

Hello students,

My name is Sameer Patil. I am from Dnyanprassarak Mandal's College and Research Centre, Assagao, Mapusa Goa.

Today, we will be discussing about the qualities of measurement, and this is the outline of my presentation, and the learning outcomes will be, to classify various types of Standards.

Now, what is the standard? A standard is a published document that contains a technical specification, or other precise criteria, designed to be used consistently as a rule, guideline or definition. Or, a known accurate measure of physical quantity is also termed as a standard.

Let us take an example. When we go to a super market, we directly pick up a packet of may be sugar or may be any other quantity. Why it is possible? Because, we know that this particular quantity is measured by the stores section, by their respective people using some weighing machine. And we rely on that. If this process was not there, in that case, there would have been many tussles while purchasing or buying any quantity. So, these standards, they help us to make our life simpler and increase the reliability and effectiveness of many goods, measurements and services that we use.

Now, the standard is a collective work done by committees of many manufacturers, users, research organizations, government departments and consumers. What they do? They sit together, they discuss on a particular parameter, that is to be measured and they finally come to a conclusion and arrive to a process called as standard. What is the aim of this? The aim is to develop standards that evolve to meet the demands of society and technology to a very high accuracy.

Now, let us study the different type of standards.

The first type is international standards. International standard is defined by international agreements. That means, the scientists and researchers of various countries they come together, they discuss and finally arrive to a conclusion, to define a particular parameter. These parameters will be periodically evaluated and checked by the absolute measurements in terms of fundamental units of physics. International standards represent units of measurement to the closest possible accuracy attainable by science and technology. And, these international standards are not available to ordinary users for measurement and calibration.

To give you an example, acceleration due to gravity is 9.8 meters per second square. This is internationally accepted by all the scientist, by all the researcher and every individual. Because, this acceleration due to gravity value has been defined by a mutual agreement from all the scientists and researchers on the entire globe.

Next, primary standards. Primary standards is used for calibration and verification of secondary standards. Primary standards will be maintained at the National Standards Laboratory in various countries. Again, primary standard is not available for use outside the National Laboratory and it is used as reference standards. So, whenever we talk about a individual country, a single country, in that case primary standards will come into picture. These primary standards will be maintained at the National Standards Laboratory in every country and all the secondary standards, which I will be discussing later, all these secondary standards will be calibrated with the primary standards on a regular basis.

Next is second extenders. Secondary standards are used as basic reference tools by measurement and calibration laboratories in various industries. Each industry has its own secondary standard, and this is treated as the highest metrological quality available at a given location. These secondary standards have to be compared regularly with the primary standards.

Let us take an example of a resistance manufacturing company. If a company wants to manufacture a 1-ohm resistor, then, this company will be having a standard value of 1 ohm resistor available with them. This value, whenever they manufacturer a new resistor, it will be compared with this 1-ohm resistor and the standard which is maintained at the industry level will be compared with the primary standards on regular basis.

Next is working standard. Working standards are principal tools of a measurement laboratory. It is also called as a field standard and it is used to calibrate measuring instruments for everyday use.

When we perform a particular experiment in laboratory, let us consider one example where I want to measure a fixed voltage of a voltage source or a power supply. In that case, I will use a voltmeter. Now, I can use an analog meter or a digital voltmeter. When I use an analog voltmeter, obviously, I will not get a very accurate reading. Why? It is because it depends on individuals view, individuals' vision. But, when we talk about a digital voltmeter, it will give me a display in terms of a readout. So, certainly, for me I will use a digital voltmeter as a standard of measurement in the laboratory. These digital instruments, or any instrument for their purpose, whatever is available in the laboratory, have to be calibrated with the secondary standards on the regular basis.

Next comes electrical standards. Now, we know that all electrical measurements are based on the fundamental quantities, i.e. current, voltage and resistance. So, if we know any two values out of these three, that is, if we know current and voltage, we can write or we can find out what is the value of resistance and similarly with the other two parameters. This is possible because of these simple rules or simple law that is ohms law, which is $V = IR$. So, if we know I and R, we can find out V. If we know V and I, we can find out R.

Next is the atomic frequency and time standards. Now, time is a very important parameter to be measured in our day-to-day life. So generally, in old times, the rotation of the earth on its axis, which determines the length of the day was used as a time standard. This time standard is also called as universal Time or UT. Now, this was considered as a tool of measurement in the past. The time that is defined in terms of earth's orbital motion, around the sun is also called as Ephemeris time or ET. This was also used as a time standard. At a later stage, quartz crystal was invented and these quartz crystals were used in the watches to get a more accurate time standard.

Now, what we use is atomic time standards as the highly accurate tool for measuring time. Now, how it is possible? Because, in an atom the transition between two energy levels, let us say E_1 and E_2 of an atom will be accompanied by an emission or absorption of radiation and it will be given by the equation, $\gamma = \frac{E_2 - E_1}{h}$ where, E_2 and E_1 are the two different energy levels and γ is the frequency and h is the Plancks constant.

So, if we know frequency, then in that case, the time period will be inverse of frequency. And that's how we can find the time period through an atomic time standard. So, to summarize, I will say that, the standards which are used, they are very important and useful tools in our day-to-day life. When we use these standards with our life becomes simpler. Suppose, if these standards were not there or if they were not present, in that case or life would have been very difficult.

The references are

I have used Electronic instrumentation by H. S. Kalsi and
Transducers an instrumentation by D. V. S. Murthy
Introduction to instrumentation and control by A.K. Ghosh
Instrumentation devices and systems by C. S. Rangan
An electronic instrumentation and instrumentation technology by M.M.S. Anand.