

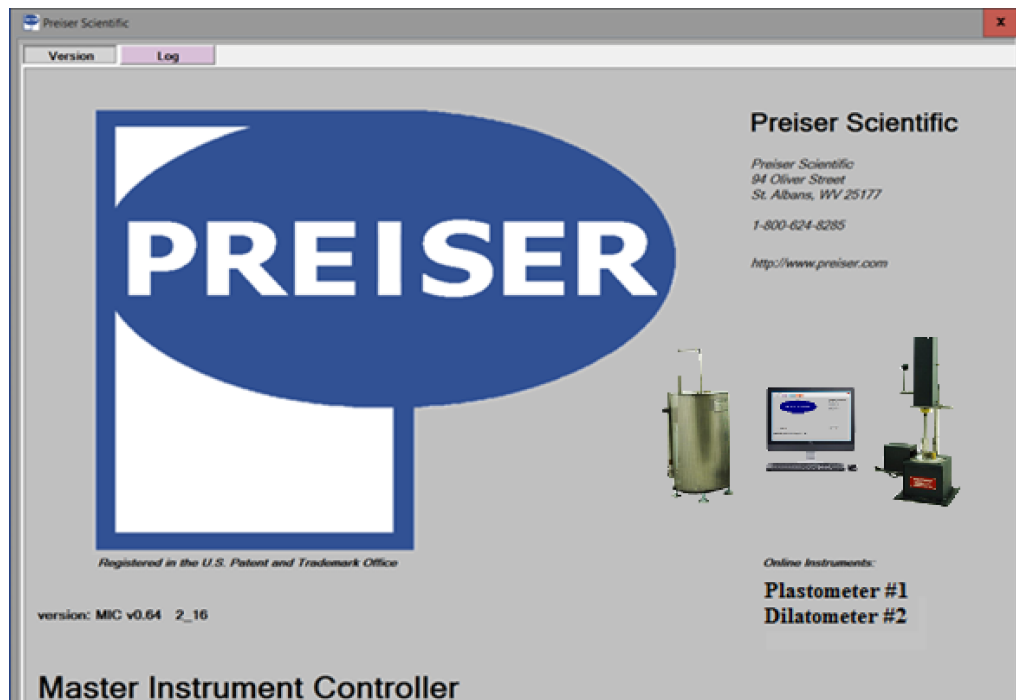
Plastometer

User and Assembly Manual

Version 2.0

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1.0 Installation Guide

It is Preiser Scientifics recommendation that a fume hood be installed over top of the instrument for normal and safe operation.

Unpack the components And conduct a pre-use visual inspection needs to be completed to insure that no components or wired connection were damaged or dislodged during shipping. Remove the top cover of the control unit and visually inspect the interior of the controller cabinet for any loose connections.

Referring to the diagrams that follow connect the interface box to the Plastometer assembly.

This instrument utilizes a Windows® operating system. Clicking on the Interface Control program will automatically configure the attached interface box to the correct instrument type.

Although the Plastometer has been calibrated and thoroughly tested at the factory, it will be necessary to recalibrate the instrument once it is setup.

1.1 Single Plastometer model 4000 Component Upgrade

- 1 Disconnect Solder Pot and Head assembly from model 4000 controller.
- 2 Reconnect Solder Pot / Head assembly Amphenol connector into new interface box.
- 3 Replace Thermocouple (type J) with new Thermocouple (type K).
- 4 Connect Interface box to Control PC with supplied USB cable.

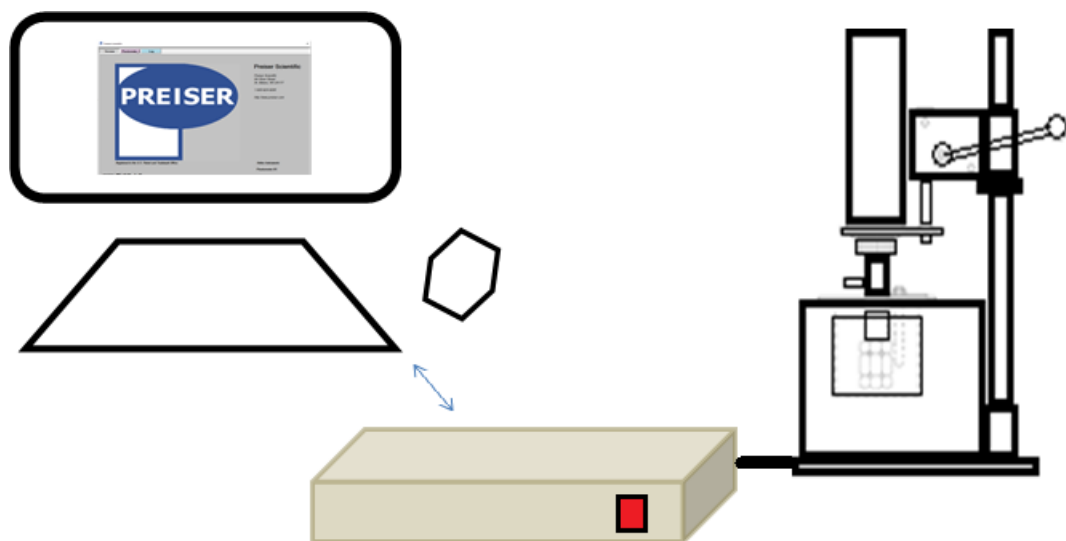


Figure 1 Control PC, Interface Box, Plastometer Solder Pot/ Head Unit

1.2 Single Plastometer New Unit

- 1 Connect Solder Pot and Head assembly to interface box via a RJ45 either net cable (patch – straight cable).
- 2 Connect Thermocouple from Head Assembly to interface box.
- 3 Connect Control PC to interface box via USB cable.

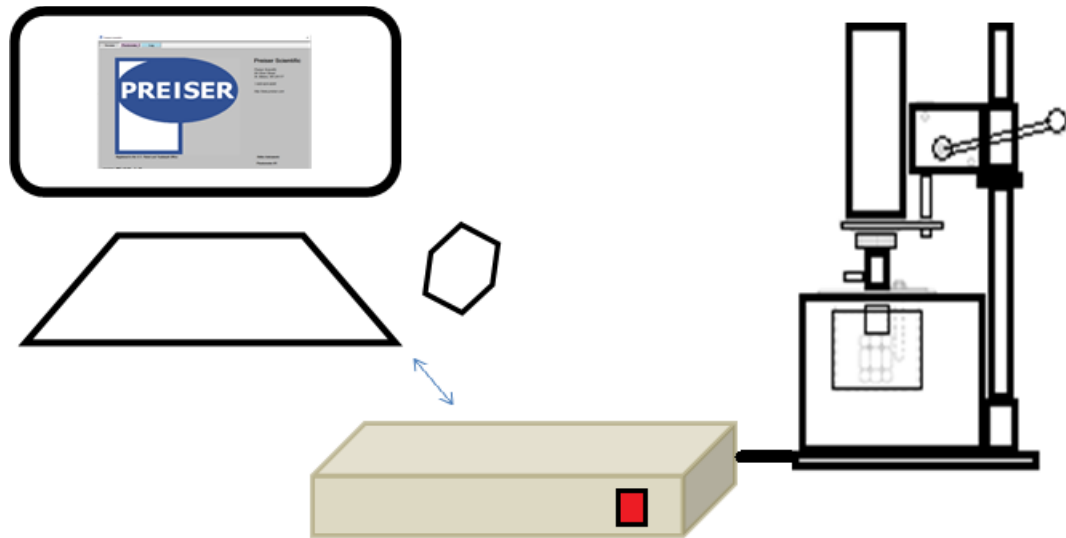


Figure 2 Control PC, Interface Box, Plastometer Solder Pot/ Head Unit

1.3 Combo Unit model 6000 Component Upgrade

(Plastometer/Plastometer, Plastometer/Dilatometer, Dilatometer/Dilatometer)

Combination units require the installation of two different interface boxes but will share a single PC controller. To upgrade, each half of the combo unit is treated as a single unit. Component installation for each of the two instrument sides of a combo are installed as described in the Plastometer and Dilatometer instructions.

The PC based control software will identify what units have been “Plugged” into the PC and will configure the control program.

A dual Plastometer/Dilatometer Unit will be upgraded as follows:

- 1 Disconnect Solder Pot and Head assembly from model 6000 controller.
- 2 Reconnect Solder Pot / Head Assembly into new interface box.
- 3 Replace Plastometer Thermocouple with new Thermocouple (type K).
- 4 Connect Interface box to Control PC with supplied USB cable.
- 5 Disconnect Dilatometer Furnace and LVDT assembly from model 6000 controller.
- 6 Reconnect Dilatometer Furnace and LVDT assembly into new interface box.
- 7 Replace Dilatometer Thermocouple with new Thermocouple (type K).
- 8 Connect Interface box to Control PC with supplied USB cable.

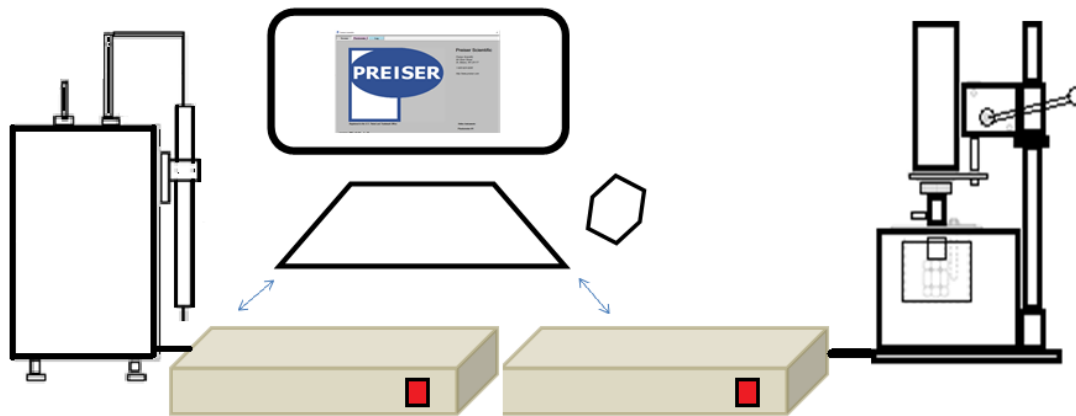


Figure 3 Combination Instrument Setup

1.4 Combo Unit - New

(Plastometer/Plastometer, Plastometer/Dilatometer, Dilatometer/Dilatometer)

Combination units will share both the PC controller and a single interface box. Component installation for each of the two instrument sides of a combo are installed as described in the Plastometer and Dilatometer instructions.

The PC based control software will identify what units have been “Plugged” into the PC and will configure the control program.

A dual Plastometer/Dilatometer Unit would be connected as follows:

- 1 Connect Solder Pot and Head assembly to interface box via a RJ45 either net cable (patch – straight cable). Furnace is connected directly to power source.
- 2 Connect Thermocouple from Solder Pot to interface box.
- 3 Connect Dilatometer Furnace to interface box via a RJ45 either net cable (patch – straight cable). Furnace is connected directly to the power source.
- 4 Connect Thermocouple from Dilatometer Furnace to interface box.
- 5 Connect Control PC to interface box via provided USB cable.

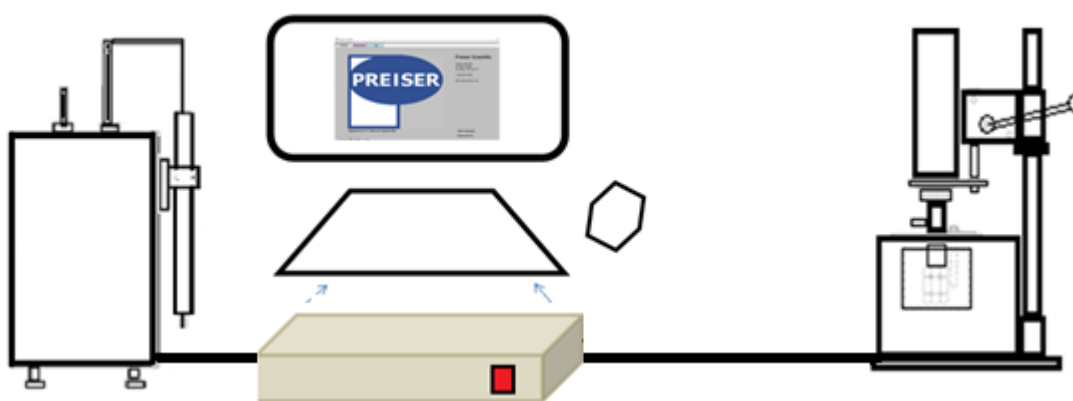


Figure 4 Combination Instrument Setup (Dilatometer - Plastometer)

1.5 Required Software

These files need to be preloaded for proper instrument operation:

C:\mic_2017\bin\MIC_2017 v2.1.exe
C:\mic_2017\bin\PdfSharp.dll

Using the install memory key, simply execute the installMic.exe program. All necessary file directories will be created and populated with required files.

Test reports will not be generated if PdfSharp.exe is not present, detailed results will only be stored in xxx.sce files.

2.0 Plastometer Operation

The Plastometer screen tab select switches the visible form to either a Plastometer Main Run Screen or Test Setup and Utilities screen.

The **Main Run Screen** is used for normal test run to test run operation.

The **Test Setup and Utilities Screen** allows the test profile to be set, thermocouple calibration, solder pot and communications monitoring. This screen is primarily used for initial test cycle definition and trouble shooting.

Various Plastometer screens are illustrated below:

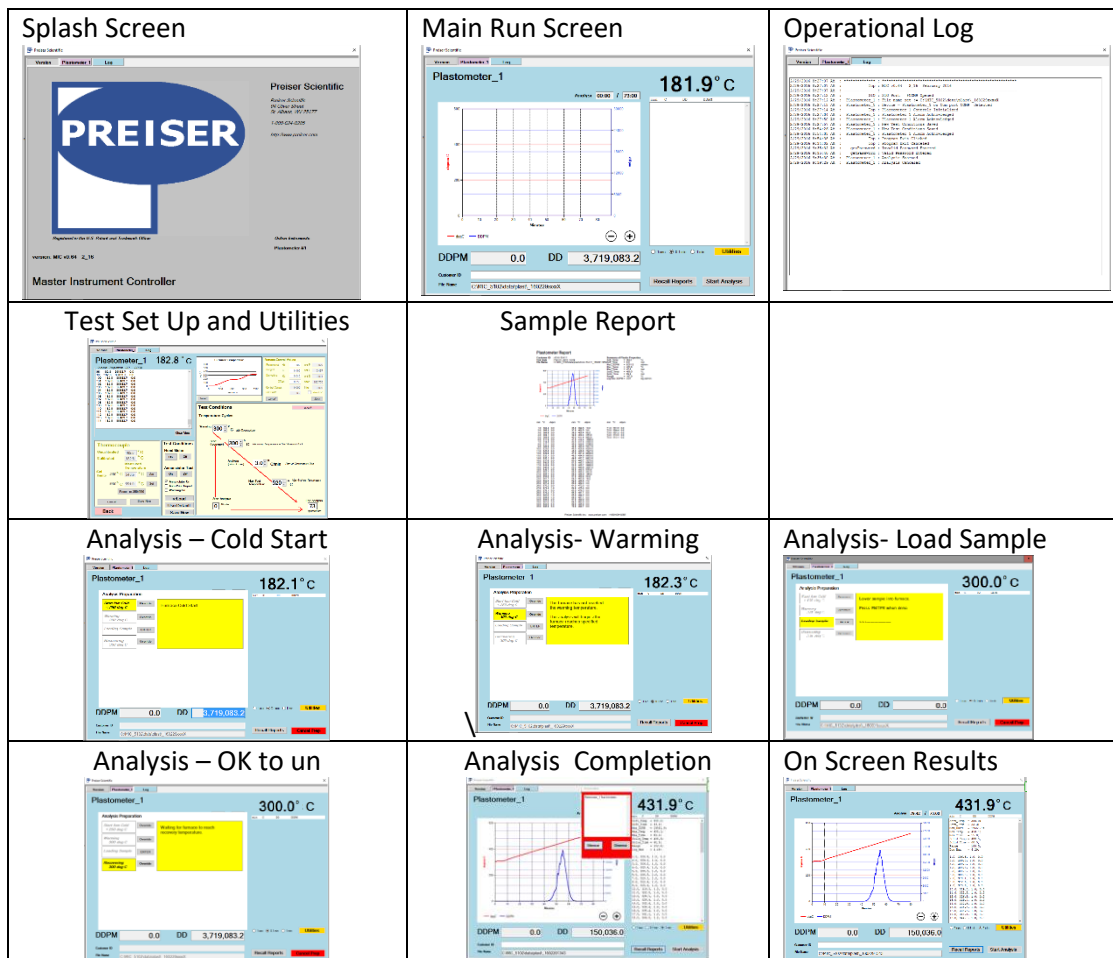


Figure 5 Plastometer Screen Displays

2.1 Instrument Calibration

Thermocouple calibration is the only adjustments necessary for the Plastometer. From the Main Screen, select the Utilities button to move to the Test Setup and Utilities Screen

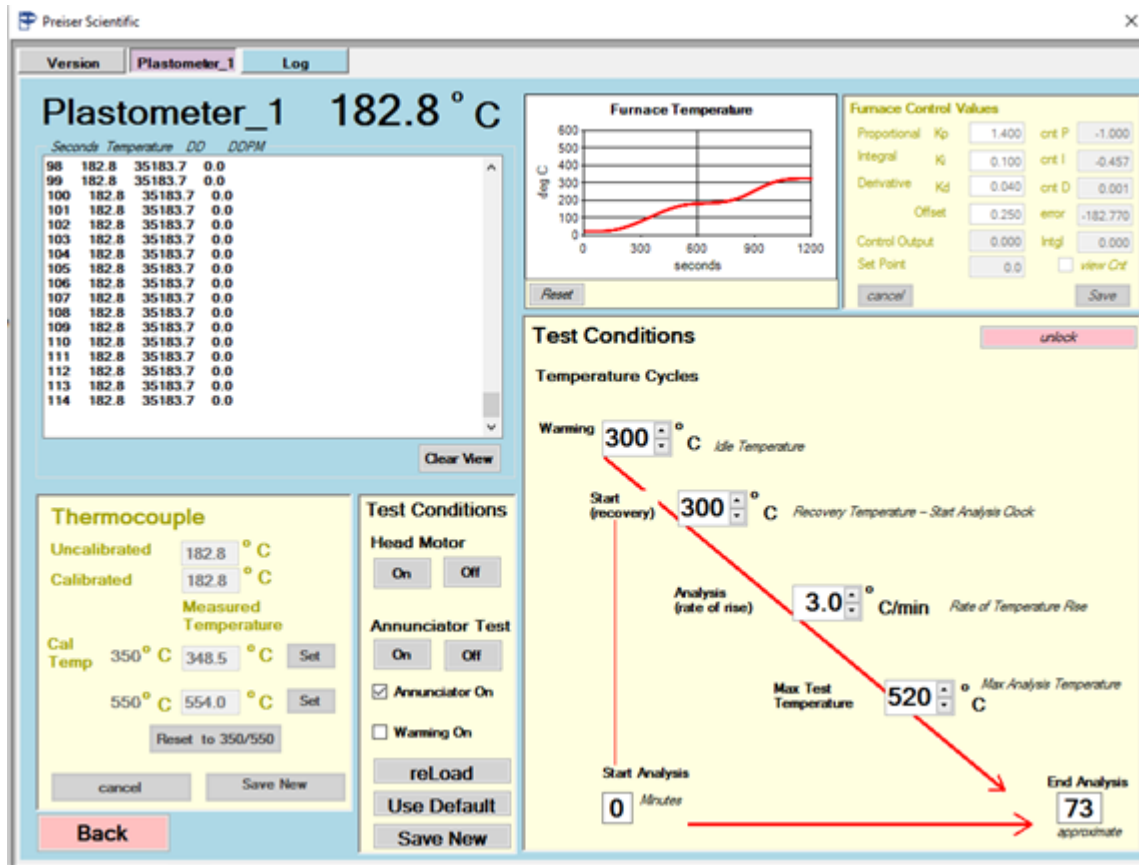
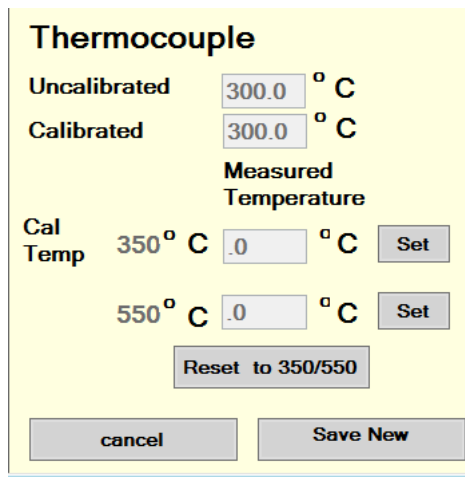


Figure 6 Test Setup and Utilities Screen



Thermocouple

Uncalibrated °C

Calibrated °C

Measured Temperature

Cal Temp 350 °C °C

550 °C °C

Figure 7 Thermocouple Calibration

The thermocouple is calibrated at two different temperatures. Apply a calibrated 350 degree input and “Set” the reading then apply a 550 degree calibration input and set the reading. Use Save New button to accept the new calibration.

2.2 Test Cycle Setup

These controls are “locked” to prevent accidental changes during normal instrument operation. Unlock the control by using the “admin” button and entering the administrative password.

Once unlocked, the critical analysis temperatures can be entered and modified. Changes must be saved (Save New) in order to take effect. Note that the run time is an estimate only and is dependent on the temperature recovery time once the sample is placed in the solder pot. Generally the estimated time will be 10% greater than the actual time needed to achieve the final test temperature.

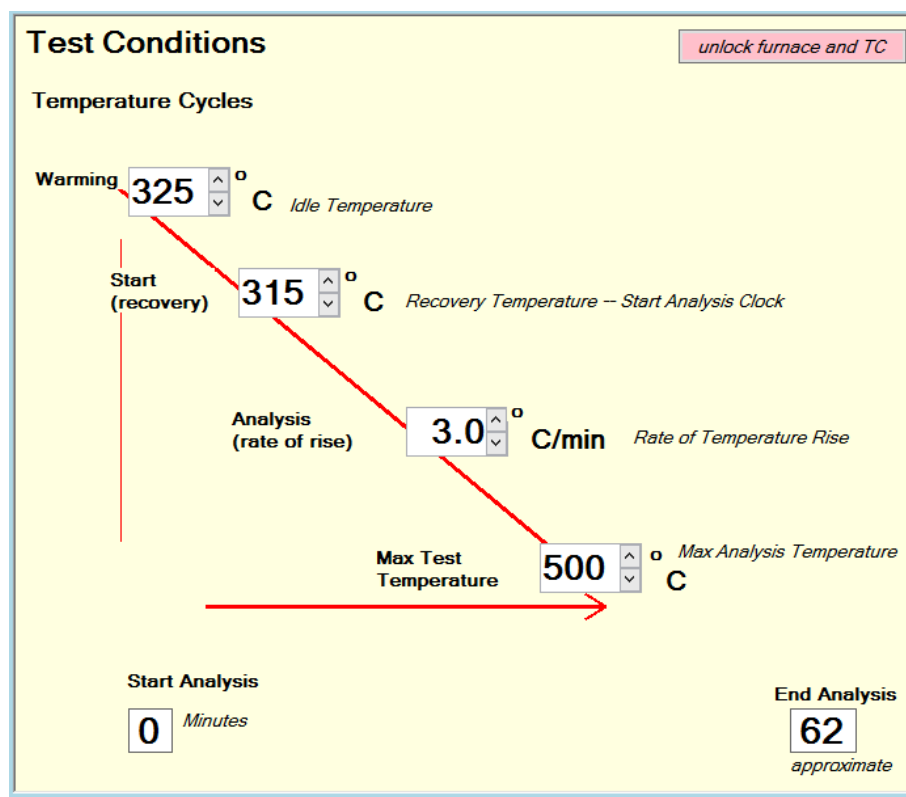


Figure 8 Test Cycle Setup

2.3 Plastometer Sample Testing

Samples should be prepared per ASTM Standards D2639.

2.3.1 Packing & Loading the Plastometer

First, mount the stirring rod in the crucible. The stirring rod should be set in the small depression of the crucible bottom. Make sure all other thumbscrews are loosened. This applies downward force to the stirring rod to keep it in position.

Introduce the sample, (no less than 5 grams to avoid damage to stirring rod), into the crucible and rotate the stirring rod to allow the sample to fill the spaces below the stirring arms: DO NOT allow the stirring rod to be lifted out of the small hole in the center of the crucible bottom. Continue to add sample until all 5 grams are introduced into the crucible. Move the piston of the packer down so that it slightly compresses the sample. Raise the packer hammer and lower the packer weight. Drop the hammer twelve times per the ASTM standard.

After completely assembling and filling the crucible and stirring rod combination, be particularly careful not to move the rod. Insert the rod into the barrel with the chimney attached and screw the barrel onto the crucible. Holding the sample by the barrel, carefully fit the stirring shaft into the drive shaft on the head assembly and tighten the collar. Take extra care to insure that the stirring shaft does not move during assembly. (Tightening the threaded connections more than hand-tight should not be necessary if the parts are properly cleaned).

2.3.2 Running a Plasticity Test

Turn the system power on. Allow the instrument to boot-up the main operating screen. If Enabled the furnaces will automatically heat up to the warming set-point temperature.

Prepare the sample per the sample preparation, loading and packing instructions.

Enter desired Sample Tag by pressing the shaded box next the Sample Tag indication.

Once proper furnace temperature is reached, connect the retort assembly (Barrel, Chimney Crucible and Stirring Rod) to the Head Assembly. Press the "START" button on the Plastometer side of the screen. Lower the sample into the molten solder bath and acknowledge by pressing the "OK" button on the screen. The Plastometer side is now in run mode and the screen will automatically change to the Plastometer plot screen. The cooler sample assembly will cause the solder bath to drop in temperature. The controller will heat the furnace up until the "start" temperature is once again reached. At the "start" temperature the controller turns the head assembly on and ramps the furnace temperature at the selected rate of rise.

Once the "stop" temperature is reached the system automatically goes into an alarm condition letting the operator know that the test is complete. Press the "Silence" or "Dismiss" button to silence the alarm.

Raise the sample assembly from the furnace.

Note: Take special care when removing the sample from the Solder Bath as to NOT get any solder on the controllers Touch Screen as this will cause damage to it.

The test is now complete and the system is ready for another test run. The next test cannot be started until the furnace temperature decreases to the "start" temperature.

2.4 Plastometer Head Assembly Adjustments

2.4.1 Torque Adjustment

Adjustable on the Plastometer is the amount of constant torque applied to the stirring shaft connected to the head assembly. The torque is controlled by a mechanical hysteresis clutch (barrel shaped object in picture below). The standard is 1.4 oz in. The control dial allows selection of amount of torque from 0.15 oz in to 2.0 oz in.

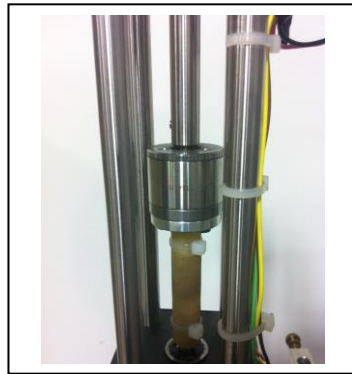


Figure 9 Hysteresis Clutch

2.4.2 Calibration Of Head Assembly Torque

Attach the Torque Test Assembly to the Head Assembly as illustrated in the following figure:

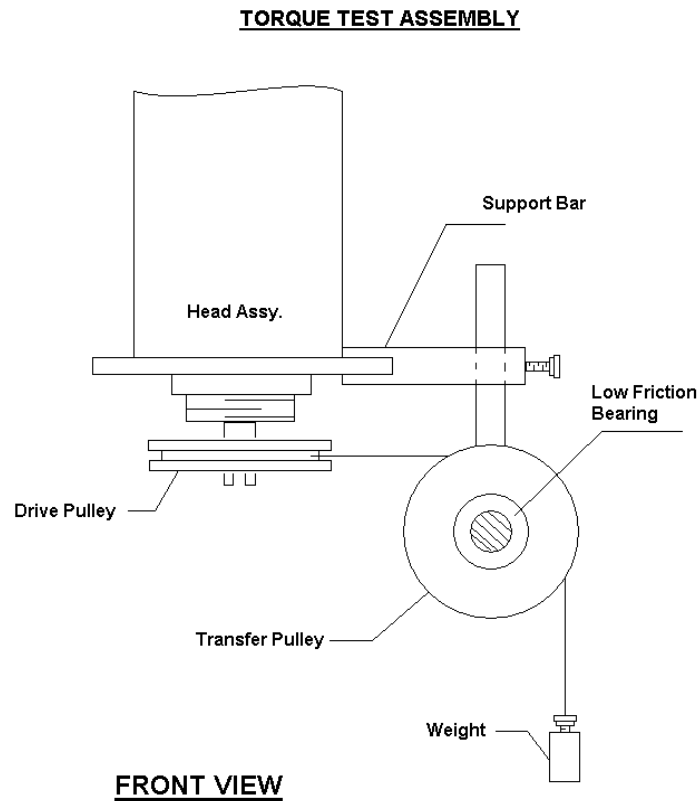


Figure 10 Torque Test Assembly

Remove the head cover by loosening the four thumb screws and pulling forward.

Located the two setscrews on the clutch and loosen until the knurled dial is adjustable.

Adjust the knurled dialed to desired setting and retighten setscrews.

1. Go to Diagnostics and activate the head motor.

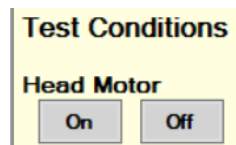


Figure 11 Head Motor Control

2. When the calibration is complete, turn the Head Motor off.
3. Repeat the above steps until the proper torque is achieved per ASTM D2639.

2.5 Plastometer Utilities

Figure 12 presents the complete Plastometer Utilities screen.

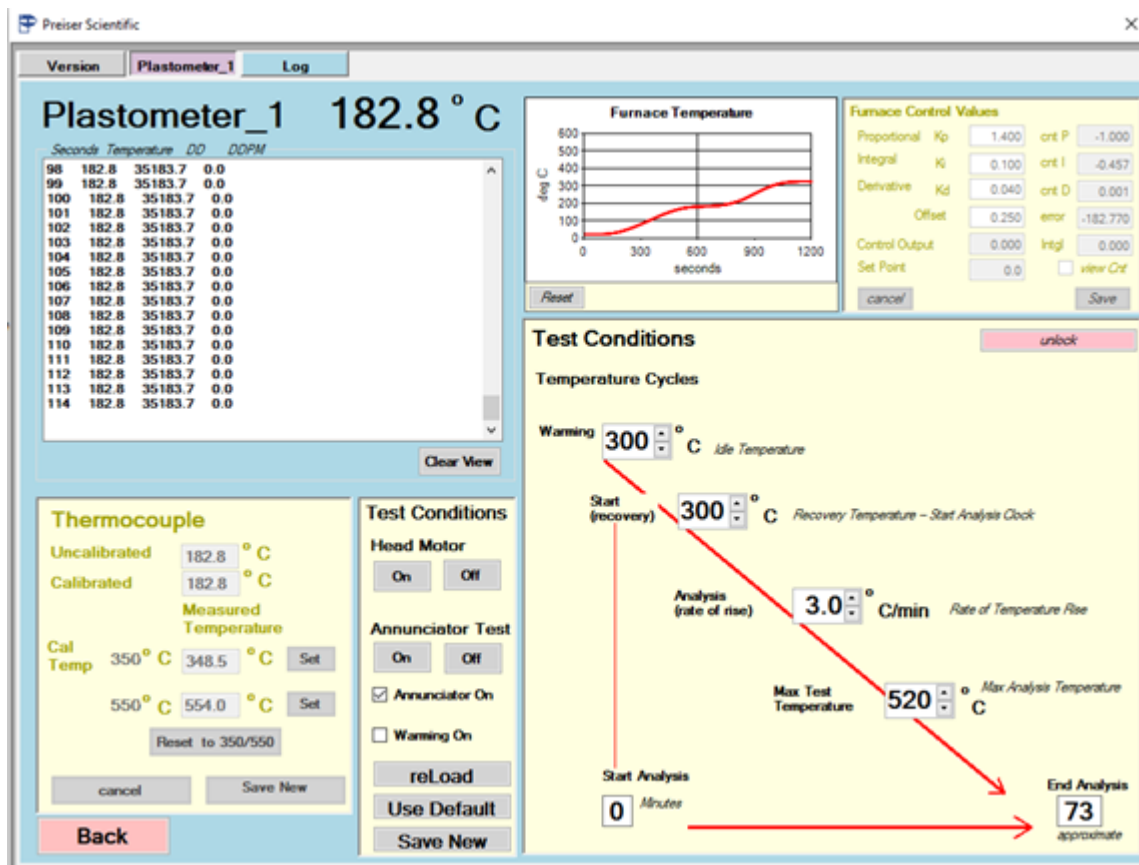


Figure 12 Utilities System I/O Diagnostics

This screen has provisions the Test Cycle setup, Thermocouple calibration, furnace condition monitoring, and instrument communications.

The Test Condition block allows the user to directly turn on the plastometer head motor for setting torque and enable furnace warming during idle time.

Presier Scientific trained and approved service personal use the furnace monitoring and instrument communications to assess instruments health, aid trouble shooting , and facilitate furnace tuning when issues arise.

2.6 Plastometer Components

2.6.1 Head Controller Interface Board

The Head Controller interface card regulates all head functions. The Head Controller interface card communicates to the main CPU via serial communications.

2.6.2 Solder Pot

The solder pot consists of a 5 inch deep x 2.62 inch inside diameter stainless steel liner with a 700 watt coil element surrounding the pot. Under control of the PC based software, the control interface sends 5 vdc pulses to the control side of the SSR, which in turn acts as an electronic switch to control the rate-of-rise of the solder temperature.

2.6.3 Head Assembly

The MIC 2017 head assembly consists of 3 main parts. A 120 VAC motor at 1800 RPM, a hysteresis clutch and a quadrature encoder all coupled together by surgical tubing. The quadrature encoder is a shaft encoder that requires two symmetrical 50% duty cycle wave output signals in quadrature relationship to each other. One channel will electrically lead the other by 90 degrees with a counter clockwise shaft rotation.

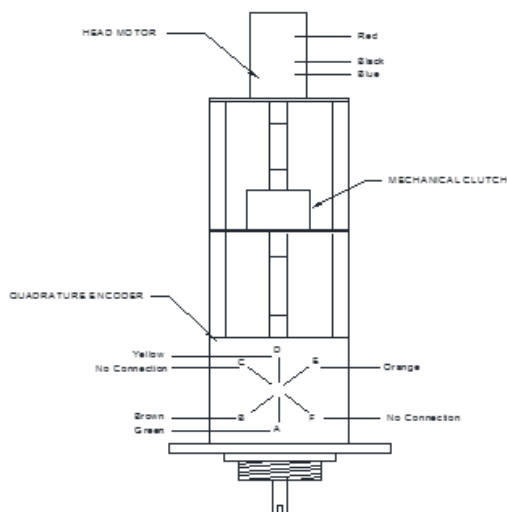
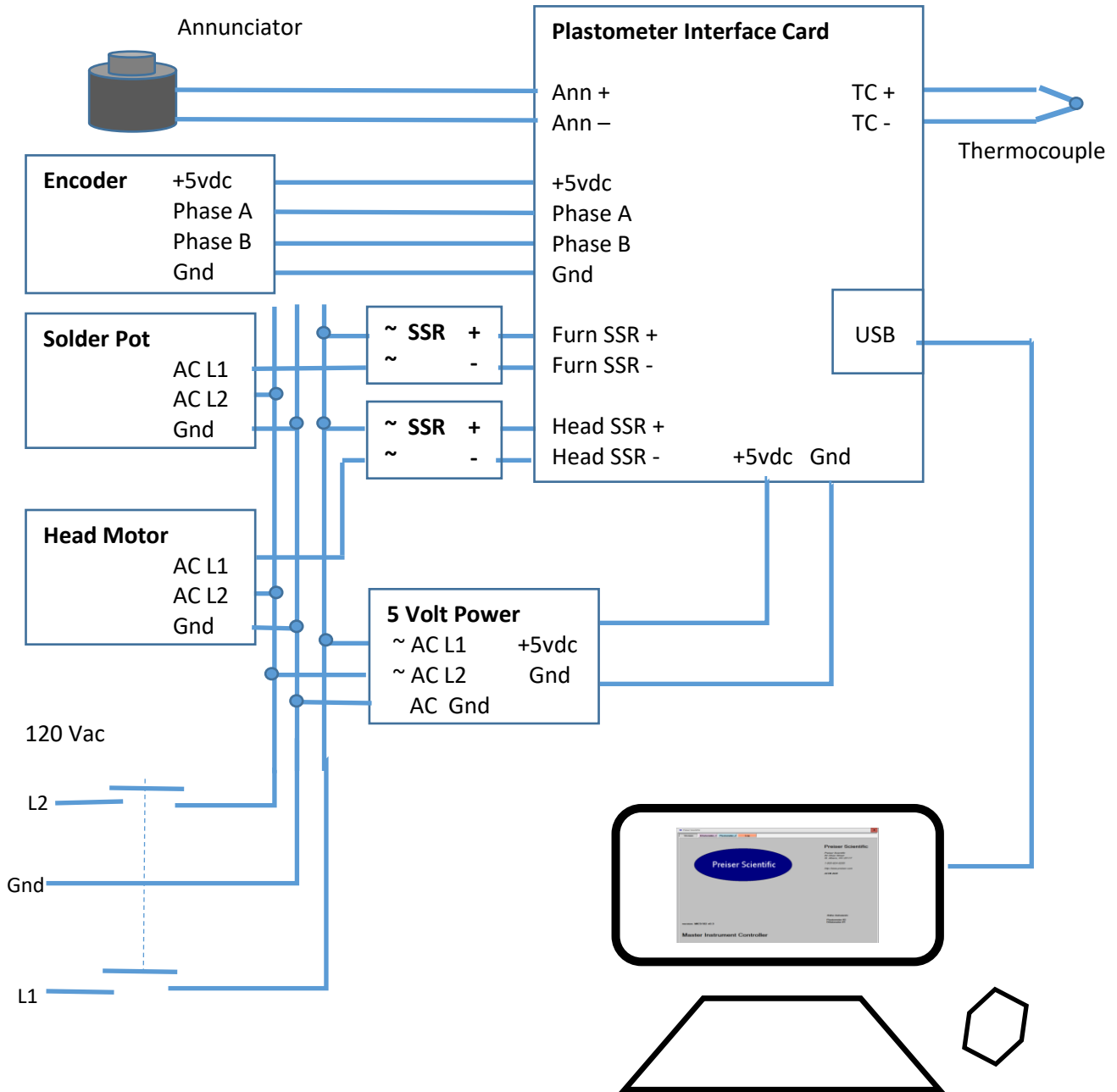


Figure 13 Head Assembly

3.0 Plastometer Interface Box

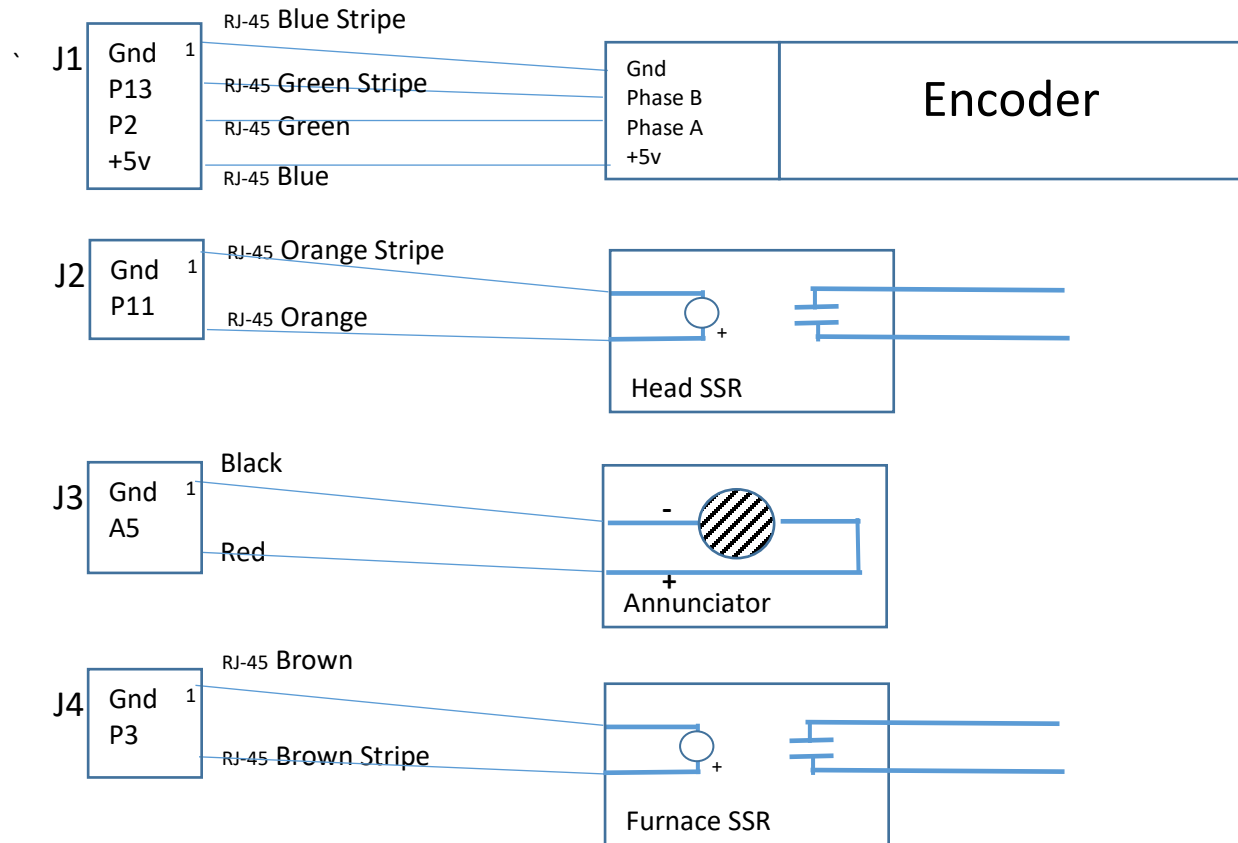
3.1 Signal Paths (not a wiring diagram)



[illegible]

PIN	Header	Function
0		
1		
2	J1	Encoder Phase_A
3	J4	Furnace
4	ADMAX	PINSC
5	ADMAX	PINCS
6	ADMAX	PINSO
7	L298	SW1
8	L298	SW2
9	L298	SW3
10	L298	SW4
11	L298 / J2	Head
12	L298	
13	J1	Encoder Phase_B
A0	J6	
A1	J7/J8	
A2	J8	
A3	J8	
A4		
A5	J3	Annunciator

3.3 Plastometer Header Cable Wiring Diagrams

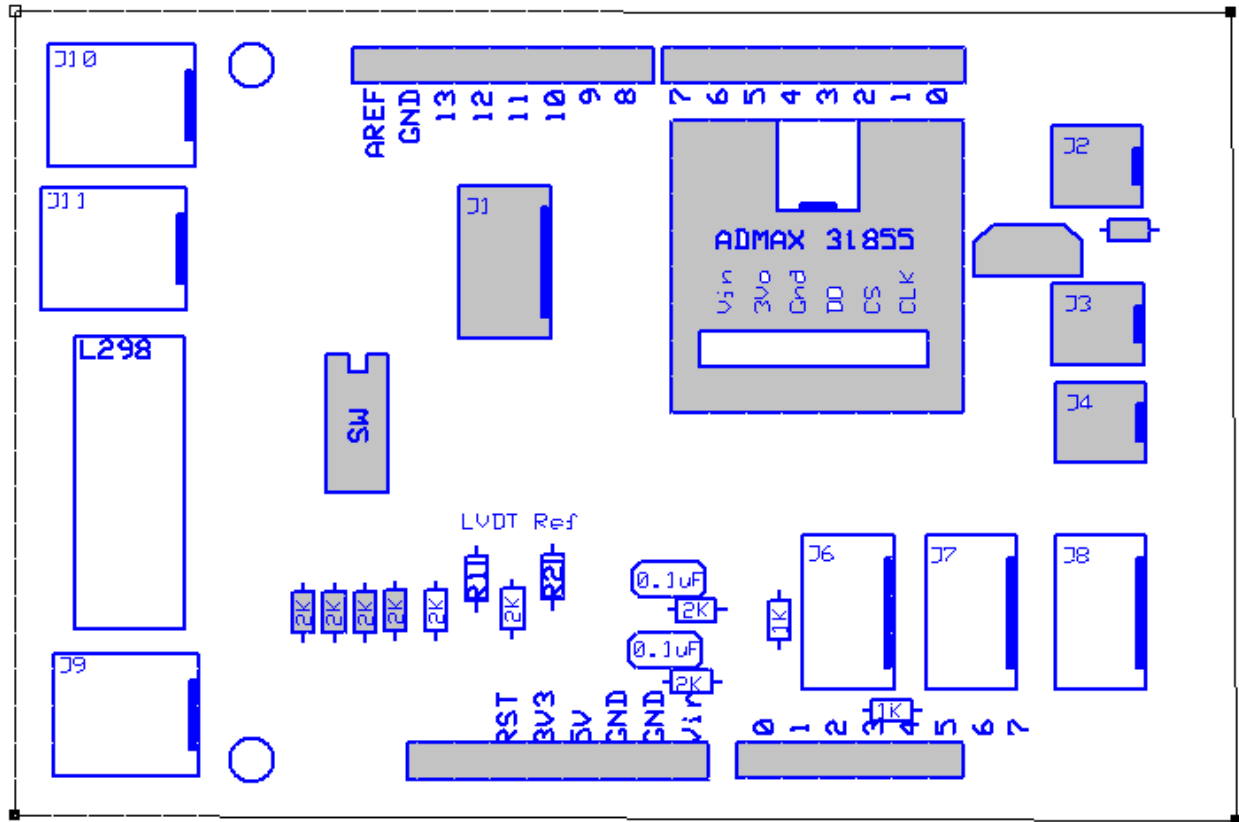


PVC Jumper	Color	RJ45 Box	RJ45 Head
J1 gnd 1	Blue Stripe	5	5
2	Green Stripe	6	6
3	Green	3	3
4	Blue	4	4
J2 gnd 1	Orange Stripe	1	2
2	Orange	2	1
J3 gnd 1	Black		
2	Red		
J4 gnd 1	Brown	8	8
2	Brown Stripe	7	7

Figure 14 PCB Jumper - RJ45 Wiring

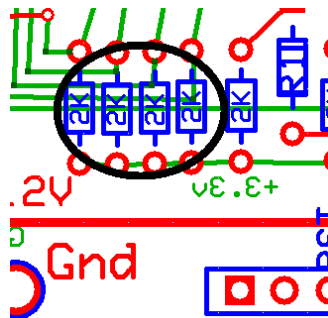
3.4 Plastometer PCB Assembly

Preiser Interface PCB v.4.0



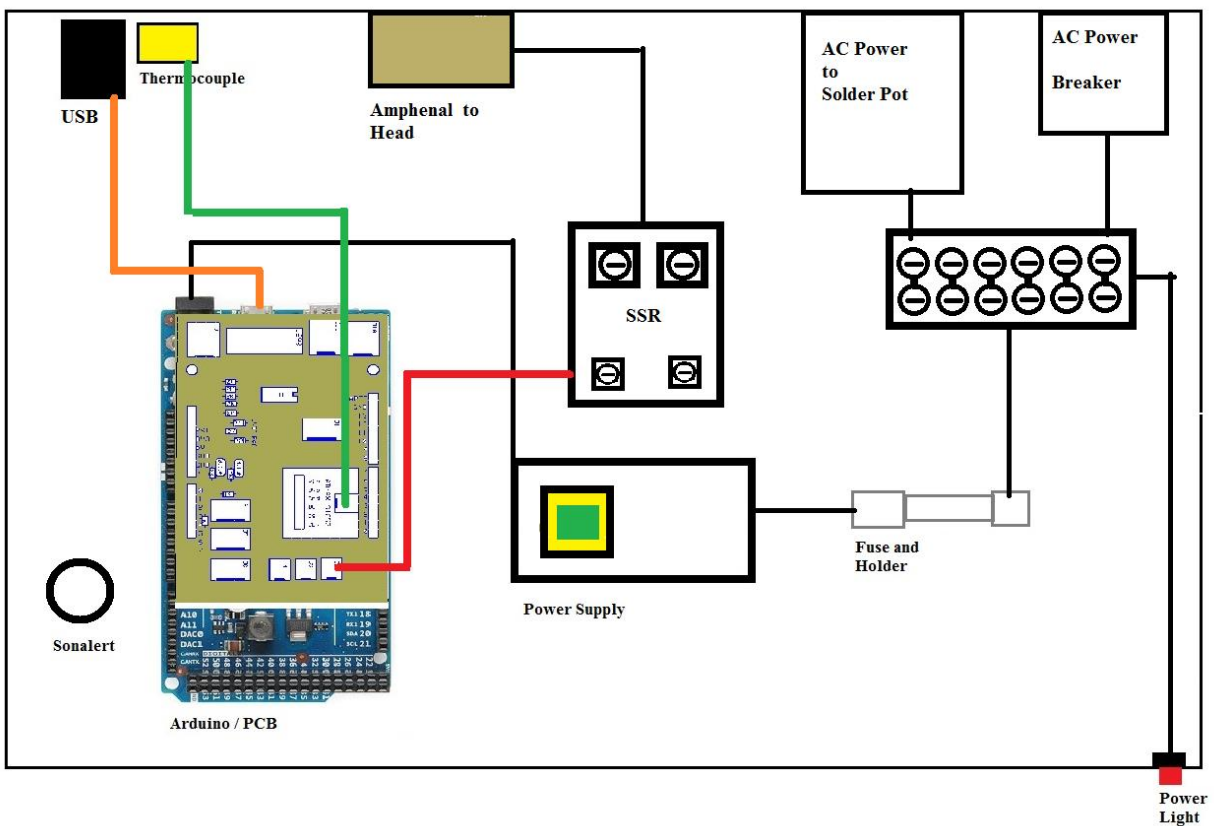
Mount 4 pin connector (Molex, .1 inch KK, up, 4 pin (DigiKey WM4202)) in J1(pin zero is top).

1. Mount 2 pin connectors (Molex, .1 inch KK, up, 2 pin (DigiKey WM4200)) in J2, J3 and J4 (pin zero is top).
2. Solder four 2k resistors below 4 pole DIP switch.



3. Solder Arduino Header Set to outer connectors (1x10pin, 2x8 pin and 1x 6 pin header) female header, with extra long legs (10.5 mm) , 0.1" spacing.
4. Mount Thermocouple Amplifier MAX31855 breakout board (0.8 x 0.8 inches)
5. Solder 4 position DIP switch into location labeled SW.
6. Mount 2n3904 and 1K resistor between J2 and J3 for the Sonalert.

3.5 Plastometer Control Box component and cable placement .



3.6 Configuration Switch Settings

PCB Switch

	SW1	SW2	SW3	SW4	
On	[x]	[x]	[x]	[x]	"0"
Off	[]	[]	[]	[]	"1"

SW1 off Dilatometer
 on Plastometer

SW2 SW3 Unit Number
 on on _01
 on off _02
 off on _03
 off off _04

SW4
 off Upgrade
 on New

Example

Plastometer _03 Upgrade

SW = 0101 (On Off On Off)

	SW1	SW2	SW3	SW4	
On	[x]	[]	[x]	[]	"0"
Off	[]	[x]	[]	[x]	"1"

SW = 0101 (On Off On Off)

	SW1	SW2	SW3	SW4	
On	[x]	[]	[x]	[]	"0"
Off	[]	[x]	[]	[x]	"1"

4.0 Cable Definitions

J1,J2, J4 to RJ-45 Control Cable

USB_Cable		
9 inches	USB Micro	USB A

DC Power Cable

Power Cable		PCB 1
Power Terminal Block		
	Pos Terminal	Red – 12” 20 AWG
	Neg Terminal	Black – 12” 20 AWG
Power Socket		Inner Lead from red wire (pos)
		Outer Lead from black wire (neg)

DC Power Socket to Bare Wire, 24AWG. DC plug diameter: 5.5mm outer / 2.1mm inner.
One cable per PCB.

AC Power

Panel Mount Male AC Connector			
Black 18 AWG 9 “	Line	To Fuse	ring terminal
White 18 AWG 8 “	Neutral	Terminal Block	ring terminal
Green 18 AWG 2 “	Ground	Chassis	ring terminal

DC Power Supply

Supply Connections			
AC – Line 1	From Fuse	18 AWG 4 "	Black
AC - Line 2	From Terminal Block	18 AWG 6"	White
Ground	To chassis	18 AWG 4"	Green
DC - Positive	To Terminal Block	18 AWG 6"	Red
DC Positive	To Terminal Block	18 AWG 6"	Black

Sonalert Cable

Molex, .1 inch KK, up, 2 pin	Sonalert	
J3-1	Neg Terminal (spade lug)	20 AWG Black
J3-2	Pos Terminal (spade lug)	20 AWG Yellow

Amphenol Signal Interface (Internal to PCB) for Upgrade Kits

Pin	Signal	24 AWG	
A	Encoder B (+5vdc)	Brown	
B	Encoder A (gnd)	Green	
C	Encoder E (phase B)	Orange	
D	Encoder D (phaseA)	Yellow	
E	NC		
F	NC		
H	Head Motor	Blue	
J	Head Motor	Black	
K	Head Motor	Red	
L	NC		
M	NC		
N	NC		

Control Cable	Interface	RJ-45 Pin #	RJ-45 Color
Cat5 Cable 24 AWG 9"			
Molex, .1 inch KK, up, 2 pin	J2-2	1	Orange Stripe
	J2-1	2	Orange
Molex, .1 inch KK, up, 4 pin			pin
	J1-4	4	Blue
	J1-3	3	Green
	J1-2	6	Green Stripe
	J1-1	5	Blue Stripe
Molex, .1 inch KK, up, 2 pin	J4-2	7	Brown Stripe
	J4-1	8	Brown

Appendix A Directory Structure

```
#####
Directory Structure
#####
Directory   Path                               File Name
//-----
// C:\MIC_2017
//      \bin
//      \configuration
//      \data
//          \dil
//          \plast
//      \help
//      \log
//      \reports
//          \dil
//          \plast
//
//-----
//Directory File Contents
//-----
// C:\MIC_2017
//      \bin
//          \MIC_2017v 2.1.exe
//          \PdfSharp.dll
//      \configuration
//          \Dilatometer_1.txt          (for combo units)
//          \Dilatometer_1_LVDTcal.cal  (for combo units)
//          \Plastometer_1.txt
//          \x6.dat
//      \data
//          \dil
//              \tag1_tag2_YYMMDDhhmmWx.pdf
//              \tag1_tag2_YYMMDDhhmmWx.sce
//          \plast
//              \tag_YYMMDDhhmmWx.pdf
//              \tag_YYMMDDhhmmWx.sce
//      \help
//          \PlastometerManual.pdf (or current manual name)
//      \log
//          \YYYY_MMM_DD.log
//
//      \reports
//          \dil  (contents as generated by control program)
//          \plast (contents as generated by control program)
```

Appendix B Plastometer Configuration File

```
//--6/22/2016 3:53:22 PM
//-- Plastometer_1 Instrument Parameters -----
instrumentName = Plastometer_1
Start_Temperature = 315
Stop_Temperature = 500
Rate = 3
Warming = 325
maxRunTime = 61.6666666666667
Sample_Rate = 6
warmingON = True
AnnunciatorEnabled = True
AutoPrintReportON = False
Kp = 0.5
Kd = 0
Ki = 0
Offset = 0
Ts = 0.166666666666667
cal_350 = 0
cal_550 = 0
slope_m = 1
intercept_b = 0
MotorRPM = 1800
Standard = ASTM
Units = F
```

```
//*****
// Config File Notes:
//-----
// 1. Commented and blank lines are ignored
// 2. White spaces are ignored
// 3. Parameter format is:
//
//          parm = value // end of line comments
//
//-----
// Optional comments
//-----
```

Appendix C Plastometer Data .SCE File

```
instrumentType = Plastometer;
//-----
// Preiser Scientific    11/16/2015 10:01 AM
//-----
Company      = 'Preiser Scientific';
CustomerID   = 'Test1';
fileName     = 'C:\MIC_2017\data\plast\Test1_1511161000.sce';
dateStamp    = 'Nov 16, 2015 10:00';
//-----
//-- Plastometer_1 Instrument Parameters -----
instrumentName = Plastometer_1;
pdfWriter = C:\Program~Files~(x86)\Adobe\Reader~11.0\Reader\AcroRd32.exe;
Start_Temperature = 315;
Stop_Temperature = 500;
Rate = 3;
Warming = 325;
maxRunTime = 61.66666666666667;
Sample_Rate = 6;
warmingON = False;
AnnunciatorEnabled = True;
AutoPrintReportON = False;
Kp = 0.5;
Kd = 0;
Ki = 0;
Offset = 0;
Ts = 0.1666666666666667;
cal_300 = 300;
cal_600 = 600;
slope_m = 1;
intercept_b = 0;
MotorRPM = 1800;
Standard = ASTM;

//-- Test Run Results-----
Soft_Temp = 00.0;
Soft_Time = 0.0;
Max_DDPM = 0;
Max_Temp = 00.0;
Max_Time = 0.0;
Solid_Temp = 00.0;
Solid_Time = 0.0;
Range = 00.0;
recoveryTime = 00.00;
//-----
```

Appendix C Sample Plastometer Collected Data .SCE File (cont)

```
//-----  
  
//seconds, deg C, DD, DDPM LVDTA LVDTB  
//-----  
data=[  
1, 026.5, 0.0, 0.0, 1.3, 1.0;  
2, 026.5, 0.0, 0.0, 1.3, 1.0;  
3, 026.5, 0.0, 0.0, 1.3, 1.0;  
4, 026.5, 0.0, 0.0, 1.3, 1.0;  
5, 026.5, 0.0, 0.0, 1.3, 1.0;  
6, 026.5, 0.0, 0.0, 1.3, 0.9;  
7, 026.5, 0.0, 0.0, 1.3, 0.9;  
8, 026.5, 0.0, 0.0, 1.3, 0.9;  
9, 026.5, 0.0, 0.0, 1.3, 0.9;  
10, 026.5, 0.0, 0.0, 1.3, 0.9;  
11, 026.5, 0.0, 0.0, 1.3, 0.9;  
12, 026.5, 0.0, 0.0, 1.3, 0.9;  
13, 026.5, 0.0, 0.0, 1.3, 0.9;  
14, 026.5, 0.0, 0.0, 1.3, 0.9;  
15, 026.5, 0.0, 0.0, 1.3, 0.9;  
16, 026.5, 0.0, 0.0, 1.3, 1.0;  
17, 026.5, 0.0, 0.0, 1.3, 1.0;  
18, 026.5, 0.0, 0.0, 1.3, 1.0;  
19, 026.5, 0.0, 0.0, 1.3, 1.0;  
20, 026.5, 0.0, 0.0, 1.3, 1.0;  
21, 026.5, 0.0, 0.0, 1.3, 1.0;  
22, 026.5, 0.0, 0.0, 1.3, 1.0;  
23, 026.5, 0.0, 0.0, 1.3, 1.0;  
24, 026.5, 0.0, 0.0, 1.3, 1.0;  
25, 026.5, 0.0, 0.0, 1.3, 1.0;  
26, 026.5, 0.0, 0.0, 1.3, 1.0;  
27, 026.5, 0.0, 0.0, 1.3, 1.0;  
28, 026.5, 0.0, 0.0, 1.3, 1.0;  
29, 026.5, 0.0, 0.0, 1.3, 1.0;  
30, 026.5, 0.0, 0.0, 1.3, 1.0;  
31, 026.5, 0.0, 0.0, 1.3, 1.0;  
32, 026.5, 0.0, 0.0, 1.3, 1.0;  
33, 026.5, 0.0, 0.0, 1.3, 1.0;  
34, 026.5, 0.0, 0.0, 1.3, 1.0;  
35, 026.5, 0.0, 0.0, 1.3, 1.0;  
36, 026.5, 0.0, 0.0, 1.3, 1.0;  
37, 026.5, 0.0, 0.0, 1.3, 1.0;  
38, 026.5, 0.0, 0.0, 1.3, 1.0;  
39, 026.5, 0.0, 0.0, 1.3, 1.0;  
40, 026.5, 0.0, 0.0, 1.3, 1.0;  
41, 026.5, 0.0, 0.0, 1.3, 1.0;  
42, 026.5, 0.0, 0.0, 1.3, 1.0;  
  
];
```

Appendix D Data File Naming Convention

Data files:

CustomerID_YYMMDDhhmmWx.pdf

CustomerID_YYMMDDhhmmWx.sce

.pdf One page report with graph and analysis results

.sce One second readings plus operating parameters and analysis results

YY 2 digit year

MM 2 digit month

DD 2 digit day

HH 2 digit hour

mm 2 digit second

Wx Unit number (P1, P2, P3, P4)

Example:

CustomerID = 'DigDeep21';

dateStamp = 'Feb 11, 2014 11:44';

Unit = Plastometer 1

DigDeep21_1402111144P1.pdf

DigDeep21_1402111144P1.sce