

7000 SERIES BRINELL TESTER

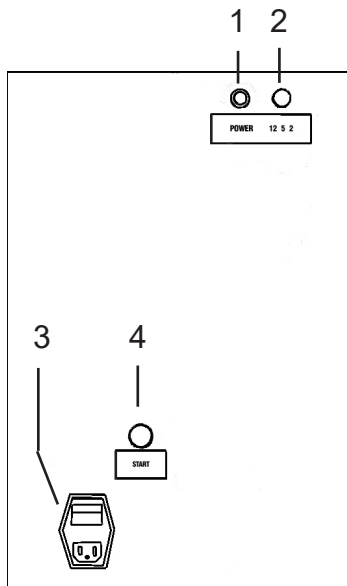
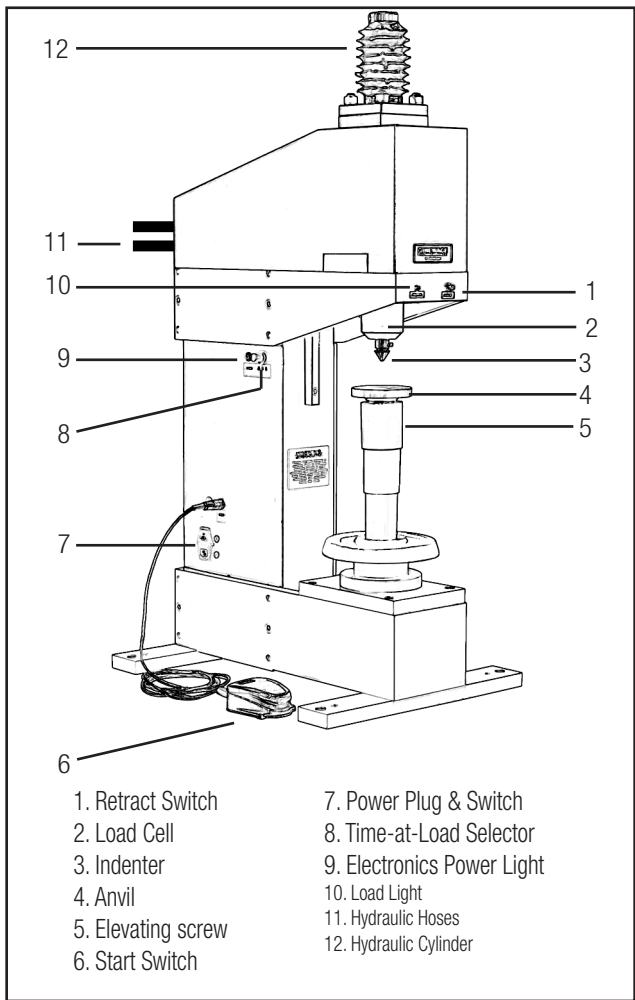
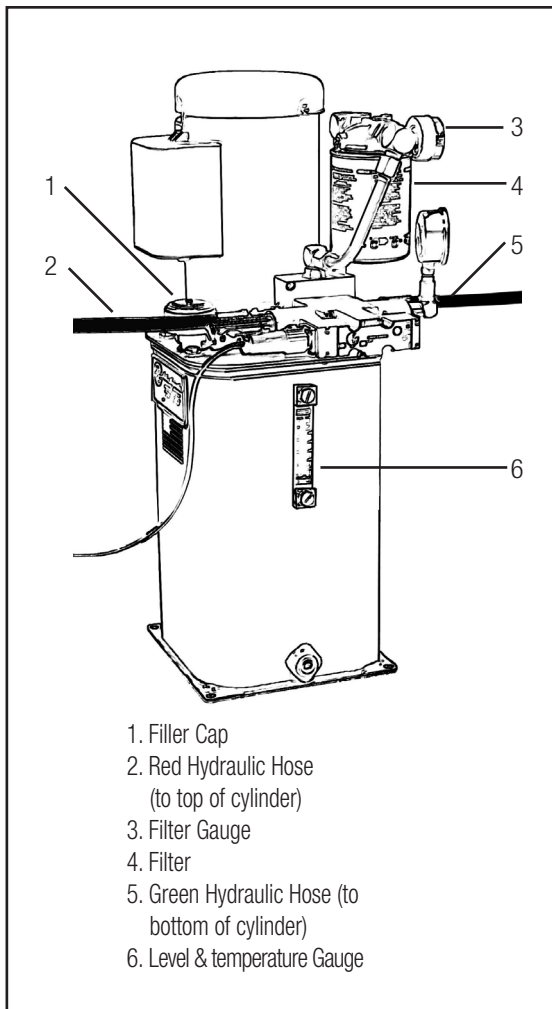
VERSION 7010

Operation Manual

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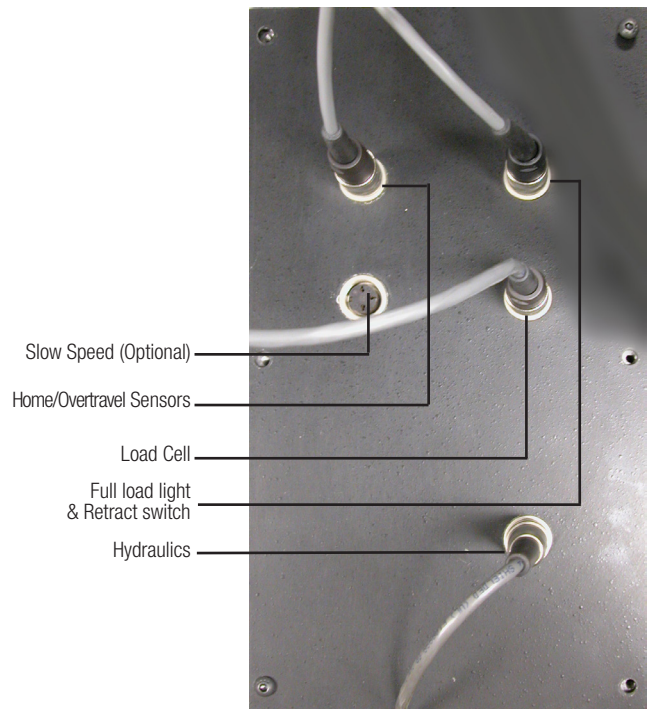
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IMPORTANT: Brinell testers apply up to 3000 kg (6600 lb) force to the indenter. The operator must make certain the test specimen is sitting in a stable position on the anvil prior to applying load to the test specimen.



Electronics panel Connections.

- 1. Power Light
- 2. Time at Load Selector
- 3. Power Switch
- 4. Start Switch



CONNECTIONS VIEWED AT TOP REAR OF TESTER

1. INSTALLATION & SETUP

1.1 Dimensions

The footprint dimensions are 19" wide x 25" deep. The standard model is 49" tall (optionally 44" to 74" tall, depending on the model) The hydraulics footprint is 10" on a side (17" with projecting components) These are the actual dimensions of the units. Additional clearance is required for proper operation, depending on the size and configuration of the parts being tested. The capacity is a nominal 8" vertical and 8" throat with 16" vertical capacity (standard model) if the elevating screw is removed.

1.2 Installation

The 7000 Series Brinell ships with only a few connections required. The electronics package and hydraulics must be wired into either a single phase 110/220, 1-1/2 horsepower circuit breaker or into a 3 phase, 230/460 volt 3 horsepower breaker, depending on the configuration. When used on 380 V 50 Hz, the rating of the motor is 2 HP. A means of disconnecting and emergency shutdown must be provided. Double-check the connectors from the start switch, hydraulics, load sensor, and stroke sensors which must be plugged in. All connectors are keyed differently to prevent improper connection. The tester must have the indenter holder fastened into the indenter shaft with the set screw and a ball installed in the indenter holder. The ball cap unscrews so the ball can be inserted and the cap reinstalled.

Note: The indenter holder is made to move vertically by 1/8" inside the black body guide.

The hydraulic package turbine grade mineral oil, Exxon Terrestrial 32 or equivalent. Port A of the Manifold connects to the top of the cylinder, port B connects to the bottom

The electronics are housed inside the black side panels.

See later sections for setting the Time-at-load, proper test techniques, and for checking calibration before commencing actual testing.

1.3 Electronics Connections

The tester is normally shipped with the connections made. The connectors are all keyed to fit only in the proper location.

The photo at lower right on opposite page is oriented from the top rear.

2. TEST SEQUENCE & FORCE CONTROL

2.1 Test Sequence

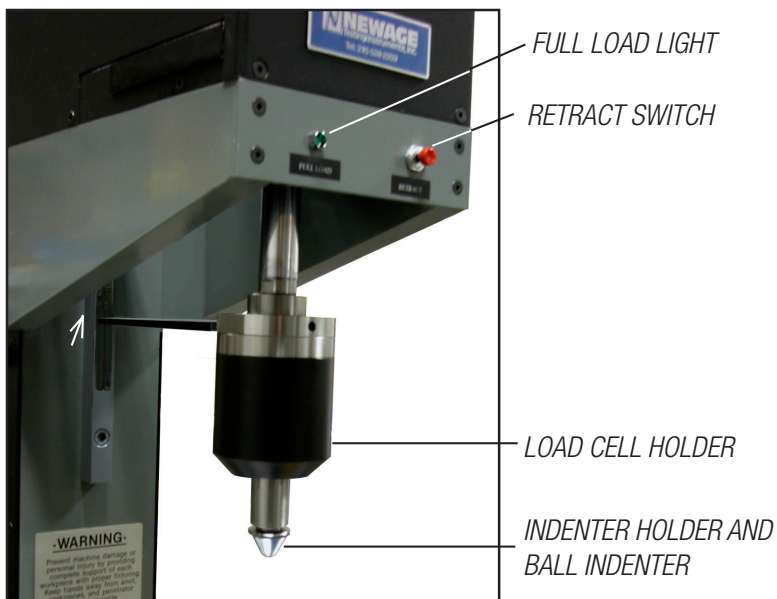
The sequence is controlled by the REXROTH proportional valve controller which in turn drives the hydraulic cylinders. The load cell, through the amplifier, returns a voltage to the REXROTH controller to adjust the proportional valve in order to maintain the desired force. This is done in real time in a closed loop with active modulation to control the force and maintain it within the required tolerance. The sequence starts when the footswitch is pressed. If the footswitch is released, the downwards movement stops. This jog mode continues until the force reaches the desired value, the full load LED turns on, at which point the footswitch can be released and the sequence continues automatically with the time at load. At the end of the time at load the LED turns off and the cylinder retracts until it reaches the home position switch. At that point the cycle ends. Depressing the retract push button also causes the cylinder to return home. In this case there is a 10 second delay before a new cycle can be started.

2.2 Force Control

During the down motion of the cylinder, when the penetrator makes contact with the specimen, the load cell is engaged and the voltage at the amplifier increases. The voltage can be checked at pin B22 on the REXROTH controller. The voltage should go from near Zero when the penetrator is not in contact with the specimen to a value between two and nine volts, at full load. The final voltage varies from machine to machine but in any case should turn on the full load output (Pin Z24 goes from zero to 24 volts). If the force applied needs to be adjusted, this can be done with "Fine Span" on the amplifier. (bottom right)

Note: all voltages are referenced to a common ground which is any black wire (B8, B20, B24, etc.)

Note: The indenter holder is made to move vertically by 1/8" inside the load cell holder.



Sensor / Switch Positions.



"Fine Span" control. located on the amplifier inside the right side panel.

3. OPERATION

This tester operates according to the standard: ASTM E-10. The operator should be familiar with the specifications for this test. Copies of ASTM E10 may be obtained from the American Society for Testing Materials in Conshohocken, PA at 610-832-9500.

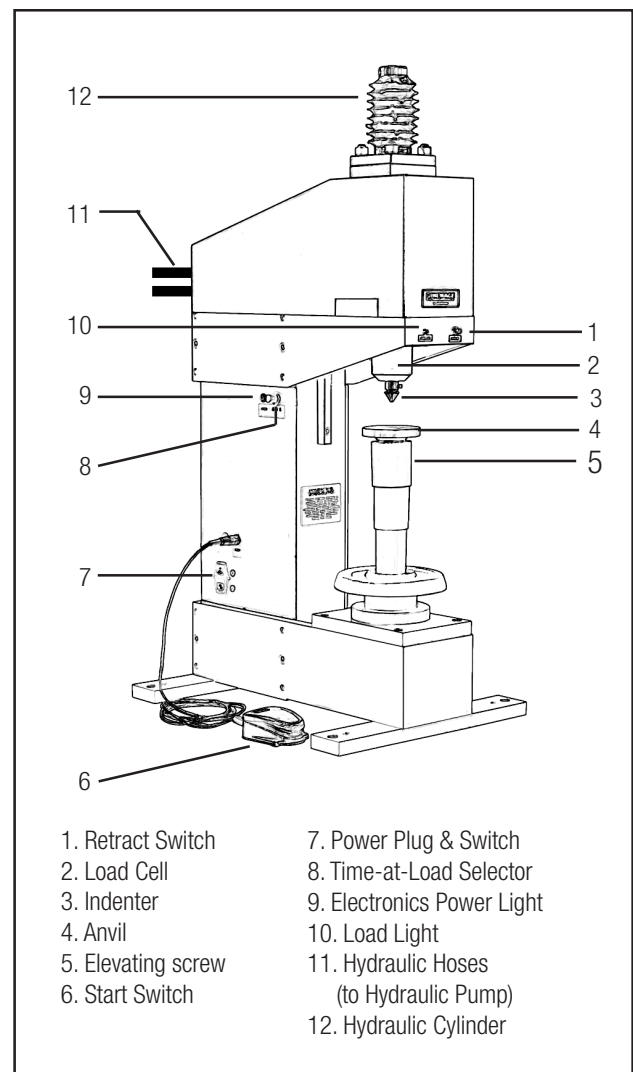
The operator must place the test specimen on the anvil and raise the elevating screw so the test surface is within 3" or 4" of the indenter. Using the Start Switch, the indenter can be lowered until the full load is applied. The tester will leave the load applied for the length of time set on the Load Time switch. The Start Switch does not need to be held down continuously, but can be jogged down so the operator is able to position the test point more accurately. The operator can release the Start Switch when the Full Load Light turns on. Another test may be performed as soon as the cylinder has retracted to the Home Position. The Brinell impression can be measured with a Brinell scope or The Newage Brinell Optical Scanning System and the measurement converted to a Brinell value using the chart in this manual.

NOTE: Prior to testing it may be necessary to grind the surface of the test part to remove surface conditions that would affect the reading, such as roughness and a different surface hardness on the part.

NOTE: This tester's indenter has a stroke of up to four inches. The time the tester needs to make a stroke can be reduced by manually positioning the test parts so they are touching the indenter when it begins its stroke.

3.1 Operational Safety

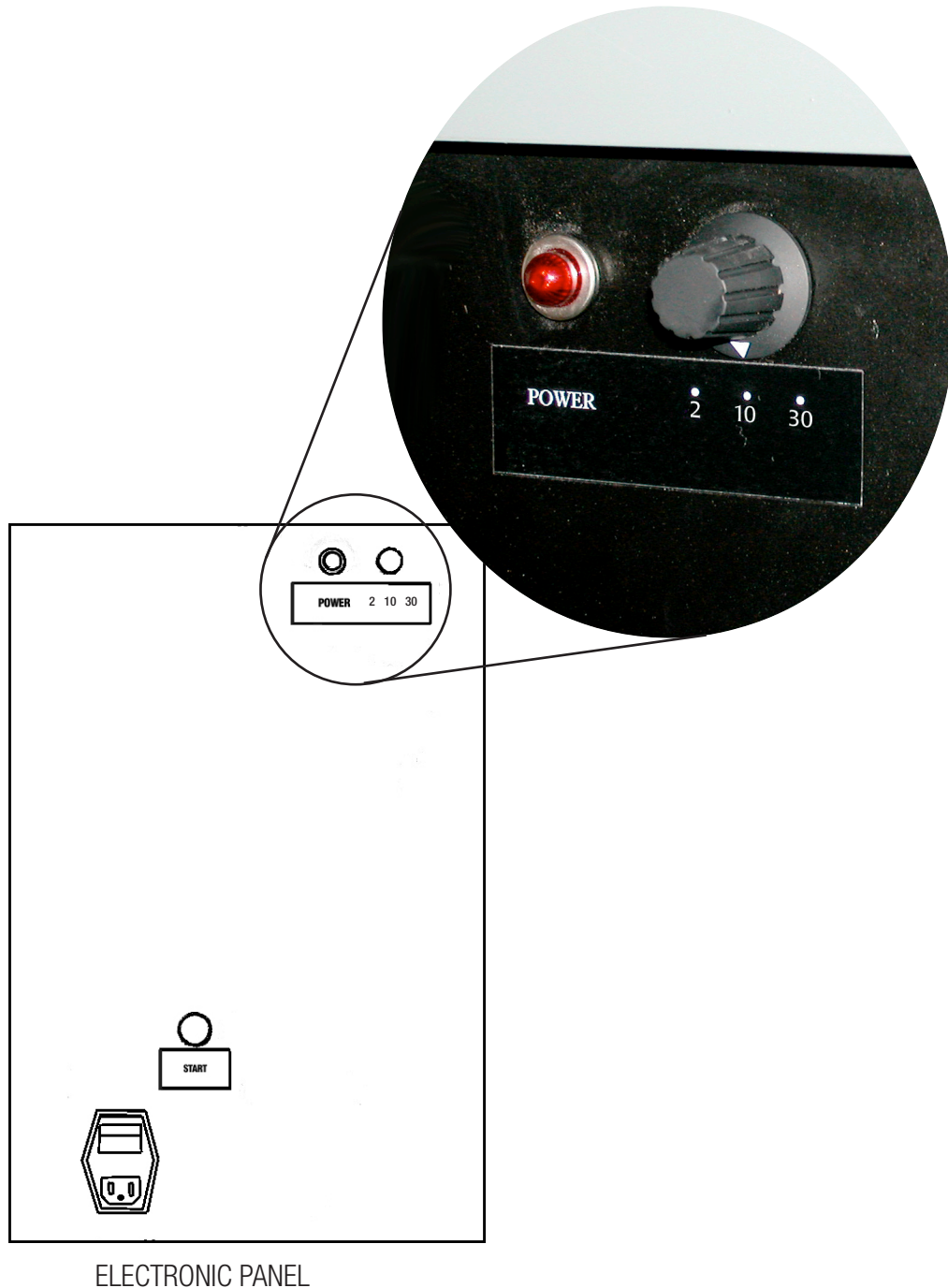
Brinell testers apply up to 3000 kg (6600 lb) force to the indenter. The operator must make certain the test specimen is sitting in a stable position on the anvil prior to applying load to the test specimen. If the load is not being applied onto a stable specimen during the test sequence, the Retract button can be pressed to stop the stroke of the indenter and the load sequence and return to the Home Position.



3.2. Changing the Time-at-Load

Set the time-at-load by turning the switch on the top right corner of the electronic panel. There are three selection: 2, 10, and 30 seconds.

The time-at-load duration should normally be set at 10 seconds. A shorter time-at-load may also be selected if it is known to provide the same result and the time at load should be reported with the test result according to ASTM E-10.



4. THE ASTM BRINELL TEST METHOD

The 7000 Series Brinell uses a fixed 3000 kg load (optionally 500 kg or other load) and a 10 mm tungsten ball indenter (optionally 5 mm). The following general information is included for the benefit of the user. Brinell testing is covered by the ASTM standard E-10.

The ASTM specification can be purchased from the ASTM (American Society for Testing and Materials) in Conshohocken, PA at 610-832-9500.

The ball size is most commonly 10mm, but 5 mm, and 2.5mm can also be used. Most commonly the a Brinell tester is setup to test at 3000 kg, but other loads of 187.5, 250, 500, 750, 1000, and 1500 are listed in the standard. The combinations of load and indenter that can be used are as follows:

<u>Hardness Scale</u>	<u>Ball dia. (mm)</u>	<u>Load (kgf)</u>
HBW 10/3000	10	3000
HBW 10/1500	10	1500
HBW 10/1000	10	1000
HBW 10/500	10	500
HBW 10/250	10	250
HBW 5/750	5	750
HBW 5/250	5	250
HBW 2.5/187.5	2.5	187.5
HBW 2.5/62.5	2.5	62.5

NOTE: HBW indicates the use of a Tungsten carbide ball. Steel balls are no longer used in Brinell testing so the previous most common designation "HBS" (to indicate a steel ball) is no longer used

The reason various loads exist is that there are a number of conditions that can exist that make it beneficial to use one load over another:

- The material may be too thin or the test position too close to an edge of the part (or other impression) to use a higher load.
- The surface or surface preparation may be rougher so a larger impression makes for a relatively greater precision in measurement.
- Larger impressions tend to average out discontinuities in hardness inherent in materials with large grain structure.
- The impression must be no closer than 2.5 impression diameters to another impression or the edge of the specimen.
- When impressions are made on a curved surface the minimum radius of curvature of the surface must be 5 times the diameter of the ball.
- The thickness of the specimen that can be tested is limited to the condition that it should not show any effects of testing on the underside of the test specimen.
- Generally the test specimen should be 10 times thicker than the impression.

4.1 Other Conditions for Testing

- The angle of test force should be 90° K2L.
- A tungsten carbide ball must be used.
- The test force should be applied smoothly for a duration of 10 to 15 seconds.
- The surface of the sample at the test location is often ground down prior to making an impression so the impression edge is easier to see and to remove any surface conditions that may affect the hardness reading.

4.2 Measuring the Brinell Impression & Obtaining a Brinell Value

The impression should be measured with a Brinell scope (usually at 20x power with a measuring scale in millimeters and a source of light to facilitate measurement) at two perpendicular axes to within the closest 0.05 mm or 0.01 with higher magnification. The average value of the two measurements is used for calculation of the Brinell value by looking up the Brinell scale (load and indenter size) in the Brinell Conversion Chart. This averaged measurement gives the corresponding hardness value. See Brinell Conversion Charts located in this operation manual.

All Brinell Values should be reported with the load, ball size, ball material, and time-at-load if it is not the most common 3000kg, 10mm tungsten ball, and 10-15 seconds time-at load. The test result is often abbreviated such as HB5 400 for Hardness Brinell, 500 kg. test value 500.

4.3 Calibration

There are two methods of calibration of the tester: direct and indirect. The direct method should be used for checking a new or rebuilt tester. Direct verification involves verifying the load is within +/- 1% of the specified load using an calibration instrument traceable to NIST, replacing the indenter with a new one and verifying the Brinell scope against a traceable standard.

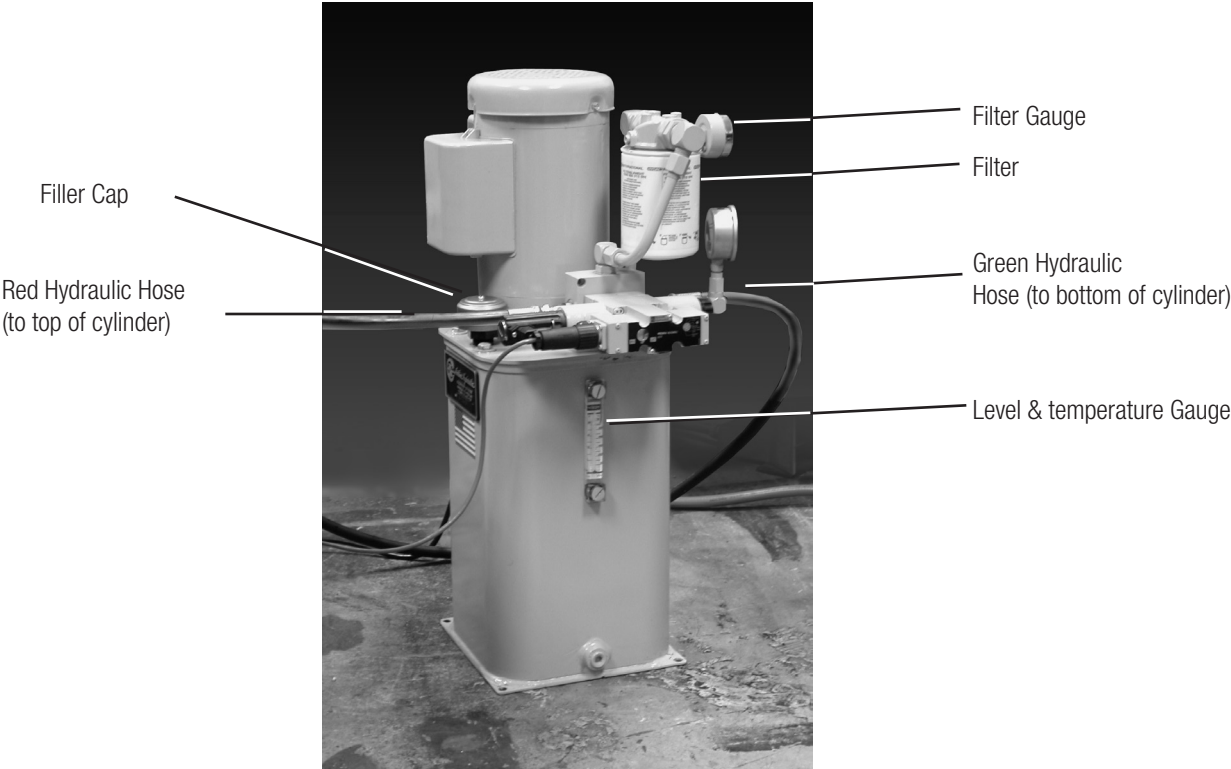
Indirect calibration should be used for routine checking. Indirect calibration involves testing on a test block and verifying the mean results fall within +/- 3% of the value indicated on the test block. A new indenter should be used when checking calibration.

5. MAINTENANCE

5.1 Hydraulic Package

The hydraulic package has a hydraulic level gauge on the side of the unit. It must be checked weekly to verify the level is above the minimum level mark. Refill as need with Exxon Teresstic 32 hydraulic oil.

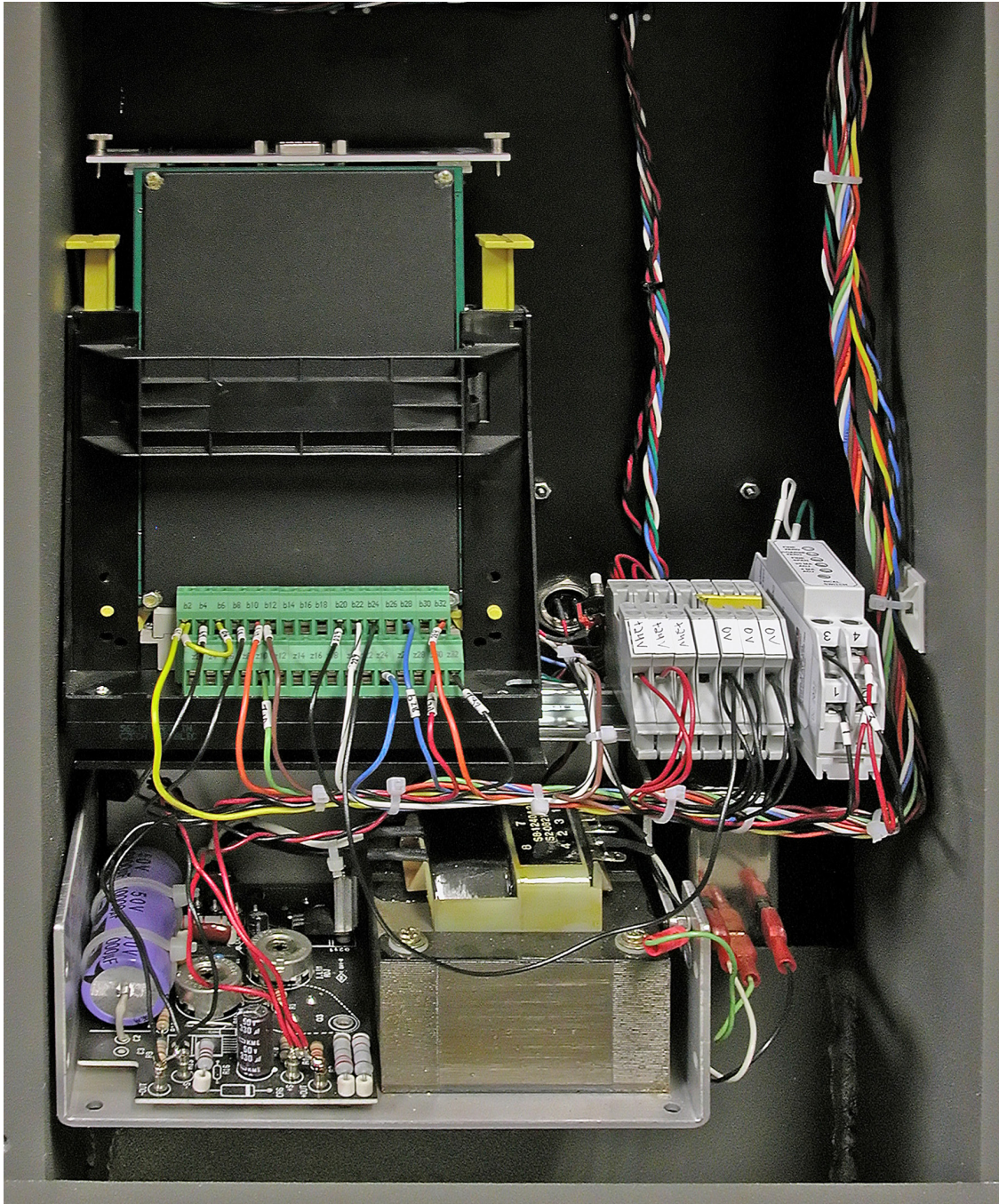
The filter gage indicates when the filter needs to be replaced. The filter is located underneath the gage.



6. SERVICE

6.1 ELECTRONIC ADJUSTMENT

To access remove right-side (facing the tester) panel between the upright columns. The “Fine Span” control is located on the right side.



6.2 Hydraulic Valve Adjustment

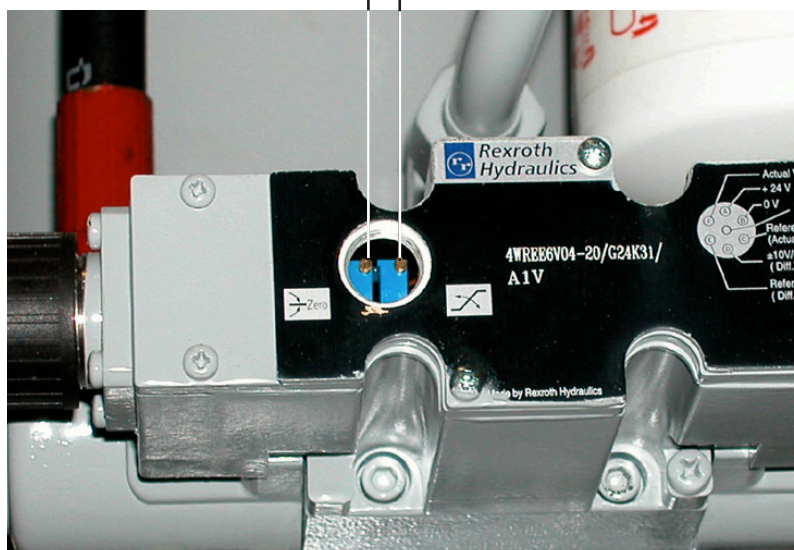
To access remove screw from hydraulic cylinder plate.

Zero Adjustment

Drive cylinder midway down the stroke and adjust zero potentiometer until the cylinder moves slowly upwards. This will keep the cylinder at the home position when not in use.

Ramp Adjustment

Turn counterclockwise all the way.



Appendix A: Brinell Conversion

Brinell Conversion: Diameter Measurement to Brinell Hardness Value Using 10 mm Ball

Diameter (mm)	LOAD (kg)				Diameter (mm)	LOAD (kg)				Diameter (mm)	LOAD (kg)			
	3000	1500	1000	500		3000	1500	1000	500		3000	1500	1000	500
3.68	272	136	91	45.4	4.23	203	102	68	33.9	4.78	157	78.5	52.3	26.2
3.69	271	135	90	45.1	4.24	202	101	67	33.7	4.79	156	78.2	52.1	26.1
3.70	269	135	90	44.9	4.25	201	101	67	33.6	4.80	156	77.8	51.9	25.9
3.71	268	134	89	44.6	4.26	200	100	67	33.4	4.81	155	77.5	51.6	25.8
3.72	266	133	89	44.4	4.27	199	100	66	33.2	4.82	154	77.1	51.4	25.7
3.73	265	132	88	44.1	4.28	198	99	66	33.1	4.83	154	76.8	51.2	25.6
3.74	263	132	88	43.9	4.29	198	99	66	32.9	4.84	153	76.4	51.0	25.5
3.75	262	131	87	43.6	4.30	197	98	66	32.8	4.85	152	76.1	50.7	25.4
3.76	260	130	87	43.4	4.31	196	98	65	32.6	4.86	152	75.8	50.5	25.3
3.77	259	129	86	43.1	4.32	195	97	65	32.4	4.87	151	75.4	50.3	25.1
3.78	257	129	86	42.9	4.33	194	97	65	32.3	4.88	150	75.1	50.1	25.0
3.79	256	128	85	42.7	4.34	193	96	64	32.1	4.89	150	74.8	49.8	24.9
3.80	255	127	85	42.4	4.35	192	96	64	32.0	4.90	149	74.4	49.6	24.8
3.81	253	127	84	42.2	4.36	191	95	64	31.8	4.91	148	74.1	49.4	24.7
3.82	252	126	84	42.0	4.37	190	95	63	31.7	4.92	148	73.8	49.2	24.6
3.83	250	125	83	41.7	4.38	189	95	63	31.5	4.93	147	73.5	49.0	24.5
3.84	249	125	83	41.5	4.39	188	94	63	31.4	4.94	146	73.2	48.8	24.4
3.85	248	124	83	41.3	4.40	187	94	62	31.2	4.95	146	72.8	48.6	24.3
3.86	246	123	82	41.1	4.41	186	93	62	31.1	4.96	145	72.5	48.3	24.2
3.87	245	123	82	40.9	4.42	185	93	62	30.9	4.97	144	72.2	48.1	24.1
3.88	244	122	81	40.6	4.43	185	92	62	30.8	4.98	144	71.9	47.9	24.0
3.89	242	121	81	40.4	4.44	184	92	61	30.6	4.99	143	71.6	47.7	23.9
3.90	241	121	80	40.2	4.45	183	91	61	30.5	5.00	143	71.3	47.5	23.8
3.91	240	120	80	40.0	4.46	182	91	61	30.3	5.01	142	71.0	47.3	23.7
3.92	239	119	80	39.8	4.47	181	91	60	30.2	5.02	141	70.7	47.1	23.6
3.93	237	119	79	39.6	4.48	180	90	60	30.0	5.03	141	70.4	46.9	23.5
3.94	236	118	79	39.4	4.49	179	90	60	29.9	5.04	140	70.1	46.7	23.4
3.95	235	117	78	39.1	4.50	179	89.3	59.5	29.8	5.05	140	69.8	46.5	23.3
3.96	234	117	78	38.9	4.51	178	88.9	59.2	29.6	5.06	139	69.5	46.3	23.2
3.97	232	116	77	38.7	4.52	177	88.4	59.0	29.5	5.07	138	69.2	46.1	23.1
3.98	231	116	77	38.5	4.53	176	88.0	58.7	29.3	5.08	138	68.9	45.9	23.0
3.99	230	115	77	38.3	4.54	175	87.6	58.4	29.2	5.09	137	68.6	45.7	22.9
4.00	229	114	76	38.1	4.55	174	87.2	58.1	29.1	5.10	137	68.3	45.5	22.8
4.01	228	114	76	37.9	4.56	174	86.8	57.9	28.9	5.11	136	68.0	45.3	22.7
4.02	226	113	75	37.7	4.57	173	86.4	57.6	28.8	5.12	135	67.7	45.1	22.6
4.03	225	113	75	37.5	4.58	172	86.0	57.3	28.7	5.13	135	67.4	45.0	22.5
4.04	224	112	75	37.3	4.59	171	85.6	57.1	28.5	5.14	134	67.2	44.8	22.4
4.05	223	111	74	37.2	4.60	170	85.2	56.8	28.4	5.15	134	66.9	44.6	22.3
4.06	222	111	74	37.0	4.61	170	84.8	56.5	28.3	5.16	133	66.6	44.4	22.2
4.07	221	110	74	36.8	4.62	169	84.4	56.3	28.1	5.17	133	66.3	44.2	22.1
4.08	219	110	73	36.6	4.63	168	84.0	56.0	28.0	5.18	132	66.0	44.0	22.0
4.09	218	109	73	36.4	4.64	167	83.6	55.8	27.9	5.19	132	65.8	43.8	21.9
4.10	217	109	72	36.2	4.65	167	83.3	55.5	27.8	5.20	131	65.5	43.7	21.8
4.11	216	108	72	36.0	4.66	166	82.9	55.3	27.6	5.21	130	65.2	43.5	21.7
4.12	215	108	72	35.8	4.67	165	82.5	55.0	27.5	5.22	130	64.9	43.3	21.6
4.13	214	107	71	35.7	4.68	164	82.1	54.8	27.4	5.23	129	64.7	43.1	21.6
4.14	213	106	71	35.5	4.69	164	81.8	54.5	27.3	5.24	129	64.4	42.9	21.5
4.15	212	106	71	35.3	4.70	163	81.4	54.3	27.1	5.25	128	64.1	42.8	21.4
4.16	211	105	70	35.1	4.71	162	81.0	54.0	27.0	5.26	128	63.9	42.6	21.3
4.17	210	105	70	34.9	4.72	161	80.7	53.8	26.9	5.27	127	63.6	42.4	21.2
4.18	209	104	70	34.8	4.73	161	80.3	53.5	26.8	5.28	127	63.3	42.2	21.1
4.19	208	104	69	34.6	4.74	160	79.9	53.3	26.6	5.29	126	63.1	42.1	21.0
4.20	207	103	69	34.4	4.75	159	79.6	53.0	26.5	5.30	126	62.8	41.9	20.9
4.21	206	103	69	34.3	4.76	158	79.2	52.8	26.4	5.31	125	62.6	41.7	20.9
4.22	204	102	68	34.1	4.77	158	78.9	52.6	26.3	5.32	125	62.3	41.5	20.8

Brinell Conversion: Diameter Measurement to Brinell Hardness Value Using 10 mm Ball

Diameter (mm)	LOAD (kg)				Diameter (mm)	LOAD (kg)				Diameter (mm)	LOAD (kg)			
	3000	1500	1000	500		3000	1500	1000	500		3000	1500	1000	500
5.33	124	62.1	41.4	20.7	5.89	100	49.8	33.2	16.6	6.45	(81.0)	(40.5)	(27.0)	(13.5)
5.34	124	61.8	41.2	20.6	5.90	99.2	49.6	33.1	16.5	6.46	(80.7)	(40.4)	(26.9)	(13.5)
5.35	123	61.6	41.0	20.5	5.91	98.8	49.4	32.9	16.5	6.47	(80.4)	(40.2)	(26.8)	(13.4)
5.36	123	61.3	40.9	20.4	5.92	98.4	49.2	32.8	16.4	6.48	(80.1)	(40.1)	(26.7)	(13.4)
5.37	122	61.1	40.7	20.4	5.93	98.0	49.0	32.7	16.3	6.49	(79.8)	(39.9)	(26.6)	(13.3)
5.38	122	60.8	40.5	20.3	5.94	97.7	48.8	32.6	16.3	6.50	(79.6)	(39.8)	(26.5)	(13.3)
5.39	121	60.6	40.4	20.2	5.95	97.3	48.7	32.4	16.2	6.51	(79.3)	(39.6)	(26.4)	(13.2)
5.40	121	60.3	40.2	20.1	5.96	96.9	48.5	32.3	16.2	6.52	(79.0)	(39.5)	(26.3)	(13.2)
5.41	120	60.1	40.0	20.0	5.97	96.6	48.3	32.2	16.1	6.53	(78.7)	(39.4)	(26.2)	(13.1)
5.42	120	59.8	39.9	19.9	5.98	96.2	48.1	32.1	16.0	6.54	(78.4)	(39.2)	(26.1)	(13.1)
5.43	119	59.6	39.7	19.9	5.99	95.9	47.9	32.0	16.0	6.55	(78.2)	(39.1)	(26.1)	(13.0)
5.44	119	59.3	39.6	19.8	6.00	(95.5)	(47.7)	(31.8)	(15.9)	6.56	(77.9)	(38.9)	(26.0)	(13.0)
5.45	118	59.1	39.4	19.7	6.01	(95.1)	(47.6)	(31.7)	(15.9)	6.57	(77.6)	(38.8)	(25.9)	(12.9)
5.46	118	58.9	39.2	19.6	6.02	(94.8)	(47.4)	(31.6)	(15.8)	6.58	(77.3)	(38.7)	(25.8)	(12.9)
5.47	117	58.6	39.1	19.5	6.03	(94.4)	(47.2)	(31.5)	(15.7)	6.59	(77.1)	(38.5)	(25.7)	(12.8)
5.48	117	58.4	38.9	19.5	6.04	(94.1)	(47.0)	(31.4)	(15.7)	6.60	(76.8)	(38.4)	(25.6)	(12.8)
5.49	116	58.2	38.8	19.4	6.05	(93.7)	(46.9)	(31.2)	(15.6)	6.61	(76.5)	(38.3)	(25.5)	(12.8)
5.50	116	57.9	38.6	19.3	6.06	(93.4)	(46.7)	(31.1)	(15.6)	6.62	(76.2)	(38.1)	(25.4)	(12.7)
5.51	115	57.7	38.5	19.2	6.07	(93.0)	(46.5)	(31.0)	(15.5)	6.63	(76.0)	(38.0)	(25.3)	(12.7)
5.52	115	57.5	38.3	19.2	6.08	(92.7)	(46.3)	(30.9)	(15.4)	6.64	(75.7)	(37.9)	(25.2)	(12.6)
5.53	114	57.2	38.2	19.1	6.09	(92.3)	(46.2)	(30.8)	(15.4)	6.65	(75.4)	(37.7)	(25.1)	(12.6)
5.54	114	57.0	38.0	19.0	6.10	(92.0)	(46.0)	(30.7)	(15.3)	6.66	(75.2)	(37.6)	(25.1)	(12.5)
5.55	114	56.8	37.9	18.9	6.11	(91.7)	(45.8)	(30.6)	(15.3)	6.67	(74.9)	(37.5)	(25.0)	(12.5)
5.56	113	56.6	37.7	18.9	6.12	(91.3)	(45.7)	(30.4)	(15.2)	6.68	(74.7)	(37.3)	(24.9)	(12.4)
5.57	113	56.3	37.6	18.8	6.13	(91.0)	(45.5)	(30.3)	(15.2)	6.69	(74.4)	(37.2)	(24.8)	(12.4)
5.58	112	56.1	37.4	18.7	6.14	(90.6)	(45.3)	(30.2)	(15.1)	6.70	(74.1)	(37.1)	(24.7)	(12.4)
5.59	112	55.9	37.3	18.6	6.15	(90.3)	(45.2)	(30.1)	(15.1)	6.71	(73.9)	(36.9)	(24.6)	(12.3)
5.60	111	55.7	37.1	18.6	6.16	(90.0)	(45.0)	(30.0)	(15.0)	6.72	(73.6)	(36.8)	(24.5)	(12.3)
5.61	111	55.5	37.0	18.5	6.17	(89.7)	(44.8)	(29.9)	(14.9)	6.73	(73.4)	(36.7)	(24.5)	(12.2)
5.62	110	55.2	36.8	18.4	6.18	(89.3)	(44.7)	(29.8)	(14.9)	6.74	(73.1)	(36.6)	(24.4)	(12.2)
5.63	110	55.0	36.7	18.3	6.19	(89.0)	(44.5)	(29.7)	(14.8)	6.75	(72.8)	(36.4)	(24.3)	(12.1)
5.64	110	54.8	36.5	18.3	6.20	(88.7)	(44.3)	(29.6)	(14.8)	6.76	(72.6)	(36.3)	(24.2)	(12.1)
5.65	109	54.6	36.4	18.2	6.21	(88.3)	(44.2)	(29.4)	(14.7)	6.77	(72.3)	(36.2)	(24.1)	(12.1)
5.66	109	54.4	36.3	18.1	6.22	(88.0)	(44.0)	(29.3)	(14.7)	6.78	(72.1)	(36.0)	(24.0)	(12.0)
5.67	108	54.2	36.1	18.1	6.23	(87.7)	(43.9)	(29.2)	(14.6)	6.79	(71.8)	(35.9)	(23.9)	(12.0)
5.68	108	54.0	36.0	18.0	6.24	(87.4)	(43.7)	(29.1)	(14.6)	6.80	(71.6)	(35.8)	(23.9)	(11.9)
5.69	108	53.8	35.8	17.9	6.25	(87.1)	(43.5)	(29.0)	(14.5)	6.81	(71.3)	(35.7)	(23.8)	(11.9)
5.70	107	53.5	35.7	17.8	6.26	(86.7)	(43.4)	(28.9)	(14.5)	6.82	(71.1)	(35.5)	(23.7)	(11.8)
5.71	107	53.3	35.6	17.8	6.27	(86.4)	(43.2)	(28.8)	(14.4)	6.83	(70.8)	(35.4)	(23.6)	(11.8)
5.72	106	53.1	35.4	17.7	6.28	(86.1)	(43.1)	(28.7)	(14.4)	6.84	(70.6)	(35.3)	(23.5)	(11.8)
5.73	106	52.9	35.3	17.6	6.29	(85.8)	(42.9)	(28.6)	(14.3)	6.85	(70.4)	(35.2)	(23.5)	(11.7)
5.74	105	52.7	35.1	17.6	6.30	(85.5)	(42.7)	(28.5)	(14.2)	6.86	(70.1)	(35.1)	(23.4)	(11.7)
5.75	105	52.5	35.0	17.5	6.31	(85.2)	(42.6)	(28.4)	(14.2)	6.87	(69.9)	(34.9)	(23.3)	(11.6)
5.76	105	52.3	34.9	17.4	6.32	(84.9)	(42.4)	(28.3)	(14.1)	6.88	(69.6)	(34.8)	(23.2)	(11.6)
5.77	104	52.1	34.7	17.4	6.33	(84.6)	(42.3)	(28.2)	(14.1)	6.89	(69.4)	(34.7)	(23.1)	(11.6)
5.78	104	51.9	34.6	17.3	6.34	(84.3)	(42.1)	(28.1)	(14.0)	6.90	(69.2)	(34.6)	(23.1)	(11.5)
5.79	103	51.7	34.5	17.2	6.35	(84.0)	(42.0)	(28.0)	(14.0)	6.91	(68.9)	(34.5)	(23.0)	(11.5)
5.80	103	51.5	34.3	17.2	6.36	(83.7)	(41.8)	(27.9)	(13.9)	6.92	(68.7)	(34.3)	(22.9)	(11.4)
5.81	103	51.3	34.2	17.1	6.37	(83.4)	(41.7)	(27.8)	(13.9)	6.93	(68.4)	(34.2)	(22.8)	(11.4)
5.82	102	51.1	34.1	17.0	6.38	(83.1)	(41.5)	(27.7)	(13.8)	6.94	(68.2)	(34.1)	(22.7)	(11.4)
5.83	102	50.9	33.9	17.0	6.39	(82.8)	(41.4)	(27.6)	(13.8)	6.95	(68.0)	(34.0)	(22.7)	(11.3)
5.84	101	50.7	33.8	16.9	6.40	(82.5)	(41.2)	(27.5)	(13.7)	6.96	(67.7)	(33.9)	(22.6)	(11.3)
5.85	101	50.5	33.7	16.8	6.41	(82.2)	(41.1)	(27.4)	(13.7)	6.97	(67.5)	(33.8)	(22.5)	(11.3)
5.86	101	50.3	33.6	16.8	6.42	(81.9)	(40.9)	(27.3)	(13.6)	6.98	(67.3)	(33.6)	(22.4)	(11.2)
5.87	100	50.2	33.4	16.7	6.43	(81.6)	(40.8)	(27.2)	(13.6)	6.99	(67.0)	(33.5)	(22.3)	(11.2)
5.88	100	50.0	33.3	16.7	6.44	(81.3)	(40.6)	(27.1)	(13.5)					

APPENDIX B: WARRANTY

ONE YEAR LIMITED WARRANTY

Should Newage Testing Instruments, Inc. equipment require service, we will repair or replace, at our option, any part or product which upon examination by a Newage service technician, shows to be defective in material or workmanship.

Excluded from this warranty are any parts that are to be replaced as part of normal product operation, such as indenters, test blocks, and indenter shrouds.

This warranty is extended to the original purchaser only, for a period of one year (12 months) from owners date of purchase.

This warranty IS NOT VALID IF THE INSTRUMENT HAS BEEN MODIFIED, MISUSED OR DAMAGED in any way. This includes damage caused by disassembly by any person other than an authorized Newage Testing Instruments' service technician.

Please read all operating instructions according to the manual supplied with the instrument prior to operation. This warranty applies only to instruments sold by Newage Testing Instruments, Inc. and its authorized distributors.

Newage Testing Instruments, Inc. is not responsible in any way for losses, damage, or other form of consequential damage resulting from equipment failure or improper use.

IMPORTANT: Register your instrument with Newage Testing Instruments, Inc. service department by filling out and returning the enclosed warranty registration card.





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