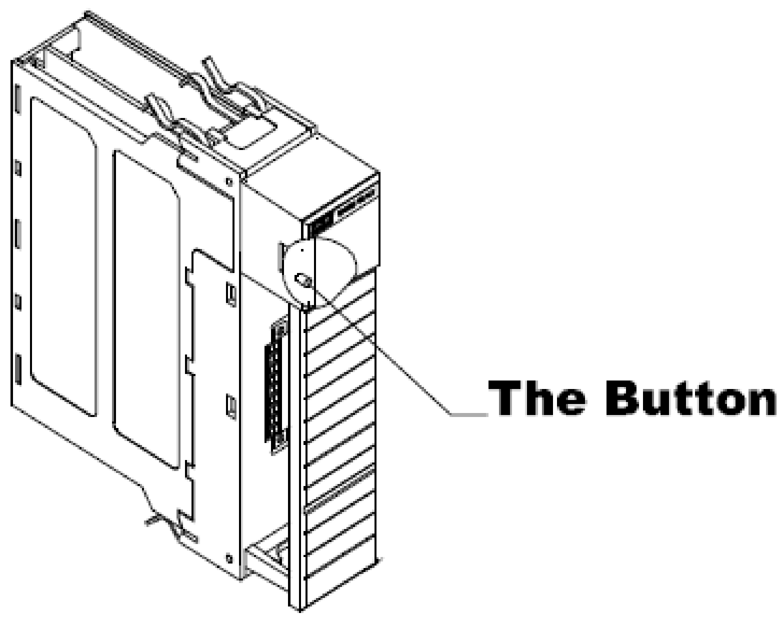
C2 calibration requires C2 load sensors. (For scales without C2 load sensors see Hard Calibration below). The Weigh Module reads the performance characteristics of the individual load cells and detects the quantity of load cell(s) in the system. C2 Calibration can be performed by pressing "THE BUTTON" located in the front panel of the module, or via Allen Bradley RS LOGIX 5000 using either the output table or ladder logic.

"THE BUTTON" C2 Calibration

Step 1. Be sure that the parameters have been setup for your weighing process. (See Chapter 4, Setup)

Step 2. Open the front door of the module.

Step 3. Press and hold "The Button" until the desired Scale LED turns green, and release, scale led will start flashing.



"THE BUTTON" location on the 1756 nDF

Step 4. Press and release "The Button" again to perform the C2 Calibration. Once the calibration is completed the Scale LED returns to a steady green.

NOTE: If you do not press THE BUTTON again within 20 seconds, the calibration process times out.

C2 Calibration Using Ladder Logic

Verify that the parameters have been setup for your weighing process in accordance with the setup information provided in Chapter 4.

Step 1. Empty your hopper, if possible.

Step 2. Set your cal low reference weight to 0 or if you have product in the hopper use that as your reference setting.

Step 3. Send the C2 calibration command by setting the output table word 0 to the command number 102.0.

Step 4. Monitor your Input table words 0 & 1. Word 0 will echo your command number when command is complete. Word 1 will be your status, 0 = no errors.

Step 5. Calibration complete if no errors

NOTE: If you are doing the C2 calibration on channel 2 of a 2 channel module, use Output table word 8 and Input table words 8 & 9.

For ladder logic examples please refer to the http://www.hardysolutions.com website. Located under the SUPPORT pull down and then select sample programs.

Hard Calibration

Hard Calibration is the traditional method of calibration using test weights. Hardy recommends that the test weights total 80 to 100% of the load capacity.

Step 1. Empty your hopper, if possible.

Step 2. Have or set your Cal Low Reference weight to 0, or if you have product in the hopper use that as your reference setting.

Step 3. Send the Cal Low command by setting the Output table word 0 to the command number 100.0.

Step 4. Monitor the Input table word 0 & 1. Word 0 will echo your command number when command is complete. Word 1 will be your status, 0 = no error.

Step 5. Add a known weight to the scale. This should be the same amount of weight as your Span parameter is set to. Span value is the zero reference weight plus the known amount of weight you will add.

Step 6. With weight on the scale, send the Cal high command by setting the Output table word 0 to the command number 101.0.

Step 7. Monitor the Input table word 0 & 1. Word 0 will echo your command number when command is complete. Word 1 will be your status, 0 = no error.

Calibration is complete if no errors.

NOTE: If you are doing the HARD calibration on channel 2 of a 2 channel module, use Output table word 8 and Input table words 8 & 9.

Hard Calibration Ladder Logic Example

Verify that the parameters have been setup for your weighing process in accordance with the setup information provided in Chapter 4.

For ladder logic examples please refer to the http://www.hardysolutions.com website. Located under the SUPPORT pull down and then select sample programs.

Chapter 6 Troubleshooting

Chapter 6 provides procedures for troubleshooting the electrical, mechanical and firmware elements of the HI 1756 nDF and for using Hardy's Integrated Technician (IT®) software utility to isolate problems. Flow charts provide troubleshooting procedures for the dispenser/filler, load cells, and cabling.

Disassembly and Reassembly Notes, Warnings and Cautions

WARNING *EXPLOSION HAZARD - DO NOT DISCONNECT EQUIPMENT OR REPLACE COMPONENTS UNLESS POWER HAS BEEN SWITCHED OFF OR AREA IS KNOWN TO BE NON-HAZARDOUS.*

- Always replace broken or damaged modules or hardware immediately.
- Always check to be sure that no loose parts are sitting on printed circuit boards or electrical connectors or wires when disassembling or reassembling.
- Always protect printed circuit boards from electrostatic discharge (ESD). Always use approved ESD wrist straps and anti-static pads.
- Always follow proper safety procedures when working on or around the Rate Controller.

This chapter describes several tests that can shorten the time for troubleshooting. Most problems require the use of two or more tests to determine the cause.

If a problem is isolated to a load cell, it may not mean the load cell is the damaged component. Mechanical imbalances and system piping stress (lack of piping flexures, pressure hoses draped over, pipes etc.) can make a load cell or weight controller seem to be the problem.

If you are in doubt as to how to resolve a problem or if you need assistance, look for Hardy Process Solutions Web-tech at http://www.hardysolutions.com. Web-tech is updated often and is available 365 days a year 24/7. It contains frequently asked questions to aid you in troubleshooting, and it provides a form for requesting additional information and answers to questions, with no waiting on hold. Located under the SUPPORT pull down, select the online support selection and then WebTech Knowledge base.

Weight and Voltage Testing

This test section looks at the readings from ALL the load cells to test overall system performance and signal voltage readings. This test works for a variety of load cell connection systems.

Further investigation to isolate system problems requires the use of hand tools and multi-meters or the Integrated Technician Summing Junction Box and using the IT© Test section.

NOTE *IT ®is a registered trademark of Hardy Process Solutions Inc.*

Weight

This displays the amount of force seen by all load cells installed in the summing junction box. Further investigation to isolate system problems will require the use of hand tools and Multi-meters or the Integrated Summing Junction box and using the IT test section. This force can show an imbalance or weight distribution problem. Review your system to insure proper balance. Motors can account for this problem. Piping should not apply any appreciable force on the scale.

mV/V

DC voltage signals are between 0-15 millivolts. Overloads and negative millivolt readings are not shown as actual readings but 15.3 for over voltage and -0.1 for negative voltage. You will need to use a multi-meter with a 200 or 300 mVDC range to view the out-of-range voltages. Millivolt/volt equals the output from a load cell per each volt of excitation. The HI 1756 nDF reads the load cell output in mV/V, which provides higher resolution (4 decimal places) than a milli-Volt reading. This provides more sensitivity to help you troubleshoot the condition of the load cell under certain conditions. Load cells are rated in millivolts/volts. To convert to mV, multiply the mV/V times the sense voltage.

IT Test

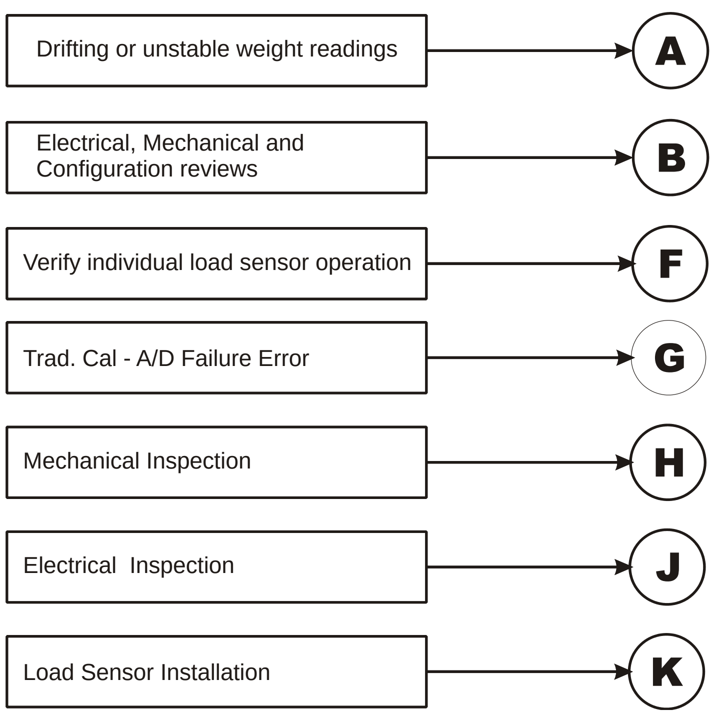
If your system has an Integrated Technician Summing Junction box, the IT test can help identify individual load cell problems up to a maximum of four load cell selections.

Sensor Number

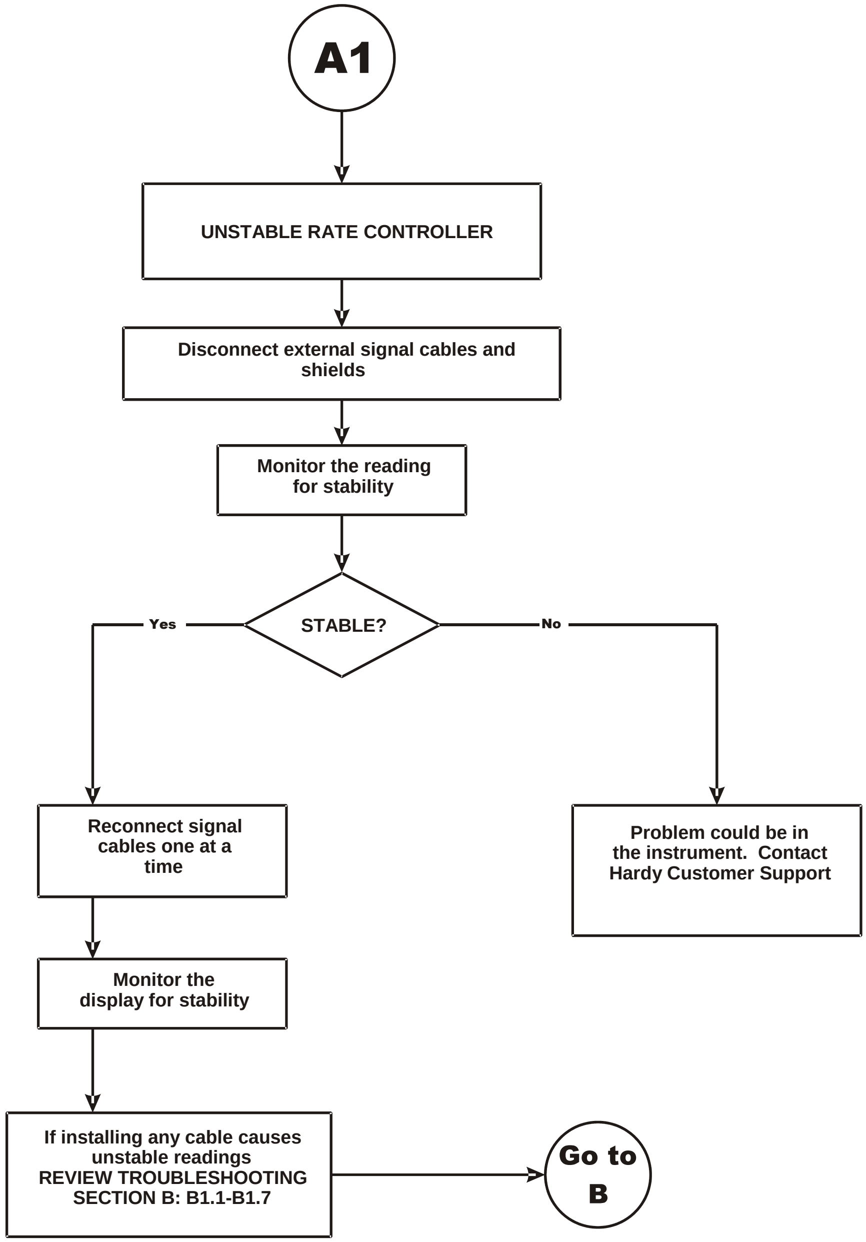
Indicates which sensor is under test. Select the target sensor to be tested.

Warning *Do not install your HI 215IT summing board in areas susceptible to high vibrations. The relays on the board can chatter and affect your weight readings and the vibration can crystallize the solder joints.*

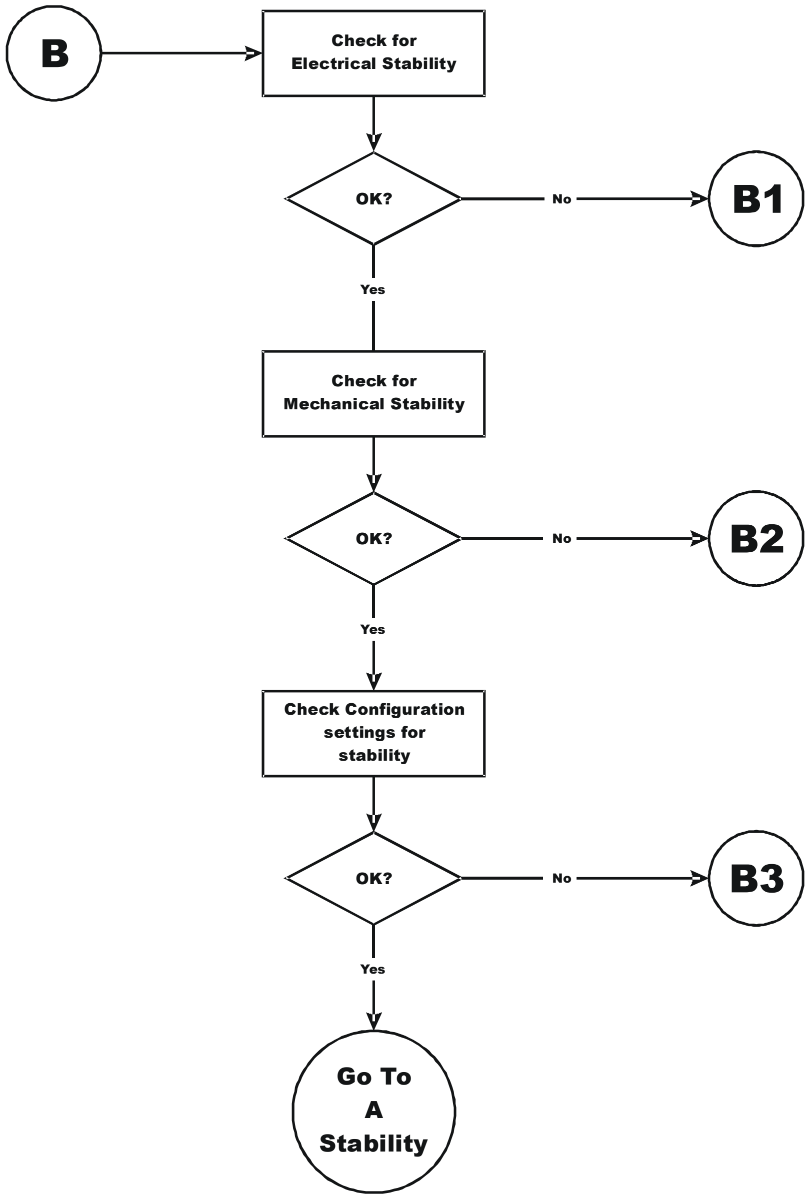
General Troubleshooting Flow Chart Index



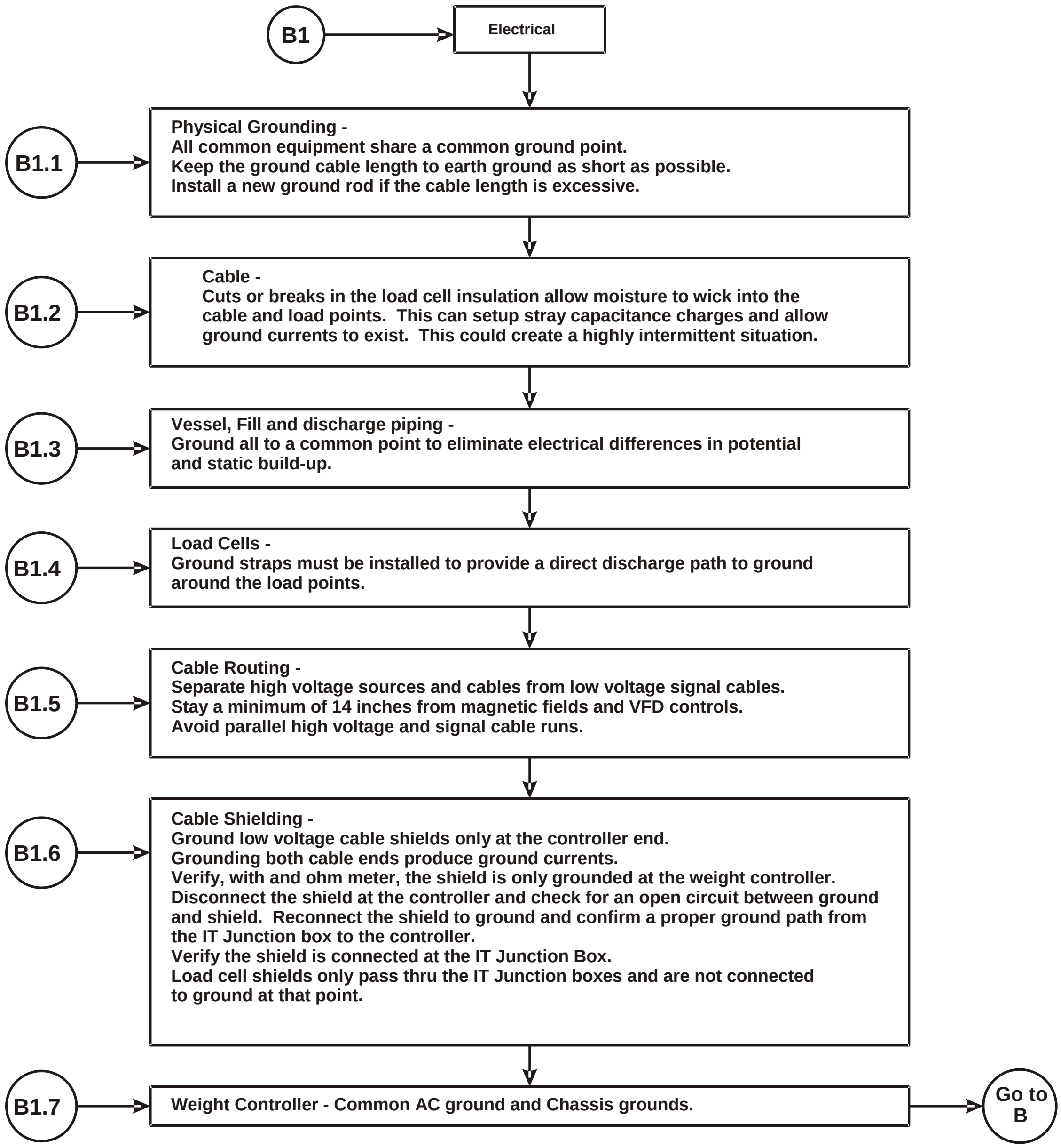
A1 - Guidelines for Instabilities on Formerly Operating System



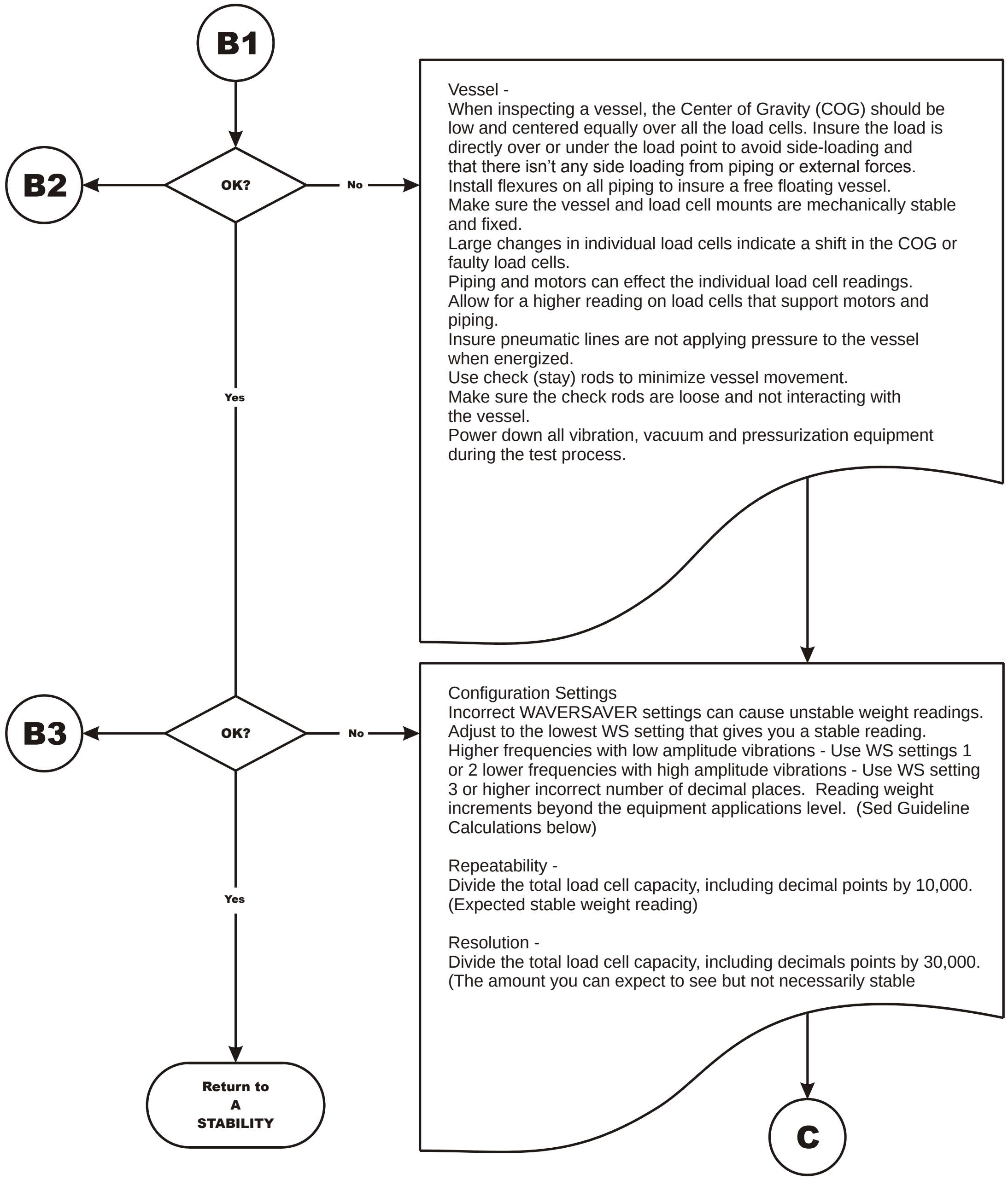
B - Guidelines for Instabilities on Formerly Operating Systems (Cont'd)



B1 - Guidelines for Instabilities on Formerly Operating Systems (Cont'd)



B1 - Guidelines for Instabilities on Formerly Operating Systems (Cont'd)

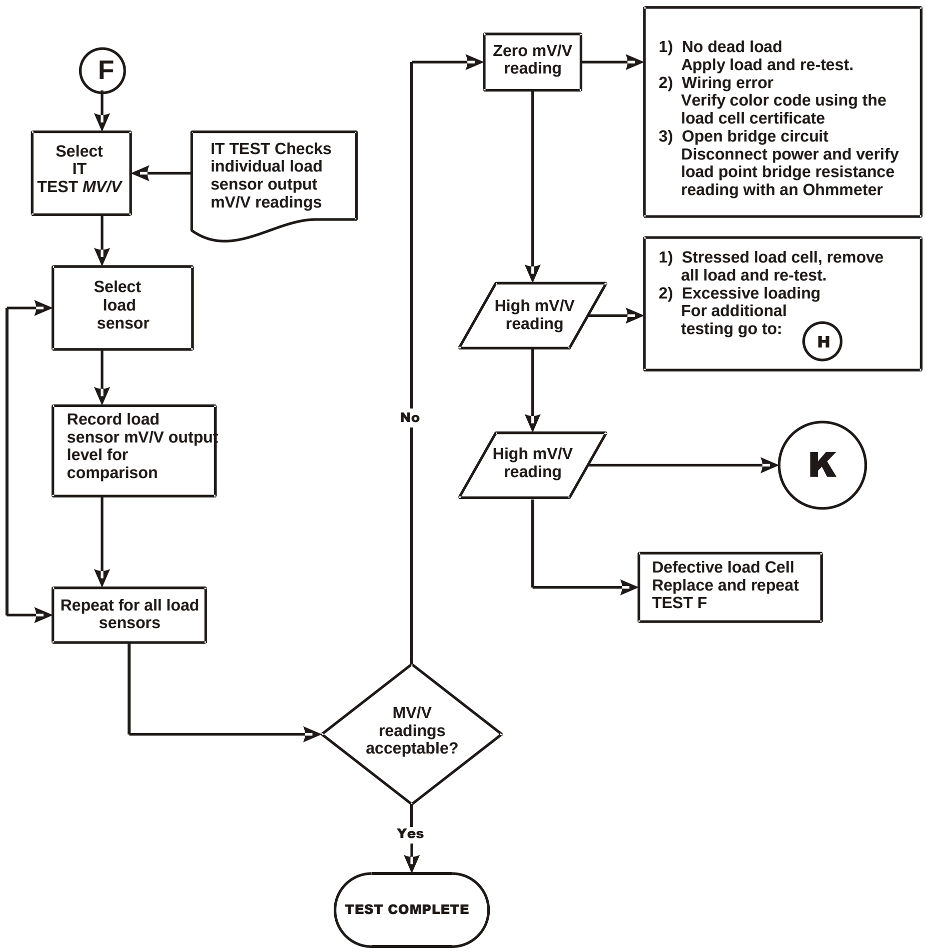


F - Verify Individual Load Cell Millivolt Readings

Testing an individual load cell signal output requires an IT Summing Junction box or millivolt meter.

Use the load cell certificate to verify the millivolt per volt (mV/V) rating:

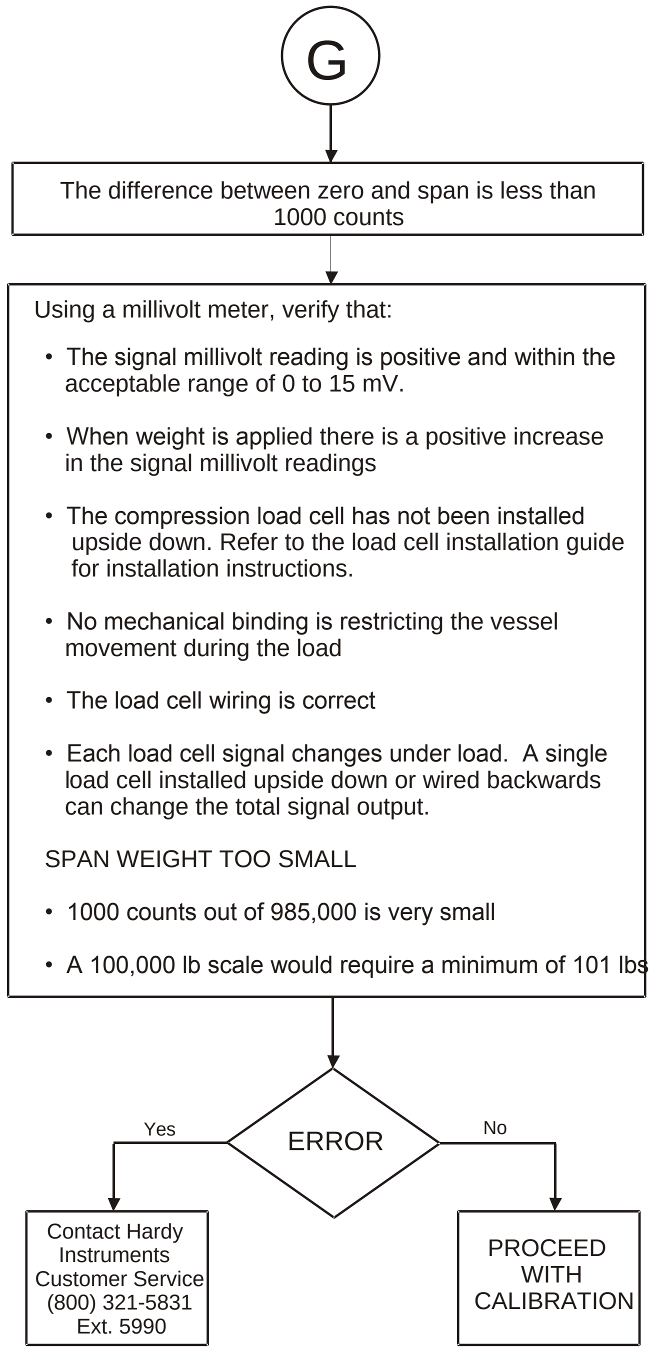
Example: 3mV/V load cells produce approximately 15mV at full load. That is 5 volts excitation x 3 mV/V. At a scale capacity of 1,000 lbs. with 100 lbs. of deadload when empty, the load point mV reading should measure 1.5mV.



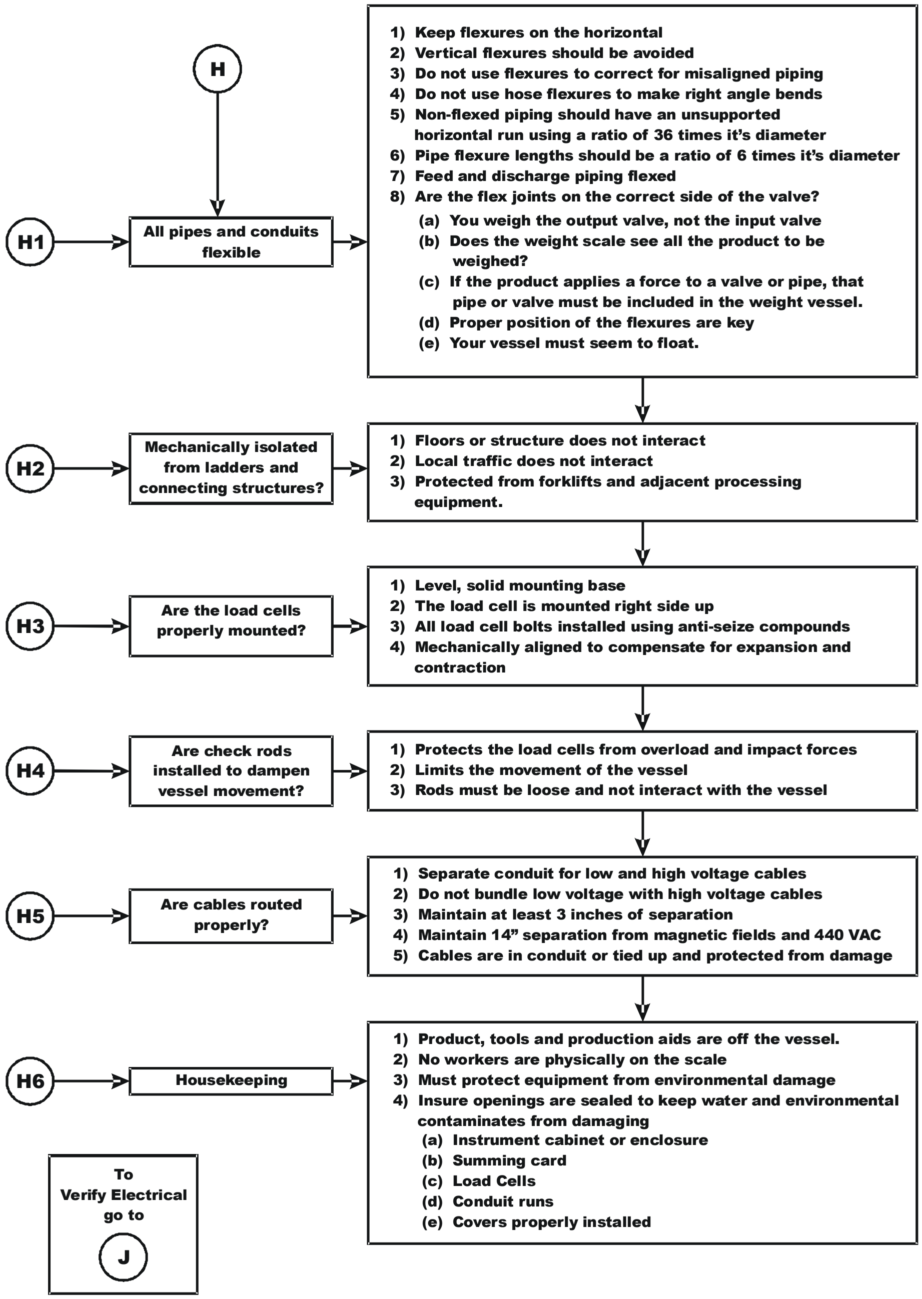
G - Calibration Failed: Not Enough Counts Between ZERO and SPAN

This error only occurs at the SPAN parameter.

You may ZERO out straps or chains and other temporary calibration equipment that held or hoisted test weights. Zeroing the temporary weight does not effect the calibration. To zero out chains or other temporary calibration equipment. Re-run the cal lo routine with an empty scale. The calibration slope will remain, only the zero reference point is adjusted.



H - Mechanical Inspection



J - Electrical Inspection

J

J1 → Verify the proper voltage level has been supplied

DO NOT POWER UP THE CONTROLLER UNTIL INPUT VOLTAGES CAN BE VERIFIED

1) Verify the proper input power, AC or DC, is properly installed
2) Use a meter to verify neutral, ground and hot are correct
3) Isolated from SCR and motor control circuits
4) Use a Common earth ground.
   (a) Keep ground cable runs as short as possible
   (b) Excessive ground cable runs can act as an antenna for AC noise
   (c) Install grounding straps around load cells to direct static away from the load cell and directly to ground
   (d) Install ground straps on the input and discharge piping and the vessel to a common earth ground

J2 → Apply power to the controller only if supply voltage is correct

1) Verify the front LEDS illuminate
2) Completes the initialization process
3) Reads the weight. This weight value will not be correct if a calibration procedure was not performed

J3 → Does the scale reflect a weight change?

1) Read the NET weight
2) Send a TARE command to ZERO the NET weight
3) Apply weight to the vessel
   (a) Does the weight increase and decrease in the correct direction with the weight?
   (b) Does the weight return to ZERO NET?
   (c) The weight value will not be correct until a proper calibration is complete

J4 → Cabling

1) Use the load cell certificate, manuals or drawings to verify the load cell color code. Input = Excitation, Output = Signal
2) Shielding
   (a) Grounded only at the rate controller
   (b) Continuous shield connection from the load cell cable to the controller. Single point EMI/RFI drain
   (c) Terminated but not grounded at the summing box
3) Sense lines installed?
   (A) Jumpers or sense lines in the J1 connector?
   (B) Sense lines must be installed for C2 calibration
4) Use IT TEST to verify readings

To Verify Proper Load Cell Operations Go to K

K - Load Sharing and Load Sensor Checkout

K

K1 → **Load Cell wiring is complete and correct?**

1) Does the mV signal increase in a positive direction
2) If you receive a negative result, check if load cell is mounted correctly.
   (a) The arrow goes with the direction of force
   (b) If there isn't an arrow, you must manually verify the correct direction. A negative reading indicates the load cell is upside down
   (c) Load cells in tension will not reflect a negative reading if installed upside down. If upside down, only the force applied by the cable will be included in the weight reading
   (d) If you are still receiving a negative signal, verify load cell wire color code

K2 → **Multiple load cells MAP the mV reading. Balance the load**

1) Verify a positive mV/V reading from each load sensor using IT TEST
2) Record the mV/V reading and compare each corner for proper load sharing
   (a) For proper load sharing you should see only a difference of +/- .5mV
   (b) Larger differences due to motors and piping should not exceed +/- 2mV
   (c) If there aren't any motors, valves or piping to explain the mV difference, adjust the corners and balance the mV readings
   (d) Use shims or if equipped adjusting bolts on the load cell mounting hardware
   (e) Drawing a load cell map helps determine the correct leg to adjust and in which direction

Three load cells balance like a three legged chair

1) Using a spirit level, verify the vessel is vertically and horizontally correct
2) Verify if any height change effects the attitude of adjacent vessels or piping
3) Adjust each leg to dynamically match mV outputs
4) Verify the mV readings and physical level when complete

Four or more load cells present a challenge

1) Use the Weight and Voltage test to determine the sum of the load cell signals to set your target mV reading for each load cell
2) Read the output of individual load cells
3) Adjust the load cell with the lowest reading to dynamically match the target mV readings obtained in Step 1
4) Read the mV readings from each load cell to verify a proper correction
5) Repeat steps 3 and 4 to achieve a proper load sharing vessel
6) Verify the mV readings and vessel level when complete

Monitor system for proper operation
Check out completely

Erratic Flow Rates

This section explains how to resolve problems relating to Flow Rate (FR) and weight calibration.

Flow Rate calculations

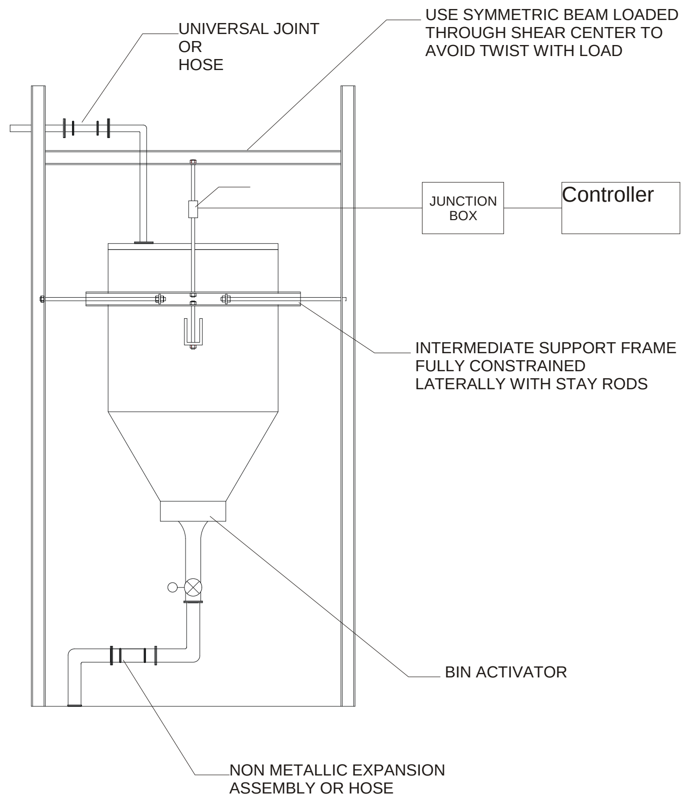
1. Verify the scale calibration using test weights. A poor weight calibration will produce poor rate calculations.
2. Follow the weight troubleshooting flow charts and correct any equipment binding, rubbing, and piping problems.
3. If the flow rate displayed does not match your test samples:
    - Re-calibrate the scale
    - Review the troubleshooting tips for mechanical influences relating to the feeder mechanism
    - Look for leaks in the delivery system or refill gate.
4. If the system is slow to change the flow rate (or weight) readings.
    - Adjust the number of averages setting lower.
    - Adjust the WAVERSAVER setting lower.
5. Look for a systematic and consistent change in weight. Determine what a stable rate should be. If the flow rate displayed on the monitor continuously falls and rises and you never get a stable rate or symmetrical change in weight pattern:
    - The rate may be too slow for the load cell capacity.
    - The material may be bridging or liquefying and basically inconsistent.
    - The feeder motor may be feeding too fast, mechanisms may be damaged, or working conditions may not be right.

System and Load Cell Tests

Overview of Typical Load Cell System

The typical load cell system consists of one or more load cells/points and an HI 1756 nDF Dispenser-Filler. If you have more than one load point, an optional IT summing junction box can read data for individual load cells.

Load Cell/Sensor/Point - is a strain gauge-based force transducer that generates an electrical signal proportional to the load applied to the scale. Tension or compression type load cells/points can be used to measure pressure, load, or torque.



The load cell/point uses the 5 volts DC excitation voltage generated by the HI 1756 nDF. It generates a millivolt output proportional to the weight on the scale (0-10mV DC for 2mV/V load cells/points or 0-15mV DC for 3mV/V load cells/points).

The HI 1756 nDF instrument provides among other functions:

- Power to the load cell(s)/point(s)
- Reads the millivolt signal output from the load cell(s)/point(s)
- Digitizes, interprets, communicates the results in terms of weight and rate

INTEGRATED TECHNICIAN (IT®)

INTEGRATED TECHNICIAN (IT®) is a diagnostics utility that enables the operator to rapidly troubleshoot the individual load cells in a weighing system. IT commands are communicated via the C2 wires connecting the summing card and controller. You must use C2 certified cable, with or without C2 load sensors. Insure the Violet and gray wires are properly installed. An HI 215IT Summing junction box is required to read data for individual load points. It provides separate inputs for up to four load cell.

If you have more than one load cell without the IT junction box, there is no easy way to isolate the load cell signals.

If you have more than one load cell with the IT junction box, the system can provide both the average numerical values and values specific to each load cell. The number for a load sensor is based on the connections in the IT junction box.

Check the installation sequence in the box to determine which load sensor is number 1, 2 and so on. Always install the first load cell in position 1.

If you do not have the optional IT junction box, some of the options described below will not appear on either interface.

Warning *Do not install your HI 215IT summing board in areas susceptible to high vibrations. The relays on the board can chatter and affect your weight readings and the vibration can crystallize the solder joints.*

To determine if an instrument or cabling problem exists, verify the basic operation of the system by performing the following system checks.

Stability Test

The Stability test lets you check the A/D Raw count and average. With the IT option, it tests and reports for each load cell. The test sends a fixed signal into the analog-to-digital convertor and calculates the mean squared variation from the average reading, using 100 samples or 150 samples, depending on the Weight Update Rate parameter. The test passes if the mean squared variation is less than 5.0.

If the weighing system passes the stability test, the results show OK and the variation and mean results are posted. FAIL indicates that the Mean Squared Variation is greater than 5.0 so the instrument is considered unstable. In that case, see the Troubleshooting Flow Charts Section.

CAUTION **Do not perform the Stability Test during production. The test activities can cause incorrect readings.**

Weight and Voltage Test

The Weight and Voltage tests are used to diagnose a weighing system and, if certain types of problems are indicated, determine their source. It provides the total scale input to the instrument, such as mV/V and Weight in the units selected (i.e. lbs, kg, oz, g).

Running the IT test will show the weight and voltage results for each load sensor, including the following values:

Weight: Weight value recorded on the sensor mV/V: The mV/V reading is sufficient to balance the corners of your scale or vessel. These readings allow you to determine if the problem is in the instrument (internal) or in a load sensor(s) (external). The normal specification range for the Rate Controller is 0-15 mV. Readings outside this range (15.5 mV, 3.1 mV/V Maximum or any negative values), indicate an external problem. (Check for improper wiring).

When you check the results, if all the load sensors read 0.00, something is probably wrong between the HI 1756 nDF and the HI 215IT junction box, e.g., the cable may be disconnected. Something could also be causing the box to not transmit the readings to the HI 1756 nDF.

If you get no reading for one or possibly two or more load sensors (e.g., sensor 3 reads 0.00 or the reading is larger or smaller than it should be) and you know that the sensors are connected to the junction box, either the load sensor is malfunctioning or its cable to the junction box is loose or incorrectly wired.

General Policies and Information

Hardy Process Solutions provides world-wide support for its products. The following paragraphs describe Hardy's customer support services and equipment warranty. When returning a product, call the Technical Service Department listed below for a Return Authorization Number. You will need to provide your company name, address, telephone number, equipment model number, S/N, and a brief description of the problem.

NOTE *For all non-warranty repairs a purchase order or credit card information is required. You can also go to the Hardy web site and request a Return Authorization number. An RA# will be e-mailed to you.* http://www.hardysolutions.com/service/repair.php

Warranty

A warranty problem may be handled by returning the product to the factory for repair or replacement under warranty. In the event you experience a problem with this instrument contact your local Hardy Representative or the Hardy Process Solutions Service Center to determine if the problem is covered under warranty.

Web Address: http://www.hardysolutions.com/service/terms.php

Ordering Replacement Parts

Contact the Hardy Process Solutions Sales Department to order replacement parts and option boards. Have your equipment model number and serial number ready. Most parts and components are only available as whole units or major assemblies.

Note *System Support (Requires Purchase Order or Credit Card)*

Technical Service is provided as follows:

- **New system start-up:** Ensure that the installation is checked and correct; instruments are calibrated, and operators trained.
- **Service:** Engineers are trained and qualified to provide on-site installation, calibration, and maintenance.
- **On-site training:** A Hardy Support Representative can be scheduled to train your operations and maintenance personnel. This can be as simple as basic load cell theory or as complete as troubleshooting techniques which allow you to service your equipment.

For Further Information Contact

Technical Services

Hardy Process Solutions, Inc.

9440 Carroll Park Drive, San Diego, CA 92121

Telephone: +1 (858) 278-2900 ext 9550

FAX: +1 (858) 278-6700

Web Site: http://www.hardysolutions.com

E-Mail: hardysupport@hardysolutions.com

Index

9440 Carroll Park Drive, Suite 150, San Diego, CA 92121
Telephone: 1-800-821-5831 FAX: (858) 278-6700
Web Address: http://www.hardysolutions.com
Hardy Process Solutions Document Number: 0596-0322-01 Revision B