## The Manufacturing  Process

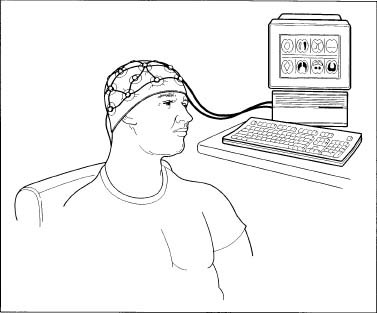
The different parts of an EEG machine are produced separately and then assembled by the primary manufacturer prior to packaging. These components, including the electrodes, the amplifier, and the storage and output devices, can be supplied by outside manufacturers or made in-house.

### *Electrodes*

* 1 The EEG electrodes are typically received from outside suppliers and checked to see if they conform to set specifications. One type of electrode commonly used for the EEG machine is a needle electrode. These can be made from a bar of stainless steel. The bar is heated until it becomes soft and then extruded to form a seamless tube.
* 2 The tube is then drawn out to produce a fine hollow tube. These tubes are cut to the desired length, and then conically sharpened to produce a point.
* 3 To ensure easy insertion, the tube is passed through a bath of polytetrafluoroethylene (Teflon) to provide a slick, chemical resistant coating. As the tube exits the bath it is warmed to evaporate the [solvent](http://www.madehow.com/knowledge/Solvent.html) and allow the coating to adhere.
* 4 The tube is then mechanically placed in a plastic adapter piece that is made with an injection molding machine. This piece allows the disposable, individually packaged needles to hook up to the lead wire.
* 5 The shielded lead wire is fitted with an adapter that can be hooked up to the primary unit.

### *Internal electronics*

* 6 The amplifiers and computer control module are assembled just like other electronic equipment. The electronic configurations are first printed on circuit boards. The boards can be fitted with chips, capacitors, diodes, fuses, and other electronic parts by hand or passed through an automated machine. This machine works like a labeling machine. It is loaded with numerous spools of electronic components and placing heads. A computer controls the motion of



A man undergoing an EEG, wearing a cap equipped with electrodes.

the board through the machine. When a board is moved under one of the component spools, a placing head stamps the electronic piece on the board in the appropriate positions. When completed the boards are sent to the next step for wave soldering.

* 7 In the next step, a wave-soldering machine affixes the electronic components to the board. As the boards enter this machine, they are washed with flux to remove contaminants that might cause short circuits.
* 8 Boards are then heated using [infrared](http://www.madehow.com/knowledge/Infrared.html) heat. The underside of the board is passed over a vat of molten solder. The solder fills into the needed areas through capillary action.
* 9 As the boards cool, the solder hardens and the electronics are held into place. Visual inspection is typically done at this point to ensure that defective boards get rejected.

### *Amplifier*

* 10 The electronic boards for the amplifier are pieced together and affixed to a housing. This is typically done by line operators who physically place the pieces on pre-fabricated boards.
* 11 The housing is made of a sturdy plastic that is constructed through typical injection molding processes. In this process, a two-piece mold is created that has the inverse shape of the desired part. Molten plastic is injected into the mold and when it cools, the part is formed. For some EEG models, the amplifier is a separate box about the size of a textbook. The outer sides of the box have connectors where the electrodes and the computer connection lines are plugged in.

### *Computer control box*

* 12 An EEG station consists of the amplifier and a computer control station. This control station typically has a desktop computer, a keyboard and mouse, a color printer, and a video monitor. These devices are all produced by outside manufacturers and assembled by the EEG manufacturer.

### *Final assembly*

* 13 Each of the components of the EEG O machine are brought together and placed into an appropriate metal frame. This process is done by line operators working in extremely clean conditions. When the components are assembled they are typically put on a sturdy, steel cart to make the device portable.
* 14 The finished devices are then put into final packaging along with accessories such as electrodes, computer software, printout paper, and manuals.

## Quality Control

At each step in the manufacturing process, visual and electrical inspections occur to ensure the quality of each EEG device being produced. Since circuit fabrication is sensitive to contamination, assembly work is done by line operators in air-flow controlled, clean rooms. Operators must also wear lint-free clothing to reduce the chance of contamination. The functional performance of each completed EEG device is also tested to make sure it works. This is done by powering up the device, turning it on, and running a series of standard tests. To simulate real-life use, these tests are done under different levels of heat and humidity.

In general, manufacturers set their own quality specifications for their EEG machines. However, in the United States the Food & Drug Administration (FDA) provides production recommendations that are usually adapted by the industry. Various other medical and governmental organizations also propose standards and performance suggestions. Some factors considered important are standardized input signal ranges, accuracy of calibration signal, frequency responses, and recording duration.

## The Future

In the future, EEG machines will be improved in their manufacture and their applications. From a manufacturing standpoint, the components that makeup the internal electronics of the device will likely get smaller. This will allow for smaller, more portable machines. It will also make the devices less expensive. This will be important because some experts suggest that future applications will make it desirable for individual consumers to have EEG machines.

While manufacturing improvements will come from research done in the general field of electronic manufacturing, specific research on EEG machines has focused on new uses and applications. For example, a device has recently been introduced that may make it possible to screen for Alzheimer's disease. This machine contains a cap that is fitted with electrodes. When worn it provides an electronic picture of a patient's brain activity. This picture is compared to the brain activity of healthy people and differences are noted.

A similar machine has been developed which can use information received from EEG electrodes to control computers. With this device the user wears an electrode-containing cap and looks at a computer screen. After a training session with the computer, users have been able to control the movement of a cursor on the screen just by using their thoughts. If fully developed, this technology could be a revolutionary development for paraplegics. Individual consumers may also benefit using such a device to control household lights, computers, and appliances just by thinking.

Read more: <http://www.madehow.com/Volume-7/EEG-Machine.html#ixzz5c7Smsu5P>

### *Books*

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### *Other*

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