



# INTERNATIONAL RESEARCH JOURNAL OF HUMANITIES AND INTERDISCIPLINARY STUDIES

( Peer-reviewed, Refereed, Indexed & Open Access Journal )

DOI : 03.2021-11278686

ISSN : 2582-8568

IMPACT FACTOR : 5.828 (SJIF 2022)

## Ancient to Modern Progression of Measurement Science

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DOI No. **03.2021-11278686** DOI Link :: <https://doi-ds.org/doi/10.2022-53945982/IRJHIS2205013>

### **Abstract:**

*Measurement has been a fundamental in human existence since the beginning of civilization. In ancient India there were different measurements units for length, mass and time. A norm of measurement must be created which is acceptable to everyone. In this article, an endeavor has been made to features the estimation units in India during vedic period.*

**Keywords:** *measurement, length, mass and time*

### **Introduction:**

Measurements are made to build knowledge and understanding of the world we live in. Measurement science is the premise of present day science and innovation and thus of current development. Early measuring techniques for length depended on the utilization of human body parts. Lengths and width of fingers, thumbs, hands, hand ranges, cubits and body ranges appears to have been well known options. Yet, there will be impressive variety in the length of the body portions of various individual so the utilization of a piece of stick of wooden or other material as unit of length was one of the splendid thoughts for length measurement [1]. During British period the inch, foot and yard were utilized to measure length though grains, ounce, pound and so on were utilized to quantify mass. The fundamental unit of mass utilized in India included ratti, masha, tola, chattank, soothsayer and maund. During Vedic period in India, the length of the shadow of trees or different objects was utilized to know the approx time and different units of measurement are utilized for calculations of tithi, naksatra and so on for social and religious occasions. Numerous civilization and sovereigns created their own measurement principles that were acknowledged all through their nation [2]. The lack of standardized quantities for measuring is drawn to attention. Further improvement of the International system of quantities and units bring significant collaborations

around the world [3]

### Length Measurement:

The manner in which base units of length have been resolved has changed incredibly over the long haul. Sometime in the past, the base for reference was the human body. For instance, the cubit was a unit that showed the length from the elbow to the fingertips. It is said that the standard proportion of length in these times was the body of the nation's ruler or another influential person. Indeed, even today, units of length in light of the human body are utilized in nations like the United States, like the yard, foot, and inch.[4]

The elements of measurement system and definition of some of the units of length may be written as in table 1.

**Table 1: Ancient and modern length measuring units.**

VEDIC ERA MODULE		EQUIVALENT TO S.I
STANDARD MEASURING UNITS	COMMONLY USED UNITS	UNIT
8 yuvamadhyā	1 angul	2 cm(0.787402 inch)
4 angul	1 dhanugraha	8 cm(3.14961 inch)
8 angul	1 dhanurmushti	16 cm(6.299 inch)
12 angul	1 vitasti	24 cm(9.44882 inch)
2 vitasti	1 aratni or hast (haath)	48 cm(18.8976 inch)
4 aratni (haath)	1 dant or dhanush	192 cm(6.299 feet)
10 dand	1 rajju	19.2 meter (62.9921 sq. ft.)
2 rajju	1 paridesh	125.98 ft.
2000 dhanush	1 krosch	4199.475 yard(3840 meter)
4 krosch(goruta)	1 yojan	9 miles(15 km)

(Source: <https://doi.org/10.3126/tgb.v6i0.26162>)

### Mass Measurement:

The mass measurements, in Vedic times, equivalent consideration was taken for exchange and trade and there was a grounded arrangement of loads measures [5]. The base of term tola is traced all the way back to the Vedic period when it used to gauge seed and different grains. During old India, the tola was utilized as one unit of mass measurement which is equivalent to 180 troy

grains (around 11.66 g).[6]. The different mass units used in Vedic era are depicted in table 2.

**Table 2: Units used in ancient and modern era for measuring mass.**

VEDIC ERA MODULE		EQUIVALENT TO S.I UNIT
STANDARD MEASURING UNITS	COMMONLY USED UNITS	
8 rattis	1 masha	0.9071856 gram
12 mashas	1 tola	10.886227 gram
80 tolas	1 ser	870.89816 gram
40 sers	1 maund	34.835926 kilogram
1 ratti	1.75 grains	0.11339825 gram(1grain= 0.064799 gram)

(Source: <https://www.nios.ac.in/media/documents/secscicour/English/Chapter-1.pdf>)

### Time Measurement:

The time measurement system in ancient India was best, and it covered a reach from microseconds to trillions of years, including the patterns of the universe. A time-based activity includes a period scale in view of some arrangement of measurement. All systems of time measurement are based on the time of revolution or rotation of various celestial bodies including the moon and the sun. The actual number of days in a month might change by a day as indicated by the place of the moon and the sun.[2]. It is an exceptionally pragmatic technique for estimating time and doesn't need any equipment. Everyone can see the moon around evening time and can perceive which day it is. The Vedic year nearly corresponds with the time of one revolution of the earth around the sun. This practice actually go on in Hindu religious schedules utilized in astrology and for festivals. The seasons and the celebrations fall practically in a similar lunar month.[5]

During this era, time was estimated by a water clock called Ghatika. People had divided day & night into 60 sections, every one of which is known as a ghari. Also the night and day are each separated into four sections every one of which is called pahar. In terrifically significant towns, a group of men called ghariyalis were delegated to measure time. To measure time a vessel with a hole at the bottom was place over another big vessel containing water. [7]

In Vedic period (5000B.C.), Indians had separate names for much smaller time intervals. The terms for smallest and larger time interval and its multiples are shown in table 3 and table 4. For larger unit of time, the year is taken as the unit.

**Table 3: Smallest measuring unit of time.**

VEDIC ERA MODULE		EQUIVALENT TO S.I UNIT
STANDARD MEASURING UNITS	COMMONLY USED UNITS	
2 permanu	1anu	52.67 $\mu$ s
3 anu	1 trisrenu	158 $\mu$ s
3 trisrenu	1 truti	474 $\mu$ s
100 truti	1 vedh	47.4 ms
3 vedh	1 love	0.1s
3 love	1 nimesh	0.43s
3 nimesh	1 kshan	1.28 s
5 kshan	1 kashta	6.4s
15 kashta	1 laghu	1.6min.
15 laghu	1 nadika (danda) = 1 ghadi	24 minute. (60 Pal)
2 nadika	1 mahurat (2 ghadi =30 kala)	48 min.
30 mahurat	1 day and 1 night	24hrs (24 hora)

**Table 4: Larger measuring unit of time in vedic and modern Era.**

VEDIC ERA MODULE		EQUIVALENT TO S.I UNIT
STANDARD MEASURING UNITS	COMMONLY USED UNITS	
2 kali yugas	1 dwapar yuga	864000 human years
3 kali yugas	1 treta yuga	1296000 human years
4 kali yugas	1 satya yuga	728000 human years
10 kaliyugas	1 mahayuga	4,320, 000, human years
1000 mahayuga	1 kalpa	4,320, 000,000 human years (1 day of Brahma)

(Source: <https://www.sanskritimagazine.com/indian-religions/hinduism/concemntpt-measurement-time-vedas/>)

### Conclusion:

In the light of above discussions, it can be inferred that the methodologies adopted for measurements in the vedic era have their correlated counterparts in modern world. Now a day's laws of science are expressed as fundamental physical quantities. These physical quantities ought to have a standardized unit of measurement prevalent in all realms of science. This article clearly establishes that the basic units of measurement in vedic time were length, mass, and time and today also these



are considered as the fundamental units of measurement.

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