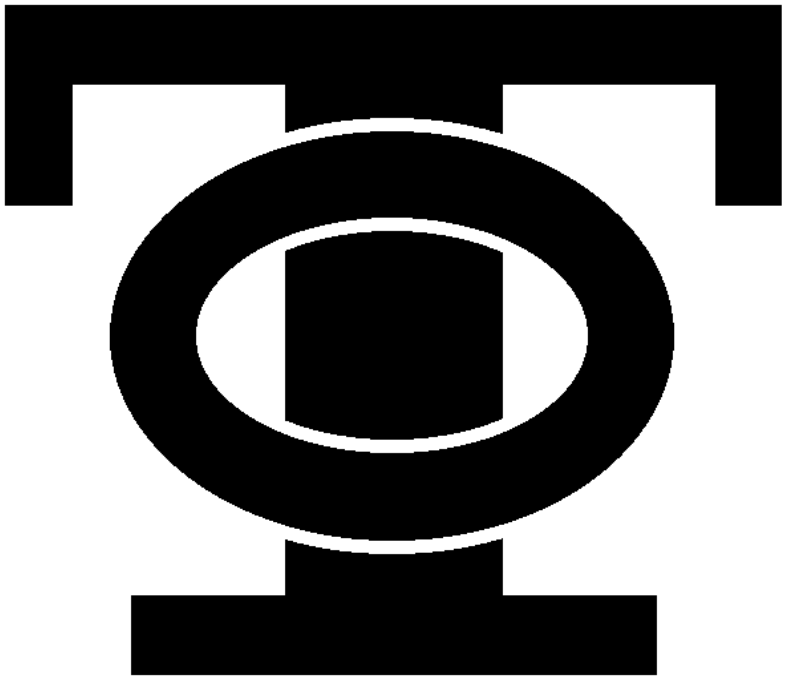
MP600 Extrusion Plastometer

(Melt Indexer)



SYSTEM INSTALLATION AND OPERATION MANUAL.

Part # 02001560

Revision 5b

Date: 15 October 2010

TINIUS OLSEN TESTING MACHINE COMPANY
1065 Easton Road
P.O. Box 1009
Horsham, Pennsylvania 19044-8009 USA

TINIUS OLSEN
Testing Machine Company

MP600 Extrusion Plastometer

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Additional Accessories & Instructions Provided:

TINIUS OLSEN TESTING MACHINE COMPANY

FACTORY CERTIFICATE

This is to certify that the Tinius Olsen MP600 Extrusion Plastometer (Melt Indexer) and Accessories are checked prior to shipment and found to conform to the applicable portions of ASTM D 1238 and ISO 1133 Test Methods (when used with the appropriate options).

The verification devices are traceable to the National Institute of Standards and Technology and are listed below.

The optional thermometers are manufactured and calibrated to standards traceable to the International System of Units (SI) through NIST.

The orifices are checked with orifice gauges manufactured and calibrated with Calibration Standards traceable to the International System of Units (SI) through NIST.

Piston feet, rods and collars are checked using devices verified with Gage Blocks traceable to the International System of Units (SI) through NIST.

The weights are calibrated with Weights traceable to the International System of Units (SI) through NIST.

Note: The instrument, and especially components subject to wear during normal use, should be inspected periodically to insure continued conformance to ASTM D 1238 and ISO 1133.

Tinius Olsen Testing Machine Co., Inc.

Declaration of Conformity

We hereby certify that the following machinery complies with all the relevant Essential Health & Safety Requirements of the Machinery Directive (89/392/EEC), Low Voltage Directive (73/23/EEC), Electromagnetic Compatibility Directive (89/336/EEC), CE Marking Directive (93/68/EEC) and the National Laws and Regulations adopting these directives.

Business Name: Tinius Olsen Testing Machine Co., Inc.

Address: 1065 Easton Road
Willow Grove, Pennsylvania 19090
USA

Machinery Name: Extrusion Plastometer

Model: MP 600

General Description: Extrusion Plastometer designed to measure the melt flow rate of thermoplastics. The unit is designed to perform tests in accordance with ASTM D 1238, ISO 1133, BS 2782, DIN 53735, and other similar standards.

Applied Standards:

EN 61010-1
EN 61010-2
EN 61326

Being the responsible person appointed by the manufacturer.

Name: Earl A. Ruth **Signature:** Earl A. Ruth

Title: Director of Technology **Date:** June 18, 2001

CAUTIONS

CAUTION: Read the instruction manual thoroughly before attempting to use this equipment.

CAUTION: This instrument has been designed to determine the melt flow index property and other thermal processing properties of polymers. It is not intended for any other use. Any attempt to use this instrument in any fashion other than its intended use may damage the machine and/or harm the operator.

CAUTION: Do not use a sharp object to press any of the keys on the Model MP600 Controller, as this will puncture the membrane cover.

CAUTION: The tools used on the machine may get hot during use.

CAUTION: Thermometers contain mercury! When a thermometer is being used, extreme care should be taken not to heat the thermometer bulb too quickly or to exceed the temperature range of the thermometer, as the internal pressure will cause it to break.

CAUTION: Always check to make sure that the “Set Temperature” does not exceed the range of the glass reference thermometer if one is being used.

CAUTION: This machine is designed for indoor use only. It shall be used in a controlled environment (temperature range 5^{o}C to 40^{o}C, maximum R.H. of 80% at 31^{o}C). Maximum operating altitude is 3,200 meters. The area that it is located shall be free from vibrations.

CAUTION: Prior to shipment, the cylinder of the machine is coated with oil to prevent rust from forming. When the machine is first turned on, it is normal for the machine to “smoke” as the cylinder comes to temperature and the oil residue burns off. To reduce the amount of smoke that forms, clean the cylinder thoroughly before turning the machine on. Be sure that a ventilation system is operating at this time.

CAUTION: In some instances an exhaust system may be used to remove the excess heat and/or odors released during a test. These instructions do not address all of the safety concerns related to ventilation of fumes produced during normal testing operations.

CAUTION: The machine is heavy and care must be used when lifting the machine from the box or moving the machine. Always lift the machine by the base plate. Never pick the machine up by the Motorized Weight Lowering Device (MWLD-600) or by the furnace assembly.

Note that Cautions are continued on the next page.

CAUTION: Over adjusting the leveling foot can run the stud (Item 28) out of the foot or out of the base of the machine, which would require the removal of the base pan to correct.

CAUTION: Possible pinch points associated with the weight-lowering device exist. One is between the lift cap and the lifter top at the bottom most position of the platform and the second exists between the weight lowering platform and the piston rod.

CAUTION: The surfaces of the furnace assembly can be extremely hot when the machine is in operation!

CAUTION: Protective gloves should be worn when operating the machine with a plastic that has a high flow rate.

WARRANTY

The Tinius Olsen Testing Machine Company guarantees its products to be free from defects in material and workmanship under normal use and service for which they were intended, and under condition of proper maintenance for one year from date of receipt of equipment.

CALIBRATION

Tinius Olsen certifies that this instrument meets all dimensional, temperature control and performance specifications of ASTM D 1238. That specification recommends verification of calibration at least once a year. Contact Tinius Olsen's Field Service Department at (215) 675-7100 or contact your local Sales & Service Representative to schedule an appointment.

1 Section 1 – Introduction

1.1 Basic Unit

The Tinius Olsen Extrusion Plastometer with microprocessor-based Model MP600 Controller/Timer is used for measuring the flow rates of thermoplastics. The unit is a dead-weight piston Plastometer with which the extrusion rate of thermoplastic materials through an orifice of specified dimensions is determined under prescribed conditions of temperature and pressure in accordance with ASTM Standard Test Method D 1238. With minor procedural modifications, the MP600 can also meet ISO 1133, BS 2782, DIN 53735, JIS K7210 and other similar standards.

The standard MP600 can be used for testing in accordance with other ASTM methods; including D 2581, D 3364, D 4203, D 4507 and D 4550 (a special orifice is required for D 3364). Other methods, such as D 2116, D 3159, D 3275 and D 3307, require the optional corrosion resistant cylinder, orifice and piston foot.

The basic Plastometer (Melt Indexer), as described, may be used for Procedure A - Manual Operation. With the addition of optional accessories, Procedure B - Automatically Timed Flow Rate Measurement may be performed. The purchaser can easily upgrade the basic model.

⚠ CAUTION: This instrument has been designed to determine the melt flow index property and other thermal processing properties of polymers. It is not intended for any other use. Any attempt to use this instrument in any fashion other than its intended use may damage the machine and/or harm the operator.

1.2 Single Unit Construction

Sturdy modular design includes housing for temperature and timing controls, rugged uprights for supporting the hardened steel test cylinder, which is heated by a precision dual zone, controlled band heater, is insulated and jacketed in an aluminum housing. A tool rack is provided for convenient access to frequently used operating tools. The unit is semi-portable and contains provisions for leveling the cylinder.

1.3 Precision Temperature Sensors

Two platinum RTD Probes sense the cylinder temperature, sending signals to the MP600 Controller, which regulates the temperature of the upper and lower portions of the cylinder to within ± 0.1℃. The te mperature of the lower portion of the cylinder is displayed as the Actual Temperature (AT).

1.4 Precision Dual Zone Band Heater

300 Watts (nominal) -- contains a special concentric heating element, which is form-fitted and designed to uniformly maintain the required temperature. The heater and furnace assembly is rated for use up to 450℃.

1.5 Machine Dimensions:

(Standard Unit) 51 cm (20 inches) wide by 38 cm (15 inches) deep and 58 cm (24 inches) in height.
(Motorized Unit) 51 cm (20 inches) wide by 38 cm (15 inches) deep and 95 cm (38 inches) in height.

Net Weight:
The (Standard Unit) approximately 18 kilograms (40 pounds), not including any weights or options.

The (Motorized Unit) approximately 32 kilograms (70 pounds), not including any weights or options.

1.6 Electrical Requirements:

The basic Model MP600 Extrusion Plastometer is arranged for 115 Volts ±10% or 220 Volts ±10%, 50/60 Hz, Single Phase. Check machine label for actual electrical requirements.

115 Volt Units

Input Power	500 W
Voltage	115 VAC +/- 10%
Current	4.5A
Frequency	50/60HZ
Phase	Single
Line Fuse	5A 250V MDL/3AG

220 Volt Units

Input Power	500 W
Voltage	220 VAC +/10%
Current	4.5A
Frequency	50/60HZ
Phase	Single
Line Fuse	5A, 250V GDC/213

Note: The line filter used in the Power Entry Module typically has a leakage current of 0.25 mA to ground at 115 VAC, and 0.5 mA at 220 VAC. This current leakage may cause a Ground Fault Interrupt (GFI) receptacle to trip, therefore a GFI is not recommended.

2 Section 2 - Model MP600 Digital Controller/Timer

2.1 Introduction

The MP600 microprocessor-based Controller/Timer is fully interactive with the operator. It features a membrane keyboard; high visibility vacuum fluorescent display; serial communications port; test parameter storage with power-up in last used parameters; calibration information stored in battery-backed-up RAM; indicating LED's; operating controls and other related features.

2.1.1 Two-Zone Temperature Control

The temperature controller features two-zone proportional, integral, and derivative (PID) control, assuring spatial temperature variations of less than ± 0.25℃ along the test area of the cylinder. Temperatures up to 450℃ are controlled and displayed to ± 0.1℃; utilizing two platinum RTD's embedded in the cylinder wall. The controller also has built-in temperature sensor failure. If an RTD opens or shorts out (or temperature control becomes erratic), power to the heater is interrupted and an error message is displayed.

2.1.2 Calibration Offsets

The "Calibration Offsets" are a correction factor for the small difference in temperature between the Actual Temperature (AT) displayed on the MP600 Controller and a NIST (National Institute of Standards and Technology) traceable temperature measuring device placed in the test area of the cylinder. In other words, the "Calibration Offset" value entered adjusts the displayed temperature to agree with the temperature standard in the cylinder.

Because of the wide range of temperatures that the MP600 Controller may be used, it may be necessary to enter Calibration Offsets for each test temperature (Set Temperature).

The actual cylinder temperature was determined at the factory using a NIST traceable RTD probe placed 10 mm above the upper face of the standard 8 mm (0.315") long orifice. The digital electronic temperature display is also NIST traceable. This procedure is described in the current version of ASTM D 1238.

For new machines shipped with optional thermometers, a MP600 Configuration/Calibration Settings Worksheet will be provided showing the Actual Cylinder Temperature, the Machine Displayed temperature, the Calibration Offset setting, and the Thermometer Reading (while inserted in the cylinder), along with the serial number of each thermometer ordered with the machine. By using the appropriate thermometer, the actual cylinder temperature can be indirectly monitored by comparing the actual thermometer reading with the thermometer reading and display temperature when the machine was calibrated. For new machines shipped without thermometers, an MP600 Configuration/Calibration Settings Worksheet will be provided for 190°, 250℃ and 300℃. There will not be any reference thermometer reading.

2.1.3 Multiple Data Determinations (Captures)

The MP600 gives the operator the ability to make up to 10 individual flow rate (melt index) determinations within a single sample charge when performing a test to ASTM Procedure B. While this feature is not required by ASTM D 1238, it can be useful for checking the consistency of results and in improving accuracy by isolating sources of error such as air bubbles and allowing the operator to eliminate obviously flawed data. The multiple capture feature may be used with any material, but it is most often used with materials that have flow rates greater than 10 g/10 minutes. A typical example of the test parameters used for a multi-capture test has been preprogrammed in Program #3 (see Table 11-2).

2.1.4 Built-in Timer

Timing functions up to 999 seconds are available for preheat timing, cut-off intervals, operating an automatic weight support and lowering device, as well as other optional features. Piston displacement timing is displayed in 0.01 second increments up to 1000 seconds and in 0.1 second increments from 1000 to 3600 seconds. An audible alarm can be activated which will prompt the operator to perform functions such as applying the load, cutting off the extrudate, etc.

2.1.5 Membrane Keyboard

CAUTION: Do not use a sharp object to press any of the keys on the Model MP600 Controller, as this will puncture the membrane cover.

The membrane keyboard allows the operator to communicate with the microprocessor in response to interactive prompts, which appear on the high-visibility vacuum fluorescent display. Up to 25 sets of testing parameters can be stored for recall or the necessary values can be entered at test time. The Parameters can be set up for conducting flow rate tests under both Procedure A (Manual Cut-off Procedure) and Procedure B (Automatic Timed Procedure).

2.1.5.1 **Display**

Four-line vacuum-florescent display for displaying software prompts and tests results.

2.1.5.2 **Numeric Key Pad**

Used for entering required numerical test data and for activating specific functions and features as required.

2.1.5.3 **Up (^) Key** (numeric key 9)

When pressed, energizes the Motorized Weight Lowering/Lifting Device (MWLD-600) to move upward.

2.1.5.4 **Down (v) Key** (numeric key 3)

When pressed, energizes the Motorized Weight Lowering/Lifting Device (MWLD-600) to move downward.

2.1.5.5 **Top (^^) Key** (numeric key 7)
Energizes the Motorized Weight Lowering/Lifting Device (MWLD-600) to move upward until its upper limit is reached or the STOP key is pressed.

2.1.5.6 **Bottom (vv) Key** (numeric key 1)
Energizes the Motorized Weight Lowering/Lifting Device (MWLD-600) to move downward until its lower limit is reached or the STOP key is pressed.

2.1.5.7 **Stop Key** (numeric key 4)
When pressed, stops the movement of the Motorized Weight Lowering/Lifting Device (MWLD-600)

2.1.5.8 **CLEAR**
This is used to delete erroneous data entries.

2.1.5.9 **EXIT**
This is used to leave the current screen when prompted.

2.1.5.10 **START**
This is used to start tests.

2.1.5.11 **ENTER**
Used to confirm and store data entry.

2.1.5.12 **Heater LED Indicators**
Flashing indicators designates top & bottom heater operation.

2.1.5.13 **Capture LED Indicator**
When this indicator is lit, the PPDT-600 Automatic Timing Switch is in operation.

2.1.5.14 **Power On/Off Switch**
In the “ON” position for normal operation. The “OFF” position removes power to the MP 600 Controller and accessories.

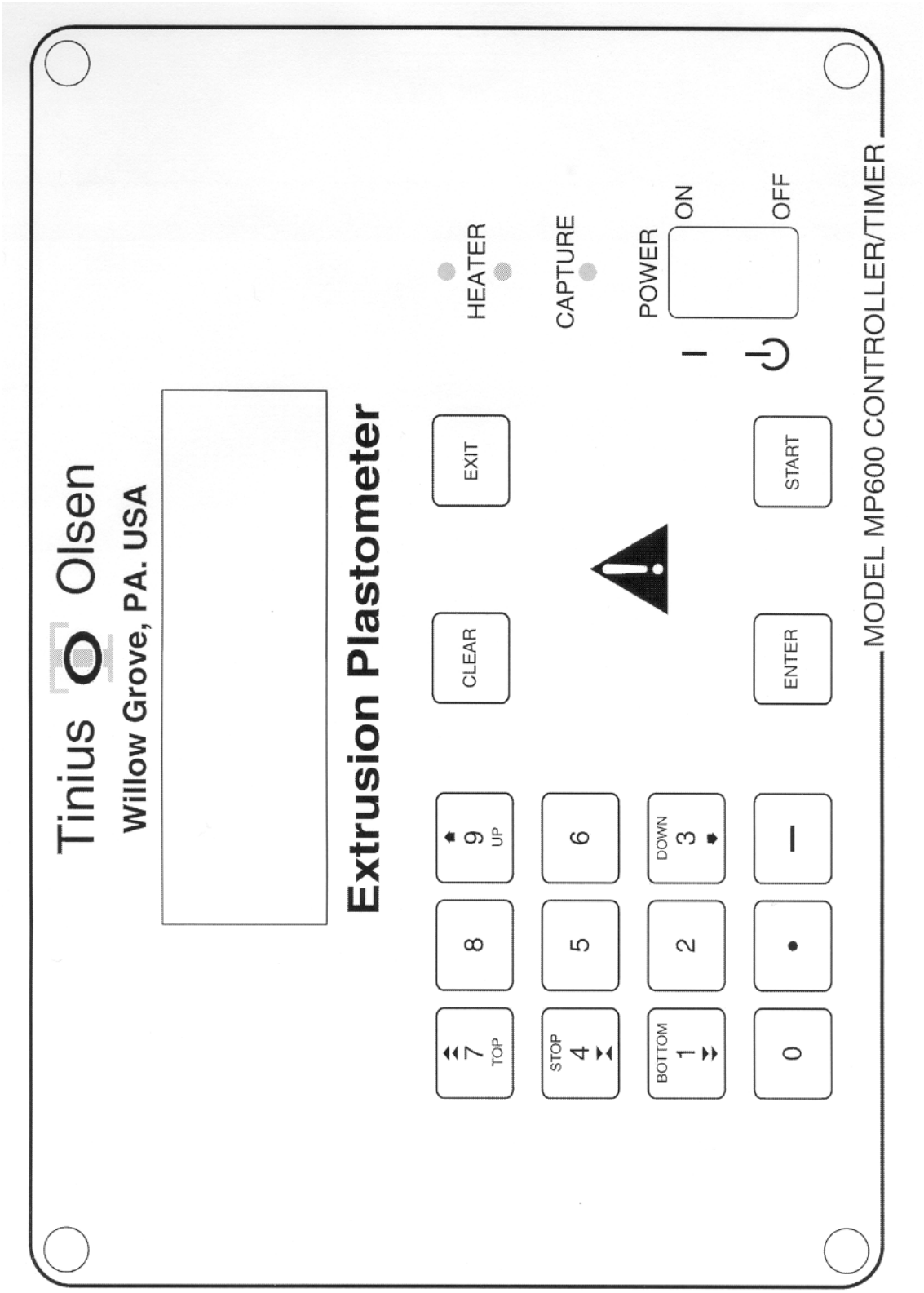

Figure 2-1 – MP600 Controller

2.1.6 Prompt Driven Operation

The selected program prompts the operator to enter the necessary information when starting a test, alerts the operator to perform tasks that may be necessary during the test, prompts for any information that might be necessary after the test, and then calculates and displays test results.

2.1.7 Test Set-Up and Storage

The MP600 Controller can store up to 25 different sets of test parameters, allowing operators to configure the MP600 Controller for the types of materials that are tested in the laboratory.

2.1.8 Test Results

For “Procedure A” type tests, the Flow Rate (Melt Index) is calculated and displayed for each manual cut-off. When Procedure B type tests are performed using the optional PPDT-600 Automatic Timing Switch, the Flow Rate (Melt Index), apparent Shear Stress, Shear Rate and Viscosity, and Volumetric Flow Rate can be selected for calculation and display. A subroutine for calculating the Melt Density of the polymer at Test Temperature is also provided.

2.1.9 Communications Port

The test information and results can be sent directly to an optional dot-matrix serial printer or the machine can be interfaced to a computer utilizing the serial Communications Port (EIA-232/485 protocol) provided as standard. Up to ten machines can be interfaced to a single computer.

B

L

A

N

K

3 Section 3 –Operating Tools & Accessories

3.1 The following tools are included with each MP600 as standard equipment: Refer to Figure 3-1 for an illustration. See Section 16 for cleaning instructions.

⚠ IMPORTANT: All these tools are made of materials that are softer than the cylinder. This is to prevent any scoring or damage to the walls of the cylinder. If the cotton cleaning patches cannot effectively clean the cylinder walls, an optional 0.406" diameter soft brass brush (available from Tinius Olsen) can be used to help clean the cylinder.

One (1) ASTM Piston Assembly (Items 1A, 1B & 1C, Figure 3-1) - consisting of a removable stainless steel piston foot (P/N: 02001086); piston guide collar (P/N: 02001088); and a piston rod (P/N: 02001085). The piston rod and foot weighs 100 grams (not including the guide collar). It is considered the first 100 grams of all test loads. Piston feet made from other materials can also be supplied. An optional combination ASTM/ISO Piston Rod (P/N: 02001439), an ISO (only) Piston Rod (P/N: 02001665) & a piston foot to ISO tolerances (P/N: 02001440) are also available.

One (1) Charging Tool (P/N: 02001582), is used to compress the test material down into the cylinder (cylinder bore), and helps to remove some of the entrapped air when charging material. Provided with a replaceable tip (P/N: 02001071).

Two (2) ASTM D 1238 Orifice (die), D2 tool steel (P/N: 02001030). Note that Carbide orifices are also available (P/N: 02001031). Contact factory for other orifice dimensions & materials

One (1) Level (P/N: 02001271) - consisting of a base (P/N: 02001226) and a circular level (P/N: 02001227), is used to check the Cylinder Alignment (Level) of the cylinder. This level is made to fit over the end of the Piston Rod Assembly, with the piston and orifice in the cylinder.

One (1) Stainless Steel Funnel, (P/N: 02001091) - is used to help introduce a sample of material into the cylinder.

One (1) Orifice Remover, (P/N: 02001073) - is used from the bottom of the furnace to push the orifice up and out of the cylinder.

One (1) Cylinder Cleaning Tool, (P/N: 02001527) is used to clean the cylinder after each test with the cotton cleaning patches.

One (1) Cutoff Tool, (P/N: 02001090) this U-shaped tool is used to cut-off the extruded sample at the bottom of the orifice.

One (1) Orifice Drill, (P/N: 02001075) this soft drill bit is used to clean material out of the inside diameter of the orifice.

⚠ CAUTION: The tools used on the machine may get hot during use.

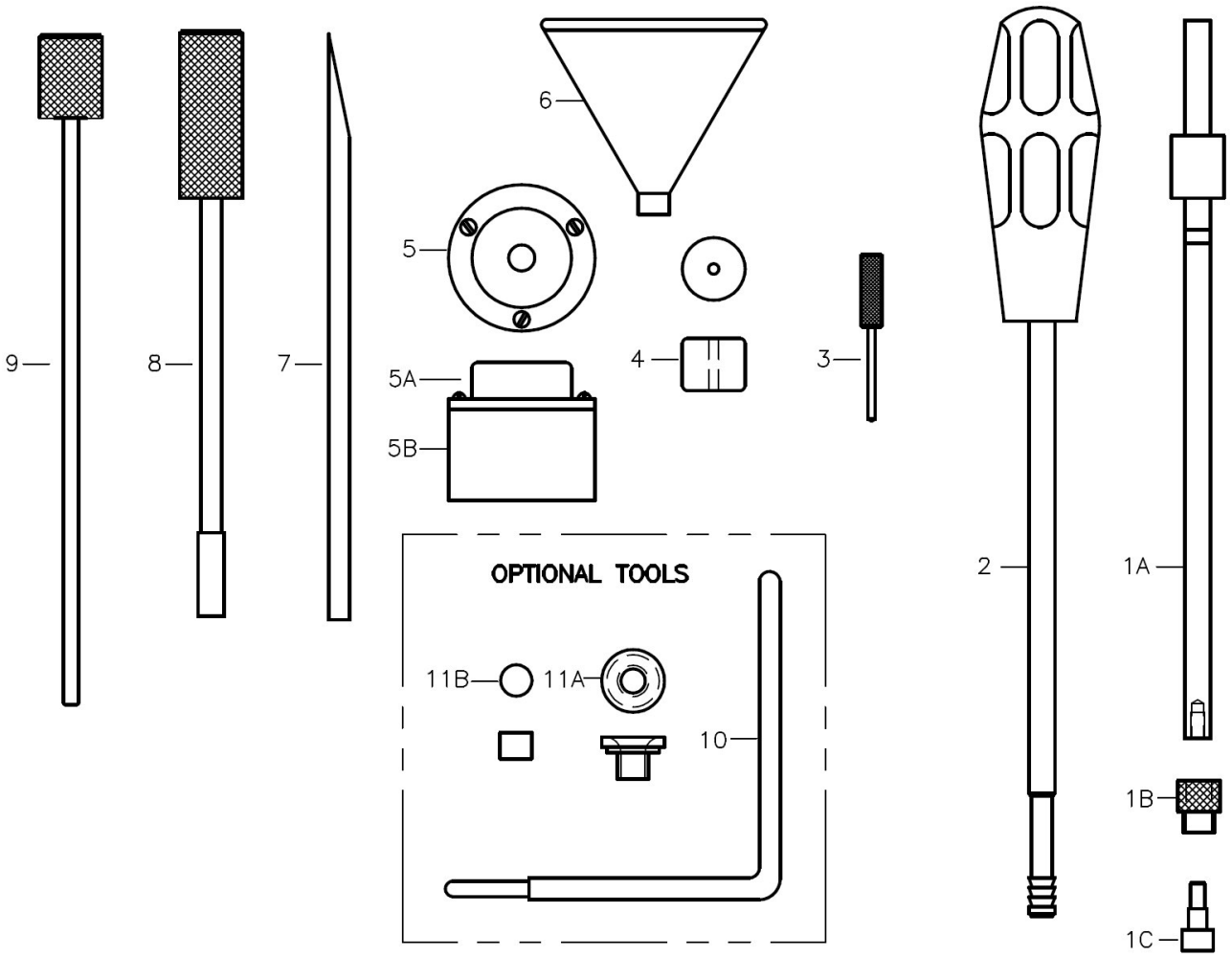

Figure 3-1 – Extrusion Plastometer Tools

1. Piston Rod Assembly
   A. Piston Rod
   B. Guide Collar
   C. Piston Foot
2. Cylinder Cleaning Tool
3. Orifice Drill
4. Orifice
5. Level Assembly
   A. Level
   B. Base
6. Funnel
7. Cutoff Tool
8. Charging Tool
9. Orifice Remover
10. Thermometer (Optional)

11A. Thermometer Support (Optional)

11B. Thermometer Plug (Optional)

4 Section 4 – Available Options & Accessories

4.1 Weights

Table 4-1 shows the weights that can be supplied for the standard test conditions in ASTM D 1238. The Piston Rod and Piston Foot (less the collar) weigh 100 grams. All the weights are marked in grams. Tinius Olsen certifies that the weights are accurate to within +/- 0.5% of the stamped weight.

EXAMPLE: To apply a Test Load of 2.16 kilograms you would use the 2,060 gram weight, adding in 100 grams for the piston rod assembly (less the collar).

Table 4-1 – Weight Loading for Typical Melt Flow Rate Tests

ASTM D 1238 TEST CONDITION (Reference Only)	TEST LOAD (GRAMS)	=	USE WEIGHT(S) (GRAMS)	+	PISTON WEIGHT
A, D & K	325	=	225 (P/N 02001019)	+	100
B, C, E, L, R, T, V & W	2,160	=	2,060 (P/N 02001023)	+	100
H & O	1,200	=	1,100 (P/N 02001022)	+	100
I	3,800	=	3,700 (P/N 02001025)	+	100
J & U	12,500	=	2,400 (P/N 02001024) + 10,000 (P/N 02001029)	+	100
G, P, S & X	5,000	=	4,900 (P/N 02001026)	+	100
F	21,600	=	6,600 (P/N 02001027) + 4,900 (P/N 02001026) + 10,000 (P/N 02001029)	+	100
M	1,050	=	950 (P/N 02001021)	+	100
N	10,000	=	9,900 (P/N 02001028)	+	100
Q	1,000	=	900 (P/N 02001020)	+	100

4.2 Glass Reference Thermometers

⚠ Caution: Thermometers contain mercury! Extreme care must be taken not to heat the thermometer bulb too quickly or to exceed the temperature range of the thermometer, as the internal pressure will cause the thermometer to break!

4.2.1 Extrusion Plastometer thermometers may be used as a reference for indirectly monitoring the approximate temperature level in the test cylinder 10 mm above the orifice. These thermometers have a 4°C range (± 2°C about the stipulated temperature) and are graduated in 0.2°C divisions. **Note: Use of a reference thermometer in the cylinder of the MP600 Extrusion Plastometer requires a Thermometer Support and Plug (P/N 02001530).**

Periodic checks (using the thermometer, thermometer support and plug) can be made to indirectly verify that the cylinder temperature is at the correct temperature. NOTE: This procedure should not be substituted for annual calibration/verification of the entire instrument.

To reduce the potential of breaking the reference thermometer, it is recommended the thermometer be safely stored once the correct operating temperature has been verified.

4.2.2 Mercury Separation

Extrusion Plastometer thermometers have expansion chambers (see Figure 4-2). The mercury in thermometers with contraction chambers tends to separate more readily than straight capillary thermometers. There is no known method to ensure that the mercury in a thermometer will not separate when the thermometer is subjected to shock. This can occur either in transit or by improper storage and handling.

Before using any thermometer it should be examined very carefully for mercury separation in the main mercury column, expansion chamber, contraction chamber and bulb (mercury separation in the bulb will usually show as small bubbles). All the mercury must be united. A check at the ice point will immediately tell if there is mercury separation.

In a small Dewar flask or thermos bottle, mix powdered dry ice with methanol or acetone. Holding the thermometer vertically, immerse about 3/4^{ths} of the lower section of the bulb into the mixture. DO NOT immerse the capillary or funnel section above the bulb into the mixture. The main portion of the mercury will retreat into the bulb and the separated portion should follow. When all the mercury, including the separated portion, has retreated into the bulb, remove the thermometer from the dry ice mixture (see Figure 4-3). The mercury should go together. Stand the thermometer in a vertical position to allow the mercury to rise into the capillary of its own accord.

⚠ Caution: Do not touch the bulb of the thermometer with your hands or it may affect the reading.

Occasionally, the separated portion may cling to the walls of the funnel portion of the bulb. If the mercury is not completely united, repeat the process, but this time, gently tap (do not bounce) the thermometer bulb vertically on a desk pad (see Figure 4-4) after removing it from the flask.

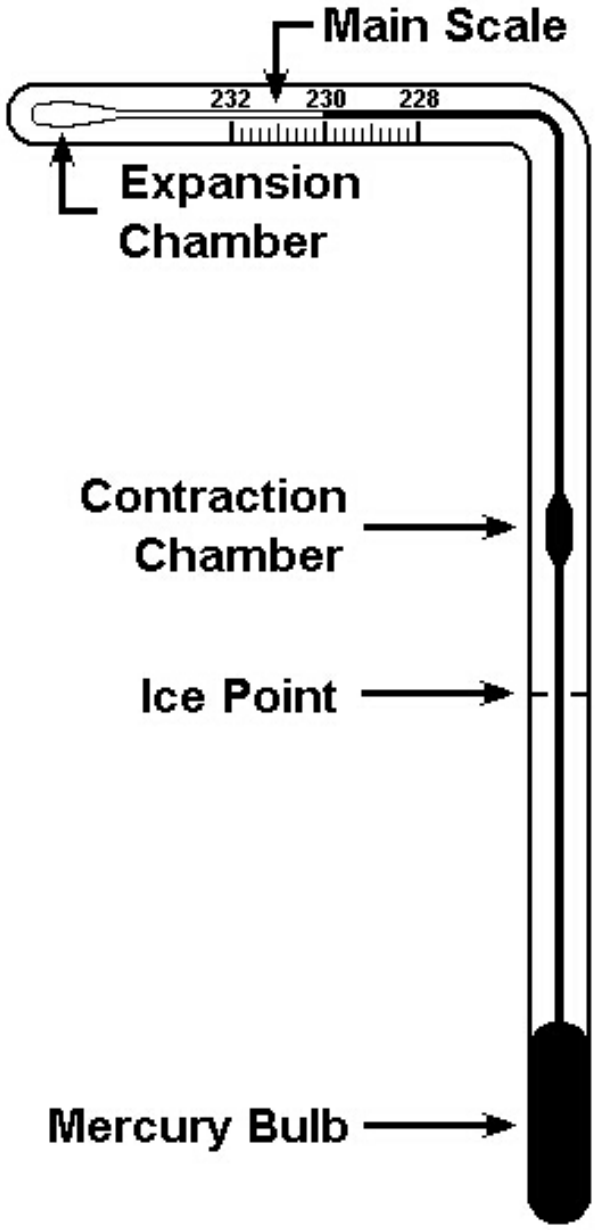

Figure 4-2 – Typical 230℃ Extrusion Plastometer th ermometer

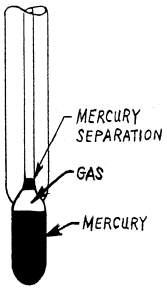

Figure 4-3

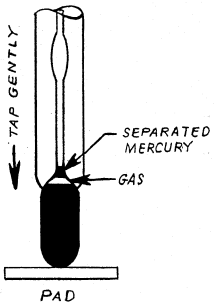

Figure 4-4

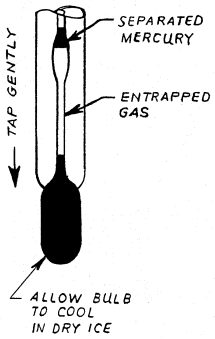

Figure 4-5

If there is a large amount of gas trapped between the separated portion of and the main portion of the mercury, immerse the bulb until the separated mercury is in the widest part of the contraction chamber, and then gently tap the bulb on a pad (see Figure 4-5). This should drop the mercury separation to the lower part of the chamber, allowing most of the gas to escape above the separation. Repeat the immersion process to completely reunite the mercury.

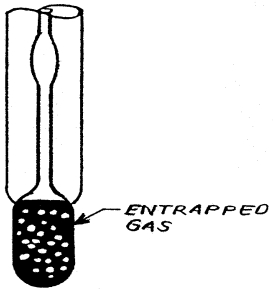

Figure 4-6

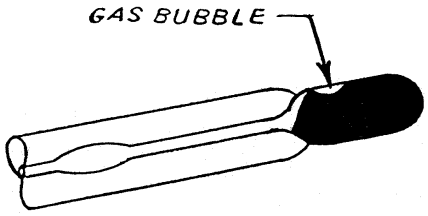

Figure 4-7

If gas bubbles are observed in the bulb of the thermometer (see Figure 4-6), immerse the bulb of the thermometer in the mixture until all the mercury has entered the bulb. Remove the thermometer bulb from the mixture and gently tap the bulb of the thermometer against a rubber pad hand while holding the thermometer horizontal with the bulb slightly elevated (see Figure 4-7). Rotate the thermometer while continuing to tap, allowing a large gas bubble to form and to roll around the inner bulb wall and gather all the small bubbles as it rolls. When all the small bubbles have been gathered, gently tap the bulb against the pad to force the gas bubble to the top of the bulb. Allow the thermometer to warm up on its own accord.

⚠ Always store any unused thermometers in a vertical position.

⚠ Caution: In case of thermometer breakage while in the melt indexer, contact your Hazardous Materials Coordinator prior to attempting the removal.

4.2.3 Thermometers Available from Tinius Olsen

P/N: 02001005	120℃	P/N: 02001012	235℃
P/N: 02001006	125℃	P/N: 02001013	250℃
P/N: 02001007	150℃	P/N: 02001014	265℃
P/N: 02001008	175℃	P/N: 02001015	275℃
P/N: 02001009	190℃	P/N: 02001016	297℃
P/N: 02001010	200℃	P/N: 02001017	300℃
P/N: 02001011	230℃	P/N: 02001066	310℃
		P/N: 02001018	372℃

Notes:

1. For a Model MP600, a Thermometer Support & Plug, P/N 02001530, is required when using reference thermometers.
2. Contact factory for thermometers other than those listed (to 400℃ max.)
3. Thermometers have a graduated range of ±2℃ in 0 .2℃ increments (up to 339℃) and in 0.5℃ increments (from 340℃ to 40 0℃).

4.3 PPDT-600 Automatic Timing Switch (P/N 02001505)

The PPDT-600 is required when conducting Procedure B - Automatically Timed Flow Rate Measurement tests in accordance with Procedure B of ASTM D 1238, ISO 1133, DIN 53735, JIS K7210 and other similar methods. The PPDT-600 utilizes a precision optical encoder to monitor piston position and operate the timer in the MP600 Controller/Timer. The Starting Positions and Piston Travel Distances for up to ten “time vs. distance” captures can be preprogrammed into the MP600 Controller/ Timer.

4.4 Automatic Timing Switch Calibrator (P/N 02001531)

Used for verifying and calibrating the actual piston travel distances measured by the PPDT-600. It can also be used to verify and/or calibrate older style Mechanical and Programmable Actuating Switches and Programmable Piston Displacement Transducers used on older Model UE, MP987, MP993 and MP993a Extrusion Plastometers. However, the instructions in this Manual cover only the verification/calibration of the PPDT-600 on a melt indexer equipped with a MP600 Controller/Timer. Contact the factory for instructions for verification/calibration when using other types of controllers and actuating switch types.

The Calibrator consists of a 0 to 2” barrel-type micrometer head with 0.001” divisions and a mounting bracket. The mounting bracket permits checking the switch while it is mounted on the machine. The standard calibrator is shipped fully assembled. A wooden storage box is also included.

NOTE: Digital version available. Contact factory for details.

4.5 MWLD-600 Motorized Weight Support, Lowering and Lifting Device with Swing–Away Weight Support Platform (P/N 02001504)

This accessory includes an integrated encoder that permits display and control of the height of the weight support platform. It can be operated manually by keys on the keyboard. When performing Procedure B tests, it can be programmed to automatically move to a selected height at the start of a test and then lower fully to reapply the load after a selected pre-heat period (Release Time).

This option is required for automatic operation and is also recommended whenever high loads are being used in a manual testing mode. Weights are contained on the weight support platform that swings-away automatically when in it's raised position for easy cylinder cleaning.

4.6 Go/No-Go Gauge

The Go/No-Go gauge is used to check the inner diameter of the standard ASTM D 1238 orifice (die) for compliance to the test method requirements.

P/N: 02001134: Go/No-Go Gauge, "Half-Die", CERTIFIED
P/N: 02001133: Go/No-Go Gauge, ASTM D 1238/ISO1133 orifice - CERTIFIED
P/N: 02001034: Go/No-Go Gauge, standard ASTM D 1238/ISO1133 orifice

4.7 OKIDATA Model 320-I Dot-Matrix Printer (P/N 02001429 for 110 V or P/N 02001454 for 220 V)

This includes a serial interface card and the MI-Printer AME Cable (see below) for connecting to the communications port on the MP600 Controller.

4.8 MI-Printer AME Cable (P/N 90002871)

A 25 pin Male to 25 pin Male, 10' long cable, for connecting an optional Dot-Matrix Serial Printer to the communications port on the MP600 Controller. **Order this option if printer is being supplied by the end user.**

4.9 Flow Rate Ratio Attachment Package (P/N 02001418)

Use of this option requires that the MP600 Extrusion Plastometer is also equipped with the PPDT-600 Automatic Timing Switch and the MWLD-600 Motorized Weight Support and Lowering Device. This package consists of:

a) Load change (lift) pins and extended safety uprights and split collars for weight containment.

b) Weight change height setting adjuster for setting up typical programs.

c) Weight set consisting of 2060 g (P/N 02001023), 7840 g (P/N 02001250) and 11,600 g (P/N 02001251) for applying loads of 2.16, 10 and 21.6 kg. (Other load combinations can be supplied - consult factory.)

Using the above components, flow rates can be determined under up to three different loads using the following automated sequence. After charging the test material and lowering the weights over the top of the piston rod, the operator starts the “Preheat” period. At the end of the “Preheat” period, the MWLD-600 lowers and applies the selected total load. The time for the first selected piston travel is measured and stored. As the test progresses, the load on the piston is reduced automatically and, after a selected distance to allow for equilibration of flow, the time for the selected second piston distance is measured and stored, and a similar sequence can be selected to obtain a measurement under a third load. At the end of the test the flow rates and other selected data are calculated by the microprocessor for readout on the display.

4.10 EP600 Data Acquisition & Machine Control Software

EP600 Software Packages are available for connecting a single Melt Indexer or up to ten Melt Indexers to a computer. Consult the factory or your local representative for complete details.

P/N 02001561 Software - EP600-Single Machine Package
P/N 02001562 Software - EP600- Multiple Machine Package

4.11 Orifice (Die) Options

P/N: 02001030 – Orifice, D2 tool steel (ASTM D 1238, ISO 1133)-Standard
P/N: 02001268 – Orifice, Carbide 0.0413” ID x 0.157” L (“Half Die”)
P/N: 02001033 – Orifice, Carbide (PVC, ASTM D3364)
P/N: 02001032 – Orifice, Stainless Steel (PVC, ASTM D3364)
P/N: 02001031 – Orifice, Carbide (ASTM D 1238, ISO 1133)

4.12 Piston Foot Options

P/N: 02001086 Piston Foot, stainless steel (standard foot)
P/N: 02001440 Piston Foot, stainless steel (to ISO tolerances)
P/N: 02001441 Piston Foot, D2 tool steel hardened 50-55
P/N: 02001113 Piston Foot, corrosion resistant alloy (for use with corrosion resistant alloy cylinder)

4.13 Miscellaneous

P/N: 02001439 Piston Rod – Combo both ASTM & ISO Scribed Lines
P/N: 02001665 Piston Rod – ISO Scribed Lines only
P/N: 02001455 Orifice Plug – for High Flow resins
P/N: 02001071 Charging Tool Tips

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5 Section 5 – Set-Up and Installation

NOTE: Instructions in this Section cover basic machine setup. For instruction on installing and operating optional accessories supplied with the unit, please refer to the appropriate Section of this manual.

⚠ CAUTION: This machine is designed for indoor use only. It shall be used in a controlled environment (temperature range 5°C to 40°C (40 to 100°F), maximum R.H. of 80% at 31°C). Maximum operating altitude is 3,200 meters (10,000 feet).

⚠ CAUTION: In some instances an exhaust system may be used to remove the excess heat and/or odors released during a test. These instructions do not address all of the safety concerns related to ventilation of fumes produced during normal testing operations.

5.1 Unpacking the Machine

5.1.1 Locate the packing list and carefully uncrate and remove all packing material from around the machine. Carefully remove the machine from the crate. Check all parts and accessories against the packing list.

⚠ CAUTION: The machine is heavy and care must be used when lifting the machine from the box or moving the machine. Always lift the machine by the base plate. Never pick the machine up by the Motorized Weight Lowering Device (MWLD-600) or by the furnace assembly.

5.2 Locating the Machine

5.2.1 Place the machine on a sturdy, level surface. The area that it is located shall be free from vibrations. Place the tools on the rack on the right hand side of the machine.

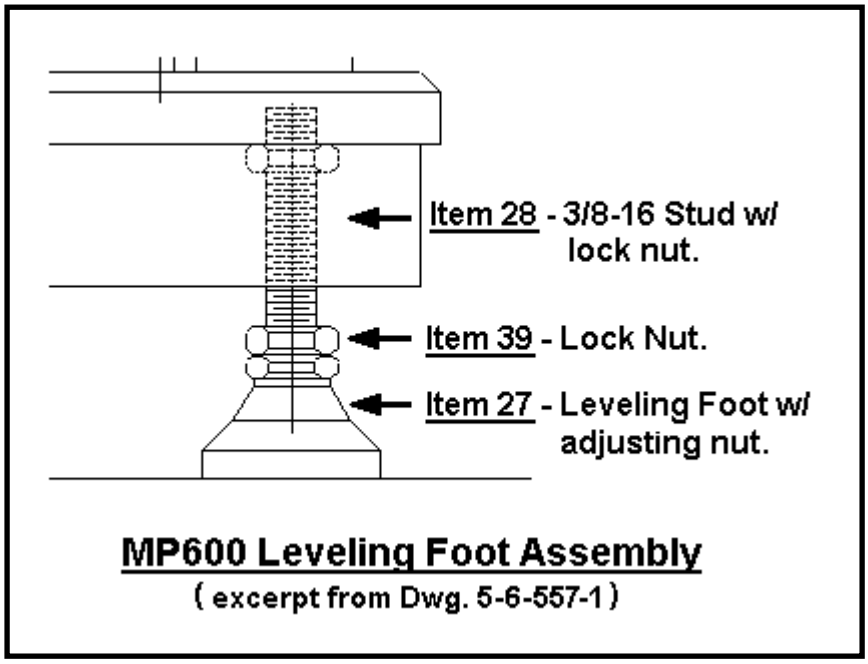
5.2.2 The basic machine is shipped fully assembled. There is some assembly required for optional accessories.

5.3 Leveling the Machine

5.3.1 Insert the orifice in the cylinder, and then insert the piston assembly.

5.3.2 Place the precision level over the top of the piston. The piston rod must be straight and the base of the level seated cleanly on the shoulder of the piston.

5.3.3 Level the machine using the 4 screw adjustment feet on the corners of the base plate. Verify that the machine is level by rotating the level only and then the piston assembly only. At all level positions, no more than half of the bubble will be outside the circle.



MP600 Leveling Foot Assembly
(excerpt from Dwg. 5-6-557-1)

To level the machine, loosen the lock nut (Item 39) up off the adjusting nut on the foot, adjust the leveling foot (Item 27) using the lower adjust nut. Note that the feet only have a limited amount of adjustment and the table surface should be fairly level to begin with. Tighten the lock nuts back down on the adjusting nuts with a wrench after leveling. The lock nut should be tightened down against the hex nut on the foot, not the bottom of the MP600.

⚠ CAUTION: Over adjusting the leveling foot can run the stud (Item 28) out of the foot or out of the base of the machine, which would require the removal of the base pan to correct. Locktite is applied to the top of the stud at assembly.

5.3.4 Remove the precision level from the piston and store it in a safe place.

6 Section 6 - OPTIONAL Programmable Piston Displacement Transducer (PPDT-600)

6.1 Installing PPDT-600 ordered with the MP600

6.1.1 Tools Required:
3/16 inch hex key (supplied); small slotted screwdriver (not supplied)

6.1.2 Remove the shrink-wrap that secures the PPDT-600 during transit. Be careful not to bend the PPDT-600 arm.

6.1.3 Mount the switch mounting bracket to the furnace as shown in Drawing 5-6-549 (located in Appendix A at the rear of this manual). Secure the bracket using the two 1/4”-20 screws provided. Ensure washers are installed between mounting bracket and furnace top.

⚠ NOTE: The PPDT-600 arm and the encoder in the PPDT-600 are very sensitive and can easily be damaged by misuse or abuse. When moving the arm by hand, never exceed the upper or lower stops. Never allow the arm to fly up from the down position. The arm must be gently guided back to the upper position using a finger.

6.1.4 Plug the PPDT-600 into appropriate port at the rear of the MP600 controller cabinet and tighten screws with a small slotted screwdriver. Be sure cable clamps are tight.

6.2 Field Installation, Setup and Configuration of the PPDT-600 for encoder type ENCI (for units that were not originally purchased with the MP600)

6.2.1 Tools Required:
3/16 inch hex key (supplied); small slotted screwdriver (not supplied)

6.2.2 Mount the switch mounting bracket to the furnace as shown in Drawing 5-6-549 (located in Appendix A at the rear of this manual). Secure the bracket using the two 1/4”-20 screws provided. Ensure washers are installed between mounting bracket and furnace top.

⚠ NOTE: The PPDT-600 arm and the encoder in the PPDT-600 are very sensitive and can easily be damaged by misuse or abuse. When moving the arm by hand, never exceed the upper or lower stops. Never allow the arm to fly up from the down position. The arm must be gently guided back to the upper position using a finger.

6.2.3 Plug the PPDT-600 into appropriate port at the rear of the MP600 controller cabinet and tighten screws with a small slotted screwdriver. Be sure the cable clamps are tight.

6.2.4 Turn on the MP600 and go through the initial dialog. Rotate the PPDT-600 clockwise into the Test position.

6.2.5 From the Main screen (shows Actual Temperature, Set Point Temperature, Program Number, and Procedure), select #4 – Options. Under the Options Menu, select #4 – Calibration.

6.2.6 Enter the Calibration access code: 8 3 5 and press ENTER.

6.2.7 Under Calibration, select #2 – PPDT. Under PPDT, select #1 – Full Calibration. Select the PPDT type as #1 – ENC.

6.2.8 The MP600 will then prompt the operator to lower the PPDT arm all the way, hold it, and press ENTER. This defines the bottom position.

6.2.9 The MP600 will then prompt the operator to set the horizontal position. Use a straight edge and place it along the PPDT arm so that it is perfectly horizontal and press ENTER.

6.1.10 The next screen prompts the user to MOVE PPDT ARM TO DETECT INDEX. Gently lower and raise the arm of the PPDT to momentarily activate the Capture LED.

6.2.11 The next screen shows you a live reading of the PPDT position (Piston Height) and the current Arm Length and Offset. Pressing ENTER toggles between allowing you to change the Arm Length and change the Offset. With each entry or movement of the PPDT arm, the Piston Height is recalculated and updated.

6.2.12 Enter the Calibrated Arm Length value found on the tag attached to the PPDT-600.

6.2.13 The Offset is used to change the PPDT position (Piston Height) relative to the top of the orifice. You may change this to trim it in if needed (see below).

6.2.14 Place a single orifice in the barrel, put the piston rod down the barrel, and put a weight on the piston rod. Position the PPDT arm under the weight. The Piston Height should read nearly zero. If not, adjust the Offset accordingly.

NOTE: The easiest way to determine the correct Offset is to set the Offset to 0. Then read the Piston Height with the PPDT arm at the zero piston position (see above). Multiply the reading by –1 and enter this as the new Offset. BE CAREFUL to change only the Offset, not the Arm Length.

6.2.15 Press EXIT to exit out of the Calibration mode and return to the Main screen.

NOTE: You can check the PPDT (Piston Height) by “entering” the Test mode (Procedure B) and proceeding to a screen that shows the Piston Height. Check the zero piston position using the procedure described above (#13). The Piston Height will probably never read exactly 0, because of minor deviations in the initialization procedure, contact surfaces, etc., but it should be within several hundredths of an inch (about 1 mm).

Changes to the PPDT Offset will not affect the calibration. However, you do want to set the Offset value so that the displayed Piston Height generally corresponds to the *actual* piston position.

NOTE: Some MP600 Extrusion Plastometers that are purchased with the optional PPDT-600 Automatic Timing Switch may have been configured for the Encoder Type **“ENC”**. If your machine has been configured in this manner, the following prompt will be shown on the display **EVERY** time that the MP600 is powered-up.

```
FULLY LOWER PPDT ARM

 HOLD DOWN ARM AND
PRESS ENTER TO INIT
```

When this prompt is displayed:

1. The user must rotate the PPDT-600 Switch clockwise on its bracket so that the tip of the arm is pointing toward the center of the barrel (the Test Position).

2. The user should then gently push down on the switch arm until it stops. DO NOT FORCE THE ARM ANY FURTHER. Then while holding the arm down in this position, press the [ENTER] key on the MP600.

3. Then gently allow the switch arm to return to its “UP” position.

Note: The above steps are required to provide the MP600 with a position reference and to initialize the PPDT-600 Automatic Timing Switch.

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7 Section 7 - OPTIONAL Motorized Weight Support and Lowering/Raising Device (MWLD-600) with Swing-Away Feature

7.1 Preparation for use of Factory Installed MWLD-600

7.1.1 Install the weight retaining rods (Refer to Drawing 5-6-543 located in Appendix A at the rear of this manual) provided with the MWLD-600. The rods are used to safely contain the weight(s). When using 3" diameter or smaller weights, three (3) rods are threaded into the inner tapped holes of the weight platform in a triangular pattern.

7.1.2 For larger diameter weights, all four of the rods should be installed using the outer, square pattern.

⚠ CAUTION: Possible pinch points associated with the weight-lowering device exist. One is between the lift cap and the lifter top at the bottom most position of the platform and the second exists between the weight lowering platform and the piston rod.

⚠ CAUTION: Do not allow the MWLD-600 to lower when there is any obstruction between the top of the furnace and the bottom of the weight platform that would prevent the full lowering of the MWLD-600. Should the MWLD-600 lowering be initiated inadvertently when an obstruction is present, immediately press the "STOP" key located on the keypad of the MP600 Controller/Timer.

7.2 Manual Operation

7.2.1 Disable the automatic operation of the MWLD-600 by changing the test parameters if necessary (see Section 11.3.19).

7.2.2 Use the [UP] and [DOWN] keys on the MP600 Controller to raise or lower the MWLD-600 weight platform. NOTE: The [UP] and [DOWN] keys will not operate when a numeric entry is expected by the MP600 Controller.

7.2.3 Use the [TOP] key to raise the MWLD-600 weight platform to the upper most Swing-Away position. Use the [BOTTOM] key to lower the MWLD-600 weight platform to the bottom most position. If running a Method B test and the weight platform is above the "Wt Sup Ht", the [BOTTOM] key will lower the weight platform to the "Wt Sup Ht". Use the [STOP] key at anytime to stop the MWLD-600 weight platform.

7.3 Automatic Operation

7.3.1 Enable the automatic operation of the MWLD-600 by changing the test parameters if necessary (see Section 11.3.19).

7.3.2 When the [START] key is used to initiate a test, the MWLD-600 weight platform will automatically lower to the weight support height (See “Wt Sup Ht” in Section 11.3.20). After the Release Time has counted down to zero, the MP600 Controller/Timer will automatically lower the MWLD-600 weight platform down to the lowest position.

While the MWLD-600 weight platform is in motion, the [STOP] key will stop the weight platform.

7.3.3 The [UP], [DOWN], [TOP] or [BOTTOM] keys can be used at any time to raise or lower the MWLD-600 weight platform, except when the MP600 Controller display is requesting a numeric input.

7.4 Field Installation of MWLD

7.4.1 Tools required: 3/32, 5/32, and 3/16 hex key, 5/8 & 11/16 wrench, flat head screwdriver, Phillips screwdriver, (optional 1 5/16 wrench).

7.4.2 Refer to Appendix A for assembly drawings and wiring diagram.

7.4.3 Unplug the MP600 from the power source. Allow the Furnace to cool down before proceeding.

7.4.4 Remove the PPDT-600, if installed. Remove all tools from the Tool Rack.

7.4.5 Remove the cover plate (Cover – MWLD Opening - Item 27 from drawing 5-6-557), located behind the furnace assembly from the base plate (item 24). The cover may be discarded, but save the screws and washers (items 40 & 71).

7.4.6 Lower the MWLD-600 Assembly into the Base Plate opening. Guide the wires towards the controller. Hand start the four mounting screws from step 3. Move the MWLD-600 until alignment between Furnace Top Plate (item 16 on drawing 5-6-530) and MWLD-600 Lifter Top (item 6 on drawing 5-6-543) is a uniform .001 to .005 inch gap. Once aligned, tighten the two #10-32 x 2.5 inch long screws (item 58 on 5-6-543) and then the four screws and washers from step 7.4.5.

⚠ Caution: If not properly align serious damage to the MWLD-600 can occur.

7.4.6.1 For angular adjustments,

7.4.6.1.1 Remove Pan Cover, (see step 7.4.7 below).

7.4.6.1.2 Loosen Furnace Leg-Screw (item 10 on 5-6-530). In the normal upright operation position, align the Furnace Top Plate with the MWLD-600 Lifter Top.

7.4.6.1.3 If still not aligned, loosen (maximum 1 turn) three 1/4-20 screws (item 34 on 5-6-530). Do not remove these screws. Again align Furnace Top Plate with the MWLD-600. Tighten these three screws; see 5-6-530 for torque setting.

7.4.6.1.4 Tighten both Furnace Leg-Screws and recheck alignment.

7.4.6.2 For height adjustments:

7.4.6.2.1 Remove the five #4-40 screws holding the Motor Cover (items 48 and 9 on 5-6-543).

7.4.6.2.2 Remove the four #8-32 screws holding the Top Cover (items 61 and 2).

7.4.6.2.3 Remove the four 1/4-20 screws holding the MWLD-600 to the Base Plate and slide the MWLD-600 back.

7.4.6.2.4 Remove the back #10-32 screw (item 55 on 5-6-557) mounting the Tool Rack (item 38). Loosen the front Tool Rack mounting screw. Rotate the Tool Rack out of the way.

7.4.6.2.5 Carefully flex open the Motor Cover with one hand while the other hand holding the Top Cover edges, lift up and out the Top Cover. This will expose the motor controller and fuse.

7.4.6.2.6 Remove the Weight Platform (item 7 on 5-6-543) by taking out the two 5/16-18 screws and washers (items 62, 67, & 71). Lift the Motor Cover up and off.

7.4.6.2.7 Loosen the two #10-32 screws (item 55 on 5-6-543) on the back holding the Lifter Top (item 6).

7.4.6.2.8 Remove the two #10-32 (item 56) though Screw Support channel (item 5). Screw threads must be cleaned (both the screw and hole) before assembly.

7.4.6.2.9 Slide the Lifter Top to vertically match the Furnace Top Plate mounting holes. Tighten the two screws (item 55) on the back.

7.4.6.2.10 Start the two #10-32 mounting screws (item 58) into the furnace to verify alignment. With cleaned screw (item 56) and hole, add a serviceable thread locker (Loctite #222) to the screw and tighten (do not over tighten).

7.4.6.2.11 Remove the two #10-32 mounting screws (item 58) and reassemble. Slide the Motor Cover back down around the motor. Slip on Top Cover. Replace the four Top Cover screws and five Motor Cover screws. Replace the MWLD-600 mounting screws (four into the Base Plate and two into the Furnace assembly).

7.4.6.2.12 Replace the back Tool Rack mounting screw and tighten the front screw. Replace the Weight Platform with screws and washers from step 7.4.6.2.6 above.

7.4.7 Flip the MP600 onto the backside, resting on the Base Plate and MWLD-600 Top Cover (item 2 on 5-6-543). Take care not to damage the MWLD-600 Motor Cover (item 9 on 5-6-543). Remove the four leveling feet and lock nuts (items 57 & 58 on 5-6-557). Remove the Pan Cover (item 26 on 5-6-557) with the four screws and washers (items 41 & 65). Lift off the Pan Cover and set aside.

7.4.8 Put the MWLD-600 wire ends into the controller Cabinet (Item 25 on 5-6-557). Mount the supplied cable clamps with screws as shown on drawing 5-6-556, keep all cables free from MWLD-600 belt and pulleys (items 16, 26 & 27 on 5-6-543).

7.4.9 Put the Pan Cover into the Base Plate groove and mount with screws & washers. Install Leveling Feet and lock nuts. Upright the MP600 back onto the Leveling Feet.

7.4.10 Remove the four screws (item 44 on 5-6-557) holding the Controller (item 42). Carefully pull the upper half of the Controller and rotate the Controller upside down onto the Base Plate.

7.4.11 See drawing 8-12-1366 for MWLD-600 wiring to the Controller. The wires maybe trimmed to suit.

7.4.12 Replace the Controller and screws from step 7.4.10.

7.4.13 Plug in the MP600. Turn on the MP600. Configure the MWLD-600 for proper operation with the MWLD-600 according to Section 7.2. The Set Point should be at room temperature.

7.4.14 After verifying proper MWLD-600 operation, level the machine per Section 5.3 of this manual.

7.4.15 With the Weight Platform (item 7 on 5-6-543) in the BOTTOM position, insert an orifice and the piston assembly into the furnace. Add the lightest 6 inch diameter weight onto the piston rod. If necessary, loosen the two 5/16 screws (items 62 on 5-6-543) and adjust the Weight Platform to have the weight seated flat on the Weight Platform. Tighten adjustment screws. Run the weight platform up and down a few times to check weight alignment is smooth on/off piston rod assembly.

7.4.16 Install the Weight Retaining Rods (item 1 on 5-6-543) per Section 7.1 of this manual.

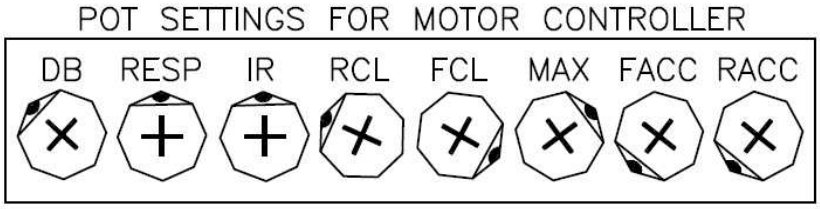
7.5 Configuring the MP600 after Field Installation of MWLD-600

7.5.1 Verify the proper MWLD Motor Controller voltage setting. (For 220 V use the inside pin settings, 110 V use the outside pin settings.)

7.5.2 Verify all of the other jumpers for proper settings.

Jumper	Set To
J1A & J1B	115 or 230 (See Step 1)
J2	1.7A
J3	A90
J4	10V
J5	SPD
J6	RTS

7.5.3 Verify MWLD Motor Controller pot settings.



7.5.4 Turn the power on.

7.5.5 When prompted, press the 9 (UP) key and hold to raise weight support. After the weight support has moved up about 1/2 inch, let go of the (UP) key and the weight support should stop. Press the 9 (UP) key and hold until weight support stops, must stop before weight support swings away. If the weight support does not move, check the encoder connections (Error Code 10) and/or turn the DB Pot counterclockwise.

7.5.6 At the SET POINT Screen and CAL OFFSET Screens, press 0 and ENTER. This will keep the furnace at room temperature.

7.5.7 At the main IDLE Screen, press 4 (OPTION) key to enter the options.

7.5.8 At the OPTION Screen, press 4 (CALIBRATE) key.

7.5.9 Enter the access code, press 8 3 5 and ENTER.

7.5.10 At the SELECT CAL FUNCTION Screen, press 1 (WT SUPPORT).

7.5.11 At the WEIGHT SUPPORT Screen, press 2 (DC) and ENTER.

7.5.12 At the DC MOTOR CALIBRATION Screen, press 2 (CONFIG WT SUPPORT). Verify the following values (change as required) and press ENTER to continue:

a. ENC RES = 46080
b. DC MOTOR OFFSET = 0%
c. DC MOTOR FS FAST = 100% (up)
d. DC MOTOR FS SLOW = 40%
e. DC MOTOR –FS FAST = -100% (down)
f. DC MOTOR –FS SLOW = -40%
g. DC MOTOR PROP BAND = 1
h. TOTAL TRAVEL = 9.070 (inch, or 230.38 mm)
i. OVER TRAVEL = .800 (inch, or 20.32 mm)
j. UNDER TRAVEL = .150 (inch, or 3.8 mm)

7.5.13 Back at the DC MOTOR CALIBRATION Screen, press EXIT several times.

7.5.14 Press the 3 (DOWN) key and hold. Weight support should move down, slowly at first then speed up. Once the weight support is near the bottom, release the 3 (DOWN) key and the weight support should stop. Continue to jog down (pressing & releasing the down key) weight support until it stops, should have about 1/8 inch gap between the Lifter Top and Lift Cap.

7.5.15 With the weight support down, turn off the MP600 and turn it back on. Following the directions on the screen, then press and hold the 9 (UP) key to raise the platform until it stops.

7.5.16 At the SET POINT Screen and CAL OFFSET Screens, press 0 and ENTER. This will keep the furnace at room temperature.

7.5.17 At the main IDLE Screen, press 1 (TEST) key to enable the weight lowering device.

7.5.18 Press the 9 (UP) key and jog the weight support as far as it will swing around. The weight support must stop at about 90° and not go any farther. Verify that the cam is not bottomed out on the cam tube slot. If it is, lower the OVER TRAVEL parameter in Step 7.5.12.

7.5.19 At the main IDLE Screen, press 4 (OPTION) key to enter the options.

7.5.20 At the OPTION Screen, press 4 (CALIBRATE) key.

7.5.21 Enter the access code, press 8 3 5 and ENTER.

7.5.22 At the SELECT CAL FUNCTION Screen, press 4 (DIAG).

7.5.23 Press ENTER 11 times to cycle though the diagnostic screens, to get to the CYCLE WS MOTOR Screen.

7.5.24 Press START to cycle the Weight Platform up and down.

7.5.25 Verify smooth weight support movement. Adjust the Motor Controller Pots (from step 2) if required. If varying speed (up or down) adjust IR pot CW. If the red LED (near the pots) is on or blinking (start-up blink OK) turn RCL pot CW.

7.5.26 Press 4 (STOP) at any time to stop the Weight Platform. When stopped and on the CYCLE WS SUPPORT Screen, all the Weight Support keys are functional: 1 (BOTTOM), 3 (DOWN), 7 (TOP), and 9 (UP).

7.5.27 When finished running the Weight Support, press 4 (STOP) and then 1 (BOTTOM). Once the Weight Support stops at the bottom position turn power OFF.

7.5.28 In final inspection do the following:

a. Check the parameters set in Step 7.5.12.
b. Check the OVER TRAVEL. Turn the machine off and then back on with the weight platform in the down position. Following the directions on the screen, then press and hold the 9 (UP) key to raise the platform until it stops. Initialize the machine and press the 7 (TOP) key to raise the weight support as far as it will swing around. The weight support must stop at about 90° and not go any farther.
c. If equipped with a PPDT Switch, match the weight support position with the switch position by adjusting the UNDER TRAVEL parameter in Step 7.5.12.

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8 Section 8 - Installation of OPTIONAL OKIDATA Model 320-Dot Matrix Printer & Printer Cable

8.1 Connect one end of the MI-Printer cable (P/N 90002871) to the serial port at the rear of the machine and connect the other end to the serial port on the printer.

8.2 Configure the MP600 as covered in Section 10.4.

8.3 Configure the printer with the appropriate communications parameters. The MP600 uses 1200 baud, Odd parity, 7 data bits, 1 stop bit. An example of the serial configuration for an OKIDATA MICROLINE 320 (with serial port option) is as follows:

Parity	Odd
Serial Data 7 or 8 Bits	7
Protocol	Ready/Busy
Diagnostic Test	No
Busy Line	SSD-
Baud Rate	1200 BPS (or as selected in the MP600)
DSR Signal	Valid
DTR Signal	Ready on Power UP
Busy Time	200 ms

B

L

A

N

K

9 Section 9 – Initial Start-Up

⚠ CAUTION: Do not use a sharp object to press any of the keys on the Model MP600 Controller, as this will puncture the membrane cover.

⚠ CAUTION: Prior to shipment, the cylinder of the machine is coated with oil to prevent rust from forming. When the machine is first turned on, it is normal for the machine to "smoke" as the cylinder comes to temperature and the oil residue burns off. To reduce the amount of smoke that forms, clean the cylinder thoroughly before turning the machine on. Be sure that a ventilation system is operating at this time.

9.1 Powering Up the MP600

9.1.1 The MP600 is now ready for operation. Check nameplate to verify the correct voltage is being used. Connect the MP 600 to a suitable power supply (500 WATT MINIMUM) and turn both Power Switches (front & rear) "ON".

9.1.2 When the MP600 is first turned on, the controller will display the EPROM program version, the date and the time. If an MWLD-600 is attached and not raised, the display may prompt the operator to raise the weight support by pressing the "9" key. Press and hold the "9" key until the platform stops. Pressing the "ENTER" key will skip this step; however, the MWLD-600 will not function until this step has been completed.

9.2 Setting the Temperature

NOTE: The "Set Temperature" and "Calibration Offset" prompts will appear at this point if the "At Program Initiate" option was selected in the Test Parameters Set-Up Mode (see Section 11).

9.2.1 The MP600 will now display the following screen:

```
SET POINT      PI  C
ENTER NEW SET POINT
PRESS ENTER TO CONT
```

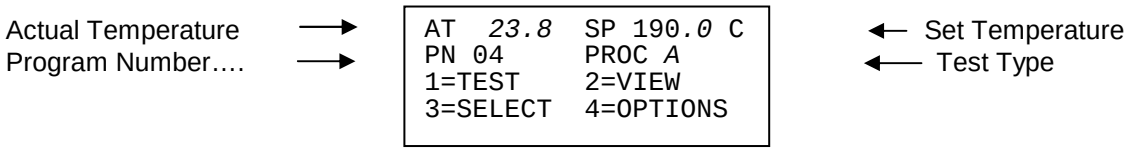
Program a fixed temperature between 0 and 450℃ and press [ENTER].

TEST TIP: If the operator is unfamiliar with melt index testing procedures and machine operations, it might be beneficial to turn off the heaters at this point. Enter a temperature near or below the ambient temperature (or enter 0°) and then press the [ENTER] key until you return to the idle screen. A 0° setting should also be entered when the Calibration Offset screens are displayed (see Section 9.3).

9.3 Entering the Calibration Offset

9.3.1 The MP600 will then prompt the operator to enter the “Calibration Offset” for top and bottom. Enter the offset values that correspond to the desired test temperature. The Calibration Offset values are found on the MP600 Configuration/Calibration Settings Worksheet that was supplied with the machine or that was supplied by the Calibration Engineer at the last calibration/verification service. Refer to Section 2.1.2 of these instructions for more information on the Calibration Offset value.

9.3.2 The MP600 Controller will now display the Idle screen that resembles the following:



At this point, the machine is ready to accept programming for the testing.

⚠ CAUTION Once the idle screen is displayed, the cylinder will start to heat up to the Set Point.

9.4 Final Preparation

9.4.1 Thoroughly clean the inside of the cylinder and orifice (see Section 16 for Cleaning Instructions), then drop the orifice into the cylinder. The orifice should fall freely to the bottom of the cylinder with an audible click. If not, remove the orifice and visually inspect the orifice and cylinder for any defects or obstructions. Clean the cylinder and orifice again if necessary. It is imperative that the cylinder has a mirror finish and that no residue remains on the outside or the inside diameter of the orifice.

9.4.2 Without using any material, and with the orifice already at the bottom, insert the Piston Rod Assembly into the cylinder.

10 Section 10 - Configuration Mode

10.1 The Configuration Mode provides for the basic setup and configuration of the MP600 Controller. This mode is accessed by pressing the [4] key (OPTIONS) from the IDLE Screen to advance to the **OPTIONS Menu**:

```
1=RUN TEST
2=EDIT PROGRAM
3=CONFIGURE
4=CALIBRATE
```

From the OPTIONS Menu; press the [3] key for “CONFIGURE”. At the “ENTER ACCESS CODE” screen, press the [8], then the [3] and then the [4] key followed by [ENTER] to access the **CONFIGURE Menu**:

```
1=GENERAL
2=TEMP CONTROL
3=SERIAL PORT
PRESS EXIT TO EXIT
```

10.2 Pressing the [1] key from the CONFIGURE Menu accesses the **GENERAL** Configuration Mode. The following screens can now be configured. (Note that pressing [ENTER] accepts the existing entry and advances to the next screen. Pressing [EXIT] returns the user to the CONFIGURE Menu.)

10.2.1 **"Alarm"** - Enter a "0" to turn off the alarm that sounds at the end of the Release Time (Preheat Time). Enter a "1" to activate the alarm.

10.2.2 **"Display Inten."** - Enter a number between 1 and 4. The higher the number the brighter the display but the shorter its expected life. A setting of 3 usually works well in most cases.

10.2.3 **"Position"** - Enter a "1" to work in inches, enter a "2" to work in millimeters.

10.2.4 **“Date”** - If incorrect, enter the current date in *mm-dd-yyyy* format.

10.2.5 **“Time”** - If incorrect, enter the current time in *hh:mm* format. **(Use the [-] key to enter the colon.)**

10.2.6 **“Language”** – Select from the available languages shown on the screen.

10.2.7 **“Print Parameters”** – If the machine is connected to a printer and “PRINTER” has been selected on the **Serial Port** Configuration screen, pressing the [1] key when on this screen will produce a printout of the “Configuration”.

10.3 Pressing the [2] key from the Configure Menu accesses the **TEMP CONTROL** Configuration Menu.

```
1=GENERAL
2=VIEW
3=SET PID PARAMS
PRESS EXIT TO EXIT
```

10.3.1 Pressing the [1] key from the **TEMP CONTROL** Configuration Menu accesses the **GENERAL** TEMP CONTROL Configuration Mode. The following screens can now be configured. (Note that pressing [ENTER] accepts the existing entry and advances to the next screen. Press [EXIT] to return to the **TEMP CONTROL** Configuration Menu.)

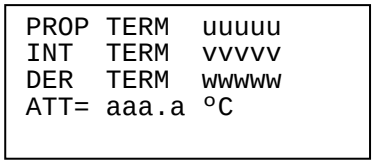
10.3.1.1 **"Voltage"** - The Extrusion Plastometer is set up at the factory for operation from either 115 or 230 VAC main power. **This screen must be set to agree with this main power requirement.** Press the [1] key if the machine is arranged for operation from 115 VAC. Press the [2] key if arranged for operation from 230 VAC.

10.3.1.2 **"High Temp"** - This temperature limit control should be set for a temperature of approximately 5 degrees C above the highest test temperature normally used, but no higher than 455°C. When this temperature is reached, the MP600 Controller will remove power from the heaters and display ERROR 16.

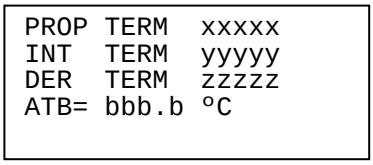
10.3.2 Press the [2] key from the **TEMP CONTROL** Configuration Menu to access the **VIEW** PID/TEMP Screens. This provides access to screens for viewing the set point, temperature of top and bottom control zones, and the proportional, integral and derivative terms for the top and bottom zones. These screens are used primarily for diagnostic purposes. Press [ENTER] to scroll through the VIEW PID/TEMP Screens. Press [EXIT] to return to the **TEMP CONTROL** Configuration Menu.

```
SET POINT    xxx.x C
ACTUAL TOP   yyy.y C
ACTUAL BOT   zzz.z C
PRESS ENTER TO CONT
```

Where *xxx.x* is the current setpoint, yyy.y is the actual top zone temperature and zzz.z is the actual bottom zone temperature. The [ENTER] Key will move the display to CFGv2. The [EXIT] Key will return the user to the **TEMP CONTROL** Configuration Menu.



CFGv2



CFGv3

CFGv2 and CFGv3 show the current PID term values and the actual temperature for the Top and Bottom zones, respectively. The [ENTER] Key will advance from CFGv2 to CFGv3 and then to the **TEMP CONTROL** Configuration Menu. Press [EXIT] key at any time to return to the **TEMP CONTROL** Configuration Menu.

10.3.3 Pressing the [3] key from the **TEMP CONTROL** Configuration Menu accesses the **SET PID PARAMS** Configuration Mode. Screens that show the present PROP BAND, RESET, ILM, RATE BAND, and RATE for both the top and bottom control zones can be viewed and new values entered. (Note that pressing [ENTER] accepts the existing entry and advances to the next screen. Pressing [EXIT] returns the user to the **TEMP CONTROL** Configuration Menu). Refer to Section 19 for additional information.

CAUTION: Machines are shipped with factory settings already entered in the above SET PID PARAMS Configuration Mode. DO NOT CHANGE ANY OF THESE SETTINGS WITHOUT A GOOD UNDERSTANDING OF THE EFFECT THE CHANGE WILL HAVE ON THE TEMPERATURE CONTROL CAPABILITY OF THE MP600.

10.4 Pressing the [3] key from the CONFIGURE Menu accesses the **SERIAL PORT** Configuration Mode. The following screens can now be configured. (Note that pressing [ENTER] accepts the existing entry and advances to the next screen. Pressing [EXIT] returns the user to the CONFIGURE Menu.)

10.4.1 **"Ser Port"** - Enter a "1" to have the MP600 work with a Dot-Matrix Serial Printer and print test reports. Enter a "2" to use the MP600 with a computer program. If “2” (Computer) is selected, refer directly to 10.4.3. If “1” (Printer) was selected, the following screen appears:

10.4.2 **“Baud Rate =”** - Select a baud rate compatible with the printer. Press [ENTER] to return to the CONFIGURE Menu.

10.4.3 **“Interface”** - Enter a “1” (RS232) if using a computer and software with a single MP600 connected to the serial port of the computer or if using Tinius Olsen’s EP600 Software Package with the MP600 connected to either the serial or USB port of the computer. Enter “2” (RS485) if the MP600 is being connected to a COM 422 card installed in the computer. Press [ENTER] to return to the CONFIGURE Menu.

10.4.4 **"Device Address"** - If using the RS485 Interface, enter a number between 0 and 9. When connecting more than one Extrusion Plastometer to a single computer using Tinius Olsen software, each Plastometer must have a different address. NOTE: This screen will only appear when the RS485 Interface is being used.

10.4.5 **“Baud Rate”** - Select the baud rate specified for the software. If using Tinius Olsen’s EP600 Software Package with the MP600 connected to either the serial or USB port of the computer, enter 19200. If the MP600 is being connected to a COM 422 card installed in the computer, enter 1200.

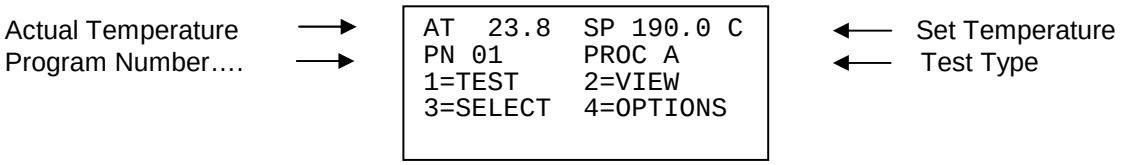
11 Section 11 - Test Parameters Programming Mode

11.1 General Information

11.1.1 Test parameters are bits of information that the microprocessor must know in order to perform a melt index test, i.e. test temperature, weight loading, etc. Test parameters vary with the material being tested. Twenty-five (25) test programs may be configured, and stored in the microprocessor for later use.

11.1.2 When this machine was originally shipped, the first four programs were set up at the factory as examples. These are shown in Table 11-2. **Do not change these programs until you fully understand the operation of the MP600 Controller.**

11.1.3 Access to the features described below is from the Idle Screen, similar to the following.



11.1.4 The test parameters in a program may be viewed, but not changed, by pressing the [2] key and following the instructions on the display.

11.1.5 Select a program by pressing the [3] key, entering a number between 1 and 25 and following the instructions on the display. The selected Program Number should now appear on the left side of the second line of the Idle Screen. (Note: When using a computer and Tinius Olsen software to operate the machine, avoid using Program 25 for operating the machine without use of the computer since the computer downloads to Program 25 and would therefore overwrite any manually programmed information.)

11.1.6 To modify (Edit) the selected program, press the [4] key for “OPTIONS” and then the [2] key for “EDIT”. At the “ENTER ACCESS CODE” screen press the [8], then the [5] and then the [2] key followed by [ENTER]. Select “EDIT PROGRAM” by pressing the [1] key. A series of parameter screens will be displayed and, in most cases, a default value will be displayed.

11.1.7 The first screen will determine the “PROCEDURE”, i.e., a Procedure A (Manual cutoff and weigh) or Procedure B (Automatically timed) Test. The “PROCEDURE” can be changed by pressing the appropriate numeric key or, press [ENTER] to accept the existing default.

11.1.8 Many of the remaining parameter screens will be dependent upon the type of test selected. The default value can be accepted by pressing [ENTER] or the existing default can be changed and then press [ENTER] to advance to the next screen. Press [CLEAR] if an entry error is made.

11.1.9 Most of the parameter screens can be answered with a numeric value, or by pressing the [-] key to enter “NU”, i.e., NOT USED, or by pressing the [START] key to enter ”TT” or “PI”, i.e., Ask at Test Time or Ask at Program Initiation. Changes are stored automatically. Pressing the [EXIT] key will exit the Programming Mode without having to respond to all screens.

11.1.10 When finished, the MP600 will return to the “EDIT/SELECT” screen and additional programs can be selected for editing. Pressing [EXIT] returns the user to the Idle Screen.

11.2 Test Parameters Programming - ASTM D 1238 Procedure A Testing

The following screens are shown when programming a Type A Test (manual cutoff and weighing of the extruded sample).

11.2.1 **“Type Test”** – Enter a “1” for a Type A Test.

11.2.2 **“Sample ID”** – This is used only for identification purposes on a printed test report. Enter either a fixed number, press the [-] key to not use the Sample ID, or press the [START] key to be prompted for the Sample ID at test time.

11.2.3 **“Run Number”** – This is used for identification purposes only on a printed test report. Enter either a number, press the [-] key to not use the Run Number, or press the [START] key to be prompted for the Run Number at test time. The Run Number is automatically incremented during a group of tests and is reset when a new group of tests is started.

11.2.4 **“Set Point”** – Enter a fixed temperature between 0 and 450° C or press the [START] key. If the [START] key is pressed, the Set Point entry will be prompted each time the program is selected.

11.2.5 **“Cal Offset”-“Top”** – This Calibration Offset is used to adjust the temperature readout and control point to agree with the temperature reference standard used to measure the cylinder temperature at 75 mm above the orifice. Enter the value provided with each new machine (or the value from reverification by a certified technician). If desired, press the [START] key to have this question asked at program initiation. The program will also set the “Cal Offset Bottom” to “PI” and skip the next screen.

11.2.6 **“Cal Offset”-“Bottom”** – This Calibration Offset is used to adjust the temperature readout and control point to agree with the temperature reference standard used to calibrate the cylinder temperature at 10 mm above the orifice. Enter the value provided with each new machine (or the value from reverification by a certified technician.) If desired, press the [START] key to have this question asked at program initiation. This screen will not show if the “Cal Offset Top” is set to “PI”.

11.2.7 **"Load"** – Enter the test load in kilograms to have Load and Shear Stress printed on the Test Report. The [START] key may be pressed to permit entry of the load at test time or the [-] key may be pressed to enter "NU" and not have the Load and Shear Stress values reported.

11.2.8 **"Orifice Dia"** – The nominal orifice diameter for ASTM D 1238 is 2.095 mm (0.0825 in.). Enter the numeric value of the orifice diameter to have Shear Stress calculated. Press the [-] key for "NU" (Not Used) or press the [START] key to permit entry of the orifice diameter at test time.

11.2.9 **"Orifice Lgth"** – The nominal orifice length for ASTM D 1238 is 8.00 mm (0.315 in.). Enter the numeric value of the orifice length to have Shear Stress calculated. Press the [-] key for "NU" (Not Used) or press the [START] key to permit entry of the orifice length at test time.

11.2.10 **"Cutoff Time"** – The manual Cutoff Interval time is entered in seconds. During the test, the timer beeps, resets, and begins recounting this time. The "beeps" are used to signal the user when to make the cut-offs. A numerical value between 1 and 999 may be entered. Press the [START] key to enter the cutoff time at test time.

11.2.11 **"Preheat Time"** (for preheat timing) – A fixed value from 1 to 999 seconds may be entered, the [START] key may be pressed to permit entry of the preheat time at test time or the [-] key may be pressed to enter "NU" (Not Used) for the preheat time.

When the preheat time is reached in a Type A Test, the alarm will sound, the elapsed timer (ET) will continue to display the total test time and the [START] key is pressed to start the Cutoff Interval Timer (CI).

Note that the optional MWLD-600 will not be lowered automatically during a Type A Test, the operator must manually position it.

11.3. Test Parameters Programming – ASTM D 1238 Procedure B Testing

The following screens are shown when programming a Type B Test (Automatically Timed Test). The PPDT-600 Automatic Timing Switch is required to perform this test type.

11.3.1 **"Type Test"** – Enter a "2" for a Type B Test.

11.3.2 **"Sample ID"** – This is used only for identification purposes on a printed test report. Enter either a fixed number, press the [-] key to not use the Sample ID, or press the [START] key to be prompted for the Sample ID at test time.

11.3.3 **"Run Number"** – This is used for identification purposes only on a printed test report. Enter either a number, press the [-] key to not use the Run Number, or press the [START] key to be prompted for the Run Number at test time. The Run Number is automatically incremented during a group of tests and is reset when a new group of tests is started.

11.3.4 **"Set Point"** – Enter either a fixed temperature between 0 and 450° C or press the [START] key. If the [START] key is pressed, the Set Point entry will be prompted each time the program is selected.

11.3.5 **"Cal Offset"-"Top"** – This Calibration Offset is used to adjust the temperature readout and control point to agree with the temperature reference standard used to measure the cylinder temperature at 75 mm above the orifice. Enter the value provided with each new machine (or the value from reverification by a certified technician). If desired, press the [START] key to have this question asked at program initiation. The program will also set the "Cal Offset Bottom" to "PI" and skip the next screen.

11.3.6 **"Cal Offset"-"Bottom"** – This Calibration Offset is used to adjust the temperature readout and control point to agree with the temperature reference standard used to calibrate the cylinder temperature at 10 mm above the orifice. Enter the value provided with each new machine (or the value from reverification by a certified technician.) If desired, press the [START] key to have this question asked program initiation. This screen will not show if the "Cal Offset Top" is set to "PI".

11.3.7 **"Load"** – Enter the test load in kilograms to have Load and Shear Stress or Viscosity printed on a test report. The [START] key may be pressed to permit entry of the load at test time or the [-] key may be pressed to enter "NU" and not have the Load and Shear Stress values reported.

11.3.8 **"Orifice Dia"** – The nominal orifice diameter for ASTM D 1238 is 2.095 mm (0.0825 in.). Enter the numeric value of the orifice diameter to have Shear Stress, Shear Rate and Viscosity calculated. Press the [-] key for "NU" (Not Used) or press the [START] key to permit entry of the orifice diameter at test time.

11.3.9 **"Orifice Lgth"** – The nominal orifice length for ASTM D 1238 is 8.00 mm (0.315 in.). Enter the numeric value of the orifice length to have Shear Stress, Shear Rate and Viscosity calculated. Press the [-] key for "NU" (Not Used) or press the [START] key to permit entry of the orifice length at test time.

11.3.10 **"Density"** – The melt density is required to obtain the Flow Rate in a Type B test. It is not required to obtain the Volume Rate, Shear Stress, Shear Rate or Viscosity.

Press the [1] key when entering a fixed melt density value, the [2] key to have the melt density calculated from a cut-off made during the first timed capture of a test, the [START] key to permit selection at test time, or the [-] key for "NU" (Not Used).

11.3.11 **"Melt Den"** - This screen appears if a "1" (fixed value) or "START" (at test time) was entered above for "Density". If a fixed "melt density" is used, enter the numeric value in grams per cubic centimeter, or press the [START] key to permit the "melt density" to be entered at test time. The melt density is required to calculate Flow Rate in a Type B test and normally has to be calculated. Do not use the room temperature density normally stated in the material specifications which is higher.

11.3.12 **"FR Constant"** – Enter the constant 426 (mean of the areas of the piston and cylinder X 600) found in the Procedure B Flow Rate Calculation Section of ASTM D 1238. (Or check other applicable Test Method for the proper constant if not using ASTM D 1238. For example ISO 1133 uses 427.)

11.3.13 **"Auto Piston Travel Select Method"** – This screen is shown only when "Entered" is selected on the above "Density" screen. If **"Yes"** is selected the MP600 will follow the criteria in ASTM D 1238 and automatically select a piston travel of 6.35 mm (0.25 in.) when the Flow Rate is "equal" to or "less than" 10 grams per 10 minutes, or a piston travel of 25.4 mm (1.00 in.) if the Flow Rate is "less than" 10 grams per 10 minutes. If **"No"** is selected, the next four screens will appear. If the [START] key is pressed, these selections can be made at test time.

The next four screens will appear <u>ONLY</u> if the "Auto Piston Travel Select Method" is set to "No".

11.3.14 **"No of Captures"** – The MP600 can make up to 10 captures (test measurements) during a test. Enter the desired number of captures or press [START] to permit selection at test time. At least one capture must be used to obtain a result.

11.3.15 **"Piston Travel Cap 1"** – Enter the desired piston travel distance for this capture or press [START] to permit its entry at test time.

11.3.16 **"Start Capture 1"** – Enter the desired starting height, i.e., distance above the top of the orifice, for "Piston Travel Cap 1". 46 mm (1.811 in.) is appropriate when testing in accordance with ASTM D 1238.

Note: If more than one capture has been selected above in the "No of Captures" screen, "Piston Travel" and "Start Capture" screens will appear for each capture. The MP600 will automatically set all Piston Travels equal to the 'Piston Travel Cap 1" distance, but these values can be overwritten by use of the numerical keys. Also, the Starting Heights are automatically set back-to-back based on the "Piston Travel Cap 1" distance, but can also be overwritten. **The starting height of a subsequent capture must be programmed not to occur prior to the finishing height of the previous capture.**

11.3.17 **"Display"** – Press the [1] key to have the Flow Rate or the [2] key to have the Volume Rate displayed on the Test Screen at the end of each capture. The [-] key will disable this function and the [START] key will permit selecting the desired result for display at test time.

11.3.18 **"Release Time"** (for preheat timing) – When the release time is reached in a Type B test, the alarm will sound (if activated) and the MWLD-600 (if available and activated) will lower its weight support platform fully. A fixed value from 1 to 999 seconds may be entered. Press the [START] key to permit the time entry at test time or the [-] key to enter "NU". If "NU" is entered and the "Auto Weight Lower" screen is set to "Yes", the weight support platform will automatically lower to the bottom when a test is started.

The following screens appear <u>ONLY</u> when the machine is equipped with the optional MWLD-600 Motorized Weight Support and Lowering Device.

11.3.19 **"Auto Weight Lower"** – Press the [0] key to disable or the [1] key to enable the MWLD-600 automatic lowering feature, or press the [START] key to permit selection at test time. If disabled, the operator must manually lower the weight support platform using the keys on the keypad. If enabled, when starting a test the optional MWLD-600 will automatically lower the weight support platform to the height entered on the following "Wt Sup Ht" screen. At the end of the "Release Time", the weight support will then be lowered automatically to the bottom of its stroke.

11.3.20 **"Wt Sup Ht"** – Enter the desired height that the weight support platform of the MWLD-600 should run to at the start of a test, or press the [START] key to permit the height entry to be made at test time. (Also, refer to 11.3.19.) Note: If an initial automatic lowering is not desired, set the above height entry to 228.6 mm (9.00 in.). The 228.6 mm entry is a nominal setting and your machine may be different depending on the under travel setting.

Displayed Results	Load	Orifice Diameter	Orifice Length	Melt Density	Piston Travel	Start Point
Melt Density				*	*	*
Shear Stress	*	*	*		*	*
Capture Time					*	*
Shear Rate		*			*	*
Viscosity	*	*	*		*	*
Flow Rate				*	*	*
Volume Rate					*	*

Table 11-1 - lists the available test results in the left column and what items must be selected in the program to obtain that result. For example to obtain the Flow Rate result the program must have the Melt Density, Piston Travel(s), Start Point(s) and Constant entered.

*** -** Indicates a value that must be entered to obtain this result. (Or press the [-] key for "NU" and this result will not be calculated.)

PROGRAM # 1	PROGRAM # 2	PROGRAM # 3	PROGRAM # 4
Procedure B	Procedure B	Procedure B	Procedure A
Sample ID NU	Sample ID NU	Sample ID NU	Sample ID NU
Run Number NU	Run Number NU	Run Number NU	Run Number NU
Set Point PI	Set Point PI	Set Point PI	Set Point PI
Cal Offset - TOP PI	Cal Offset - TOP PI	Cal Offset - TOP PI	Cal Offset - TOP PI
Cal Offset - BOTTOM PI	Cal Offset - BOTTOM PI	Cal Offset - BOTTOM PI	Cal Offset - BOTTOM PI
Load TT	Load TT	Load TT	Load TT
Orif Dia 2.096 mm (0.0825 in.)	Orif Dia 2.096 mm (0.0825 in.)	Orif Dia 2.096 mm (0.0825 in.)	Orif Dia 2.096 mm (0.0825 in.)
Orif Lgth 8.001 mm (0.315 in.)	Orif Lgth 8.001 mm (0.315 in.)	Orif Lgth 8.001 mm (0.315 in.)	Orif Lgth 8.001 mm (0.315 in.)
Density Entered	Density Calc	Density Entered	Cutoff Time TT
Melt Den TT		Melt Den TT	Preheat Time 420 s
FR Constant 426.0	FR Constant 426.0	FR Constant 426.0	
Auto Piston Travel Select Method No		Auto Piston Travel Select Method No	
No of Captures 1	No of Captures 1	No of Captures 4	
Piston Travel Cap 1 TT	Piston Travel Cap 1 TT	Piston Travel Cap 1 6.35 mm (0.250 in.)	
Start Capture 1 46.00 mm (1.811 in.)	Start Capture 1 46.00 mm (1.811 in.)	Start Capture 1 46.00 mm (1.811 in.)	
Display Flow Rate	Display Flow Rate	Piston Travel Cap 2 6.35 mm (0.250 in.)	
Release Time TT	Release Time TT	Start Capture 2 39.65 mm (1.561 in.)	
Auto Wt Lower Yes	Auto Wt Lower Yes	Piston Travel Cap 3 6.35 mm (0.250 in.)	
Wt Sup Ht 228.6 mm (9.00 in.)	Wt Sup Ht 228.6 mm (9.00 in.)	Start Capture 3 33.30 mm (1.311 in.)	
		Piston Travel Cap 4 6.35 mm (0.250 in.)	
		Start Capture 4 26.95 mm (1.061 in.)	
		Display Flow Rate	
		Release Time TT	
		Auto Wt Lower Yes	
		Wt Sup Ht 228.6 mm	

Table 11-2 Factory Programmed MP600 Test Parameter Screens

(Note: Programs No. 5 through 25 are factory programmed the same as Program No. 4.)

PROGRAM #	PROGRAM #	PROGRAM #	PROGRAM #
Procedure A	Procedure A	Procedure A	Procedure A
Sample ID	Sample ID	Sample ID	Sample ID
Run Number	Run Number	Run Number	Run Number
Set Point	Set Point	Set Point	Set Point
Cal Offset - Top	Cal Offset - Top	Cal Offset - Top	Cal Offset - Top
Cal Offset - Bottom	Cal Offset - Bottom	Cal Offset - Bottom	Cal Offset - Bottom
Load	Load	Load	Load
Orif Dia	Orif Dia	Orif Dia	Orif Dia
Orif Lgth	Orif Lgth	Orif Lgth	Orif Lgth
Cutoff Time	Cutoff Time	Cutoff Time	Cutoff Time
Preheat Time	Preheat Time	Preheat Time	Preheat Time

PROGRAM #	PROGRAM #	PROGRAM #	PROGRAM #
Procedure A	Procedure A	Procedure A	Procedure A
Sample ID	Sample ID	Sample ID	Sample ID
Run Number	Run Number	Run Number	Run Number
Set Point	Set Point	Set Point	Set Point
Cal Offset - Top	Cal Offset - Top	Cal Offset - Top	Cal Offset - Top
Cal Offset - Bottom	Cal Offset - Bottom	Cal Offset - Bottom	Cal Offset - Bottom
Load	Load	Load	Load
Orif Dia	Orif Dia	Orif Dia	Orif Dia
Orif Lgth	Orif Lgth	Orif Lgth	Orif Lgth
Cutoff Time	Cutoff Time	Cutoff Time	Cutoff Time
Preheat Time	Preheat Time	Preheat Time	Preheat Time

Table 11-3 – For User Developed Programs for Procedure A Tests

This blank page can be copied and used to write in the specific programs for ASTM D 1238 Procedure A - Manual Cutoff Test Procedure that are set up after receiving the unit. Keep them in your records or with the machine for future reference.

PROGRAM #	PROGRAM #	PROGRAM #	PROGRAM #
Procedure B	Procedure B	Procedure B	Procedure B
Sample ID	Sample ID	Sample ID	Sample ID
Run Number	Run Number	Run Number	Run Number
Set Point	Set Point	Set Point	Set Point
Cal Offset-Top	Cal Offset-Top	Cal Offset-Top	Cal Offset-Top
Cal Offset-Bottom	Cal Offset-Bottom	Cal Offset-Bottom	Cal Offset-Bottom
Load	Load	Load	Load
Orif Dia	Orif Dia	Orif Dia	Orif Dia
Orif Lgth	Orif Lgth	Orif Lgth	Orif Lgth
Density	Density	Density	Density
Melt Den	Melt Den	Melt Den	Melt Den
FR Constant	FR Constant	FR Constant	FR Constant
Auto Piston Travel Select Method- Yes/No	Auto Piston Travel Select Method- Yes/No	Auto Piston Travel Select Method- Yes/No	Auto Piston Travel Select Method- Yes/No
No of Captures	No of Captures	No of Captures	No of Captures
Piston Travel Cap 1	Piston Travel Cap 1	Piston Travel Cap 1	Piston Travel Cap 1
Start Capture 1	Start Capture 1	Start Capture 1	Start Capture 1
Piston Travel Cap 2	Piston Travel Cap 2	Piston Travel Cap 2	Piston Travel Cap 2
Start Capture 2	Start Capture 2	Start Capture 2	Start Capture 2
Piston Travel Cap 3	Piston Travel Cap 3	Piston Travel Cap 3	Piston Travel Cap 3
Start Capture 3	Start Capture 3	Start Capture 3	Start Capture 3
Piston Travel Cap 4	Piston Travel Cap 4	Piston Travel Cap 4	Piston Travel Cap 4
Start Capture 4	Start Capture 4	Start Capture 4	Start Capture 4
Piston Travel Cap 5-10	Piston Travel Cap 5-10	Piston Travel Cap 5-10	Piston Travel Cap 5-10
Start Capture 5-10	Start Capture 5-10	Start Capture 5-10	Start Capture 5-10
Display	Display	Display	Display
Release Time	Release Time	Release Time	Release Time
Auto Wt Lower Yes/No	Auto Wt Lower Yes/No	Auto Wt Lower Yes/No	Auto Wt Lower Yes/No
Wt Sup Ht	Wt Sup Ht	Wt Sup Ht	Wt Sup Ht

Table 11-4— For User Developed Programs for Procedure B Tests

This blank page can be copied and used to write in the specific Programs for ASTM D 1238 Procedure B - Automatic Timed Test Procedure that are set up after receiving the unit. Keep them in your records or with the machine for future reference.

B

L

A

N

K

12 Section 12 - Testing Polymers According to ASTM D 1238 "Procedure A" (Manual Cut-Off Operation)

NOTE: The instructions in this Section are based on ASTM D 1238. This test method should be thoroughly studied by all operators prior to using the MP600. Copies of the standard are available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959 USA Telephone: (610) 832-9721.

12.1 Introduction

12.1.1 Each MP600 is shipped from the factory with the first four programs already configured with example Test Parameters (see Table 11-2). Program 4 is set up for a "Procedure A" test. The instructions in this Section will follow the factory settings in Program 4. Any changes the operator makes in the program may affect the way the controller prompts the operator.

12.1.2 To perform tests to ASTM D 1238 Procedure A, only the basic machine is required, along with the appropriate weight(s) for the polymer to be tested, and the optional thermometer, if desired. If the machine is equipped with a PPDT-600 Automatic Timing Switch, simply rotate the switch in a counter-clockwise direction until it is out of the way. The optional Motorized Weight Lowering Device (MWLD-600) may be used if desired. However, the weight platform will have to raised and lowered manually by use of the keys. A laboratory scale, (not supplied by Tinius Olsen), having a resolution of 0.001 grams is also required.

12.2 Configuring the MP600 Controller for "Procedure A" Testing

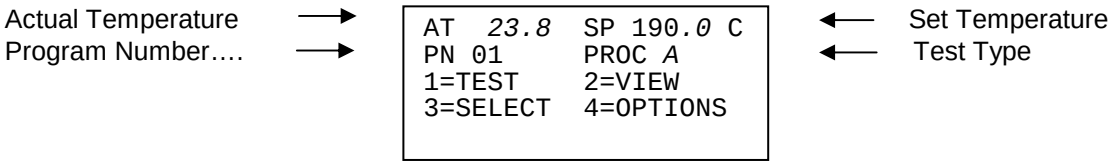
12.2.1 When the unit is powered up, the MP600 will prompt the user to "ENTER NEW SET POINT". Use the numeric keys to enter the desired test temperature and press the [ENTER] key.

NOTE: If the machine is equipped with the optional MWLD-600 Motorized Weight Lowering Device, the MP600 may first prompt the user to "RAISE WT SUPPORT". In this case, press the [9] (UP) key until the MWLD-600 weight platform stops and displays the above prompt.

12.2.2 The MP600 will then prompt the user to enter the "TOP OFFSET". Enter the TOP calibration offset for the above entered test temperature. Refer to the MP600 Configuration/Calibration Settings Worksheet that was supplied by the factory (or at the last calibration/verification). Press the [ENTER] key.

12.2.3 The display will prompt the user to enter the "BOTTOM OFFSET". Enter the BOTTOM calibration offset for the above entered test temperature. Refer to the MP600 Configuration/Calibration Settings Worksheet that was supplied by the factory (or at last calibration/verification). Press the [ENTER] key.

12.2.4 After the temperature prompts have been answered, the Idle Screen, similar to the one shown below, will be displayed. The MP600 Controller will then begin to ramp the temperature up to the Set Temperature (SP). The Program Number is shown on the left side of the second line of the Idle Screen. If the Program Number is not set to 4; press the [3] key to select a new program. Then press the [4] key and the [ENTER] key and follow the prompts to access the Idle Screen for Program 4 (PN).



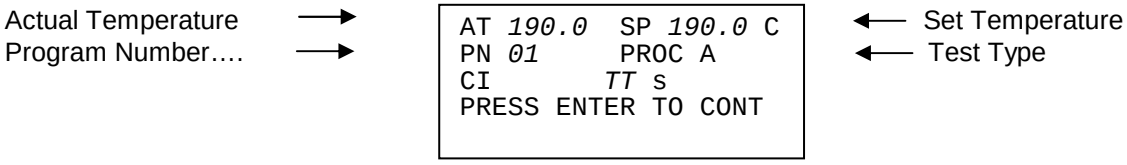
⚠ CAUTION: The surfaces of the furnace assembly can be extremely hot when the machine is in operation!

12.2.5 Once the machine has stabilized at the set temperature (+/- 0.2°C), remove the orifice (if present) and thoroughly clean the inside of the cylinder and orifice (see Section 16 for Cleaning Instructions).

12.2.6 Insert the orifice into the cylinder. The orifice should fall freely to the bottom of the cylinder with an audible click. If not, remove the orifice and visually inspect the orifice and cylinder for any defects or obstructions. Clean the cylinder and orifice again if necessary and insert the orifice into the cylinder. It is imperative that the cylinder has a mirror finish and that no residue remains on the outside or the inside diameter of the orifice.

12.2.7 Check that the piston rod assembly is clean and that the guide collar slides freely along the piston rod. Clean as needed and insert the piston into the cylinder. Allow the machine to stabilize at the set temperature.

12.2.8 To start the Procedure A type test, press the [1] "Test" key. The Test Mode Screen, similar to the one shown below, will be displayed. Note that the piston and orifice must be at temperature and in place prior to starting the test. **DO NOT** start a test with a room temperature piston and orifice.



12.2.9 Press [ENTER]. The MP600 will then prompt the user to enter "LOAD". Use the numeric keys to enter the total test load in kilograms and press [ENTER].

12.2.10 The MP600 will then prompt the user to enter the "CUTOFF TIME". Use the numeric keys to enter the appropriate Cutoff Time Interval in seconds. (Refer to Table 2 of ASTM D 1238 for the appropriate Time Interval that is based on the Flow Rate of the material under test.) DO NOT PRESS [ENTER] AT THIS TIME.

12.3 Test Procedure

12.3.1 Remove the preheated piston and place it in the tool rack. Verify that the orifice is at the bottom of the cylinder.

12.3.2 Press [ENTER]. The display will prompt the user to “LOAD SAMPLE” while indicating the elapsed time, “ET”.

12.3.3 Charge the cylinder with the material that is to be tested. Refer to ASTM D 1238, Table 1 (Table 2 in earlier versions) for suggestions on the amount of polymer to use for a test. To charge the cylinder, insert the funnel into the cylinder, and then slowly pour the material into the funnel. Do not dump it in all at once as it will melt and stick to the funnel. The brass orifice remover may be used to guide the material into the cylinder. This should be done within a reasonable time (refer to test method).

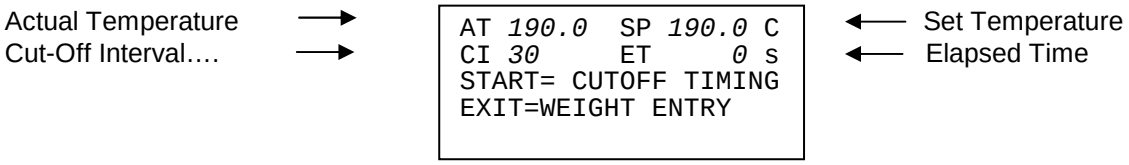
⚠ CAUTION: The funnel, when placed in the cylinder, can become extremely hot when the machine is at operating temperature! The time that the funnel is allowed to sit in the cylinder should be kept to a minimum.

12.3.4 After charging the cylinder, reinsert the piston and place the appropriate weight on the piston. If the machine is equipped with the optional Motorized Weight Support and Lowering Device, use the [DOWN] (3) key to lower the unit and apply the weight to the piston. NOTE: The ASTM D 1238 Method allows one minute to charge the cylinder, insert the piston, and start the preheat time of test.

TEST TIP: When testing materials with high melt flow rates (> 10 g/10 minutes), the weight platform of the optional MWLD-600 can be used to prevent excessive polymer from being purged from the cylinder prior to the end of the preheating period. To use this feature, lower the weight platform so that the top surface of the platform is approximately 25 mm (1 inch) above the 46 mm (1.81 inch) start position of the test measurement. (This can be accomplished above in 12.3.4 by using the [3] (DOWN) key to obtain a reading of approximately 71 mm (2.81”) on the “WT SUP HT” display. The weight platform will now catch the weight as it falls and support it, temporarily reducing the load on the material in the cylinder. When the Elapsed Time reaches the 420 seconds preheat requirement, lower the weight platform all the way and allow the test to continue.

Materials with extremely high melt flows may require the orifice to be plugged in addition to supporting the weight. Use the optional Tinius Olsen High Melt Flow Orifice Plug (TO P/N 02001455).

12.3.5 Press [ENTER] and the Test Screen, similar to the one shown below, will be displayed. The Elapsed Time (ET) display will reset to zero and begin to count up, in seconds. Material will begin to extrude through the orifice.



12.3.6 When the Elapsed Timer reaches the “Release Time” (Preheat Time) that was entered in the Set-up Parameters, an alarm will sound for about 5 seconds. At that time, the first (lower) scribe line on the piston rod should be close to entering the guide collar. ASTM D 1238 requires a preheat time of 7 +/- 0.5 minutes (420 +/- 30 seconds). If the scribe line has not entered the guide collar during the preheating period, the amount of material charged should be reduced. Alternatively, the material in the cylinder can be manually purged during the first 300 seconds of the preheating period.

12.3.7 Using the cutoff tool, cut off the material that has extruded from the orifice, while at the same time pressing the [START] key to activate the Cutoff Interval Timer (CI). (All cut-offs must be made directly at the bottom of the orifice.) The timer will then begin counting down. When the Cutoff Interval Timer reaches zero, the alarm will beep. The cut-off should be made at the time of the beep. The timer will automatically reset and begin counting for the next cut-off should additional cutoffs be required. To reset the timer during the middle of a test, press the [START] key. When the cut-off(s) have been completed, press the [EXIT] key.

12.3.8 The operator will then be prompted to enter the weight of the first cut-off. Weigh this cut-off to the nearest milligram (0.001 grams). Enter its weight, in grams, using the numeric keys and press the [ENTER] key. The display will show the FLOW RATE in grams per 10 minutes. Press the [ENTER] key and continue entering cutoff weights to obtain FLOW RATE values for additional cut-offs that were made. Enter 0 for a cutoff weight when you are finished, and the average FLOW RATE and the number (n=) of cut-offs will be displayed.

12.3.9 Allow the remaining material to purge from the cylinder and then, if the machine is equipped with the optional MWLD-600, press the [7] (TOP) key to raise the weight support platform.

12.3.10 Thoroughly clean the piston, cylinder and orifice as described in Section 16. **IT IS IMPERATIVE THAT THE MACHINE IS CLEANED AFTER EACH TEST.** If no more tests are needed, remove the piston and orifice from the furnace before turning the MP600 off to prevent them from being welded in place as any material left in the barrel hardens.

12.3.11 To prepare for another test, press the [EXIT] key. The display will Prompt, “Another Test? 1=SAME PARAMETERS, 2=NEW PARAMETERS, PRESS EXIT to EXIT”. If the [1] key is pressed, the CUTOFF TIME screen will be displayed and the previous time entry can be accepted by pressing [ENTER] or the time entry can be changed by use of the numeric keys. If the [2] key is pressed, all “At Test Time” screens will be displayed and can be changed by use of the numeric keys or accepted by pressing [ENTER]. After all “At Test Time” (TT) screens have been reviewed or changed, pressing [ENTER] returns the user to the “LOAD SAMPLE” screen in preparation for the next test. Pressing [EXIT] returns the user to the Idle Screen.

13 Section 13 - Testing Polymers According to ASTM D 1238 Procedure B (Automatically Timed Flow Rate) when the Melt Density is known.

NOTE: The instructions in this Section are based on ASTM D 1238. This test method should be thoroughly studied by all operators prior to using the MP600. Copies of the standard are available from ASTM at 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, USA – Telephone: (610) 832-9721.

13.1 Introduction

13.1.1 The MP600 must be equipped with the PPDT-600 Automatic Timing Switch in order to perform a test according to ASTM D 1238, Procedure B. The test also requires the appropriate weight(s) for the polymer to be tested. The optional Motorized Weight Lowering Device (MWLD-600) may be used if desired.

13.1.2 Each MP600 is shipped from the factory with the first four programs already configured with example Test Parameters (see Table 11-2). Programs 1, 2 & 3 are set up as examples of a Procedure B test. Instructions in this Section will follow the factory settings in Program Number 1. Any changes the operator makes in the program may affect the way the controller prompts the operator.

13.1.3 If the optional MWLD-600 is being used, it is good practice to manually lower the weight onto the piston prior to testing in order to check the alignment of the piston with respect to the hole in the weight. After checking the alignment, raise the weight platform to its upper position.

13.2 Configuring the MP600 Controller for Procedure B Testing

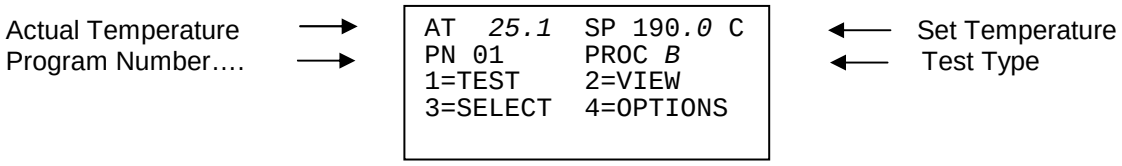
13.2.1 When the unit is powered up, the MP600 will prompt the user to “ENTER NEW SET POINT”. Use the numeric keys to enter the desired test temperature and press the [ENTER] key.

NOTE: If the machine is equipped with the optional MWLD-600 Motorized Weight Lowering Device, the MP600 may first prompt the user to “RAISE WT SUPPORT”. In this case, press the [9] (UP) key until the MWLD-600 weight platform stops and displays the above prompt.

13.2.2 The MP600 will then prompt the user to enter the “TOP OFFSET”. Enter the TOP calibration offset for the above entered test temperature. Refer to the MP600 Configuration/Calibration Settings Worksheet that was supplied by the factory (or at the last calibration/verification). Press the [ENTER] key.

13.2.3 The display will then prompt the user to enter the “BOTTOM OFFSET”. Enter the BOTTOM calibration offset for the above entered test temperature. Refer to the MP600 Configuration/Calibration Settings Worksheet that was supplied by the factory (or at last calibration/verification). Press the [ENTER] key.

13.2.4 After the temperature prompts have been answered, the Idle Screen, similar to the one shown below, will be displayed. The MP600 Controller will then begin to ramp the temperature up to the Set Temperature (SP). The Program Number is shown on the left side of the second line of the Idle Screen. If the Program Number is not set to 1; press the [3] key to "Select "a new program. Then press the [1] key and the [ENTER] key and follow the prompts to access the Idle Screen for Program 1 (PN).



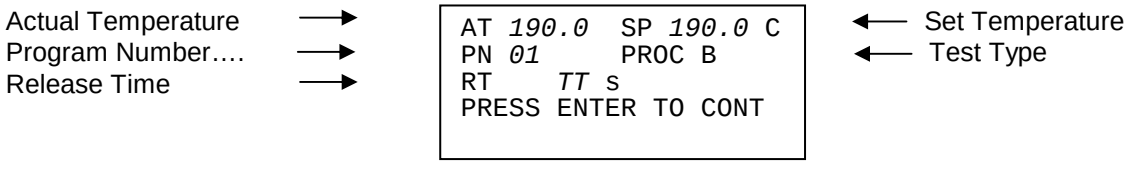
⚠ CAUTION: The surfaces of the furnace assembly can be extremely hot when the machine is in operation!

13.2.5 Once the machine has stabilized at the set temperature (+/- 0.2^{o}C), remove the orifice (if present) and thoroughly clean the inside of the cylinder and orifice. (See Section 16 for Cleaning Instructions)

13.2.6 Insert the orifice into the cylinder. The orifice should fall freely to the bottom of the cylinder with an audible click. If not, remove the orifice and visually inspect the orifice and cylinder for any defects or obstructions. Clean the cylinder and orifice again if necessary and insert the orifice into the cylinder. It is imperative that the cylinder has a mirror finish and that no residue remains on the outside or the inside diameter of the orifice.

13.2.7 Check that the piston rod assembly is clean and that the guide collar slides freely along the piston rod. Clean as needed and insert the piston into the cylinder. Allow the machine to stabilize at the set temperature.

13.2.8 To start the Procedure B type test, press the [1] "Test" key. The Test Mode Screen, similar to the one shown below, will be displayed.



13.2.9 Press [ENTER]. The MP600 will then prompt the user to enter "LOAD". Use the numeric keys to enter the total test load in kilograms and press [ENTER].

13.2.10 The MP600 will then prompt the user to enter the “MELT DEN” (Melt Density). Use the numeric keys to enter the Melt Density of the resin in grams per cubic centimeter and press [ENTER].

13.2.11 The MP600 will then prompt the user to enter the “Piston Travel – Cap (Capture) 1”. ASTM D 1238 requires a piston travel of 6.35 mm (0.25 inch) for materials with expected flow rates of up to 10 grams/10 minutes and 25.4 mm (1.0 inch) for higher flow rate materials. Use the numeric keys to enter the appropriate piston travel and press [ENTER].

TEST TIP: The above Step for selecting the appropriate piston travel distance can be eliminated by modifying Program 1 or setting up another Program with “AUTO PISTON TRAVEL SELECT METHOD” = “YES” (Refer to Section 11). If this method is used, the MP600 will automatically select the correct piston travel based on a real-time calculation of the Flow Rate at the end of the first 6.35 mm (0.25”) capture of piston travel. If = or < 10 the test measurement will then terminate automatically. If >10 the test measurement will continue for the entire 25.4 mm (1”).

13.2.12 The MP600 will then prompt the user to enter “START CAPTURE 1”, i.e., the starting distance above the top of the orifice, for CAP (Capture) 1. For ASTM D 1238, an acceptable starting position is 46 mm (1.811”). This is the default value. Press [ENTER] to accept this value.

13.2.13 The MP600 will then prompt the user to enter the “Release Time”. The release time is actually the preheat time. Currently, ASTM D 1238 requires a preheat time of 7 +/- 0.5 minutes (420 +/- 30 seconds). However, refer to the appropriate ASTM material specification to determine the recommended preheat time for the material that is to be tested. Enter 420 seconds or other appropriate time. DO NOT PRESS [ENTER] AT THIS TIME.

13.3 Test Procedure

13.3.1 Remove the piston and place it in the tool rack. Verify that the orifice is at the bottom of the cylinder.

13.3.2 Press [ENTER]. The display will prompt the user to “LOAD SAMPLE” while indicating “ET” the elapsed time.

13.3.3 Charge the cylinder with the material that is to be tested. Refer to ASTM D 1238, Table 1 (Table 2 in earlier versions), for suggestions on the amount of polymer to use for a test. To charge the cylinder, insert the funnel into the cylinder, and then slowly pour the material into the funnel. Do not dump it in all at once as it will melt and stick to the funnel. The brass orifice remover (P/N: 02001073) may be used to guide the material into the cylinder.

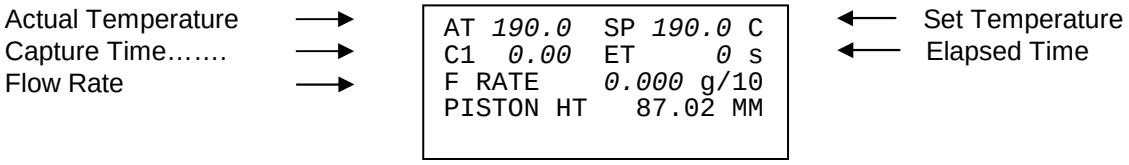
CAUTION: The funnel, when placed in the cylinder, can become extremely hot when the machine is at operating temperature! The time that the funnel is allowed to sit in the cylinder should be kept to a minimum.

13.3.4 After charging the cylinder, tamp the material down with the charging tool (P/N 02001582) in order to remove some of the trapped air. (Depending on the amount of material to be charged, you may have to tamp the material down more than once to load it all into the cylinder). Reinsert the piston, rotate the PPDT-600 clockwise so that the end of the arm is close to the piston rod, and place the appropriate weight on the piston (either manually or, if using the optional MWLD-600, hold the [3] (DOWN) key depressed). NOTE: The ASTM D 1238 Method allows 1 minute to charge the cylinder, insert the piston rod and start the preheat time of the test.

TEST TIP: When testing materials with high melt flow rates (> 10g/10 minutes), the weight platform of the optional MWLD-600 can be used to prevent excessive polymer from being purged from the cylinder prior to the end of the preheating period. To use this feature, lower the weight platform so that the top surface of the platform is approximately 25 mm (1 inch) above the 46 mm (1.81 inch) start position of the test measurement. This can be accomplished above in 13.3.4 by using the [3] (DOWN) key to obtain a reading of approximately 71 mm (2.81") on the "WT SUP HT" display. The weight platform will now catch the weight as it falls and support it, temporarily reducing the load on the material in the cylinder. When the Release Time reaches 420 seconds (or other time entered above in 13.2.13), the weight platform will lower fully and allow the test to continue. Note that to achieve the total preheat time of 420 +/- 30seconds, it may be necessary to reduce the Release Time. The total time from start of test to the start of test measurement can be observed by watching the elapsed time "ET" display.

Materials with extremely high melt flows may require the orifice to be plugged in addition to supporting the weight. Use the optional Tinius Olsen High Melt Flow Orifice Plug (P/N 02001455).

13.3.5 Press [START] and the Test Screen, similar to the one shown below, will be displayed. The Elapsed Time (ET) display will reset to zero and begin to count up, in seconds. Material will begin to extrude through the orifice. The test can be aborted at any time by pressing the [EXIT] key.



⚠ CAUTION: If the optional MWLD-600 is being used in the automatic mode, and the Weight Support has been programmed to run to a height less than its maximum height, the weight platform will automatically begin to lower the weight(s) when the [START] key is pressed. Keep hands clear!

13.3.6 When the elapsed time (ET) reaches the "Release Time" (Preheat Time) that was entered in 13.2.13, an alarm will sound (if enabled) for about 5 seconds. The first (lower) scribe line on the ASTM piston rod should now be close to entering the guide collar.

⚠ CAUTION: If the optional MWLD-600 is being used, and the “Auto Wt Lower” screen has been set to “Yes”, the MWLD-600 will automatically begin to lower the weight(s) at the end of the preheating period (Release Time), provided that it has not already been lowered all the way at the start of the test. Keep hands clear!

Note: ASTM D 1238 requires the test measurement to be started at 46+/-2 mm (1.81+/- 0.079 inches) above the top of the orifice and 7+/-0.5 minutes (420+/-30 seconds) after starting the release (preheat) time. If the preheat time criteria is not met, the amount of material charged and/or the release time used should changed accordingly.

13.3.7 When the weight drives the arm of the PPDT-600 to the “Start Capture 1” Height, a momentary alarm will sound and the “Capture” light on the MP600 will illuminate. The MP600 will automatically start recording the time it takes for the piston to travel the programmed “Piston Travel CAP 1” distance entered in 13.2.11.

NOTE: There is no need to cut off the extrudate during a typical Procedure B test when the Melt Density value has been entered.

13.3.8 When the arm of the PPDT-600 reaches the end of the capture distance, the alarm will beep twice and the “Capture” light will turn off.

13.3.9 At the end of the measured piston travel, the “F RATE” will be shown on the third line of the display (and all results will printed if a printer is connected). If a printer is not being used, all results can be viewed by pressing the [ENTER] key.

13.3.10 Allow the remaining material to purge from the cylinder and then, if the machine is equipped with the optional MWLD-600, press the [7] (TOP) key to raise the weight support platform.

13.3.11 Rotate the PPDT-600 counter-clockwise so that its arm is toward the rear of the furnace. This will prevent damage to the arm during cleaning operations.

13.3.12 Clean the piston, cylinder and orifice thoroughly as described in Section 16. IT IS IMPERATIVE THAT THE MACHINE IS CLEANED AFTER EACH TEST. If no more tests are needed, remove the piston and orifice from the furnace before turning the MP600 off to prevent them from being welded in place as any material left in the barrel hardens.

13.3.13 To prepare for another test, press the [EXIT] key. The display will prompt, “Another Test? 1=SAME PARAMETERS, 2=NEW PARAMETERS, PRESS EXIT to EXIT”. If the [1] key is pressed, the “Melt Density” screen will be displayed. The previous entry can be accepted by pressing [ENTER] or the entry can be changed by use of the numeric keys. If the [2] key is pressed, all “At Test Time” screens will be displayed and can be changed by use of the numeric keys or accepted by pressing [ENTER]. After all “At Test Time” (TT) screens have been reviewed or changed, pressing [ENTER] returns the user to the “LOAD SAMPLE” screen in preparation for the next test. Press [EXIT] to return to the Idle Screen.

14 Section 14 - Testing Polymers According to ASTM D 1238 Procedure B (Automatically Timed Flow Rate) when the Melt Density is Unknown (Procedure for Calculating the Melt Density of a Polymer)

NOTE: The instructions in this Section are based on ASTM D 1238. This test method should be thoroughly studied by all operators prior to using the MP600. Copies of the standard are available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959 USA – Telephone: (610) 832-9721.

14.1 Introduction

14.1.1 The MP600 must be equipped with the PPDT-600 Automatic Timing Switch in order to determine the melt density. The test also requires the appropriate weight(s) for the polymer to be tested. The optional Motorized Weight Lowering Device (MWLD-600) may be used if desired. A laboratory scale, (not supplied by Tinius Olsen), having a resolution of 0.001 grams is also required.

14.1.2 Each MP600 is shipped from the factory with the first four programs already configured with example Test Parameters (see Table 11-2). Programs 1, 2 & 3 are set up as examples of a Procedure B test. Instructions in this Section will follow the factory settings in Program Number 2. Any changes the operator makes in the program may affect the way the controller prompts the operator

14.1.3 If the optional MWLD-600 is being used, it is good practice to manually lower the weight onto the piston prior to testing in order to check the alignment of the piston with respect to the hole in the weight. After checking the alignment, raise the weight platform to its upper position.

14.2 Configuring the MP600 Controller for Procedure B Testing

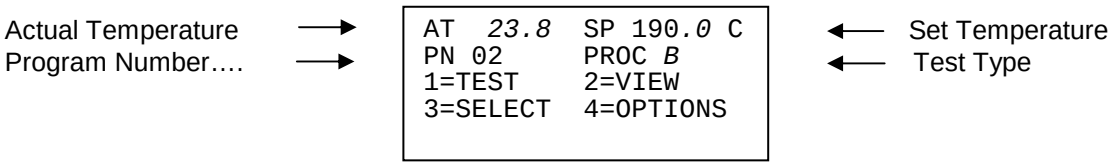
14.2.1 When the unit is powered up, the MP600 will prompt the user to “ENTER NEW SET POINT”. Use the numeric keys to enter the desired test temperature and press the [ENTER] key.

NOTE: If the machine is equipped with the optional MWLD-600 Motorized Weight Lowering Device, the MP600 may first prompt the user to “RAISE WT SUPPORT”. In this case, press the [9] (UP) key until the MWLD-600 weight platform stops and displays the above prompt.

14.2.2 The MP600 will then prompt the user to enter the “TOP OFFSET”. Enter the TOP calibration offset for the above entered test temperature. Refer to the MP600 Configuration/Calibration Settings Worksheet that was supplied by the factory (or at the last calibration/verification). Press the [ENTER] key once to accept the entry and again to advance to the next screen.

14.2.3 The display will then prompt the user to enter the “BOTTOM OFFSET”. Enter the BOTTOM calibration offset for the above entered test temperature. Refer to the MP600 Configuration/Calibration Settings Worksheet that was supplied by the factory (or at last calibration/verification). Press the [ENTER] key.

14.2.4 After the temperature prompts have been answered, the Idle Screen, similar to the one shown below, will be displayed. The MP600 Controller will then begin to ramp the temperature up to the Set Temperature (SP). The Program Number is shown on the left side of the second line of the Idle Screen. If the Program Number is not set to 2; press the [3] key to “Select “a new program. Then press the [2] key and the [ENTER] key and follow the prompts to access the Idle Screen for Program 2 (PN).



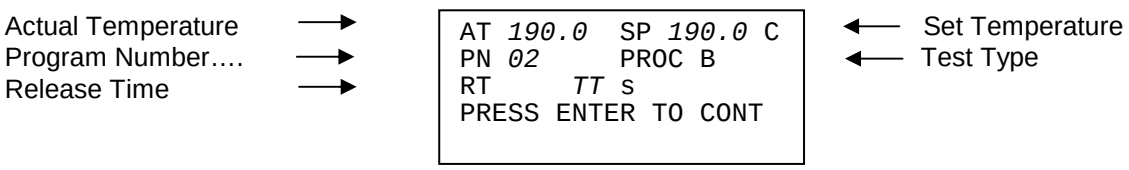
⚠ CAUTION: The surfaces of the furnace assembly can be extremely hot when the machine is in operation!

14.2.5 Once the machine has stabilized at the set temperature (+/- 0.2^{o}C), remove the orifice (if present) and thoroughly clean the inside of the cylinder and orifice. (See Section 16 for Cleaning Instructions)

14.2.6 Insert the orifice into the cylinder. The orifice should fall freely to the bottom of the cylinder with an audible click. If not, remove the orifice and visually inspect the orifice and cylinder for any defects or obstructions. Clean the cylinder and orifice again if necessary and insert the orifice into the cylinder. It is imperative that the cylinder has a mirror finish and that no residue remains on the outside or the inside diameter of the orifice.

14.2.7 Check that the piston rod assembly is clean and that the guide collar slides freely along the piston rod. Clean as needed and insert the piston into the cylinder. Allow the machine to stabilize at the set temperature.

14.2.8 To start the Procedure B type test, press the [1] “Test” key. The Test Mode Screen, similar to the one shown below, will be displayed.



14.2.9 Press [ENTER]. The MP600 will then prompt the user to enter “LOAD”. Use the numeric keys to enter the total test load in kilograms and press [ENTER].

14.2.10 The MP600 will then prompt the user to enter the “Piston Travel – Cap (Capture) 1”. ASTM D 1238 requires a piston travel of 6.35 mm (0.25 inch) for materials with expected flow rates of up to 10 grams/10 minutes and 25.4 mm (1.0 inch) for higher flow rate materials. Use the numeric keys to enter the appropriate piston travel and press [ENTER].

14.2.11 The MP600 will then prompt the user to enter “START CAPTURE 1”, i.e., the starting distance above the top of the orifice, for CAP (Capture) 1. For ASTM D 1238, an acceptable starting position is 46 mm (1.811”). This is the default value. Press [ENTER] to accept this value.

14.2.12 The MP600 will then prompt the user to enter the “Release Time”. The release time is actually the preheat time. Currently, ASTM D 1238 requires a preheat time of 7 +/- 0.5 minutes (420 +/- 30 seconds). However, refer to the appropriate ASTM material specification to determine the recommended preheat time for the material that is to be tested. Enter 420 seconds or other appropriate time. DO NOT PRESS [ENTER] AT THIS TIME.

14.3 Test Procedure

14.3.1 Remove the piston and place it in the tool rack. Verify that the orifice is at the bottom of the cylinder.

14.3.2 Press [ENTER]. The display will prompt the user to “LOAD SAMPLE” while indicating “ET” the elapsed time.

14.3.3 Charge the cylinder with the material that is to be tested. Refer to ASTM D 1238, Table 1 (Table 2 in earlier versions), for suggestions on the amount of polymer to use for a test. To charge the cylinder, insert the funnel into the cylinder, and then slowly pour the material into the funnel. Do not dump it in all at once as it will melt and stick to the funnel. The brass orifice remover (P/N: 02001073) may be used to guide the material into the cylinder.

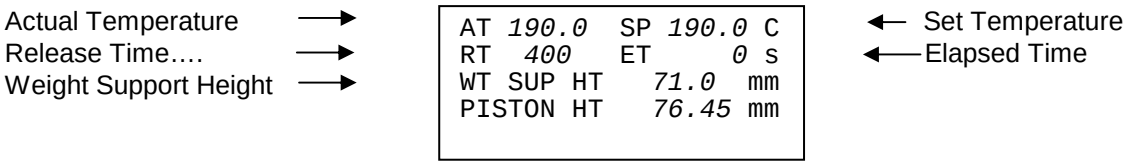
⚠ CAUTION: The funnel, when placed in the cylinder, can become extremely hot when the machine is at operating temperature! The time that the funnel is allowed to sit in the cylinder should be kept to a minimum.

14.3.4 After charging the cylinder, reinsert the piston, and then rotate the PPDT-600 clockwise so that the end of the arm is close to the piston rod, and place the appropriate weight on the piston (either manually or if using the optional MWLD-600, hold the [3] (DOWN) key depressed). NOTE: The ASTM D 1238 Method allows 1 minute to charge the cylinder, insert the piston rod and start the preheat time of the test.

TEST TIP: When testing materials with high melt flow rates (> 10 g/10 minutes), the weight platform of the optional MWLD-600 can be used to prevent excessive polymer from being purged from the cylinder prior to the end of the preheating period. To use this feature, lower the weight platform so that the top surface of the platform is approximately 25 mm (1 inch) above the 46 mm (1.81 inch) start position of the test measurement. (This can be accomplished above in 14.3.4 by using the [3] (DOWN) key to obtain a reading of approximately 71 mm (2.81") on the "WT SUP HT" display. The weight platform will now catch the weight as it falls and support it, temporarily reducing the load on the material in the cylinder. When the Release Time reaches 420 seconds (or other time entered above in 14.2.12), the weight platform will lower fully and allow the test to continue. Note that to achieve the total preheat time of 420+/-30seconds, it may be necessary to reduce the Release Time. The total time from start of test to the start of test measurement can be observed by watching the elapsed time "ET" display.

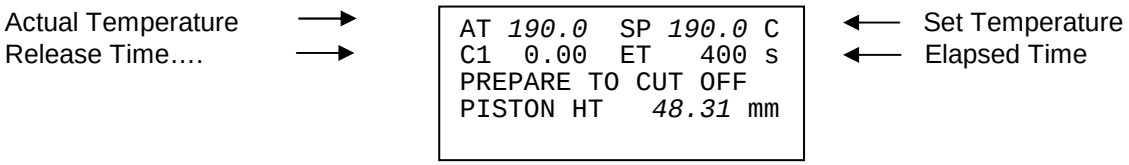
Materials with extremely high melt flows may require the orifice to be plugged in addition to supporting the weight. Use the optional Tinius Olsen High Melt Flow Orifice Plug (TO P/N 02001455).

14.3.5 Press [START] and the Test Screen, similar to the one shown below, will be displayed. The Elapsed Time (ET) display will reset to zero and begin to count up, in seconds. Material will begin to extrude through the orifice. The test can be aborted at any time by pressing the [EXIT] key.



⚠ CAUTION: If the optional MWLD-600 is being used, and the Weight Support has been programmed to run to a height less than its maximum height, the weight platform will automatically begin to lower the weight(s) when the [START] key is pressed. Keep hands clear!

14.3.6 When the elapsed time (ET) reaches the “Release Time” (Preheat Time) that was entered in 14.2.12, an alarm will sound (if enabled) for about 5 seconds and the “Cut Off Prompt” Screen, similar to the one shown below, will be displayed. The first (lower) scribe line on the ASTM piston rod should now be close to entering the guide collar.



⚠ CAUTION: If the optional MWLD-600 is being used, and the “Auto Wt Lower” screen has been set to “Yes”, the MWLD-600 will automatically begin to lower the weight(s) at the end of the preheating period (Release Time), provided that it has not already been lowered all the way at the start of the test. Keep hands clear!

Note: ASTM D 1238 requires the test measurement to be started at 46+/-2 mm (1.81+/- 0.079 inches) above the top of the orifice and 7+/-0.5 minutes (420+/-30 seconds) after starting the release (preheat) time. If the preheat time criteria is not met, the amount of material charged and/or the release time used should changed accordingly.

14.3.7 Observe the “PISTON HT” on the display. When the weight drives the arm of the PPDT-600 to the “Start Capture 1” Height, i.e., 46 mm (1.81“), a single beep will sound and the “Capture” light on the MP600 will illuminate. Simultaneously with this single beep, use the Cut-Off Tool to cut off and discard the material that has extruded through the orifice during the “Preheat” period. The MP600 will automatically start recording the time it takes for the piston to travel the programmed “Piston Travel CAP 1” distance entered in 14.2.10.

14.3.8 When the arm of the PPDT-600 reaches the end of the capture distance, the alarm will beep twice and the “Capture” light will turn off. Simultaneously with this double beep, cut off the material that has extruded through the orifice during the capture time.

TEST TIP: For best accuracy it is important that the cut-offs are made directly at the bottom of the orifice and precisely at the sound of the single and double beeps.

14.3.9 The display will now prompt the user to “ENTER CUTOFF WT 1”. Weigh the material cut off in 14.3.8, use the numeric keys to enter its weight (in grams) and press [ENTER].

14.3.10 The calculated “FLOW RATE” will be displayed (and all results will printed if a printer is connected). If a printer is not being used, all results can be viewed by repeatedly pressing the [ENTER] key. Record any data as required.

14.3.11 Allow the remaining material to purge from the cylinder and then, if the machine is equipped with the optional MWLD-600, press the [7] (TOP) key to raise the weight support platform.

14.3.12 Rotate the PPDT-600 counter-clockwise so that its arm toward the rear of the furnace. This will prevent damage to the arm during cleaning operations.

14.3.13 Clean the piston, cylinder and orifice thoroughly as described in Section 16. **IT IS IMPERATIVE THAT THE MACHINE IS CLEANED AFTER EACH TEST.** If no more tests are needed, remove the piston and orifice from the furnace before turning the MP600 off to prevent them from being welded in place as any material left in the barrel hardens.

14.3.14 Once the Melt Density is established for a particular polymer formulation, this value should be recorded. (It is well to perform several tests to obtain an average value.) Subsequent tests on this formulation can then be made without the need to cut-off and weigh the extrudate. (Refer to Section 13.) Keep in mind that any additive and/or variation in the formulation can affect the melt density value.

14.3.15 To prepare for another test, press the [EXIT] key. The display will prompt, “Another Test? 1=SAME PARAMETERS, 2=NEW PARAMETERS, PRESS EXIT to EXIT”: If the [1] key is pressed, the user will be returned to the “LOAD SAMPLE” screen. If the [2] key is pressed, all “At Test Time” screens will be displayed and can be changed by use of the numeric keys or accepted by pressing [ENTER]. After all “At Test Time” (TT) screens have been reviewed or changed, pressing [ENTER] returns the user to the “LOAD SAMPLE” screen in preparation for the next test. [EXIT] returns the user to the Idle Screen.

15 Section 15 - FLOW RATE RATIO PACKAGE

15.1 Introduction

15.1.1 The optional Flow Rate Ratio (FRR) Attachment is designed for use with a Model MP600 Extrusion Plastometer that is equipped with a PPDT-600 Automatic Timing Switch and an MWLD-600 Motorized Weight Lowering Device.

15.1.2 The FRR Attachment allows flow rate determinations to be made using two or three different test loads on one charge of material. Refer to Figure 15-1 for help with identifying components. Flow Rate Ratio determinations can be made with or without a computer and Tinius Olsen software. However, the use of the software makes setting up and collecting data much easier. Also, the software will calculate the flow rate ratios; whereas, they must be calculated from the basic flow rate data obtained from the MP600 when a computer and Tinius Olsen software are not used.

15.1.3 The three test loads most commonly used for this test are 21.6, 10.0, and 2.16 kilograms. (Weight sets can be provided for other load combinations.) The weights will be set to change at the heights given in the example that follows. Individual weights for the above test loads are 2,060, 7,840, and 11,600 grams. At the end of the preheat period, the MWLD-600 lowers the total weight stack (21.6 kg) and, once the start point has been reached, the MP600 records the flow rate for that particular load. When the “upper” weight reaches the Load Change Collars, it is removed from the weight stack. The test continues with the lower two weights (10 kg) applying the load. After the second flow rate is determined, the “middle” weight will be removed from the weight stack by the Load Change Pins. The third and last flow rate is made with only the lower weight applying the test load. Flow rate values are calculated using ASTM D 1238, Procedure B methodology.

15.1.4 A two load test operates in a similar manner except that the upper, or upper and middle weights are supported after the first flow rate determination while the remaining weight(s) continue(s) downward for second flow rate measurement.

15.2 Flow Rate Ratio Attachment Components

15.2.1 (3) Load Change Pins - used to remove (lift) the intermediate 5 inch diameter weight. Each pin has two different length-adjusting screws with hex nuts. The length-adjusting screws used are dependent on the height at which the load change is to occur.

15.2.2 (4) Extended Weight-Retaining Rods - used for containing the weights. They also hold the four split Load Change Collars used to remove the upper 6” diameter weight.

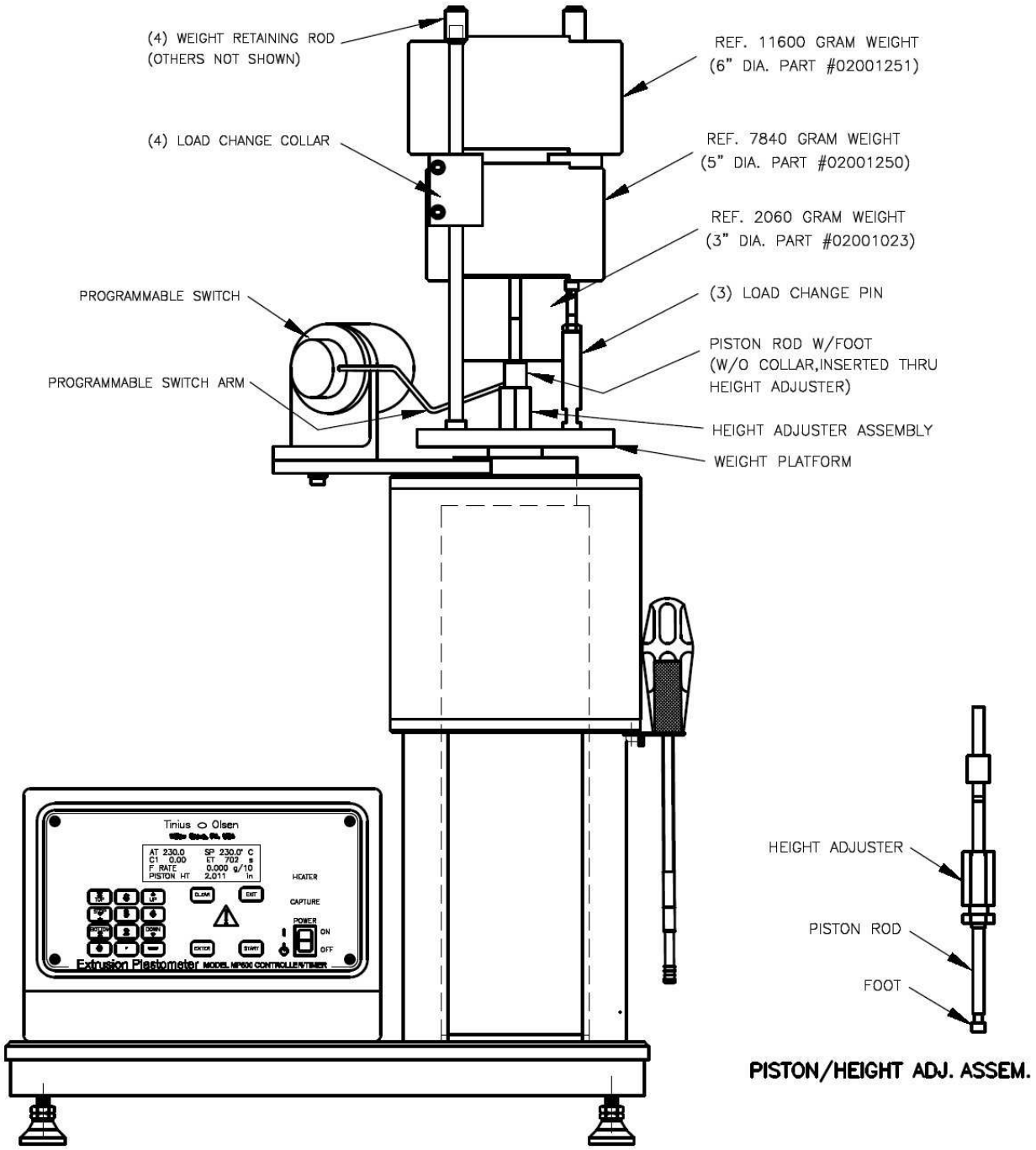


Figure 15-1 - Optional Flow Rate Ratio Package Setup for Three-Load Testing

Notes:

1. The Load Change Collars are used to remove the 6" diameter Weights.
2. The Load Change Pins are used to remove the 5" diameter Weights.

15.2.3 Height Adjuster - used during set-up to support the weight(s) at the desired load change heights so that the height of the Load Change Pins and Load Change Collars can be set.

15.2.4 Weights - includes (1) 2,060 gram weight (P/N: 02001023); (1) 7,840 gram weight (P/N: 02001250); and (1) 11,600 gram weight (P/N: 02001251). (Other combinations are available)

15.3 Installation of Components for a Three-Load FFR Test

Note: To reduce the risk of burns, assemble the FRR components when the machine is at ambient temperature.

15.3.1 Prior to installation, it must be decided at what piston heights the changes of the test loads will occur. Normally, flow rate data is captured when the piston foot is between 46 mm (1.81 in.) and 20.6 mm (0.81 in.) above the top of the orifice. Also, it is recommended that at least 2.5 mm (0.1 in.) of piston travel, or two minutes of time, be allowed between the load change and the start of the next capture of flow rate data. This will usually allow sufficient time for the polymer to adjust to the new pressure, so that the subsequent flow rate measurement will be obtained under an equilibrated pressure.

15.3.2 A typical three-load FRR test starts by measuring the flow rate over a 10 mm (0.40 in.) of piston travel, starting when the piston is 46 mm (1.81 in.) above the top of the orifice. The load is then changed when the piston foot is at 33.5 mm (1.31 in.) above the top of the orifice. The material is allowed a stress equilibration period, and then the flow rate is measured over a 5 mm (0.20 in.) of piston travel, starting when the piston foot is 32 mm (1.26 in.) above the top of the orifice. The third load change occurs when the piston foot is 25.65 mm (1.01 in.) above the top of the orifice and the flow rate is measured over 2.5 mm (0.10 in.) of piston travel, starting when the piston is 23.1 mm (0.91 in.) above the orifice.

Action	Piston Foot Height Above Orifice
Start First 10 mm (0.4 in.) Capture	46 mm (1.81 in.)
End First Capture	36 mm (1.41 in.)
Change Weight	34.54 mm (1.36 in.)
Start Second 5 mm (0.2 in.) Capture	32 mm (1.26 in.)
End Second Capture	27 mm (1.06 in.)
Change Weight	25.65 mm (1.01 in.)
Start Third 2.5 mm (0.1 in.) Capture	23.1 mm (0.91 in.)
End Third Capture	20.6 mm (0.81 in.)

Table 15-1 – Typical Three-Load Flow Rate Ratio Test Set-Up

15.3.3 Apply power to the MP600 and advance to the Idle Screen, similar to the following. (If asked for “SET POINT”, enter 23.0 to maintain the machine at room temperature during setup.)

```
AT 23.0   SP  23.0 C
PN 01     PROC B
1=TEST    2=VIEW
3=SELECT  4=OPTIONS
```

15.3.4 From the Idle Screen, press the [1] key for “Test” and then lower the weight platform of the MWLD-600 Motorized Weight Lowering Device as far as it will go by pressing the [1] (Bottom) key.

Note: Keys used to operate the MWLD-600 do not function when the MP600 display screen is asking for a numerical input.

5.3.5 Press the [EXIT] key to return to the Idle Screen. Press the [4] key for “Options”. From the OPTIONS Menu, press the [4] key for “CALIBRATE”. At the “ENTER ACCESS CODE” screen, press the [8], then the [3], and then the [5] key followed by [ENTER] to access the SELECT CAL FUNCTION Menu. Now press the [2] key for “PPDT-600” and then the [2] key for “Short Cal” to advance to the “PPDT-600 Calibration” screen, similar to the following:

```
PISTON HT   75.03 mm
ARM LGTH   152.40 mm
OFFSET      15.25 mm
EDIT ARM LGTH / EXIT
```

IMPORTANT: Do not attempt to raise or lower the MWLD-600 or press any of the numeric keys while on the above screen. Doing so will overwrite the “ARM LGTH” calibration value. Should overwriting inadvertently occur, press [CLEAR] to restore the “ARM LGTH”.

15.3.6 Thread the three Load Change Pins into the three inner tapped holes located on the MWLD-600 weight support platform. Thread a ¼”-20 socket head cap screw (with hex nut) into the top of each Pin. The cap screw is used to adjust the weight change point. There are two different screw lengths provided. Usually the shorter screws are used.

15.3.7 Install the four Weight Retaining Rods and Load Change Collars in place of the standard retaining rods.

15.3.8 Loosen the locking set screws on the Load Change Collars and lower them so that they are resting on the weight platform.

15.3.9 Remove the piston foot and guide collar from the piston rod. Place the Height Adjuster on the piston rod so that the long hex portion of the adjuster is towards the top of the rod. See Figure 15-1. Reinstall the piston foot. **Do not put the guide collar back on the piston rod at this time.**

15.3.10 Place the piston rod in the cylinder. The tip of the Height Adjuster should fit into the cylinder.

15.3.11 Place the 2,060 and 7,840 gram weights over the Piston Rod

15.3.12 While holding the arm of the PPDT-600 down, rotate the PPDT-600 clockwise so that its arm is under the 2,060 gram weight. Adjust the height of the weights and piston rod by rotating the long hex portion of the Height Setting Adjuster until the “PISTON HT” display reads the desired lowest change weight position. In this example, the lowest weight change occurs at 25.65 mm (1.01 in.).

15.3.13 Adjust the three 1/4”-20 screws in the top of the three Load Change Pins so that the tops of the screws are against the bottom of the 7,840 gram weight. Use the longer screws, if necessary, to achieve the height required. Tighten the hex nuts against the top of the Pins to lock the setting of these screws.

15.3.14 Using the Height Setting Adjuster as before, adjust the height so that the “PISTON HT” display reads the position at which the upper weight change is to occur. In this example the upper weight change is to occur at 34.54 mm (1.36 in.).

15.3.15 Place the 11,600 gram weight on top of the 7,840 gram weight. Slide the Load Change Collars up and lock them in place so that they are touching the bottom of the 11,600 gram weight.

15.3.16 Press the [EXIT] key repeatedly to return to the Idle Screen. From the Idle Screen press the [1] key to advance to the “Test” Mode. Now raise the weight support platform of the MWLD-600 by pressing the [7] (TOP) key. Remove the piston rod from the cylinder. Remove the Height Adjust Assembly from the piston and replace the piston guide on the piston rod assembly.

15.3.17 Press the [EXIT] key to return to the Idle Screen and program the MP600 for the appropriate two or three load Type B test. Referring to Section11, proceed as covered in Sections 11.1.5, 11.1.6 and 11.3. If using the examples in Tables 15-1 and 15-2, note that the “PISTON TRAVEL CAP 1 through 3 for the three-load test would be 10, 5, and 2.5 mm (0.4, 0.2, and 0.1 in.), and the “START CAPTURES” would be 46, 32, and 23.1 mm (1.81, 1.26, and 1.01 in.). The proper response to the “Load” screen is NU. Refer to Table 15-2 for examples of typical two and three-load testing programs for polyethylene.

NOTE: If the MP600 is operated from a PC using Tinius Olsen’s software, the piston travel, capture distances, starting points, loads, etc., are programmed into the test parameters of the software. Therefore, Section 15.3.17 can be ignored.

15.4 Typical Three-Load FRR Test

15.4.1 From the Idle Screen of the MP600, once the machine has stabilized at the set temperature (+/- 0.2°C), remove the orifice (if present) and thoroughly clean the inside of the cylinder and orifice. (See Section 16 for Cleaning Instructions)

15.4.2 Reinsert the orifice into the cylinder. The orifice should fall freely to the bottom of the cylinder with an audible click. If not, remove the orifice and visually inspect the orifice and cylinder for any defects or obstructions. Clean the cylinder and orifice again if necessary and insert the orifice into the cylinder. It is imperative that the cylinder has a mirror finish and that no residue remains on the outside or the inside diameter of the orifice.

15.4.3 Check that the piston rod assembly is clean and that the guide collar slides freely along the piston rod. Clean as needed and insert the piston into the cylinder. Allow the machine to stabilize at the set temperature.

15.4.4 To start the Procedure B type test, press the [1] "Test" key. The Test Mode Screen, similar to the one shown below, will be displayed.

```
AT 190.0  SP 190.0 C
PN 10     PROC B
RT   390 s
PRESS ENTER TO CONT
```

15.4.5 Remove the piston and place it in the tool rack. Verify that the orifice is at the bottom of the cylinder.

15.4.6 Press [ENTER]. The display will prompt the user to "LOAD SAMPLE" while indicating "ET" the elapsed time.

15.4.7 Charge the cylinder with the material that is to be tested. Refer to ASTM D 1238, Table 1 (Table 2 in earlier versions), for suggestions on the amount of polymer to use for a test. To charge the cylinder, insert the funnel into the cylinder, and then slowly pour the material into the funnel. Do not dump it in all at once as it will melt and stick to the funnel. The brass orifice remover (P/N: 02001073) may be used to guide the material into the cylinder.

⚠ CAUTION: The funnel, when placed in the cylinder, can become extremely hot when the machine is at operating temperature! The time that the funnel is allowed to sit in the cylinder should be kept to a minimum.

15.4.8 After charging the cylinder, reinsert the piston rod, and then rotate the PPDT-600 clockwise so that the end of the arm is close to the piston rod. NOTE: The ASTM D 1238 Method allows 1 minute to charge the cylinder, insert the piston rod and start the preheat time of the test.

15.4.9 Press [START] and the Test Screen, similar to the one shown below, will be displayed. The Elapsed Time (ET) display will reset to zero and begin to count up and the weight support platform of the MWLD-600 will be driven automatically to the programmed “WT SUP HT”. Material will begin to extrude through the orifice. The test can be aborted at any time by pressing the [EXIT] key.

```
AT 190.0  SP  190.0C
RT   390  ET     0 s
WT SUP HT   200.0 mm
PISTON HT   76.45 mm
```

15.4.10 When RT, the “Release Time”, reaches zero, the weight support platform of the MWLD-600 will lower fully, applying the full 21.6 kg test load. When the bottom of the piston foot is 46 mm (1.81 inches) above the top of the orifice, the MP600 will emit a single “beep” and the first test measurement (C1) will begin. At the end of the first measurement the MP600 will emit a second ”beep”. The “upper” weight will come to rest on the Load Change Collars after the second “beep”, reducing the test load to 10 kg.

15.4.11 When the bottom of the piston foot is 32 mm (1.26 inches) above the top of the orifice, the MP600 will again emit a single “beep” and the second test measurement (C2) will begin. At the end of the second measurement, the will emit a second “beep”. Shortly after this, the “middle” weight will come to rest on the Load Change Lift Pins, reducing the test load to 2.16 kg.

15.4.12 When the bottom of the piston foot is 23.1 mm (0.91 inches) above the top of the orifice, the MP600 will again emit a single “beep”, indicating that the third test measurement (C3) is beginning. Completion of the third measurement will be indicated by a double “beep”.

TEST TIP: Prior to actual testing, run several practice tests. Confirm that each individual test measurement is completed prior to the point where the uppermost weight (either the 11,600 gram or the 7,840 gram weight, depending on which capture) reaches the Load Change Collars or the Load Change Pins. This can be confirmed by observing if the “beep”, signifying the end of a test measurement, occurs before the weight is supported on the collars or pins. Also, observe that sufficient time has been allowed for stress equilibrium in the molten polymer. Insufficient piston travel or time will result in low flow rate values. It may be necessary to increase the distance between the weight change and the start of the next capture.

15.4.13 At this point, a three-load test is completed. If the MP600 is not connected to a printer or interfaced to a computer with Tinius Olsen’s software, obtain the data by scrolling through the displays and recording the results by hand. If the MP600 is interfaced to a printer, the raw test data will be automatically printed at the end of the test. Either way, the FRR can be calculated by using one of the following equations:

$$FFR = \frac{\text{Flow Rate @ 21.6 kg}}{\text{Flow Rate @ 2.16 kg}} \quad OR \quad \frac{\text{Flow Rate @ 21.6 kg}}{\text{Flow Rate @ 10.0 kg}} \quad OR \quad \frac{\text{Flow Rate @ 10.0 kg}}{\text{Flow Rate @ 2.16 kg}}$$

15.4.14 Allow the remaining material to purge from the cylinder and then, if the machine is equipped with the optional MWLD-600, press the [7] (TOP) key to raise the weight support platform.

15.4.15 Rotate the PPDT-600 counter-clockwise so that its arm toward the rear of the furnace. This will prevent damage to the arm during cleaning operations.

15.4.16 Clean the piston, cylinder and orifice thoroughly as described in Section 16. IT IS IMPERATIVE THAT THE MACHINE IS CLEANED AFTER EACH TEST.

15.4.17 To prepare for another test, press the [EXIT] key. The display will prompt, “Another Test? 1=SAME PARAMETERS, 2=NEW PARAMETERS, PRESS EXIT to EXIT”.

15.5 Test Procedure for a Typical Two-Load FFR Test

15.5.1 Tests using only two of the three available loads can also be performed once the components have been installed in accordance with Section 15.3.

15.5.2 For testing using loads of 21.6 and 2.16 kg, carefully scribe a thin reference line on each of the four Weight Retaining Rods directly above the Load Change Collars. Then loosen the Load Change Collars, lower them at least 12.5 mm (0.5 in) and retighten them at this lower position. Also, program the MP600, as shown in Table 15-2, for a 21.6/2.16 kg Two-Load Test (or, if a computer is being used, setup the appropriate parameters in the software).

NOTE: If the Load Change Pins were removed as covered in Section 15.5.3, they must be replaced.

15.5.3 For testing using loads of 21.6 and 10 kg, it is only necessary to remove the three Load Change Pins and program the MP600, as shown in Table 15-2, for a 21.6/10.0 kg Two-load Test (or, if a computer is being used, setup the appropriate parameters in the software).

NOTE: The Load Change Collars must be positioned as described in Section 15.3.15. If they have been moved as described in Section 15.5.2, they can be repositioned using the scribe lines on the weight retaining rods as positioning references.

15.5.4 For testing using loads of 10.0 and 2.16, it is only necessary to remove the 11,600 gram weight and program the MP600, as shown in Table 15-2, for a 10.0/2.16 kg Two-load Test (or, if a computer is being used, setup the appropriate parameters in the software).

15.5.5 Proceed with testing following Sections 15.4.1 through 15.4.17 (except that only two measurements will be made and only one FRR can be calculated).

Table 15-2 - Typical Test Programs for Flow Rate Ratio Testing of Polyethylene

Two-Load Test	**Two-Load Test**	**Three-Load Test**
21.6/2.16 or 10/2.16 kg	***21.6/10 kg***	***21.6/10/2.16 kg***
Procedure B	Procedure B	Procedure B
Sample ID NU*****	Sample ID NU*****	Sample ID NU*
Run Number NU*	Run Number NU*	Run Number NU*****
Set Point 190.0	Set Point 190.0	Set Point 190.0
Cal Offset Per calibration data	Cal Offset Per calibration data	Cal Offset Per calibration data
Load NU	Load NU	Load NU
Orif Dia NU	Orif Dia NU	Orif Dia NU
Orif Lgth NU	Orif Lgth NU	Orif Lgth NU
Density Entered	Density Entered	Density Entered
Melt Den 0.7638	Melt Den 0.7638	Melt Den 0.7638
FR Constant 426.0	FR Constant 426.0	FR Constant 426.0
Auto Piston Travel Select Method No	Auto Piston Travel Select Method No	Auto Piston Travel Select Method No
No of Captures 2	No of Captures 2	No of Captures 3
Piston Travel Cap 1 10 mm (0.4 in.)	Piston Travel Cap 1 10 mm (0.4 in.)	Piston Travel Cap 1 10 mm (0.4 in.)
Start Capture 1 46.0 mm (1.81 in.)	Start Capture 1 46.0 mm (1.81 in.)	Start Capture 1 46.0 mm (1.81 in.)
Piston Travel Cap 2 2.5 mm (0.1 in.)	Piston Travel Cap 2 5mm (0.2 in.)	Piston Travel Cap 2 5mm (0.2 in.)
Start Capture 2 23.1 mm (0.91 in.)	Start Capture 2 32.0 mm (1.26 in.)	Start Capture 2 32.0 mm (1.26 in.)
		Piston Travel Cap 3 2.5 mm (0.1 in.)
		Start Capture 3 23.1 mm (0.91 in.)
Display Flow Rate	Display Flow Rate	Display Flow Rate
Release Time 390 sec	Release Time 390 sec	Release Time 390 sec
Auto Wt Lower Yes	Auto Wt Lower Yes	Auto Wt Lower Yes
Wt Sup Ht 71.4 mm	Wt Sup Ht 71.4 mm	Wt Sup Ht 71.4 mm

*** -** If the MP600 is connected to a dot–matrix serial printer, Sample ID and Run Number screens can be set to TT during programming. This will permit numeric entries made at test time to be printed out.

B L A N K

16 Section 16 – Cleaning Instructions

16.1 It is absolutely imperative that the cylinder, orifice and piston are cleaned thoroughly after EACH test.

16.2 After the test has been completed, allow the weight to remain on the piston until all the excess material in the barrel has extruded through the orifice.

⚠ CAUTION: The piston rod assembly and the orifice become hot during use.

16.3 Remove the weight and the piston. If an MWLD-600 is being used, raise the weight platform all the way up until the weight platform swings out of position. Wipe the piston thoroughly using a cloth made from a natural fiber (cotton). The cloth must be clean and free from oil or grease of any type as they may affect future test results. Place the piston on the tool rack or on an insulated surface that will prevent it from rolling.

16.4 Using the Orifice Removal Tool (P/N: 02001073) to remove the orifice by pushing it up from the bottom of the cylinder. Clean the outside of the orifice with the clean, natural fiber cloth. Clean the bore of the orifice with the soft orifice drill (P/N: 02001075). If necessary, the orifice bore can be brushed, using a 0.090” diameter brass brush available from Tinius Olsen (P/N: 02001142). There should be no residue on the orifice after cleaning.

16.5 Clean the cylinder by placing a cotton patch over the cylinder, then pushing the patch through the cylinder using the Cylinder Cleaning Tool (P/N: 02001527) in a manner similar to cleaning a gun barrel. Change the patch and repeat at least 3 times or until there is no visual evidence of material remaining on the cylinder wall. If necessary, the cylinder can be brushed, using a replaceable 0.406” diameter brass brush tip (P/N: 02001143) and barrel brush handle (P/N: 02001144) available from Tinius Olsen. 2-1/2” square Cotton patches (P/N 02001136) are available from Tinius Olsen.

16.6 Drop the orifice in the cylinder. It should fall to the bottom easily and there should be an audible click when it hits the bottom of the cylinder. If not, remove the orifice and re-clean it and the cylinder.

16.7 Always replace the piston and orifice back into the furnace as soon as possible so that they are up to temperature for the next test.

Note: If no more tests are needed, **ALWAYS** remove the piston and orifice from the furnace before turning the MP600 off to prevent them from being welded in place as any material left in the barrel hardens.

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17 Section 17 – Preventative Maintenance

17.1 Cleanliness

17.1.1 The most important factor in maintaining the accuracy of a melt index machine is cleanliness. It is absolutely necessary that the cylinder, orifice and piston be cleaned after each test. However, be aware that, despite the best efforts, some material will build up on the components, causing them to appear tarnished or discolored. Tinius Olsen does not recommend any other cleaning practices besides those detailed in ASTM D 1238. Refer to Section 16.

17.1.2 At some point, it may become necessary to remove the insulator plate and orifice support at the base of the furnace assembly. This will be necessary to remove any build up of material at the base of the cylinder that has not been removed by the normal cleaning process.

17.1.3 Some components of a melt indexer, including the cylinder, piston foot and orifice, are considered to be consumable, meaning that normal wear will cause them to go out of tolerance over time. Check the orifice bore frequently using the Go/No-Go gauge. Inspect the piston foot for nicks or scratches, or for signs of wear on the edges. Check the cylinder visually for nicks and or scratches. Any obviously damaged components shall be discarded and replaced.

17.2 PPDT-600 Arm Length Adjustment

17.2.1 Because any physical adjustments to the PPDT-600 require a complete disassembly of the PPDT-600, it is recommended that the user does not attempt to physically change the length of the arm of the PPDT-600. The PPDT-600 is a precision instrument and should be treated with care. It has been designed so that it resists damage from everyday use, even if the MWLD-600 Weight Lowering device is lowered onto it when it is not rotated into the proper position. If the arm is accidentally bent, it should be bent back into the approximate original shape and recalibrated. A brief discussion of this procedure follows, a more thorough one can be found in Section 18.1.

17.2.2 Changing the physical length of the PPDT-600 arm requires removing the rotating assembly from the encoder shaft. This could cause the encoder to loose the reference pulse and fail to calibrate at startup. There is no easy way for the user to find this reference pulse and so it is recommended that no user attempt to alter the physical length be made. If it becomes necessary to adjust the arm length of the PPDT-600, the unit must be returned to the factory for adjustment.

Warning: If you have a PPDT-600, be sure to initialize it before entering the Calibration mode. Otherwise, the PPDT-600 calibration may be lost.

17.2.3 The arm on the PPDT-600 is designed so that the tip extends 5 9/16" from the counterweight giving a theoretical length from the center of rotation of 6 inches. This length was set at the factory and should NOT be adjusted in the field.

17.3 Motorized Weight Lowering Device (MWLD-600)

17.3.1 For lubrication of the Motorized Weight Lowering Device refer to Assembly Drawing No. 5-6-543 in Appendix A of these instructions. This should be done approximately once a year or every 1,000 hours of use.

17.3.2 To lubricate the Acme screw & nut, lower the MWLD-600 weight platform to its bottom position. Remove all weights from the weight platform. Take off the weight platform (Item 7) by removing the two 5/16-18 x 1 BHCS (Item 62) and washers (Items 67 & 71). Using an extreme pressure grease NLGI consistency #2, add grease through grease fitting (Item 34).

17.3.3 To reassemble weight platform with mounting hardware, insert an orifice and piston assembly into the furnace. Add the lightest 6-inch diameter weight available on the piston rod. Align the weight platform with the 6-inch diameter weight. Run the weight platform up and down a few times to check alignment and evenly distribute the grease.

17.4 Miscellaneous

17.4.1 Heater Condition

17.4.1.1 With the power disconnected, remove the four screws and carefully pull the MP600 controller out of the console to expose the main terminal strip on the rear of the MP600 controller.

17.4.1.2 Check the resistance of the heater bands using an ohmmeter. The resistance between Terminals 5 and 14 (Wires T and C) should be 71 to 79 ohms. The resistance between Terminals 6 and 14 (Terminals B and C) should be 76 to 84 ohms. The resistance between Terminals 5 and 6 (Wires T and B) should be 147 to 163 ohms. The resistance between any of the wires to the case of the heater or machine ground should be above 10 Megohms.

18 Section 18 – Calibration/Verification

NOTE: ASTM D 1238 recommends that the melt indexer should be thoroughly inspected and verified for compliance to the specification at least annually. Follow the guidelines as detailed in the current version of ASTM D 1238, or contact Tinius Olsen Field Service to arrange to have the machine verified by Tinius Olsen personnel. Tinius Olsen's Field Service Department is accredited by A2LA for the calibration/verification of melt flow indexers and maintains NIST traceable calibration equipment and can issue the calibration/verification certificates that are required by many quality programs. Contact the Tinius Olsen Field Service Department for more information.

18.1 Calibration/Verification Procedure for PPDT-600

18.1.1 Introduction

18.1.1.1 Accurate calibration and verification of the measuring capabilities of the PPDT-600 can be accomplished using the optional PPDT Calibrator (Part Number 02001531). The calibrator consists of a "0 -2" barrel type micrometer head and a mounting bracket. The micrometer has a resolution of 0.001 inch.

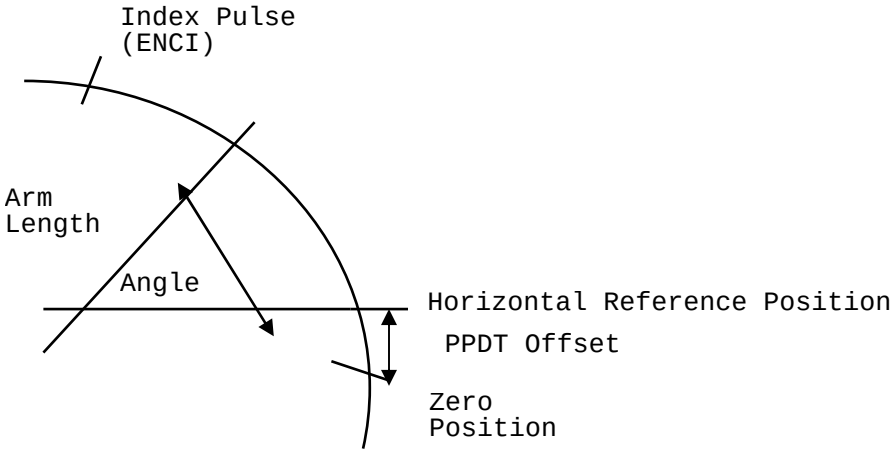
18.1.1.2 The instructions in this section only cover the calibration of the PPDT-600 when used with the MP600 Controller. Please contact the factory for information on calibrating other types of actuating switches and controllers.

18.1.1.3 Before proceeding, read and comprehend the information on the PPDT-600 theory of operation found in Section 18.1.2. Only then should you proceed with the PPDT-600 Verification/Calibration.

18.1.2 Theory of Operation

This section will describe how the calibration parameters affect the operation of the PPDT.

The distance of the piston above the zero position is calculated using the angle from the horizontal reference, the PPDT-600 Offset and the PPDT-600 Arm Length (which are set in the Calibration Menu) using the equation in Section 18.1.2.1.



18.1.2.1 Normal Operation

There are three options for PPDT type that are programmed in the Calibration Mode: type 0 (none), type 1 (encoder without index pulse) and type 2 (encoder with index pulse). Select type 2 for the PPDT-600.

The PPDT-600 is mechanically and electrically structured so that the index pulse will trigger just as the arm starts to move down from its upper-most (resting) position. The relationship between the index pulse and the horizontal position are established during the calibration process. By detecting the index pulse and knowing the horizontal position (defined under calibration), the controller knows the position of the tip (height of piston) at any time.

The angle, relative to horizontal (0 degrees), is as follows.

PPDT Angle Calculation $$Angle = \frac{Counts}{100{,}000} \times 360$$

Where *counts* is the number of encoder counts.

The distance of the piston above the orifice is calculated as follows.

Piston Position Calculation $$Position = Offset + (ArmLength * \sin(Angle))$$

Where the *Offset* and *ArmLength* are defined in the Calibration Mode and *Angle* is defined in the equation above. The Arm Length multiplied by the sine of the angle (relative to the horizontal) gives the linear position (relative to the horizontal). The Offset is added in to give the height above the top of the orifice (Piston Height).

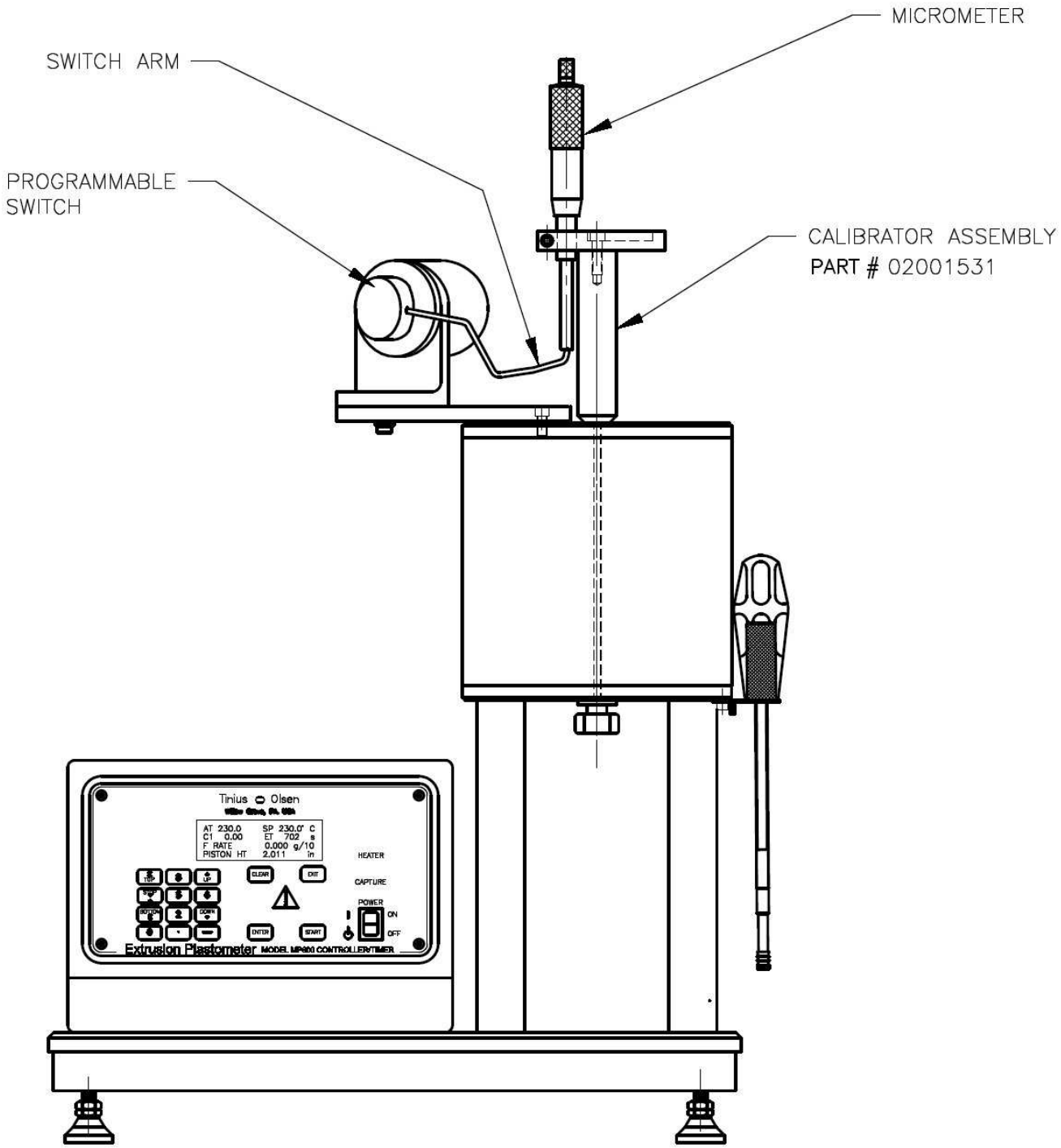


Figure 18-1 – Calibration of the PPDT-600 Automatic Timing Switch

NOTE: IT IS MOST IMPORTANT THAT THE CALIBRATOR CLAMPING SCREW IS TIGHTENED FIRMLY SO THAT THERE IS NO CHANCE OF IT SHIFTING DURING THE SWITCH VERIFICATION AND CALIBRATION PROCEDURES.

18.1.3 Mounting the Calibrator to the Extrusion Plastometer

18.1.3.1 Enter a Set Temperature of 0^{o}C and allow the furnace to cool down to room temperature. Do not insert or use the Calibrator when the furnace is hot. A hot furnace can cause the Calibrator to expand and introduce errors.

18.1.3.2 Remove the piston and orifice from the cylinder. If the MP600 is equipped with an optional Motorized Weight Lowering Device, the weight support platform must be raised and rotated out of the way.

18.1.3.3 Before mounting the Calibrator, make certain that all the parts of the Calibrator are firmly tightened.

18.1.3.4 Insert the stem of the calibrator down the cylinder and place the washers and nut on the bottom (threaded) portion. Tighten the nut and ensure that the apparatus is seated properly and is perfectly vertical. The calibrator must be kept square with respect to the PPDT-600.

18.1.4 Verification/Calibration Procedure

18.1.4.1 Follow the prompts on the display until the Idle screen is displayed. The MP600 will show the Actual Temperature (AT) and Set Point Temperature (SP) on the top line. The next line will display the Program Number (PN) and Test Procedure (A or B). The bottom two lines are your menu options.

18.1.4.2 Make sure the Set Point Temperature (SP) is below room temperature and that the heaters are off (heater LEDs should be off). If the heaters are on they must be turned off. If the Program prompts you to enter the Set Point Temperature, enter 0 deg C. If the Set Point Temperature is set in the Program, select Options (4) and choose Edit (2). Enter the pass code (8 5 2 ENTER). Choose Edit Program (1) and use the ENTER key to move through the screens until you get to the screen for Set Point Temperature. Change this to Program Initiate (PI) by pressing START. Then Press ENTER. Press EXIT until the Idle Screen is displayed, and then Select (3) Program Number or simply power down and power back up.

18.1.4.3 While the Idle screen is displayed, move the PPDT-600 (ENCI encoder) arm through its entire travel. This will allow the PPDT-600 to find its Index pulse.

18.1.4.4 Pivot the PPDT-600 into position so that the tip of the switch arm is directly below and centered with the anvil on the end of the micrometer screw.

18.1.4.5 Enter the Calibration Mode by selecting Options (4) from the Idle screen. Then select Calibration (4) and enter the pass code (8 3 5 ENTER). Choose PPDT (2), and then select SHORT calibration to verify your readings. **IMPORTANT: Be certain the PPDT-600 has been initialized properly BEFORE selecting the SHORT Calibration. If not, you will lose your calibration, the displayed Piston Height will not make sense and you will need to do a FULL Calibration.**

18.1.4.6 Use a straight edge and/or a square and adjust the micrometer so that it makes the tip of the PPDT-600 arm perfectly horizontal with the center of rotation of the arm. Record your micrometer reading.

NOTE: Always operate the calibrator downward when taking readings.

18.1.4.7 With the tip of the switch arm centered under the micrometer tip, turn the calibrator until the Position Display reads at least 47.000 mm (1.8500 in.) and then turn it slowly down to the nearest value to 46.000 mm (1.8100 in.). Because of the 0.01 mm (0.0004 in.) resolution of the system, the display may not show the exact value.

18.1.4.8 Record the reading shown on the Position Display as the Starting Height, and record the reading from the micrometer. Turn the micrometer down exactly 6.35 mm (0.250 in.). Record the Position Display reading. Repeat this process until you have moved the PPDT-600 arm a total of 25.4 mm (1.000 in.).

18.1.4.9 Check the displayed position readings. If the error between the 6.35 mm (0.250 in.) increments is 0.025 mm (0.001 in.) or less; no changes will need to be made.

NOTE: If any of the errors are too large or are not linear, check to make sure that the PPDT-600 has been set up as previously described and that the PPDT-600 has been initialized properly. Improper initialization will result in non-linearity. Also, you may attempt to reduce the errors by calculating and entering a new Arm Length and repeating this procedure. If, after several attempts, the errors have not been reduced or have increased, you should do a FULL Calibration. This allows you to define the key points (such as the Lower limit and the Horizontal position) that are critical to the mathematical determination of the Piston Height. For the PPDT-600 (ENCI type encoder), the Index pulse will also be found. Once you have defined the points (see above) and determined the correct Arm Length, you should get the correct change in position on the display for the corresponding change in the micrometer reading.

18.1.5 Arm Length Calculation

18.1.5.1 The physical length of the PPDT-600 Arm, from its tip to the center of rotation of the encoder shaft, should be about 152.4 mm (6.000 in.).

18.1.5.2 The relationship of the real and displayed Arm Lengths and Travels (change in position) can be approximated as follows:

(Real Tvl / Real Arm Lgth) = (Displayed Tvl / Displayed Arm Lgth)

18.1.5.3 With some simple algebraic manipulation, the Real Arm Length can be estimated as:

*Real Arm Lgth = (Real Tvl * Displayed Arm Lgth) / Displayed Tvl*

18.1.5.4 When doing these calculations, use the total 25.4 mm (1.000 in.) travel. You may need to repeat this several times.

NOTE: Always operate the calibrator downwards when taking readings.

18.1.6 Height Offset

18.1.6.1 Enter the Calibration Mode by selecting Options (4) from the Idle screen. Then select Calibration (4) and enter the pass code (8 3 5 ENTER). Choose PPDT (2), and then select SHORT calibration to verify your readings. **IMPORTANT: Be certain the PPDT-600 has been initialized properly BEFORE selecting the SHORT Calibration. If not, you will lose your calibration, the displayed Piston Height will not make sense and you will need to do a FULL Calibration.**

18.1.6.2 Remove the Calibration device, and replace the orifice and piston. Place a weight on the piston and position the PPDT-600 arm beneath the weight. The displayed height should be 0. If not, determine how much the error is, multiply it by –1, and enter the result as the offset.

Note: The sine operation translates the rotary motion of the encoder into a linear value. The Offset is simply a value, relative to the true horizontal position of the PPDT-600 arm, that is added in after the sine correction to make the PPDT-600 readings agree with the true piston height.

18.2 Temperature Verification/Calibration

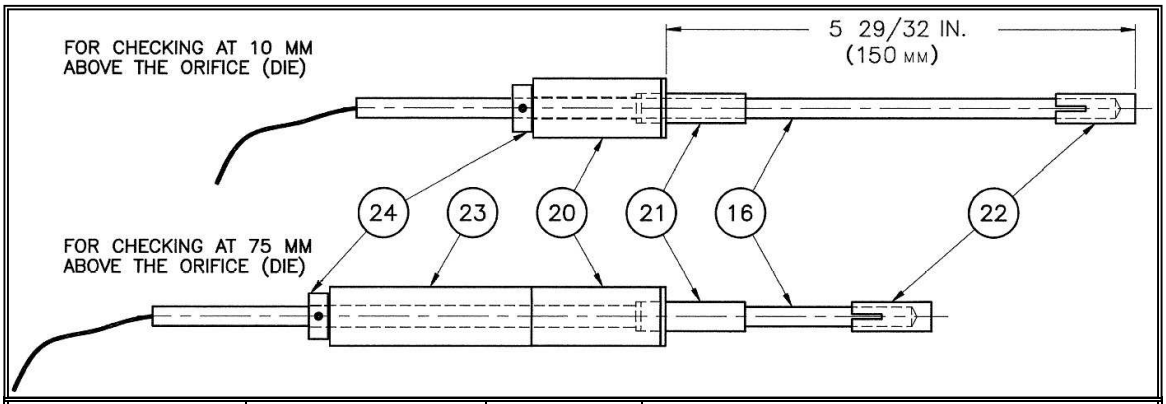
18.2.1 Suggested Equipment

18.2.1.1 Digital Temperature Indicating Unit, Model 4202C (Dual-Probe) available from;

INSTRULAB, Inc.
1205 Lamar Street, P O Box 98
Dayton, OH 45404-0098
Telephone: (800) 241-2241 / Fax: (937) 223-1705
Website: www.instrulab.com

18.2.1.2 RTD Probe, INSTRULAB, Model 832-154-01 (300℃)

18.2.1.3 Miscellaneous Parts from TINIUS OLSEN P/N: 02001451 (See Figure 18-2)
Includes:
10 mm Spacer (Insulator), Part Number 02001474
RTD Sensor Guide, Part Number 02001475
RTD Sensor Bushing, Part Number 02001476
65mm Spacer (Insulator), Part Number 02001477
Stop Setscrew Collar, Part Number 90001065



Part Number	Item Number	Quantity	Description
	16	1	INSTRULAB Sensor 832-154-01
02001474	20	1	10 mm Spacer (Insulator)
02001475	21	1	RTD Sensor Guide
02001476	22	1	RTD Sensor Bushing
02001477	23	1	65 mm Spacer (Insulator)
90001065	24	1	Stop Setscrew Collar

Figure 18-2 - RTD Calibration Probe Assembly

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19 Section 19 – Temperature Control Configuration Mode

19.1 PID Parameters

Note that the default PID values shown should suffice for most users. However, further tuning of the PID parameters may be necessary for any given machine in order to obtain optimum performance for any particular set of test conditions/requirements. The user should consult a good engineering controls text to become familiar with the concept of PID parameters before making adjustments. Refer to page 19-5 for further PID Revisions.

19.1.1 Refer to Section 10 for instructions on entering the Temp CONTROL Configuration Menu and the SET PID PARAMS Configuration Mode screen, shown below. The screens will cycle through the **TOP** settings and then the **BOTTOM** settings.

19.1.2 **Proportional Band (PB)** - The PB directly affects the Proportional Term, but it also affects the Integrator and Derivative Terms. See the Proportional Term under View (see Section 10.3.2).

```
PROP BAND aaa
           ww.w   C
ENTER NEW VALUE
PRESS ENTER TO CONT
```

MP 600 Factory Settings For Proportional Band (PB)	
115V	**230V**
Top: 14	Top: 100
Bottom: 8	Bottom: 50

19.1.3 **Reset** - The Reset affects the Integrator Term. The Reset Term is active when within the PB. See the Integrator Term under View (see Section 10.3.2).

```
RESET aaa
           w.ww
ENTER NEW VALUE
PRESS ENTER TO CONT
```

MP 600 Factory Settings For Reset	
115V	**230V**
Top: 0.1	Top: 0.1
Bottom: 0.22	Bottom: 0.22

19.1.4 **Integral Limit Multiplier (ILM)** - The Integral Limit Multiplier (w.wwww) is internally multiplied by the Set Point Temperature to determine the maximum Integrator Term value that is allowed. This helps prevent large temperature overshoots on heat up. Note: Once the MP600 settles in at the Set Point Temperature (within +/- 0.1 deg), the current Integrator Term value becomes the new limit. This helps prevent large temperature overshoots on recovery.

```
INTEGRAL LIMIT MULT
          w.wwwww
 ENTER NEW VALUE
PRESS ENTER TO CONT
```

MP 600 Factory Settings For Integral Limit Multiplier (ILM)	
115V	**230V**
Top: 0.00080	Top: 0.00024
Bottom: 0.00160	Bottom: 0.00028

19.1.5 **Rate Band (RB)** - The RB is a multiple of the PB. The Rate Term is active when within this band.

```
RATE BAND aaa
            ww.w   C
ENTER NEW VALUE
PRESS ENTER TO CONT
```

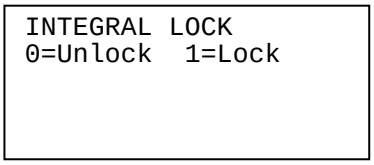
MP 600 Factory Settings Rate Band (RB)	
115V	**230V**
Top: 3	Top: 1
Bottom: 1	Bottom: 1

19.1.6 **Rate** - The Rate affects the Derivative Term. It is active within the Rate Band. See the Derivative Term under View (see Section 10.3.2).

```
RATE aaa
            w.ww
ENTER NEW VALUE
PRESS ENTER TO CONT
```

MP 600 Factory Settings Rate	
115V	**230V**
Top: 1	Top: 1
Bottom: 0.5	Bottom: 0.5

19.1.7 **INTEGRAL LOCK** - This will lock the INTEGRATOR TERMS at the set temperature and the default setting is **LOCK.** Sometimes due to power fluctuations the MP600 will not quite hold the set temperature and unlocking will allow the integral terms to keep adjusting. This is only asked after the **TOP** settings but applies to the **BOTTOM** as well. This unlock feature was added as of MP600 EPROM Version 4.0



After this screen the MP600 will cycle through the **BOTTOM** settings Screens.

19.2 MP600 Temperature Control Equations

19.2.1 **Proportional Term** = (SP – AT) / PB

Proportional Term is limited to a range of –1 to +1.
If AT < (SP - PB), Prop. Term = 1.
If AT > (SP + PB), Prop Term = -1.

The Proportional Term works on the current temperature error. A large PB means a small Kp, a small PB means a large Kp.

19.2.2 **Integrator Term** = Previous Integrator Term + (Integrator Error / Kit)

Integrator Term is limited to a range of 0 to 1.
If AT < (SP - PB), Integrator Term = 0.
If AT > (SP+PB), Integrator Term = 0.

where:

Integrator Error = (SP – AT) / PB

Integrator Error is limited to a range of –1 to +1.
If AT < (SP - PB), Integrator Error = 1.
If AT > (SP + PB), Integrator Error = -1.

Kit = Integrator Gain * 60* Sample Rate
Integrator Gain = 1 / Reset
Sample Rate = 10 samples / second

The Integrator Term works on the sum of the accumulated temperature errors. Since the Reset values are typically fractional (ex. 0.1), a smaller Reset means a smaller Integrator term. A larger Reset means a larger Integrator term.

19.2.3 **Derivative Term** = ((AT – LT) * 60 * Rate) / PB

Derivative Term is limited to a range of –1 to +1.
Derivative Term is 0 when:

AT < (SP – (RB * PB))
AT > (SP + (RB * PB))

The Derivative Term works on the changing temperature. Unlike the other terms that are added together in the Power formula, the derivative Term is subtracted from the others.

19.2.4 **Power Formula:**

Power% *= 100 * (Proportional Term + Integrator Term – Derivative Term)*

The Power (0 – 100%) is the total of the three terms, multiplied by 100. It determines how many cycles are ON and how many are OFF for regulating the power to the heaters. The MP600 can turn the heaters ON and OFF at 50 or 60 times per second, depending on the line frequency.

For 230V systems, the Power Rating is divided by 4 and limited to 25%. With twice the voltage and twice the current of the 115V configuration, this technique will produce the same average power.

19.2.5 **Terminology:**

SP = Set Point Temperature
AT = Actual Temperature Reading at current time (t seconds)
LT = Last Temperature Reading at previous time (t-1 seconds)
PB = Proportional Band
RB = Multiple of the Proportional Band
Kp = Proportional Gain
Kit = Integrator Gain
Kd = Derivative Gain
Sample Rate = 10 samples per second

Revised PID Values for the MP 600 Controller

Further work with the MP600 Controller and various changes to the RTD probes has led us to modify the default PID values used for controlling the temperature. In some cases, a range of values is indicated. Further tuning may be necessary on a case-by-case basis due to slight variations between machines, should the end user wish to optimize the performance. However, the default values supplied with the machine should be adequate for most situations.

MP600 Controller on an MP600 Furnace System (stranded wire probes)

	115 VAC		230 VAC	
	Top	**Bottom**	**Top**	**Bottom**
Prop. Band	14 – 20	8 – 12	100	50
Reset	0.05 – 0.10	0.09 – 0.22	0.05 – 0.10	0.11 – 0.22
ILM*	0.0008 – .001	0.0016	0.0002 – 0.00024	0.00028
Rate Band	2 – 3	1	1	1
Rate	1 – 1.5	0.5 – 0.6	1	0.5

As of October 2003, the original MP600 stranded wire probes were changed to a solid (nickel alloy) wire probe and the following default PID Values used.

MP600 Controller on an MP600 Furnace System (solid wire probes)

	115 VAC		230 VAC	
	Top	**Bottom**	**Top**	**Bottom**
Prop. Band	20	14	120	70
Reset	0.05	0.07	0.10	0.20
ILM*	0.001	0.0016	0.0002	0.00028
Rate Band	2	1	1	1
Rate	1.5	0.6	1	0.6

The following Table is only for Retrofit Dual Zone Furnace Systems that use a single Dual Zone Probe that is inserted into the rear off-center well next to the center bore of the furnace; the front off-center well can be used for an L-shaped thermometer. The thermometer well should be plugged when not being used for better heat retention and to keep material out of the well. This system is used for retrofitting earlier model Extrusion Plastometers with a single zone furnace system such the MP 993, MP 987, U.E. or Thermodyne Models with a MP 600 Controller with a Dual Zone Heater Band.

MP600 Controller on a Retrofit Furnace System (single Dual Zone Probe)

	115 VAC		230 VAC	
	Top	**Bottom**	**Top**	**Bottom**
Prop. Band	9	7	40	35
Reset	0.10	0.20	0.05	0.10
ILM*	0.002	0.0016	0.00025	0.00025
Rate Band	1	1	1	1
Rate	0.7	0.5	1	0.5

*** –** The ILM (Integrator Limit Multiple) is multiplied by the Set Point temperature to get the maximum value that the Integrator term is allowed to build up to. As such, it may be necessary to increase this value at higher Set Point temperatures or with lower line voltages in order for the machine to make the set temperature.

B L A N K

20 Section 20 - Communications

20.1 Overview—Serial Port Connection

20.1.1 The MP600 has a 25 pin D-subminiature female connector located on the rear of the Melt Indexer. All connections to external serial devices (dot-matrix serial printers or computers) are made through this port. A ribbon cable inside the console connects this port with the 25 pin serial port on the MP600 controller itself.

20.1.2 The serial communications for the MP600 are Odd parity, 7 data bits, 1 stop bit. Baud rate is selectable (1200 – 19200). Hardware handshaking signals are not used by the MP600.

20.1.3 The MP600 can use either EI-232 or EI-485(422) communications. Communications protocol is selected in the SERIAL PORT Configuration Mode. See Section 10.

CAUTION: ALWAYS UNPLUG THE 115V/230V POWER CORD BEFORE REMOVING THE CONTROLLER FROM ITS CONSOLE.

20.1.4 The user selects whether the MP600 will be interfaced to a dot-matrix serial printer or to a computer through the SERIAL PORT Configuration Mode. Additionally, if the computer utilizes a COM422 board for communication with multiple Melt Indexers, a unique device ID number (0-9) must be assigned to the melt indexer.

20.1.5 A list of the cables and communications standards for each MP600 application is given in these instructions.

20.2 Connecting a Dot-Matrix Serial Printer to the MP600

20.2.1 Connect the dot-matrix serial printer to the MP600 using the Tinius Olsen 25M/25M Null Modem MI Printer Cable (P/N 90002871).

20.2.2 Configure the printer with the appropriate communications parameters. The MP600 uses Odd parity, 7 data bits, 1 stop bit. Baud rate is selectable (1200-19200). An example of the serial configuration for an OKIDATA MICROLINE 320 (with serial port option) is as follows:

Parity	Odd
Serial Data 7 or 8 Bits	7
Protocol	Ready/Busy
Diagnostic Test	No
Busy Line	SSD-
Baud Rate	(Set to agree with MP600 selected rate.)
DSR Signal	Valid
DTR Signal	Ready on Power UP
Busy Time	200 ms

20.2.3 Configure the MP600 by accessing the SERIAL PORT Configuration Mode as covered in Section 10. Set “Ser Port” to “1” and “Baud Rate” to a rate compatible with the printer setting.

20.2.4 At the start of a series of tests, the MP600 will transmit the heading information to the printer. At the completion of each test, the MP600 will transmit the results to the printer.

20.3 Connecting a single MP600 to a Computer running EP600-Single Software (EIA-232 protocol)

20.3.1 Use the Tinius Olsen 9F/25M MI-Interface AME Cable (P/N 90002820) to connect the 9 pin serial port of the computer to the 25 pin serial port on the Melt Indexer.

20.3.2 Configure the MP600 by accessing the SERIAL PORT Configuration Mode as covered in Section 10. Set “Ser Port” to “2”, “Interface” to “1” and “Baud Rate” to “19200” when using EP600 software.

20.3.3 Refer to the EP600 Software Manual to run the program. Note that after the software is installed on the computer, the EP600 Software Verification Key must be inserted in the USB port of the computer to enable operation of the software.

20.3 Connecting Multiple MP600 Melt Indexers to the USB Port on a computer using EP600-Multiple Software Package (EI-232 protocol)

20.3.1 Connect the USB Hub to the USB Port on the computer using the provided 6 foot long cable.

20.3.2 Connect the first two Melt Indexers to the USB Hub using two 9F/25M MI-Interface Cables (P/N 90002820).

20.3.3 If more than two Melt Indexers are being connected, Auxiliary Interconnection Packages (P/N 02001567) are required to connect additional Melt Indexers. Each of these packages can connect up to two additional Melt Indexers.

20.3.4 Configure each MP600 Melt Indexer for use with EP600 software by accessing the SERIAL PORT Configuration Mode as covered in Section 10. Set “Ser Port” to “2”, “Interface” to “1” and “Baud Rate” to “19200”.

20.4.5 After the software is installed on the computer, the EP600 Software Verification Key must be inserted in a second USB port on the computer or in the port on the USB Hub to enable operation of the software.

20.4.6 Refer to the EP600 Software Manual to run the program.

20.5 Connecting MP600 Melt Indexers to an existing computer system running MFW-2 Multiple Machine Software (EI-485/422 protocol)

20.5.1 These existing computer/MFW-2 software systems normally have a COM 422 card already installed in the computer.

20.5.2 The first two Melt Indexers are connected to the 9-pin port on the COM 422 card in the computer using Tinius Olsen Main Interface Cable (P/N 02001261).

20.5.3 If more than two Melt Indexers are being connected, the Main Interface Cable (P/N 02001261) connects to the first machine. Successive machines are daisy chained together using Auxiliary Interface Cables (P/N 02001246).

20.5.4 Configure each MP600 Melt Indexer for use with the software by accessing the SERIAL PORT Configuration Mode as covered in Section 10. Set “Ser Port” to “2”, “Interface” to “2”, “Device Address” to “a unique address number of 0 to 9”, and “Baud Rate” to “1200”.

NOTE: If you are not using the Tinius Olsen software, a list of commands has been included in these instructions for developing your own software. However, due to the complexity of the communications, Tinius Olsen strongly recommends using Tinius Olsen software if data storage and/or machine control through a PC is desired.

20.6 Communication Parameters:

EIA-232	**EIA-485**
Odd Parity	Odd Parity
7 Data Bits, 1 Stop Bit	7 Data Bits, 1 Stop Bit
1200-19200 Baud	1200-19200 Baud
XON/XOFF Protocol	ANSI x3.28 (Full) Protocol

20.7 MP600 Communication Commands

All characters are transmitted in ASCII. In the command listings below, <sp> denotes a space character and <cr> represents a carriage return character. The general format for a write command is =<sp>COMMAND<sp>PARAMETER<sp>DATA<cr>. The general format for a read command is ?<sp>COMMAND<sp>PARAMETER<cr>.

The EIA-232 uses an XON/XOFF protocol. The computer sends the command in the format above. The MP600 returns a DC3 (XOFF), then a DC1 (XON) and then any data requested by a read command followed by a <cr>.

The EIA-485 uses a Full Protocol. The computer sends the DEVICEID<enq>. The MP600 returns DEVICEID<ack>. The computer sends <stx> Command <etx>. The MP600 returns an <ack>. The computer sends an <eot>. If the command was a write command, the MP600 returns an <eot>. If the command was a read command, the MP600 returns <stx> Data <cr><etx>. The computer sends an <ack> and the MP600 returns an <eot>.

20.7.1 *ACT*

This read only command returns the measured process temperature of the bottom zone. There is no decimal point. Format: “?<sp>ACT<cr>”.

20.7.2 *ACT2*

This read only command returns the measured process temperature of the top zone. There is no decimal point. Format: “?<sp>ACT2<cr>”.

20.7.3 *ATP*

This read/write command accesses the active test parameters. The parameters have the same ranges as the front-panel displays. The parameter values of NU, TT and PI will return N, T and P respectively. These characters are also used to set parameters to NU, TT or PI. The ATP command will only change the volatile copy of the programmed parameter. This command is not valid while a test is running. Format: “?<sp>ATP<sp>data<cr>” or “=<sp>ATP<sp>data<sp>value<cr>”

	DATA	VALUES
0.	Test Type	1=Procedure A, 2-Procedure B
1.	Sample ID	N,T
2.	Run Number	N,T
3.	Set Temperature	P
4.	Bottom Cal Offset	P
5.	Load	N,T
6.	Orifice Diameter	N,T
7.	Orifice Length	N,T
8.	Cutoff Time	T
9.	Density Type	1=Entered, 2=Calculated, N
10.	Density	N,T
11.	Piston Travel No. 1	N,T
12.	Piston Travel No. 2	N,T
13.	Piston Travel No. 3	N,T
14.	Piston Travel No. 4	N,T

15.	Piston Travel No. 5	N,T
16.	Start Point No. 1	N,T
17.	Start Point No. 2	N,T
18.	Start Point No. 3	N,T
19.	Start Point No. 4	N,T
20.	Start Point No. 5	N,T
21.	Release Time	N,T
22.	Auto Weight Lower	0=No, 1=Yes, T
23.	Piston Travel No. 6	N,T
24.	Piston Travel No. 7	N,T
25.	Piston Travel No. 8	N,T
26.	Piston Travel No. 9	N,T
27.	Start Point No. 6	N,T
28.	Start Point No. 7	N,T
29.	Start Point No. 8	N,T
30.	Start Point No. 9	N,T
31.	Preheat Time	N,T
32.	Flow Rate Constant	T
33.	Auto Piston Travel	0=No, 1=Yes, T
34.	Number of Captures	T
35.	Rate Display	0=Volume Rate, 1=Flow Rate, N
36.	Support Height	T
37.	Pre-Test Lower	T
38.	Top Calibration Offset	P

20.7.5 *BOT*

This write only command will move the weight support device to the lower limit. Format: "=<sp>BOT<cr>".

20.7.6 *CALAI*

This write only command calibrates the RTD inputs. Format: "=<sp>CALAI<sp>resistance<cr>". The controller must be in factory calibration mode for this command to work. The resistance is entered with decimal point and as accurately as it is measured.

20.7.7 *CAP*

This read/write command represents the capture number. A read returns the total number of valid captures. A write will set the current capture number. The capture number can range from 1-20 for Procedure A tests and 1-10 for Procedure B tests. Format: "?<sp>CAP<cr>" or "=<sp>CAP<sp>data<cr>.

20.7.8 *CPxx*

This read only command returns the actual time and actual bottom process temperature for the capture represented by xx. The value xx can range from 1 to 20 (although only captures 1-10 are valid for Procedure B type tests). If a capture has not been taken the time and temperature will be zero. There are no decimal points. Format: "?<sp>CPxx<cr>".

20.7.9 *CTxx*

This read only command returns the actual time and actual bottom process temperature for the capture represented by xx. It is used for Procedure B tests only and there are no decimal points. The value xx can range from 1 to 10. If a capture has not been taken the time and temperature will be zero. Format: “?<sp>CPxx<cr>”.

20.7.10 *CUR*

This read/write command represents the current program number. It has the same range as the front panel prompt. Format: “?<sp>CUR<cr>” or “=<sp>CUR<sp>data<cr>”.

20.7.11 *GSP*

This read/write parameter is used for setting global setup parameter values that are also accessible via the front panel. The data values have the same range as the front panel prompts. Format: “?<sp>GSP<sp>parm<cr>” or “=<sp>GSP<sp>parm<sp>data<cr>”. Format (NE indicates included for backwards compatibility, has no effect):

	Parmeter	Data Value
0.	Inches/millimeters	1=inches, 2=mm
1.	Alarm active	1=on, 2=off
2.	Printer/computer	1=printer, 2=computer
3.	Offset difference	0 (NE)
4.	High temp alarm	
5.	PPDT type	0=none, 3=encoder, 4=encoder w/index
6.	Delay time	0 (NE)
7.	Position/arm length	
8.	Zone select	2 (NE)
9.	Intensity adjust	1-4
10.	Pretest lower time/position	0 (NE)
11.	Date	mm-dd-yy
12.	Time	hh:mm (write with hh-mm)
13.	Language	1=english
14.	Weight support type	0=NA, 1=AC, 2=DC
15.	Weight support encoder resolution	
16.	Weight support total travel	
17.	Weight support over travel	
18.	PPDT offset	
19.	RTD user calibration slope top	x.xxxx (read only)
20.	RTD user calibration slope bottom	x.xxxx (read only)
21.	RTD user calibration offset top	x.xxxx (read only)
22.	RTD user calibration offset bottom	x.xxxx (read only)
23.	Model number	(read only)
24.	Serial number	(read only)
25.	Date code	(read only)
26.	DC Motor Offset	
27.	DC Motor +Full Scale Fast	
28.	DC Motor –Full Scale Fast	
29.	DC Motor Proportional Band	
30.	Weight support under travel	
31.	DC Motor +Full Scale Slow	
32.	DC Motor –Full Scale Slow	

20.7.12 *INP*

This read only command is used to read the digital inputs and returns a 0 if the input is off or a 1 if the input is on. Format: “?<sp>INP<sp>parm<cr>”. The parm values are:

0. Upper Limit Switch
1. Weight Support Position Switch
2. Expand Input One
3. Expand Input Two
4. Expand Input Three
5. Expand Input Three
6. Expand Input Four
7. Expand Input Five
8. Expand Input Six

20.7.13 *KEY*

This read only command is used to read the status of the front panel keys. Format: “?<sp>KEY <cr>”.

The chart below shows the data returned:

Key	Value	Key	Value
None	0	6	100
0	1	7	200
Decimal	2	8	400
Dash	4	9	800
1	8	Enter	20000
2	10	Start	8000
3	20	Exit	10000
4	40	Clear	1000
5	80		

20.7.14 *LOC 1*

This read/write command determines if the PID Integral Lock is active. This value is stored in non-volatile memory. Format: “?<sp>LOC” or “=<sp>LOC<sp>parm”. Parameter settings are 1=Lock & 0=Unlock. (Added as of MP600 Version 4.0)

20.7.15 *MAV 1*

This write only command is included for backward compatibility. The controller will toggle between test procedure A and procedure B each time this command is received. This command will only change the volatile copy of the programmed procedure type. It will not be valid if a test is running. Format: “=<sp>MAV<sp>1<cr>”.

20.7.16 *MCT*

This read/write command is the value of the Maximum Capture Time that is allowed during the Procedure “B” tests. The Range is 0 to 3600 seconds. On power-up, the default is 3600 seconds. Format: “?<sp>MCT” OR “=<sp>MCT<sp>parm”. (Added as of MP600 Version 4.0)

20.7.17 *MDKY 1*

This write only command simulates the Enter Key. Format: “=<sp>MDKY<sp>1<cr>”.

20.7.18 *MDL*

This read only command returns the unit model number and software version. The controller’s response will be: “600 x.xx yyyyy”, where x.xx is the software version and yyyyy is the software build Format: “?<sp>MDL<cr>”.

20.7.19 *MEM*

This read only command represents a single byte memory location in the controller. The address and data returned will be in hex format. Format: “?<sp>MEM<sp>address<cr>”.

20.7.20 *MEMD*

This read only command represents a double byte memory location in the controller. The address and data returned will be in hex format. Format: “?<sp>MEMD<sp>address<cr>”.

20.7.21 *MOD*

This read only command will return the procedure type that the controller is using. A query will return 0 for procedure A and 2 for procedure B. Format: “?<sp>MOD<cr>”.

*2*0.7.22 *MODE*

This read only command represents the status of the controller. Format: “?<sp>MODE <cr>”. The return values are:

0. Powerup mode (Initialization prompts)
1. Idle mode (Idle prompt)
2. Results mode (Test results prompts)
3. View mode (View prompts)
4. Program mode (Edit program prompts)
5. Setup mode (Configuration prompts)
6. Service mode (Calibration prompts)
7. Calibration mode (Factory RTD calibration prompts)
8. Select mode (Select prompt)
9. Start mode (Start test prompts)
10. Work mode (Running test prompts)

20.7.23 *MOTR*

This write only command operates the weight support motor. The weight support will move to the position specified in data. Note that the data will be interpreted in the current unit of measure and includes the decimal point. Format: “=<sp>MOTR<sp>data <cr>”.

20.7.24 *OPT*

This read/write command operates the expansion outputs. Format: “=<sp>OPT<sp>parm<cr>” or “=<sp>OPT<sp>parm<sp>data <cr>”. The data is 0=Off and 1=On.

0. Motor Lower
1. Motor Raise
2. Orifice Plug
3. Cutoff
4. Purge
5. Expand One
6. Expand Two
7. Expand Three

20.7.25 *PGM*

This read/write command accesses the current programmed test parameters for the program selected with the CUR parameter or selected on the display. The parameters have the same ranges as the front-panel displays. The parameter values of NU, TT and PI will return N, T and P respectively. These characters are also used to set parameters to NU, TT or PI. Changes made with the PGM parameter will be saved in non-volatile memory. This command is not valid while a test is running.

Format: “?<sp>PGM<sp>data<cr>” or “=<sp>PGM<sp>data<sp>value<cr>” The data and values for this command are the same as for the ATP command.

20.7.26 *PPDT*

This read only command is used to read the current position of the PPDT. Note that the data will be interpreted in the current unit of measure and includes the decimal point. If the PPDT Type is set to ENCI and the index has not yet been detected, the data returned will be #####. Format: “?<sp>PPDT<cr>”.

20.7.27 *PTxx*

This read only command is used to read the actual piston travel for capture xx. The value xx can range from 1 to 10 since this command is only used for Procedure B. The value return includes decimal places and is in the current units. Format: “?<sp>PTxx <cr>”.

20.7.28 *RAW*

This read only command represents the raw A/D counts of the controller inputs. Format: “?<sp>RAW<cr>”. The response will be in the form: top a/d<sp>bottom a/d<sp>reference a/d<cr> in hex format.

20.7.29 *RCTO*

This read only command gets the specified cutoff weight for the passed capture number for procedure A or B. Format: “?<sp>RCTO<sp>capture_number<cr>”.

20.7.30 *RES*

This is a read/write command. On a write it stops the current test and returns the unit to the idle mode, clearing all test parameters. On a read it returns zero to be compatible with older units. Format: “?<sp>RES<sp>1<cr>” or “=<sp>RES<sp>1<cr>”.

20.7.31 *RST*

This write only command restores the factory calibration if the system is at the restore prompt. Format: “=<sp>RST<sp>1<cr>”.

20.7.32 *RUN*

This read only command will return a –1 if running a test (Start mode, Work mode or Results mode). Returns 0 otherwise. Format: “?<sp>RUN<cr>”.

20.7.33 *SER*

This read/write command represents the temperature control configuration prompts. The prompts have the same range as in the front panel displays. Format: “?<sp>SER<sp>parm<cr>” or “=<sp>SER<sp>parm<sp>data<cr>”. Parm settings are:

0. Proportional Band, Bottom
1. Reset, Bottom
2. Rate, Bottom
3. Rate Band, Bottom
4. Integral Limit Multiplier, Top
5. Proportional Band, Top
6. Reset, Top
7. Rate, Top
8. Rate Band, Top
9. Integral Limit Multiplier, Bottom
10. Voltage Setting (1=115, 2=230)

20.7.34 *SP1*

This read/write command represents the current setpoint that both zones are controlling to. A write will change only the volatile copy of the programmed setpoint. The data has the same range as the front panel prompt. There is no decimal point. Format: “=<sp>SP1<sp>data<cr>”.

20.7.35 *SST*

This is a read/write command. On a write it starts a test running if the system is in the Idle mode or stops a running test if the system is in Work mode (the stop has the same results as pressing the Exit key). On a read it will return a value of zero. Format: “?<sp>SST<sp>1<cr>” or “=<sp>SST<sp>1<cr>”.

20.7.36 *TIM*

This read/write command represents either preheat time for procedure A or release time for procedure B. It changes only the volatile copy of the programmed time. Format: “?<sp>TIM<cr>” or “=<sp>TIM<sp>data<cr>”.

20.7.37 *TLT*

This read only command represents the total time for capture 1, capture 2, and capture 3. Format: “?<sp>TLT<cr>”. The data is returned without a decimal point.

20.7.38 *TOP*

This write only command will move the weight support device to the upper limit. Format: “=<sp>TOP<cr>”.

20.7.39 *WRN*

This read/write controls the 10 second cutoff interval alarm used in Procedure ”A” tests. This value is stored in non-volatile memory. Format: “?<sp>WRN” or “=<sp>WRN<sp>parm”. Parameter settings are: 1=Enable & 0=Disable. (Added as of MP600 Version 4.0)

20.7.40 *WTSP*

This read only command represents the weight support position. Note that the data will be interpreted in the current unit of measure and includes the decimal point. Format: “?<sp>WTSP<cr>”.

21 Section 21 - Troubleshooting

21.1 System Warnings - If the data that is required to run a test has not been entered, a warning will be flashed on the display. The following is a list of the meaning of the warnings that may be displayed.

Warning Code	Priority Code	Description	Corrective Action
1	1	Not used	N/A
2	2	No pickup type entered	A PPDT type must be entered in order to run a type B test.
3	3	Not used	N/A
4	4	Not used	N/A
5	5	Not used	N/A
6	6	Not used	N/A
7	7	Temperature differential between zones too great	Bottom temperature within 0.5℃ of setpoint and top temperature is >10% off of setpoint.

21.2 System Errors - These errors appear on the display if the system detects a problem with any of the hardware.

Error Code	Priority Code	Description	Corrective Action
1	N/A	Not Used	N/A
2	N/A	Not Used	N/A
3	N/A	Not Used	N/A
4	N/A	Not Used	N/A
5	1	EEPROM Error	A read or write to the EEPROM did not complete correctly.
6	2	A/D error - Temp reads 0 C	Power Cycle the MP600 to correct.
7	N/A	Not Used	N/A
8	N/A	Not Used	N/A
9	N/A	Not Used	N/A
10	N/A	Not Used	N/A
11	8	Open Sensor Bottom Error	The measured resistance on the sensor input is higher than that allowed for the range of the sensor or the A/D is not functioning properly.
12	9	Shorted Sensor Bottom Error	The measured resistance on the sensor input is higher than that allowed for the range of the sensor or the A/D is not functioning properly.
13	10	Open Sensor Top Error	The measured resistance on the sensor input is higher than that allowed for the range of the sensor or the A/D is not functioning properly.
14	11	Shorted Sensor Top Error	The measured resistance on the sensor input is higher than that allowed for the range of the sensor or the A/D is not functioning properly.
15	N/A	Not Used	N/A
16	7	High Temperature Bottom	The actual process has exceeded the high temperature alarm value.
17	8	High Temperature Top	The actual process has exceeded the high temperature alarm value.
18	N/A	Not Used	N/A
19	9	RTC Battery Error	The real time clock battery is bad.
20	10	Weight Support Encoder Error	The motor output is on but no pulses have been received from the encoder for at least 0.5 sec. (refer to Section 21.4)
21	N/A	Not Used	N/A
22	11	Sensors Not Calibrated	The sensor inputs have not been calibrated. Restore factory settings and recalibrate.
23	12	No Zero Cross	Zero crossing detection interrupt for the SCRs is not working. Check AC power.

21.3 Electrical Checks

21.3.1 The MP600 Controller will need to be removed for these checks. **BE SURE THE POWER IS DISCONNECTED** from the melt indexer Controller before removing.

21.3.2 The heater bands can be checked with an ohm meter by measuring the resistance at the Main Terminal Strip located on the rear of the MP600 Controller. The resistance between Terminals 5 and 14 (Heater Terminals T and C) should be 75 ohms ±5%. The resistance between Terminals 6 and 14 (Heater Terminals B and C) should be 80 ohms ±5%. The resistance between Terminals 5 and 6 (Heater Terminals T and B) should be 155 ohms ±5%. The resistance between any of the wires to the case of the heater should be above 10 Megohms.

21.3.3 The RTD probes can be checked with an ohmmeter. Each probe has three wires. With the two common colored wires shorted, check the resistance between the common colored wires and the odd colored wire. The resistance measured will vary with the temperature of the probe. This resistance should be approximately 100 ohms at 0°C and about 109 ohms at 23°C. There should be **no continuity** between any of the wires and the case of the probe. If any of these tests fail, replace the probe and recalibrate.

21.3.4 The MP600 Controller, with both heater zones on full, draws about 3 to 4 Amps at 115 VAC service and about 4.5 Amps at 230 VAC service.

21.3.5 The motor for the optional Motorized Weight Lowering Device draws about 1.0 Amps.

NOTE: The line filter used in the Power Entry Module typically has a leakage current of 0.25 mA to ground at 115 VAC, and 0.5 mA at 220 VAC. This current leakage may cause a Ground Fault Interrupt (GFI) receptacle to trip, therefore a GFI is not recommended.

21.4 MP600 Error 20

21.4.1 Every occurrence of Error 20 that has been documented has been due to a blown fuse in the motorized weight-lowering device (MWLD). To access this fuse, the covers on the MWLD must be removed as follows:

21.4.1.1. Tools Required
A 3/16” Hex Key, a 5/32” Hex Key 3/32”, a Hex Key, and a #1 Phillips Screw Driver

21.4.1.2 Remove the 2 screws that attach the weight platform to the MWLD using the 3/16” Hex Key.

21.4.1.3 Remove the 2 screws that come in from the rear and attach the MWLD to the furnace using the 5/32” Hex Key.

21.4.1.4 Remove the 4 screws that retain the upper cover using the 3/32” Hex Key.

21.4.1.5 Remove the 5 screws that retain the aluminum sheet metal cover using the #1 Phillips Screw Driver.

21.4.1.6 Carefully flex the sheet metal cover enough to remove the upper cover, and then remove the sheet metal cover by raising it.

21.4.1.7 Replace the fuse in the in-line fuse holder with a 250 V, 2 Amp, 3AG Slow Blow Fuse, Tinius Olsen part number SRE01505.

21.4.1.8 Replace the covers and screws in reverse order.

21.4.1.9 Do not add grease to the grease fitting under the weight platform unless the weight lowing device is completely lowered.

21.4.1.10 Adjust the weight platform so that a weight centered on the platform will find its way on to a piston rod and when the MWLD is raised, the weight will freely release from the piston rod.

21.4.1.11 Adjust the weight platform so that a weight centered on the platform will find its way on to a piston rod and when the MWLD is raised, the weight will freely release from the piston rod.

21.4.2 After replacing the fuse, one should check to see if there is an obvious reason for the fuse to have blown. Adjust the weight platform so that a weight centered on the platform will find its way on to a piston rod and when the MWLD is raised, the weight will freely release from the piston rod.

21.4.2.1 A fuse may blow due to surges in the power line supplying AC power to the equipment.

21.4.2.2 The fuse may blow if the device is overloaded by doing things such as purging material be tested with the MWLD.

21.4.2.3 The fuse may blow if the upper switch does not work properly.

21.4.2.3.1 Turn the machine off with the MWLD in the down position.

21.4.2.3.2 Turn the machine on and follow the instructions to raise the MWLD using the 9 key. If the MWLD goes all the way up, turns 90° and jams, there is something wrong with the switch.

21.4.2.4 The fuse may blow if the device tries to lower too far and hits the mechanical stops. In this case, the TOTAL TRAVEL must be adjusted.

21.4.2.5 The fuse may blow if grease is added to the MWLD with the device anywhere except in the totally lowered position.

21.4.2.6 The fuse may blow if the device tries to raise too far and hits the mechanical stops.

21.4.2.6.1 Turn the machine off with the MWLD in the down position.

21.4.2.6.2 Turn the machine on and follow the instructions to raise the MWLD using the 9 key.

21.4.2.6.3 Initialize a test, and then press the UP (7) key to raise the platform the rest of the way.

21.4.2.6.4 If the platform turns more than 90° from the front position, the OVER TRAVEL parameter in the MWLD configuration options must be reduced. If this needs to be done, reduce the OVER TRAVEL by about 0.5 mm and reduce the TOTAL TRAVEL by the same amount.

21.4.3 To access the OVER TRAVEL and TOTAL travel parameters:

21.4.3.1 Turn power on.

21.4.3.2 At the SET POINT Screen and CAL OFFSET Screens, press 0 and ENTER. This will keep the furnace at room temperature. Be certain to initialize the PPDT by moving the arm up and down through its full travel before proceeding (going into Calibration). Otherwise, the reference points get lost and you need to do a Full Calibration on the PPDT.

21.4.3.3 At the main IDLE Screen, press 4 (OPTION) key to enter the options.

21.4.3.4 At the OPTION Screen, press 4 (CALIBRATE) key.

21.4.3.5 Enter the access code, press 8 3 5 and ENTER.

21.4.3.6 At the SELECT CAL FUNCTION Screen, press 1 (WT SUPPORT).

21.4.3.7 At the WEIGHT SUPPORT Screen, press ENTER, note, it should be defaulting to DC, if not, press 2 (DC) and ENTER.

21.4.3.8 At the DC MOTOR CALIBRATION Screen, press 2 (CONFIG WT SUPPORT). Verify the following values (change as required) and press ENTER to continue:

21.4.3.8.1 ENC RES = 46080

21.4.3.8.2 DC MOTOR OFFSET = 0%

21.4.3.8.3 DC MOTOR FS FAST = 100% (up)

21.4.3.8.4 DC MOTOR FS SLOW = 40%

21.4.3.8.5 DC MOTOR –FS FAST = -100% (down)

21.4.3.8.6 DC MOTOR –FS SLOW = -40%

21.4.3.8.7 DC MOTOR PROP BAND = 1

21.4.3.8.8 TOTAL TRAVEL = Approx. 9.070 (inch, or 230.38 mm). This is one of the values that may need to be changed.

21.4.3.8.9 OVER TRAVEL = Approx. 0.800 (inch, or 20.32 mm). This is one of the values that may need to be changed.

21.4.3.8.10 UNDER TRAVEL = Approx. 0.150 (inch, or 3.8 mm). This value may need to be adjusted to have platform position agree with PPDT position.

21.4.3.8.11 Return to the DC MOTOR CALIBRATION Screen, by pressing EXIT several times.

21.4.4 Check the OVER TRAVEL again by:

21.4.4.1 With the weight support down, turn off the Mp600 and turn it back on. Following the directions on the screen press and hold the 9 (UP) key to raise the platform until it stops.

21.4.4.2 At the SET POINT Screen and CAL OFFSET Screens, press 0 and ENTER. This will keep the furnace at room temperature.

21.4.4.3 At the main IDLE Screen, press 1 (TEST) key to enable the weight-lowering device. Press the 9 (UP) key and jog the weight support as far as it will swing around. The weight support must stop at about 90° and not go any further.

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22 Section 22 – Recommended Spare Parts List

22.1 The following list of items is included to help prevent lost time in the use of this piece of equipment due to normal wear of parts, electronic component failure and accidental breakage.

Description	Part Number	Booklet Reference	Recommended Quantity
Piston Foot[1] (ASTM Stainless Steel)	02001086	Figure 3-1	2
Piston Rod[1] (w/ ASTM Scribe Lines)	02001085	Figure 3-1	1
Orifice (D2 Tool Steel)	02001030	Figure 3-1	2
Charging Tool Tip	02001071	Figure 3-1	2
L-Shaped Thermometers	Specify (C°) Temperature	Figure 4-2	1 (each Temp.)
RTD Temperature Sensor Probe	02001407	W/D 8-12-1366	2
Barrel Brush Handle (only)	02001144[2]	Not Shown	1
0.406" dia. brass Barrel Brush tips	02001143[2]	Not Shown	4
0.090" dia. brass Orifice Brush	02001142[2]	Not Shown	2
2-1/2" square Cotton Patches	02001136	Not Shown	Bag of 500

Notes:

1. There is now a combination Piston Rod available with both the ASTM & ISO Scribed Lines (P/N 02001439), a ISO (only) Piston Rod (P/N 02001665) and a Piston Foot (P/N 02001440) to ISO's tolerances.
2. The Barrel Brush Handle (P/N 02001144) does not come with any brushes: order the 0.406" dia. barrel brush tips (P/N 02001143) with 8/32" threads for the Barrel Brush Handle. The 0.090" dia. brass Orifice Brushes (P/N 0201142) are used when the orifice will not pass the minimum ID requirement. **DO NOT USE STEEL BRUSHES.**

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23 Section 23 – MP600 Packaging/Shipping Instructions

IMPORTANT: Each Melt Indexer order is packaged slightly different depending upon which options were ordered with the machine. Please keep all packing materials that the machine was sent with in order to ship the machine properly!

23.1 Place the Accessories pocket into the box making sure that it is on the right-hand side of the box (Refer to Figure 23-1). The Accessories Pocket is used to store the Automatic Timing Switch Calibrator - P/N 02001531 (optional); Load Change Collar (optional w/ flow rate ratio package, see manual pg. 15-2 Figure 15-1 #4); and any extra weights, should they be ordered.

23.2 Install the X-shaped cardboard separator (for the weights) at the bottom of the box. (Refer to Figure 23-1). This must be installed due to the fact that this supports the machine from getting damaged during shipment. It is advisable to wrap all weights in foam prior to placing the in the box.

Figure 23-1 (This picture shows the accessories pocket on the right-hand side and X cardboard separator on bottom left next to the accessories pocket with the cardboard sub-floor ready to be placed on top.)

NOTE: If only one weight is ordered it is placed in the parts box and not in the lower compartment.

NOTE: If a full set of weights are ordered by the customer, they will be packed into a separate box and shipped separately from the box containing the Melt Indexer. (This is done due to the weight of the package.)

23.3 Place cardboard sub-floor on top of the X-shaped cardboard separator after placing any weights to be shipped with the unit.

23.4 Place cardboard spacer on top of the cardboard sub-floor. (Refer to Figure 23-2)

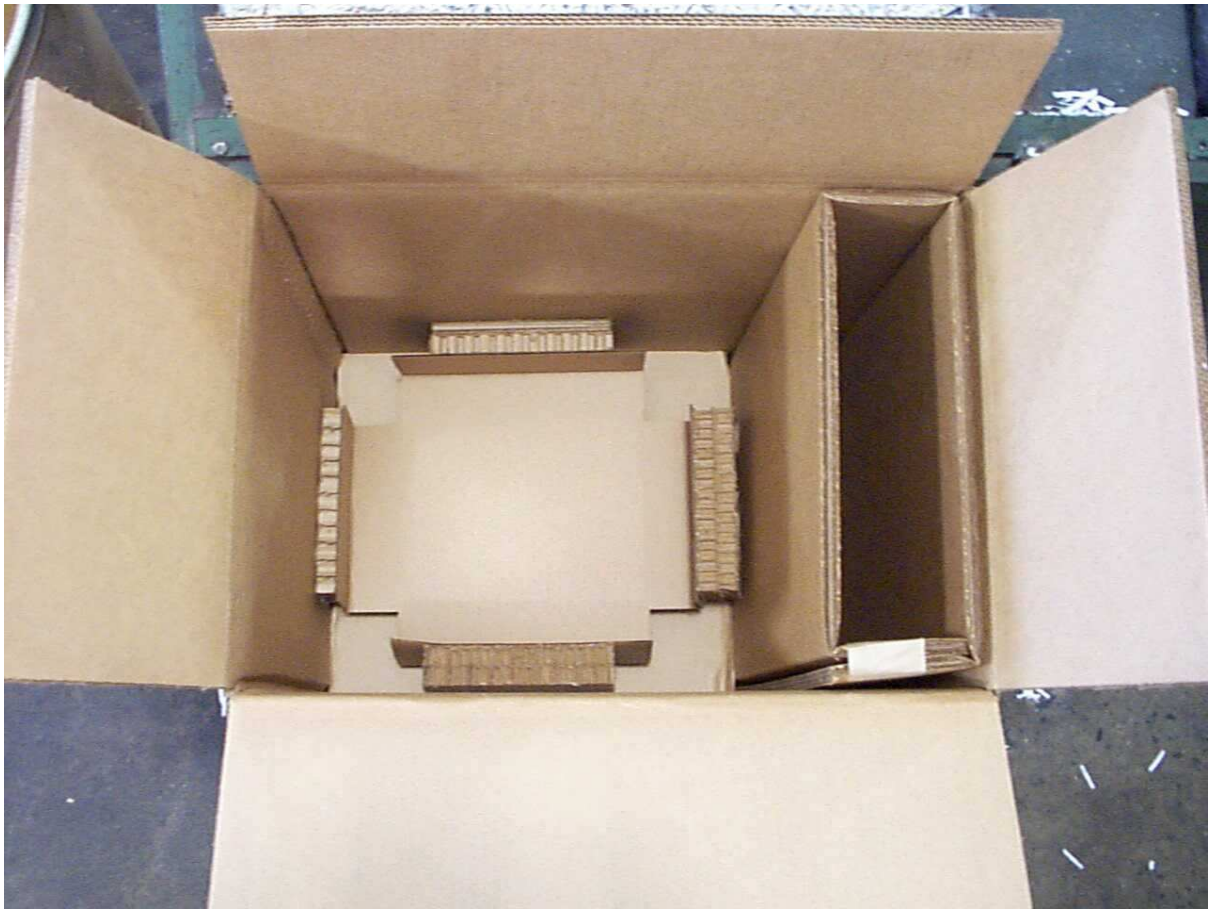

Figure 23-2 (Shows cardboard spacer installed)

23.5 Place the MP600 Melt Indexer into the box making sure that it is sitting flat and securely on the cardboard spacer. (Refer to Figure 23-3)

23.6 Place a piece of foam on the table in the front and back of the digital display unit. This will keep the cardboard divider from scratching the table.

23.7 Next place the cardboard divider (looks like a U) around the digital display unit. (Refer to Figure 23-3)

Figure 23-3 (This picture shows the Melt Indexer securely in place with the foam on the table under the cardboard divider.)

23.8 Pack up the parts box (Refer to Figure 23-4). The parts must be placed in the box in the following order:

23.8.1 PPDT-600 Automatic Timing Switch - P/N 02001505 (optional - wrap in foam) & bracket (in plastic bag) – Place this box in the bottom right-hand corner of the parts box.

23.8.2 Thermometers (optional – place this box on top of the Automatic Timing Switch, make sure that it is on top due to the weight of the switch)

23.8.3 System Installation & Operation Manual - P/N 02001560

23.8.4 Weight (optional) wrapped in foam NOTE: The only time that the weight is in the parts box is when there is only one weight that was ordered.

23.8.5 Electric Cord

23.8.6 Retaining Rods (optional - standard for weight lowering device – MWLD – in plastic bag, see manual pg. A-5, 5-6-543 Item #1)

23.8.7 Level Assembly (Level base - P/N 02001226 & Circular Level - P/N 02001227)

23.8.8 Any extra parts ordered

23.8.9 Standard Tools (in plastic bag)

- 23.8.9.1 Orifices - P/N 02001030
- 23.8.9.2 Carbide Orifice (optional)
- 23.8.9.3 Orifice Drill - P/N 02001075
- 23.8.9.4 Cylinder Cleaning Tool - P/N 02001527
- 23.8.9.5 Charging Tool - P/N 02001582
- 23.8.9.6 Cutoff Tool - P/N 02001090
- 23.8.9.7 Piston Assembly - Stainless Steel Piston Foot - P/N 02001086, Piston Guide Collar - P/N 02001088 & ASTM Piston Rod - P/N 02001085 (fully assembled)
- 23.8.9.8 Orifice Remover - P/N 02001073
- 23.8.9.9 Stainless Steel Funnel - P/N 02001091

Figure 23-4 (Shows the parts that are packed into the parts box)

23.9 Place the parts box on the left-hand side of the box on top of the cardboard divider. (Refer to Figure 23-5) The parts box may protrude out of the box a little bit (this is normal). By closing the lid, this will push the parts box down. Once the box is banded, it will secure the machine in place for shipment.

Figure 23-5 (This is how the box should look like before closing.)

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APPENDIX A

TYPICAL ASSEMBLY DRAWINGS

WITH PARTS LIST & WIRING DIAGRAMS.

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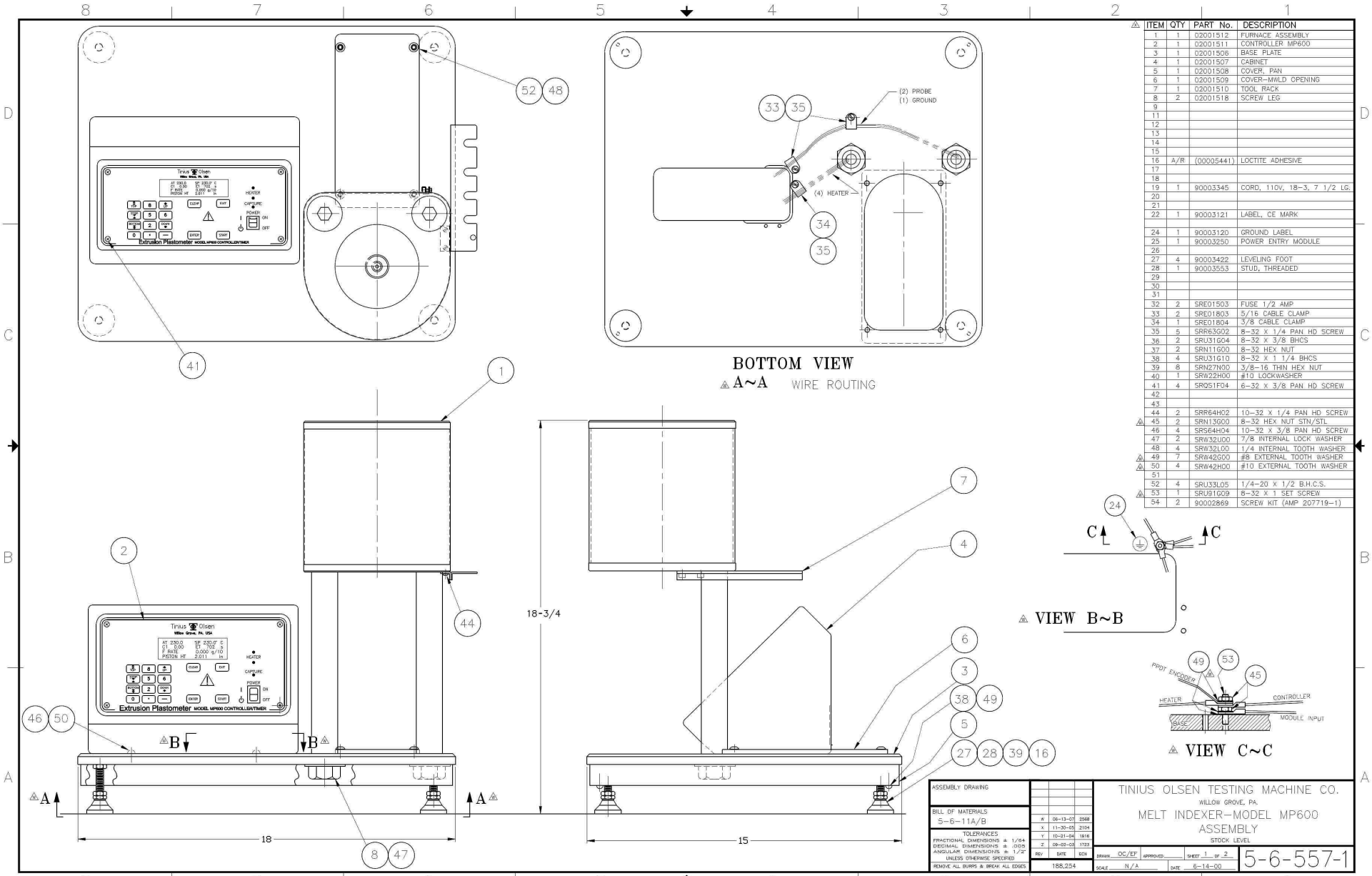


ITEM	QTY	PART No.	DESCRIPTION
1	1	02001512	FURNACE ASSEMBLY
2	1	02001511	CONTROLLER MP600
3	1	02001506	BASE PLATE
4	1	02001507	CABINET
5	1	02001508	COVER, PAN
6	1	02001509	COVER-MWLD OPENING
7	1	02001510	TOOL RACK
8	2	02001518	SCREW LEG
9			
11			
12			
13			
14			
15			
16	A/R	(00005441)	LOCTITE ADHESIVE
17			
18			
19	1	90003345	CORD, 110V, 18-3, 7 1/2 LG.
20			
21			
22	1	90003121	LABEL, CE MARK
24	1	90003120	GROUND LABEL
25	1	90003250	POWER ENTRY MODULE
26			
27	4	90003422	LEVELING FOOT
28	1	90003553	STUD, THREADED
29			
30			
31			
32	2	SRE01503	FUSE 1/2 AMP
33	2	SRE01803	5/16 CABLE CLAMP
34	1	SRE01804	3/8 CABLE CLAMP
35	5	SRR63G02	8-32 X 1/4 PAN HD SCREW
36	2	SRU31G04	8-32 X 3/8 BHCS
37	2	SRN11G00	8-32 HEX NUT
38	4	SRU31G10	8-32 X 1 1/4 BHCS
39	8	SRN27N00	3/8-16 THIN HEX NUT
40	1	SRW22H00	#10 LOCKWASHER
41	4	SRQS1F04	6-32 X 3/8 PAN HD SCREW
42			
43			
44	2	SRR64H02	10-32 X 1/4 PAN HD SCREW
45	2	SRN13G00	8-32 HEX NUT STN/STL
46	4	SRS64H04	10-32 X 3/8 PAN HD SCREW
47	2	SRW32U00	7/8 INTERNAL LOCK WASHER
48	4	SRW32L00	1/4 INTERNAL TOOTH WASHER
49	7	SRW42G00	#8 EXTERNAL TOOTH WASHER
50	4	SRW42H00	#10 EXTERNAL TOOTH WASHER
51			
52	4	SRU33L05	1/4-20 X 1/2 B.H.C.S.
53	1	SRU91G09	8-32 X 1 SET SCREW
54	2	90002869	SCREW KIT (AMP 207719-1)

ASSEMBLY DRAWING

BILL OF MATERIALS
5-6-11A/B

TOLERANCES
FRACTIONAL DIMENSIONS ± 1/64
DECIMAL DIMENSIONS ± .005
ANGULAR DIMENSIONS ± 1/2°
UNLESS OTHERWISE SPECIFIED
REMOVE ALL BURRS & BREAK ALL EDGES

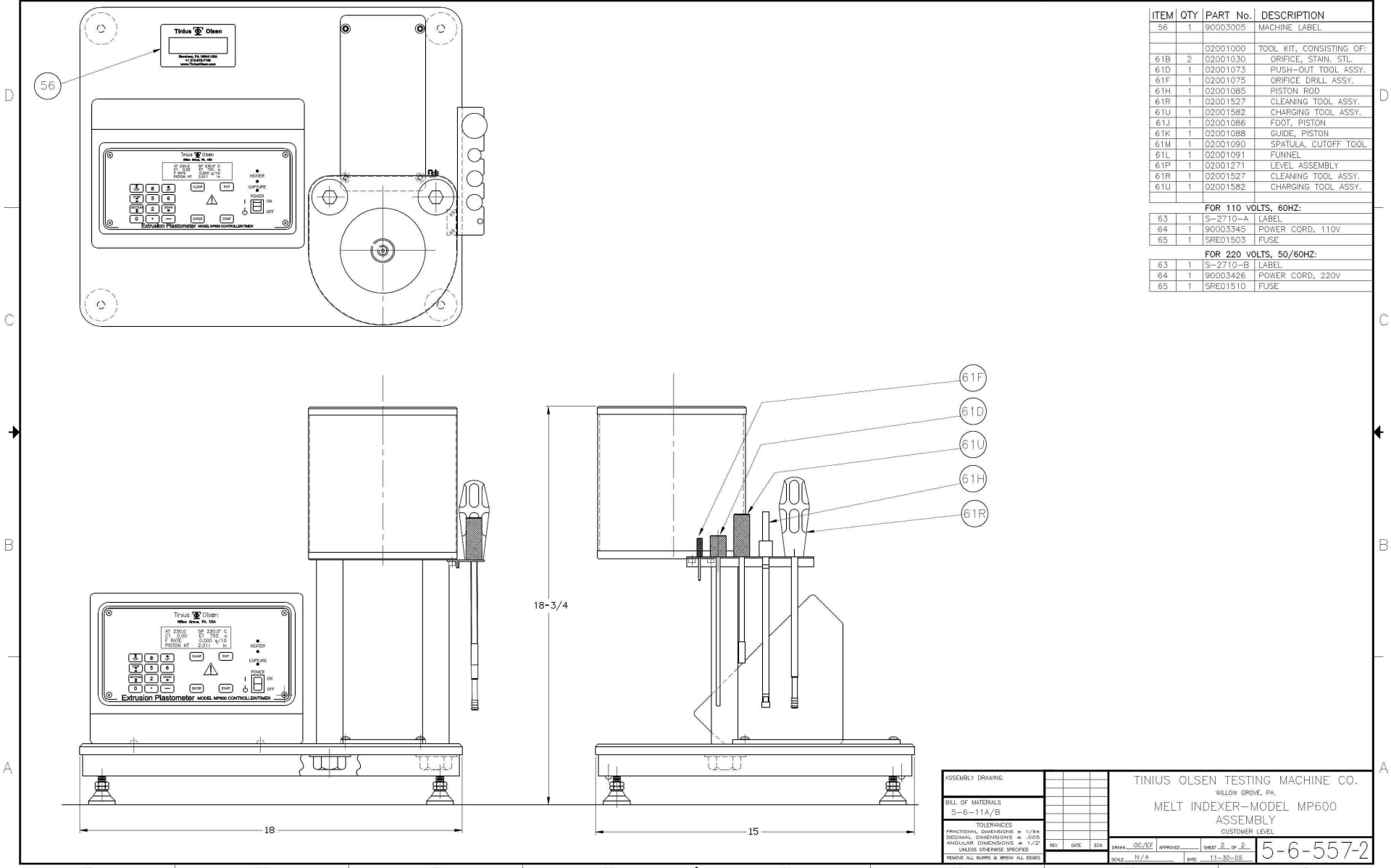
REV	DATE	ECN
N	06-13-07	2568
X	11-30-05	2104
Y	10-21-04	1816
Z	09-02-03	1723

188,254

TINIUS OLSEN TESTING MACHINE CO.
WILLOW GROVE, PA.
MELT INDEXER-MODEL MP600
ASSEMBLY
STOCK LEVEL

DRAWN OC/EF | APPROVED | SHEET 1 OF 2
SCALE N/A | DATE 6-14-00

5-6-557-1



ITEM	QTY	PART No.	DESCRIPTION
56	1	90003005	MACHINE LABEL
		02001000	TOOL KIT, CONSISTING OF:
61B	2	02001030	ORIFICE, STAIN. STL.
61D	1	02001073	PUSH-OUT TOOL ASSY.
61F	1	02001075	ORIFICE DRILL ASSY.
61H	1	02001085	PISTON ROD
61R	1	02001527	CLEANING TOOL ASSY.
61U	1	02001582	CHARGING TOOL ASSY.
61J	1	02001086	FOOT, PISTON
61K	1	02001088	GUIDE, PISTON
61M	1	02001090	SPATULA, CUTOFF TOOL
61L	1	02001091	FUNNEL
61P	1	02001271	LEVEL ASSEMBLY
61R	1	02001527	CLEANING TOOL ASSY.
61U	1	02001582	CHARGING TOOL ASSY.
		FOR 110 VOLTS, 60HZ:	
63	1	S-2710-A	LABEL
64	1	90003345	POWER CORD, 110V
65	1	SRE01503	FUSE
		FOR 220 VOLTS, 50/60HZ:	
63	1	S-2710-B	LABEL
64	1	90003426	POWER CORD, 220V
65	1	SRE01510	FUSE

ASSEMBLY DRAWING

BILL OF MATERIALS
5-6-11A/B

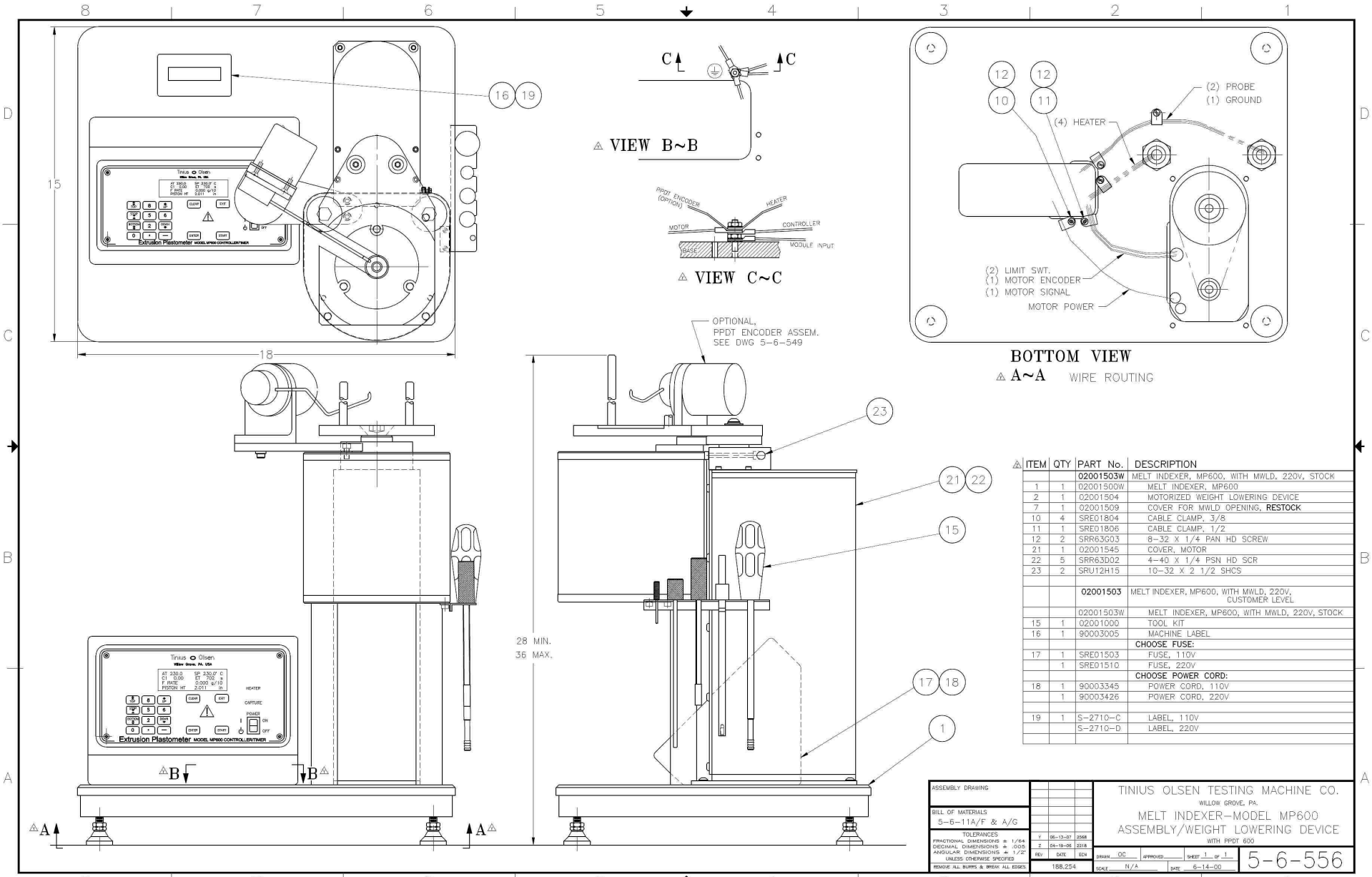
TOLERANCES
FRACTIONAL DIMENSIONS ± 1/64
DECIMAL DIMENSIONS ± .005
ANGULAR DIMENSIONS ± 1/2°
UNLESS OTHERWISE SPECIFIED
REMOVE ALL BURRS & BREAK ALL EDGES

REV. | DATE | ECN

TINIUS OLSEN TESTING MACHINE CO.
WILLOW GROVE, PA.
MELT INDEXER-MODEL MP600
ASSEMBLY
CUSTOMER LEVEL

DRAWN QC/EF | APPROVED | SHEET 2 OF 2
SCALE N/A | DATE 11-30-05

5-6-557-2



ITEM	QTY	PART No.	DESCRIPTION
		02001503W	MELT INDEXER, MP600, WITH MWLD, 220V, STOCK
1	1	02001500W	MELT INDEXER, MP600
2	1	02001504	MOTORIZED WEIGHT LOWERING DEVICE
7	1	02001509	COVER FOR MWLD OPENING, **RESTOCK**
10	4	SRE01804	CABLE CLAMP, 3/8
11	1	SRE01806	CABLE CLAMP, 1/2
12	2	SRR63G03	8-32 X 1/4 PAN HD SCREW
21	1	02001545	COVER, MOTOR
22	5	SRR63D02	4-40 X 1/4 PSN HD SCR
23	2	SRU12H15	10-32 X 2 1/2 SHCS
		02001503	MELT INDEXER, MP600, WITH MWLD, 220V, CUSTOMER LEVEL
		02001503W	MELT INDEXER, MP600, WITH MWLD, 220V, STOCK
15	1	02001000	TOOL KIT
16	1	90003005	MACHINE LABEL
			CHOOSE FUSE:
17	1	SRE01503	FUSE, 110V
	1	SRE01510	FUSE, 220V
			CHOOSE POWER CORD:
18	1	90003345	POWER CORD, 110V
	1	90003426	POWER CORD, 220V
19	1	S-2710-C	LABEL, 110V
		S-2710-D	LABEL, 220V

ASSEMBLY DRAWING

BILL OF MATERIALS
5-6-11A/F & A/G

TOLERANCES
FRACTIONAL DIMENSIONS ± 1/64
DECIMAL DIMENSIONS ± .005
ANGULAR DIMENSIONS ± 1/2°
UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS & BREAK ALL EDGES

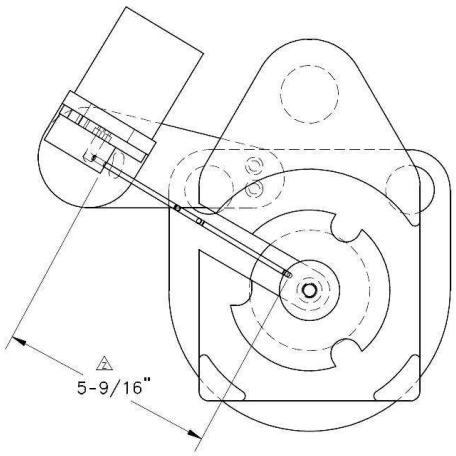
REV	DATE	ECN
Y	06-13-07	2568
Z	04-19-06	2318

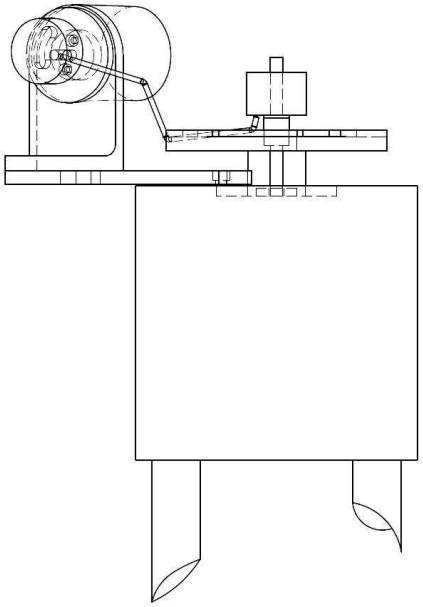
188,254

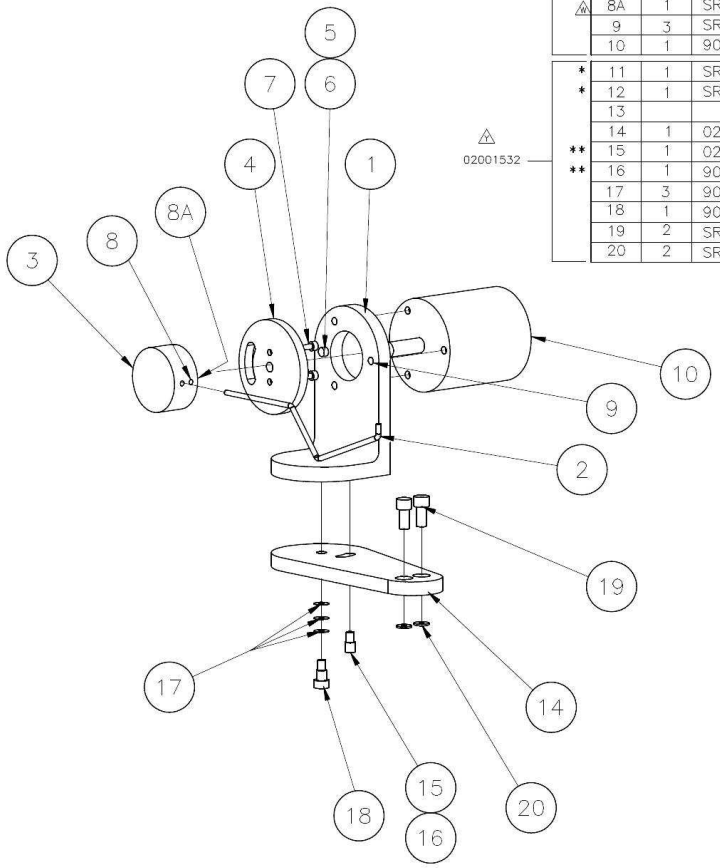
TINIUS OLSEN TESTING MACHINE CO.
WILLOW GROVE, PA.
MELT INDEXER-MODEL MP600
ASSEMBLY/WEIGHT LOWERING DEVICE
WITH PPDT 600

DRAWN OC | APPROVED | SHEET 1 OF 1
SCALE N/A | DATE 6-14-00

5-6-556







ITEM	QTY	PART No.	DESCRIPTION
1	1	02001554	ENCODER SUPPORT
2	1	02001555	FEELER ROD
3	1	02001556	COUNTERWEIGHT
4	1	02001557	ROD POSITIONER
5	1	02001559	BUMPER
6	1	90003361	'O' RING
7	2	SRU13F04	6-32 X 3/8 S.H.C.S.
⚠⚠ 8	1	SRU91F02	6-32 X 1/4 SET SCREW
⚠ 8A	1	SRU03F02	6-32 X 1/4 SET SCREW BRASS TIP
9	3	SRR32H06	10-32 X 5/8 FL.HD.SCR.
10	1	90003365	ENCODER
* 11	1	SRE01801	CABLE CLAMP
* 12	1	SRR63G02	8-32 X 1/2 PAN HEAD BLACK
13			
⚠ 14	1	02001558	MOUNTING BRACKET
** 15	1	02001559	BUMPER
** 16	1	90003361	'O' RING
17	3	90003440	CURVED WASHER
18	1	90003112	SHOULDER SCREW
19	2	SRU13L05	1/4 X 1/2 SOC.HD.CAP SCR.
20	2	SRW72L00	.040 WASHERS

⚠ 02001505W

⚠ 02001532

* = NOT SHOWN

** = SAME AS ITEM #5 & 6

NOTES: 1. SET ENCODER INDEX PULSE 1/4 TO 1/2 INCH BELOW TOP STOP. (SEE S-2767 FOR DETAILS.)
2.

ASSEMBLY DRAWING

BILL OF MATERIALS
5-6 #8/G

TOLERANCES
FRACTIONAL DIMENSIONS ± 1/64
DECIMAL DIMENSIONS ± .005
ANGULAR DIMENSIONS ± 1/2°
UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS & BREAK ALL EDGES

REV	DATE	ECN
W	09-15-05	2063
X	5-11-04	1838
Y	11-08-01	1408
Z	8-27-01	1382

188,254

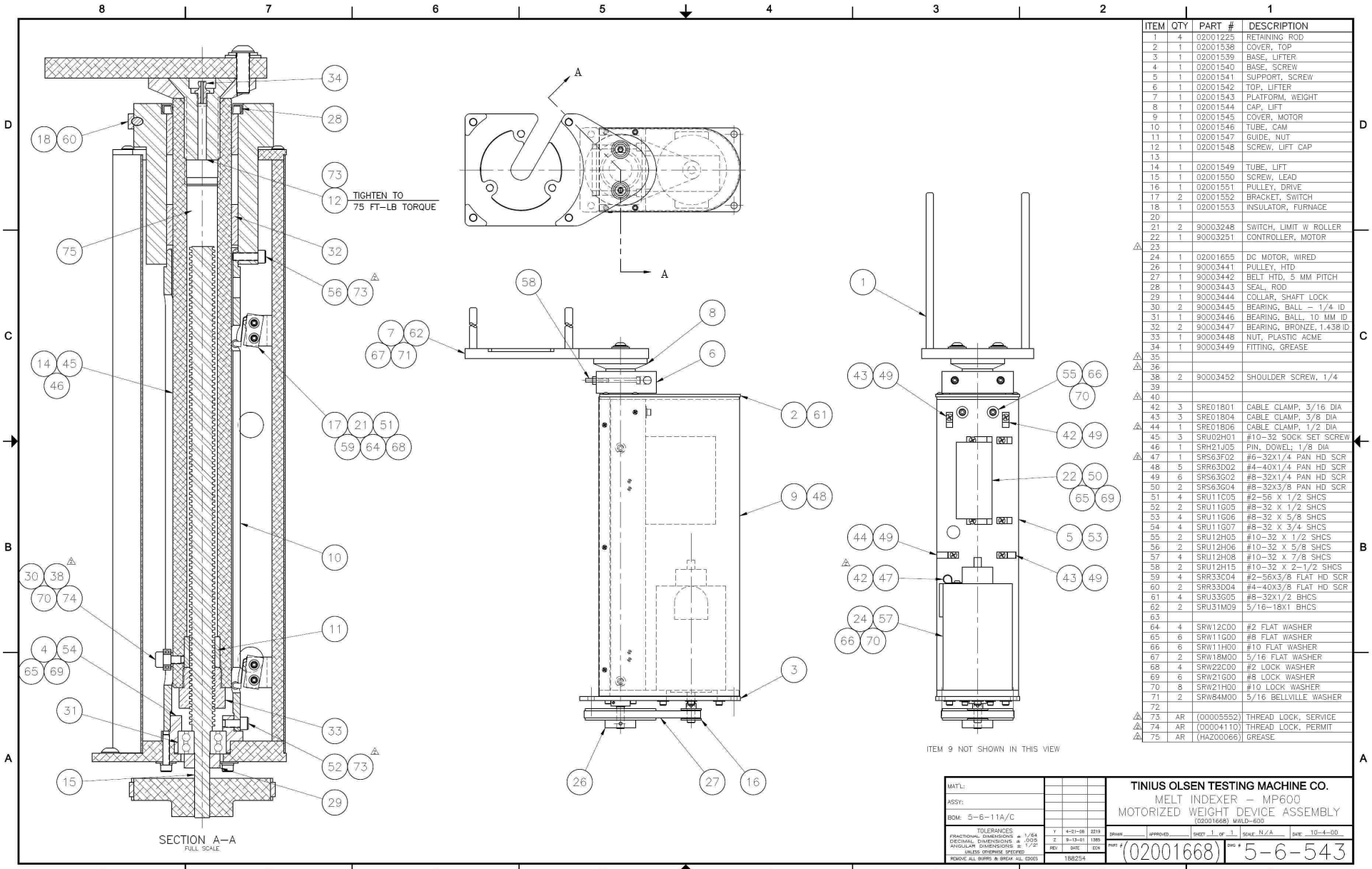
TINIUS OLSEN TESTING MACHINE CO.
WILLOW GROVE, PA.

MELT INDEXER - MP600
PPDT-600 OPTION ASSEMBLY
SHOWING MOUNTING DIAGRAM WITH MWLD AND 225 g WEIGHT

DRAWN ____ APPROVED ____ SHEET 1 OF 1

SCALE N/A DATE 8/4/00

5-6-549



ITEM	QTY	PART #	DESCRIPTION
1	4	02001225	RETAINING ROD
2	1	02001538	COVER, TOP
3	1	02001539	BASE, LIFTER
4	1	02001540	BASE, SCREW
5	1	02001541	SUPPORT, SCREW
6	1	02001542	TOP, LIFTER
7	1	02001543	PLATFORM, WEIGHT
8	1	02001544	CAP, LIFT
9	1	02001545	COVER, MOTOR
10	1	02001546	TUBE, CAM
11	1	02001547	GUIDE, NUT
12	1	02001548	SCREW, LIFT CAP
13			
14	1	02001549	TUBE, LIFT
15	1	02001550	SCREW, LEAD
16	1	02001551	PULLEY, DRIVE
17	2	02001552	BRACKET, SWITCH
18	1	02001553	INSULATOR, FURNACE
20			
21	2	90003248	SWITCH, LIMIT W ROLLER
22	1	90003251	CONTROLLER, MOTOR
23			
24	1	02001655	DC MOTOR, WIRED
26	1	90003441	PULLEY, HTD
27	1	90003442	BELT HTD, 5 MM PITCH
28	1	90003443	SEAL, ROD
29	1	90003444	COLLAR, SHAFT LOCK
30	2	90003445	BEARING, BALL – 1/4 ID
31	1	90003446	BEARING, BALL, 10 MM ID
32	2	90003447	BEARING, BRONZE, 1.438 ID
33	1	90003448	NUT, PLASTIC ACME
34	1	90003449	FITTING, GREASE
35			
36			
38	2	90003452	SHOULDER SCREW, 1/4
39			
40			
42	3	SRE01801	CABLE CLAMP, 3/16 DIA
43	3	SRE01804	CABLE CLAMP, 3/8 DIA
44	1	SRE01806	CABLE CLAMP, 1/2 DIA
45	3	SRU02H01	#10-32 SOCK SET SCREW
46	1	SRH21J05	PIN, DOWEL; 1/8 DIA
47	1	SRS63F02	#6-32X1/4 PAN HD SCR
48	5	SRR63D02	#4-40X1/4 PAN HD SCR
49	6	SRS63G02	#8-32X1/4 PAN HD SCR
50	2	SRS63G04	#8-32X3/8 PAN HD SCR
51	4	SRU11C05	#2-56 X 1/2 SHCS
52	2	SRU11G05	#8-32 X 1/2 SHCS
53	4	SRU11G06	#8-32 X 5/8 SHCS
54	4	SRU11G07	#8-32 X 3/4 SHCS
55	2	SRU12H05	#10-32 X 1/2 SHCS
56	2	SRU12H06	#10-32 X 5/8 SHCS
57	4	SRU12H08	#10-32 X 7/8 SHCS
58	2	SRU12H15	#10-32 X 2-1/2 SHCS
59	4	SRR33C04	#2-56X3/8 FLAT HD SCR
60	2	SRR33D04	#4-40X3/8 FLAT HD SCR
61	4	SRU33G05	#8-32X1/2 BHCS
62	2	SRU31M09	5/16-18X1 BHCS
63			
64	4	SRW12C00	#2 FLAT WASHER
65	6	SRW11G00	#8 FLAT WASHER
66	6	SRW11H00	#10 FLAT WASHER
67	2	SRW18M00	5/16 FLAT WASHER
68	4	SRW22C00	#2 LOCK WASHER
69	6	SRW21G00	#8 LOCK WASHER
70	8	SRW21H00	#10 LOCK WASHER
71	2	SRW84M00	5/16 BELLVILLE WASHER
72			
73	AR	(00005552)	THREAD LOCK, SERVICE
74	AR	(00004110)	THREAD LOCK, PERMIT
75	AR	(HAZ00066)	GREASE

MAT'L:
ASSY:
BOM: 5-6-11A/C

TOLERANCES
FRACTIONAL DIMENSIONS ± 1/64
DECIMAL DIMENSIONS ± .005
ANGULAR DIMENSIONS ± 1/2°
UNLESS OTHERWISE SPECIFIED
REMOVE ALL BURRS & BREAK ALL EDGES

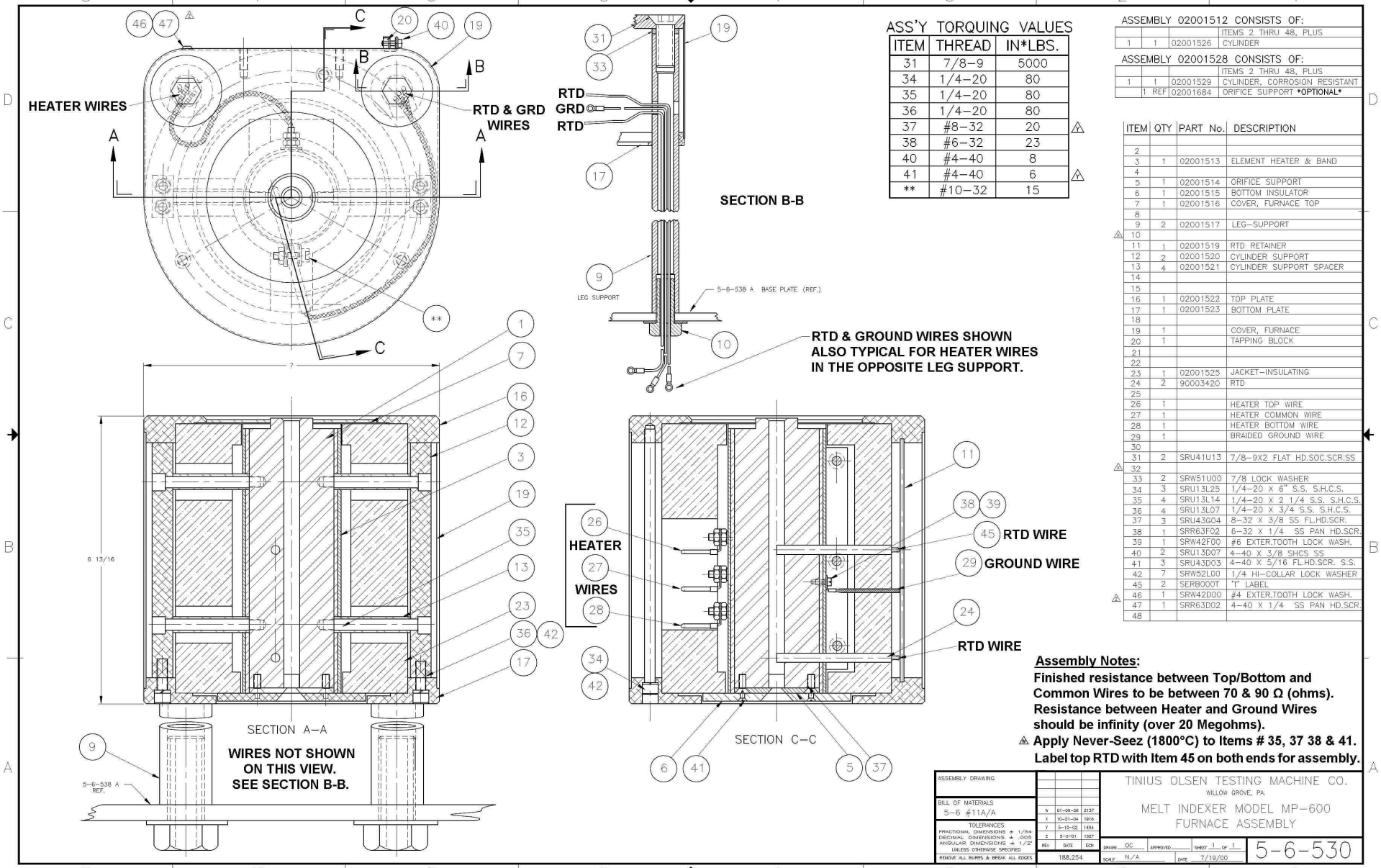
REV	DATE	ECN
Y	4-21-06	2219
Z	9-13-01	1365

188254

TINIUS OLSEN TESTING MACHINE CO.
MELT INDEXER – MP600
MOTORIZED WEIGHT DEVICE ASSEMBLY
(02001668) MWLD-600

DRAWN _____ APPROVED _____ SHEET 1 OF 1 SCALE N/A DATE 10-4-00

PART # (02001668) DWG # 5-6-543



ASS'Y TORQUING VALUES

ITEM	THREAD	IN*LBS.	
31	7/8-9	5000	
34	1/4-20	80	
35	1/4-20	80	
36	1/4-20	80	
37	#8-32	20	⚠
38	#6-32	23	
40	#4-40	8	
41	#4-40	6	⚠
**	#10-32	15	

ASSEMBLY 02001512 CONSISTS OF:

			ITEMS 2 THRU 48, PLUS
1	1	02001526	CYLINDER

ASSEMBLY 02001528 CONSISTS OF:

			ITEMS 2 THRU 48, PLUS
1	1	02001529	CYLINDER, CORROSION RESISTANT
	1 REF	02001684	ORIFICE SUPPORT *OPTIONAL*

ITEM	QTY	PART No.	DESCRIPTION
2			
3	1	02001513	ELEMENT HEATER & BAND
4			
5	1	02001514	ORIFICE SUPPORT
6	1	02001515	BOTTOM INSULATOR
7	1	02001516	COVER, FURNACE TOP
8			
9	2	02001517	LEG-SUPPORT
⚠ 10			
11	1	02001519	RTD RETAINER
12	2	02001520	CYLINDER SUPPORT
13	4	02001521	CYLINDER SUPPORT SPACER
14			
15			
16	1	02001522	TOP PLATE
17	1	02001523	BOTTOM PLATE
18			
19	1		COVER, FURNACE
20	1		TAPPING BLOCK
21			
22			
23	1	02001525	JACKET-INSULATING
24	2	90003420	RTD
25			
26	1		HEATER TOP WIRE
27	1		HEATER COMMON WIRE
28	1		HEATER BOTTOM WIRE
29	1		BRAIDED GROUND WIRE
30			
31	2	SRU41U13	7/8-9X2 FLAT HD.SOC.SCR.SS
⚠ 32			
33	2	SRW51U00	7/8 LOCK WASHER
34	3	SRU13L25	1/4-20 X 6" S.S. S.H.C.S.
35	4	SRU13L14	1/4-20 X 2 1/4 S.S. S.H.C.S.
36	4	SRU13L07	1/4-20 X 3/4 S.S. S.H.C.S.
37	3	SRU43G04	8-32 X 3/8 SS FL.HD.SCR.
38	1	SRR63F02	6-32 X 1/4 SS PAN HD.SCR.
39	1	SRW42F00	#6 EXTER.TOOTH LOCK WASH.
40	2	SRU13D07	4-40 X 3/8 SHCS SS
41	3	SRU43D03	4-40 X 5/16 FL.HD.SCR. S.S.
42	7	SRW52L00	1/4 HI-COLLAR LOCK WASHER
45	2	SERB000T	"T" LABEL
⚠ 46	1	SRW42D00	#4 EXTER.TOOTH LOCK WASH.
47	1	SRR63D02	4-40 X 1/4 SS PAN HD.SCR.
48			

Assembly Notes:

Finished resistance between Top/Bottom and Common Wires to be between 70 & 90 Ω (ohms). Resistance between Heater and Ground Wires should be infinity (over 20 Megohms).

⚠ Apply Never-Seez (1800°C) to Items # 35, 37 38 & 41.

Label top RTD with Item 45 on both ends for assembly.

ASSEMBLY DRAWING

BILL OF MATERIALS
5-6 #11A/A

TOLERANCES
FRACTIONAL DIMENSIONS ± 1/64
DECIMAL DIMENSIONS ± .005
ANGULAR DIMENSIONS ± 1/2°
UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS & BREAK ALL EDGES

REV.	DATE	ECN
W	01-09-06	2137
X	10-21-04	1918
Y	5-10-02	1494
Z	5-3-01	1327

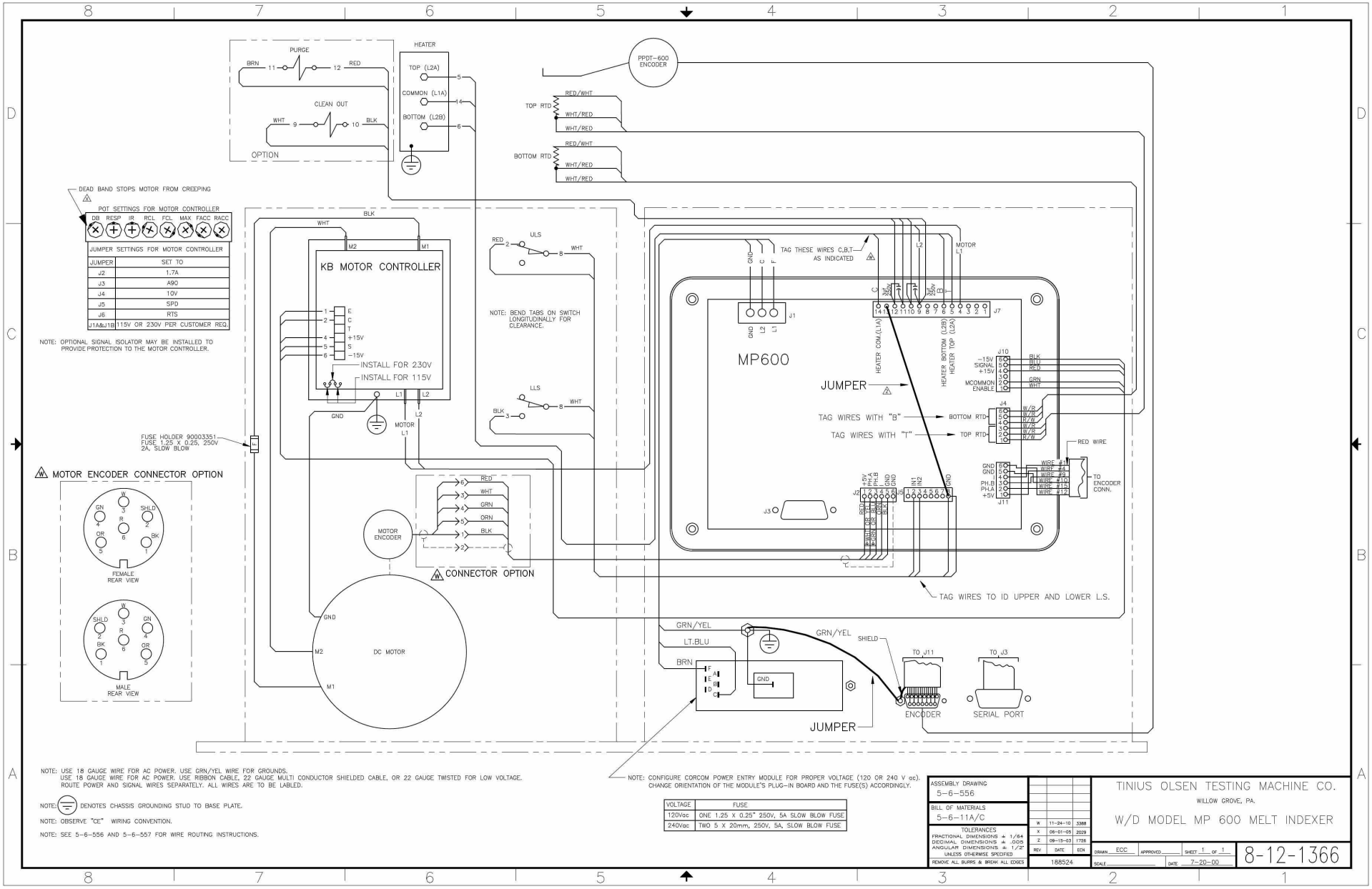
188,254

TINIUS OLSEN TESTING MACHINE CO.
WILLOW GROVE, PA.

MELT INDEXER MODEL MP-600
FURNACE ASSEMBLY

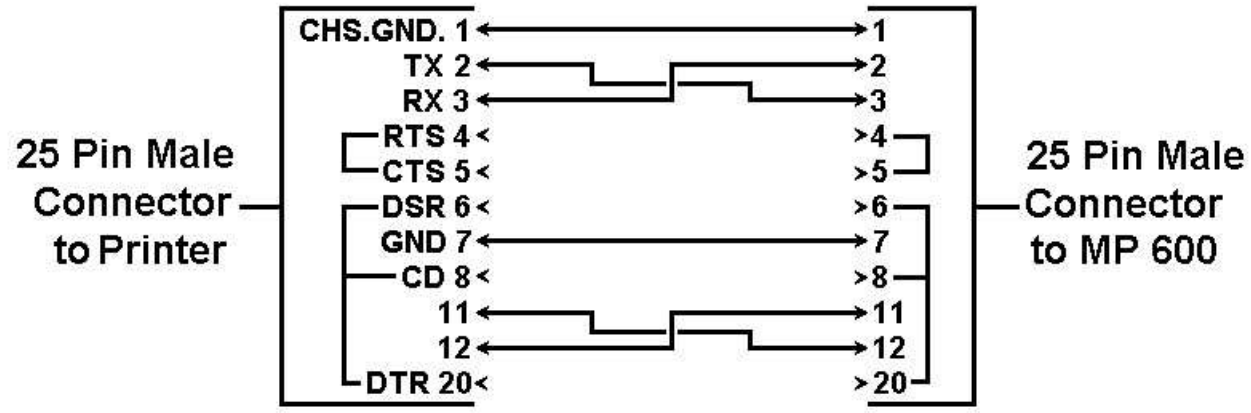
DRAWN OC | APPROVED | SHEET 1 OF 1
SCALE N/A | DATE 7/19/00

5-6-530

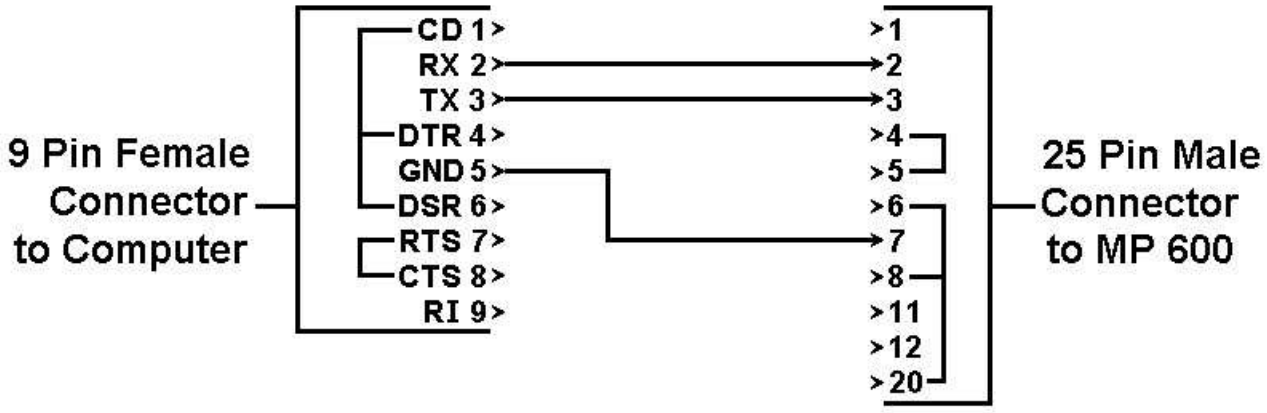

PURGE
BRN
11
12
RED
CLEAN OUT
WHT
9
10
BLK
OPTION
HEATER
TOP (L2A)
COMMON (L1A)
BOTTOM (L2B)
5
14
6
PPDT-600 ENCODER
TOP RTD
BOTTOM RTD
RED/WHT
WHT/RED
DEAD BAND STOPS MOTOR FROM CREEPING
POT SETTINGS FOR MOTOR CONTROLLER
DB RESP IR RCL FCL MAX FACC RACC
JUMPER SETTINGS FOR MOTOR CONTROLLER
JUMPER | SET TO
J2 | 1.7A
J3 | A90
J4 | 10V
J5 | SPD
J6 | RTS
J1A&J1B | 115V OR 230V PER CUSTOMER REQ.
NOTE: OPTIONAL SIGNAL ISOLATOR MAY BE INSTALLED TO PROVIDE PROTECTION TO THE MOTOR CONTROLLER.
KB MOTOR CONTROLLER
INSTALL FOR 230V
INSTALL FOR 115V
ULS
LLS
NOTE: BEND TABS ON SWITCH LONGITUDINALLY FOR CLEARANCE.
MP600
TAG THESE WIRES C,B,T AS INDICATED
JUMPER
TAG WIRES WITH "B"
TAG WIRES WITH "T"
BOTTOM RTD
TOP RTD
TAG WIRES TO ID UPPER AND LOWER L.S.
FUSE HOLDER 90003351
FUSE 1.25 X 0.25, 250V 2A, SLOW BLOW
MOTOR ENCODER CONNECTOR OPTION
FEMALE REAR VIEW
MALE REAR VIEW
MOTOR ENCODER
CONNECTOR OPTION
DC MOTOR
GRN/YEL
LT.BLU
BRN
SHIELD
ENCODER
SERIAL PORT
JUMPER
NOTE: USE 18 GAUGE WIRE FOR AC POWER. USE GRN/YEL WIRE FOR GROUNDS. USE 18 GAUGE WIRE FOR AC POWER. USE RIBBON CABLE, 22 GAUGE MULTI CONDUCTOR SHIELDED CABLE, OR 22 GAUGE TWISTED FOR LOW VOLTAGE. ROUTE POWER AND SIGNAL WIRES SEPARATELY. ALL WIRES ARE TO BE LABLED.
NOTE: DENOTES CHASSIS GROUNDING STUD TO BASE PLATE.
NOTE: OBSERVE "CE" WIRING CONVENTION.
NOTE: SEE 5-6-556 AND 5-6-557 FOR WIRE ROUTING INSTRUCTIONS.
NOTE: CONFIGURE CORCOM POWER ENTRY MODULE FOR PROPER VOLTAGE (120 OR 240 V ac). CHANGE ORIENTATION OF THE MODULE'S PLUG-IN BOARD AND THE FUSE(S) ACCORDINGLY.
VOLTAGE | FUSE
120Vac | ONE 1.25 X 0.25" 250V, 5A SLOW BLOW FUSE
240Vac | TWO 5 X 20mm, 250V, 5A, SLOW BLOW FUSE
ASSEMBLY DRAWING 5-6-556
BILL OF MATERIALS 5-6-11A/C
TOLERANCES FRACTIONAL DIMENSIONS ± 1/64 DECIMAL DIMENSIONS ± .005 ANGULAR DIMENSIONS ± 1/2° UNLESS OTHERWISE SPECIFIED
REMOVE ALL BURRS & BREAK ALL EDGES
W 11-24-10 3388
X 06-01-05 2029
Z 98-15-03 1726
REV DATE ECN
188524
TINIUS OLSEN TESTING MACHINE CO.
WILLOW GROVE, PA.
W/D MODEL MP 600 MELT INDEXER
DRAWN ECC APPROVED SHEET 1 OF 1
SCALE DATE 7-20-00
8-12-1366

MP 600 Controller Interface Connections

(10 foot Shielded Cables)



MI-Printer AME Serial Cable - P/N 90002871.



MI-Interface (RS-232/423) AME Cable - P/N 90002820.

Reference Sketch # S-2132a.