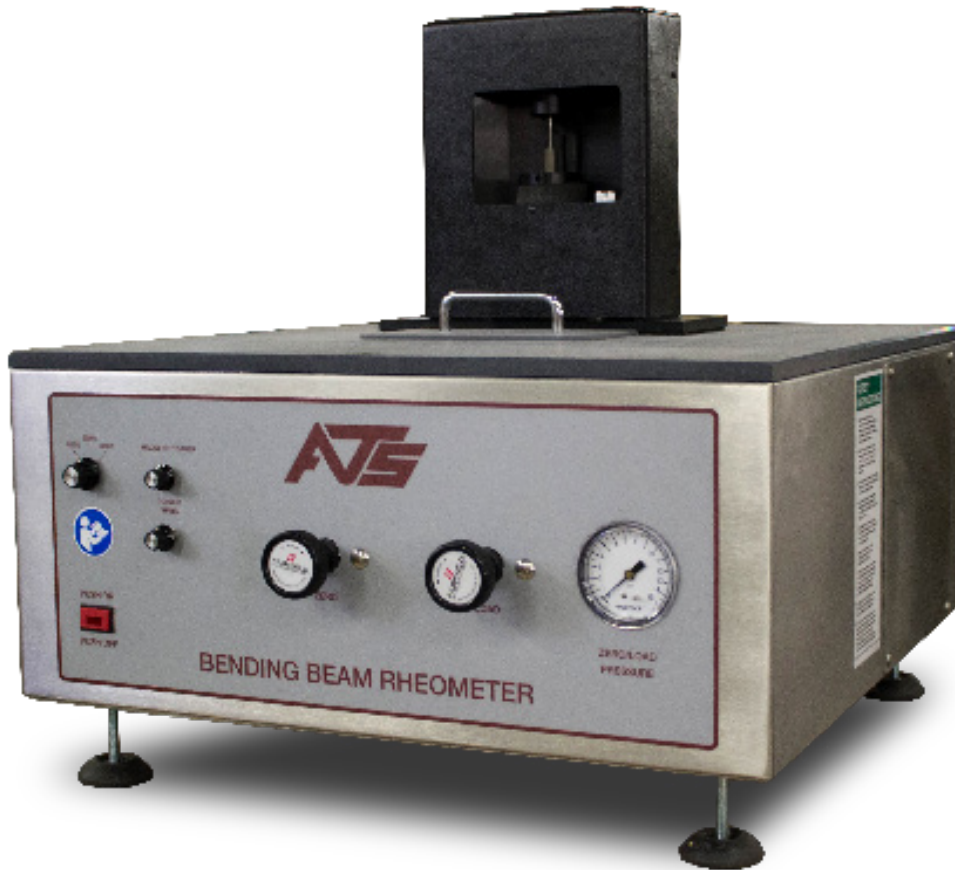


# BBR2S

## Bending Beam Rheometer



This manual contains important operating and safety information. Carefully read and understand the contents of this manual prior to the operation of this equipment.

[www.atspa.com](http://www.atspa.com)

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For assistance with set-up or operation, contact the ATS service department. Please have this manual and product serial number available when you call.

Telephone: +1-724-283-1212.

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# A. Introduction

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## A.1 Unpacking

Retain all cartons and packing materials until the unit is operated and found to be in good condition. If damage has occurred during shipping, notify Applied Test Systems (ATS) and the carrier immediately. If it is necessary to file a damage claim, retain the packing materials for inspection by the carrier.

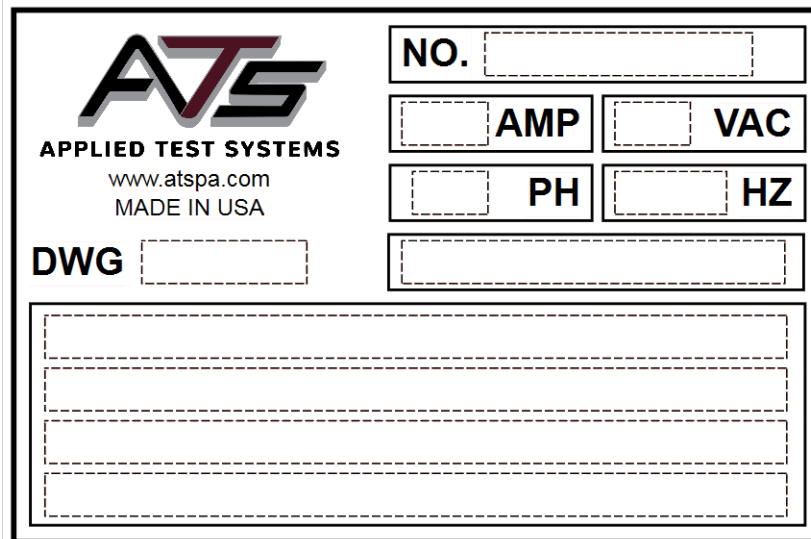
## A.2 Warranty Information

All new ATS systems are shipped with a warranty. Units have a warranty against defective parts and workmanship for one full year from the date of shipment. Please see APPENDIX A of this manual for complete details on the warranty.

## A.3 After Sale Support

If there are any questions concerning the operation of the unit or software, contact the ATS Service Department at +1-724-283-1212.

Before calling, please obtain the software revision number and the serial number from the unit's data tag. A sample data tag is illustrated below, and can be completed with the unit's information for easy reference. Please be prepared to give a complete description of the problem to the ATS Service Department.



The image shows a sample data tag for Applied Test Systems (ATS). It features the ATS logo and company information on the left, and a series of input fields for technical specifications on the right. The fields are arranged in a grid-like structure with dashed borders for input.

<b>ATS</b> APPLIED TEST SYSTEMS www.atspa.com MADE IN USA	NO. <input type="text"/>	
	<input type="text"/> AMP	<input type="text"/> VAC
	<input type="text"/> PH	<input type="text"/> HZ
	<input type="text"/>	
	<input type="text"/>	

DWG

Figure A.1: ATS Sample Data Tag

## B. Safety

---

### B.1 For Owners, Operators, and Maintenance

All ATS equipment is designed to be operated with the highest level of safety. This manual uses note, caution, and warning symbols throughout to draw your attention to important operational and safety information.

Read and understand all instructions and safety precautions listed in this manual before installing or operating your unit. If you have any questions regarding operation of the unit or instructions in this manual, contact the ATS Service Department at +1-724-283-1212.

Read and follow these important instructions. Failure to observe these instructions can result in permanent damage to the unit, significant property damage, personal injury or death.

### B.2 Safety Instructions



Read and understand all instructions and safety precautions listed in this manual before installing or operating your unit. If you have any questions regarding operation of the unit or instructions in this manual, contact our Service Department.



Thoroughly understand the safety features and operation of the equipment. This manual will provide operators with safety concerns and general procedures. Be familiar with correct operating principals and use good judgment. Also refer to the appropriate manuals for system component safety instruction manuals.



Obey all national and local electric code requirements.



Dangerous high voltages present. Do not attempt to open the enclosure or gain access to areas where you are not instructed to do so. Refer servicing to qualified service personnel only.



Use caution when working with liquids at low temperatures. Protect skin by wearing protective clothing, and follow safety, operation, and maintenance procedures described in the appropriate instruction manuals.

### B.3 Warnings

The following statements are WARNING statements. Unlike CAUTION statements, WARNING statements alert the operator to conditions that may injure personnel. Operators must be aware of these conditions in order to prevent

injuries that may occur while operating this equipment.



**WARNING:** Injury to the operator could occur if operational procedures are not followed. Follow all steps or procedures as instructed and refer to accompanying documents.



**WARNING:** Flammable vapors may be emitted from bath. Operate fluid bath in a well ventilated area. Do not smoke or use open flame near the bath. Refer to fluid manufacturer's documentation for more detailed information specific to safety precautions for the bath fluid being used.



**WARNING:** Do not submerge hand and arm in extremely cold test bath. Do not attempt to pull the drain plug when the fluid bath level is high and temperature is extremely cold. Extremely cold fluid may cause frost bite.



**WARNING:** Use caution when handling air hoses during operation or when performing maintenance as contents will be under pressure.

## B.4 Cautions

The following statements are CAUTION statements. These statements alert the operator to conditions that may damage equipment. Operators must be aware of these conditions to ensure safe operation of this equipment.



**CAUTION:** Handle the load cell with care. The load cell will be damaged if the load frame is put on its side with the load nose attached, or if the load nose is over tightened.



**CAUTION:** Handle the refrigeration hose with care. The refrigeration hose may be damaged if it is twisted or pulled, especially when the unit is cold. Do not move the refrigeration unit unless it has been turned off for at least 8 hours and has reached room temperature.



**CAUTION:** Prevent damage to the cooling unit. Never operate the cooling unit if the ambient temperature is higher than 25°C.



**CAUTION:** The cooling unit should be placed in a well-ventilated area, on a stand at least six inches above the floor and not on the same surface as the BBR.



**CAUTION:** Carefully place the calibration weights on the load cell's weight plan. If the Linear Variable Differential Transducer (LVDT) shaft is bumped, it may become inaccurate or even permanently damaged.



# C. System Overview

---

## C.1 Equipment Parts

### Front of Unit



- |                           |                             |
|---------------------------|-----------------------------|
| 1. Load Frame             | 5. Zero/Load Pressure Gauge |
| 2. Power Switch           | 6. Zero Regulator           |
| 3. Mode Select Switch     | 7. Load Regulator           |
| 4. Stirrer Motor Controls |                             |

Figure C.1: BBR2S Front

## Back of Unit



- 1. Incoming Air Connection
- 2. Air Connections to Load Frame
- 3. AC Power Connection
- 4. Chiller RTD (Connects to Back of Chiller)
- 5. USB Connection to BBR Computer
- 6. Load Frame Sensor Cables

Figure C.2: BBR2S (Rear View)

## Gauge Kit

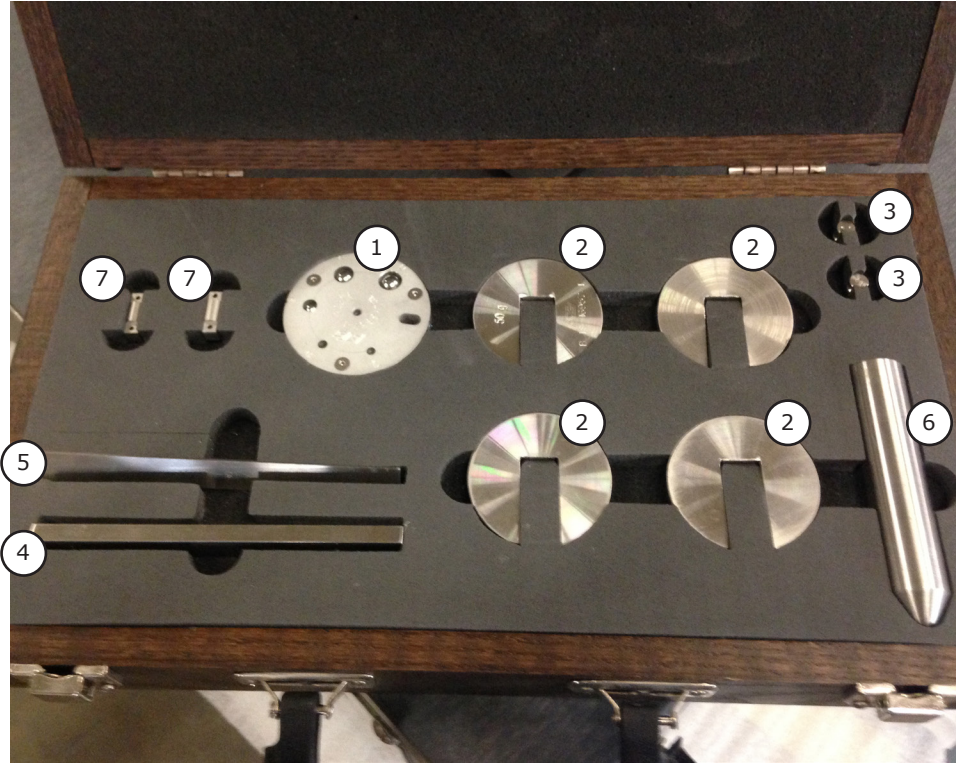


Figure C.3: BBR2S Gauge Kit

- |                             |                               |
|-----------------------------|-------------------------------|
| 1. Step Disk                | 5. Confidence Beam            |
| 2. 50 gram cal. weights (4) | 6. Load Shaft                 |
| 3. 2 gram weights (2)       | 7. Anvil Support Adapters (2) |
| 4. Non-Compliant Beam       |                               |

## C.2 General Product Description

The ATS Bending Beam Rheometer (BBR2S) has been designed to provide a state-of-the-art means for testing the flexural creep stiffness properties of asphalt binders in a temperature range of -40°C to 25°C. This testing is in accordance with the Strategic Highway Research Program (SHRP) Test, Method B-002, AASHTO Designation T313, and ASTM D 6648. The BBR2S's design does not allow it to perform any additional functions other than the intended functions specified in this manual.

The BBR2S consists of the following:

### Major Components

- Base Unit
- Load Frame Assembly
- Personal Computer
- BBR2S Software
- Mechanical Refrigeration Unit

### Accessory Items

- Specimen Molds (5 Molds)
- Confidence Beam
- Non-Compliant Beam
- LVDT Calibration Gaging Disk
- Load Cell Calibration Weights (4 50-gram and 2 2-gram)

The BBR2S test control function and data acquisition is operated by a Windows® based personal computer. During testing, the software controls the BBR2S load function, displays and records the load, deflection, and temperature data received from the unit. When tests are not being performed, the software permits access to test information including graphs, raw data tables, and test analysis.

### Product Specifications

Power Requirements	120 VAC, 60 Hz or 230 VAC, 50/60 Hz
Dimensions	24.125" W X 24.125" D X 23.25" H (w/ load frame)
Weight	Approximately 270 lbs.
Coolant Capacity	2 gallons (7.57 liters)
Recommended Fluid	Non-flammable ethylene glycol mixture
Test Standards	ASTM D6648, BS EN 14771, AASHTO T313

Operating Temperature	Ambient to -40°C
-----------------------	------------------

## Recommended Tools

The following tools are recommended for use during installation and operation of the BBR2S.

### Installation

- 9/16" Open-Ended Wrench
- Set of Hexagonal Wrenches
- Flat Bladed Screw Driver

### Operation

- Metal Tongs for the placement and removal of the specimen from the fluid bath.
- Protective eye wear and gloves for use during testing.

## Environmental Conditions

The BBR2S is designed for use in an industry/laboratory setting in an indoor and dry environment. The Base Unit should be placed on a clean, stable work surface with the connecting mechanical refrigeration unit nearby. The mechanical refrigeration unit should be placed 6 in. above the floor and in an area that will not constitute a tripping hazard.

## Load Frame

The load frame is an independent three-point loading device designed to apply a load of up to 1960 mN. The load frame may be operated in the supplied fluid bath, or it may be used in ambient conditions. It features rigid construction and a space saving design, as well as durable, corrosion resistance.

Each load frame is constructed from stainless steel plates and durable high-strength PVC uprights that are designed to be dimensionally stable and provide accurate force control. The load frame consists of an integral, free-floating loading shaft within an air bearing to permit specimen loads in the range of 0 to 1960 mN. The air bearing also provides reliable and rapid loading with an accuracy of  $\pm 5$  mN.

The load frame is constructed with a horizontal shelf that extends across the top of the base unit to provide supports to suspend the lower portion of the load frame in the fluid bath. The upper part of the load frame is covered by an access panel that permits the user to easily view the top of the loading shaft. This panel also provides access to the weight pan for easy calibration of the load cell and the Linear Variable Differential Transformer (LVDT). Two low voltage, sealed lamps are mounted in the base of the load frame in order to illuminate the specimen in the fluid bath.

The load frame is made up of an LVDT shaft, weight pan, air bearing, load shaft, load cell, and adapter. A hard, plastic shroud is mounted to the load frame and serves to protect the load cell from splashing fluid and minimize the affect of fluid movement on the load nose.



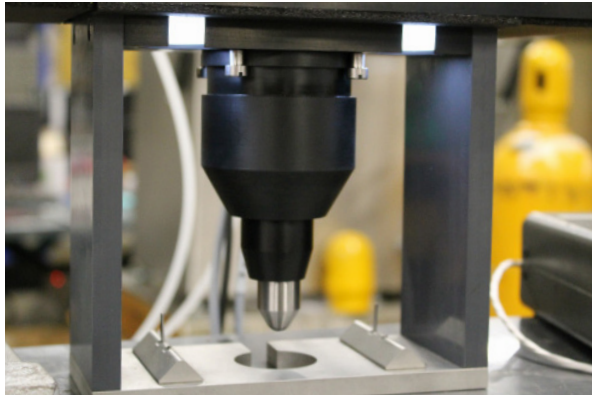


Figure C.4 - Load Frame without Anvil Adapters

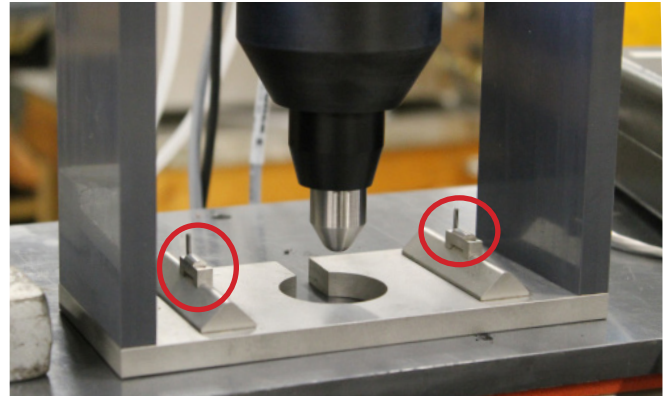


Figure C.5 - Load Frame with Anvil Adapters

## Specimen Support

The bottom half of the load frame consists of an anvil with two metal supports designed for alignment of the specimen. These specimen supports have a 3 mm contact radius and are fixed 102 mm apart from each other. They are designed to align samples that are approximately 127.00 mm x 12.70 mm x 6.35 mm.

Resting on each of the anvil's specimen supports are two anvil adapters (see Figure C.5). During crack sealant testing these anvil adapters need to be removed by lifting STRAIGHT UP on the adapter and pulling it off of the guide pin. The load frame should be removed from the bath and allowed to warm to room temperature before removing the anvil adapters. The anvil adapters should be installed on the anvil supports for testing of any regular asphalt binder samples.

The specimen supports and lower portion of the load frame are designed to be submerged in the constant-temperature fluid bath during the test. The fluid in the bath provides a buoyant force that counterbalances the weight of the specimen.

## Linear Variable Differential Transformer (LVDT)

The LVDT is calibrated at between 0 and 6 mm and is mounted in the upper section of the load frame assembly. A free-floating core rod is attached directly to the load shaft. It measures the displacement of the specimen as the test load is applied.



**CAUTION:** Carefully place the calibration weights on the load cell's weight pan. If the LVDT shaft is bumped, it may become inaccurate or even permanently damaged.

## Load Cell

The load cell is a precision strain gauge-type, with 500 gram (4903 mN) force capacity. It is constructed of stainless steel to prevent corrosion or damage by the fluid during test procedures.



**CAUTION:** The load cell can be easily damaged, especially from side loading and excessive torque. Use caution while handling the test frame when the loading shaft is attached. Remove loading shaft before laying load frame on its side, especially before shipping.

## Resistance Temperature Detector (RTD)

The RTD is a platinum measuring device that measures the cooling fluid bath temperature and relays the information to the computer control system software. It is mounted on the load frame directly under the test specimen supports. The RTD must be calibrated at two points. One point must be calibrated at 0°C and the second at the testing temperature or beyond it (at least -10°C or lower). The RTD is factory-calibrated at 0°C and -36.0°C. No further adjustment should be made under normal operating conditions.

## Computer Control System Software

The computer control system software provides user control of the BBR2S system in a Windows® environment with keyboard and/or mouse access to these functions. The software provides pull-down menus, button selections, and data entry text boxes for easy updates and access to information.

The software is designed to run on a standard PC which is connected to the base unit. During operation, the software collects and records the data from the various sensors on the load frame. During tests, the software controls specimen loading and unloading. The software is organized so all of the information required to conduct a particular test is stored in the PC. This design allows future enhancements or new releases to be easily added to the existing system without the need for hardware additions or modifications.

## Mechanical Refrigeration Unit

The refrigeration unit is an immersion cooler designed as a cooling source for sub-ambient work in liquid baths. The unit rests on the floor and maintains the cooling fluid at a constant temperature by use of the unit's temperature controller and the magnetic stirrer located in the bath. The single stage refrigeration system is equipped with one compressor. A hose carries refrigerant through the cooling probe located in the bath.

Refer to the manufacturer's literature for more detailed information regarding safety, operation, and maintenance of the refrigeration unit.



**WARNING:** Refrigeration unit will cause the test bath to be extremely cold. Do not submerge hand or arm into the test bath. Do not attempt to pull the drain plug when the test bath level is high and the temperature is extremely cold. Extremely cold fluid may cause frostbite.

## Accessories

- **Specimen Molds:** Used to create specimens. Each mold consists of five aluminum bars of various sizes, three mylar strips, and two holding rings. Five of these molds are supplied with the BBR2S.
- **Confidence Beam:** A thin, stainless steel beam of known stiffness. This beam is placed on the specimen supports of the load frame during the confidence check.
- **Non-Compliant Beam:** A length of stainless steel that has the same dimensions as the specimen. This beam is placed on the specimen supports when verifying and calibrating the load cell and when performing the compliance test.
- **Step Disk:** The step disk is used during LVDT standardization and verification. It has five positions containing high precision balls. The calibration positions include a zero gaging and four subsequent steps which decrease in increments of 1, 3, 5, and 6 mm. These steps are labeled on the disk using

the letters A (1 mm), B (3mm), C (5mm), and D (6mm). This provides the 6mm test range required by both ASTM and AASHTO Specifications.

- **Load Calibration Weights:** Four 50 gram and two 2 gram load cell calibration weights are supplied with the BBR2S. These weights are placed on the load frame weight pan during load cell verification. The weights are also used to calibrate the load cell and ensure system compliance.

## Controls

- **Internal Controls:** Two controls are located inside the right panel of the BBR2S base unit. These controls are factory set (the line pressure regulator is positioned on the right inside of the panel. This pressure is set at 60 psi. The bearing pressure regulator is located to the left of the line pressure regulator and is set at 15 to 20 psi. Verify the settings if necessary.
- **Base Unit Controls:** The BBR2S base unit controls can be seen in Figure C.1.
- **Mechanical Refrigeration Unit:** The refrigeration unit's power control is located on the front of the unit. The temperature set-point is located on the temperature control on the front of the unit (see manufacturer's literature for set-up).



# D. Installation

---

## D.1 Recommended Tools

The following tools are recommended for use during installation and operation of Bending Beam Rheometer.

### Installation

- 9/16" Open Ended Wrench
- Set of Hexagonal Wrenches
- Flat Bladed Screw Driver

### Operation

- Metal tongs for the placement and removal of the specimen from the fluid bath.
- Protective eye wear and gloves for use during testing.

## D.2 Unpacking the BBR2S

To unpack and prepare the BBR2S for operation, complete the following steps.



**CAUTION:** Use care when moving the base unit. The refrigeration unit is attached, and the refrigeration hose may be damaged if it is twisted or pulled, especially when the unit is cold.

1. Remove the base unit and the refrigeration unit from the box, and place them on a sturdy work surface.



**WARNING:** Position the BBR2S in a well-ventilated area. Consider that flammable vapors may be emitted from the bath during operation. Refer to fluid manufacturer's MSDS documentation for further information.

2. Remove the load frame assembly and place it on a sturdy work surface near the base unit.

3. Remove any packing materials from the unit. The following items should also be located and set aside:

- Case containing the step disk, a non-compliant test beam, a non-compliant test beam, a confidence check beam, a six-piece weight set, (2) anvil supports, and load nose.
- USB-A to USB-B cable which connects between the BBR base unit and BBR computer.
- Plastic bag containing crack sealant specimen mold pieces.
- Air hoses and magnetic stirrer.
- Envelope containing certifications of verification, manual CDs for chiller, and NI drivers CD.

4. Remove the computer system from its box, and place it on a work surface beside the base unit.
5. Inspect the base unit, refrigeration unit, the computer system, and the load frame for any obvious damage that may have occurred during shipping.



NOTE: If damage is found or suspected, notify the shipper and contact ATS immediately by calling +1-724-283-1212.

### D.3 Assembling the Load Nose

Assemble the loading shaft to the load frame assembly by following the steps below.

1. There are four screws securing the shroud to the load frame (Figure D.1). Loosen the back two screws slightly, and completely remove the front two screws. This should allow you to remove the shroud from the frame.

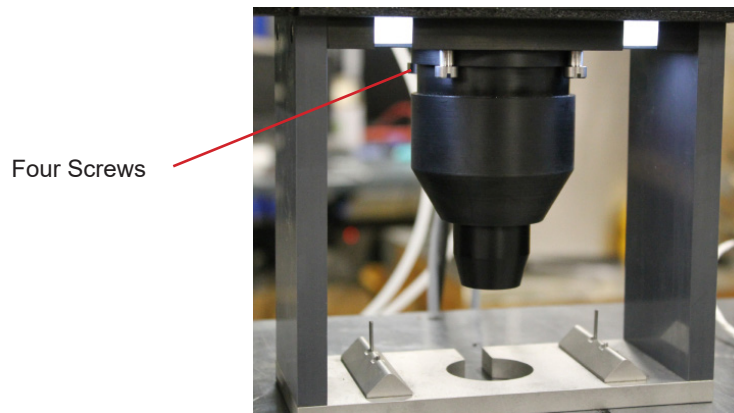


Figure D.1 - Load frame screw location

2. Remove the foam from inside of the load shroud (Figure D.2). Unscrew the lower portion of the load shroud from the upper portion (Figure D.3). Set the lower portion aside.

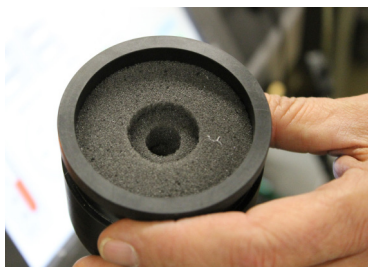


Figure D.2 - Foam Inside Load Shroud



Figure D.3 - Unscrew the Lower Portion of the Load Shroud

3. Retrieve the load nose from the BBR2S gauge kit. Place the load nose in the upper portion of the load shroud.

4. Position the shroud and load nose at the base of the load frame. Lift the load nose and carefully screw it on to the threaded stud in the bottom of the load cell until it is finger tight. When complete, secure the load nose in place by tightening the set screw on the side of the load nose (see Figure D.4 and D.5).

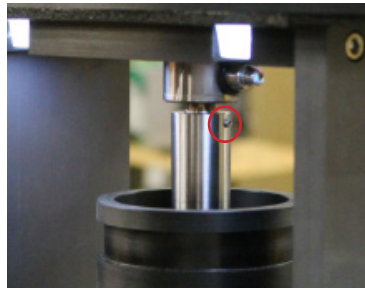


Figure D.4 - Set Screw Location on Load Nose



Figure D.5 - Tightening the Set Screw



**WARNING:** Do not over tighten the load nose, or damage to the load cell may occur.

5. Once the load nose is secured, lift the upper portion of the shroud around it. Use the back two screws to guide it into place before tightening them and carefully screwing in the front two screws. See Figure D.6.

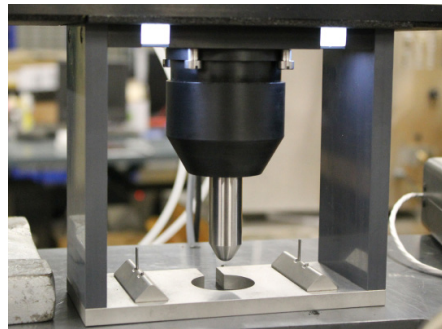


Figure D.6 - Upper portion of shroud attached to Load Cell



**CAUTION:** Do not over tighten the load nose on the load cell, or the load cell may become damaged. The load cell is extremely sensitive to this twisting movement.



**CAUTION:** The load cell can be easily damaged, especially from side loading and excessive torque. **DO NOT** place Load Frame on its side once the Load Nose is in place. Improper handling will result in irreversible Load Cell damage.

6. To re-attach the lower portion of the load shroud, place the lower portion of the shroud on a flat surface. **CAREFULLY** lift the load frame, and position it so that the load nose is directly above the lower portion of the

shroud (Figure D.7). Lift the lower portion of the shroud up and gently screw it in to the upper portion (Figure D.8).

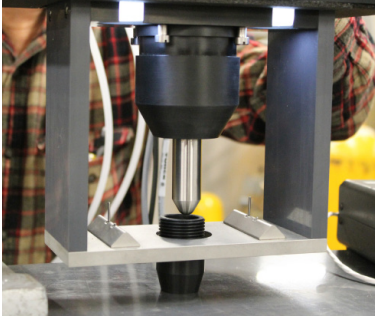


Figure D.7 - Attaching lower portion of Load Shroud

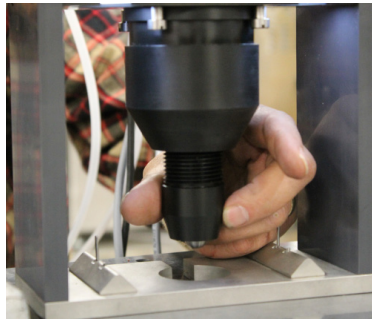


Figure D.8 - Attaching lower portion of Load Shroud

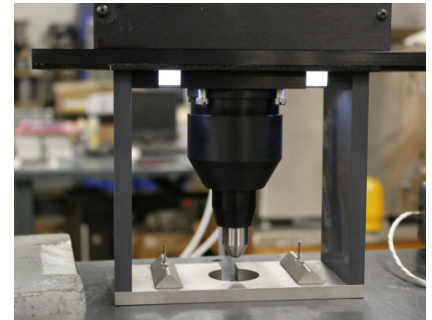


Figure D.9 - Attached Load Nose with Shroud

## D.4 Connecting Equipment

The following hoses and cables are shipped with the BBR2S. Use them for connecting the BBR2S equipment and refer to Figure D.10 on p.16.

- Zero/Load Hose (Item 2)
- Air Bearing Hose (Item 2)
- Temperature Sensor Cable (integral to base) (Item 4)
- Four Color-Coded Electrical Cables (integral to base) (Item 6)
- Communication Cable (USB-A to USB-B) (Item 5)
- Main Electrical Power Cable(s) (Item 3)

1. Connect the air hose ports on the rear of the base unit. The air supply connections supply a minimum of 60psi of clean, dry air. Make sure the location of the air hoses are such that they will not snag or catch on anything in the surrounding environment.

2. Connect the temperature sensor cable from the BBR base to the refrigeration unit.

3. Connect the color-coded electrical cables from the rear of the base unit to the rear of the load frame assembly.

4. Connect all needed cables and equipment for the computer system.

5. Connect the communication cable between the rear of the base unit and the computer system.

6. Plug the power cables from the base unit, the computer system, and the refrigeration unit into a surge-protected power source of appropriate voltage. Refer to the data tag of the BBR2S base unit.



**NOTE:** If at any point power is lost, disconnect all power sources and place all controls in an OFF position. Reconnect power sources and restart the system.



- |  |  |
|--|--|
| 1. Incoming Air Connection                                   | 4. Chiller RTD (Connects to Back of Chiller) |
| 2. Air Connections to Load Frame (Air Hose & Zero/Load Hose) | 5. USB Connection to BBR Computer            |
| 3. AC Power Connection                                       | 6. Load Frame Sensor Cables                  |

Figure D.10 - BBR2S Connections



## D.5 BBR2S Software Installation

If the BBR2S has been purchased with a computer supplied by Applied Test Systems, the necessary hardware drivers and the BBR operating software will have already been installed and set-up at ATS. **If you have purchased a computer supplied by ATS, the following steps are not required to complete the installation of your BBR2S.**

Should you decide to supply your own computer to operate the BBR, it will be necessary to install the correct hardware drivers and the BBR operating software on this computer prior to attempting to operate the BBR. The installation files to install the hardware drivers and the BBR software are copied into a directory on the BBR computers C: drive named Software. If you wish to use a different computer than the ATS supplied computer to operate the BBR you will need to copy the contents of the BBR computer Software Directory on to a USB flash drive or a CD , then install these programs on to your new computer. If your BBR was not supplied with a computer, the necessary files will be on a USB flash drive included with your BBR. Hardware drivers will be on a CD drive.

The software must be installed on a computer with a hard disk containing at least 4 GB of free space. The installation consists of four basic steps.

### 1. Install the hardware drivers.

- Turn the power on to the computer and wait for it to complete the Windows® start-up sequence.
- Locate the CD-ROM disk containing the National Instruments hardware drivers and insert it into the computers CD-ROM drive.
- Follow the on-screen prompts to launch the Setup Wizard application to install the drivers. Use default directories as destinations and accept all license agreements .
- When installation has completed, select Restart later and exit the setup application.

### 2. Install the BBR2S operating software.

- Locate the USB flash drive containing the BBR2S installation software, which was included with your BBR.
- On the flash drive, locate the file folder named 2.6.1.x , where x indicates the current software revision level.
- Inside is a folder labeled Install Disk. Open the file folder, and double click on the file named setup.exe to install the BBR2S software.
- Follow all on screen prompts and accept all license agreements.
- When the installation is complete, select Restart Now to exit the setup program and restart the computer.

### 3. Enter Calibrated Gauge Kit values into the BBR software.

- Locate the Certificates of Verification for your BBR and your Calibrated Gauge kit.
- Open the BBR2S software, and navigate to the Standardization menu.
- At the top of the menu screen, you will see places to enter the measured values for the step disk, calibrated weights, and the non- compliant beam. A similar screen to input the measured values for the Confidence beam is located on the first screen in the Verification Menu.
- Enter the measured values for the Weights , Step Disk, and Non-compliant beam in the appropriate fields in the Standardization menu exactly as they appear on the Certificates of Conformance for the BBR gauge kit. When entering the values for the calibrated weights and the step disk, enter the measured values shown on the Certificates, NOT the displacement from Zero Setup or Known weight from Zero setup values shown on the Certificates. These values will automatically be calculated by the Software. The measured values for the

Confidence beam are entered in to the appropriate fields in the Verification Menu.

- When finished, either go to the setup menu and select Save from the options in this menu, or exit the BBR2S software to ensure that the new values are written to the BBR software.

#### 4. Entering the BBR Serial Number in the BBR2S Config. File

- The Serial Number information for the BBR is stored in the BBR2S.cfg file. , which is located inside of the config. directory in the BBR2S program file directory in the ATS folder on the computer's C: drive. Figure D.11 shows the pathway to this file. The file can be opened for editing or viewing using the Notepad application in Windows®.

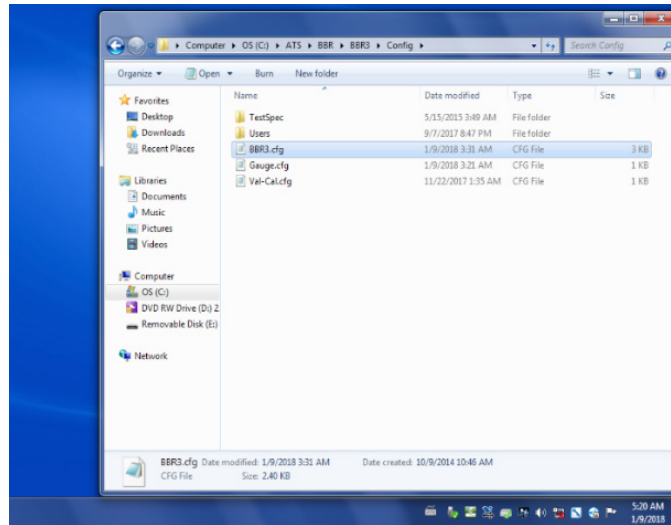


Figure D.11 - Pathway to the File

- Figure D.12 shows how the file will appear after opening in Notepad.

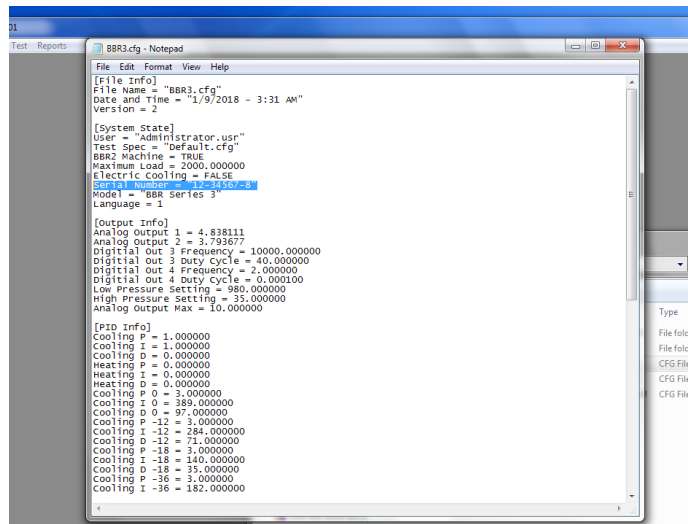


Figure D.12 - File After Opening Notepad

- In the BBR2S.cfg file, locate the line which says “Serial Number = 12-34567-8.” Edit this line such that the 12-34567-8 is replaced with either the Serial Number of the BBR as shown on the nameplate on the back of the load frame, or with whatever designation you prefer. Save the changes to the file when exiting Notepad.



# E. Operation

---

## E.1 Filling the Bath



**WARNING:** The protection of the device is impaired if used in a manner not specified in the manual.



**WARNING:** Possible Eye and/or skin irritant. Wear protective clothing and adequate eye protection during test procedures. Hazards can differ from fluid type to fluid type. Refer to fluid manufacturer's MSDS documentation for detailed information.



**WARNING:** During operation and testing never use bare hands to place objects in the fluid bath. Wear protective clothing and adequate eye protection during test procedures and use metal tongs for object placement and removal. Extremely cold fluid may cause frostbite.



**NOTE:** Depending on your temperature verification / calibration device, you may need to adjust the amount of fluid in the bath to reach proper submersion depths. Refer to individual specifications for more information.

1. Fill the BBR2S with approximately 2 gallons (7.57 liters), so the liquid is approximately 1 ½ to 2 inches from the top. Refer to individual test specifications for fluid type.

## E.2 Power Up the BBR2S

1. Press the power button on the rear of the BBR2S base unit. The power indicator light on the front of the unit will illuminate.
2. Turn on the refrigeration unit (chiller) by flipping the power switch in the rear of the unit.
3. Wait one to two minutes after powering up the computer system before opening the program. The computer requires this time to properly load the software and device drivers, and opening the program sooner will prevent it from operating as intended.
4. Once the drivers have loaded, a dialog window may appear on the screen. Press DISMISS.
5. Press the BBR software desktop icon to launch the program.

## E.3 Overview of Touchscreen and Menus

The chart in Figure E.1 outlines the BBR2S's software screens. Once the BBR2S program has launched, the Main Screen (shown in Figure E.2) will launch. This screen allows you to setup, run, and view tests, and calibrate/verify machine components.

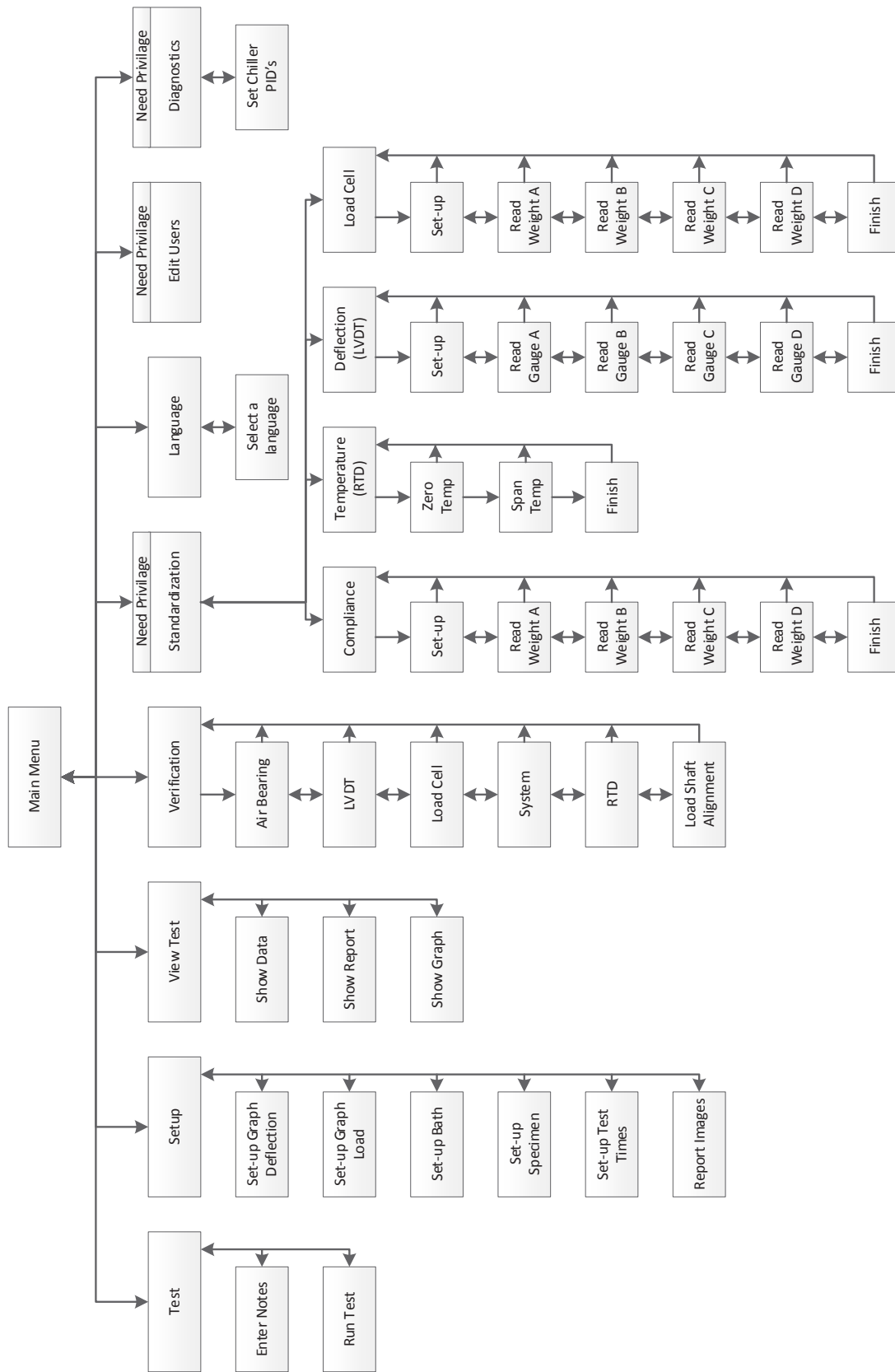


Figure E.1 - BBR2S Software Screen map

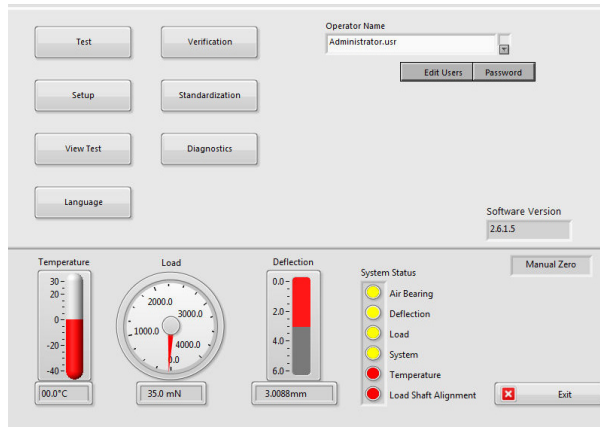


Figure E.2 - Main Menu Screen

Once the Main Menu screen appears, the user will be prompted for a username and password. If no password is entered, the software will automatically open in the default.usr screen. The available usernames and accesses provided within the software are as follows:

USERNAME	PASSWORD	PERMISSIONS
Administrator	admin	Allows access to all of the operating features of the BBR2S, including the Standardization and Diagnostics menu screens.
ATS Programmer		Provides access for qualified ATS personnel only.
Default		Allows users to run tests, add/modify test specifications, view previous tests, select the display language of the BBR2S, and perform a verification of the system. It does NOT allow access to the Standardization or Diagnostics screen. No password is required.
Operator	oper	Allows the user to access all of the menu screens of the BBR2S except the Diagnostics screen,

The lower part on the screen shows values for machine temperature, load, and deflection. It also has system status lights and controls for the machine.



**NOTE:** The “Exit” button on the bottom right of the screen will exit the BBR2S program and return to Windows. To return to the Main Menu screen from any other BBR2S software screen, press the “Main Menu” button in the upper right corner.

## E.4 Editing Users and Permissions

When you press the “Edit Users” button on the Main Screen the dialog shown in Figure E.3 is displayed. The “Edit Users” button will not be shown on the main menu unless the currently logged in user has permission to edit users on the system. You must be logged in as an administrator to edit users the first time.

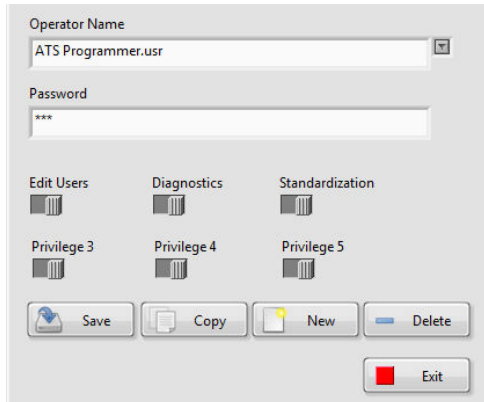


Figure E.3 - Edit Users dialog

### Operator Name Field

Allows you to select a user to edit. Use the down arrow button to drop down a list of users saved on the system.

### Password Field

Contains the current password for the selected user. If this field is left blank no password will be required to log in as this user, but this user will not be able to add a password in the future.

### User Privilege Switches

The first three user privilege switches set up privileges or permissions for the system:

- Edit Users – Allows this user to edit any of the users on the system.
- Diagnostics – Allows this user to enter a diagnostic or maintenance screen.



NOTE: Extreme caution should be used with this permission as there are no safety restrictions in this screen.

- Standardization - Allow this user to perform a standardization on the system.

Currently switches 3, 4, and 5 do not add or remove any additional permissions.

### Save Button

Saves the current user. **This should be done any time you make any changes you want to keep. If you exit this screen without pressing SAVE you will lose any changes you have made.**

### Copy Button

Makes a copy of a selected user under a new name. This is useful if you need to make a new user with similar permissions as a current user. Press “Save” when complete.

## New Button

Creates a new user using default values. Press “Save” once you have created a new user.

## Delete Button

Deletes a saved user. Once pressed it will verify that you want to delete the selected user. If you answer “Yes” the user will be permanently deleted from the system. To prevent software lockout, the system will not allow you delete the Default user.

## E.5 Standardization Process

Before standardization, verify that the bath is set at your desired testing temperature. Set the chiller controller to the testing temperature desired.

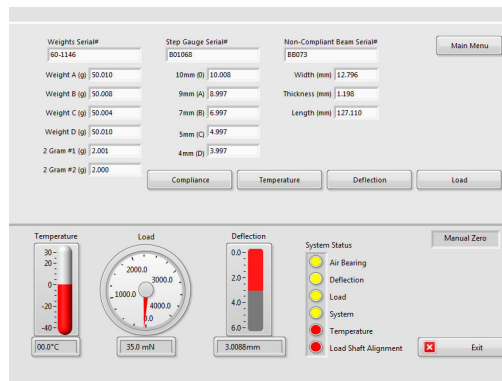


Figure E.4 - Standardization Screen

From the Main Screen press the “Standardization” button to enter the Standardization Screen (Figure E.4).



**NOTE:** The standardization button will not be shown on the main menu unless the currently logged in user has permission to perform standardization.

The BBR2S’s system status lights, located at the bottom right of the screen, indicate whether or not a component requires standardization.

- Red = the component requires standardization
- Yellow = the component requires verification
- Green = the component is ready for testing

Prior to standardization, verify that the information entered into the necessary fields matches the information provided on the Certificate of Conformance that was shipped with the gauge kit being used for the standardization. Make adjustments as necessary. You will also need a BBR2S gauge kit.



**WARNING:** Be certain to perform ALL STEPS in the standardization menu for each of the

senors EXACTLY AS DESCRIBED. Failure to perform all steps of the standardization procedure may result in incorrect or erratic operation of the BBR2S.

## 1. Standardizing the Temperature (RTD)



NOTE: Before beginning temperature standardization, verify that the temperature of the BBR bath has been set to 0.0 degrees C and allowed to stabilize for at least 1-2 hours . All temperature settings for the BBR bath are performed using the up/down arrows on the front panel of the chiller's temperature controller.

- a. Verify that the load frame is in the bath, and that the temperature of the bath is set to 0.0 deg. C.
- b. Allow temperature to stabilize for one to two hours after set point is reached.
- c. After temperature has stabilized, select MAIN MENU on the BBR software and then select the STANDARDIZATION button.
- d. Select the TEMPERATURE button.
- e. You will need a calibrated partial immersion reference thermometer suitable to ASTM 133C. A calibrated PRT thermometer may also be used. Submerge the thermometer in the BBR bath at the appropriate depth next to the load frame RTD.
- f. Leave the thermometer in place for a minimum of two minutes and note the temperature reading of the bath to the nearest tenth of a degree (within 0.1° C)
- g. Adjust the chiller setpoint temperature if necessary to obtain a bath temperature of 0.0° C.
- h. When the calibrated thermometer indicates a bath temperature of 0.0° C, select ZERO in the Standardization menu, then select NEXT.
- i. Change the set point temperature of the BBR bath to a temperature colder than the coldest temperature you normally test at, or to -36° C. Allow the temperature of the bath to stabilize at the selected temperature for a minimum of 30 minutes.
- j. Note the temperature of the calibrated thermometer, and enter this reading in to the box labeled TEMPERATURE on the BBR menu screen. Select FINISH to save this value and exit the Temperature Standardization menu.
- k. The BBR Load Frame RTD should now be standardized.

## 2. Standardizing the Load (Load Cell)

- a. Select the "Load" button from the Standardization Screen.
- b. With the load frame in the bath, load the non-compliant beam into test position.
- c. Using the zero regulator, adjust the load nose so it is slightly above the beam.
- d. Press the "Tare" button.
- e. Using the zero regulator, gently lower the load nose lightly onto the beam with minimal load (20mN ± 10mN).

Press the “Next” button.

- f. Select weight A from the gauge kit and place it on the weight pan. Wait five seconds and press the “Next” button.
- g. Select weight B from the gauge kit and place it on top of weight A. Wait five seconds and select the “Next” button.
- h. Select weight C from the gauge kit and place it on top of weight B. Wait five seconds and select the “Next” button.
- i. Select weight D from the gauge kit and place it on top of weight C. Wait five seconds and select the “Next” button.
- j. Press “Finish” to record the calibration constant.



NOTE: The calibration constant should be  $\leq 2.5\text{mN}$  and repeatable within 10% from one standardization to another. If it is not, contact Applied Test Systems at +1-724-283-1212.

### 3. Standardizing Deflection (LVDT)

- a. Press the “Deflection” button on the Standardization Screen.
- b. With the load frame in the bath, remove any beams from the supports and any weights from the BBR2S.
- c. Adjust the zero regulator to raise the load nose to its highest position.
- d. Remove the step disk from the gauge kit and place it on the load frame.
- e. Gently rotate the step disk so the locator pin is above the 0 step.

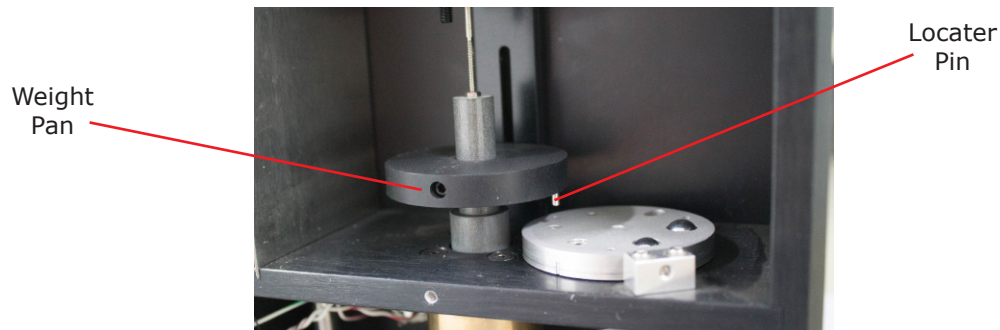


Figure E.5 - Step disk positioned under locator pin

- f. Using the zero regulator, gently lower the load nose until the pin rests lightly on the 0 step.
- g. Place two 50g weights on the weight pan, wait five seconds and press “Next”.

- h. Manually raise the load nose by lifting the weight pan and gently rotate the step disk to the “A” position. Gently lower the load nose until the pin rests lightly on the “A” step. Wait five seconds and press “Next”.
- i. Manually raise the load nose again and gently rotate the step disk to the “B” position. Gently lower the load nose until the pin rests lightly on the “B” step. Wait five seconds and press “Next”.
- j. Manually raise the load nose again and gently rotate the step disk to the “C” position. Gently lower the load nose until the pin rests lightly on the “C” step. Wait five seconds and press “Next”.
- k. Manually raise the load nose again and gently rotate the step disk to the “D” position. Gently lower the load nose until the pin rests lightly on the “D” step. Wait five seconds and press “Next”.
- l. Press “Finish” to record calibration.



NOTE: The calibration constant should be  $\leq 2.5\mu\text{m}$  and repeatable within 10% from one standardization to another. If it is not, contact Applied Test Systems at +1-724-283-1212

#### 4. Standardizing the Compliance

- a. Press the “Compliance” button on the Standardization Screen.
- b. With the load frame mounted in the bath load the non-compliant beam into test position.
- c. Slowly adjust the zero regulator to the lower loading nose until it gently makes contact with the beam (20mN  $\pm$ 10mN). Press the “Next” button.
- e. Select weight A from the gauge kit and place it on the weight pan. Wait five seconds and press the “Next” button.
- g. Select weight B from the gauge kit and place it on top of weight A. Wait five seconds and press the “Next” Button.
- i. Select weight C from the gauge kit and place it on top of weight B. Wait five seconds and press the “Next” button.
- k. Select weight D from the gauge kit and place it on top of weight C. Wait five seconds and select the “Next” button.
- m. Select “Finish” to record the calibration constant.



NOTE: The calibration constant should be less than or equal to  $5\mu\text{m}/\text{N}$  and repeatable within 10% from one standardization to another. If it is not, contact Applied Test Systems at +1-724-283-1212

### E.6 Verification Process

Verification of most BBR2S components will need to occur every 24 hours - this is usually done at the beginning of a day of testing. You will need a BBR2S gauge kit and a calibrated thermometer (see RTD) to perform a verification.

The BBR2S's system status lights, located at the bottom right of the screen, indicate whether or not a component



requires verification.

- Red = the component requires standardization
- Yellow = the component requires verification
- Green = the component is ready for testing

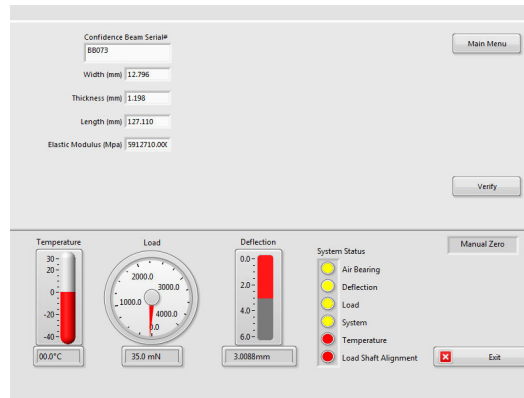


Figure E.6 - Verification main screen

1. To begin, select “Verification” from the Main Screen. The screen shown in Figure E.6 will display.
2. Verify the information entered in the Confidence Beam Serial # section matches the information on the certification of conformance form that was shipped with the BBR2S. Make corrections if necessary.
3. Press the verification button to begin the verification sequence.
4. Verify the load bearing.
  - a. Place the thin steel beam on the sample supports, and apply a 35mN load to the beam by turning the zero load regulator.
  - b. Observe the reading of the LVDT. Gently grasp the shaft and lift it upwards approximately 5mm by observing the reading of the LVDT.
  - c. When the shaft is released, it should immediately float downward and gently make contact with the beam.
  - d. Remove any beams from the supports.
  - e. Use the zero load regulator arrows to adjust the loading shaft so that it is free floating at the approximate midpoint of its vertical travel.
  - f. Gently add a 2g mass to the loading shelf.
  - g. The shaft will slowly drop down under the weight of the added mass. If everything works as the prompts require, press “Verification Complete” and then press “Next”.
  - i. If the results are not in acceptable range, press “Standardization Required” and then press “Next”.

## 5. Verify the LVDT

- a. With the loading frame mounted in the bath at the test temperature, remove all beams from the supports.
- b. Place the step gauge disk in any position and apply the provided two 50g weights to the weight pan.
- c. Compare the measured displacement to the known gauge disk location. This information can be found on the Certification of Conformance form, as well as on the main Verification screen.
- d. If the known dimensions differ from the measurements by more than  $\pm 5\mu\text{m}$ , standardization is required. Press the "Standardization Required" button and then press the "Next" button.
- e. If the measurements are within  $\pm 5\mu\text{m}$ , press the "Verification Complete" button and then press the "Next" button to move to the next section.

## 6. Verify the Load Cell

### a. Verify the Contact Load

- i. Place the Non-Compliant Beam on the sample supports and apply a 20mN load  $\pm 10\text{mN}$  using the zero load regulator. Add a 2g mass to the weight pan.
- ii. Verify the increased measured load is 20mN  $\pm 5\text{mN}$ . Add the second 2g weight to the weight pan. Verify the increased measured load is 20mN  $\pm 5\text{mN}$ .
- iii. If the measurements do not fall within these ranges, standardization is required. Press the "Standardization Required" button and press "Next" to move to the next section.

### b. Verify the Test Load

- i. Place the non-compliant beam on the sample supports.
- ii. Apply 20mN  $\pm 10\text{mN}$  load using the zero load regulator.
- iii. Add two 50g weights to the weight pan.
- iv. If the increase in measured load falls within 981mN  $\pm 5\text{mN}$  press the "Verification Complete" button and then press the "Next" button to move to the next section.
- v. If the increase in measure does not fall within 981mN  $\pm 5\text{mN}$  press the "Standardization Required" button and then "Next".

## 7. Verify the System

- a. Ensure the load frame is in the bath.
- b. Place Confidence Beam on the sample supports.
- c. Apply two 50g weights to the weight pan.
- d. Press "Record".
- e. Apply two additional 50g weights to the weight pan and press "Record".

- f. The modulus reported should be within 10% of the modulus of the Confidence Beam, as listed on the verification conformance form.
- g. If the measurement is within 10% press “OK” then the “Verification Complete” button.
- h. If the measurement is more than 10% press “OK” and then the “Standardization Required” button.
- i. Press the “Next” button to move on to the next section.

## 8. Verifying the RTD

- a. You will need a partial submersion calibrated reference thermometer suitable to ASTM 133C.
- b. With the load frame in the bath, immerse the calibrated reference thermometer into the bath close to the RTD.
- c. Compare the measured system temperature to the reference thermometer
- d. If the temperatures differ more than  $\pm 0.1^{\circ}\text{C}$ , press the “Standardization Required” button and then press “Next”.
- e. If the observed temperatures are within  $\pm 0.1^{\circ}\text{C}$  press the “Verification Complete” button and then press “Next”.

## 9. Verifying the Load Shaft Alignment



NOTE: This only needs done every six months. To skip this step, press the FINISH button without pressing any of the radio buttons.

- a. For this process you will need a strip of white paper 12.7 mm x approx. 25 mm long, and a strip of carbon paper of the same or similar dimensions.
- b. Place the white paper strip on the non-compliant beam and secure with tape.
- c. Remove the load frame from the liquid bath and set it in an upright position on a flat surface.



WARNING: Do not lay the load frame flat with the load nose attached. This will damage the load cell.

- d. Place the non-compliant beam on the sample supports, with the white paper facing up.
- e. Place a small section of carbon paper over the white paper with the dark side facing the white paper.
- f. With the air pressure applied to the air bearing, gently press the shaft downward causing the load nose to make an imprint through the carbon paper onto the white paper.
- g. Remove the carbon paper and measure the distance from the center of the carbon imprint to each sample support using vernier calipers.
- h. If the difference between the two measurements is 1.0mm or less, press the “Verification” button followed by the “Finish” button.
- i. If the difference between the two measurements is more than 1.0mm, press “Standardization Required” and

contact the Applied Test Systems Service Department at +1-724-283-1212.

## E.7 Test Setup

Test setup is used to define a BBR2S test specification as well as the type of report it will generate. When you press the SETUP button the screen shown in Figure E.7 will display.

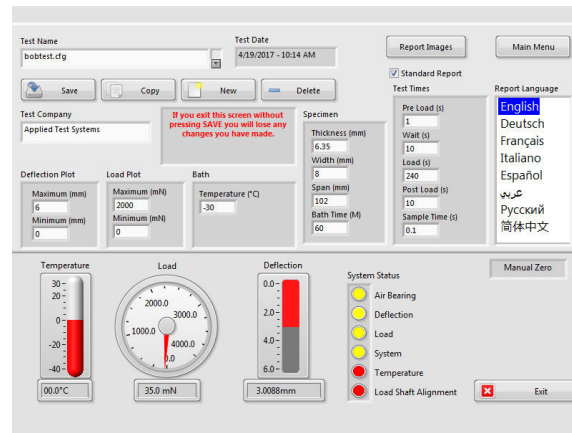


Figure E.7 - Test Setup Main Screen

### Test Name

The name of the currently selected test specification. The only limit to the number of tests that can be stored is the size of the disk drive in the computer system. Since a test specification takes about 1K of storage space, it would be nearly impossible to run out of space on the drive. You can use the "Test Name" combo to select different test specifications already saved. Just press the down arrow button to get a list.

### Test Date

Shows the last time that the currently selected test was saved.

### Saving Test Parameters

The "Save" button will save all the current screen data to the currently selected test specification.

This should be done any time you change anything that you want to keep. **If you exit this screen without pressing SAVE you will lose any changes you have made.**

### Copying a Test

The "Copy" button is used to make a copy of a test specification under a new name. This is useful if you wish to make a new test with only a couple of changes from a currently save test.

Remember to press SAVE once you have the changes you want. **If you exit this screen without pressing SAVE**

you will lose any changes you have made.

## Creating a New Test

The “New” button will create a new test using default test specification values. Remember to press “Save” once you have created a new test, even if you have not changed anything so that it is saved.

## Deleting a Test

The DELETE button will delete a saved test. Once pressed, a pop up will require you to verify that you want to delete the test. If you answer YES the test cannot be recovered.

## Adding Report Images

The REPORT IMAGES button allows you to select images that are printed on the report that this test generates. When pressed it will display the dialog seen in Figure E.8, which will allow you to select each image.

The best image size is listed on screen for each position, and are as follows:

- Report Header Left Image (200x100)
- Report Header Right Image (200x100)
- Report Footer Left Image (200x50)
- Report Footer Right Image (200x50)

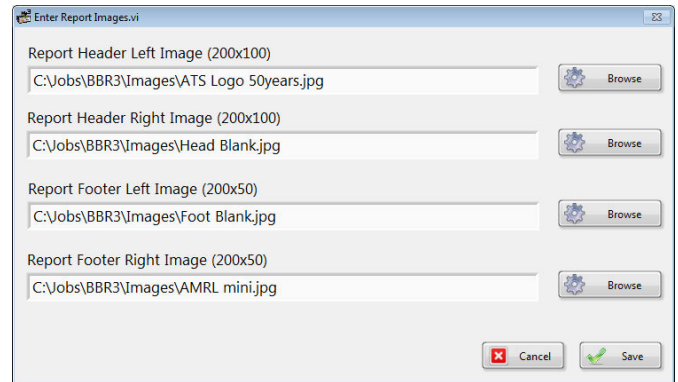


Figure E.8 - Add images to test dialog

If the image entered is a different size it will be resized to fit, but may appear distorted.

## Adding a Test Company

The “Test Company” is any text you wish to enter. It is stored with the test specification and printed on the report that this test will generate.

## Standard or Data Report

The “Standard Report” check box lets you select a standard report or a data report. The data report is most often used to chart in Excel or another similar program to generate additional calculations or graphs.

Time	Load	Deflection	Measured Stiffness (kN/m)	Estimated Stiffness (kN/m)	Difference (%)	P-value
0.0	0.0	0.000	-	-	-	-
0.5	990.0	5.547	-	-	-	-
1.0	1980.0	11.094	1990.000	1970.000	0.74	0.942
1.5	2970.0	16.641	1980.000	1970.000	0.51	0.976
2.0	3960.0	22.188	1960.000	1970.000	0.08	0.988
2.5	4950.0	27.735	1950.000	1970.000	0.99	0.999
3.0	5940.0	33.282	1930.000	1970.000	0.52	1.000
3.5	6930.0	38.829	1910.000	1970.000	0.52	1.004
4.0	7920.0	44.376	1890.000	1970.000	-	-

Figure E.9 - Standard Report

Number	Time (sec)	Deflection (mm)	Load (kN)	Temperature (°C)
0	-12.000	0.547	0.000	-20.000
1	-11.800	0.547	0.000	-20.000
2	-11.600	0.547	0.000	-20.000
3	-11.400	0.547	0.000	-20.000
4	-11.200	0.547	0.000	-20.000
5	-11.000	0.547	0.000	-20.000
6	-10.800	0.547	0.000	-20.000
7	-10.600	0.547	0.000	-20.000
8	-10.400	0.547	0.000	-20.000
9	-10.200	0.547	0.000	-20.000
10	-10.000	0.547	0.000	-20.000
11	-9.800	0.547	0.000	-20.000
12	-9.600	0.547	0.000	-20.000
13	-9.400	0.547	0.000	-20.000
14	-9.200	0.547	0.000	-20.000
15	-9.000	0.547	0.000	-20.000
16	-8.800	0.547	0.000	-20.000
17	-8.600	0.547	0.000	-20.000
18	-8.400	0.547	0.000	-20.000
19	-8.200	0.547	0.000	-20.000
20	-8.000	0.547	0.000	-20.000
21	-7.800	0.547	0.000	-20.000
22	-7.600	0.547	0.000	-20.000
23	-7.400	0.547	0.000	-20.000
24	-7.200	0.547	0.000	-20.000
25	-7.000	0.547	0.000	-20.000
26	-6.800	0.547	0.000	-20.000
27	-6.600	0.547	0.000	-20.000
28	-6.400	0.547	0.000	-20.000
29	-6.200	0.547	0.000	-20.000
30	-6.000	0.547	0.000	-20.000
31	-5.800	0.547	0.000	-20.000
32	-5.600	0.547	0.000	-20.000
33	-5.400	0.547	0.000	-20.000
34	-5.200	0.547	0.000	-20.000
35	-5.000	0.547	0.000	-20.000

Figure E.10 - Data Report

## Deflection Plot and Load Plot

DEFLECTION PLOT and LOAD PLOT set the graph limits when a test is running. They are stored with the test specification and are used each time that test spec is run.

## Bath Values

The BATH value shows the temperature the bath should be set to for this test.

## Specimen Values

The SPECIMEN values are used in the calculations and printed on the report that this test specification generates.

## Test Times

The TEST TIMES are what set the sequence and sample rate the system uses when running this test specification.



NOTE: Each stored data point is a running average of four data points.

Once you have entered your desired test parameters, press SAVE and then EXIT.

## Report Language

This is the language used when generating a report. It does not have to be the same language used in the operation of the machine.

## E.8 Run Test

Test setup will need to be done before you run a test. See Section E.7 for more details if you have not already set up your test. When you press the TEST button the run screen shown in Figure E.11 will display.

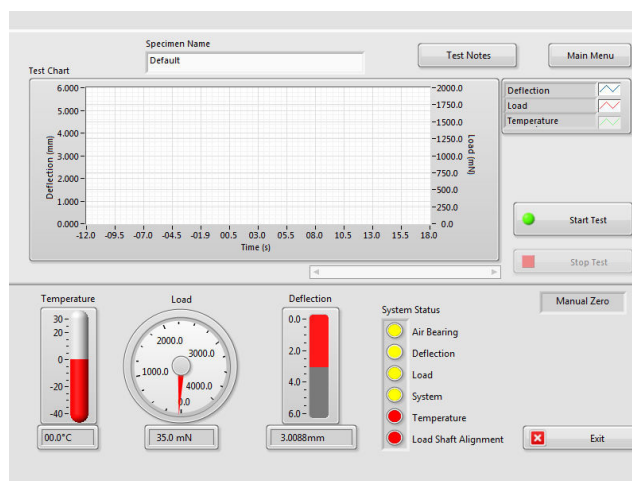


Figure E.11 - Run Test main screen

The BBR2S's system status lights, located at the bottom right of the screen, indicate whether or not a component is ready for testing.

- Red = the component requires standardization
- Yellow = the component requires verification
- Green = the component is ready for testing

The SPECIMEN NAME is any text you wish to make it. It is stored with the run data and printed on the report. This allows you to keep track of which test data or report you are looking at. Be sure you set this BEFORE you run a test for it to be included in the report.

The TEST NOTES button will bring up a dialog to allow you to enter any note you wish to keep with this test run. They are stored with the run data and printed with the report. Be sure you write these BEFORE you run a test for them to be included on the report.

If the BBR2S was sitting idle and the loading shaft was free hanging for more than one hour, place the non-compliant beam on the specimen support, then manually exercise the load cell. To do this, place 100 gram of weight on the weight pan and remove it, allowing three or four seconds between loading and unloading. Repeat this at least four times, allowing three or four seconds between each time.

## Load Setup

1. Load the non-compliant beam on the specimen supports.
2. The load control switch is located on the front of the BBR2S. Make sure the switch has been set to ZERO before proceeding. (Figure E.12).



Figure E.12 - Load Control Switch

3. Adjust the zero regulator until the loading shaft contacts the non-compliant beam with a minimal force of  $35 \pm 10$  mN.

4. Use the mode switch to move the load control switch to the load position.
5. Adjust the load regulator until the load display reading is  $980 \pm 50$  mN.
6. Use the mode switch to move the load control switch between zero (contact load) and load (test load) several times to recheck the specimen load and verify that the values are stable.



NOTE: Allow the specimen to stabilize in the cooling fluid bath at the required test temperature according to the specifications.

7. When finished, place the mode switch in the AUTO position.

### Start Test

1. Raise the loading shaft. Remove the non-compliant beam and place the specimen in the test position.
2. Gently lower the loading shaft, so it contacts the specimen. Make sure the load display is  $35 \pm 10$  mN. If it is not, adjust the zero regulator.
3. Press the START TEST button.
4. The horizontal graph allows the operator to monitor test progress. Current deflection and load values are displayed on the graph.
5. To abort the test, press the STOP TEST button.
6. When the test is complete the system will automatically generate a report and display it.
7. If you have connected a printer to your BBR2S, you can print the test summary report from this screen. To do so, select file and then print.

### Run Crack Sealant Test

1. Before running this test you will need to remove the (2) anvil adapters from the Anvil. This is performed by lifting STRAIGHT UP on each adapter off the guide pins.



WARNING: Load frame should be removed from the bath and allowed to warm to room temperature before removing the anvil adapters.

2. Raise the loading shaft. Remove the non-compliant beam and place the specimen in the test position. Gently lower the loading shaft, so it contacts the specimen. Make sure the load display is  $35 \pm 10$  mN. If it is not, adjust the zero regulator.
3. Press the START TEST button.
4. The horizontal graph allows the operator to monitor test progress. Current deflection and load values are displayed on the graph.
5. To abort the test, press the STOP TEST button.



6. When the test is complete the system will automatically generate a report and display it.

## View Test

View Test is used to look at test data for tests that have already been run and saved. When you press the VIEW TEST button the screen shown in Figure E.13 will display.

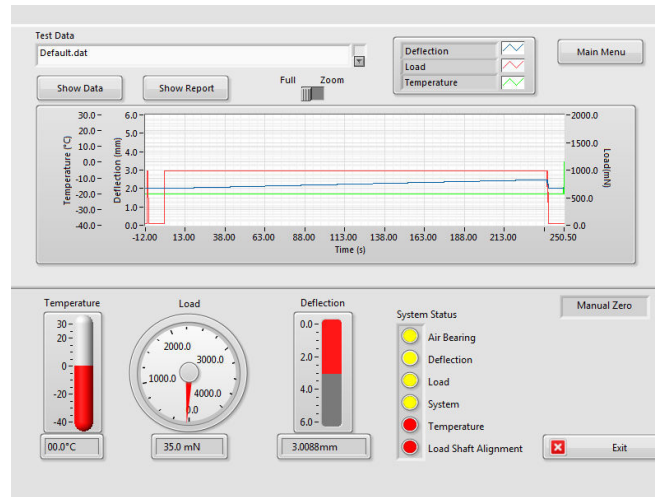


Figure E.13 - View Test main software screen

The TEST DATA sections allows users to select different test runs already saved. Press the down arrow button to show a list. Once a data set has been selected, the data is displayed in the graph.

Press the SHOW DATA button to open a dialog that shows a table of the data values for the selected run. It can also be printed from this dialog.

The SHOW REPORT button will open the report that was generated for the selected test run.

Use the TIME switch to change between FULL GRAPH and ZOOM. ZOOM will let you zoom in on the time scale and put a scroll bar under the graph to allow you to move the display back and forth.

You can also click on either end of any of the scales to change that value to zoom in on just part of the graph. Keep in mind that pressing the TIME switch will reset this.

## E.9 Diagnostics

When you press the DIAGNOSTICS button the screen in Figure E.14 will be shown.

You should not have permission for this screen unless you are experienced with the machine and what it does.

There are no safety features in this screen. It should mostly be use for maintenance to trouble shoot I/O problems.

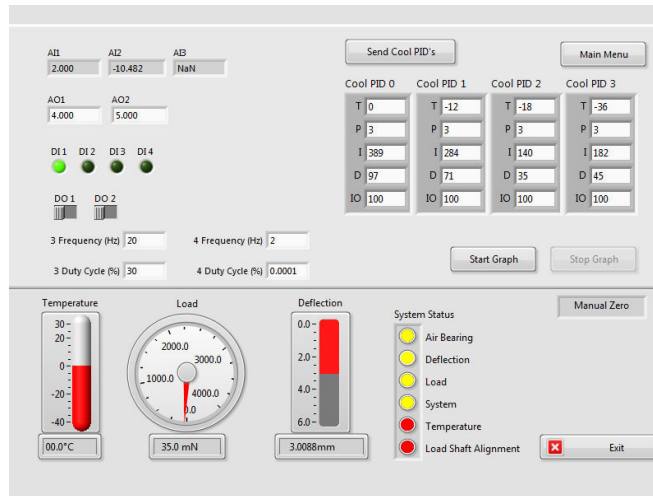


Figure E.14 - Diagnostics main software screen

The diagnostics button will not be shown on the main menu unless the currently logged in user has permission for this screen.

### Analog Inputs AI1, AI2, and AI3

Raw voltages into the system. You should be able to use a voltmeter to test the voltage at the input pin and it should match what is shown here. AI1 is deflection, AI2 is load, and AI3 is temperature.

### Analog Outputs AO1 and AO2

Raw voltages out of the system. Use a voltmeter to test the voltage at the output pin and verify that it matches the value shown on the diagnostics screen.

### Digital Inputs 1, 2, 3, and 4

Raw values into the system. Use a voltmeter to test the state at the input pin and verify that it matches the value shown on the diagnostics screen. DI1 and DI2 are used to bring in the auto/zero/load switch. DI3 and DI4 are not used at this time.

### Digital Outputs 1 and 2

Raw values out of the system. Use a voltmeter to test the state at the output pin and verify that it matches the value shown on the diagnostics screen. DO1 is the valve to switch between contact and test loads. DO2 is not used at this time.

### Digital Outputs 3 and 4

High speed pulse outputs. Use a scope to test the output pin and verify that it matches the frequency and duty cycle entered in the diagnostics screen. DO3 and DO4 are not used at this time.

# F. Troubleshooting

---

## F.1 Preface

Listed within this section are the most common troubleshooting errors that operators may encounter when using the BBR2S. Users may follow the steps provided to work through these basic errors.

Any additional issues or system errors should be brought to the attention of the Applied Test Systems Service Department immediately by calling +1-724-283-1212 or emailing [service@atspa.com](mailto:service@atspa.com).

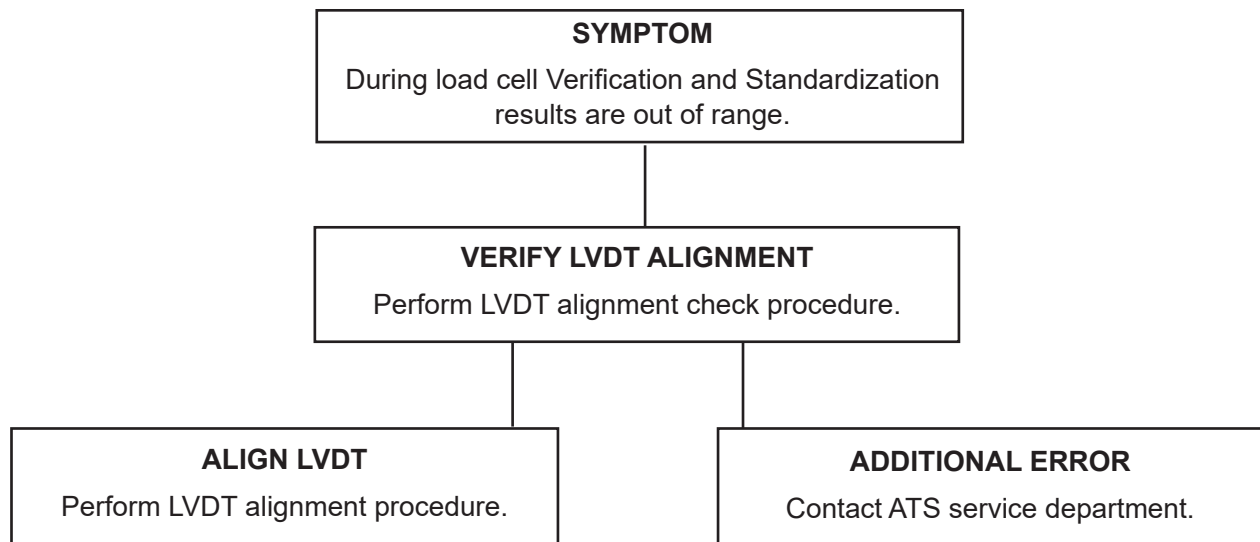
DO NOT attempt to independently fix any other system errors. Any additional errors fixed independent of technical support at Applied Test Systems could result in damage to the equipment, or injury on the part of the operator.



**WARNING:** To prevent electrical shock, use extreme caution when removing covers or panels. Follow your company's electrical safety procedures thoroughly.

## F.2 Load Shaft Stuck or Stalled During Verification or Standardization

When the load shaft seems to be stuck or stalled during verification and standardization procedures, the most likely cause is a misaligned LVDT. To fix this issue, perform the following steps:



1. In order to determine if the LVDT is misaligned, the LVDT must be viewed from above.

- Place a weight on the weight plan. Alternatively, place a sheet of white paper around the LVDT shaft.
- Shine a flashlight at the lower end of the LVDT shaft. This light reflects up the shaft, so the LVDT can be viewed from above. See Figure F.1.

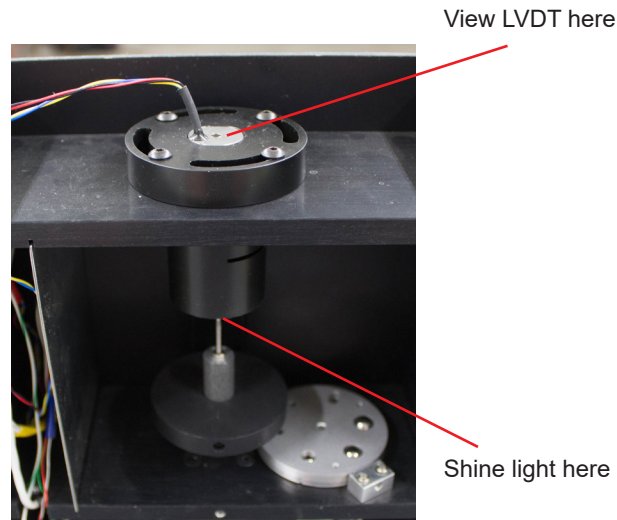


Figure F.1 - LVDT Shaft

2. If the LVDT shaft appears to be centered in the LVDT, re-secure the cover and contact ATS for assistance.
3. If you determine that the shaft is misaligned, attempt to center it by performing the steps below.
  - Loosen the four retainer screws using a 3/32-inch Allen wrench.
  - Continue to shine the flashlight on the lower end of the LVDT shaft, while carefully adjusting the housing with the other hand. Position the LVDT housing so the shaft is in the center of the LVDT housing.



CAUTION: Never attempt to adjust the LVDT shaft. If the shaft becomes damaged, the load frame will not produce accurate results.



CAUTION: The load cell can be easily damaged, especially from side loading and excessive torque. DO NOT place Load Frame on its side when the Load Nose is in place. Doing so will result in damage to the Load Cell.

# G. Maintenance

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## G.1 General Maintenance

When cleaning the surface of the BBR2S, first disconnect all power sources and place all controls in an OFF position. Use a very mild cleaning agent and be careful not to allow the cleaning agent to enter and contaminate the fluid bath.

# Appendix A: Warranty

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Your Applied Test Systems product has been manufactured and inspected by experienced craftsmen. Applied Test Systems warrants, for the original purchaser, each product to be free from defects in material and workmanship for a period of thirteen (13) months from date of shipment or twelve (12) months from date of installation - whichever comes first. This warranty does not apply to failures caused by normal usage, misuse, or repair or service by unauthorized personnel, nor does it cover limited life electrical components which deteriorate with age such as tubes, lamps, fuses, and heaters. Load cells are covered for manufactured defects only - incidents of over load or other customer misuse are not covered under warranty. The warranty does not extend to products not manufactured or assembled by Applied Test Systems.

This warranty is expressly limited to the repair, replacement, or adjustment of the product at Applied Test Systems' option. The product must be returned to the Applied Test Systems factory or an authorized repair center. Applied Test Systems shall not be liable for any labor, transportation, or installation costs that may arise in connection with the product or return.

To obtain warranty service:

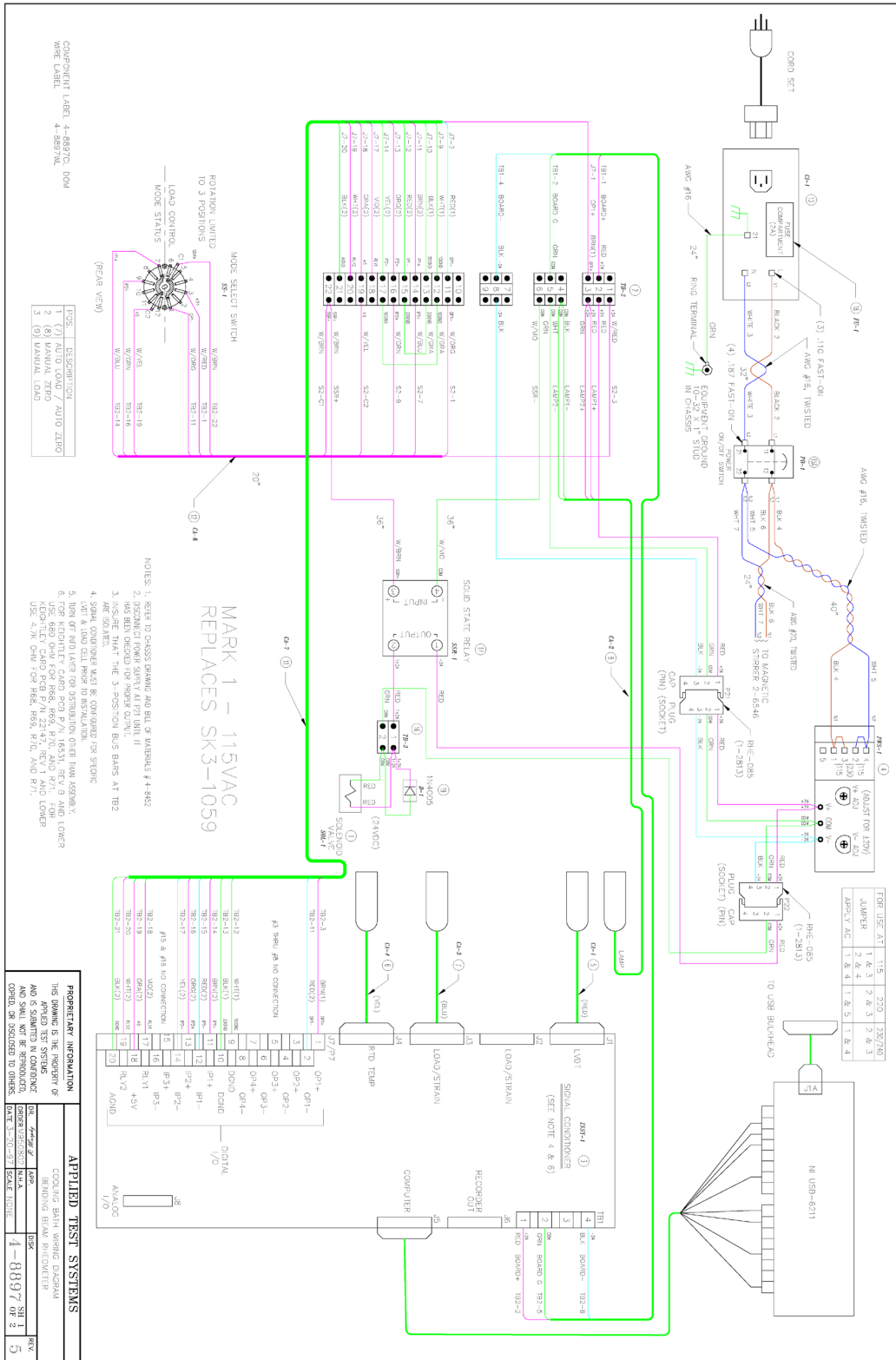
1. Applied Test Systems must be promptly notified in writing of the defect.
2. Upon receipt of written authorization, said defective equipment is returned as directed, with transportation charges prepaid by the buyer and –
3. Applied Test Systems examination of such equipment discloses to its satisfaction that the defect exists and was not caused by negligence, misuse, improper installation, accident, or unauthorized repair or alteration.

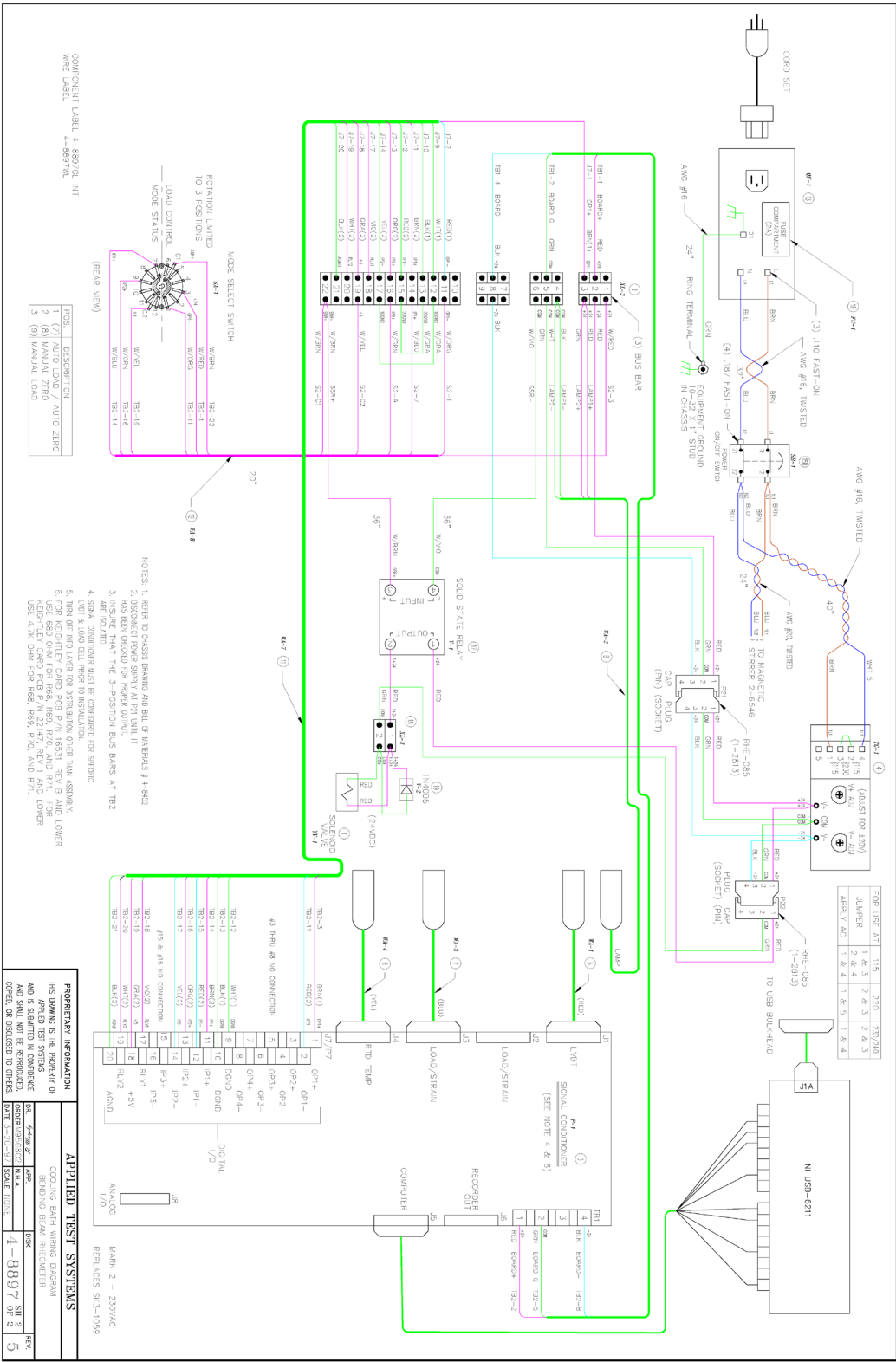
This warranty is in lieu of all other warranties, expressed or implied, including the implied warranty of merchantability or fitness for particular purpose. In no event shall Applied Test Systems be liable for direct, indirect, special, incidental, collateral, or consequential damages.

The aforementioned provisions do not extend the original warranty period of any article that has been either repaired or replaced by Applied Test Systems.

Applied Test Systems reserves the right to change published specifications.

# Appendix B: Wiring Diagrams







# Appendix C: Image Glossary

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