HT-3000

便携式里氏硬度计

使用说明书

G & R Technology Inc.

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简介

HT-3000 便携式里氏硬度计是采用里氏测量原理的冲击式硬度计，适用于多种测试环境下的多种金属硬度的检测，具有精度高、体积小、重量轻、操作简便、结实耐用等特点。

HT-3000 便携式里氏硬度计具有蓝牙传输功能，可将数据传输到便携式打印机和手机上（通过 APP）。

HT-3000 便携式里氏硬度计符合 ASTM A 956-22 标准的所有要求。

1. 技术参数

测试范围： 200-900HL
测试硬度种类： HL，HV，HB，HRB，HRC，HS
测试材料： 钢/铸钢、合金工具钢、不锈钢/耐热钢、轴承钢、灰铸铁、球墨铸铁、铝合金、黄铜、青铜、铜
精　　度： ±4HL 或±0.5%（在 800HL 范围，取 5 个测试点的平均值）
测试方向： 任意方向
极限抗拉强度： Kgf/mm^2(38—267Kgf/mm^2)
$Tons/in^2$（23—135 $Tons/in^2$）
$kLbs/in^2$（54—382 $kLbs/in^2$）
数据存储： HT-3000 最多可储存 300 个数据值或 50 个数据组。
包括测试组编号、测试时间、测试材料、测试方向、测试里氏值、换算值、平均值、最大值和最小值
数据传输方式： 蓝牙传输
温　　度： 工作温度　14℉—104℉（-10℃—40℃）
存贮温度　-4℉—122℉（-20℃—50℃）
时　　钟： 当前的时间显示，并存储了十年的日历。
电　　源： 硬度计:一个 CR2450 钮扣电池或 RJD2450 可充电纽扣电池
打印机:可充电锂电池
电池寿命： 硬度计：电池工作寿命连续工作 40 小时（可测试 2000 次）
打印机:充满电可连续打印 2 小时
机身材质： 外壳：铝合金
套管：钛合金
硬度计重量： 170 克
硬度计外形尺寸： 165 x 34 x 28mm

被测材料硬度测试和换算范围表:

被测材料	硬度标尺					
	里氏 (HL)	维氏 (HV)	布氏 (HB)	洛氏 B (HRB)	洛氏 C (HRC)	肖氏 D (HS)
钢/铸钢 (ST)	300-900	80-940	80-650 (F=30D²)	38.4-99.5	20-68	32.5-99.5
合金工具钢 (AS)	300-840	80-900			20.4-67	
不锈钢/耐热钢 (SS)	300-800	85-800	85-670 (F=30D²)	46.5-100	20-63	
轴承钢 (GS)	500-880	80-800			20-68.8	32.5-99.0
灰铸铁 (GC)	360-660		93-340 (F=30D²)			
球墨铸铁 (NC)	400-660		130-390 (F=30D²)			
铝合金 (AL)	200-560	32-190	30-160 (F=10D²)	27-91		
黄铜 (BS)	200-560	45-200	40-180 (F=10D²)	12-94		
青铜 (BZ)	300-700		60-290 (F=10D²)			
纯铜 (CU)	200-420	50-130	45-120 (F=10D²)	4-72		

注：1. 当测量结果超出此表范围，屏幕显示会报错。

2. 表中空白为不可测量范围

2. 标准配置

HT-3000 型里氏硬度计
便携式蓝牙打印机
里氏硬度块
13mm 支撑环
CR-2450 锂电池
挂绳
毛刷
中英文使用说明书
携带箱

可选配件：

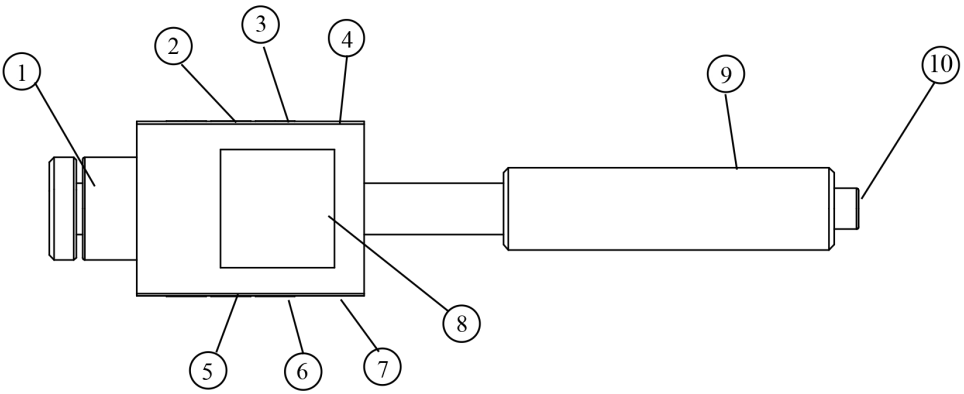
金刚石冲击体:金刚石球更耐磨，适用于含有高碳化物的工具钢、高硬度材料（合金工具钢）的测试或使用频率非常高的用户。

DL 冲击装置：用于测试空间狭小的工件硬度，例如齿轮，凹槽等

异形支撑环：用于测试曲面工件。（R≥30mm 不必选用）

3. 硬度计外观、各部份名称说明

HT-3000 硬度计的各部份功能如下图：



① 支撑环	② **SET** 键	③ **PR** 键
④ **I/O** 键（开关键）	⑤ ⬇ 键	⑥ ✚ 键
⑦ ━ 键	⑧ LCD 显示屏	⑨ 加载导管
⑩ 释放按钮		

关机后，硬度计进入睡眠模式，测试结果保存，时钟照常运转；

开机后，硬度计恢复关机前的设置并显示最后一次的测试结果。

注：开机状态下，如在三分钟内没有任何操作，硬度计将自动关机。

4. 被测工件的预处理

里氏硬度测试是一种动态测试法，其对试件的要求与静态测试法有所不同，被测工件的表面应满足以下的要求以保证测试精度。

被测点厚度要求：30mm 以上。

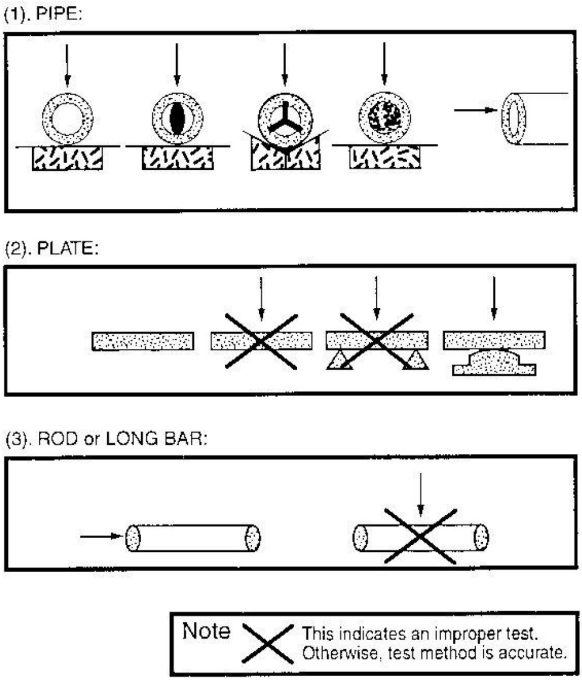
工件重量要求：工件重量超过 5Kg 可直接测试。
工件重量在 3-5KG 之间，可将工件固定于一平面上，避免其在测试过程中发生弯曲、形变或位移；
工件重量小于 2Kg，应将其耦合在工作台或稳固的支撑物上。工件与支撑物之间的表面必须坚硬、清洁、光滑。（耦合方法：请在工件和支撑物的接触面涂抹凡士林或黄油，将工件牢固地压在支撑物上，并来回移动以消除两个接触面之间的空气。耦合的工件应采用垂直向下的方向测试。）

表面粗糙度的要求：表面粗糙度（Ra）必须限制在 Ra≤ 2μm。
工件表面越粗糙，硬度测试结果越低。

洁净度要求：工件的测试表面必须清洁，无油污、锈迹、电镀或油漆残留。被测工件不能有较强的磁性。

稳定性的要求：为了避免工件在测试过程中发生位移，应将工件固定使其被测表面与冲击方向垂直。

对于平板形的，长条形的和有曲面的工件来说，测试要比实际值略低。这些形状的工件的测试方法如下图所示：



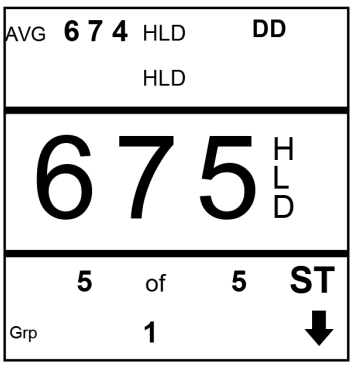
被测工件曲面半径要求：试件测试部位表面曲率半径 R≥30mm 的可以直接测试，R 在 10～30mm 之间的应使用异形支撑环。
注意：一组 12 个异形支撑环可用于测试弯曲表面。

热处理表面的厚度要求：硬化层的厚度应大于 0.8mm。

5. 基本操作

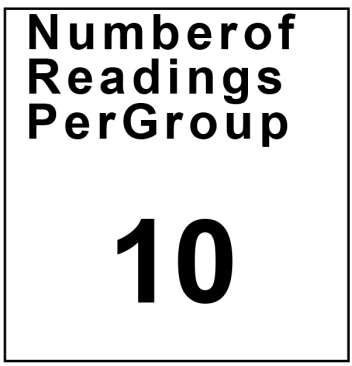
1. 开机

按 I/O 键开机，屏幕显示上一次的测试结果：

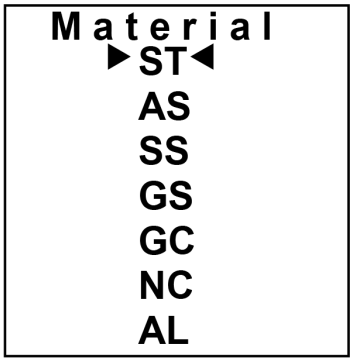


2. 参数设置

按 SET 键开始设置，屏幕显示一组测试所包含的测试次数：

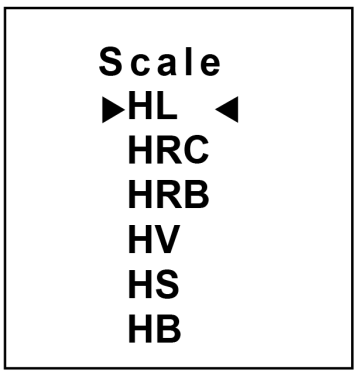


测试次数可设定为 1-20，按✚键或━键调整，选择好后按 SET 键保存参数并进入下一步材料选择，屏幕显示：

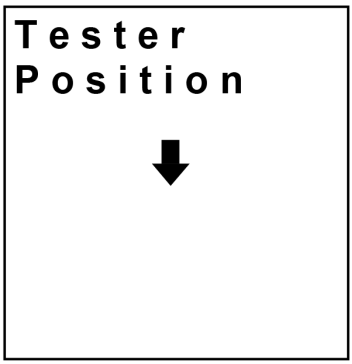


ST（ 碳　钢 ）	AS（合金工具钢）
SS（ 不锈钢 ）	GS（ 轴承钢 ）
GC（ 灰口铸铁）	NC（ 球墨铸铁 ）
AL（ 铸 铝 ）	BS（ 黄 铜 ）
BZ（ 青 铜 ）	CU（ 纯 铜 ）

按✚键或━键上下移动箭头进行选择，选择好后按 SET 键保存参数并进入下一步标尺选择，屏幕显示：



按✚键或━键上下移动箭头进行选择，选择好后按 SET 键保存参数并进入下一步测试方向选择，屏幕显示：



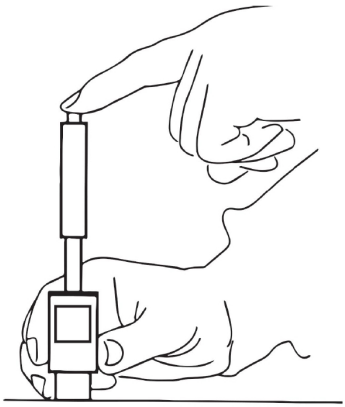
垂直向下　斜向下 45º　水平　斜向上 45º　垂直向上

按✚键或━键选择，选择好后按 SET 键保存参数，硬度计返回测试界面，开始新的测试。

注：每一步参数选择好后都必须按 SET 键保存参数并进入下一步，如果按⬇键直接进入下一步，则所选参数不会被保存。

3. 测试

测试具体步骤如下：

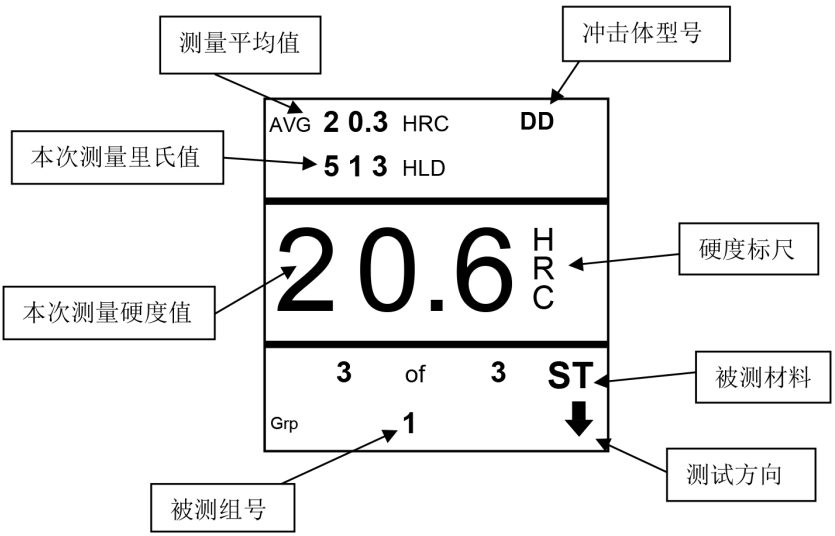


(1) 用手握住加载套管，将加载套管向支撑环方向压缩到底，再将其缓慢松回原位，此过程中不可松手。保持加载套管回弹不可太快，以免损伤内部机件。

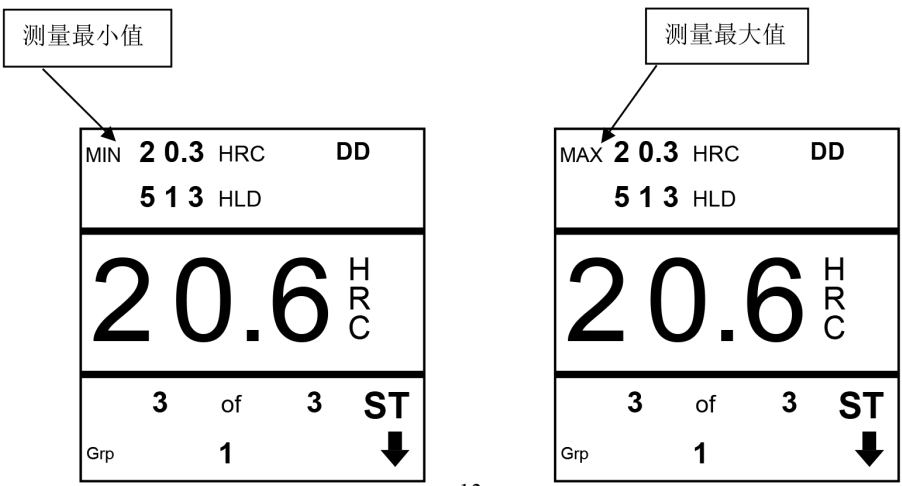
(2) 用拇指和食指握住显示器将硬度计置于工件表面，见上图。

(3) 保持硬度计与工件之间相对稳定，用另一个手的食指轻按下启动按钮。

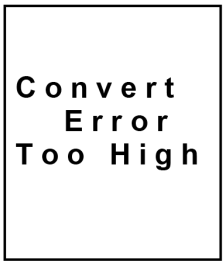
(4) 屏幕显示如下图：



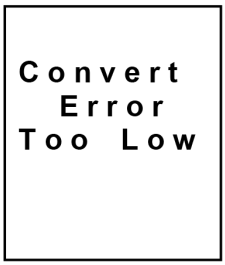
按⬇键可以切换窗口分别显示本组测试的平均值、最大值或最小值。



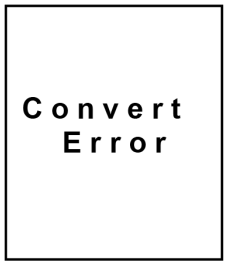
注：当选择里氏以外的硬度标尺，并且硬度值超出《被测材料硬度测试和换算范围表》范围时，屏幕会显示：



换算值过高



换算值过低



换算错误

4. 数据管理

HT-3000 最多可储存 300 个数据值或 50 个数据组，包括测试组编号、测试时间、测试材料、测试方向、测试里氏值、换算值、平均值、最大值和最小值。

1. 数据查看和删除

（1）查看和删除当前数据

在测试界面按✚键循环显示本组的每个数据。按━键删除当前显示的数据。

（2）查看和删除历史数据

删除单个数据

测试界面按住⬇键 5 秒后松开，屏幕显示数据组编号。按⬇键选择数据组，然后按 SET 键进入该组，屏幕显示该组的第一个数据，再按✚键循环显示该组的每个数据，按━键删除当前显示的数据。

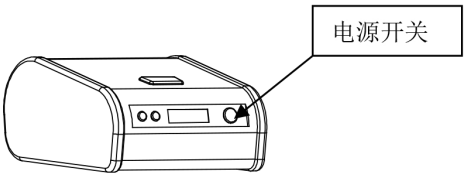
删除一个数据组

在测试界面按住⬇键 5 秒后松开，屏幕显示数据组编号。

按⬇键选择数据组，然后按━键直接删除该组数据。

2. 数据打印

设置硬度计的数据传输模示为打印机并打开打印机电源。



（1）打印当前数据组

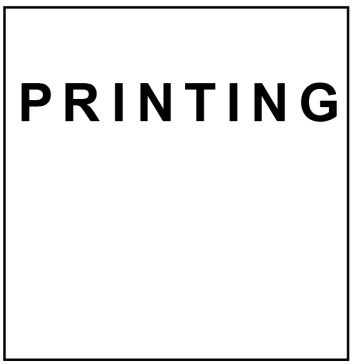
在测试界面按 PR 键，直接打印当前测试组数据。

（2）打印历史数据组

在测试界面按住⬇键 5 秒后松开，屏幕显示数据组编号。

按⬇键选择数据组，再按 PR 键打印该组数据。

按 PR 键开始打印屏幕显示：



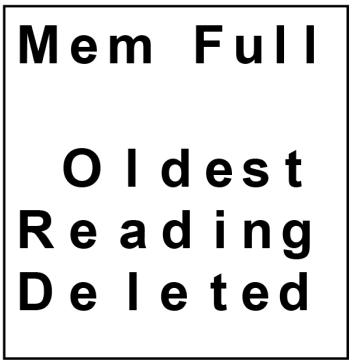
打印成功屏幕显示：

打印失败屏幕显示：

失败原因可能是打印机没有开机或硬度计与打印机距离太远。

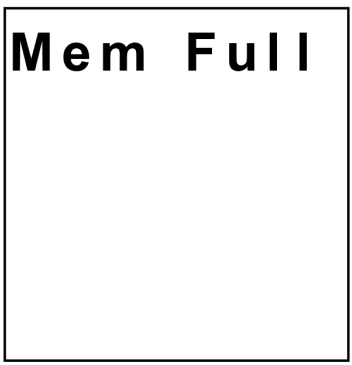
3. 数据存储到达上限

（1）当保存的测试数据值到达上限 300 时屏幕会显示：



之后最新的测试数据值会自动替换最早的测试数据值，请及时打印测试数据。

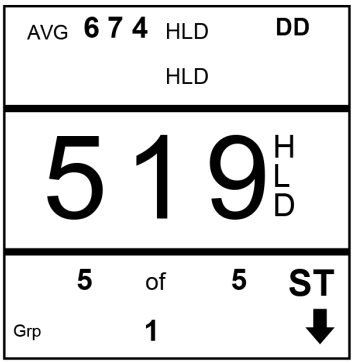
（2）当保存的测试组数到达上限 50 时屏幕会显示：



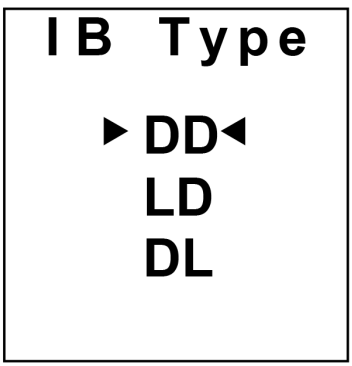
此时无法继续测试，请及时打印测试数据并手动删除旧数据再进行测试。

6. 其它参数设置

其它参数设置，包括设置冲击体类型（金刚石冲击体 DD，碳化钨冲击体 LD，和 DL 冲击装置），强度换算，时间模式（日/月/年，或月/日/年），日期和时钟，校准误差和蓝牙传输方式。
按 I/O 键开机进入测试界面

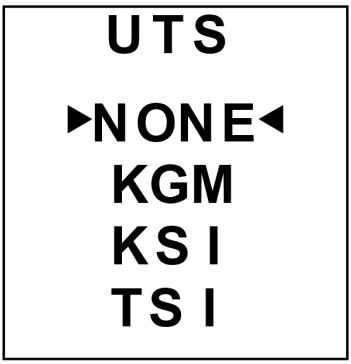


同时按 I/O 键，SET 键和✚键，然后同时松开，屏幕显示：



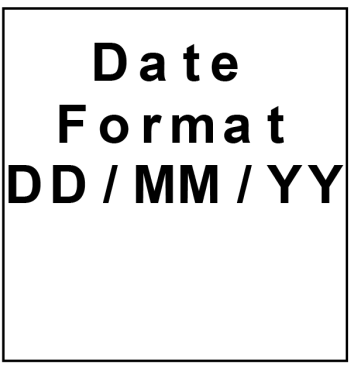
DD 金刚石球冲击体　　**LD** 碳化钨球冲击体　　**DL** DL 长管冲击装置

按✚键或━键上下移动箭头进行选择，然后按 SET 键保存参数并进入下一步设置强度换算，屏幕显示：



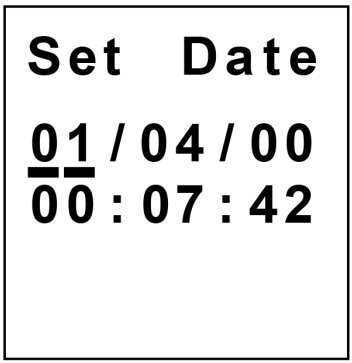
NONE	KGM	KSI	TSI
不换算强度	Kgf/mm²	Klbs/in²	Tons/in²

按✚键或━键上下移动箭头进行选择，然后按 SET 键保存参数并进入下一步设置时间模式，屏幕显示：

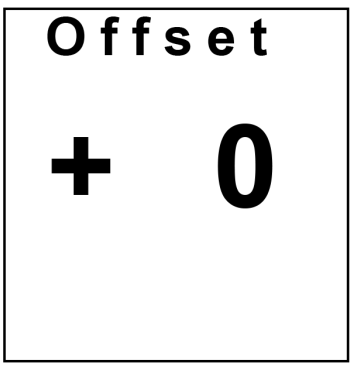


DD/MM/YY	MM/DD/YY
日/ 月/ 年	月/ 日/ 年

按✚键或━键进行选择，然后按 SET 键保存参数并进入下一步设置日期和时钟



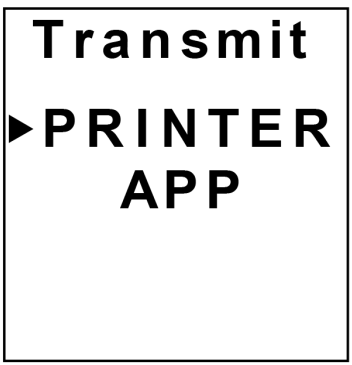
按⬇键移动光标选择日，月，年，时，分，秒，按✚键或━键设定日，月，年，时，分，秒的数值。然后按 SET 键保存参数并进入下一步校准误差，屏幕显示：



按✚键或━键进行调整。
误差调整范围为-50 到+50 里氏硬度值。
通过误差校准使硬度计的实际测试结果趋近于硬度块的硬度值。

当测试值低于标准值时，按✚键调高测试值。
当测试值高于标准值时，按━键调低测试值。

调整好后再按 SET 键保存参数并进入下一步设置蓝牙传输方式，屏幕显示：



按✚键或━键选择打印机（PRINTER）或者手机 APP，选好后再按 SET 键保存参数，完成其它设置，硬度计返回测试界面。

7. 维护保养

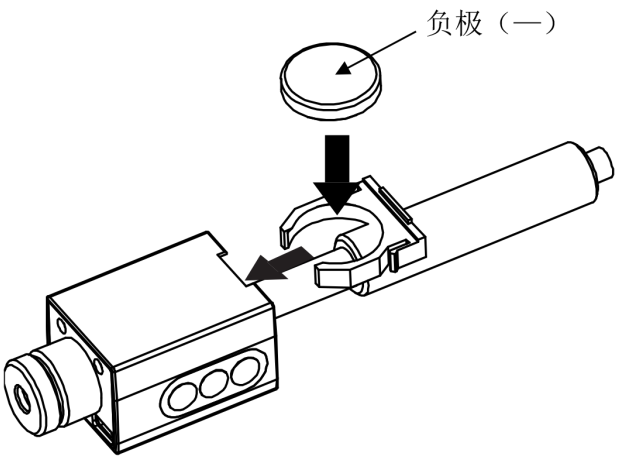
HT-3000 硬度计是精密仪器，存放或操作时应避免以下情况：

1. 硬度计跌落或受到冲击和剧烈撞击。
2. 避免将任何油、油脂和/或其他液体滴落或洒到硬度计上。
3. 避免在被测工件上涂抹任何油、脂等液体。
4. 避免灰尘或气体较多的操作环境，可能会损坏硬度计。

更换电池

电池寿命为四十个小时，电池寿命会随着使用频率而变化。

使用一个 3V CR2450 锂电池（推荐松下品牌电池）



注：更换硬度计的电池后，应先打开硬度计电源键,然后关闭硬度计，使硬度计进入睡眠模式。

硬度计的清洁

应定期清洁硬度计的导管。在正常操作条件下，建议在 1,000 次测试后或使用 1-2 个月后进行清洁，以先到者为准。

应按照以下程序使用随附的刷子清洁导管：

1. 拧下硬度计支撑环。
2. 拆下冲击体。
3. 刷几次导管内部。
4. 用酒精或其他“非油”基清洁液清洁冲击体。
5. 更换冲击体（注意，冲击球头应朝向支撑环）。
6. 拧上硬度计支撑环。

硬度计的精度

当标准硬度试块反复测试的结果始终高于实际硬度值时，冲击体可能已磨损。请联系我们的销售部门更换冲击体。

注：如果硬度计或任何附件出现问题，请勿尝试拆卸或修理硬度计，请联系我们的客户服务部寻求帮助。

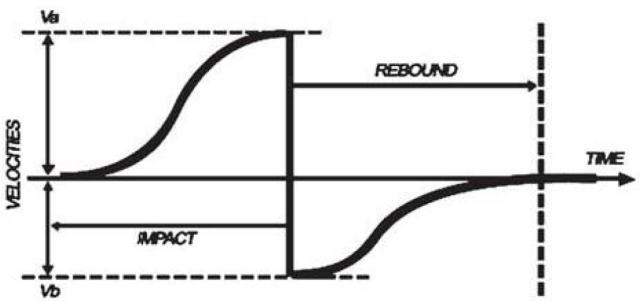
8. 里氏测量及应用

里氏测量法的原理是使用与冲击体上的回弹速度和冲击速度成正比的回弹电压和冲击电压的商，来确定被测工件的硬度。工件表面越硬，回弹速度越快，测试值越大。
里氏硬度（L 值）表示以下材料的直接硬度测量值：钢/铸钢、合金钢、不锈钢或耐火钢、灰铸铁、球墨铸铁、铝、黄铜、青铜和铜。布氏、洛氏、维氏和肖氏值是使用静态转换曲线确定的。

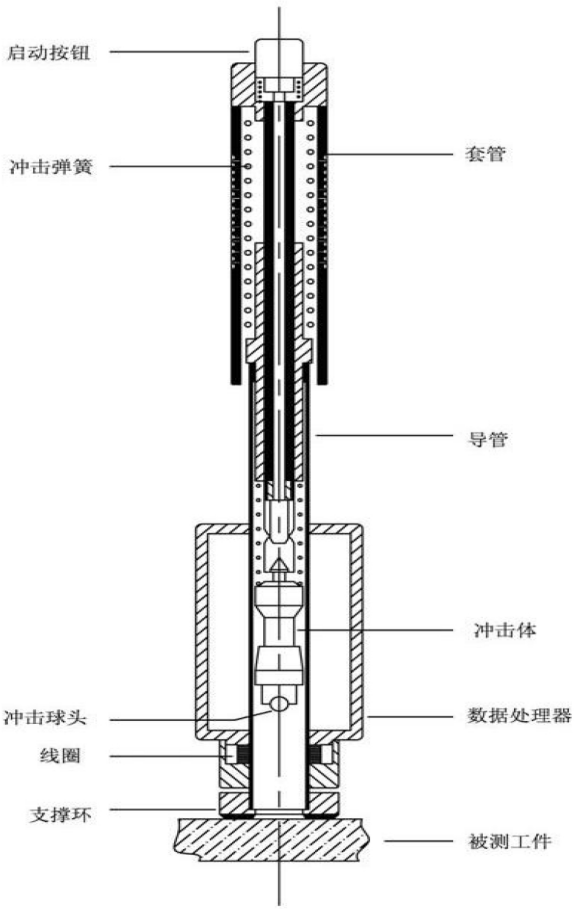
里氏硬度测试的定义

冲击体即指定直径的碳化钨球，以给定的冲击力冲击到被测工件上。在距工件表面 0.039 英寸（1 毫米）的距离处，使用电磁原理测量冲击速度和回弹速度，其中感应电压与这些速度成正比。
里氏硬度可以通过电子方式测量，其 L 值定义为：

$$HL=（Vb/Va）x1000$$



其中 Vb 为冲击体的回弹速度，Va 为冲击体的冲击速度。当冲击体通过感应线圈时，回弹速度和冲击速度的电压特性如图所示。


启动按钮
冲击弹簧
套管
导管
冲击体
冲击球头
数据处理器
线圈
支撑环
被测工件

9. 构建特殊的比较曲线

典型工件的里氏硬度和其他硬度比较曲线

HT-3000 硬度计存储十种材料的里氏硬度等硬度对比曲线。硬度对比曲线应满足大多数硬度测试要求。但是，如果需要测试特殊类型的材料，则可以为里氏硬度和其他静态硬度建立对比曲线。

选择和预测试样品的要求

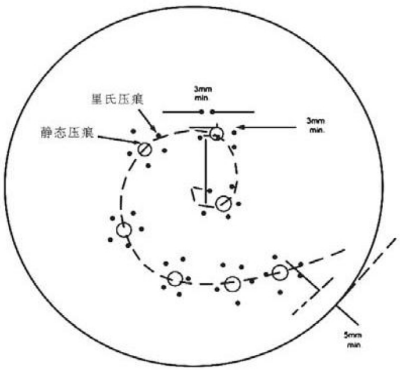
1. 样品材料类型应与工件材料类型相匹配。
2. 尽可能选择大而重的样品。建议使用直径为 3 ½”（90mm）和长度为 2 3/8”（60mm）的实心圆柱体。
3. 样品的表面处理应满足“被测工件的预处理”（第 6 页）中描述的所有要求。
4. 为了构建硬度对比曲线，选择三个相同材料但不同硬度值的样品，以找出上极值、下极值和中间值。

测试样品的硬度测量

为样品选择所需的硬度格式（布氏、维氏、洛氏 B 或洛氏 C），然后使用硬度计确定样品的里氏硬度（HL）。测量要求如下：

1. 测试点应选择在下图所示的螺旋上，另外还必须满足以下要求：
   被测面上两个里氏硬度压痕的之间距离应≥0.12”（3mm）。
   被测面上两个静态硬度压痕的之间距离应≥0.4”（10mm）。
   里氏硬度压痕与静态硬度压痕的边缘应≥0.12”（3mm）。
   里氏硬度压痕与测试样品边缘之间的距离应≥ 0.2”（5mm）。
2. 测试样品前应校准静态硬度计。应用的标准硬度块硬度值应接近被测样品的硬度。
3. 与静态硬度计类似里氏硬度计在测试样品前也应进行校准。

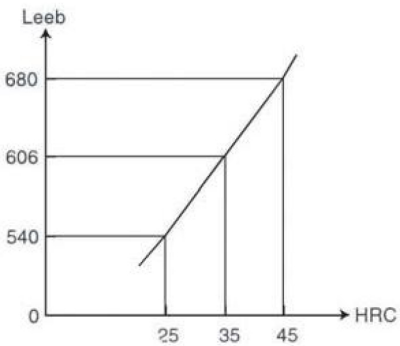
4. 试验时样品应水平，使冲击体与被测面垂直。



制作样品硬度对比曲线

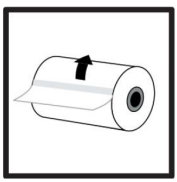
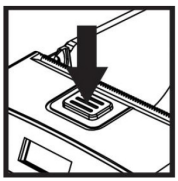
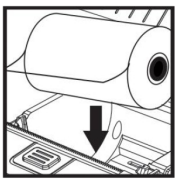
1. 分别用里氏硬度计和静态硬度计（如洛氏硬度计）对三种硬度不同的样品进行测试，对每种样品的测试不得少于 5 个点。计算三种样品的里氏硬度测试结果的平均值和静态硬度测试结果的平均值。
2. 使用静态硬度值作为 x 轴，里氏硬度值作为 y 轴，在绘图纸上为每种样品获得的平均值绘制对应点，连接这三个点以构建平滑曲线。

注：点数越多，构建的曲线越平滑。要取得更好的比较结果，可以用更多的测试样品和更多的测试结果来生成曲线。



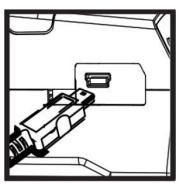
10. 打印机使用说明

1. 打印纸安装

 拆掉打印纸封条	 向下按开盖键打开纸仓盖
 将纸卷放进纸仓	 将纸张沿出纸口抽出一段，盖上纸仓盖

2. 打印机充电

将 USB 线一头与插头连接，一头与打印机充电口连接进行充电。



General Description

The G & R HT-3000 portable Leeb hardness testers are advanced instruments distinguished by their friendly operation, durability, small size, high precision, light weight and wide measuring range. They are impact type testers that incorporate the Leeb principle of measurement. They are used for testing the hardness of a variety of metals in remote locations.

The HT-3000 has a digital readout for direct hardness readings in HL, HV, HB, HRB, HRC, and HS scales. It also has Bluetooth to communicate with a portable printer or mobile device.

The HT-3000 complies with all of the requirements of ASTM Test Method A956-22 Standard

Contents

1. Technical Specifications

Testing Range:
200 to 900 HL (Leeb Value)

Converted Hardness Scales:
HB, HV, HRB, HRC, HS

Accuracy and Variation:
+/- 4 HL or +/- 0.5% (based on the average of five measurements around 800HL)

Testing Direction:
Any direction

Steel Ultimate Tensile Strength (UTS):
KSI (54 to 382 1000Lbs/in²)
Kgf/mm² (38 to 267 Kgf/mm²)
Tons/in² (23 to 135 Tons/in²)

Temperature:
Operating Temperature: 14°F to 104°F (-10°C to 40°C)
Storage Temperature: - 4°F to 122°F (-20°C to 50°C)

Data Storage:
Automatic recording and storing of up to 300 test results or 50 test groups, including readings, time, test material, test hardness scale, and test direction.

Data Transmission:
Bluetooth

Power Supply:
Tester: One 3V Button Cell Lithium Battery (CR2450)
OR 3.7V Button Cell Rechargeable Lithium Ion Battery (RJD2450)
Printer: Rechargeable Lithium-Ion Battery

Battery Life:
Tester: Work life 40 hours continuous (up to 2000 tests)
Sleep life 2 years
Printer: 2 hours continuous

Tester weight:
6 oz (170g)

Tester Dimensions:
6.5" x 1.35" x 1.1" (165mm x 34mm x 28mm)

Material Hardness Measuring and Converting Ranges:

Test Sample Material	Standard Hardness Scales					
	Leeb (HL)	Vickers (HV)	Brinell (HB)	Rockwell B (HRB)	Rockwell C (HRC)	Shore D (HS)
Steel/Cast Steel (ST)	300 - 900	80 - 940	80 – 650 ($F=30D^2$)	38.4 -99.5	20 - 68	32.5 -99.5
Alloy Tool Steel (AS)	300 – 840	80 - 900			20.4 - 67	
Stainless or Refractory Steel (SS)	300 - 800	85 - 800	85 - 670 ($F=30D^2$)	46.5 - 100	20 - 63	
Bearing Steel (GS)	500-880	80 - 800			20 – 68.8	32.5 -99.0
Gray Cast Iron (GC)	360 – 660		93 - 340 ($F=30D^2$)			
Nodular Cast Iron (NC)	400 - 660		130 -390 ($F=30D^2$)			
Aluminum Alloys (AL)	200 - 560	32 - 190	30 -160 ($F=10D^2$)	27 - 91		
Brass (BS)	200 - 560	45 - 200	40 - 180 ($F=10D^2$)	12 - 94		
Bronze (BZ)	300 - 700		60 –290 ($F=10D^2$)			
Copper (CU)	200 - 420	50 - 130	45 -120 ($F=10D^2$)	4 - 72		

Table 1.1

Notes: The above table shows the valid hardness ranges for typical materials. A test outside the specified range is invalid and the display screen will indicate an "E" (Error). Errors are normally caused by setting the tester for a different material than that being tested.

If the hardness of a material is not in the range given by the table, the hardness is not valid and will produce an error

2. Check Package

HT-3000 Standard Package Contents:

HT-3000 Hardness Tester (Including Diamond Tipped Impact Body)
Portable Bluetooth Printer
Standard Test Block
Support Ring .79" (20 mm)
Support Ring .53" (13.5 mm)
CR-2450 Lithium Battery
Lanyard
Carrying Case
Tube Cleaning Brush
User's Manual

Optional Accessories:

Diamond Tipped Impact Body: for harder test samples or high frequency testing applications.

DL Impact Body with Long Test Tip: for extremely confined spaces at the base of grooves.

Set of 12 Special Support Rings: for testing curved and uneven surfaces (not necessary for radius of curvature over 30mm).

3. Functional Description

Different parts of the HT-3000 are listed below:

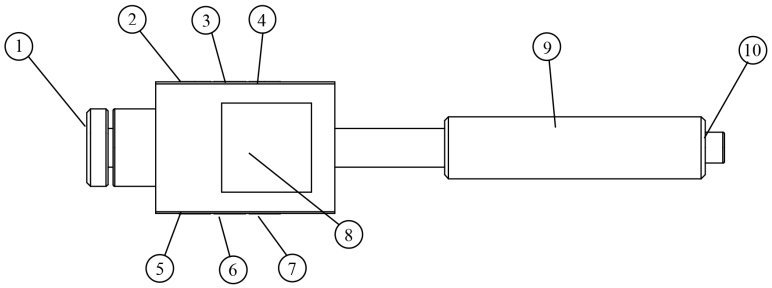


Figure 3.1

① Support Ring	② **SET** Key	③ **PR** Key
④ **I/O** Key	⑤ ⬇ Key	⑥ ✚ Key
⑦ ━ Key	⑧ LCD Monitor	⑨ Loading Tube
⑩ Release Button		

Press the **I/O** key to power ON/OFF.
Pressing this key will switch the power from OFF to ON or ON to OFF. When the tester is turned OFF, it enters a sleep mode: the memory is saved and the timer still runs. When the power is turned back ON, the tester will automatically go to the last test results with the previous settings intact for ease of operation.

Note: To prolong battery life, the tester will automatically enter sleep mode if the tester has been idle for approximately three minutes.

4. Pre-Treatment of the Test Sample

The Leeb hardness test is a dynamic test, as opposed to a static test. The test sample surface needs to meet the following requirements in order to ensure accuracy.

Minimum Weight Requirements

To achieve correct test results, select thick, heavy, and solid samples for testing whenever possible. The surface area where the impact body strikes should have an even hardness.

A solid test sample that weighs more than 11 lbs. (5 kg) can be tested on directly with the HT-3000 Hardness Tester.

A test sample that weighs 6 to 11 lbs. (3 to 5 kg) should be fixed to a bearing or support weighing over 11 lbs (5kg) to avoid bending, deformation, and displacement during testing.

A test sample that weighs less than 4 lbs. (2 kg) should be secured to a workbench or a stable support. The surface between the sample and the support must be hard, clean, and smooth. To secure the sample, apply petroleum jelly or yellow grease to the adjoining surfaces of the sample and support, press the sample firmly onto the support, and remove air bubbles between the two surfaces by moving the workpiece back and forth. The sample should be tested in a vertical downward direction.

Minimum Thickness Requirements

Thin samples are prone to vibrations which contribute to errors in a Leeb test. Test samples should be at least 1" (30mm) thick for the most accurate results.

Surface Roughness Requirements

To eliminate measurement errors which could result from the roughness of the test surface, the surface should be polished so that a metallic luster appears. The roughness (Ra) of the surface must be limited to $\leq 2\mu m$. Note that the rougher the surface of the test sample, the lower the hardness test results.

Cleanliness Requirements

To ensure test accuracy, the test surface of the test sample must be clean and free of any oil stains, rust, and remains from electro-plating or paint.

Stability Requirements

To avoid displacement during testing, the test sample should be firmly fixed with its test surface perpendicular to the impact direction. Due to the impact of the Impact Body, the test area may deform or vibrate, even for some test samples with suitable weight and thickness.

The tested hardness may be lower than normal. This is especially true for test samples such as large plates, long bar or rods, and samples with curved surfaces. Some testing recommendations for these samples are shown in figure 4.1.

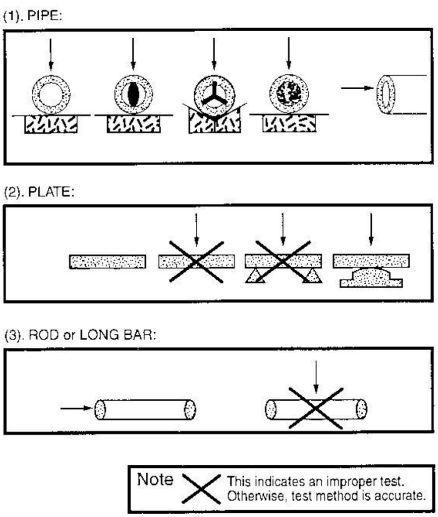


Figure 4.1.

Samples with Curved Surfaces

The larger the curvature of the test sample's surface, the easier the testing operation. Under normal conditions, testing can be done directly with the standard support ring to a curvature with radius of 1 3/16" (30mm) or longer.

For a sample with a radius of less than 1 3/16" (30mm), a special support ring should be used for testing.

Note: A set of special support rings is available for testing curved and uneven surfaces.

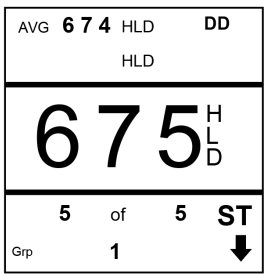
Heat Treated Surface Thickness Requirements

The heat treated layer must be greater than 0.8mm.

5. Basic Operations

5.1 Powering On

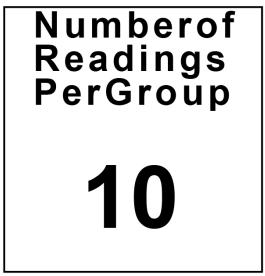
Press the **I/O** key to turn on power. The LCD monitor will show the last test reading:



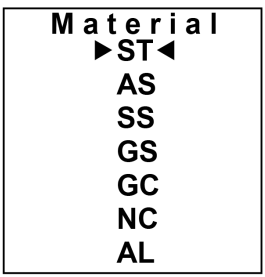
5.2 Select operating parameters

Now set up the tester

1. Press the **SET** key to start and set up a new test. You will now select the operating parameters. The LCD monitor will prompt for a number of test readings in a test group:



2. Press the **+** and **−** keys to adjust the number of readings, from 1 to 20. After you have selected a value, press the **SET** key and the display will prompt you to select a sample material:

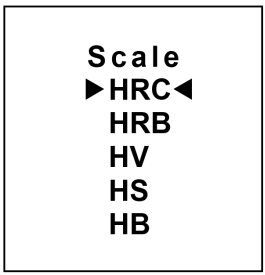


3. Press the **+** and **−** keys to adjust from **ST**, **AS**, **SS**, **GS**, **GC**, **NC**, **AL**, **BS**, **BZ**, or **CU**. The symbols represent the following materials:

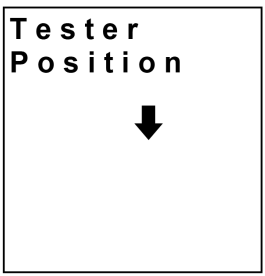
ST Carbon Steel	**AS** Alloy Steel	**SS** Stainless Steel	**GS** Bearing Steel	**GC** Gray Cast Iron
NC Nodular Cast Iron	**AL** Aluminum	**BS** Brass	**BZ** Bronze	**CU** Copper

Press the **SET** key again to select a testing scale.

Press the **+** and **−** keys to adjust from **HL**, **HV**, **HB**, **RB**, **RC**, or **HS**. The screen will display:



Press the **SET** key again to select a testing direction.



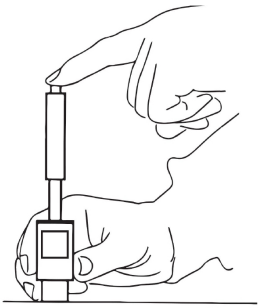
Upright 45º Down Horizontal 45º Up Upside Down

Press the **+** and **−** keys to adjust the testing direction from Upright, 45º Down, Horizontal, 45º Up, or Upside Down.

Press the **SET** key to save all options and exit to the main screen.

5.3 Testing

Take the following steps to perform a hardness test:

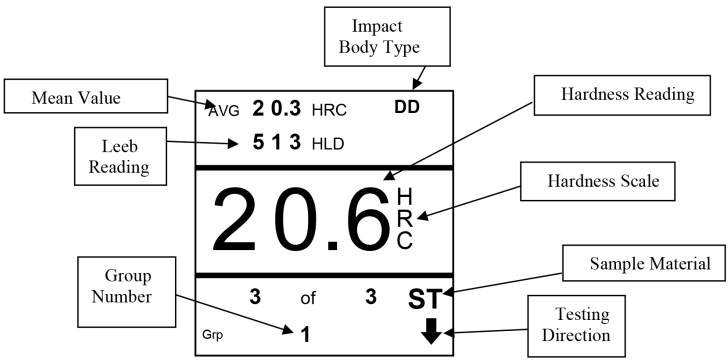


1. Hold the Loading Tube and slide it towards the support ring until the impact body is hooked. Then, while still holding on to the Loading Tube, slowly return it to its original position.

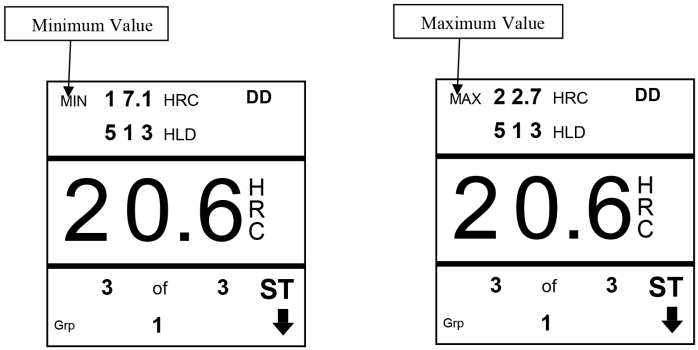
   Note: Returning the Loading Tube back to its original position too quickly may damage the tester's parts. ALWAYS hold onto the Loading Tube and slowly guide it back in a controlled fashion.

2. Hold the black part between your other hand's thumb and index finger and press the tester against the test sample, as shown in the above figure.

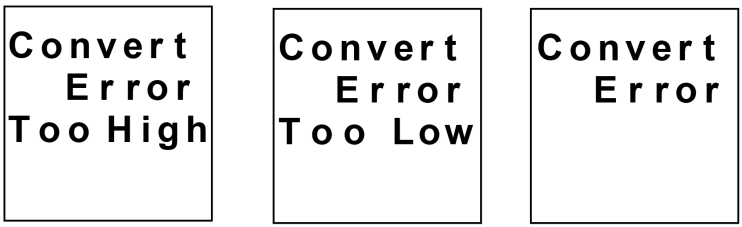
3. Keeping the tester steady, gently press the Tester Release button with your index finger. The screen will display the hardness reading as show below:



Press the ⬇ key to change the group statistic from average (mean), maximum value, or minimum value of the group.



Note: If the test results are outside the ranges listed in Table 1.1, the screen will display one of the following errors：



5.4 Memory Management

The HT-3000 can store up to 300 readings, including the group number, test time, material, direction, and conversion.

Viewing and Deleting Readings

Readings within a group:

Press the ✚ key to advance through each reading within the current group.
Press the ━ key to delete this reading.

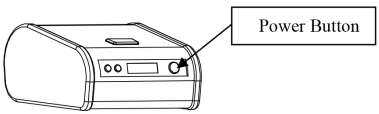
Changing groups:

On the main screen, hold down the ⬇ key for at least 5 seconds and then release it. The tester will enter the group selection screen. Press the ✚ key to advance through each group. Press the ━ key to delete this entire group.

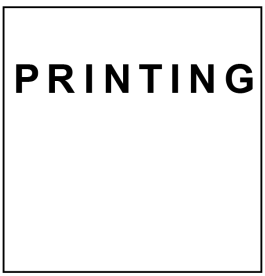
Press the **SET** key to enter this group. The tester will return to the main screen displaying the first reading from this group.

Printing a group

First, ensure the tester is set to transmit to a printer. Power on the printer and ensure the printer is working properly.



Press the **PR** key on the tester, after a few seconds, the printer will automatically print and the tester will display:



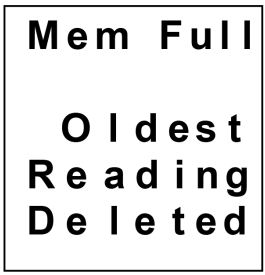
If the tester sends the data to the printer, the screen will display:

If the tester does not successfully send data to the printer, the screen will display:

Then the printing failed. Possible reasons include the printer is not powered on or is too far away from the tester.

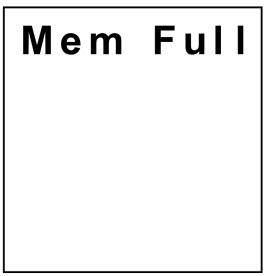
Memory Capacity

When the number of tests stored have reached the limit, the oldest reading will be automatically deleted. The first time the oldest reading is deleted, the screen will display a warning:



Subsequent tests will continue to replace the oldest readings, but this warning will no longer appear.

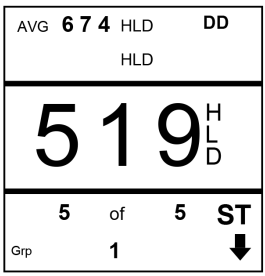
When the number of groups stored have reached the limit, groups cannot be added and the screen will display a warning:



6. Other Settings

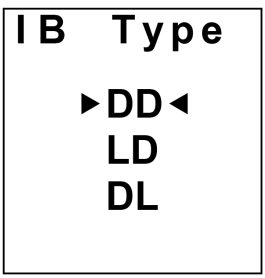
Other settings include impact body type (Diamond **DD**, Tungsten Carbide **LD**, or Long Test Tip **DL**), conversion, date format, date and time, and offsets.

Starting at the main screen:



Simultaneously hold down the **I/O**, **SET**, and **✚** keys and then release them.

The screen will prompt which impact body (IB) to use：

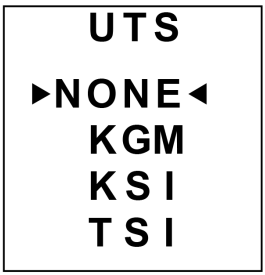


DD
Diamond Impact Body

LD
Tungsten Carbide Impact Body

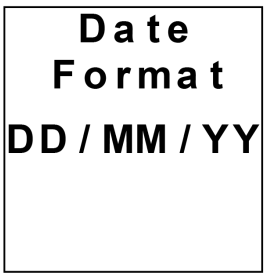
DL
Long Tip Impact Body

Press the **+** and **−** keys to switch between **DD**, **LD**, or **DL** type impact bodies. Then press the **SET** key to save this selection and go to the next setting, UTS Conversion. The screen will prompt for a conversion to Ultimate Tensile Strength (UTS):

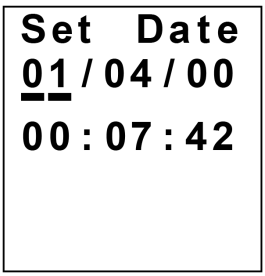


NONE	**KGM**	**KSI**	**TSI**
No Conversion	Kgf/mm²	Klbs/in²	Tons/in²

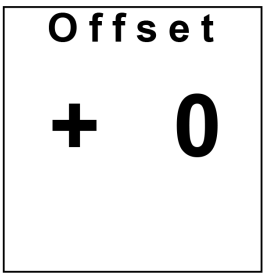
Press the **+** and **−** keys to switch between **NONE**, **KGM**, **KSI**, or **TSI**. If you do not need to convert to UTS, select **NONE**. Then press the **SET** key to save this selection and go to the next setting, the date format. The screen will display:



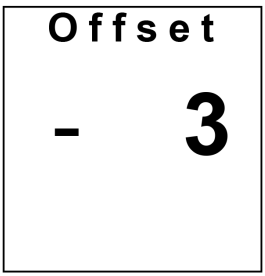
Press the **+** and **−** keys to toggle between **MM/DD/YY** (Month First) or **DD/MM/YY** (Day First) format. Press the **SET** key to save the selection and go to the next setting, changing the time and date:



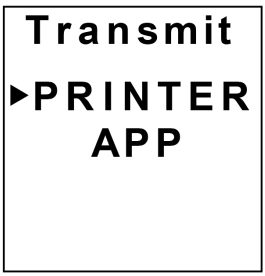
Press the **⬇** key to switch between the month, day, year, hour, minute, and second fields. Press the **+** or **−** keys to adjust each field. Press the **SET** key to save the time and date, and go to the next setting, the offset:



If there is a discrepancy between a test reading on a standard test block and the block's nominal value, press the **+** and **−** keys to change the offset and resolve the discrepancy.



Press the **SET** key to save the offset, and go to the next setting, Bluetooth device:



The screen prompts for the device the tester connects to via Bluetooth. Press the **+** or **−** key to toggle between the included printer or a mobile device. Press the **SET** key to save the Bluetooth device, and complete the settings and return to the main screen.

7. Maintenance and Repair

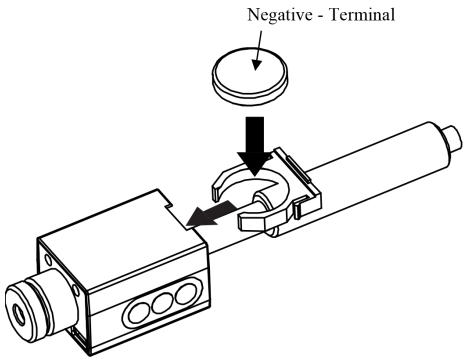
Hardness Tester Storage and Operating Precautions

The HT-3000 tester is a precision instrument. When storing or operating the tester, avoid the following:

1. Dropping the tester or subjecting it to shock and sharp impact.
2. Dropping or spilling any oil, grease and/or other liquids onto the tester.
3. Applying any oil, grease and other liquid to the workpiece being tested.
4. An operating environment with heavy dust or gas that can damage to the tester.

Replacing Batteries

The battery life is eighty hours. The battery life will vary with the frequency of use. To replace the battery:



Use one 3V Lithium CR2450 battery (Panasonic brand battery recommended).

Note: After changing batteries in the tester, turn the tester power ON, then OFF to enter sleep mode.

Cleaning the Tester

The tester's Guide Tube should be cleaned periodically. Under normal operating conditions it is recommended that cleaning be done after 1,000 tests or after 1–2 months of use, whichever comes first.

The Guide Tube should be cleaned using the included brush following this procedure:

1. Unscrew the Tester Support Ring.
2. Remove the Impact Body.
3. Brush the inside of the Guide Tube several times.
4. Clean the Impact Body with alcohol or other "non-oil" based cleaning fluid.
5. Replace the Impact Body (note: the Impact Ball Head should face towards the Support Ring).
6. Replace the Support Ring.

Impact Body and Tester Accuracy

When results from repeated testing on a standard hardness test block are consistently higher than the actual hardness value, the Impact Body is probably worn. Please contact our Customer Service Department to replace the Impact Body.

Note: If problems occur with the tester or any accessories, do not attempt to disassemble or repair the tester. Contact our Customer Service Department for assistance.

8. Leeb Measurement and Applications

Using the quotient of the rebound and impact voltages that are proportional to the rebound and impact velocities on an impact body, the hardness of a test sample can be determined. The harder the surface of the test sample, the faster the rebound velocity and the larger the test value.

The Leeb hardness (L-value) represents a direct hardness measurement for the following materials: steel, cast steel, alloy steel, stainless steel or refractory steel, gray cast iron, nodular cast iron, aluminum, brass, bronze, and copper.

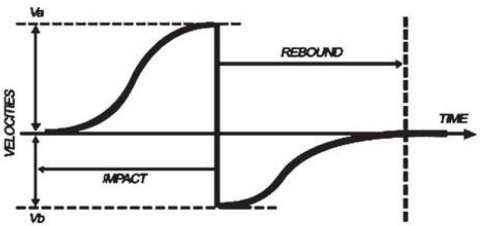
Brinell, Rockwell, Vickers and Shore values are determined using static conversion curves.

Definition of the Leeb Hardness Test

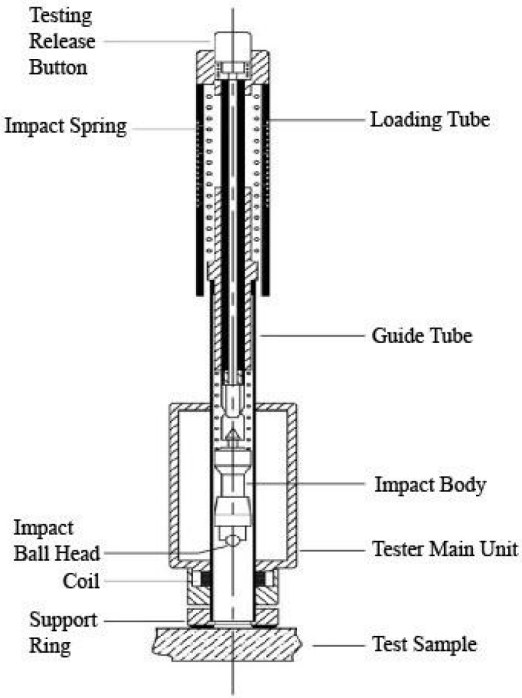
An impact body, i.e. a tungsten-carbide ball of a specified diameter, is projected against the workpiece under test with a given impulse force. At a distance of 0.039”(1 mm) from the surface of the workpiece, both the impact and rebound velocities are measured using the electromagnetic principle where the induced voltages are directly proportional to these velocities.

Leeb hardness can be measured electronically and its L-value is defined by：

HL=（Vb/Va）x1000



Where Vb is the rebound velocity of the impact body, and Va is the impact velocity of the impact body. The voltage characteristics of the rebound and impact velocities, as the impact body passes through the induction coil.


Testing
Release
Button
Impact Spring
Loading Tube
Guide Tube
Impact Body
Impact
Ball Head
Tester Main Unit
Coil
Support
Ring
Test Sample

9. Constructing Special Comparative Curves

Leeb and Other Hardness Comparative Curves for a Typical Test Sample

The HT-3000 hardness tester stores Leeb and other hardness comparative curves for ten types of materials. The included hardness comparative curves should meet most hardness testing requirements. However, if testing of a special type of material is required, a hardness comparative curve can be constructed for Leeb and other static formats.

Guidelines for Selecting and Pre-Testing a Test Sample

1. The type of material for the test sample should match the type of material of the workpiece.

2. Select large and heavy test samples whenever possible. A solid cylinder with a diameter of 3 ½" (90mm) and length 2 3/8" (60mm) is recommended.

3. The surface of the test sample should be treated to meet all the requirements described in "Pre-treatment of the Test Sample" (page 8).

4. To construct a hardness comparative curve, three test samples of the same material but of different hardness values are selected to find the upper extreme, the lower extreme, and the medium values.

Hardness Measurement for Test Samples

Select the desired hardness format for the test samples (i.e. Brinell, Vickers, Rockwell B, or Rockwell C), then use the hardness tester to determine the standard Leeb hardness (HL) of the test sample. Measurement requirements are as follows:

1. Test points should be selected on the spiral shown in the figure below, additionally, the following requirements must be met:

   The center of Leeb testing markings on the tested surface should be ≥ 0.12" (3mm).

   The center of static testing markings on the tested surface should be ≥ 0.4" (10mm).

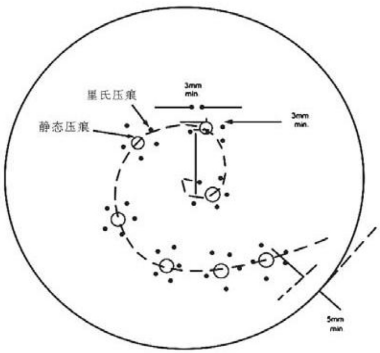
   The distance between the center of the Leeb testing marking and the edge of the static testing should be ≥ 0.12" (3mm).

   The distance between the center of the Leeb marking and the edge of the test sample should be ≥ 0.2" (5mm).

2. Prior to testing the samples, the static hardness tester should be adjusted. The testing block hardness, for adjustment purposes, should be close to the hardness of the test sample.

3. Similar to the static hardness tester, the Leeb hardness tester should also be adjusted prior to testing the samples.

4. During testing, the test sample should be level so the Impact Body is perpendicular to the tested surface.

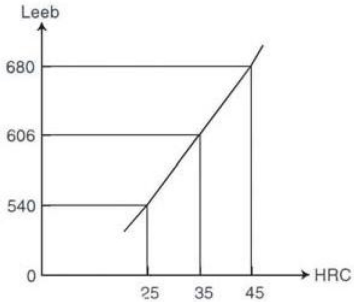


Creating Hardness Comparative Curve for Samples

Test three samples with different hardnesses with both Leeb and static (such as Rockwell) hardness testers. Test at least 5 points for each sample. Calculate the averages (mean) of the Leeb and static hardness readings for each of the three samples

Use the static hardness averages as the x-axis, and the corresponding Leeb values as the y-axis, plot a point for the obtained average values for each test sample on the plotter paper. Repeat plotting for two other samples' averages. Connect the three points to form a smooth curve.

Note: The more the points, the smoother the constructed curve. A more accurate comparative curve can be generated with more test samples and more tests.



Hardness Comparative Curve for Direction Adjustment

In case the surface of the workpiece under test is perfectly horizontal, different test angles can be selected in the testers to compensate for the gravitational effects. With the built-in comparative curves in the memory, the hardness tester can automatically adjust the Leeb test results according to the test direction and convert the Leeb hardness values to other desired hardness values.

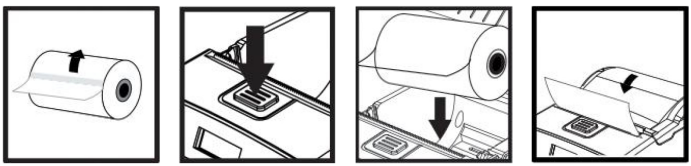
10. Printer

Power

Press the power button to power on the printer. Press the power button to power down the printer.

Replacing Paper

Turn off the printer. Press the large orange button to open the paper cover. Lift the end of the paper roll to unstick the paper and place it into the paper holder. Close the cover.



Charging the Printer

Plug the USB-C connector into the printer to charge it.