

Measurement and Metrology

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Measurement and Metrology



Sections:

- 1. Measurement as the Language of Science
- 2. The Uses of Measurement
- 3. Communications about Measurement
- 4. Acts and Applications of Measurement
- 5. Codification of Measurement
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Measurement and Metrology





Measurement as the Language of Science



Measurement - a procedure in which an unknown quantity is compared to a known standard, using an accepted and consistent system of units

The means by which inspection by variables is accomplished

Metrology – the science of measurement

Concerned with seven basic quantities: length, mass, electric current, temperature, luminous intensity, time, and matter





Measurement as the Language of Science

Table 1. SI base units			
Base quantity	Name SI bas	Symbol e unit	
length	meter	m	
mass	kilogram	kg	
time	second	s	
electric current	ampere	A	
thermodynamic temperature	kelvin	K	
amount of substance	mole	mol	
luminous intensity	candela	cd	

The Uses of Measurement

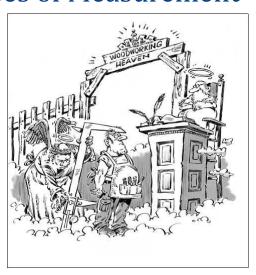


There are three reasons why we all need measurements:

- Measurement to make things
- Measurement to control manufacturing
- Measurement for progress



The Uses of Measurement



Communications about Measurement



SYMBOL FOR:	ASME Y14.5M	150
STRAIGHTNESS		
FLATNESS		
CIRCULARITY	0	0
CYLINDRICITY	Ø	Ø
PROFILE OF A LINE	$\overline{}$	^
PROFILE OF A SURFACE		٥
ALL AROUND	<u>-</u>	(proposed)
ANGULARITY		
PERPENDICULARITY		
PARALLELISM	//	//
POSITION	Φ	+
CONCENTRICITY (concentricity and coaxiality in ISO)	0	0
SYMMETRY	=	=
CIRCULAR RUNOUT	7	1
TOTAL RUNOUT	21	21
AT MAXIMUM MATERIAL CONDITION	₩	M
AT LEAST MATERIAL CONDITION	(L)	©.
REGARDLESS OF FEATURE SIZE	NONE	NONE
PROJECTED TOLERANCE ZONE	(P)	(P)
TANGENT PLANE	①	① (proposed)
FREE STATE	Ē	(F)
DIAMETER	Ø	Ø
BASIC DIMENSION (theoretically exact dimension in ISO)	50	50
REFERENCE DIMENSION (auxiliary dimension in ISO)	(60)	(50)
DATUM FEATURE		EULED OR NOT SHUSD

FIGURE 1–4 Revisions to the American Society of Mechanical Engineers Dimensioning and Tolerancing Standard (ASME Y14.SM-1994) are intended to improve national and international standardization.

Communications about Measurement



DISCIPLINE OF MEASUREMENT

- 1. The accuracy of a measurement can never be as great as that of the standard.
- 2. The accuracy is diminished by errors.
- 3. Calibration, comparison to a higher standard, is the test for accuracy.
- 4. Repeatability is the usual test for precision.
- 5. Every measurement alters the object being measured and the measurement system.
- 6. The potential errors are reduced by:

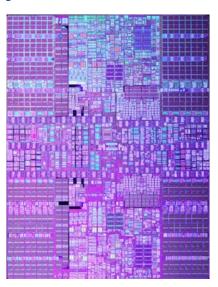
 - Elimination of separate measurement acts. Elimination of separate parts of the measurement system.
 - Elimination of separate fluctuating conditions.
 - Elimination of separate positional variables.
- 7. The least positional error results when the line of measurement, standard, and axis of the comparison instrument are all in line.

FIGURE 1–5 These considerations are of extreme importance and must be understood and practiced.





Acts and Applications of Measurement



Codification of Measurement



Measurement and quality assurance.

How much measurement is necessary?

A team decision and what is required by the product to meet the requirements of the customer.





A Look Ahead





Summary

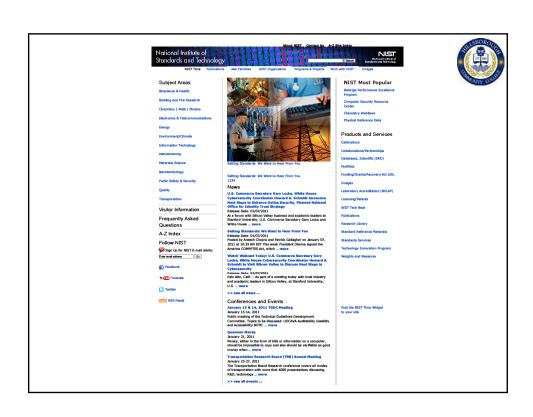


- Measurements support a wide range of products and processes across science, medicine, manufacturing, health and safety, and government.
- Communication of measurements within and across industries is essential to both manufacturing and service companies.
- •The quality of goods and services offered is highly dependent on reliable measurement.
- Traceability is the cornerstone of quality control programs. Without traceability, measurement is meaningless.



Summary

- •Skills in linear measurement are readily marketable. They are far more widely needed as an aid for performing other work, because almost every technical pursuit involves measurement.
- •An even greater benefit of a familiarity with the basic principles is the discipline it provides for logical thought, a benefit that applies to all activities.
- •Metrology requires communications for its use. It has its own terms and symbolism. These are analogous to all attempts to communicate without error and distortion.
- •Part of the communication is the codification. Although it is burdensome, it ensures an orderly process that is understood by those working in a given area of metrology.







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