RubyMetrology
INNOVATION CONTINUES...

Quick Check Educational Kit

A World Class Skill Development and Quality Improvement Tool







World's First, Patented, Multi-function, Multi-dimension, Educational Kit. A versatile Skill Development and Quality Improvement Tool. To create world class industry ready engineers or technicians. To produce Excellent Quality with Zero defect. To save rework, rejection and wastage in manufacturing process.

Quality - Fitness for purpose, Value for money, Customer satisfaction.
Excellent Quality - A blend of Quality of design, Quality of conformance, Quality of performance.
An unbroken chain of thousands of quality steps till it reaches its customer for fulfilling static and implied needs.

General concept of advance manufacturing and role of metrology. Eye-opening facts, innovative solutions and suggestions to take the same to next level

Manufacturing has witnessed tremendous changes in past few decades due to advancement in technology, automation, globalization, competitive environment and sustainability concepts like mass production, high productivity, standardization, interchangeability, excellent quality, zero defect are some results of these changes.

Thinkers in every corner of the world are busy to find optimal solutions to cope with these changes in manufacturing process and to produce excellent quality. A common practice is to purchase more advance, expensive, highly sophisticated machines and accurate measuring devices with an assumption that everything will be fine and controlled, but it never happens practically.

Product quality does not depend only on the sophisticated machines and precise instruments but it also depends on their proper uses, handling, storage, timely up-gradation, routine calibration and maintenance. Besides that engineering or technology can't be related only how to make things efficiently, it is more focused now to measure the things accurately. Because **"If you can't measure, you can't make".** This experience increases role of "Metrology" remarkably in the industrial world and nevertheless growing everyday.

"Metrology – The Science of Measurement"

Manufacturing people know very well that measuring instruments plays a vital role in any manufacturing process, because as per measurement and inspection results people set their machine or process. So faulty instrument means incorrect measurement or improper machine setting and results in huge rework, rejection and wastage or unexpected quality issues. So people must be very careful about selecting the right measuring instrument w.r.t. their range, least count, design, accuracy, precision, calibration etc.

Advance Manufacturing + Accurate Measurement → Quality Output

World class manufacturing needs world class metrology, simply because "If you can't measure, You can't make". But apart from these two so many other things and support functions are required, for best results. So we must pay equal importance to all the functions to achieve our objectives.

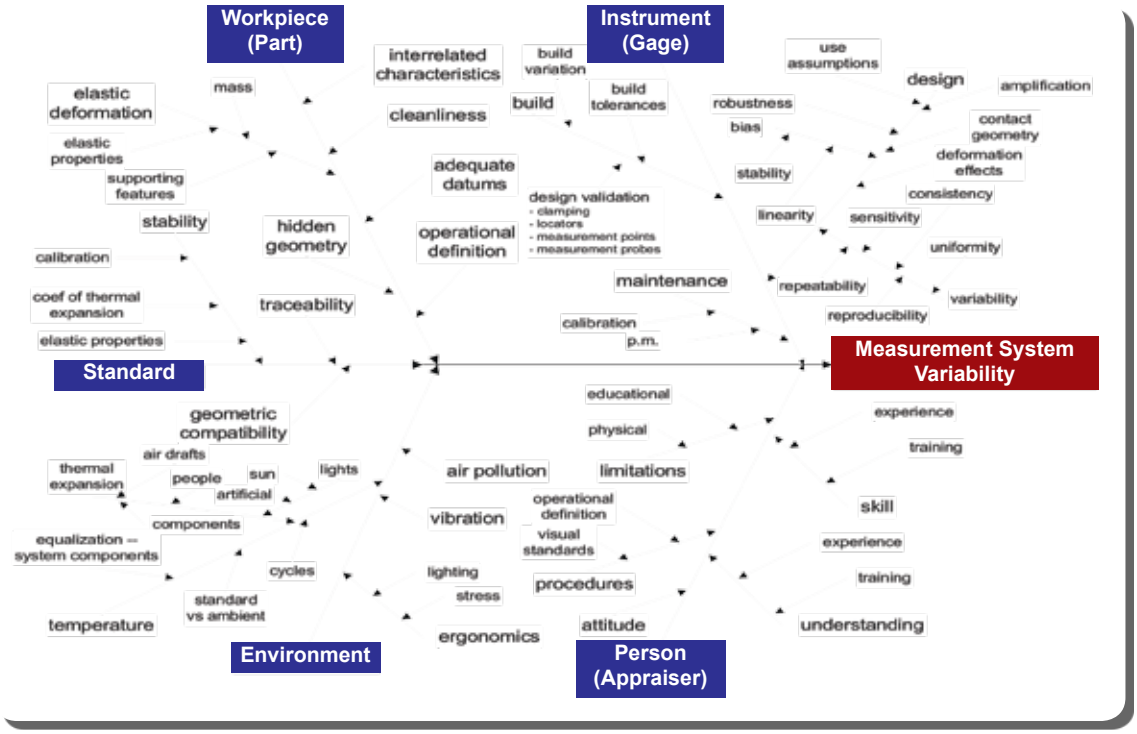
Metrology "The science of measurement", "A combination of science and art both". Building measurement and inspection skills in the people needs training on basic metrology covering it's key principles and hands on experience on various measuring instruments and parameters.

Researchers have proved that the selection only of right measuring instruments is not sufficient for a robust measurement system because measurement is not just a science rather it's a combination of science and art both, so apart from good measuring instruments our focus must be to train our people theoretically and practically about inspection and measurement process like application of different instruments and their proper uses, design specialty, basic fundamentals, required environmental conditions, accuracy, precision, limitation and constraints. Then only we can achieve manufacturing excellence. Traditionally, dimensional metrology has been considered as a non-value-added quality control activity and very little effort has been expanded on developing sound measurement processes and skills of user in the industries and institutions.

But now a day's things are changed and improved a lot. People are aware and understand upcoming requirements, so they want to improve this scenario from the ground level to face future challenges.

Interestingly, one more important thing arises here how and where people are developing their measurement skills, generally people develop these skills during their profession by self learning or with the help of seniors or with different job exposures and sometimes shockingly with repeated failures.

So educationists and field experts want to impart training on measurement skills at institutional level to all students for developing first time right, zero defect and world class quality like concepts in students from the beginning, to enhance their career perspective and to create technology marvels by these people in future.



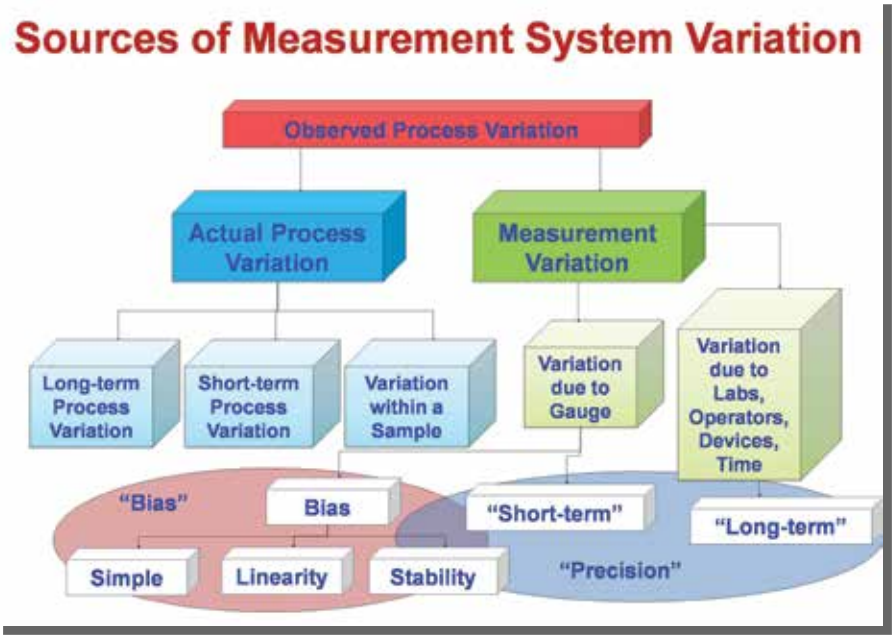
"Cause and effect diagram for measurement system variability due to various sources"

Fishbone diagram shows beautifully all the major source of variations in a measurement system. S.W.I.P.E. - Standard, Workpiece, Instrument, Person, Environment. Measurement system variation effects - capability, performance, consistency, uniformity etc.

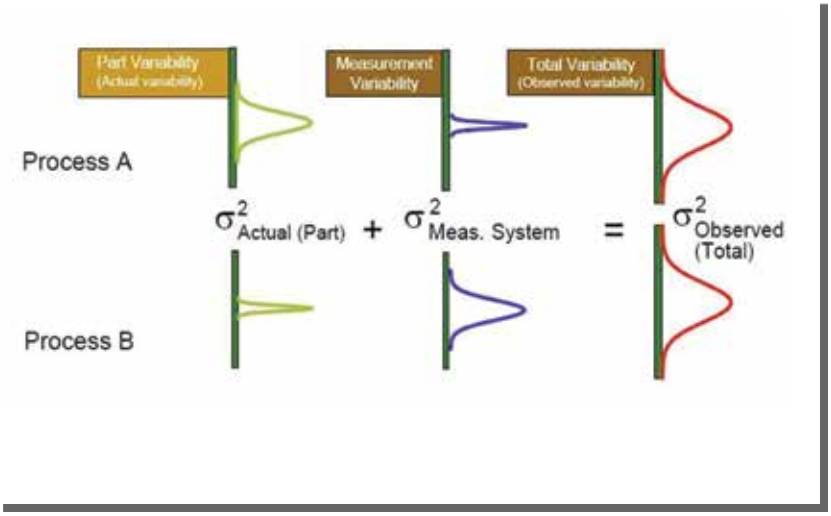
"Variation" - A natural phenomenon exists in every process. Understanding different type of variations like process variation, measurement system variation and their effects on the whole system is always an added advantage for process owner to run a fullproof manufacturing process.

To understand importance of measurement process and to acquire best measurement skills we need to study one natural concept called **"variation"**. Similar to all processes a measurement process is also impacted by random and systematic sources of variation.

These sources of variation are due to common and special causes. In order to understand system variability, potential sources of variation ought to first identify and rectify from the process.



Measurement variability in data : (example of two processes)



Which process is best?

We can divide variation into two categories- **location variation** and **width variation**. **Errors due to location variation - bias, linearity, stability, accuracy**. Types of location variation- within part, within standard, within instrument, within appraiser, within environment, within process.

Errors due to width variation - repeatability, reproducibility, precision, uniformity, gauge R&R, consistency. Types of width variation- between parts, between standards, between instruments, between appraisers, between environments, between methods.

Measurement system must be stable and repeatable, variation should be due to common cause. Measurement variation should be very less to overall process variation, if measurement variation will be more, it will hide actual process variation and mislead all the analysis and feedback mechanism.

A skilled person can take good results from an inferior instrument or a machine, vice versa an unskilled person can give wrong output with a world class machine or a measuring device. So it is very clear person standing in-front of the machine is more important than an expensive machine.

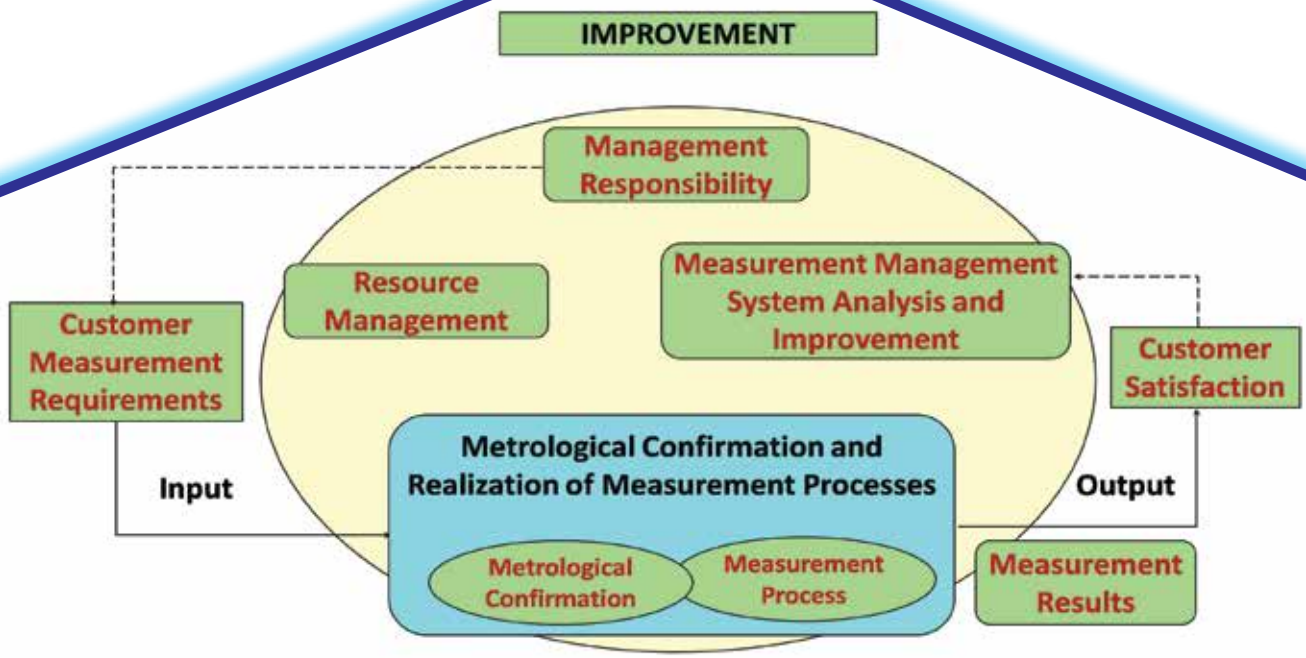
Conclusion & Suggestions :

To take Manufacturing to the next level and to unlock some of the enormous potential, it is necessary to see measurement and inspection activity not just as a routine work but as a information exchange format, a feedback mechanism during product development stage as well as in mass production for defining geometrical properties, key characteristics, product functionality, manufacturing process, approx cost, level of quality etc. of the parts. This will help to establish qualitative and quantitative benchmarks.

Besides, that measurement process must be treated same like a manufacturing process where a numeric value is our output, so measurement and inspection skills must be provided to all students and working people first at institutional level i.e. ITI, Polytechnic, vocational training centre's and engineering colleges. Then in industry on regular basis like other engineering skills.

This will make people more efficient, knowledgeable, reliable and be capable to produce excellent quality from the very first day in their professional career, because a skilled person may give good results with an inferior machine or measuring device & vice versa. An unskilled person may produce wrong results with highly advance machine or precision instruments.

So it is very clear now that imparting measurement and inspection skills to students at institutional level is very important to get their best performance and to make them the first choice of the leading organizations of the world.



Model of Measurement Management System

An effective measurement system ensures that all the measuring equipments, personnel and measurement processes are fit for their intended purpose and also sufficient to minimize the risk of incorrect measurements in a manufacturing process.

Quick Check Educational Kit - A wonderful skill development and quality improvement tool, that improves overall quality, efficiency, effectiveness of a manufacturing process and increases reliability, capability, productivity, confidence level, decision making power of user.

TYPE – A (SIDE)

TYPE – E (BACK)

TYPE – B (FRONT)

TYPE – B (SIDE)

Answer is here - Quick Check Educational Kit

Quick Check Educational Kit is a very innovative skill developing and quality improvement tool. It's a result of continual research by a cross functional team, work includes, study of world's renowned technical education systems, finding their best parts and lapses, interacting with more than 3000 peoples to analyze their knowledge and skill level, visiting more than 200 companies and institutions in India and abroad to know ground realities. This journey is still continue to add more features in Quick Check to impart best measurement skills in the most easiest way.

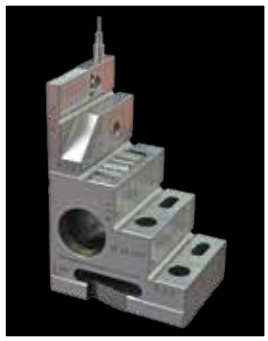
Kit comprises of five types of Quick Check "A B C D E", some gauges and powerful software "MSA Expert". Different types of Quick Checks are designed to demonstrate application of variable instruments, attribute gauges, GD&T parameters, CMM and other advanced measuring instruments. All Quick Checks look similar but have different dimensions, on multiple steps which are difficult to remember by human beings. Hence gives actual feedback and authentic data.

It's intelligent design makes it compact, hard, accurate, precise, all side usable, multi-function, multi-dimension and doesn't require special skills to handle. Anybody can use it easily. It looks like a component and gives feeling of actual working conditions to user and significantly improves his knowledge and skills in various fields. Further all Quick Checks are designed to work individually as well as in groups to perform various studies or activities.

With respect to its construction every shape, size, step, depth, taper, contour, bore, slot, radius, angle, thread, pin, chamfer or relief has its own strong technical or functional reason and are arranged so beautifully as to provide best learning and covers maximum instruments varieties with different range, least count, accuracy, make and models.

It covers parameters like length, diameter, taper, radius, angle, groove, depth, straightness, flatness, roughness, perpendicularity, parallelism, roundness, cylindricity, coaxiality, contour, profile, position, threads, gear parameters, runout and many more. All dimensions are marked with deep and broad laser for their long life and clear visibility. These small improvements and innovations make Quick Check Kit a wonderful plug and play device.

Quick Check Educational Kit is much useful for various institutions like ITI, vocational training centre's, polytechnics, engineering colleges etc.



TYPE – C (SIDE)

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TYPE – B (BACK)

TYPE – D (BOTTOM)

Kit comprises of five types of Quick Check "A B C D E", some gauges and powerful software "MSA Expert". All Quick Checks look similar but have different dimensions to perform various studies and activities, they are compact, handy and feels like a component to user hence impart best skills.

Learning with kit, not only develop users skills and confidence. It develops them with right attitude, sound knowledge and innovative approach. It helps to achieve quality, productivity, efficiency, cost effectiveness in the manufacturing process and retain valuable customers in this competitive world.

TYPE – E (BOTTOM)

TYPE – D (SIDE)

TYPE – D (FRONT)

TYPE – A (SIDE)

to educate their students in engineering metrology, applications of various measuring instruments and gauges, key principles, operating procedures, design specialty, limitations, do's and don'ts etc.

Kit can be equally beneficial for almost all types of manufacturing industries like Automobiles, Aerospace, Railways, Shipping, Defence, Consumer Goods, Electrical, Electronics, Tool Rooms, Rubber and Plastic, Sheet Metal, Casting, Forging etc. for training & skill development of people, to perform various MSA studies, daily calibration and verification of instruments, to reduce rework, rejection and wastages in supply chain and improve overall system efficiency vice versa Quality of goods and services will automatically improve.

So we can proudly say that Quick Check Educational Kit must be an integral part of any institution or industry to improve overall accuracy, precision, gauge R&R, stability, process capability, uniformity, reliability etc. Noticeably, on the one side it makes users skillful and knowledgeable in measurement and inspection process and on the other side it checks all kinds of instruments at workplace and exposes faulty instruments repeatedly from the process.

Quick Check implements the concept **"TQM by TQM", i.e. "Total Quality Management by Total Quality Measurement"**. Further this methodology empowers human beings the biggest asset of any organization and execute quality control system from the bottom of pyramid of manufacturing.

Quick Check support various Quality Systems :

- QS: 9000, MSA / Check Standard / Training & Skill Development
- ISO: 9000, Calibration System / MSA / Training & Skill Development
- ISO: 10012, Measurement Management Requirements / Training
- ISO: 17025, Laboratory Management System / Training
- TS : 16949, Daily Calibration / MSA / Training & Skill Development
- Ford Q1: Drop Out Policy / MSA / Daily Calibration / Training
- NABL: Measurement Uncertainty / Training / Daily Verification

Some useful applications of Quick Check Educational Kit :

- QC Kit as a dimensional measurement and inspection skill development tool
- QC Kit as a calibration and verification master
- QC Kit as an artifact for various GD&T parameters practically
- QC Kit and MSA Expert Software a complete package for manufacturing excellence

TYPE – D (SIDE)

TYPE – E (FRONT)

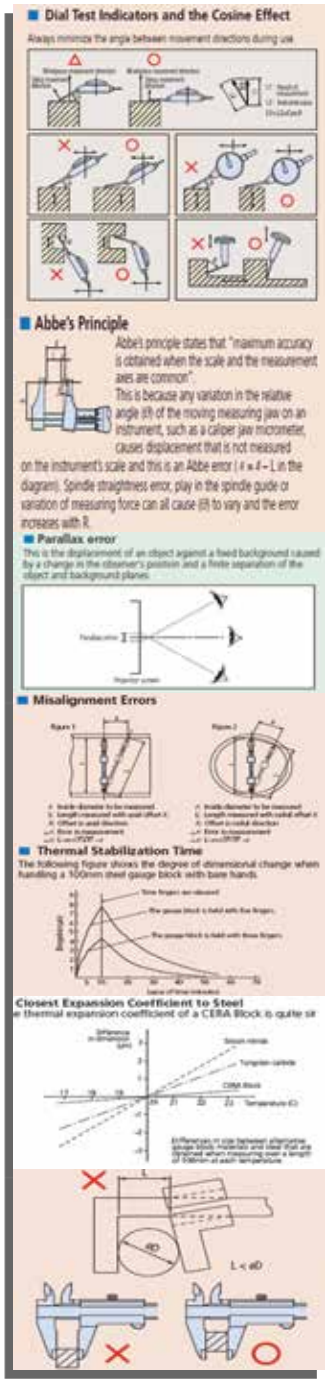
TYPE – C (BACK)

TYPE – E (SIDE)

Quick Check Educational Kit - An innovation for measurement reliability, wide range of applications, must be an integral part of any institutions, vocational training centre's and industries to take manufacturing and quality into next level. "Ordinary to Extraordinary".

Dimensional measurement is a vital link between designer's intent and actual product. Designer provides specification in the form of dimensions and manufacturing converts these dimensions into finished product with wide variety of dimensional measurement that shows importance of dimensional measurement in manufacturing.

Quick Check Kit as a dimensional measurement and inspection skill development tool



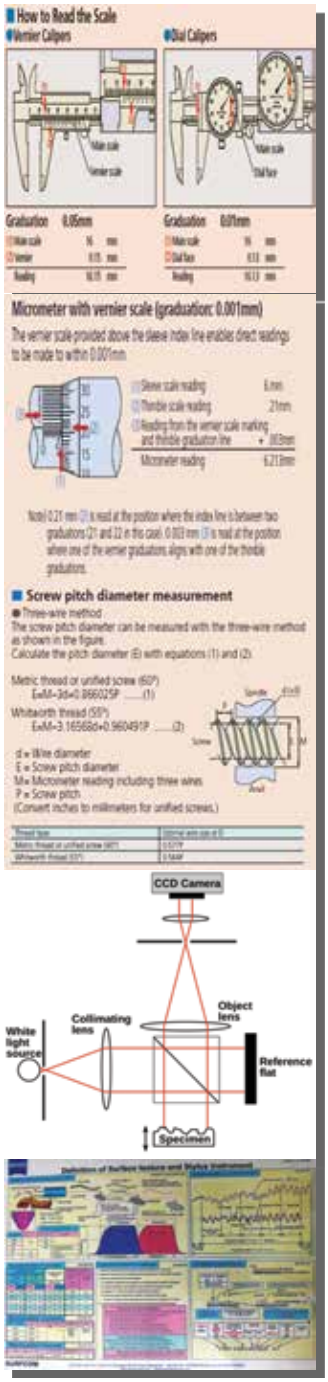
Why dimensional measurement skill is required by people?

Dimensional measurement is a vital link between designer's intent and actual product, designer provides specification in the form of dimensions and manufacturing converts these dimensions into finished product with the wide variety of dimensional measurement. Further the Quality control maintains its control on product by still more dimensional measurement, so it clearly shows the importance of dimensional measurement in a manufacturing process.

Quick Check Kit is designed to impart dimensional measurement and inspection skills to user in a most efficient manner. It covers both the aspects of training- theoretical and practical with an analytical tool, "MSA Expert Software". This helps users to develop their operating skills, with their own, on the variety of instruments and gauges with varying ranges, least count, accuracy and precision. This close loop combination works effectively and does actual skill development of people.

This learning gives people adequate knowledge and all basic inputs about measuring instruments, their behavior, operating procedures, key principles and fundamentals, required precautions, do's and don'ts and all that sharpen their skills and make them conceptually strong and capable of choosing the right things and perform as per system's requirement.

Users develop learning skills on various variable instruments like vernier caliper, micrometer, height gauge, depth gauge, puppy dial, plunger dial, bore gauge, bevel protector etc. on attribute gauges (go/nogo gauges) like plug gauge, snap gauge, ring gauge, thread plug gauge, thread ring gauge, setting rings etc. and on special purpose gauge like radius gauge, feeler gauge, thread pitch gauge, measuring pins etc.



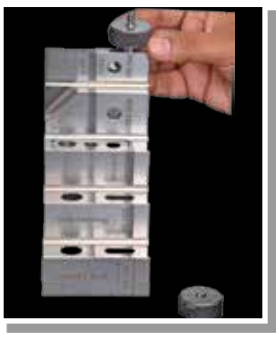
- Important fundamentals and key principles of dimensional metrology -

Seven main elements for a robust dimensional measurement and inspection system, "right people, right instrument, right part, right method, right standard, right environment, right assumption", P.I.S.M.O.E.A. error model.

In an era where science, engineering, technology and material standards of living are changing rapidly, the effectiveness of skills in translating concepts, dimensions and designs from imagination to commercial reality, is the ultimate test by which an industrial economy succeeds and organization grows.

Thread Plug Gauge

Thread Pitch Gauge



Setting Ring Gauge

Thread Ring Gauge

Application of various instruments and gauges

Apart from that users understand various terms, parameters and symbols of metrology and get introduced themselves with so many advance measuring instruments and their specific uses like coordinate measuring machine, profile projector, vision system, form tester, roughness tester etc. and also acknowledge inspection reports of various testings for their exceptional learning and development.

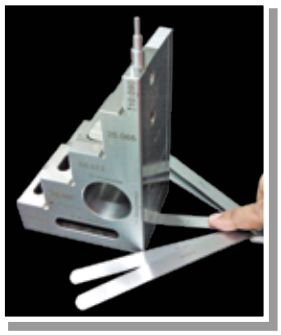
Kit develops people with understanding of some important aspects like, What to measure? Where to measure? How to measure? When to measure? Suitable instruments, adequate environment conditions and other resources which are required for a perfect measurement and so they do "measurement with sense and high confidence level".

They also learn how they should hold the instruments to obtain high accuracy and precision, applying pressure on instrument in different conditions, selection of material as per wear pattern or uses, periodic maintenance, calibration, setting of various masters, reading of vernier scale and calculation of least count with different varieties of instruments and gauges.

It makes the users multi skill, confident, sensible, realistic, industry ready, to perform from the very first day of his working. This fills talent gap of people and motivate them to produce world class, defect free quality products. Further practicing Quick Check Kit with variety of instruments makes them enable to reduce measurement system variability by various sources like part, person, environment, method etc. as discussed earlier.

The user learns various principles and theories like Abbes principle, Hertz theorem, parallax error, accuracy, precision, misalignment error, thermal coefficient error, thermal stability etc. This rich learning makes them expert of metrology and helps to carryout lots of inspection work accurately in industry, like the inspection of dies, components, tooling, machine parts, fixture etc.

Plug Gauge



Feeler Gauge

Radius Gauge

Snap Gauge

The accuracy of an instrument indicates how well it agrees with the true value.
The precision of an instrument refers to the dispersion of measurements.
Thus choosing the right equipment for the job is extremely important for less uncertainty in results.

Calibration - "Calibration process is a set of operations that establish, under specified conditions, the relationship between a measuring device and a traceable standard of known reference value and uncertainty".
Traceability - An unbroken chain of comparisons with national or international standards with known uncertainties.

Quick Check as a calibration and verification master

Why calibration process is required for instruments & gauges ?

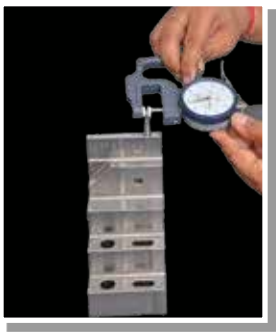
Calibration of instruments and gauges is a very essential process for any manufacturing unit because it ensures real time availability of right instruments at workplace and exposes defective instruments from the process. In other words, it controls measurement system. That's why it's a mandatory requirement of all international standards and quality systems like ISO: 9001, QS: 9000, TS: 16949, Ford Q1 etc.

Quick Check works as a calibration or verification master to check various measuring instruments at workplace by user itself, checking frequency can be daily, weekly or prior to use or as specified. It can check various instruments like vernier caliper, micrometer, depth micrometer, height gauge, dial indicator, depth gauge, bevel protractor, thickness gauge, inside-outside caliper, v-block, try square, electronic probe, bore gauge, combination set etc.

Quick Check can check instruments with different ranges, least count, make and models available worldwide. It works like a paperless office and exposes faulty or wear instruments in the system timely. This strengthens measurement system and increase confidence level of user and reduces rework, rejection and wastage in supply chain caused by wrong measurement or measuring instruments.

Quick Check is very compact and its single piece construction has no loosen accessories, like slip gauges because it is very difficult to maintain master instruments with accessories at workplace and sometimes improper selection or fitment of loosen accessories incurs huge error in calibration process.

Quick Check can check status of any drop down / broke down instruments within few seconds. This makes it the user's first choice as a surveillance master.


Thickness Gauge


Dial Depth Gauge


Vernier Depth Gauge


Outside Micrometer


Snap Micrometer


Bevel Protractor

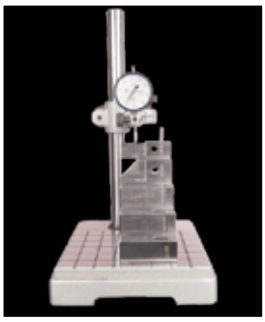

Lever Type Dial


Combination Set

Instrument calibration required, when purchase a new instrument, after repair or modification, after a specified time period or uses, before a critical measurement, sudden changes in weather and other environmental conditions, as specified by customer, as per national and international standards.

Periodic calibration and daily calibration - These two systems are not exclusive alternatives, rather they complement each other and must run parallel together. They create most reliable calibration system in a manufacturing industry, lapse of any one, may create blunders in measurement process.

Digital Caliper OD Jaws



Plunger Dial

Dial Thickness Gauge

Digital Height Gauge

Quick Check does not require special skills to handle it. It is very simple, just like as length standard and all dimensions are broadly laser marked, any person with some basic knowledge of inspection and measurement process can check his various instruments easily without any help with less measurement uncertainty.

Daily calibration or verification of instruments gives assurance of adequate working of all precision devices at shop-floor, in between two periodic calibrations. This system works as a wonderful feedback mechanism to understand behavior and wear pattern of instruments and the user can make some changes in periodic calibration system to run defect free manufacturing process.

Benefits of Quick Check in Calibration Process

IT REDUCES :

- Physical movements of instruments, people and paper work
- Inspection failures, rework, rejection and wastages
- Measurement uncertainty, bias, linearity, gauge R&R error
- Dependency, delays and wrong interpretation of results
- Calibration cost, inventory cost and cost of master instruments

IT IMPROVES :

- Accuracy and reliability of measurement process
- Subject knowledge, awareness and confidence level of users
- Inspection quality, consistency, uniformity and capability
- Working life and all time availability of measuring instruments
- Efficiency, stability and repeatability of measuring instruments

Depth Micrometer

Flute Micrometer

Digital Caliper ID Jaws

Bore Gauge

Uncertainty of measurement - A parameter, associated with the result of a measurement, that characterizes the dispersion of the values that could reasonably be attributed to the measurand. High measurement uncertainty shows volatile process, so it should be always very less as possible.

Drawing is the language of engineers and GD&T is the language of drawings. It is used to describe the allowable variances of manufactured feature sizes, shapes and locations beyond that which can be controlled by regular rectilinear, angular dimensions and tolerances in conventional drawings.

Quick Check Kit as an artifact to understand various Geometric Dimensioning & Tolerancing (GD&T) parameters and terms practically

Co-axiality

Profile

Straightness

Angularity

What is GD&T ? Why it is so important ?

GD&T is a language used on mechanical engineering drawing. It is composed of symbols that are used to efficiently, accurately communicate geometry requirements for associated features on component and assemblies.

In today's environment knowledge of GD&T parameters is very important. Every drawing, engineering specification, technical literatures are full with GD&T signs, without GD&T parameters no drawing can be completed and so the user must understand GD&T parameters like roundness, flatness, perpendicularity, parallelism, concentricity, runout, position, cylindricity etc.

GD&T is a simple and efficient method for describing the tolerancing mandated by the designer for the part and good of standardization, interchangeability and minimum conflict with customers. This methodology forces the designer to consider all functions, manufacturing process and inspection methods and assembly conditions for the part.

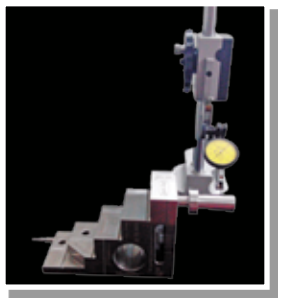
The result is larger tolerances that guarantee function but reduce manufacturing and inspection costs. Also the bonus or extra tolerance for certain conditions can result in significant production cost savings. In addition, the time to analyze, whether a missed dimension is acceptable, is dramatically reduced.

As we know drawing is the language of engineering thus GD&T is lifeline of drawing. It gives lots of strength to drawing to represent so many features in less word and space, and increases its efficiency in a vast way.

Worldwide organizations which require accurate, compact and common lines of communication between engineering design, manufacturing, quality and customer expectation consider GD&T as their mechanical drawing standard.

Perpendicularity

Parallelism



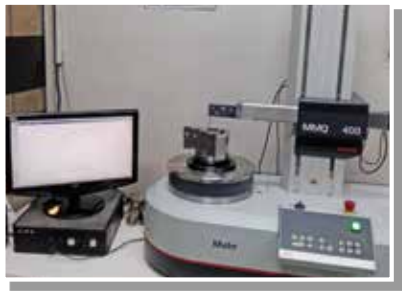
Runout

Flatness

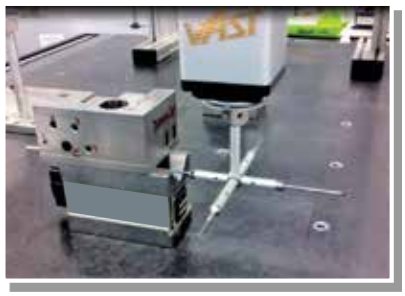
DRF is the most important concept of GD&T in order to manufacture or inspect a part with drawing, three plane concept is necessary and they must be mutually perpendicular (90° to each other), the same is needed and created to measure form, in GD&T this is called DRF, Datum Reference Frame.

Major concepts of GD&T : DRF - datum reference frame, FCF - feature control frame, MMC - maximum material condition, LMC - least material condition, RFS - regardless of feature size.
Location tolerance, Profile tolerance, Runout tolerance, Orientation tolerance, Form tolerance.

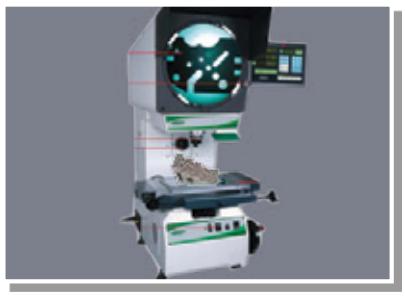
	SYMBOL	NAME	ON DRAWING	TOLERANCE ZONE	GAUGING
FORM		Straightness			
	Ⓜ	Straightness			
		Flatness			
	Ⓜ	Flatness			
		Circularity			
		Cylindricity			
ORIENTATION	//	Parallelism			
	⊥	Perpendicularity			
	⊥Ⓜ	Perpendicularity			
	∠	Angularity			
PROFILE	⌒	Profile of a line			
	⌓	Profile of a surface			
LOCATION	⌖	True Position			
	⌖Ⓜ	True Position			
	◎	Concentricity			
	≡	Symmetry			
RUNOUT	↗	Runout			
	↗↗	Total Runout			



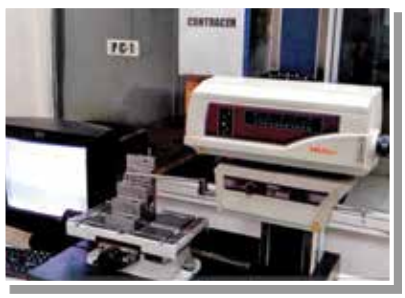
Roundness Tester



3D Coordinate Measuring Machine



Profile Projector

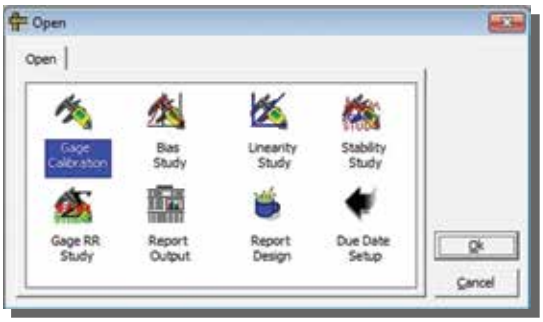


Roughness & Contour Tester

GD&T is a clear and concise technique for defining a reference coordinate system (datum's) on a component or assembly to be used throughout the design, manufacturing and inspection processes. It dramatically reduces the need for drawing notes to describe complex geometry requirements and use standard symbology.

Quick Check not only builds your confidence, it helps you to analyze the data to improve further and make it a journey for continual improvement, to achieve higher productivity, exceptional quality, zero defect, appropriate cost, like goals etc. to retain your valuable customer in this competitive world.

Quick Check Educational Kit with "MSA Expert Software"
A complete package for manufacturing excellence



MSA Expert Software is a very wonderful analytical tool and a calibration management software for instruments and gauges. It gives valuable information and feedback about the running process and guide for betterment. It emphasis on defect prevention rather defective prevention methodology and habits to achieve manufacturing excellence.

It helps people to grow and encourage them to become creative, innovative and motivated to be ahead in competition. **Concept of Quick Check starts at student level and continue with industry after creating world class manpower.** These people are not only good in measurement techniques rather they produce more with less input with consideration of sustainability.

It teaches selection and operational skills of instruments to user.

It teaches calibration process and its importance to user.

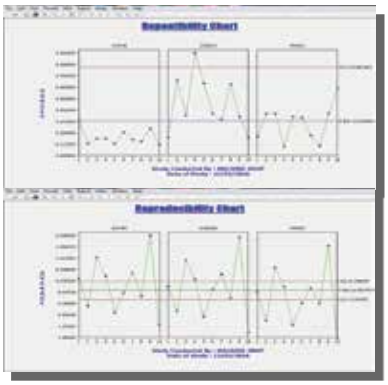
It teaches GD&T and important fundamental of drawing to user.

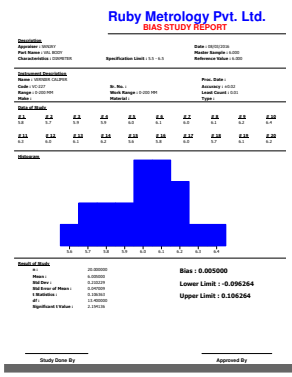
It teaches analysis of measurement data with software.

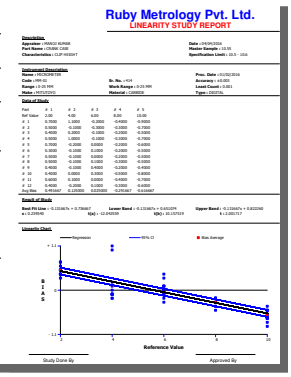
It teaches people how to read inspection reports of different measuring instruments.

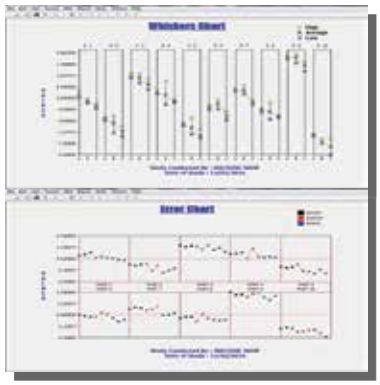
So we can say it's a complete package for manufacturing excellence.

The user understand terms like sensitivity, uniformity, anova, gauge performance curve, discrimination, measurement uncertainty etc. They conduct various MSA studies like bias, linearity, stability, gauge repeatability & reproducibility.









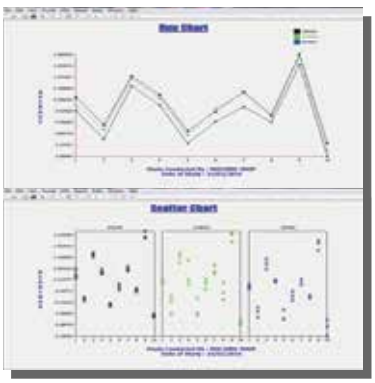
Bias, Linearity, Stability, Gauge Repeatability & Reproducibility are main five errors in measurement system. GR&R is an estimate of the combined variation of repeatability and reproducibility and it is sum of within system and between system variances.

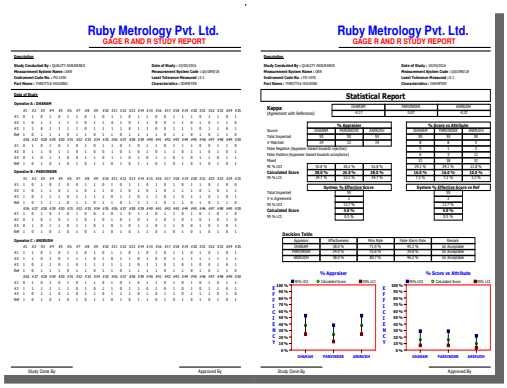
Measurement system - A collection of instruments, standards, methods, fixture, environment, software, personnel etc.
Measurement process - The assignment of numbers or value to the material things to represent the relations among them with respect to particular properties.

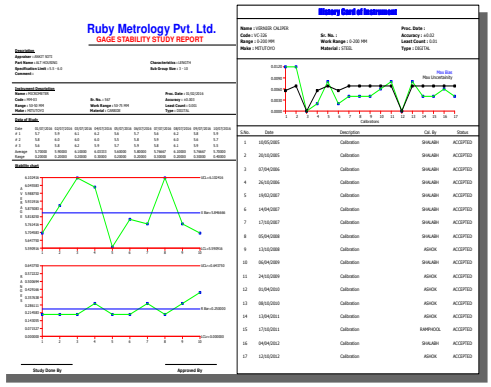
Now we can say, Metrology is not just a process of measurement that is applied to an end product. It plays a vital role in advance manufacturing so it should also be one of the considerations taken into account at the design stage. According to the Geometrical Product Specification (GPS) model, tolerancing and uncertainty issues should be taken into account during all stages of design, manufacture and testing. The most compelling reason is that it is often considerably more expensive to re-engineer a product at a later stage when it is found that it is difficult to measure, compared to designing at the starting stage with consideration of metrological needs in mine.

Besides this lots of studies show that technological development and industrial advancement in any country cannot be achieved without the improvement of national capability in the precision measurement. For this imparting knowledge of dimensional metrology to students and other people is very crucial and must be provided on priority for sustainable development of people, society, environment and country as a whole.

Quality output needs quality input from all sources like man, machine, method, money, environment, material etc. Further operational excellence is an element of organizational leadership that stress the application of a variety of principles, systems and tools toward the sustainable improvement of key performance metrics and to create industrial benchmarks and to achive perfection.







Various studies of Measurement System Analysis (MSA) are quality tools, like other statistical tools. All quality tools are based on assumptions, If you violate the assumptions the tool becomes unpredictable and could lead to a false conclusion, so special care and fundamental knowledge is really essential during analysis process.

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