Instrument

MODEL CPT
PORTABLE HARDNESS TESTER

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SUN-TEC
HARDNESS TESTING SPECIALISTS

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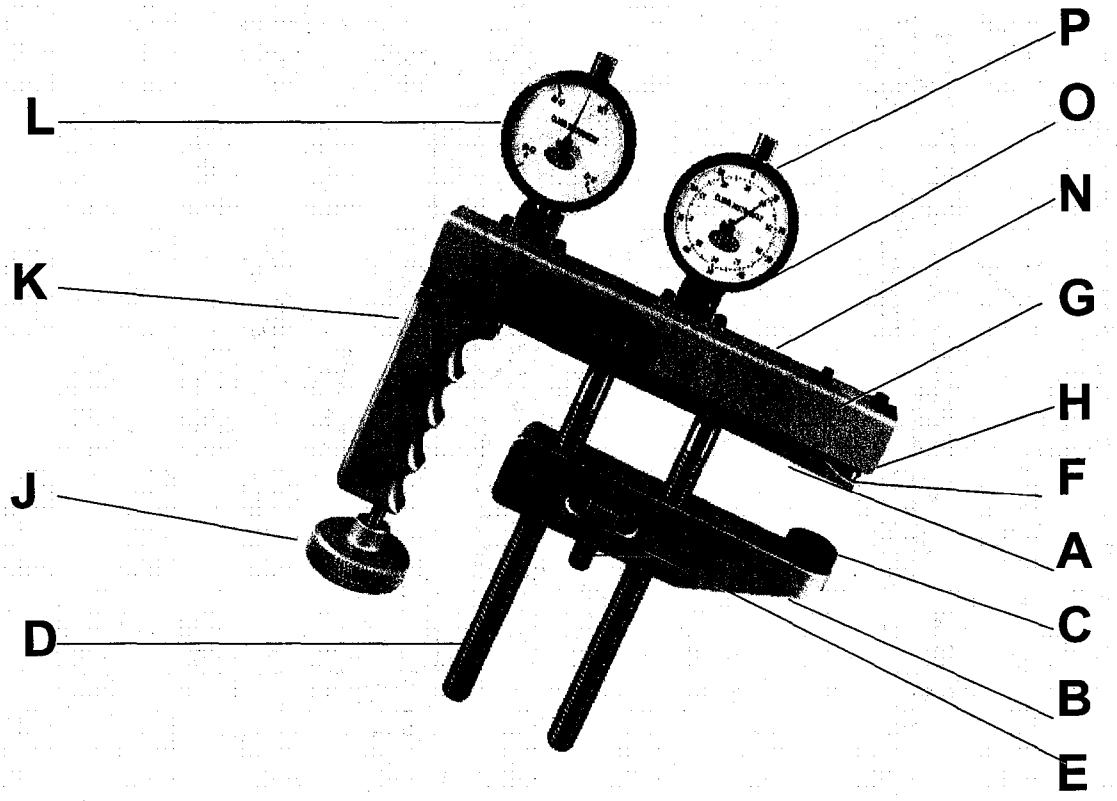
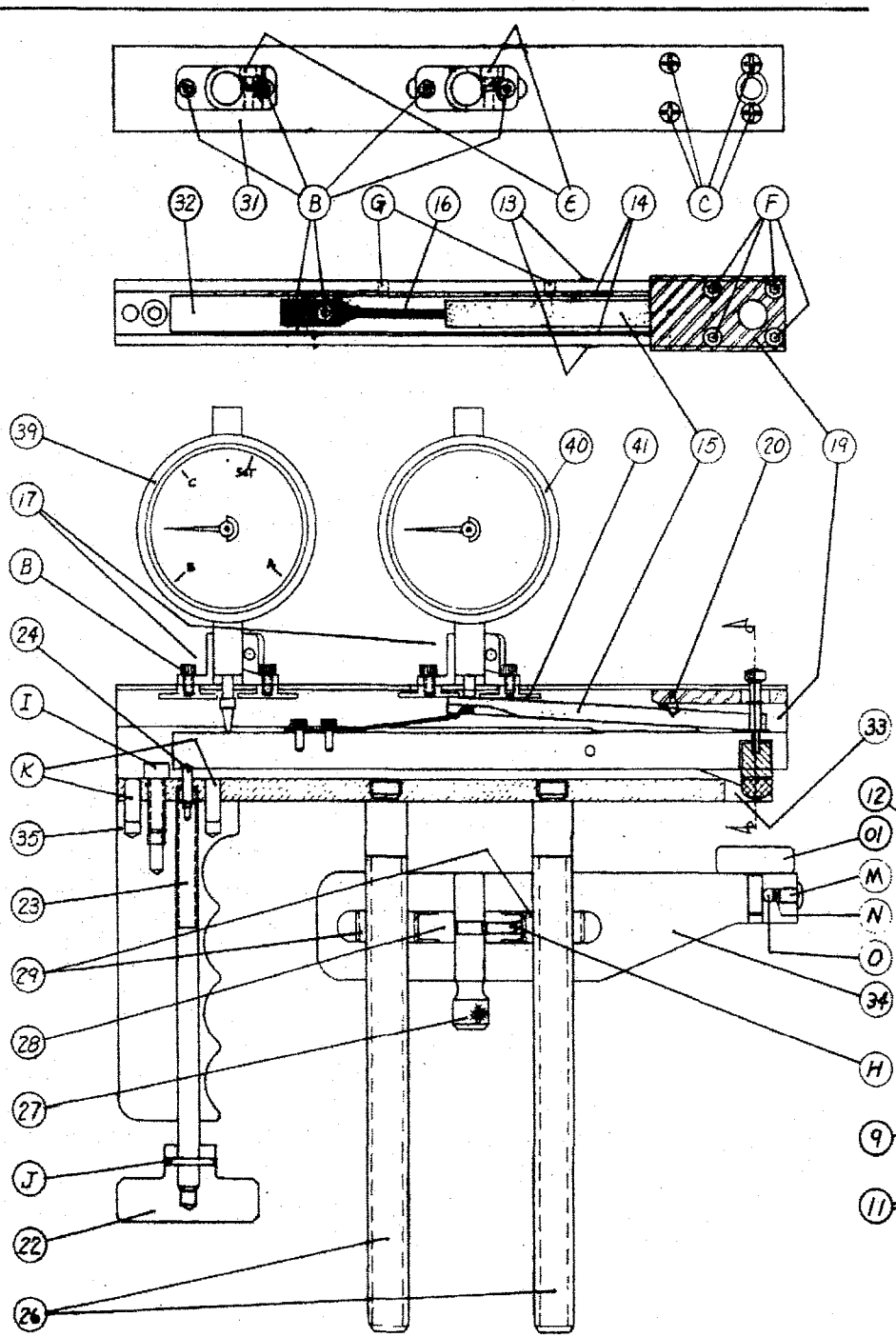
MODEL CPT
CLARK PORTABLE HARDNESS TESTER
For Rockwell Readings

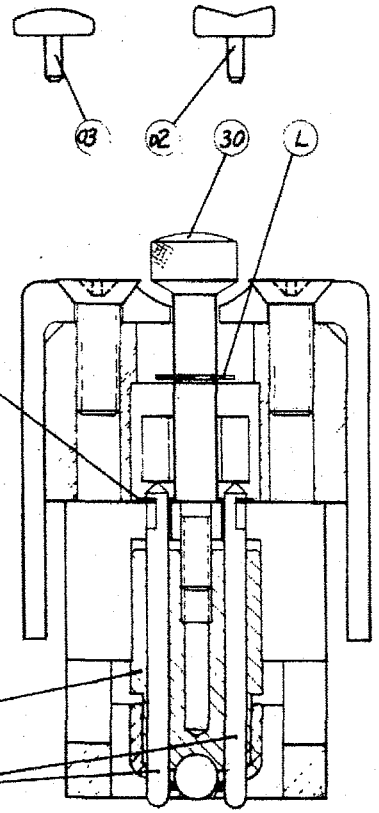


A - Upper Clamp
B – Lower Clamp
C – Anvil
D – Adjusting Screws
E – Adjusting Knob
F – Penetrator
G - Penetrator Clamp Screw
H - Weight Bar
J – Loading Screw
K - Grip
L – Load Indicator
N – Indicator Support
O – Indicator Clamp Bracket
P – Penetration Indicator

P/N	PART NAME	REQ
01	FLAT ANVIL	1
02	"V" ANVIL	1
03	CONVEX ANVIL	1
09	DE*6 OR *10, PENETRATOR	1 ea.
11	CONTACT PIN	2
12	RETAINER, CONTACT PIN	1
13	PIVOT PIN	1
14	SPACER, PIVOT PIN	2
15	ACTUATING LEVER	1
16	SPRING	1
17	CLAMP, INDICATOR	2
19	HOLDING PIECE, PIVOT CONE	1
20	PIVOT CONE	1
22	LOADING KNOB	1
23	SHAFT, LOADING KNOB	1
24	PIN, LOADING SHAFT	1
26	SCREW	2
27	PINION, SHAFT	1
28	GEAR, PINION (LARGE)	1
29	GEAR (SMALL)	2
30	SCREW, RETAINING PENETRATOR	1
31	SUPPORT, INDICATOR SEAT	1
32	WEIGHT BAR	1
33	CLAMP, UPPER	1
34	CLAMP, LOWER	1
35	HANDLE (GRIP)	1
39	LOAD INDICATOR	1
40	HARDNESS INDICATOR	1
41	KEY	4
42	SCREW, ANVIL	1

P/N	LIST OF FASTENERS	REQ
*A	0-80 x 1/8 SLOTTED MACHINE SCREW FILLET	2
B	5-40 x 5/16 SOCKET CAP SCREW	6
C	5-40 x 3/8 OVAL HEAD MS. SS. PT	4
D		
E	5-40 x 1/2 SOCKET CAP SCREW	6
F	5-40 x 5/8 SOCKET CAP SCREW	4
G	6-32 x 3/16 SOCKET SET CUP POINT SCREW	2
H	6-32 x 3/8 SOCKET SET CUP POINT SCREW	2
I	10-32 x 3/8 SOCKET CAP SCREW	1
J	1/16 x 5/8 ROLL PIN	1
K	5/16 x 1/2 DOWEL PINS	2
L	SNAP RING # IRR5133	1
M	10-32 x 3/8 JAM SCREW	1
N	1/4 x .148 SPRING	1
O	5/32 BALL	1





CLARK Instrument

MODEL "CPT"

GENERAL

The Clark Portable Hardness Tester was developed to meet the need for a lightweight instrument to make tests based on one of the universally recognized systems for hardness testing. The instrument is quite universal in its application, being readily adjustable to a wide range of sizes and shapes which would be difficult, or impossible, to test in a bench type hardness tester. It can be used to advantage by a receiving inspection department to check the hardness of flat or round bar stock, as well as sheet stock. In the shop it is useful in giving an indication of the drawing or machining properties of material, either before or while in process. It is particularly adaptable to field tests by service technicians, inspectors, and sales persons. Innumerable applications will suggest themselves to users in various industries. The tester is designed for making Rockwell type tests which are comparable to the bench type of machine, since the load, the shape of the penetrator, and the penetration measurement are the same as used on the bench type machine for the various scales which may be used. The basic procedure in making a test is as follows:

1) Apply the initial or minor load of 10 Kg with loading knob (left gage to "set").
2) Set the hardness or penetration indicator to zero on the black scale (right gage).
3) Apply a major load of 60, 100, or 150 Kg. (depending on the scale) and then reduce the load back to "set".
4) Read the hardness directly on the penetration indicator. The hardness reading is based on the measurement of the additional increment of penetration produced by applying a major load after the minor load has produced an initial penetration.
    a) Initial indication of movement, including initial penetration.
    b) Initial penetration produced by minor load.
    c) Penetration from major load.

d) Recovery in depth of penetration upon removal of major load.

e) Increment of depth, to be read as hardness number.

The above will be recognized as the standard basic conditions for making the Rockwell type test.

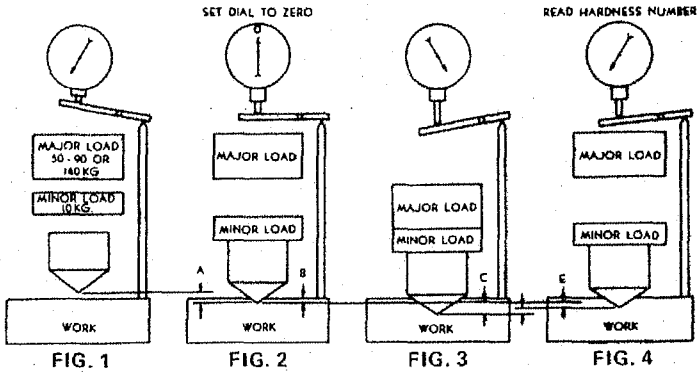


FIG. 1 FIG. 2 FIG. 3 FIG. 4

OPERATING PROCEDURE

SCALE	PENETRATOR	MAJOR LOAD	FIGURES	APPLICATION
A	Diamond	60 kgs.	Black	For extremely hard materials such as sintered carbides. For hard sheets which are too thin for heavier loads.
B	1/16" Ball	100 kgs.	Red	Annealed steel, cast iron and non-ferrous metals.
C	Diamond	150 kgs.	Black	Hardened steel
E	1/8" Ball	100 kgs.	Red	Aluminum
F	1/16" Ball	60 kgs.	Red	Soft Bearing Materials
H	1/8" Ball	60 kgs.	Red	Aluminum

1. Select penetrator to be used.
    a. Use diamond penetrator for hardened or heat treated steel.
    b. Use ball penetrator for non-ferrous or materials softer than C-20.
2. Select proper anvil to suit piece.

3. Make sure loading screw is backed off sufficiently so that penetrator does not project beyond upper clamp.
4. Clamp work firmly between upper clamp and anvil by means of adjusting knob on lower clamp. DO NOT FORCE.
5. Check zero setting of load indicator. Rotate bezel to bring pointer over small black dot for zero load.
6. Apply 10 KG. Minor load (pointer to "set") by means of loading screw. *Caution:* Hold the instrument steady to avoid twisting motion of penetrator on the work.
7. Check zero setting of penetration indicator. Rotate bezel to bring pointer to "0" on the Black scale.
8. Apply major load. Normally "C" scale (150 Kg.) or "A" scale (60 KG.) for diamond or "B" scale (100 KG.) for ball.
9. Take off major load - reduce to minor load. (Pointer back to "set".)
10. Hardness is indicated on penetration indicator.
    a. Read black figures when using diamond penetrator.
    b. Read red figures when using ball penetrator.
11. Release load completely by backing off loading screw.
12. Turn adjusting knob to left to loosen lower clamp.

DESCRIPTION

The illustrations on page 3 show the general arrangement and identify the various visible components of the hardness tester. It will be noted from the general arrangement that the adjusting screws "D" and the penetration indicator "P" are set back some distance from the penetrator end of the clamps. This makes it feasible to use the tester on either the outside of the inside surface of tubing as well as on many other applications where the clearance above the penetrator or below the anvil is limited.

The loading and load weighing arrangement is shown schematically in Figure 5:

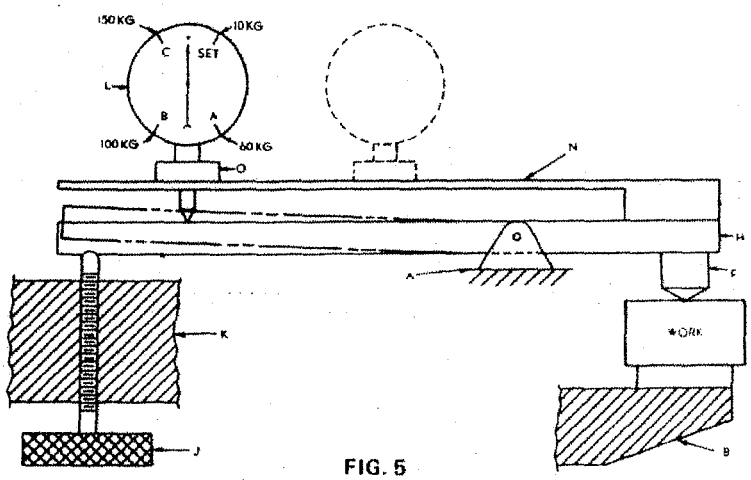


FIG. 5

Load is applied by the loading screw "J" against one end of the weigh bar "H". The weigh bar is pivoted at a central point so that the opposite end forces the penetrator down into the work when making a test. As load is applied, the weigh bar is deflected, as indicated by the broke lines, and the amount of this deflections is proportional to the applied load. The dial load indicator "L", which is supported from the opposite end of the weigh bar, indicates the amount of this deflection at one point on the weigh bar. The load indictor can be moved in or out to a point so that the four points, "SET", "A", "B", and "C" on the dial correspond respectively to loads of 10, 60, 100, 150 Kg. At the penetrator, the proper position for this indicator was determined at the factory during the process of calibration and should normally never be moved unless so indicated by a recalibration of the tester.

The Penetration Measuring System consists of a dial indicator "P" and actuating lever and contact pins arranged as illustrated in Figure 6:

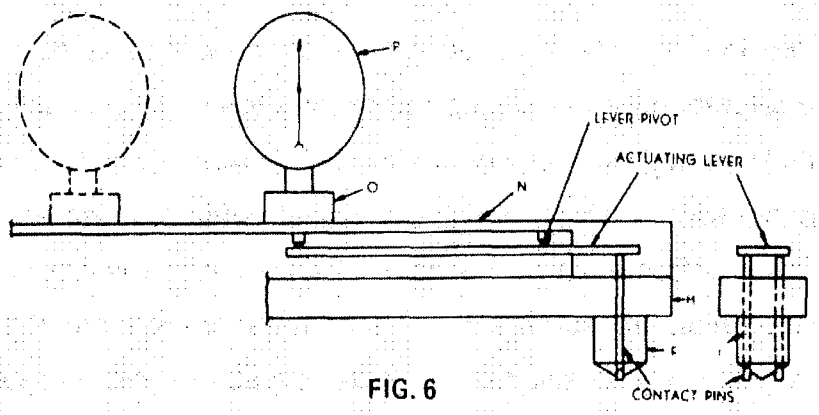


FIG. 6

The penetration measurement is made using the surface of the work adjacent to the indentation as a reference. The two contact pins, one on either side of the penetrator, transfer this point of reference to the actuating lever. It will be apparent that any motion of the penetrator, with reference to the work after the contact pins are resting on the surface of the work, will result in motion of he pointer on the dial indicator. On flat samples there will normally be 1 ½ to 2 revolutions of the pointer before the penetrator makes contact since the contact pins extend below the point of the penetrator. All initial movement on this indicator, however, is to be ignored until the minor load has been applied. Actual reading of hardness on the penetration indicator is based the zero setting determined after the application of the minor load as indicated in the operating procedure.

Also, the load weighting system is so arranged that the stem of the dial indicator is actuated positively in the loading direction. This safeguards against overshooting the desired load or complete overload of the device with possible injury of the penetrators, etc. A sticky indicator can very readily fail to indicate load if the indicator stem moves outward with increasing load, that is, if the indicator must "follow up" the motion of the deflection member.

The functions of loading and of penetration measurement are completely isolated. The loading screw "J" is not used for measuring purposes so that any inaccuracy or wear will not affect the accuracy of the instrument.

Another feature in the system for using the surface of the sample next to the indentor as a reference for measuring rather than the opposite surface, which is in contact with the anvil as, is customary inmost testers of this type. This feature makes it unnecessary to obtain absolutely sound contact at the anvil since any crushing or other deformation at the point of anvil contact is not included as a part of the penetration measurement and does not therefore; affect the accuracy of hardness reading. The position of the lower clamp or even an increase in the looseness of the lower clamp after a period of use does not affect the accuracy of the tester since these parts are not a part of the penetration measuring system.

DIRECTIONS FOR USE

SELECTING THE PENETRATOR – every Clark Portable Hardness Tester is equipped to take a diamond penetrator, or a 1/16" or 1/8" ball penetrator. By referring to the conversion chart which has been set up to clearly illustrate the range of each of the penetrators on each of two different scales, the operator can determine rather readily which penetrator should be used. The ball penetrator should not be used on materials harder than the B-100 to avoid the danger of flattening the ball. The ball indenter should not be used on readings below 0, to avoid the danger of the ball retainer coming in contact with the sample. On materials that approach 0, a lighter load or a larger diameter ball should be used.

The diamond penetrator with 150 Kg. Load can be used on materials from the hardest down to those giving a reading of C-20. It will be noted that there is very little overlap between the B and C Scales, however, the A Scale using the diamond penetrator and 60 Kg. Load provides considerable overlap which will be found useful in a transition range.

When the expected hardness of a material is completely unknown to the operator, it may as a precaution, be well to take a preliminary reading on the A Scale, as a guide in selecting the proper scale to be used.

The penetrators are retained in the tester by means of a small knurled retaining screw extending from the top of the tester above the penetrator. To remove a penetrator, have at least two or three inches of space between the upper and lower clamps so that one hand can be placed underneath the upper clamp to catch the penetrator when it is released by loosening the retaining screw. Such a procedure should be followed to prevent the penetrator from falling on the lower anvil or other hard object that might readily chip a diamond or flatten a ball. It will be noted that the two contact pins, Fig. 6, which extend through the penetrator on either side of the penetrator point, are retained in the tester when the penetrator is removed. To replace a penetrator, it must be turned so that the locating pin on the penetrator is in line with the slot provided to take the pin. Guide the contact pins into their respective holes through the penetrator. With the penetrator in place, clamp it securely by means of the penetrator retaining screw and make one or two preliminary tests to properly seat the penetrator.

SELECTION OF THE ANVIL – each tester is supplied with a flat anvil, a "V" anvil, and a convex anvil. These are adequate to cover a wide range of applications. The one best suited in a particular case can readily be determined from the nature of the parts to be tested. The necessity for an absolutely sound bearing at the anvil, is not as important on the Clark Tester as it is on other machines of this type. It is for this reason that a wide variety of anvils, normally considered necessary, are not required with this tester. Many special applications, of course, require special anvils to suit the particular case. It obviously is of major importance that the anvils contact the work in such a manner that there is absolutely no danger of slipping off, and that the part is supported so the test surface is normal to the indenter.

ZERO SETTING – This tester can be used in any position, however, it may be noted that as the tester is held indifferent positions that the zero setting of the load pointers will vary slightly as the position is changed. Zero setting on the load dial is indicated by a small black dot to the left of the work "SET". Before applying any load or bringing the penetrator in contact with the work, the load indicator bezel (the knurled ring around the indicator dial) should be turned so that the pointer falls directly over the black dot. In the normal run of work requiring a portable instrument the position of the tester will not be changed during a test, due to the size of the piece; however, when checking small parts such as test blocks where the sample is being held by the instrument, it can be seen that the position should not be changed during the test.

Initial motion of the pointer on the penetration indicator as the minor load is being applied, must be ignored. When the minor load has been applied, rotate the bezel of this indicator so as to bring the zero point, Fig. 2, on the black scale directly under the pointer. Zero on the black scale is always the starting point regardless of which scale is being used.

HARDNESS READING – hardness readings are read directly on the penetration indicator which is to be read after the major load has been removed leaving only the original "SET" or minor load of 10 Kg. on the penetrator, Fig 4.

In reporting a hardness number, the number is to be prefixed by a letter to indicate the scale on which the reading was obtained, for example C-44 or B-68.

REPLACING CONTACT PINS – The contact pins are retained in the tester when penetrators are changed by means of a retaining ring, which engage notches in the side of the contact pins. Should the pins require replacement due to wear or injury, they may be replaced by first removing the indicator support which is held by four screws adjacent to the penetrator retaining screw. After removing the

indicator support, remove the four screws holding the indicator support block and this will now give access to the contact pin retaining ring.

SURFACE PREPARATION – The degree of surface refinement will depend on the accuracy required. Surfaces that are ridged perceptibly by rough machining or grinding may not produce accurate reproducible results. Heat treating or forging scale must be removed before testing. A spot prepared wit a smooth mill file will normally give good results. Best results will obviously be obtained with a good ground finish.

SELECTING SPOT FOR INDENTATION – The measuring arrangement used on this tester makes it necessary to have sufficient surface on either side of the penetrator to support both contact pins; one pin in contact is not satisfactory. Some equalization is provided between the pins so that they will compensate for some unevenness. Previous indentations must be avoided with the penetrator and should be avoided with the contact pins when possible.

THICKNESS OF MATERIAL – The sample must be of sufficient thickness so that there is no evidence of the indentation on the backside. In general, the minimum thickness should be at least 10 times the depth of penetration. Minimum safe thickness = 10 – reading (Diamond Scales) x .0008" x 10 OR 130 – reading (Ball Scales) x .00008" x 10.

CURVED SURFACES – Results of test on curved surfaces cannot be expected to be as accurate as those on flat surfaces due to unequal support for the penetrator. Hardness values obtained on cylindrical surfaces are lower than on flat surfaces of the same material because the resistance to penetration is reduced by the curvature. The following table is from ASTM designation: E-18:

TABLE 1. – CORRECTIONS TO BE ADDED TO ROCKWELL C, A, AND D VALUES OBTAINED ON CYLINDRICAL SPECIMENS OF VARIOUS DIAMETERS.

Dial Reading	1/4 in.	3/8 in.	1/2 in.	5/8in.	3/4 in.	7/8 in.	1 in.
20	6.0	4.5	3.5	2.5	2.0	1.5	1.5
25	5.5	4.0	3.0	2.5	2.0	1.5	1.5
30	5.0	3.5	2.5	2.0	1.5	1.5	1.0
35	4.0	3.0	2.0	1.5	1.5	1.0	1.0
40	3.5	2.5	2.0	1.5	1.0	1.0	1.0
45	3.0	2.0	1.5	1.0	1.0	1.0	0.5
50	2.5	2.0	1.5	1.0	1.0	0.5	0.5
55	2.0	1.5	1.0	1.0	0.5	0.5	0.5
60	1.5	1.0	1.0	0.5	0.5	0.5	0.5
65	1.5	1.0	1.0	0.5	0.5	0.5	0.5
70	1.0	1.0	0.5	0.5	0.5	0.5	0.5
75	1.0	0.5	0.5	0.5	0.5	0.5	0
80	0.5	0.5	0.5	0.5	0.5	0	0
85	0.5	0.5	0.5	0	0	0	0
90	0.5	0	0	0	0	0	0

TABLE 2. – CORRECTIONS TO BE ADDED TO ROCKWELL B, F, AND G VALUES OBTAINED ON CYLINDRICAL SPECIMENS OF VARIOUS DIMATERS

Dial Reading	1/4in.	3/8 in.	1/2 in.	5/8 in.	3/4 in.	7/8 in.	1 in.
0	12.5	8.5	6.5	5.5	4.5	3.5	3.0
10	12.0	8.0	6.0	5.0	4.0	3.5	3.0
20	11.0	7.5	5.5	4.5	4.0	3.5	3.0
30	10.0	6.5	5.0	4.5	3.5	3.0	2.5
40	9.0	6.0	4.5	4.0	3.0	2.5	2.5
50	8.0	5.5	4.0	3.5	3.0	2.5	2.0
60	7.0	5.0	3.5	3.0	2.5	2.0	2.0
70	6.0	4.0	3.0	2.5	2.0	2.0	1.5
80	5.0	3.5	2.5	2.0	1.5	1.5	1.5
90	4.0	3.0	2.0	1.5	1.5	1.5	1.0
100	3.5	2.5	1.5	1.5	1.0	1.0	0.5

Tests should be made with the penetrator pins parallel to the axis of curvature particularly on relatively small diameters, since, if the contact pins are crosswise to the longitudinal axis or curvature, the indicator will be operating outside the range of maximum accuracy.

PRECAUTIONS

1. **USE PRECISE CARE.** The results obtained with tester will depend upon the degree of care that is used to obtain accurate conditions of test; i.e., quantitative accuracy of load application, accuracy of setting and reading penetration indicator, penetrator in good condition, sample in good condition, etc.
2. **AVOID PREVIOUS IMPRESSIONS.** This applies particularly to check tests on test blocks. Any test in which the zero setting of the penetration indicator

varies considerably from other similar tests should be viewed with suspicion. Avoid impressions close together,

3. **OBSERVE NORMAL OPERATION.** Any deviation in the normal continuous motion of both indicators while changing load by means of the loading screw should be questioned.

4. **AVOID TWISTING MOTION.** Avoid oscillating the tester in a manner that will give the penetrator a twisting motion on the sample.

5. **DO NOT LEAVE TESTER UNSUPPORTED** while the penetrator is under load. Damage to the diamond penetrator might result.

6. **ADEQUATE REGIDITY OF SAMPLE.** The penetrator is limited in the amount of available travel, so that a piece such as a thin tube clamped over the O.D. might deflect under load to a degree that the major load could not be obtained.

7. **DO NOT CHANGE CALIBRATION.** The tester was carefully calibrated at the factory for the best overall accuracy. Apparent error will usually be found in a defective penetrator or faulty operation rather than in error in calibration.

8. **CHECK FREQUENTLY WITH TEST BLOCKS.** Replace test blocks as they become filled with impressions. Do not attempt to refinish and use again.

9. **REMEMBER THIS IS A PRECISION INSTRUMENT.** The penetration system measures in units of .00008" (80 millionths of an inch). Readings in this range with such a device obviously must be made with care and the device must be handled with a reasonable degree of card to avoid damage.

10. KEEP IN CARRYING CASE AT ALL TIMES WHEN NOT IN ACTUAL USE.

11. **SERVICE AND CALIBRATION.** Complete service and calibration facilities are available at the factory.

REPLACEMENT PARTS LIST

Load Indicator

Penetration Indicator

- Diamond Penetrator
- 1/16" Ball Penetrator
- 1/8" Ball Penetrator
- Spare 1/16" and 1/8" Balls only

Penetrator Retaining Screw

Contact Pins

Contact Pins Retainer

Anvils:

- Flat
- Vee
- Convex

Hardness Test Blocks

- C-62 Approx.
- C-25 Approx.
- B-85 Approx.

Carrying Case

- Operation Instructions
- Conversion Chart

When ordering replacement parts, always refer to the Serial Number of the instrument for which the parts are required.