

## BALL MANUFACTURE

The processes involved in the manufacture of tennis balls have barely changed during the last 100 years. The various processes are described below, detailing the manufacturing process of a tennis ball from start to finish.

### Stage 1: Production of Solutions

The raw rubber comes into the factory in bales of 70-250 lbs. The rubber is thoroughly masticated (kneaded) to make it softer to work and to ensure that subsequently the solution will flow correctly.

A variety of powders are added to the rubber to give the required properties (e.g. strength, colour, etc.) to enable it to cure. The rubber compound is then put into a tank with a quantity of petroleum solvent and left to soak. A sticky dough results after a number of hours. The dough is diluted by stirring with more solvent until a solution of the required consistency is produced.

### Stage 2: Formulations

Core formulations for pressurised balls are normally based on natural rubber containing a high loading of fine-particle filler for low gas permeability. A formulation (parts by weight) is as follows:

Natural rubber 72

Butadiene rubber 28

Clay 40

Magnesium carbonate 8

Calcium carbonate 20

Zinc oxide 2.5

Sulphur 3.5

### Stage 3: Extrude

The rubber compound is heated and extruded, by being forced through an orifice under pressure, to form a rod which is then cut into pellets. The pellets are then cooled.



### Stage 4: Form

The pellets are loaded into a hydraulic press which forms them into hemispherical 'half-shells' and partially cures them, typically for 2 ½ min at 150°C.



The half-shells are removed from the press, joined together in a sheet by the 'flash', which has spread out of the moulds during the forming.

The flash is removed by a hydraulic press, fitted with cutting knives, which remove the half-shells from the sheet.

### Stage 5: Edge Buff

The edge of the half shell is roughened (or buffed) with a grinding wheel to provide a key for the adhesive which is next applied.



A vulcanising rubber solution is applied to the edge of the buffed half shell.

### Stage 6: Cure and Inflate

For pressurised balls, there are two methods of inflating or pressurising the ball. The first method is by the use of chemicals. This process can be accurately controlled and the inflation occurs after the core has been assembled. The inflation chemicals are usually sodium nitrite and ammonium chloride, which produce nitrogen during the moulding process.

The compressed-air inflation method is much more complex. The two shell halves are brought together and the air is trapped in the shell. The closing of the shell occurs in stages as follows:

- a) The press closes until the edges of the half-shells are not quite touching.
- b) In this position the internal platen area is isolated from the atmosphere by a rubber sealing ring around the periphery of the platens.
- c) Compressed air is introduced at the required pressure to the platen area.
- d) The press platens are then brought together, so trapping the compressed air between the half-shells and forming a pressurised core.
- e) The platens are then heated to vulcanise the rubber solution and then cooled prior to core extraction.



Balls are usually pressurised to about 12lb/in<sup>2</sup>.

Owing to the fact the rubber compounds are permeable to gas, the balls would be out of specification within a few months as the pressure is gradually lost. Pressurised balls are therefore sold in pressurised cans to maintain the balls pressure until the cans are opened.

### Stage 7: Core Solution

The core is buffed to provide a rough surface to act as a key for the solution which is applied next. The cores are then coated with a rubber solution in a barrelling operation, in which cores together with a measured volume of rubber solution are tumbled together, coating each ball with a uniform layer of solution.



## Stage 8: Fabric Cover

There are two types of cloth used in making tennis balls. The two types are Melton cloth, which has high wool content, and Needle cloth, which is cheaper to produce and can have a greater content of synthetic fibres.



The cloth arrives in 100 metre rolls. The cloth is coated on its reverse side with a vulcanising solution by means of one or more spreading operations. 'Dumb-bell' shaped blanks are cut from several layers of cloth at once by an automated stamping machine. Two blanks are then used to cover each ball.

The edges of the blanks are coated with vulcanising solution, which ultimately forms the seam of the ball. When the solution is dry the covers are ready to place on the core of the ball.

Two covers are carefully located onto the core by machine, one cover centred along the core seam, the other at 90° to the core seam.



## Stage 9: Moulding

The ball is placed in a moulding press and heated, curing together the rubber solution on the core and that on the back of the cloth. The heat and pressure also cure the rubber solution in the join between the two covers and moulds it into a smooth seam. The moulded ball is cooled and removed from the press. This moulding leaves the cloth very smooth and compressed but with a ridge around it where the mould closed upon it.

## Stage 10: Steaming

Tumbling the balls slowly through a steam laden atmosphere causes the cloth to fluff, giving a raised and softer surface, and the ridge around the ball also disappears.

## Stage 11: Finishing

The balls are then tested and graded.



The brand name is now marked on the ball by a transferring process. Pressurised balls are usually packed into pressurised tins or tubes which maintain the balls pressure whilst stored. The balls are now ready for dispatch.