



HARPENDEN SKINFOLD CALIPER

CE 0120

THE HARPENDEN SKINFOLD CALIPER HSK-BI BY BRITISH INDICATORS

Thank you for purchasing our product. We are confident that you have chosen one of the most up to date and versatile calipers on the market.

Used correctly it will give good service and reliable results for many years and, in order that optimum results are obtained, we suggest strongly that you read your manual thoroughly even if experienced in the use of this type of equipment.

The Harpenden Skinfold Caliper Model: HSK-BI is CE marked in compliance with the Medical Devices Directive 93/42/EEC for a Class 1 Device with Measuring Function.

Details of our related products may be obtained directly from British Indicators (address on last page) or from one of our selected distributors.

The carry case should contain, one Harpenden Skinfold Caliper Instrument and one copy of this handbook.

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1 BODY COMPOSITION - ITS EVALUATION AND MEANING

The most accurate estimation of body composition is achieved by use of the underwater or hydrostatic weighing technique. Obviously, this method places severe restrictions on both practicality and convenience, and the alternative basis of skinfold thickness measurements is therefore used in all but the most stringent of requirements.

The use of skinfold calipers in the performance of skinfold thickness measurements (from which are derived the estimates of body fat) has been well established and documented over the last 40 years, references to which can be found in the Bibliography section of this manual.

These thickness measurements do not measure overall body fat mass or its percentage directly but rely on validated equations that describe the relationship between measures of skinfold fat as well as other body dimensions and the measured body density. Body fat percentage is determined from the estimate of body density.

Various experimenters have put forward equations which are used with either skinfold thickness alone or in conjunction with other measurements such as body circumference or limb lengths. Two of the most common sets of equations used are attributable to Durnin & Womersley (skinfolds alone), and to Jackson & Pollock (skinfolds and body measurements). The result obtained from the equations (that of body fat density) is subsequently used in the Siri equation to calculate the body fat.

Tables are included that show the fat percentage based on the Durnin and Womersley system. Values are shown for both males and females across the whole age range based on the sum of 4 skinfold measurements, and the results shown for each 2 millimetre increment of skinfold thickness.

Skinfold measurements, when properly taken, correlate very highly (0.83 to 0.89) with hydrostatic weighing, with a standard error of only about 3 or 4 %. In comparison, the correlation of height and weight charts is much lower at about 0.60.

The explanation of the use of skinfold thickness measurement in the derivation of body fat data has been simplified enormously, and can never detract from the tremendous volume of research and scientific ability in the fields of both nutrition and fitness. We all owe much respect and our considerable thanks to the specialists responsible for guiding us towards a healthier life world-wide.

2 SETTING AND USING THE HARPENDEN SKINFOLD CALIPER

2.1) CARE AND USE

- a) Ensure that your Calipers are clean and open freely and smoothly. Always clean the Caliper before and after use on a test subject.
- b) Open the Calipers to approx 20mm and allow to close several times.
- c) Check for repeatability of the zero reading within one division (0.2mm).
- d) **DO NOT OPEN AND SHUT THE CALIPERS RAPIDLY OR ALLOW THE CALIPERS TO SNAP SHUT.** This can cause damage to the Indicator mechanism.
- e) When taking measurements, do not allow the calipers to snap shut onto the test subject, as this could cause discomfort.

2.2) SETTING THE CALIPERS

- a) To re-set the Dial Indicator to zero, rotate the Bezel to the appropriate position.
- b) The Calipers are now ready for use.
- c) To calibrate the Harpenden Skinfold Calipers a special Calibration Kit can be purchased.

3 TAKING THE SKINFOLD MEASUREMENTS

The accuracy of measurement is, as one would expect, dependant upon the accuracy of the equipment used, the correct selection and location of the skinfold sites, the proper technique in taking the measurements, and the experience of the user.

3.1 EQUIPMENT REQUIRED

A TAPE MEASURE - To assist in locating the correct site.

SKINFOLD CALIPER - Accurately calibrated and with a constant spring pressure of 10g/mm² throughout its entire range. Your Harpenden Caliper has been calibrated to this performance prior to disptch from the factory.

3.2 CORRECT TECHNIQUE

Essential for accurate and repeatable tests, specific guidelines for taking skinfold measurements have been established.

Following a standard method of assessment helps ensure accuracy and repeatability on future testing.

- a) Measurement should be taken on healthy undamaged, uninfected dry skin. Moist skin is harder to grasp and can influence the measurement. **Do not use the Caliper on broken or infected skin.**
- b) Instruct the test subject to keep the muscles relaxed during the test.
- c) Take all measurements on the right side of the body. An exception might be where a deformity or missing limb would necessitate using the left side.
- d) Mark the skinfold site (see pages 5 to 7) using a pen with water soluble ink. Use a tape measure to accurately find the mid-points.
- e) The skinfold should be firmly grasped by the thumb and index finger, using the pads at the tip of the thumb and finger. Gently pull the skinfold away from the body.
- f) The Caliper should be placed perpendicular to the fold, on the site marked, dial up, at approximately 1 cm below the finger and thumb. While maintaining the grasp of the skinfold, allow the Caliper to be released so that full tension is placed on the skinfold. The dial should be read to the nearest 0.50 mm, 1 to 2 seconds after the grip has been fully released.
- g) The Caliper should not be placed too close to the body or too far away on the tip of the skinfold. Try to visualise the location of a true double fold of skin thickness, and place the Caliper there.
- h) A minimum of two measurements should be taken at each site. If repeated tests vary by more than 1 mm, repeat the measurement. If consecutive measurements become increasingly smaller, the fat is being compressed. Go to another site and come back a little later and recheck the problem site.
- i) The final value recorded should be the average of the two that seems best to represent the skinfold fat site.
- j) Record each skinfold as you measure it. It is easy to forget the first measurement if you try to keep it all in your head.
- k) Experience is necessary to grasp the same size skinfold in the same location consistently.

Practice these techniques until you get consistent results.

4 SITE SELECTION

Site selection is very important and frequently a source of error in skinfold testing. The sites selected must match the particular protocol being used.

There are two protocols usually involved, the 4-site system being the most commonly used. This system is the same for male and female subjects and has been used as the basis for the correlations in this manual.

The second system uses 3 sites, the sites differing for either male or female subjects, and are used in conjunction with the Body Density formulae (Jackson & Pollock) given on page 11 of the manual.

4.1 THE 4 SITE SYSTEM FOR MALE AND FEMALE SUBJECTS

SITE 1) BICEPS

The anterior surface of the biceps midway between the anterior axillary fold and the antecubital fossa.

SITE 2) TRICEPS

A Vertical fold on the posterior midline of the upper arm, over the triceps muscle, halfway between the acrosion process (bony process on top of the shoulder) and olecranon process (bony process on elbow). The elbow should be extended and the arm relaxed.

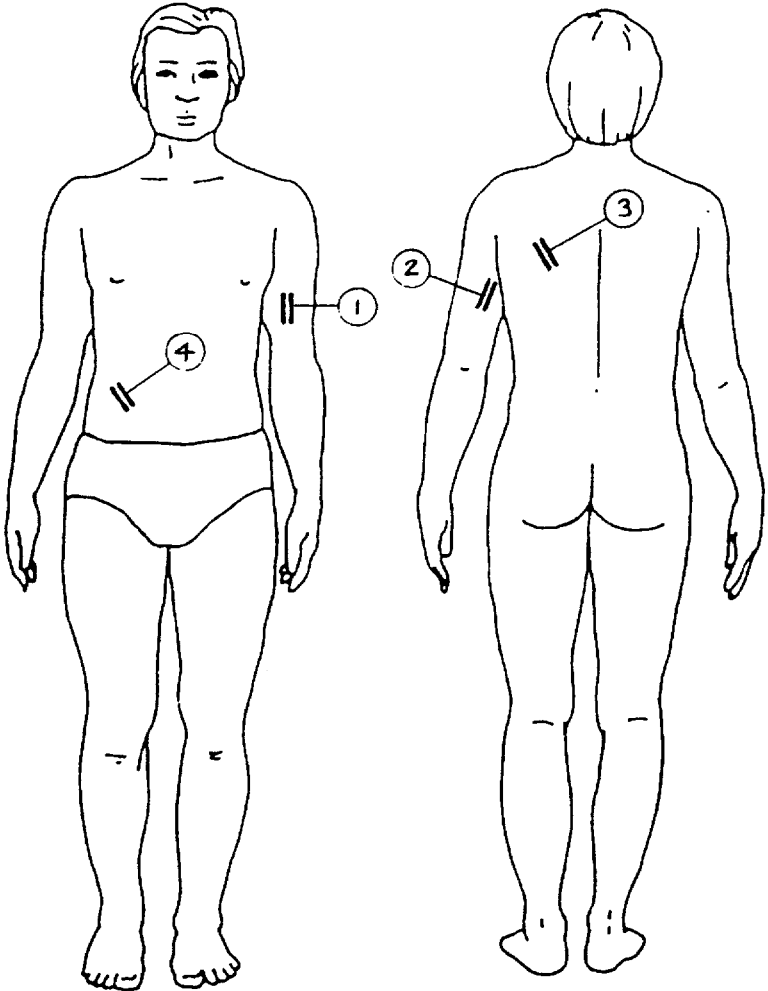
SITE 3) SUBSCAPULAR

The fold is taken on the diagonal line coming from the vertebral border to between 1 and 2 cm from the inferior angle of the scapulae. (A diagonal fold about 1 to 2 cm below the point of the shoulder blade and 1 - 2 cm toward the arm.)

SITE 4) SUPRILIAC

A diagonal fold above the crest of the ilium at the spot where an imaginary line would come down from the anterior axillary line just above the hip bone and 2 - 3 cm forward.

THE 4 SITE SYSTEM FOR MALE AND FEMALE SUBJECTS



THE 3 SITE SYSTEM FOR MALE SUBJECTS

4.2

SITE 1) CHEST (JUXTA-NIPPLES)

A diagonal fold taken one half of the distance between the anterior auxiliary line and the nipple.

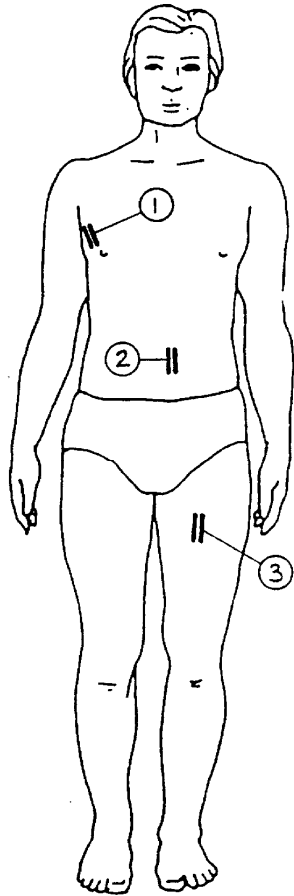
(The anterior auxiliary line is the crease where the top of the arm, when hanging down, meets the chest.)

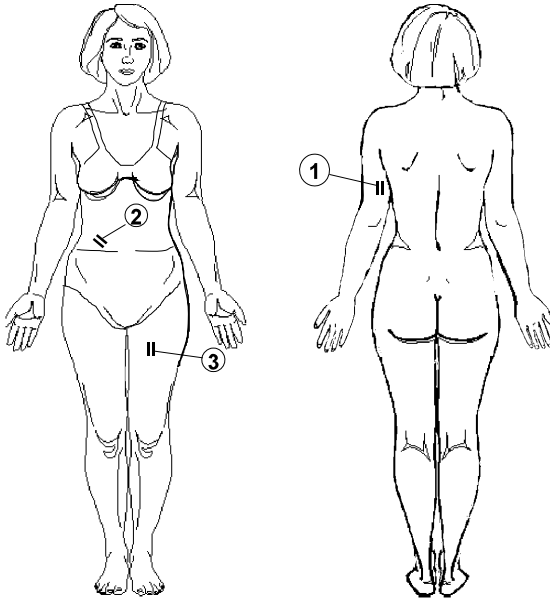
SITE 2) ABDOMINAL

The vertical fold taken at the lateral distance of approximately 2 cm from the umbilicus (2cm to the side of the umbilicus).

SITE 3) THIGH

A vertical fold on the anterior aspect of the thigh, midway between the hip and knee joints (on the front of the thigh halfway between the hip joint, where the leg bends when the knee is lifted, and the middle of the knee cap). The leg should be straight and relaxed.)





SITE 1) TRICEPS

A Vertical fold on the posterior midline of the upper arm, over the triceps muscle, halfway between the acromion process (bony process on the top of the shoulder) and olecranon process (bony process on elbow).

The elbows should be extended and the arm relaxed.

SITE 2) SUPRAILIAC

A diagonal fold above the crest of the ilium at the spot where an imaginary line would come down from the anterior auxiliary line just above the hip bone and 2 - 3 cm forward).

SITE 3) THIGH

A vertical fold on the anterior aspect of the thigh, midway between the hip and knee joints (on the front of the thigh halfway between the hip joint, where the leg bends when the knee is lifted, and the middle of the knee cap).

The leg should be straight and relaxed.

5 MAXIMUM DESIRABLE FAT PERCENTAGE - PREFERRED LEVELS AND NORMALITY

5.1 MALE SUBJECTS

The levels recommended are based on a recent population survey of 9000 individuals performed by Durnin et al (1985), as well as the consensus of previous opinion (Katch & McArdle (1973); Durnin & Rahaman (1967); and Royal College of Physicians (1983). The maximum levels are age and sex dependent, reflecting an increased risk of morbidity and heart disease in males if they are fat and young (Van Itallie (1979), but allowing for a greater fat mass (25%) as the age of men increases to 40 years and beyond. A more preferable level would be 4 to 5% lower (i.e. 20%) and this should be sought. Younger men of less than 20 should have a preferred value of 15% or lower and there is a sliding scale of maximum fatness from the early twenties to forties and beyond.

MAXIMUM PREFERRED OR DESIRABLE FATNESS LEVELS FOR AGES

UP TO 24 YEARS	15%
25 - 27 YEARS	17%
28 - 29 YEARS	18%
30 - 32 YEARS	19%
33 - 39 YEARS	20%
OVER 40 YEARS	21%

5.2 FEMALE SUBJECTS

The average fat content for females is between 24 and 26% dependent upon country of residence and, although from a health point of view a maximum desirable level of 30% (young) and 35% (older) may pose no threat, this level of moderate obesity would not satisfy the desirable shape or quirks of contemporary fashion. The fashion model type of body composition reflects a fat percentage of 15% or less, female gymnasts as low as 8% and distance runners down to 6%. The maximum desirable level suggested is based on the work of Katch & McArdle (1973), Pollock et al (1975) and Brown & Jones (1977) and is 25% for women of 30 years and over, but starts at 20% for those less than 20 years old. Again there is a sliding scale reflecting advancing years and a reduction in health risk. Contemporary fashion would indicate a preferred female level of perhaps 3% lower than these values.

MAXIMUM PREFERRED OR DESIRABLE FATNESS LEVELS FOR AGES

UP TO 20 YEARS	17%
20 - 22 YEARS	18%
23 - 25 YEARS	19%
25 - 29 YEARS	20%
OVER 30 YEARS	22%

TABLE 1 - BODY FAT % VERSUS SKINFOLD THICKNESS - MALE SUBJECTS

SKINFOLD THICKNESS	AGE	AGE	AGE	AGE	AGE
	17-19	20-29	30-39	40-49	50+
10 mm	0.41	0.04	5.05	3.30	2.63
12 mm	2.46	2.1	6.86	5.61	5.20
14 mm	4.21	3.85	8.40	7.58	7.39
16 mm	5.74	5.38	9.74	9.31	9.31
18 mm	7.10	6.74	10.93	10.84	11.02
20 mm	8.32	7.96	12.00	12.22	12.55
22 mm	9.43	9.07	12.98	13.47	13.95
24 mm	10.45	10.09	13.87	14.62	15.23
26 mm	11.39	11.03	14.69	15.68	16.42
28 mm	12.26	11.91	15.46	16.67	17.53
30 mm	13.07	12.73	16.17	17.60	18.56
32 mm	13.84	13.49	16.84	18.47	19.53
34 mm	14.56	14.22	17.47	19.28	20.44
36 mm	15.25	14.90	18.07	20.06	21.31
38 mm	15.89	15.55	18.63	20.79	22.13
40 mm	16.51	16.17	19.17	21.49	22.92
42 mm	17.10	16.76	19.69	22.16	23.66
44 mm	17.66	17.32	20.18	22.80	24.38
46 mm	18.20	17.86	20.65	23.41	25.06
48 mm	18.71	18.37	21.10	24.00	25.72
50 mm	19.21	18.87	21.53	24.56	26.35
52 mm	19.69	19.35	21.95	25.10	26.96
54 mm	20.15	19.81	22.35	25.63	27.55
56 mm	20.59	20.26	20.73	26.13	28.11
58 mm	21.02	20.69	23.11	26.62	28.66
60 mm	21.44	21.11	23.47	27.09	29.20
62 mm	21.84	21.51	23.82	27.55	29.71
64 mm	22.23	21.90	24.16	28.00	30.21
66 mm	22.61	22.28	24.49	28.43	30.70
68 mm	22.98	22.65	24.81	28.85	31.17
70 mm	23.34	23.01	25.13	29.26	31.63
72 mm	23.69	23.36	25.43	29.66	32.07
74 mm	24.03	23.70	25.73	30.04	32.51
76 mm	24.36	24.03	26.01	30.42	32.93
78 mm	24.68	24.36	26.30	30.79	33.35
80 mm	25.00	24.67	26.57	31.15	33.75

TABLE 2 - BODY FAT % VERSUS SKINFOLD THICKNESS - FEMALE SUBJECTS

SKINFOLD THICKNESS	AGE	AGE	AGE	AGE	AGE
	17-19	20-29	30-39	40-49	50+
10 mm	5.34	4.88	8.72	11.71	12.88
12 mm	7.60	7.27	10.85	13.81	15.10
14 mm	9.53	9.30	12.68	15.59	16.99
16 mm	11.21	11.08	14.27	17.15	18.65
18 mm	12.71	12.66	15.68	18.54	20.11
20 mm	14.05	14.08	16.95	19.78	21.44
22 mm	15.28	15.38	18.10	20.92	22.64
24 mm	16.40	16.57	19.16	21.95	23.74
26 mm	17.44	17.67	20.14	22.91	24.76
28 mm	18.40	18.69	21.05	23.80	25.71
30 mm	19.30	19.64	21.90	24.64	26.59
32 mm	20.15	20.54	22.70	25.42	27.42
34 mm	20.95	21.39	23.45	26.16	28.21
36 mm	21.71	22.19	24.16	26.85	28.95
38 mm	22.42	22.95	24.84	27.51	29.65
40 mm	23.10	23.67	25.48	28.14	30.32
42 mm	23.76	24.36	26.09	28.74	30.96
44 mm	24.38	25.02	26.68	29.32	31.57
46 mm	24.97	25.65	27.24	29.87	32.15
48 mm	25.54	26.26	27.78	30.39	32.71
50 mm	26.09	26.84	28.30	30.90	33.25
52 mm	26.62	27.40	28.79	31.39	33.77
54 mm	27.13	27.94	29.27	31.86	34.27
56 mm	27.63	28.47	29.74	32.31	34.75
58 mm	28.10	28.97	30.19	32.75	35.22
60 mm	28.57	29.46	30.62	33.17	35.67
62 mm	29.01	29.94	31.04	33.58	36.11
64 mm	29.45	30.40	31.45	33.98	36.53
66 mm	29.87	30.84	31.84	34.37	36.95
68 mm	30.28	31.28	32.23	34.75	37.35
70 mm	30.67	31.70	32.60	35.11	37.74
72 mm	31.06	32.11	32.97	35.47	38.12
74 mm	31.44	32.51	33.32	35.82	38.49
76 mm	31.81	32.91	33.67	36.15	38.85
78 mm	32.17	33.29	34.00	36.48	39.20
80 mm	32.52	33.66	34.33	36.81	39.54

6

BODY DENSITY EQUATIONS

LINEAR REGRESSION EQUATIONS (DURNIN & WORMERSLEY)

BODY DENSITY = C-[M(LOG10 SUM OF ALL FOUR SKINFOLDS)]

MALE	17-19 YRS	20-29 YRS	30-39 YRS	40-49 YRS	50 + YRS
C	1.1620	1.1631	1.1422	1.1620	1.1715
M	0.0630	0.0632	0.0544	0.0700	0.0779

FEMALE	16-19 YRS	20-29 YRS	30-39 YRS	40-49 YRS	50 + YRS
C	1.1549	1.1599	1.1423	1.1333	1.1339
M	0.0678	0.0717	0.0632	0.0612	0.0645

THE SIRI EQUATION

$$\text{FAT\%} = \left[\left(\frac{4.95}{\text{BD}} \right) - 4.5 \right] \times 100$$

BODY DENSITY EQUATIONS (JACKSON & POLLOCK)

$$\begin{aligned} \text{MALE BD} = & 1.0990750 - 0.0008209 (X_2) + 0.0000026 (X_2)^2 \\ & - 0.0002017 (X_3) - 0.005675 (X_4) + 0.018586 (X_5) \end{aligned}$$

Where X_2 = sum of the chest, abdomen and thigh skinfolds in mm

X_3 = age in years

X_4 = waist circumference in cm

X_5 = forearm circumference in cm

$$\begin{aligned} \text{FEMALE BD} = & 1.1470292 - 0.0009376 (X_3) + 0.0000030 (X_3)^2 \\ & - 0.0001156 (X_4) - 0.0005839 (X_5) \end{aligned}$$

Where X_3 = sum of triceps, thigh and suprailiac skinfolds, in mm

X_4 = age in years

X_5 = gluteal circumference, in cm

- Brown. W.J. & P.R.M. Jones (1977). The distribution of body fat in relation to physical activity. *Ann Humm. Biol.* 4,537-550
- Brozek. J. & A. Keys (1951). *Br. Nutr.* 5,194
- Durnin. J.V.G.A. F.C. McKay and C. 1. Webster (1 985). A new method of assessing fatness and desirable weight, for use in the Armed Services Army Department, Ministry of Defence.
- Durnin J.V.G.A. and M.M. Rahaman (1967). The assessment of the amount of fat in the human body from the measurement of Skinfold Thickness. *Br. J. Nutr* 21,681-688
- Durnin J.V.G.A. and J. Wormersley (1974). Body fat assessed from total body density and its estimation from Skinfold Thickness. Measurement on 381 men and women aged 16 to 72 years. *Br. J. Nutr* 32, 77-92
- Katch Fl. & W.D. McArdle (1973). Prediction of body density from simple anthropometric measurements in college-age men and women. *Hum. Biol.* 45 445-454
- Pollock M.L. et al (1975). Prediction of body density in young and middle aged women. *J. Appl. Physiol.* 38,745-749
- Royal College of Physicians (1 983). Obesity. *J. Roy. Col. Phys. of Lon.* 1 7:1, 1-58
- Siri. W. E. (1956). The gross composition of the Body. *Adv. Biol. Med. Phys.* 4, 239-280
- Van Itallie T.B. (1979) Obesity: Adverse effects on health and longevity. *Am J. Clin. Nutr.* 32,2723-2733
- Wilmore J.H. & A.R. Behnke (1968). Predictability of lean body weight through anthropometric assessment in college men. *J. Appl. Physiol.* 25, 349-355
- Katch Fl. & W.D. McArdle (1977). *Nutrition, Weight Control and Exercise.* Houghton Mifflin Co., Boston.
- J.M. Tanner. The measurement of body fat in man. *Brit. Nutr. Soc.*, 18,148. 1959

- 8.1 All information of a medical nature contained in this manual, is based upon the documents cited in the Bibliography and is offered in good faith for convenience of the user. The manufacturer or supplier of this instrument does not however accept any liability for conclusions drawn, diagnosis, estimates of state-of-health ,treatments or any other medical assessment whatsoever based upon the measurements taken using this instrument.
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9 TECHNICAL INFORMATION ON THE HARPENDEN SKINFOLD CALIPERS

RANGE	RESOLUTION	REPEATABILITY	ACCURACY
80.00 mm	0.20 mm	0.20 mm	99.00%

NOTE

Resolution is defined as the minimum graduation of the instrument and is not the same as the expected accuracy.

The Harpenden Skinfold Caliper Model: HSK-BI is CE marked in compliance with the Medical Devices Directive 93/42/EEC for a Class 1 Device with Measuring Function and is Calibrated using masters traceable to national standards.



10 MAINTENANCE AND REPAIR

Keep the Calipers clean using a lint free cloth and ensure that they are stored in dry conditions to prevent corrosion.

Do not use any spirit based cleaner on the Caliper as it may cause damage to the plastic materials.

If the Calipers are dropped, damaged or fail to maintain repeatability, please return them to the address below or to our accredited agent from whom you originally purchased the caliper.

To ensure that the Caliper functions correctly, it should be periodically calibrated in accordance with the requirements of the establishment where it is to be used.

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NOTES: