



Humboldt Marshall/TSR Loader

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Introduction

Applications

The HM-1327 Marshall Loader is designed specifically for running Marshall and TSR tests. Its modular design minimizes initial costs and allows easy upgrades. And with array of connectivity options, data presentation has never been easier.

Product Use

This product is intended for use only in accordance with the directions and specifications contained in this User Guide. Your HM-1327 has been configured according to your specifications.

The HM-1327 Marshall Loader has been designed for testing that complies with ASTM D6927 and D4123-82 and AASHTO T245, T283, BS 598-107, and applicable International standards.

Product Description

HM 1327 Marshall Loader has been designed to provide all the basic functions required to carry out Hot Mixed Asphalt (Marshall, TSR) testing in a single instrument. Your Compression Testing Frame/Master Loader arrives factory calibrated.

The HM 1327 Marshall Loader includes the following key features:

- Single speed motor of 2 in/min (or equivalent 50 mm/min).
- Support for 2 analogue transducer inputs from 0 to 100 mV (one load and one displacement transducer). Configuration and calibration capability is provided, and all-important data is stored in non-volatile memory for safe preservation.
- Complete Data logger capacity for the Marshall and TSR tests. All are fully configurable for automated Start, Stop and Logging conditions and can hold up to 1000 readings per test.
- A large LCD screen and 9 key membrane panel for easy presentation of results, parameter configuration, and machine control. To protect against operator misuse, key parameters can only be changed under pass code control.

- Plug and play Serial port (RS232) communications with Humboldt Material Testing Software (HMTS) for controlling and HM Download Software for downloading machine run test data.

In addition, the loader offers a large, backlit LCD display, a touch-sensitive keypad, a battery-backed real time clock, and auto-conversion of calibration and speed parameters between English and SI units.

General Warnings

Safety Warnings

Operators should take care to operate this machine under the maximum load restrictions. The machine is programmed at the factory to provide safety shutdown if the upper or lower maximum travel is exceeded as well as if the upper instrument calibration is exceeded.

Electrical Warnings

Typically, there is no reason for the operator to open the machine. However, if the customer's engineers attempt to change settings to the circuit board connected to the back panel, the machine must always be unplugged before this operation. Unplugging the internal connection to the back panel circuit board while the machine is under power will result in permanent damage to the circuit board.

Manufacturer's Rights and Responsibilities

Software Copyright

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Updated products

The manufacturer reserves the right to change or modify product design or construction without prior notice and without incurring any obligation to make such changes and modifications on products previously or subsequently sold.

Fitness for application

The manufacturer makes no recommendations or claims regarding fitness for applications other than the specific tests as defined in this User Guide.

Quick Start Guide

Startup Scenarios

1

If your HM-1327 was purchased with instrumentation for one specific test: the instrumentation has been installed and calibrated. There is no need to configure or calibrate the machine. It is ready for use.

DO NOT RECALIBRATE!

Refer to the Installation and Setup Section and then proceed to the section for the specific test desired.

2

If your HM-1327 was purchased with instrumentation for multiple tests: one of those tests is ready for use and the additional tests may or may not require the mounting of a different transducer than the one that is currently mounted. However all instrumentation shipped with your unit is calibrated and assigned specific input channels for use. These input channels are marked on the corresponding instrumentation. Unless it is required by your QC/QA program, there is no need to configure or calibrate the machine. It is ready for use.

DO NOT RECALIBRATE!

Refer to the Installation and Setup Section and then proceed to the section for the specific test desired.

3

If your HM-1327 was purchased without instrumentation for specific tests: you will need to acquire, check compatibility, mount and calibrate your instrumentation for use with the HM-1327.

Refer to the Installation and Setup Section to make sure if your instrumentation is compatible with the HM-1327. You will need to calibrate your instrumentation, please refer to configuration and calibration instructions. You can then proceed to the Section for the specific test desired.

Installation and Set-up

Unpacking

Initial inspection should include checking for physical damage during shipping and obvious external damage to the product.

Package contents are defined by your packing list. Each Marshall Loader is configured according to customer specifications. In your inspection, make certain that the contents of your shipment match the documentation provided by your packing list.

Place unit on a flat smooth surface and use leveling feet (supplied) and a bubble level to ensure that the unit is level side-to-side and back-to-front.

Electrical Connections

The HM-1327 is equipped with an internal, digital, switching power supply, which allows it to be used with most power configurations throughout the world. The unit is supplied with an IEC electrical cord with a standard 110V plug.

The HM-1327 arrives ready for operation. Attach the supplied IEC electrical cord to the machine and plug into a standard wall receptacle for use in the United States.

For locations other than the U.S., replace the supplied electrical cord with an IEC cord with the correct plug for your application. The supplied cord can also be used by cutting the standard plug from the cord and attaching the correct plug.

Instrument Inputs (load cell/transducer connections)

The HM-1327 has 2 instrumentation inputs located on the back panel to accommodate load cell/transducer connections. This feature allows you to set up and calibrate up to 2 different instruments, which the unit can quickly switch between for those needing to do multiple types of tests.

If you purchased load cells/transducers with your unit, they will either be mounted and calibrated, or in the case of multiple load cells/transducers, will be calibrated but not mounted. Additional load cells/transducers will be marked to indicate what input channel was used in the calibration; and, these load cells/transducers should be connected to the indicated inputs.

Third-party load cells/transducers, which are compatible, can also be used with the HM-1327. Compatible units will have an excitation voltage of 0-10 volts and an output of 0-100 millivolts. Prior to use all third-party instrumentation must be configured and calibrated for use. Please refer to the Configuration and Calibration sections of this manual.

If you are using third-party cables for load cells/transducers connections, make sure they are wired to be compatible with the HM-1327. Consult Figure #1 for a compatible reference wiring diagram. Plugs to connect third-party instrumentation to the Humboldt HM-1327 are available, order part HM-000474.

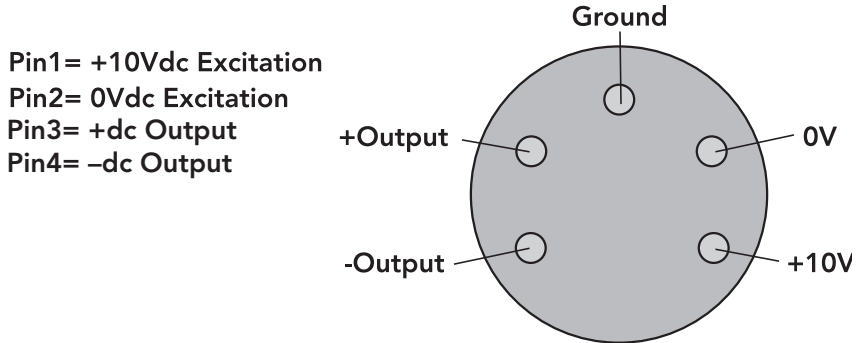


Figure 1. Compatibility wiring diagram for 3rd party cables

Mounting Load Cells and Transducers

If you purchased your HM-1327 with instrumentation, one of the load cell/transducer setups should already be mounted. If you are using the machine for multiple tests or want to use instrumentation not included, including third-party instrumentation, the following photos can be used as a guide for load cells/transducers setup.



Figure 2. Marshall Setup



Figure 3. TSR/Soil Cement Setup

Computer Connection

Single Device Connection

The HM-1327 can be connected to a PC computer to take advantage of Humboldt's HMTS software capabilities, conduct real time data logging and enhanced report generation, or with the HM Download Software to download tests performed directly on the device. This is accomplished via the RS-232 port on the back panel of the machine (refer to Figures 7 & 8.). Use a RS-232 cable (supplied) and attach it between the computer's RS-232 port and the HM-1327.

The minimum compatible computer configuration is a PC with Pentium III 800 MHz processor, 512 MB of RAM and a 40GB hard drive. Windows 2000 or XP with SP2 or later.

Analog Device Connection

The HM-1327 can be set up to output directly to a chart recorder to provide a hard copy printout of test results. To accomplish this, connect your chart recorder via cable attached to the HM-1327's Analogue port on the back panel (see Figure 7).

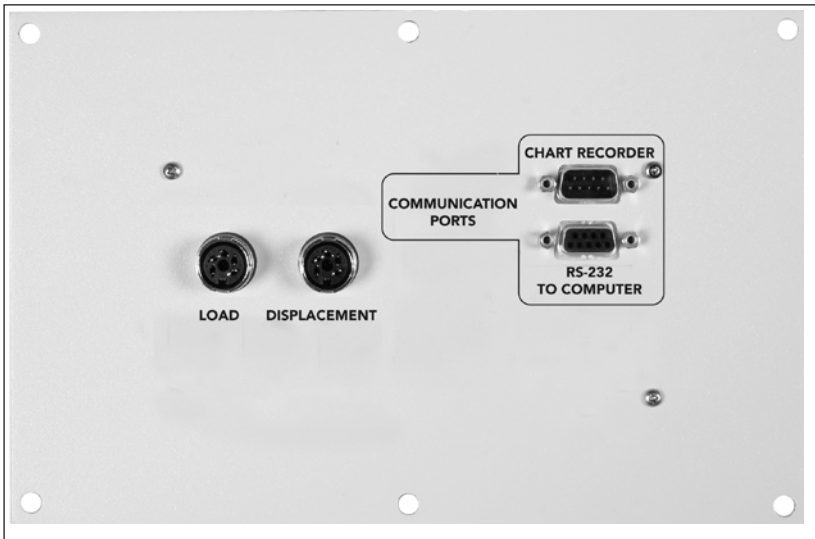
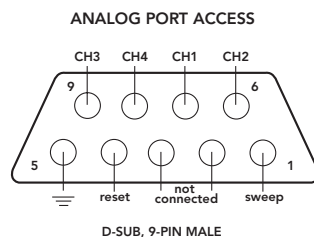


Figure 7. Rear panel of HM-1327 showing Chart Recorder Port, RS-232 Port and the two instrumentation channel inputs.

Cable configuration for analogue port access.

Pins 1, 2, 3 & 4
(Reserved for Humboldt Chart Recorder)



Operation

Power Switch

The Power Switch is located in the back panel on the rear of the machine above the electrical cord inlet. Also, located between the electrical cord inlet and the Power Switch is the Fuse Compartment. The HM-1327 uses a 10 amp fuse. To begin operation, press the Power Switch.

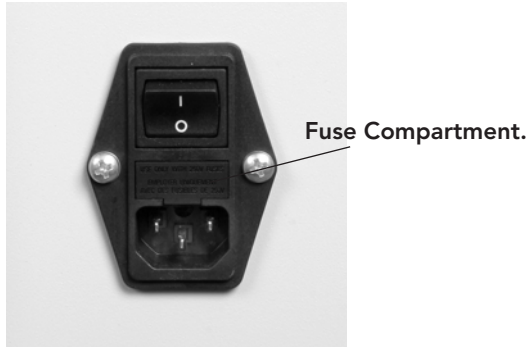


Figure 10. HM-1327 Power Switch, Electrical Cord Inlet and Fuse Compartment.

Key Functions

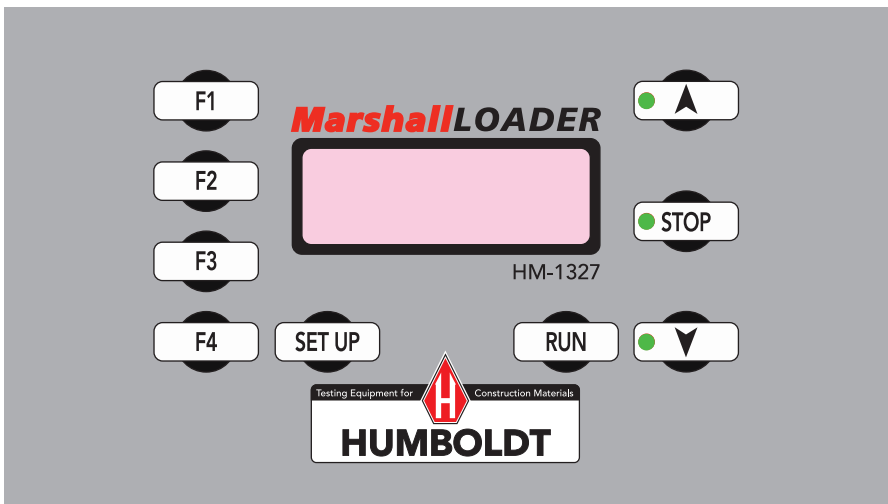


Figure 11. HM-1327 Front Control Panel

SET UP**Set Up Key**

Pushing the Set Up Key brings up the main set up screen from which you can run a test, review your last test, access the engineering set up menus and set the date, time, units, standards criteria. This key also is used to return to a previous screen.

UP**Up Key**

Pushing the Up Key allows you to move the platen up to facilitate testing. When the key is pushed the green light next to it is lit.

STOP**Stop Key**

Pushing the Stop Key stops platen movement. When the key is pushed the red light next to it is lit.

DOWN**Down Key**

Pushing the Down Key allows you to move the platen down. When the key is pushed the green light next to it is lit.

F1**Function Keys**

The four function keys are used to navigate through the HM-1327's menu-driven display. The function keys correspond with the command lines on the HM-1327's menu display. F1 corresponds with the first command line; F2, the second, etc. Command lines that are active in any display will be preceded by an (*). If no (*) is present, the corresponding function key is not active.

F2**F3****F4**

Humboldt HM-1327

STAB	=	1.2 lbs
FLOW	=	0.003 in

Humboldt HM-1327

STAB	T =	0.0 lbs
FLOW	T =	0.000 in

Except when viewing inputs values as above left, the function keys will perform a tare function to the displayed value and "T" will be displayed next to the input name to indicate that the value of the input has a tare (above right).

Set-up Functions

Set Date

To set the Date press  until you see this screen:

- * REVIEW LAST TEST
- * RUN TEST
- * MORE SETUP

Press  you will see this screen:

- * ENGINEERING SETUP
- * SENSOR LIMITS OFF
- * RAW_DATA
- * MORE SETUP

Press  you will see this screen:

- * RECALL CALIBRATION
- * CHANGE DEVICE ID
- * MORE SETUP

Press  you will see this screen:




- * DATE/UNIT/STANDARD
- * MANUFACTURERS INFO.

Press  (DATE/UNIT/STANDARD). You should see this screen:

- * CHANGE DATE
- * CHANGE TIME
- * UNIT = ENGLISH/METRIC
- * STANDARD = ASTM/BS

Press  (CHANGE DATE). You should see this screen:

* DATE = "MM/DD/YY"
 * INCREASE
 * DECREASE

Press  (DATE) to select the month/date/year. Press  (INCREASE) or Press  (DECREASE) to change the appropriate number.

To return to any prior screen you can always press 

Set Time

To set the Time press  until you see this screen:

* REVIEW LAST TEST
 * RUN TEST
 * MORE SETUP

Press  you will see this screen:

* ENGINEERING SETUP
 * SENSOR LIMITSOFF
 * RAW_DATA
 * MORE SETUP

Press  you will see this screen:

* RECALL CALIBRATION
 * CHANGE DEVICE ID
 * MORE SETUP

Press  you will see this screen:





DATE / UNIT / STANDARD
 * MANUFACTURERS INFO.

Press  (DATE/UNIT/STANDARD). You should see this screen:


* CHANGE DATE
 * CHANGE TIME
 * UNIT = ENGLISH/METRIC
 * STANDARD = ASTM/BS

Press  (CHANGE TIME). You should see this screen:

* TIME = "HH/MM/SS"
 * INCREASE
 * DECREASE

Press  (TIME) to select the HOURS/MINUTES/SECONDS. Press  (INCREASE), or Press  (DECREASE) to change the appropriate number. To return to any prior screen you can always press .

Set Units

To set the Units the HM-1327 will use to display results, press  until you see this screen:

* REVIEW LAST TEST
 * RUN TEST
 * MORE SETUP

Press  you will see this screen:

* ENGINEERING SETUP
 * SENSOR LIMITSOFF
 * RAW_DATA
 * MORE SETUP

Press  you will see this screen:

* RECALL CALIBRATION
 * CHANGE DEVICE ID
 * MORE SETUP

Press  you will see this screen:

- * DATE/UNIT/STANDARD
- * MANUFACTURES INFO

Press  (DATE/UNIT/STANDARD). You should see this screen:


- * CHANGE DATE
- * CHANGE TIME
- * UNIT = ENGLISH/METRIC
- * STANDARD = ASTM/BS

Press  (units) to toggle between English and Metric Units.

Select the standard desired—the flashing standard is the active choice.

To return to any prior screen you can always press 

Set Standards

To set the Standards the HM-1327 will use, press  until you see this screen:

- * REVIEW LAST TEST
- * RUN TEST
- * MORE SETUP

Press  you will see this screen:

- * ENGINEERING SETUP
- * SENSOR LIMITSOFF
- * RAW_DATA
- * MORE SETUP

Press  you will see this screen:

- * RECALL CALIBRATION
- * CHANGE DEVICE ID
- * MORE SETUP

Press **F4** you will see this screen:

* DATE/UNIT/STANDARD
* MANUFACTURERS INFO.

Press **F3** (DATE/UNIT/STANDARD). You should see this screen:

* CHANGE DATE
* CHANGE TIME
* UNIT = ENGLISH/METRIC
* STANDARD = ASTM/BS

Press **F3** (STANDARD) to toggle between ASTM and BRITISH STANDARD.

Select the standard desired—the flashing standard is the active choice.

To return to any prior screen you can always press **SET UP**

Input Configuration

If you are adding new instrumentation, changing existing instrumentation or reconfiguring the HM-1327's input setup, you need to configure the input for use with the devices you have.

To configure a input, press **SET UP** You should see this screen:

* REVIEW LAST TEST
* RUN TEST
* MORE SETUP

Press **F4** you will see this screen:

* ENGINEERING SETUP
* SENSOR LIMITSOFF
* RAW_DATA
* MORE SETUP

Press **F1** (ENGINEERING SETUP). You should see this screen:

* CONFIGURATION
* CALIBRATION

Press **F1** (CONFIGURATION) You will be asked for a password, enter:
F2 **F2** **F2** **F3** **F4** You should see this screen:

CONFIGURATION screen
 * SELECT INPUT "CHI"
 * CONFIGURE CHANNEL

Press **F2** (SELECT INPUT) to scroll through and choose the input you wish to configure. Once you have selected a channel press **F3** (CONFIGURE INPUT). You should see this screen:

INPUT 1	CONFIGURE
NAME	= STAB
SENSOR MIN	= 0
*SENSOR MAX	= 10000

Configuring Input

The Configuration screen will allow us to configure the Sensor Max value. The sensor max value contains the formatting of this input as well as the maximum value we will be calibrating to.

Sensor Min

The Sensor Zero (SENSOR MIN) is not configurable and is set at 0.

Sensor Max

Press **F4** (SENSOR MAX) to set the Sensor Maximum value.

You should see this screen:

```

"CH1" MAX SETUP
* SENSOR MAX = "000000"
* INCREASE
* DECREASE
  
```

Press **F2** (SENSOR MAX) to move between the numbers. Keep pressing **F2** until the digit you want to change is flashing. Once you have selected the number you want to change, press **F3** (INCREASE) or **F4** (DECREASE) to change the number to the desired value. Below is a configuration chart for Humboldt instrumentation. These are the numbers that correspond to each Humboldt sensors.

Load Cell	Part#	English Max (lbf)	Metric Max (kN)
10,000 lb. (50kN)	HM-2300.100	010000	050.00
5,000 lb. (25kN)	HM-2300.050	005000	025.00
2,000 lb. (10kN)	HM-2300.020	2000.0	10.000
1,000 lb. (5kN)	HM-2300.010	1000.0	05.000
500 lb. (2.5kN)	HM-2300.005	0500.0	02.500
LVDT Transducer	Part#	English Max (in.)	Metric Max (mm)
0.4" (10.0mm)	HM-2310.04	0.4000	10.000
1.0" (25.4mm)	HM-2310.10	01.000	25.000
2.0" (50.8mm)	HM-2310.20	02.000	50.000
Pore Pressure	Part#	English Max (psi)	Metric Max (kPa)
100psi (1000kPa)	HM-2300.100	0100.0	001000

To return to any prior screen you can always press **SET UP**

Calibration

This menu item is used to calibrate or verify the calibration of the HM-1327.

WARNING: Calibration should only be performed by trained personnel with proper, certified equipment. The HM-1327 and its instrumentation should be calibrated once a year or as the need arises.

Input Calibration

To calibrate a input, press  You should see this screen:

* REVIEW LAST TEST
* RUN TEST
* MORE SETUP

Press  you will see this screen:

* ENGINEERING SETUP
* SENSOR LIMITSOFF
* RAW_DATA
* MORE SETUP

Press  (ENGINEERING SETUP). You should see this screen:

* CONFIGURATION
* CALIBRATION

Press  (CALIBRATION) You will be asked for a password, enter:

     You should see this screen:

CALIBRATION screen
* SELECT INPUT 1
* CALIBRATION INPUT
* CLEAR CALIBRATION

Press **F2** (SELECT INPUT) to scroll through and choose the channel you wish to calibrate. Once you have chosen the desired channel you wish to calibrate press **F4** (CLEAR CALIBRATION).

WARNING: IF YOU CLEAR A CALIBRATION IT IS LOST FOREVER!

After the calibration has been cleared, Press **F3** (CALIBRATE CHANNEL)
You should see this screen:

INPUT CALIBRATION	
* SET GAIN	1
* SET SENSOR MIN	123
* SET SENSOR MAX	12345

Press **F2** (SET GAIN). With the instrument you wish to calibrate mounted to a calibration frame attached to the HM-1327, record the sensor min value with no load on the instrument (X divisions).

Next, apply the full engineering load value to instrument on the calibration frame and again, record the sensor min reading (X divisions). Subtract the two values. This value should be a number larger than the sensor maximum rating.

If not, you need to increase the gain to compensate for the difference. Press **F2** (SET GAIN) and repeat until the difference between the two values is more than the maximum sensor rating.

EXAMPLE:

If you are calibrating a 10,000 lb. load cell, you need a difference value of at least 10,000 divisions. If you register a min value reading of 450 divisions with no load on the sensor and your min is 8450 divisions at full load on the instrument, your difference value will be 8000 divisions. ($8450 - 450 = 8000$). To increase the gain press **F2** (SET GAIN) until you have more than 10,000 divisions.

Once the gain has been set, the zero point needs to be set. To set the zero point, apply the 0% force to the sensor and press **F3** (SET SENSOR MIN). Now apply the 100% force to the sensor and press **F4** (SET SENSOR MAX).

To return to any prior screen you can always press **SET UP**


On the next page is an Instrumentation calibration chart listing max divisions, as well as typical gain factors needed in calibrating each instrument type.

Humboldt Calibration Instrumentation Chart

Load Cell	Part#	English (divisions)	Gain	Metric (divisions)	Gain
10,000 lb. (50kN)	HM-2300.100	10000	4	5000	4
5,000 lb. (25kN)	HM-2300.050	5000	2	2500	4
2,000 lb. (10kN)	HM-2300.020	20000	8	10000	4
1,000 lb. (5kN)	HM-2300.010	10000	4	5000	4
500 lb. (2.5kN)	HM-2300.005	5000	4	2500	4
LVDT Transducer					
0.4" (10.0mm)	HM-2310.04	4000	2	10000	2
1.0" (25.4mm)	HM-2310.10	1000	1	25000	2
2.0" (50.8mm)	HM-2310.20	2000	1	50000	4
Pore Pressure					
100psi (1000kPa)	HM-2300.100	1000	1	1000	1

Device ID

Factory set device ID to 1, if multiple units are connect to a single computer a unique device ID for each unit has to be establish for the computer to recognize the correct instrumentation and the correct motors.

To set the Device ID the HM-1327 will use, press  until you see this screen:

* REVIEW LAST TEST
* RUN TEST
* MORE SETUP

Press  you will see this screen:




* ENGINEERING SETUP
* SENSOR LIMITS OFF
* RAW_DATA
* MORE SETUP

Press  you will see this screen:

* RECALL CALIBRATION
* CHANGE DEVICE ID

Press  (CHANGE DEVICE ID). You should see this screen:

DEVICE ID = 1
* INCREASE
* DECREASE

Press  to increase the ID number or press  to decrease the number. Once the ID has been changed, press  to go back to previous menu. Note: Up to 16 devices can be connected to a single computer.

SENSOR LIMITS


Sensor upper limits can be set to ON or OFF. If the Sensor's Upper limit is set to ON and the motor/test is in progress, when the sensor reaches its upper limit, the motor/test will stop and a warning message will be displayed. In addition, if a sensor has been unplugged from the instrumentation back panel, the same warning message will be displayed.

RAW_DATA

RAW-DATA refers to the digital output of the sensors prior to apply the calibration factor and conversion into engineering units.

Standard Tests

Marshall


Center the breaking head on the platen. Press the  button to raise the head to the start position, close to the load cell. There should be about a 1/8" (3.000mm) gap between the breaking head and the load cell.

Press  You should see this screen:


* REVIEW LAST TEST
* RUN TEST
* MORE SETUP

Press  (RUN TEST) You should see this screen:

* MARSHALL TEST
* TSR TEST

Press  (MARSHALL TEST) This will automatically start the platen to rise at a rate of 2.0 in/min (50.8mm/min). You should see this screen:

MARSHALL TEST # of readings
STAB "##"
FLOW "##"
* END TEST

The display above will give constant real-time readings of the stability and flow measurements during the test cycle. You can end the test at any time by pressing . This will stop all data collection and reverse the platen to its down position.

As the breaking head makes contact with the load cell, the HM-1327 will automatically zero the stability and flow readings and begin to take readings every 0.1 seconds. Once the test has reached peak stability (i.e. peak load) and fallen back 2%, data will cease being collected and the platen will begin to reverse and move back to the down position. As the platen moves down, the screen will display the peak values.

You should see this screen:

```

STAB PEAK          "##"
FLOW PEAK          "##"
REVIEW DATA
* RUN MARSHALL TEST
  
```

Peak values are shown on the first two lines. To review all the data, press **F3** (REVIEW DATA). You should see this screen:

```

* PRINT DATA
* SCROLL DATA
* RUN MARSHALL TEST
  
```

Pressing **F1** (PRINT DATA) will print the data to a printer or save a file in ASCII mode to your computer using Humboldt Material testing Software (HMTS) or Windows Hyper terminal. Once the data has been printed or transferred, you can begin another test after you have loaded another sample and raised the head to the start position, close to the load cell, by pressing **F4** (RUN MARSHALL TEST).

If you don't have a printer or a computer connected to the HM-1327, you can press **F3** (SCROLL DATA) to scroll the data. You should see this screen:

```

STAB              "READING"
FLOW              "READING"
* NEXT
* LAST           Time = 0.0 sec
  
```

Using the **F3** (NEXT) key to scroll through the readings and the **F4** (LAST) key to view the last reading taken.

To return to any prior screen you can always press **SET UP**.

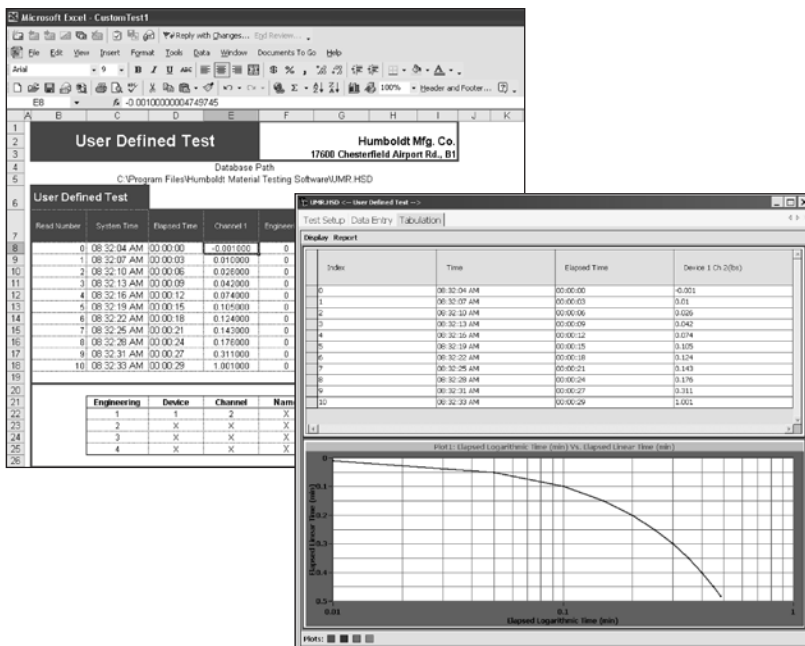
TSR

See User-Defined Unconfined Compression, without the displacement transducer selected in the test configuration

Software

The HM-1327 comes with Humboldt's HMTS data collection software. This software can be used to collect data from tests by creating user-defined test parameters (start/stop). The resulting data can then be opened in Microsoft Excel to view the data collected, as well as create a simple table and graph.

Optional pre-defined reporting software modules and templates are available for specific tests, such as CBR, Triaxial, etc. These modules provide more control over start and stop conditions for specific tests, as well as provide extended reporting capabilities. Contact Humboldt for more information.



Table/graph and Excel output of user-defined test generated from software included.

HM Download Software

This software is designed to be used to download test that have been run directly on the HM-1327. It downloads and saves tests directly to a PC. Custom graphs and reports can be generated and exported into multiple formats.

Specifications

Applicable Standards

Covers: Marshall Tests

ASTM: D6927 and D4123-82

AASHTO:T245 and T283

BS 598: Part 107

Mechanical Specifications

Dimensions (l x w x h)	17 x 22 x 42 inch (432 x 559 x 1295mm)
Platen Travel	3 inches (76mm) Max.
Net Weight	206 lbs. (94kg)
Shipping Weight	300 lbs. (660kg)
Speed Range	2 inches/min (51mm/min)
Load capacity	11000 lbs. (50 kN)
Vertical clearance	24 inch (610mm) Max.
Horizontal clearance	11.5 inch (292mm)

Electrical /Electronics Specifications

Voltage	110/220 VAC 50/60HZ
Current	8.5 Amps
Analog to digital converter	16 Bit
Data storage	4000 Reading
Data collection rate	100 ms
Computer port	RS232

Test Accessories

HM-3005—Marshall Stability Accessory Set:

HM-2300.100	Load cell 10,000 lb. (50 kN)
HM-2310.10	Displacement Transducer 1.0”(25mm)
HM-4178BRT	Displacement Transducer Bracket
HM-3005SW	Marshall Reporting Software

Support

Phone support is available for general operating questions and trouble shooting problems between 8am and 5pm Eastern Time. Please call:

1.800.537.4183

1.919.832.6509 or fax: 1.919.833.5283

support@humboldtmg.com

For sales and sales-related information, such as available accessories, general sales questions, pricing, please call:

1.800.544.7220

1.708.456.6300 or fax: 1.708.456.0137

hmc@humboldtmg.com

Hidden Functions

The following are functions that are possible if needed, to access them, please contact support at the numbers or email address listed above.

1. **System reset**

Reset available in case of serious problem in system memory. This will cancel all data in memory calibration/configuration of all input channels.

NOTES

NOTES

Humboldt Mfg. Co.

875 Tollgate Road
Elgin, Illinois 60123 U.S.A.

U.S.A. Toll Free: 1.800.544.7220

Voice: 1.708.456.6300

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Email: hmc@humboldtmfg.com

Testing Equipment for



Construction Materials

HUMBOLDT

www.humboldtmfg.com