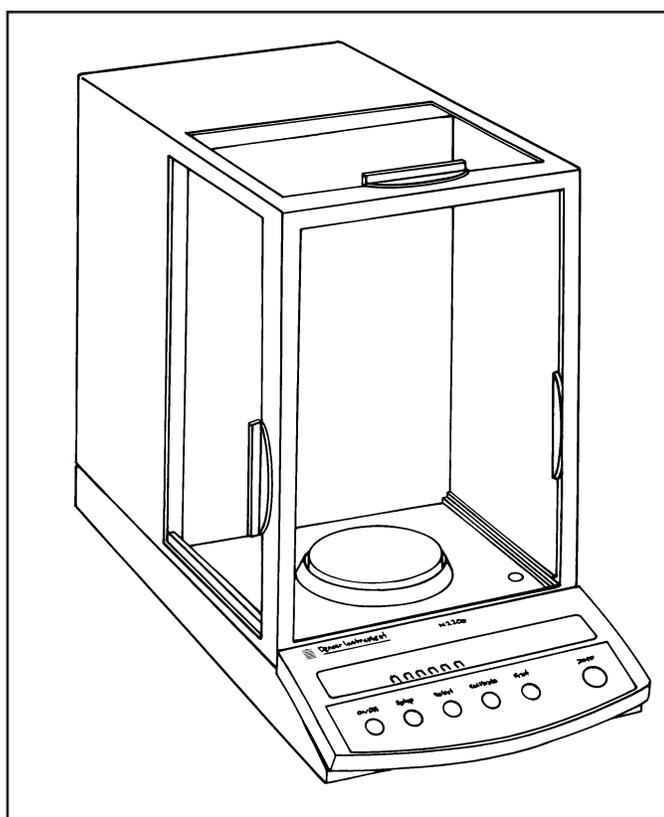


 Denver Instrument Company

M-Series

Analytical Balances



Operation Manual

700714.1 Rev. F

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You have purchased a quality precision weighing instrument that requires handling with care.

*Read entire contents of this **Operation Manual** prior to operating your new Denver Instrument balance.*

Disclaimer Notice

“Calibrate your balance using reference weights of the appropriate tolerance (class). An instrument can be no more accurate than the standard to which it has been compared. For assistance in the selection of reference weights, please contact the factory”.

Class A Digital Devices:

Notice: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. The equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this device in a residential area is likely to cause harmful interference in which the user will be required to correct the interference at his own expense.

Caution: Changes or modifications not expressly approved by the manufacturer could void the user's authority to operate this equipment.

Manufactured in the U.S.A. by:



Denver Instrument Company

6542 Fig Street • Arvada, Colorado 80004
(303) 431-7255 • (800) 321-1135 • Fax(303) 423-4831

Introduction

Thank you for choosing one of our precision instruments. Your balance is designed and manufactured to the most rigorous standards in order to give you years of service. Check the contents of the shipping carton. You should find the following:

- **Operation Manual**
- **Warranty Card**
- **Weighing Pan**
- **External Power Transformer**
- **Pan Ring**
- **Power Cord**

Immediately verify that all items have been included and that there has been no damage in shipping. To take advantage of your new balance's many features, carefully read your operating manual. It contains step-by-step procedures, examples, and other vital information.

Warranty Card

Remember to return your completed warranty card within ten days and to record all purchase information in the space provided on the back cover of your manual.



Warning: Use of this product in a manner not specified by the manufacturer may impair any safety protection provided by the equipment!

Specifications

Model #	M-120	M-220	M-310	M-220D
Capacity	120g	220g	310g	220g/31g
Readability	0.1mg	0.1mg	0.1mg	0.1mg/0.01mg

Common Specifications and Features

Electrical Requirements	115/230~50/60 Hz.
Response Time	Variable
Controls	Membrane Keyboard, 5 Keys plus Zero (Tare) key
Display, Message	0.25" high Vacuum Fluorescent, 14 segment, 10 characters.
Display, Numeric	0.5" high Vacuum Fluorescent, seven segment character.
Pan Diameter	3 1/4" (8.25 cm).

RS-232 Bidirectional Interface, 5 different formats.
Automatic Calibration with built-in NIST (National Institute of Standards and Technology) Traceable Weights.

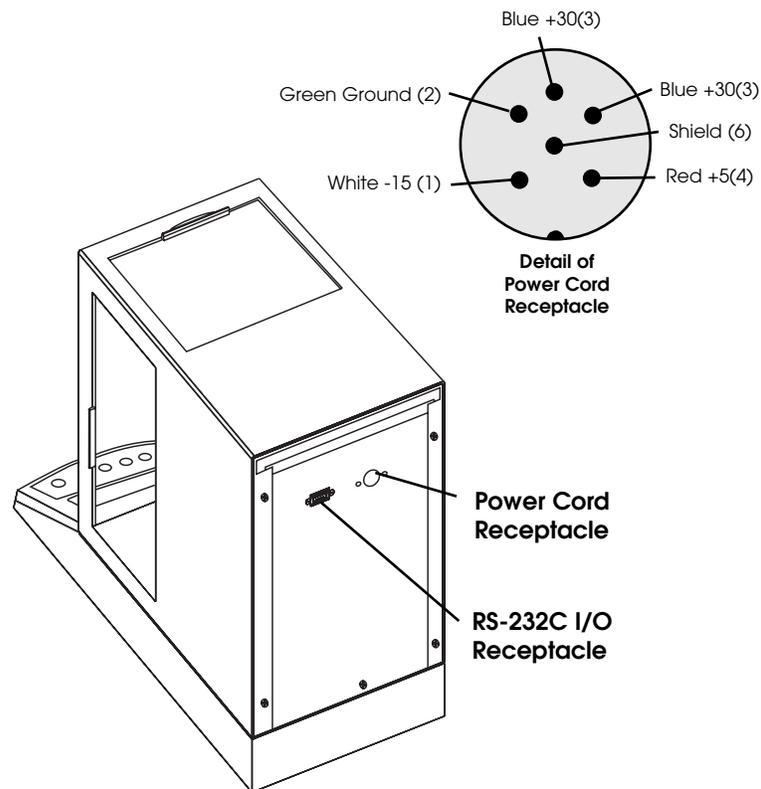
Installation

Environment

The M-Series analytical balance is a precision instrument and for optimum performance should be used in a work area relatively free from drafts, vibrations and excessive room temperatures. Room temperatures above 104°F/40°C or below 59°F/15°C could affect balance operation and accuracy.

Do not install the balance:

- near magnetic materials or equipment/instruments which use magnets in their design.
- near air conditioning or heating vents which can cause temperature fluctuations.
- in direct sunlight, near open windows or moving doors which can cause air drafts.
- on an uneven or nonrigid work surface.
- near other equipment which can generate a vibration on the same work surface.



Power Source

The line voltage, which is used to power the analytical balance, should be reasonably constant and free from fluctuations. It is also not advisable to use an outlet that is shared with fluorescent fixtures or other electrical equipment that draws current in an inconsistent manner.

Leveling the Balance

Place the balance in a work area as described above. The balance must then be leveled to weigh accurately. A level indicator vial on the floor of the weighing chamber is provided for your convenience. Adjust the leveling foot at the back of the balance, then the side leveling feet until the bubble is in the center of the level indicator vial. Turn clockwise to raise or counterclockwise to lower the balance.

Installing the Weighing Pan and Pan Ring

Gently place the weighing pan into the load receiver which shows through the hole in the center of the weighing chamber floor. Then place and center the pan ring on the outside of the weighing pan. A metal ring on the floor of weighing chamber will keep the pan ring in place and from touching the weighing pan.

Connecting the External Transformer

1. Prior to connecting the power to the balance, it is important to verify that the external power supply matches the voltage of the power source. If the proper transformer is not used, damage to the balance may occur.
2. Connect the power cord to the external transformer. Then noting the orientation of the connector, connect the external transformer cord to the receptacle on the back of the balance. See figure on following page.
3. Finally, plug the power cord in to a proper AC outlet. The balance will go through a self test procedure, display check and then indicate the model designation.

Your balance is designed to be continuously plugged in. If the balance is unplugged from the power source, it will be necessary to go through a warm up period for the balance to stabilize.

Warm Up

To stabilize the balance for accurate weighing, it is important that the balance be warmed up for a minimum of 24 hours for the model 220D and 2 hours for all other models.

General Information

Display Features

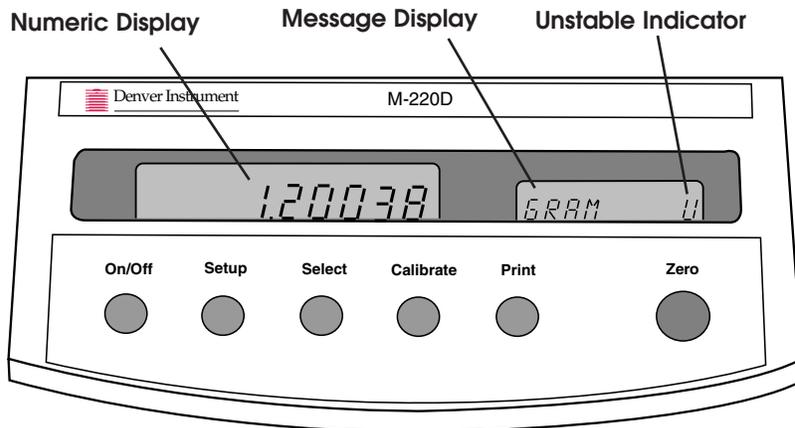
Your balance features two displays (a large Numeric Display and a smaller Message Display) to give you complete weighing information.

Numeric Display

The Numeric Display continuously shows your weighing results. The number of decimal places displayed depends on the balance model.

Message Display

The Message Display conveniently uses text to clearly provide weighing information. During a weighing, the Message Display continues to show the weighing unit, (for example, GRAM) and also the unstable indicator. Whenever the balance is unstable, an indicator (U) appears on the far right side of the Message Display. During the Set Up procedures, the Message Display will scroll through the available set up options.



Keypad

The balance features a sealed membrane keypad for easy and reliable operation. To operate a key quickly press it firmly and then release. When scrolling through a list of selections, the key may also be held and released when the desired selection is shown in the Message Display.

The following outlines the function of each key.

- On/Off** Enters desired setting in Set Up Display and Set Up Print Menus.
Turns display ON and OFF.

Setup	Accesses Set Up Display Menu and Set Up Print Menus. Cycles through the Display Set Up Menu options.
Select	Cycles through Set Up selections. Changes Range on Model-220D only.
Calibrate	Initiates automatic internal calibration.
Print	Initiates data transmit via serial I/O. Cycles through the Set Up Print Menu options.
Zero	Re-zeroes (tares) the Numeric Display. Exits Set Up Display and Set Up Print Menus to weighing display.

Calibration

After the warm-up period, the balance should be calibrated before using it. Calibration of the balance can be done with the internal weights or with your own external calibration weights. calibration should be performed, as necessary, to ensure accurate weighing.

Model	Internal Calibration Weights	Permissible External Calibration Weights
120	50g (2x)	20g, 50g, 100g, 120g
220	100g (2x)	50g, 100g, 150g, 200g
310	100g (2x)	50g, 100g, 200g, 300g
220D	150g/30g	100g, 180g, 200g (coarse range) 10g, 20g, 30g (fine range)

To calibrate with internal weights:

1. Remove any weight from the pan, close the doors and press the **Zero** key.

The display shows:

0.0000 **ZEROING**

then

0.0000 **GRAM**

2. Press the **Calibrate** key. The display shows:

The display shows:

----- **CAL**

then

----- **CAL-XXX-**

then

----- **ZEROING**

then

0.0000 **GRAM**

To calibrate with External weights:

1. Remove any weight from the pan, close the doors and press the **Zero** key.

The display shows:

0.0000 **ZEROING**

then

0.0000 **GRAM**

2. Place a permissible calibration weight on the pan and close the doors. (100 gram weight used for illustration).

The display shows:

100.0001 **GRAM**

3. Press the **Calibrate** key.

The display shows:

100.0000 **CAL-100-**

4. Remove the weight.

The display shows:

0.0000 **GRAM**

Balance Operation

The balance operation is designed for ease of use. Always make sure the balance is stable before each step of weighing. When the balance is stable, the unbalance indicator (**U**) will disappear from the right hand side of the Message Display. The balance is set to weigh in Grams. Other weighing units can only be set through the I/O port. (See page 18)

I. Default (Factory) Settings

The balance is preset at the factory to correspond to the most common user requirements. Listed below are the factory settings that are activated when the balance is initially turned on. (See the Set Up Menus Section IV)

Filter – FAST	Auto Zero – ON	Beeper – On, long
Range* – Manual	Print – Single	Baud – 300
Format – Type 1	Zero Print – ON	Parity – OFF
Interval – No Interval	Echo – ON	

* For Model 220D only.

II. Basic Weighing

To weigh **without** a container:

1. Close the doors of the weighing chamber.
2. Press the **Zero** key.

The display shows:

0.0000 **ZEROING**

then

0.0000 **GRAM**

3. Place the object or material to be weighed on the weighing pan.

The display shows:

123.0120 **GRAM** (For example)

4. Wait for the unstable indicator (U) to disappear and then take the weight reading.

Dual Range Weighing (Model 220D)

Pressing the Select key toggles between the fine and coarse ranges.

III. Zeroing (Taring)

All models have zeroing capability up to the capacity of the balance. By zeroing the container prior to adding a sample, the container's weight is stored in memory until the **Zero** key is pressed again.

To weigh **with** a container:

1. Close the doors of the weighing chamber.
2. Press the **Zero** key.

The display shows:

0.0000 **ZEROING**

then

0.0000 **GRAM**

3. Place the container to be zeroed on the weighing pan and close the doors.

The display shows:

23.3485 **GRAM** (For example)

4. Wait for the unstable indicator (U) to disappear and then press the Zero Key.

The display shows:

0.0000 **ZEROING**

then

0.0000 **GRAM**

5. Place the sample to be weighed into the container.

The display shows:

124.2234 **GRAM U** (For example)

6. Wait for the unstable indicator (U) to disappear, then take the weight reading.

IV. Set Up Menu

The balance menu structure consists of two Set Up Menus which allow the operator to configure the balance to your specific operating environment or weighing applications.

A. DISPLAY MENU

These parameters are related to how the weighing information is displayed. Parameters in the following:

- Current** Shows the current balance menu settings.
- Default** Sets the parameter to factory default settings.
- Filter** Optimizes response to vibrations by changing the update speed.
- Auto Zero** Automatic re-zero of the display when near zero.
- Beeper** Audible BEEP when keys are pressed.
- Range** **(On the models 220D only)**, selects method for range change.

•To check the Current configuration:

1. Press the **Setup** key. The display shows **Setup**.
2. Press the **Setup** key again. The display shows **Current**.
3. Press the **On/Off** key to select the **Current** option.
4. Press the **Select** key repeatedly to scroll through the current parameter selections.
5. Press the **Zero** key to return to the weighing mode.

•To set the Default (factory) settings:

1. Press the **Setup** key three (3) times. The display shows **Default**.
2. Press the **On/Off** key to select the **Default** settings. The display will return to the weighing mode.

•To set the Filter selection:

1. Press the **Setup** key four (4) times. The display shows **Filter**.
2. Press the **Select** key repeatedly to scroll through the three (3) selections:
 - **FT FAST** — (Filter Fast): Used under ideal conditions.
 - **F NORMAL** — (Filter Normal): Used under standard laboratory conditions.
 - **FT SLOW** — (Filter Slow): Used in areas with drafts and vibrations.
3. Press the **On/Off** key to select the desired Filter setting when it appears in the Message Display.
4. Press the **Setup** key to go to **Auto Zero**, or the **Zero** key to return to the weighing mode.

• **To set Auto Zero:**

1. Press the **Setup** key five (5) times. The display shows **A-Zero**.
2. Press the **Select** key repeatedly to scroll through the two (2) selections:
 - **A-Z ON** — (Auto Zero On): Automatically compensates for zero drift.
 - **A-Z OFF** — (Auto Zero Off): Turns off this correction feature.
3. Press the **On/Off** key to select the desired **Auto Zero** setting when it appears in the Message Display.
4. Press the **Setup** key to go to **Beeper** or the **Zero** key to return to the weighing mode.

• **To Change Beeper duration or to turn Off:**

1. Press the **Setup** key six (6) times. The display shows **Beeper**.
2. Press the **Select** key repeatedly to scroll through the three (3) selections:
 - **BP SHORT** — (Beeper Short): Sets audible tone to a short duration
 - **BP LONG** — (Beeper Long): Sets audible tone to a long duration
 - **BP OFF** — (Beeper Off): Sets audible tone to OFF.
3. Press the **On/Off** key to select the desired Beeper setting when it appears in the Message Display.
4. Press the **Setup** key to go to **Default** (or Range on model 220D) or the **Zero** key to return to the weighing mode.

• **To set method for Range change (model 220D only):**

1. Press the **Setup** key seven (7) times. The display shows Range.
2. Press the **Select** key repeatedly to scroll through the two (2) selections:
 - **AUTO R** — (Auto Range): After placing a sample weight on the pan that exceeds its' 31 gram capacity, the balance will automatically switch from fine to coarse range and tare out the sample. The display shows: 0.000. To return to fine range, remove weight and press the **Select** key
 - **MANUAL R** — (Manual Range): Keeps the balance from switching ranges when 31 grams is exceeded. The display shows: - - - - , when this occurs.
3. Press the **On/Off** key to select the desired Range setting when it appears in the Message Display.
4. Press the **Setup** key to go to **Default**, or the **Zero** key to return to the weighing mode.

B. PRINT MENU

These parameters are related to the set up of the serial interface for printer or computer interface applications:

- Print** Allows the balance to send data to a computer or printer when interfaced.
- Baud** Sets the transfer rate unit for serial data transmission in bits/second.
- Format** Sets the format for the type of I/O string.
- Zero Print** Permits balance to print at zero weight.
- Parity** Permits recognition of simple bit errors in data transmissions.
- Interval** Adapts data transfer to match receivers of different speeds.
- Echo** Permits verification of commands sent from a computer

• To set Print when the data string is sent:

1. Press the **Setup** Key. The display shows **Setup**.
2. Press the **Print** key. The display shows **Print**.
3. Press the **Select** key repeatedly to scroll through the three (3) selections:
 - **SINGLE** — Manually sends a single data string from the balance to printer or computer after stability.
 - **AFTR STB** — (After stability): Automatically sends a single data string after the display stabilizes.
 - **EACH DSP** — (Each Display): Continually sends signal through the serial port.
4. Press the **On/Off** key to select the desired Print setting when it appears in the Message Display.
5. The display will return to the weighing mode.

• To set the Baud rate:

1. Press the **Setup** key. The display shows **Setup**.
2. Press the **Print** key twice (2). The display shows **Baud**.
3. Press the **Select** key repeatedly to scroll through the six (6) selections:

110BD	1200BD
300BD	2400BD
600BD	4800BD

4. Press the **On/Off** key to select the desired Baud Rate when it appears in the Message Display.
5. The display will return to the weighing mode.

•**To set Format:**

1. Press the **Setup** key. The display shows **Setup**.
2. Press the **Print** key three (3) times. The display shows **Format**.
3. Press the **Select** key repeatedly to scroll through the five (5) selections: (See page 15 for Output Specifications)

TYPE 1	TYPE 3	TYPE 5
TYPE 2	TYPE 4	

4. Press the **On/Off** key to select the desired **Format** setting when it appears in the Message Display.
5. The display will return to the weighing mode.

•**To set Zero Print:**

1. Press the **Setup** key. The display shows **Setup**.
2. Press the **Print** key four (4) times. The display shows **ZPrint**.
3. Press the **Select** key repeatedly to scroll through the two (2) selections:

- **Z PR ON** — (Zero Print On): Prints when displays reads zero.
- **Z PR OFF** — (Zero Print Off): Does not prints when display reads zero.

4. Press the **On/Off** key to select the desired Zero Print setting when it appears in the Message Display.
5. The display will return to the weighing mode.

•**To set Parity:**

1. Press the **Setup** key. The display shows **Setup**.
2. Press the **Print** key five (5) times. The display shows **Parity**.
3. Press the **Select** key repeatedly to scroll through the three (3) selections:

- **PRTY OFF** — (Parity Off) - Turns parity off.
- **EVN PRTY** — (Even Parity) - Requires that the number of set bits must be even.
- **ODD PRTY** — (Odd Parity) -Requires that the number of set bits must be odd.

4. Press the **On/Off** key to select the desired **Parity** setting when it appears in the Message Display.
5. The display will return to the weighing mode.

• **To set Interval:**

1. Press the **Setup** key. The display shows **Setup**.
2. Press the **Print** key six (6) times. The display shows **Interval**.
3. Press the **Select** key repeatedly to scroll through the four (4) selections:

- **NO INTVL** — (No Interval): Transfers data automatically when any change or update occurs.
- **1/1 SEC**** — (Print 1/1 second): Transfers data once every second or up date.
- **1/10 SEC**** — (Print 1/10 seconds): Transfers data once every ten seconds.
- **1/60 SEC**** — (Print 1/60 seconds): Transfers data once every 60 seconds.

****to use this setting, the Each Display (EACH DSP) must first be selected. See page 14.**

4. Press the **On/Off** key to select the desired **Interval** setting when it appears in the Message Display.
5. The display will return to the weighing mode.

• **To set Echo:**

1. Press the **Setup** key. The display shows **Setup**.
2. Press the **Print** key seven (7) times. The display shows **Echo**.
3. Press the **Select** key repeatedly to scroll through the two (2) selections:

- **ECHO ON:** Balance echoes command back to computer.
- **ECHO OFF:** No echo from the balance.

4. Press the **On/Off** key to select the desired Echo setting when it appears in the Message Display.
5. The display will return to the weighing mode.

Interface Applications

TECHNICAL SPECIFICATIONS

I. Signal Definition

Your balance uses a RS-232C interface, with the default setting at 8 data bits, Parity Off and two (2) stop bits. The balance must receive one (1) or two (2) stop bits.

Data output:	Voltage output compatible with RS-232C levels, 300 ohm source resistance units and ± 10 volt swing minimum.
Data input:	Voltage input compatible with RS-232C levels, nominal 3000 ohms input impedance, ± 5 volt minimum swing, ± 20 volts maximum voltage.
Case ground:	Tied to earth ground through the power cord.
Signal ground:	Tied internally to the case ground.

II. I/O Specifications

The information transfer to and from the balance is accomplished with RS-232C serial compatible signals, using a choice of 8 data bits with Parity Off or 7 data bits with Parity On. The interface connector is a 9 pin male subminiature D plug.

It is important to determine interface requirements of equipment connected to the balance. The maximum recommended cable length is 25 feet. The information is transmitted at variable baud rates (from 110 to 4800) in standard ASCII format. See page 15 to change the baud rate.

Output Specifications

Output can be in one of the following forms:

	Stable	Unstable
Type 1	1 + 0000.0002	U + 0000.0002
Type 2	S + 0000.0003g	SD + 0000.0003g
Type 3	ST + 0000.0003	US + 000.0003
Type 4	+ 0000.0003	+ 000.0003
Type 5	+ 0000.0003 grams	+ 0000.0003 unstable

The output string is terminated with a <cr> <lf>.

III. I/O Connector

The mating connector is a 9 pin subminiature D socket, DE - 9S or equivalent. Pins used are as follows:

PIN #	FUNCTION
1	Case Ground
2	Data Input to balance
3	Data Output from balance
7	Signal Ground

IV. I/O Commands

Using I/O commands greatly expands the features and functions of your balance. If more information regarding the additional balance operations is needed, please contact our Customer Service Department. The following commands can be used to perform the functions. The commands will either be immediate or must be followed by carriage return, noted by **<cr>**. Do **not** press the **<cr>** unless it is included in the command. The symbol **#** designates a number following the command letter. It can be either a simple character or a string of characters. Except as noted, all commands are upper case.

Symbol	Description
<hr/> <i>Zero (Tare)</i>	
T	Immediately Zeroes (tares) balance to zero.
<hr/> <i>Calibrate command.</i>	
CAL<cr>	Allows the user to re-calibrate the balance using the allowed calibration weights. To use, place the calibration weight on the pan and send the calibrate command. The balance displays CALIBRATE (it may flash very quickly; the balance is able to complete the calibration without waiting), and then returns with the new calibration, if possible.
<hr/> <i>Parts Re-calibration.</i>	
P#<cr>	Allows the user to display a number to represent the weight on the pan. This can be used for parts counting, check weighing, or conversion to other weight functions not available with the F command. The number # can be any value from .000001 to 999999; however, care must be exercised when using this command to ensure accurate results.
<hr/> <i>Decimal Point Position.</i>	
D#	When in the COUNT function, the decimal point may be positioned as necessary. Position zero is

to the right of the least significant digit and position seven is to the left of the seventh digit. Seven digits plus the decimal place are available, but there may be some variations depending upon the unit's capacity.

Range Change. Selects Range on dual range models.

RL Changes Range to Lower capacity.
RH Changes Range to Higher capacity.

Function select.

F# The balance changes to the function selected by the function number (#). The # represents a hex number (0-9, B-D). It is not necessary to remove the weight or Zero (tare) when changing functions. The following table lists the Function number and function name.

0 - COUNT	5 - GRAIN	9 - DRAM
2 - DWT (Pennyweight)	6 - CARAT	B - MATH A
3 - OUNCE	7 - POUND	D - MILLI (Milligrams)
4 - OZT (Troy Ounce)	8 - SCRUP (Scruple)	

SU<cr> Set Up Accesses Set Up Menu and lists all options.

M# <cr> Enters balance Identification Name.

D Sets Default Values and Exits.

F# Function. Disables Functions 0-9, A-C.
 Example: F10 = GRAMS OFF

F#1 Enables Functions 0-9, A-C.
 Example: F11 - GRAMS ON

FI Function Initialization resets factory parameters.

I# Sets Filter integration speeds using a hex number (1-9, A-F) with 1 being fastest, 5 being the standard, and F being the slowest.

Auto-Zero. Sets Zero Reading Adjustment.

Z0 Disables Auto-Zero.

Z1 Enables Auto-Zero.

Beeper. Adjusts Beeper tone.

B0 Disables Beeper tone.

B1 Sets Beeper for short, soft tone.

B2 Sets Beeper for longer, louder tone.

Range. A Range Change on dual range models.

RA Sets Automatic Range change when lower capacity is exceeded.

RM Keeps balance in lower capacity range, operated Manually.

Exit.

X Exits and Saves settings that remain stored even if power is lost.

Set up print.

SUP Accesses Print Menu and lists all options.

Print. Sends data string to printer.

PØ Prints continuously.

P1 Single when Print Key is pressed after balance has stabilized.

P2 Prints after balance has stabilized.

Baud.

B# Sets Baud.
1 - 110 **3** - 600 **5** - 2400
2 - **300** **4** - 1200 **6** - 4800

Format.

F# Sets Format Type for I/O string with F1 being the standard setting.
1 - Type 1 **3** - Type 3 **5** - Type 5
2 - Type 2 **4** - Type 4

Zero Print. Sets Printer for Zero Printing.

ZØ Does not print at zero weight.

Z1 Prints at zero weight.

Parity. Sets Parity Parameters.

PTØ Turns OFF Parity.

PT1 Turns ON Parity.

PT2 Sets Parity at even.

PT3 Sets Parity at odd.

Interval. Sets time Intervals for printing.

IØ No Interval.

I # Prints at Intervals set by seconds up to once every 120 seconds.

Echo.

EØ Sets Echo OFF, half display.

E1 Sets Echo ON, full display

Print.

?# Prints the data # of times when the balance has stabilized. The # can be 1 to 9. If # is zero, then the balance does a continuous output of the data.
Example: If # = 4, then the balance (when stable) outputs its data string four times consecutively following the receipt of the command.

Balance Identification Number

- ID=#<CR>** Enters Balance Identification Number. Up to an eight digit number can be entered, but only the last six digits are shown on the Message Display.
- ID<CR>** Displays balance name and Identification number.

Statistical Analysis

- RC** Clears memory of any statistical data.
- RN#** Sample #. Assigns the first sample Number with additional samples being numbered consecutively. # can be from 1 to 1,000
- E** Enters sample from weighing pan and assigns sample number beginning with the number previously set.

Recall.

- R<cr>** Recalls all statistical data.

Multiple Tare Values.

- Z#S** Enters Multiple ZERO (Tare) Weight directly from the weighing pan.
- Z#=#<cr>** Enters a Multiple ZERO (Tare) Value. The first # is the number of the ZERO (tare) value which can be any digit between 0 and 9. The second # is the weight of the (tare) value which can be any 6 digit number plus a decimal point.
- Z#R** Recalls a multiple tare value that has been stored (0-9).

Math Function.

- A#<cr>** Enters the value for A.

OFF.

- OF** Turns Display OFF.
- ON** Turns Display ON.

Keyboard.

- KL** Set Up Menu lock.
- KU** Set Up Menu unlock.

Linearity Correction.

- W0** Internal Weight Off
- W1** Small Internal Weight On.
- W2** Large Internal Weight On.

Appendix A - Troubleshooting Guide

Display Shows	Cause	Remedy
 (Blank Screens)	On/Off key pressed to turn Off Displays. Power cord not connected. No power to outlet or improper voltage. Temporary fault	Press the On/Off key Connect cord. Check power supply and voltage switch. Disconnect and reconnect power cord. (Wait at least five seconds before reconnecting it.)
	Weight exceeds balance capacity.	Reduce weight.
	Pan not properly installed.	Install properly.
	Pan obstructed.	Move balance.
	Air movement around balance. Unstable location.	Move balance or alter filter. Make sample stationary.
	Balance operating error	Re-calibrate balance.
	Pan obstructed	Check level. Check pan placement.
	Calibration error	See Calibration Section.

NOTE

This unit contains no user serviceable parts. Please refer to the inside back cover of this manual for the phone number of your sales and service representative.

Cleaning Instructions

The exterior surfaces of the product may be cleaned with a mild water-based detergent and a lint-free nonabrasive cloth. Alternately, isopropyl alcohol may be used. Do not immerse the product in any liquid.

Appendix B - Initialization* and/or Linearity Correction

Warning: *The following procedure should only be performed by a qualified technician. Improper adjustment will effect the accuracy of readings.*

Equipment: Use two test weights of similar value to set linearity. Recommended weight is either 1/3 or 1/2 of the balance capacity. However, the exact value of either weight need not be known to do this procedure.

NOTE: *Pressing **Zero** during this procedure will exit linearity.*

1. Press the **Setup** key.
The display shows:
SET UP
2. Press the **Calibrate** key.
The display shows:
INITALZ
3. Press the **Select** key.
The display shows:
INIT

To **initialize** the balance, proceed to the next step. To perform the **linearity correction**, skip to Step #6.

4. Press the **On/Off** key.
The display shows:
INIT -XX-
5. Press the **Zero** key and return to normal operation.
The display shows:
ZEROING
6. Press the **Select** key again.
The display shows:
LIN
7. Press the **On/Off** key.
The display shows:
LIN 1
8. When the Numeric Display is stable, again press **On/Off** key.
The display shows:
LIN 2
9. Place the first test weight on the weighing pan.
10. When the Numeric Display is stable, again press **On/Off** key. The display shows:
LIN 3
11. Remove the first test weight and place the second test weight on the weighing pan.

12. When the Numeric Display is stable, again press **On/Off** key.
The display shows:
LIN 4
 13. Place both test weights on the weighing pan.
 14. When the Numeric Display is stable, again press the **On/Off** key and the Message. Display shows the Linearity Correction.
The display shows:
L number.
 15. Remove weights and press the **Zero** key to return to normal operations.
- * Initialization resets to the default parameters and erases all user data.

Appendix C - Glossary of Terms

Automatic Calibration	Automatic self-calibration of the balance.
Auto-Zero	Automatically correcting the zero display due to slow drift.
Baud Rate	The transfer rate unit for serial data transmission in bits/seconds between the computer and the printer.
Bit	Unit used for the information content of a communication.
Calibrate	Adapts the balance to a reference weight.
Capacity	The maximum mass that a balance is capable of weighing (the top end of the range scale). See Balance Specifications for capacity.
Coarse Range	Normal weighing range with ten time less readability than the fine range. (See Dual Range.)
Counting Pieces	A weighing application for determining the piece count of identical weighing samples.
Default	Preset parameters automatically in use when the balance is turned on.
Dual Range Balance	Balance with an auxiliary fine range that has a ten times greater readability than the coarse range.
Electronic Balance	Using one of several methods, an electronic balance senses a physical force when weight is placed on it and translates this force into digital form.
Factory Setting	Settings pre-selected in the menu by the manufacturer for normal applications and conditions. These can be changed by the user, but they also can be reset using the default Set Up Procedure.
Fine Range	Weighing range with ten times greater readability than the coarse range.
Interface	Connector with standardized data transfer between the balance and another component of the system (printer, computer).
Leveling	Horizontal aligning of the balance during installation.
Linearity	The amount a weight reading may deviate from a straight line between 0 grams and the maximum capacity of the balance. Within the capacity of the balance, weight readings will deviate a very small amount.
Menu	A series of settings from which the user can choose in order to the balance to a particular weighing situation
Parity	Checking information in the data transmission.

Readability	The smallest increment that a balance is able to display.
Resolution	The minimum discernible measurement. In other words, the minimum weight that must be added to the balance to enable the display.
Re-zero	Returns balance to zero setting using the Zero (Tare) key.
Set Up	The process of configuring the balance to operate in a certain way.
Tare Weight	Weight of a container or package that should not be taken into account in the weighing.
Taring	Compensating for a Tare Weight by setting the display of the balance at zero with the container or other packaging material on the weighing pan. Also called re-zeroing or zeroing.
Unstable Indicator	Symbol that is automatically displayed when the balance is not stable. It disappears when the balance becomes stable.
Weighing Mode	Used for the weighing operation. The weighing unit being used is displayed on the Message Display.

Appendix D - Accessories

ITEM	DENVER INSTRUMENT PART NO.
Lock-down Device	36800110.1
Printer 115V	901038.1
Printer 230V	901039.1
Printer Paper	901044.1
Printer Ribbon	901045.1
External Calibration Weights - available through your distributor.	

Part#	Input	Output all power supplies
700754.1	115V~, 50/60 hz, 25 watts	+30 V, $\bar{\bar{=}}$ 100mA
700754.3	230V~, 50/60 hz, 25 watts	+15 V, $\bar{\bar{=}}$ 100mA
700754.4	100V~, 50/60 hz, 25 watts	-15 V, $\bar{\bar{=}}$ 100mA
700754.7	220V~, 50/60 hz, 25 watts	+5 V, $\bar{\bar{=}}$ 1mA

The tolerance for AC input to the external transformer is $\pm 10\%$. A separate cord set is provided to connect the external transformer to the mains supply.

Note: Other main connector plug configurations may be available. Contact your sales representative.

Appendix E - Calibration Variance

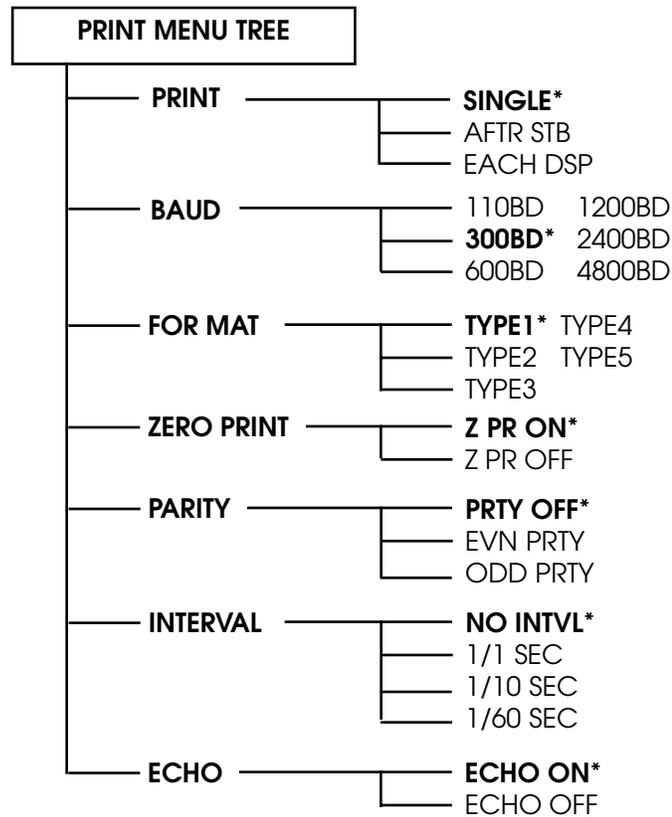
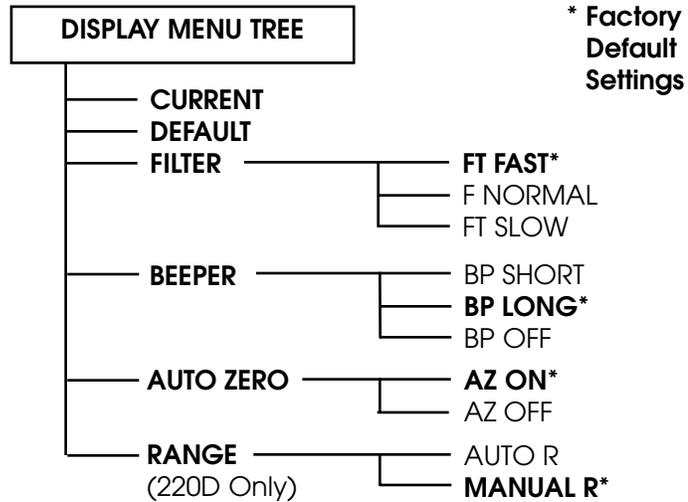
Corrections can be made to the calibration values to compensate for the difference between the actual weight being used and the permissible value. This feature allows the calibration value to match certified weights with correction value. A permissible weight value can be altered as much as ± 19.9 milligrams, and on the Model 220D low range, ± 1.99 milligrams.

NOTE: *Altering the calibration value for an external calibration weight which matches to that models internal weight, will change the internal calibration variance as set at the factory. The variance, which is established in the following procedure, will remain in memory until this procedure is performed again.*

To modify the calibration variance:

1. Press the **Calibrate** key.
The display shows:
CAL
2. Press repeatedly the **Setup** key until the calibration value to be modified is displayed.
The display shows: (100 grams used in this example.)
CAL-100-
3. Press the **On/Off** key to select the value.
The display shows:
V + 00.0
4. Press the **Setup** key repeatedly to display either the plus (+) or minus (-) sign.
5. Press the **On/Off** key when the desired sign is displayed. The display shows:
V - 00.0
6. Press the **Select** key repeatedly to change the first digit (digits cycles 0-1).
The display shows:
V-10.0
7. Press the **On/Off** key when the desired digit is displayed.
8. Press the **Select** key repeatedly when the desired digit is displayed.
9. Repeat steps 8 and 9 for each additional digit. The balance returns to the weighing display when the last digit has been selected with the **On/Off** key.

Appendix F – Menu Trees

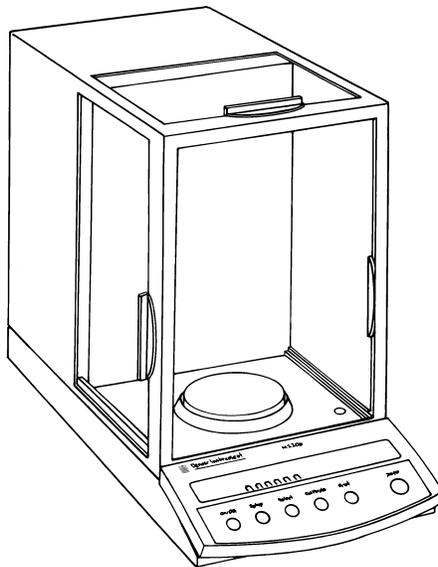


Warranty Instructions

1. Please return the prepaid, pre-addressed Purchase Registration Card to Denver Instrument Company promptly upon your purchase of the Denver Instrument product. the return of the card is not a condition precedent to warranty coverage.
2. If you have any questions about a Denver Instrument product, please call toll-free, **1-800-321-1135** (or FAX description of problem to (303) 423-4831) for technical assistance.
3. If it becomes necessary to return your Denver Instrument product for service, you must obtain a **"Return Authorization Number"**. Please pack the product securely in its original approved packing carton or other suitable container and include your Return Authorization Number on the shipping label and as a precaution also a note inside the box. Shipping charges must be fully prepaid.

Ship to:

Denver Instrument Company
6542 Fig Street
Arvada, Colorado 80004



Denver Instrument Company

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1-800-321-1135 • (303) 431-7255 • Fax (303) 423-4831
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