Free Fall Apparatus

1m, Mechanical Release, Without Timer

MF1871-301

Description:

The IEC mechanical release type 'Free Fall Apparatus' permits a ball of any type of metal to be released from an adjustable height up to 1000mm. As the ball falls from the upper platform, the starting of the timer is clean, accurate and reliable.

To permit the tall instrument to be positioned up on a demonstration table and permit a person to reach the release mechanism, the release is by a cord hanging down the side of the instrument to a point close to the base. A sprung bronze wire is pushed into a small hole in the ball and the ball is held upwards against the underside of the upper platform by the weight on the release cord. As the release cord is gently pulled downwards, the sprung bronze wire is pulled from the ball and it falls cleanly.

Length: 250mm	Width: 150mm	Height: 1140mm	Weight: 1.8kg

Kit Contents:

1 pce. Base plate.

1 pce. Aluminium rail and 4x mounting screws for attachment to base plate, with adjustable plastic covered metric scale.

1 pce. Upper Platform with START terminals and ball release.

1 pce. Lower Platform with STOP terminals.

1 pce. Weight, cord and release loop.

1 pce. Ball, brass (heavy), 20mm diameter.

1 pce. Ball, brass (small), 16mm or 12.7mm diameter.

1 pce. Ball, aluminium (light), 20mm diameter.

2 pair Connecting leads with banana plugs.

1 set Storage components (Pillars and rectangular plates) for 3 balls.

Assembly of Equipment:

Sometimes this apparatus is packed in a slim tube and one box containing all parts.

1) Lay the aluminium rail down with the zero on the scale to your left and facing up. In the box find the sets of 3 balls fitted to small pillars and 3 small rectangular plates used as spacers. Find also the plastic platform with the cord and brass ball attached and the other platform with the plate attached.
2) Take the platform with the cord attached and with the clamp screw to the rear, slide it up the tube towards the far end. See the image on the front page to see the position of the platform and the clamping screw at the back clamps into the slot.
3) Into the same slot from the scale zero end, take the smallest ball on the pillar and slide the small base up the slot (it fits the slot only one way around). Follow it with a spacer plate up the slot, then the middle size ball on the pillar, then the next spacer plate and finally the largest ball on its pillar and then the last spacer plate.
4) Take the bottom platform and turn it to project in the same direction as the top platform and slide it on the base and clamp it so it cannot slide off.
5) Remove the 4x small screws from plastic bag, take the base and using the screws, fit the base to the rail (see drawing). Tighten screws firmly.
6) Stand the unit on a table and be sure the scale shows 1000mm at the top and Zero at the bottom. With the lower platform resting on the base, slide the scale with the fingers until the Zero mark is exactly in line with the UPPER edge of the lower platform. Position the upper platform until the LOWER edge is in line with the 1000mm line on the scale (choose correct reference level step for the size of ball being used). Lock both platforms firmly in place with the thumb screws provided.
7) Notice that the upper platform provides two levels to be used as reference edges against the scale. Unscrew the large diameter ball from its storage pillar and support it under the upper platform so that it is pressing upwards into the location hole. Notice that the lowest point of the ball is in line with the bottom edge of the platform and therefore is in line with the lower reference edge against the scale. The lowest point of the small ball aligns with the higher reference edge.
8) Raise the weight hanging from the cord so that the wire support loop passes through the hole to hang down below the upper platform. Take the wire loop and firmly press it into the hole in the ball so that it grips in the hole. Lower and finally release the weight gently so that the ball is lifted and held into the hole in the underside of the platform. Without rocking the instrument, pull gently downwards on the weight so that the loop extracts from the hole in the ball and see the ball fall freely to hit the lower platform. THE BALL MUST NOT STRIKE THE TERMINALS ON THE LOWER PLATFORM. If the ball misses the centre of the lower platform, check that the instrument's base is not bent or damaged and check that the table is level.

Notes:

- When any ball is held upwards by the release loop and weight, the two upper terminals are short circuited by the ball. The instant the ball begins to fall, the START terminals are open circuited. As the ball hits the lower platform the lower terminals are momentarily open circuited. It is the open circuiting of the upper and lower terminals that controls the starting and stopping of the Electronic Timer. The time measured is accurate to 1/10,000 second (0.1 millisecond).
- The positions of the cord loop and cord guide hole may be reversed in the upper platform if desired.

Electronic Digital Timer:

For accurate measurement of the time taken for a ball to fall approximately 1 metre, the model MF1871-301A Free Fall Apparatus is normally used with the IEC digital timer model LB4057-001. This model has ‘Auto range’ up to 200 Sec x 0.1mS., battery operated, crystal locked for high accuracy, low cost and is complete with the unique Automatic Mode feature.

Understanding And Using The IEC Timer: LB4057-001

The Digital Event Timer with large LCD display is fully portable and is powered by 3x 'AA' dry cells for long battery life. To increase battery life further, the instrument will automatically shut off after a long period of non-use.

To replace batteries, remove the lower end cover and slide the front panel from the housing until the battery holders are in full view. Be sure to insert batteries the correct way around with the spring on the negative end of the battery.

'AUTO MODE' feature: The Event Timer automatically sets its open circuit / closed circuit mode of operation each time the STOP and RESET buttons are pressed. This useful feature makes the instrument very versatile and very easy to use (see more explanation below). Please note that complete information is provided with the timer.

Manual Control - Buttons:

Try the START, STOP, RESET/HOLD and RECALL buttons on the timer to understand their functions. Start button always starts timing. STOP button always stops timing. RESET/HOLD button always resets display to zero if timer is stopped. If the timer is running, the same button will hold the display while the timer is continuing to operate in the background. When the button is released, the timer will display the current time.

Remote Control - Socket Terminals:

MAINTAINED:

The sockets marked START/RUN will run the timer only while connection is maintained.

MOMENTARY:

The sockets marked START and STOP will perform their function if connection is only momentary. After the function is performed, the connection at the socket has no effect on the timer.

1. Join START/RUN sockets. Timer runs whilst joined. When not joined, timer stops. Timer will run only whilst these sockets are joined.
2. Keep these sockets joined and allow timer to time past 19.999 seconds. Note that the display will 'auto range' and the decimal point will shift.
3. Special unique 'AUTO MODE' feature:

While sockets are joined, press the STOP button then the RESET button. This will zero the timer and automatically set the 'mode' of operation. Now, since the sockets are already joined after setting the mode, if the connection is un-joined the timer will START and if re-joined it will STOP.

Now leave these sockets un-joined and go to the Momentary sockets and, using the leads provided, try joining the START and STOP socket sockets of the timer in combinations as listed below:

- START and STOP sockets both joined. RESET the display.
- Break the start MOMENTARILY and re-join. See timer operate. Break the Stop MOMENTARILY and re-join. See timer stop.
- START and STOP sockets both joined. RESET the display.
- Break the Start, do not re-join. See timer operate. Break the Stop, do not re-join. See timer stop.
- START and STOP both open un-joined. RESET the display. Join the start MOMENTARILY and un-join. See timer operate. Join the stop MOMENTARILY and un-join. See the timer stop.
- START and STOP both open circuit. RESET the display. Join the start, do not un-join. See timer operate. Join the stop, do not un-join. See the timer stop.

Summary:

Note that when display is RESET to zero, the Mode is set. When the status of a pair of sockets is CHANGED, the timer will either start or stop. Once started, the START sockets have no effect and, once stopped, the STOP sockets have no effect.

Connections to the 'Free Fall' Instrument:

The START/RUN sockets are not used when connecting to the 'Free Fall' apparatus. Connect the sockets on the Upper Platform to the Momentary START sockets and connect the lower Platform sockets to the Momentary STOP sockets on the Event Timer.

Perform the Experiment:

Load a ball into the upper platform ready to fall, (see previous instructions for attaching balls to release loop).

Important:

If the unit is bumped or for any reason the ball is not steady in position, there may be a momentary break of the contact between the ball and the contacts. If this occurs, simply STOP and RESET the timer again whilst the ball is being pulled AGAINST the underside of the hole by the cord and weight.

Pull down smoothly and gently on the weight until the release loop is extracted from the ball and the ball falls. DO NOT ROCK THE INSTRUMENT. Notice the timer will start as the ball begins to fall and will stop exactly as the ball hits the lower platform.

Try several times with the brass (heavy) ball, then store the brass ball on its storage screw and then try with the aluminium (light) ball. The brass ball is approximately three times the weight of the aluminium ball. Then try with the small ball, but do not forget to use the higher reference edge on the Upper Platform to align with the scale.

Try releasing the ball with your finger and note that no matter how fast you move, the time is always wrong. When you use your finger, the dropping of the ball is not perfectly 'Free Fall'.

Calculations to Determine 'g':

Using d = distance fallen by the ball (metres).

g = acceleration due to gravity (metres/sec/sec).

u = initial velocity (metres/sec)

v = final velocity (metres/sec).

t = time of fall (seconds).

The basic formulae for behaviour under gravity are::

1. $v = u + gt$
2. $d = ut + 1/2\ gt^2$
3. $v^2 = u^2 + 2gd$

For 'Free Fall' we use formula #2: $d = ut + 1/2\ gt^2$

now, in this case, since u is zero, we can say: $d = 0 + 1/2\ gt^2$

thus: $g = 2d/t^2$

Repeat the experiment several times and calculate an average value of ‘g’ by taking measurements of ‘d’ and ‘t’. Repeat the experiment with the other ball to prove that weight of the falling object does not affect the time taken to fall. Alter 'd' and re-calculate for 'g'. Determine final velocities after falling different distances.

Designed and manufactured in Australia

1) Raise weight to lower release loop through hole
2) Push release loop into ball
3) Gently lower weight until ball makes contact
4) Stop and reset timer
3) Pull down on weight string to release ball

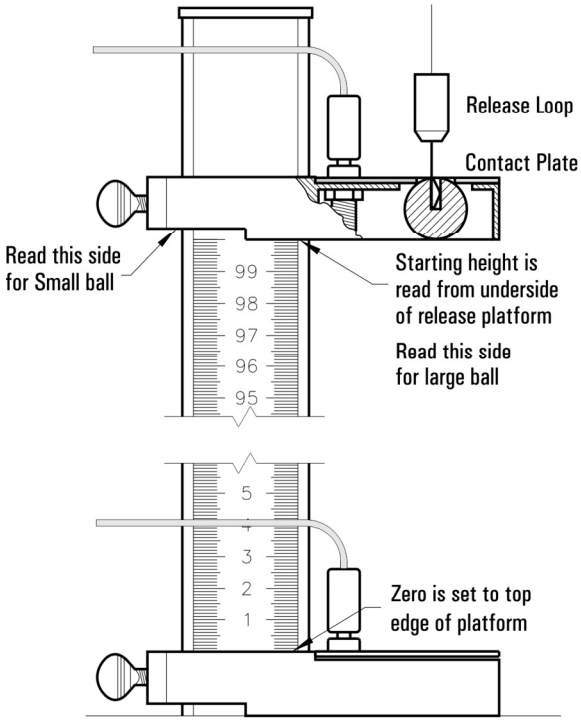

Fig 1