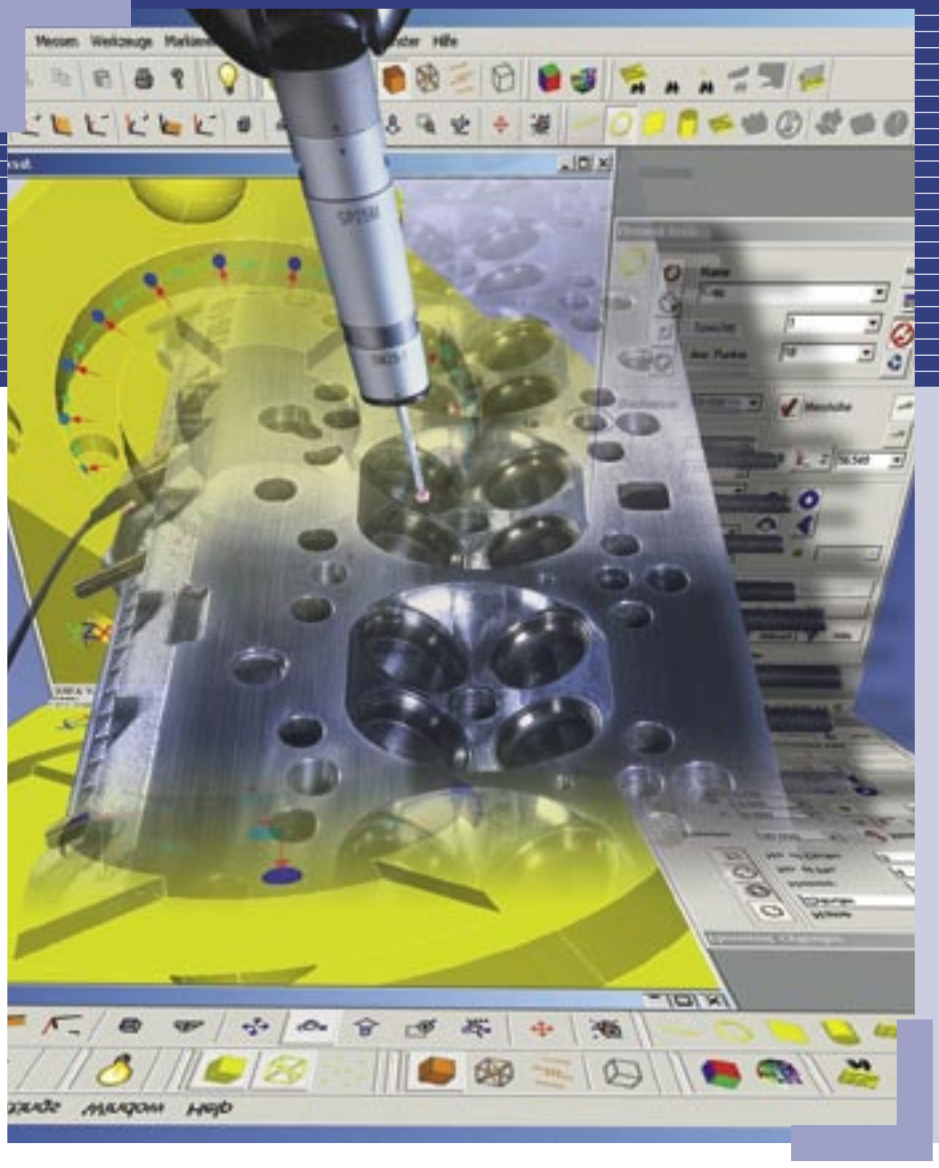
Data Processing System for Manual/CNC CMM

MCOSMOS

Catalog No. E4180-525



MiCAT

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CMM

High-specification user-friendly software for CMM

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MCOSMOS

Adoption of Windows XP as the OS

MCOSMOS is a new data processing program family for any type of coordinate measuring machine (CMM). This is a modular system running under the Windows XP operating system.

Simple Operation

This program does not need to use specific code numbers since it adheres to the Windows standards and allows measurement procedure to be selected from icons or pull-down menus.

Supporting Manual and CNC Measurement

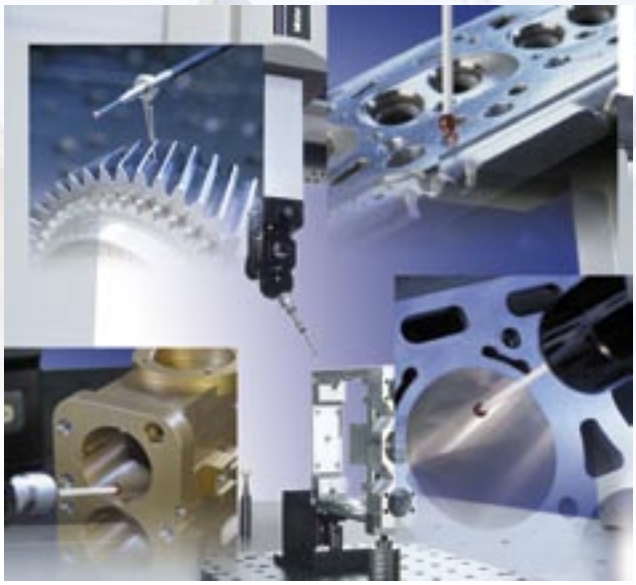
MCOSMOS is available in two versions: one for a manual type CMM and one for a CNC type CMM. Both use a consistent mode of operation to handle manual or CNC measurement tasks.

Multifunctional Graphic Display of Measuring Elements

This program not only can graphically display an element determined by measurement/calculation, but also can invoke an element by clicking directly on its graph with the mouse.

Customizing a Screen Configuration

The user can freely choose to display or not display any window, set the display size and position of graphics to customize a screen configuration for maximum user-friendliness.



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System performance from every viewpoint

Performance features of standard software packages.

	MCOSMOS 1	MCOSMOS 2	MCOSMOS 3
	Manual		
	CNC		
PartManager The control center from which the software package is initialized, and individual part programs are managed.	●	●	●
GEOPAK (Geometry module) For (online/offline) part program creation, using the measurement of geometric elements. Extensive tolerance comparisons and output functions are included.	●	●	●
CAT1000P (CAD based programming module) For (online/offline) part program creation, using the measurement of geometric elements directly from the CAD model, with automatic collision avoidance.		●	●
CAT1000S (3D freeform surface evaluation module) CAD model based generation of surface measurement points, and comparison of actual/nominal data, with graphical output.			●
SCANPAK (2D profile evaluation module) For the scanning and evaluation of workpiece contours, and 3D digitizing of surfaces.			●

* CAT 1000S and SCANPAK can be individually added to MCOSMO 1 and MCOSMOS 2.

GEOPAK
(Universal Geometric Measurement Program)

Basic Screen Configuration

Elements Toolbar
• A group of icons for measurement of point, line, plane, circle, ellipse, cone, sphere, cylinder, curve, curved surface, and gear elements. Click on the icon of an element to be measured to display a sub-window which allows you to change the number of input points, select a calculation formula, invoke an element from memory, combine multiple elements, calculate the point(s) of intersection of two elements, and so on.

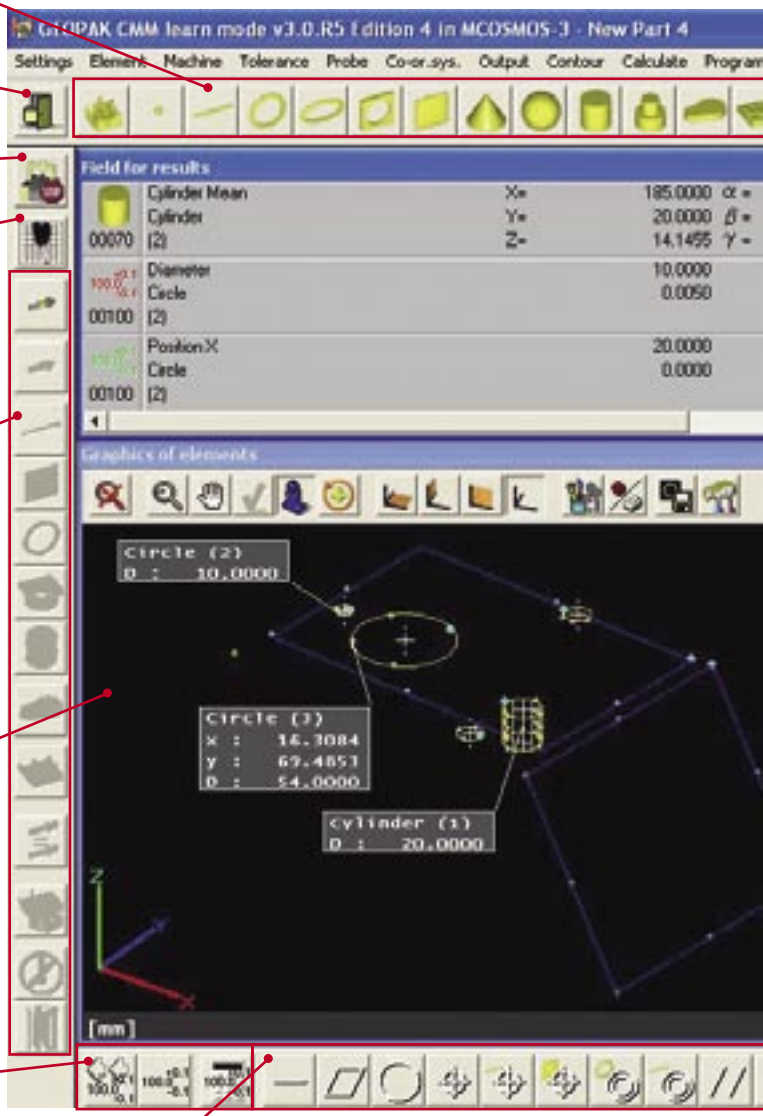
Measurement End Instruction Icon

Emergency Stop Icon
• Implements an emergency stop during CNC measurement.

Probe Setting Icon
• Provides optional functions such as probe replacement and stylus replacement in addition to basic functions including probe information key-in, correction and deletion, and file storage and invocation.

Auto Element Toolbar (CNC)
• Provides the function of auto-measuring a point, line, plane, circle, cylinder or curve by giving design values, the number of input points, etc.

Element Drawing (Measurement Result Graphic Display) Window
• Graphically displays measurement results in real-time (Auto-magnification).
• Recalls an element from memory by clicking its graph with the mouse.



Tolerance Zone Measurement Toolbar
• Performs tolerancing on a measured or calculated value from the design value and tolerance.

Form/Orientation Deviation Calculation Toolbar
• Performs tolerancing for straightness, flatness, roundness, position, concentricity, coaxiality, parallelism, squareness, angularity, symmetry, runout, or profile. (Profile tolerancing is optional.)

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- **Software program for universal geometric measurement of a workpiece.**
- **This program allows measurement operation with the same operational feeling as Windows.**
- **The program has achieved extraordinary ease of operation by a new method using toolbar/icon menus and totally without using any code or code number.**

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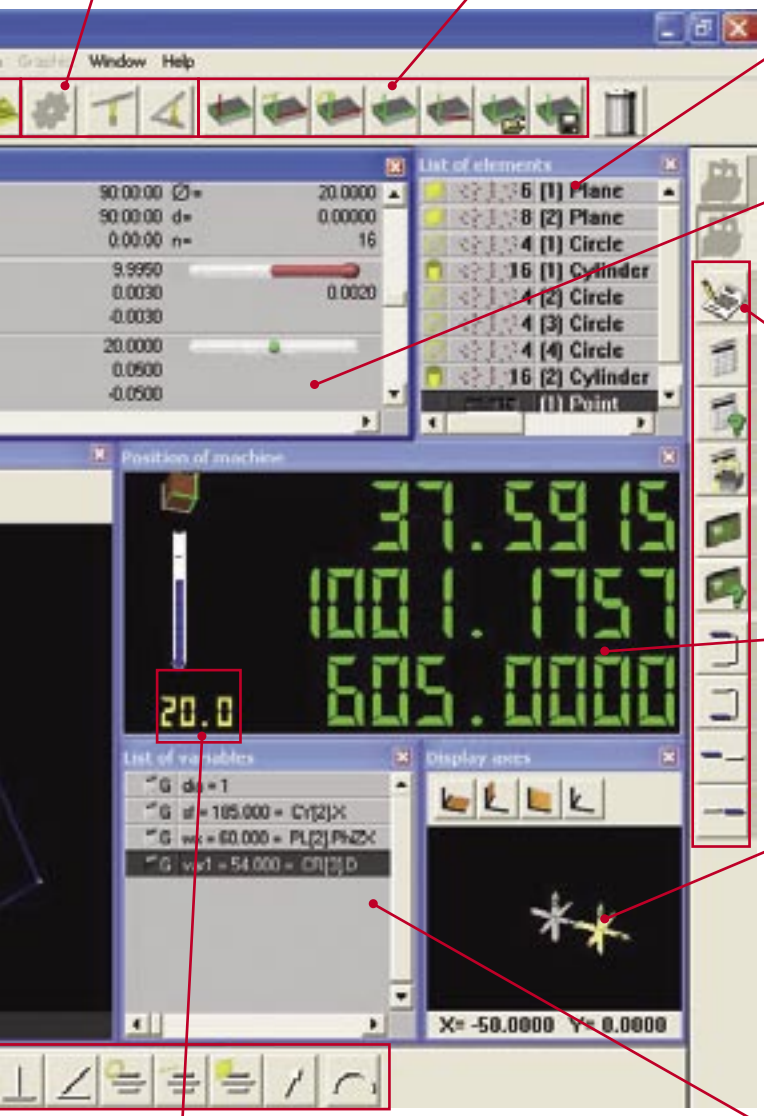
cmm

Distance Calculation Toolbar

• Performs calculation of a distance or an angle by specifying two elements that have been measured.

Coordinate System Setting Toolbar

• Sets up a coordinate system by setting a reference plane, reference origin, or reference axis, or axis rotation, etc. It also can store reference coordinates that have been set or recall them from memory.



Element List Window

• Displays elements that have been measured/calculated in a list.

Measurement Result Display Window

• Displays measurement results and tolerancing results for each design value.

Program Control Toolbar

• Inserts various control statements in a part program to perform logical operations, such as looping the program over a certain section and branching according to defined conditions.

Counter Display Window

• Displays the current position readout from the X, Y and Z scales.

Coordinate System Display Window

• Graphically displays the correlation between the machine coordinate system and part coordinate system. When measurement is performed while the coordinates are displaced frequently, this window allows easy confirmation of the current part coordinate position. It can also change the viewpoint of the coordinate system.

Variable List Window

• Displays the substituted variables in a list.

Current Temperature Display

• Displays the current reading from each temperature sensor. (Only for a CMM equipped with the temperature compensation function.)

PART MANAGER

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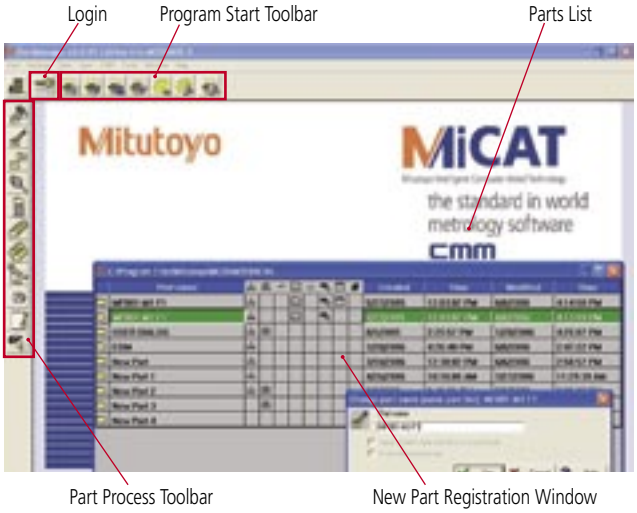
PART MANAGER

PART MANAGER manages measurement parts and starts various programs.
The Part Manager registers and manages the part programs to be used on a CNC type CMM and the measurement procedures for a manual CMM.



●Login

- An operator logs on to the system by entering their User Name and password. This makes it possible to set User Rights for each operator.

<Example of Priority>

	Class	User Rights
Operator A	Admin	All system operations including the changing and registration of User Rights
Operator B	User	All measurement operations including the creation of part programs
Operator C	User	Running part programs

● Program Start Toolbar

- Starts GEOPAK, part editor, CAT1000PS, etc.

● Part Process Toolbar

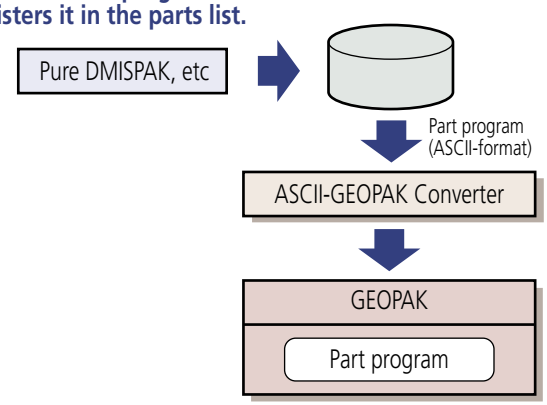
- Provides such functions as new part creation, part name change, copy, deletion, search, registration/output of graphics (.BMP file) and voice (.WAV file), and head data input.

● Parts List

- Displays the list of parts that have been already created. In the column right to part names, a data type (GEOPAK part program, CAT1000S CAD data, statistical data, memo data, graphics/voice file, or head data) included in each part is displayed with a symbol, giving you an at-a-glance configuration of data.
  Double-click on a data type button, then the program will start if data exists.
- If graphics have been registered in parts, the parts list can be displayed with the graphics. This allows you to check the form of a workpiece to be measured next to a picture or photo. (Double-clicking this picture starts the program.)

ASCII-GEOPAK Converter

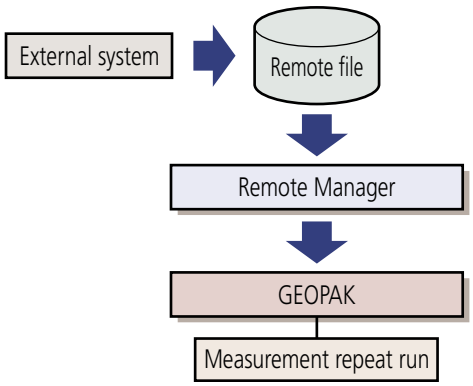
This converter reads an ASCII-format part program created by an external program such as Pure DMISPAK and registers it in the parts list.



Remote Manager

Provides a remote start function for GEOPAK.

- **When a specified format file is written in the communication folder, the remote manager reads the file and starts the GEOPAK program according to the file contents.**
- **Sharing the communication folder on the network allows file writing from other computers and remote instructions for repeat runs of GEOPAK.**



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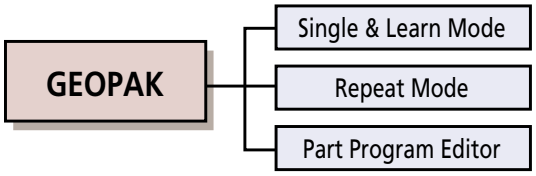
Three Measurement Modes

GEOPAK has three modes of operation.



● **Single & Learn Mode**
Performs usual single-workpiece measurement. At this time the measurement procedures are stored as parts and available in the Repeat mode.

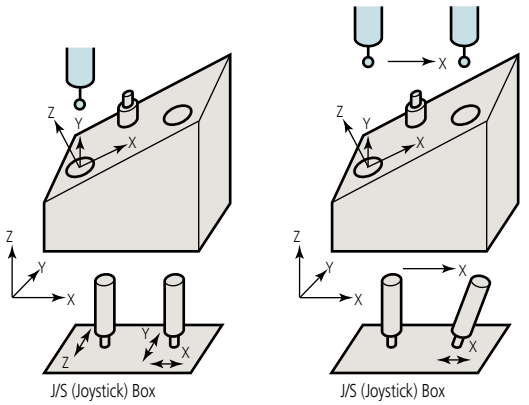
● **Repeat Mode**
Performs measurement according to the part program or procedure. A CNC type CMM performs automatic measurement.

● **Part Program Editor**
Allow a part program or procedure to be edited.

Probe Movement by Joystick (CNC)

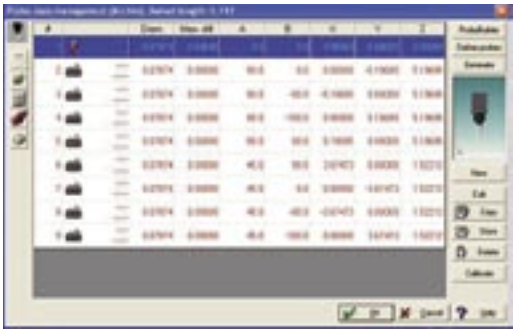
The CMM probe can be moved parallel with an axis of a part coordinate system (PCS) by tilting the joystick. (It is only effective for CMM with this function).

(Movement parallel to an axis)



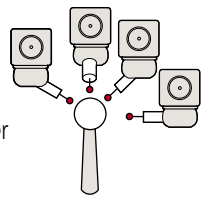
Useful Probe Setting Functions

● **Probe Data Manager**
Performs creation, edit (change), copy, delete, or storage of probe data and calibration (compensation of stylus ball center position and diameter by probing the master ball).
A set of probe data that has been registered can easily be selected by highlighting that data set with the mouse. (See figure below.)



● **Probe Builder**
Builds the probe configuration to be used by selecting a probe and stylus from the screen. Auto-calibration can start with the built probe configuration.

● **Auto Calibrate Probe (CNC)**
Automatically performs probe calibration just from one probed point on top of the master ball, made using the joystick.
This function has drastically reduced the number of man-hours compared with the conventional method of step-by-step instruction.



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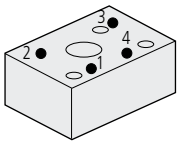
User-friendly Coordinate System Setting

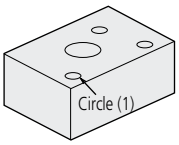
Sets up the coordinate system for a workpiece placed anywhere within the measuring volume.

● Coordinate System Definition Using a Predefined Element Sequence

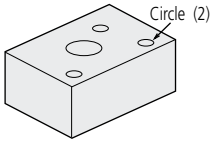
- Probing sequences using eight predefined combinations of typical workpiece elements are available to define the part coordinate system. The most appropriate sequence for any particular workpiece is invoked by selecting the corresponding menu icon.
- In contrast to conventional coordinate setting, you can change an element within a sequence and the number of points that define its orientation.



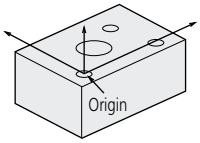
1. Defining a datum plane



2. Probing a circular element to set up the origin



3. Probing a circular element for axis alignment



4. The completed part coordinate system definition

● Coordinate System Definition Using the Separate Element Functions

A part coordinate system can also be defined by combining coordinate system setting functions and element measurement functions.

[Coordinate Setting Toolbar]

- Plane alignment (part inclination alignment, height origin setting)
- Axis alignment parallel to an axis (axis alignment with a line, cylinder axis, etc.)
- Axis alignment with reference to a point (axis alignment with a point, circle center point, etc.)
- Offset axis alignment (axis alignment with a point off the axis)
- Origin setting
- Translation and rotation of the coordinate system (translation/rotation by key-in)
- Coordinate system call
- Coordinate system storage
- RPS correction (coordinate system setting with a measurement point and design value)
- Coordinate system best-fitting

A Rich Choice of Elements and Calculation Methods

Single and multiple element measurement options and calculation methods are available.

- Point (point/point with radius compensation/side face/midpoint/intersection point)
- Line (line*/bisector line/line of intersection/tangent line)
- Circle (circle*/intersection circle/intersection circle/tangent circle)
- Ellipse (ellipse/tangent ellipse)
- Inclined circle
- Plane (plane/bisector plane)
- Cone
- Sphere (sphere/tangent sphere)
- Cylinder
- Stepped cylinder
- Contour (option)
- Surface (option)
- Gear tooth surface (option)
- Distance (maximum/central/minimum/spatial distance)
- Angle (real surface/spatial/supplementary angle)

* The calculation method can be chosen as the least squares, circumscribed circle, inscribed circle or minimum zone methods.

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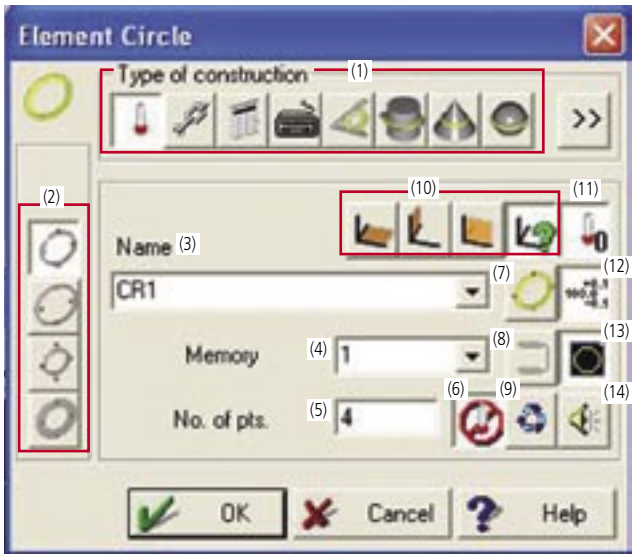
● Sub Window

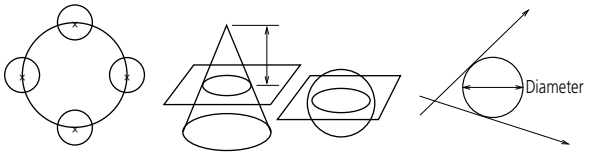
When an element measurement is selected, a sub window will appear. This window allows setting a calculation method, changing the number of input points, and other settings.

[Sub Window appears after Selection of Circle Icon]



(1) Element measurement method selection

This toolbar allows selection of real input, combination, call from memory/recalculation, creation of theoretical circle by key-in, intersection of circle between a plane and a cylinder/cone/sphere or height up to the specified intersection circle radius, two-axis tangent circle, etc.



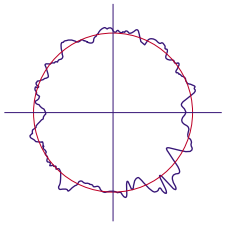
[Combination]
Calculates a new element created in combination with other elements.

[Intersection circle]
By specifying a circle created by intersecting two elements or the circle diameter, it is possible to calculate the height to an apex.

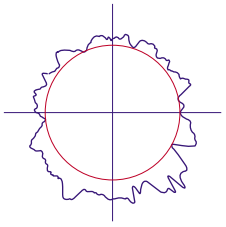
[Intersection circle]
Calculates the position of circle that touches two line elements. (A diameter is given.)

(2) Calculation formula selection

This toolbar selects a calculation method for circle measurement from among the least squares, inscribed circle, circumscribed circle or minimum zone methods.



[Least square method]
Determines the circle that makes the sum of the squares of the deviation between that circle and the measurement data a minimum.



[Inscribed circle method]
Determines the largest diameter circle that inscribes the measurement data.

(3) Element name

An arbitrary name can be given to an element to be measured.

(4) Memory number

Specifies the memory location number for an element.

(5) Number of input points

The number of measurement input points is specified here. No limit is placed on the number of points.
(The upper limit is dependent on computer performance.)

(6) Unspecified number of input points

If the number of measurement input points is unknown, this icon is turned ON. Measurement can be interrupted at any given number of points during measurement.

(7) Auto-measurement ON/OFF (only for CNC CMM)

Auto-measurement can be performed just by specifying a design value.

(8) Memory location increment

To automatically increment an element memory number during looping, this icon is turned ON.
(Usually, if the command is specified in the loop, the icon is automatically turned ON.)

(9) Repeat measurement

This icon specifies whether or not to repeat the same measurement.

(10) Datum plane

This toolbar specifies the datum plane for circle calculation manually or by auto-selection.

(11) Datum plane projection ON/OFF

Specifies whether or not to perform projection onto the datum plane.
A circle is calculated as that projected on the datum plane if this icon is turned ON and as that located at the mean height of input points if it is turned OFF.

(12) Tolerance zone measurement ON/OFF

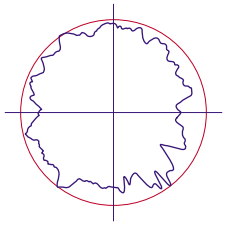
Specifies whether or not to perform tolerance zone measurement. If this icon is turned ON, the Tolerance Zone Measurement Setup window (see page 11) is automatically opened after the end of element measurement.

(13) Graphics ON/OFF

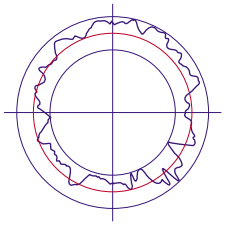
Specifies whether or not to display an element graphic on the input point number counter.

(14) Voice ON/OFF

Specifies whether or not to inform you of the count of input points by voice.



[Circumscribed circle method]
Determines the smallest diameter circle that circumscribes the measurement data.



[Minimum zone method]
Determines the circle that is equidistant between two concentric circles that enclose the measurement data so as to produce the minimum separation.

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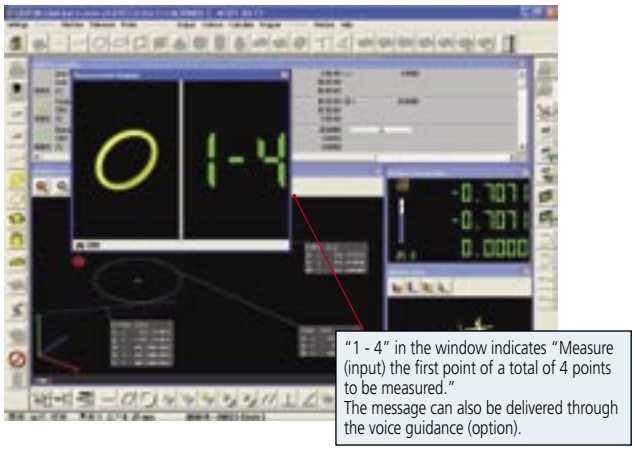
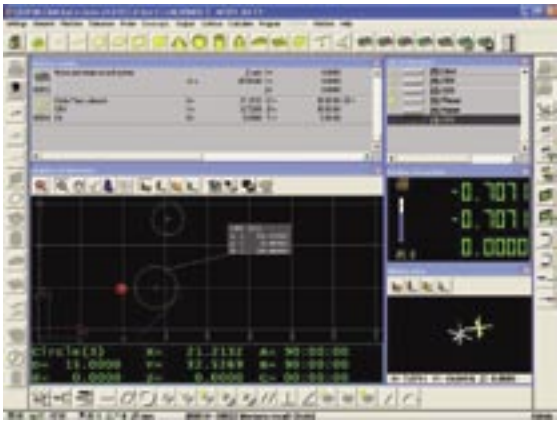
● Measurement/Measurement Result Display

When a measurement element is selected, the Measurement Display (Measurement Point Number Display) window appears. Now, you can start by measuring the position of a point.

[Measurement/Measurement Result Display]



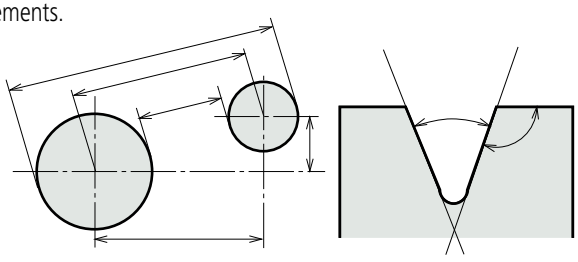
"1 - 4" in the window indicates "Measure (input) the first point of a total of 4 points to be measured."
The message can also be delivered through the voice guidance (option).



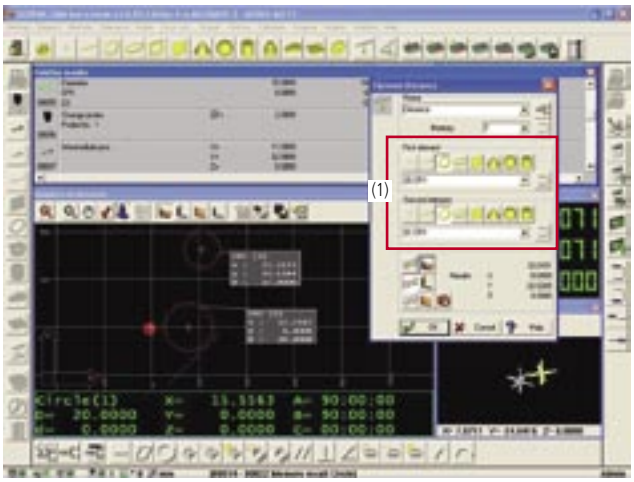
When measurement (input) has been completed, actual measurement values are displayed in the Result Display field (window) and the graphics of measured elements are displayed in the Element Drawing window. (Auto-magnification and zooming are possible in drawing.)

● Distance/Angle Calculation

Performs calculation of a distance or angle by specifying two elements.



[Measurement Example of Distance (Pitch) between Two Circle Centers]



In this example, after circle data has been collected (circle 1 to circle 3), the distance between the centers of circles 1 and 2 is measured. At this time circle 1 and circle 2 can also be selected from the pull-down list shown in (1). However, these circles can be selected more easily by directly clicking on their graphics displayed in the Element Drawing window. (Selected graphics are marked with red numerals.)

Tolerancing (Tolerance Zone Comparison)

Compares element data from measurement or calculation against the design value for a specified tolerance.

● Element/Form Tolerance Zone Measurement

The measurement result for an element is analyzed by specifying the element that has been measured or calculated and giving the design value and tolerance to be applied.

[Items That Can Be Toleranced for Each Element]

Elements	Items to be specified
Point	Coordinate
Line	Coordinate, angle, straightness
Plane	Coordinate, angle, distance, flatness
Circle	Coordinate, radius/diameter, roundness
Ellipse	Coordinate, minor axis, major axis, ellipticity
Cone	Coordinate, angle, full apex angle/half apex angle, conicity
Sphere	Coordinate, radius, diameter, roundness, sphericity
Cylinder	Coordinate, radius, diameter, cylindricity
Distance	Distance and its individual X, Y, Z component outputs
Angle	Spatial angle, XY-, YZ-, and ZX-projected angles

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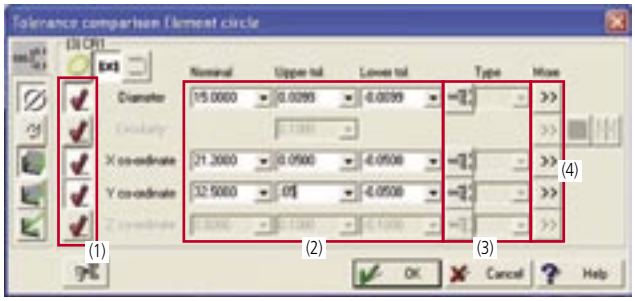
[Circle Element Tolerance Zone Measurement Setup Window]



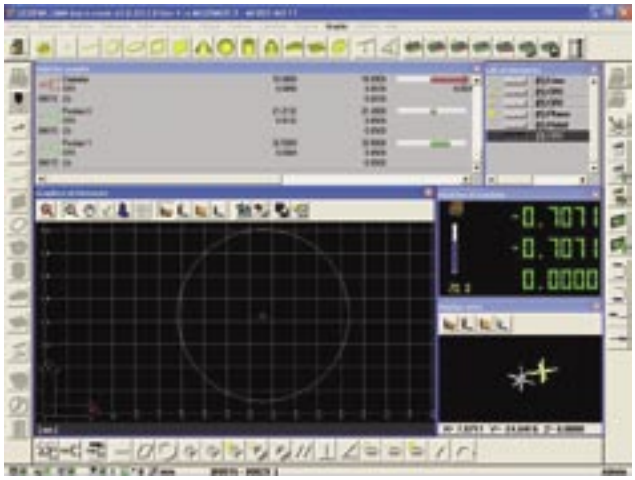
(1) Tolerance zone measurement ON/OFF
Click on the button of an item to be toleranced.

(2) Design value/tolerance input
Enter the design value and upper/lower tolerance limit for each item.

(3) Fitting symbol specification
Tolerancing can also be performed by giving a design value and type of fit symbol.

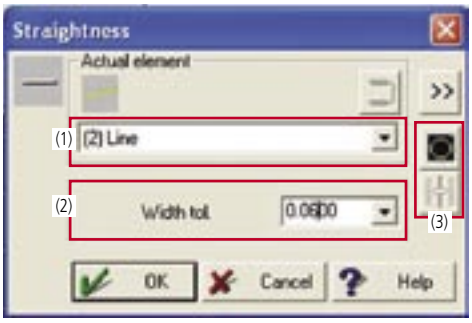
(4) Extended tolerancing specification
Select any of these buttons to output tolerancing data to MeasurLink (Statistical Processing Program).

[Tolerancing Result Compared with Design Value]



When the design data has been entered, tolerancing results are displayed. In the Result Display field, tolerance status is displayed in bar graph form in addition to actual measured values, design values, tolerance limits, and errors for specified items, giving you an at-a-glance status of measured data. (A result within tolerance is displayed green or yellow, and that out of tolerance is displayed red.)

[Straightness Tolerance Zone Measurement Setup Window]

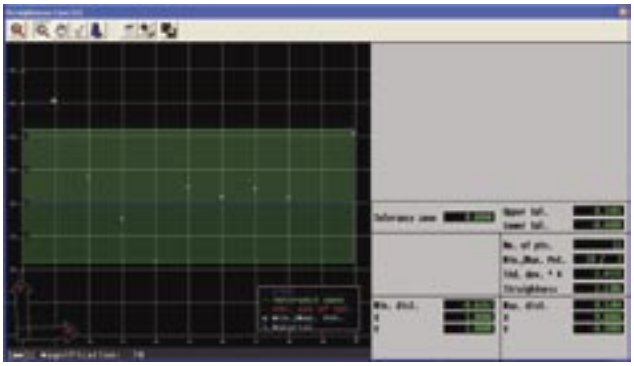


(1) Element identification
Specifies an element for straightness calculation.

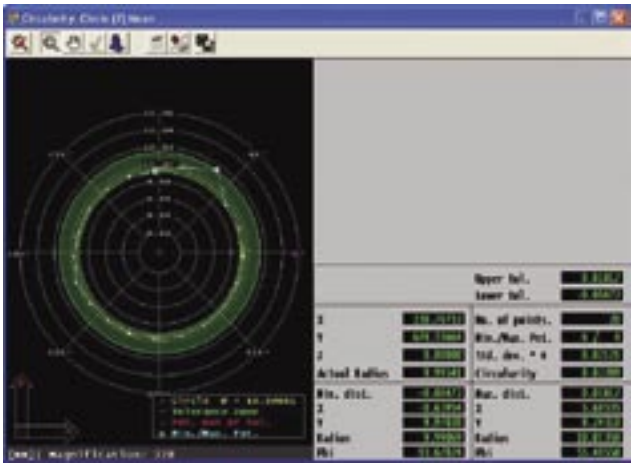
(2) Tolerance specification
A tolerance for straightness is entered here.

(3) Graphical specification
Used to draw a graphic of straightness calculation result.

[Straightness Evaluation Graphic]



[Roundness Evaluation Graphic]



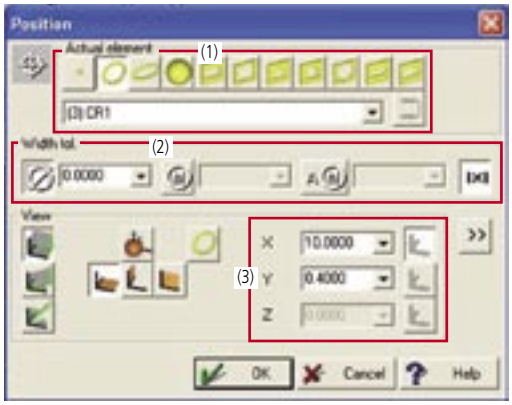
* The window can also draw graphics for flatness and runout.

GEOPAK

Positional Deviation Tolerance Zone Measurement

Performs calculation of positional deviation, concentricity, coaxiality, and symmetricity by specifying two elements that have been measured or calculated.

[Positional Deviation Tolerance Zone Measurement Setup Window]



(1) Element identification

Identifies an element for which positional deviation tolerancing is to be performed.

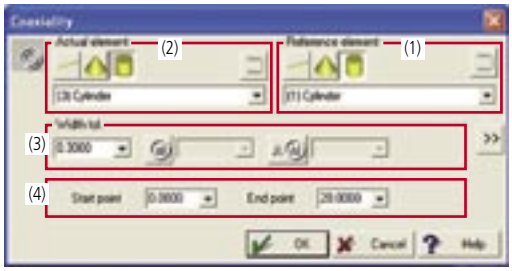
(2) Positional Deviation Parameter Setting

These fields specify a diameter tolerance, a positional deviation tolerance, a maximum material tolerance, etc.

(3) Design value input

These fields specify the design values of an element for which positional deviation tolerancing is to be performed.

[Coaxiality Tolerance Zone Measurement Setup Window]



(1) Reference element identification

This field identifies a reference element for performing coaxiality tolerancing.

(2) Element identification

Identifies the element for which coaxiality tolerancing is to be performed.

(3) Coaxiality parameter setting

These fields specify a tolerance, maximum material tolerance, etc.

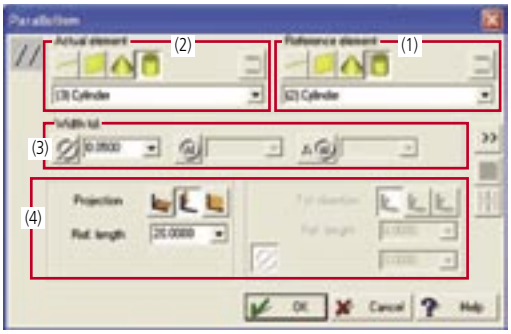
(4) Start point/End point

Specifies a section in which coaxiality evaluation is to be performed.

Orientation tolerance zone measurement

- Performs tolerancing of parallelism and squareness by specifying two elements.

[Parallelism Tolerance Zone Measurement Setup Window]



(1) Reference element identification

This field specifies a reference element for performing parallelism tolerancing.

(2) Element identification

Identifies an element for which parallelism tolerancing is to be performed.

(3) Parallelism parameter setting

These fields specify a tolerance, a maximum material tolerance, etc.

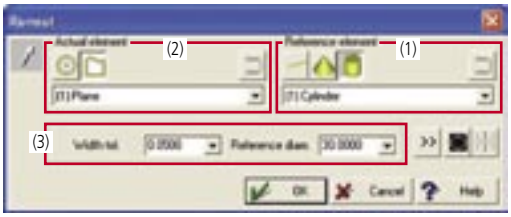
(4) Tolerance zone specification

This field specifies projection/non-projection (space), projection plane, and reference length.

Runout Tolerance Zone Measurement

- This function performs tolerancing of runout.

[Runout Tolerance Zone Measurement Window]



(1) Reference element identification

This field identifies a reference element for performing runout tolerancing.

(2) Element identification

Identifies the element for which runout tolerancing is to be performed.

(3) Runout tolerancing parameter setting

These fields specify a tolerance, a reference diameter, and a radial direction/axial direction.

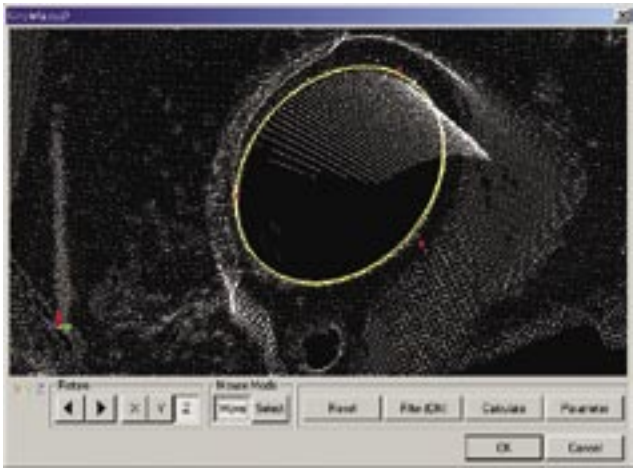
● Line Laser Probe Element Extraction (CNC)

This function extracts geometric elements from point group data obtained with a line laser probe within the specified range.

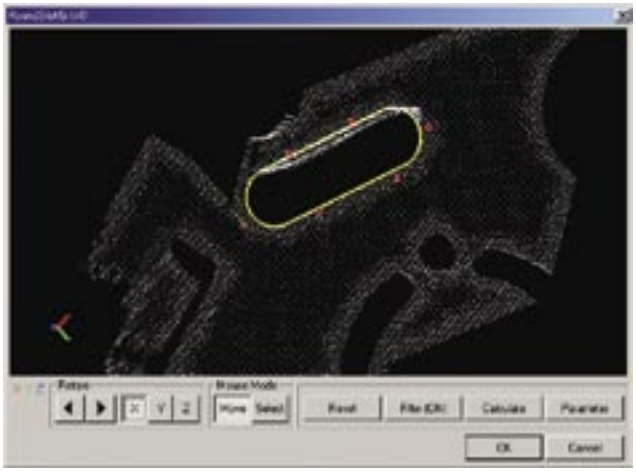
Elements compatible with extraction

- Circle
- Plane
- Sphere
- Cylinder
- Slotted hole
- Rectangular hole

[Circle Element Extraction Example]



[Slotted Hole Extraction Example]



CNC Parameter Setting (CNC)

This function allows setting of traverse speed, approach distance, positioning accuracy and other factors for a CNC type CMM.

[CNC Parameter Setting Window]

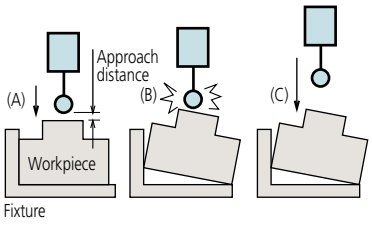
(1) Traverse speed

Sets the maximum traverse speed for the CMM.

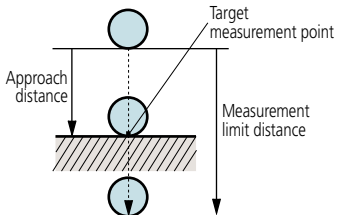
(2) Measuring speed

Sets a measuring speed for the CMM.

(3) Approach distance



Sets the distance at which a CMM probe stylus decelerates from traverse speed to measuring speed when approaching the target measurement point. If the mounting position of a workpiece is only approximate, or if its dimensional variation is large, there is a risk the stylus could bump the workpiece (B) at traverse speed if the approach distance is specified as the ideal minimum (A). If this is the case, this field can be used to guarantee safe operation (C) by making sure the approach distance includes a sufficiently large safety margin.



(4) Measurement limit distance

Specifies the distance at which the probe is allowed to move at the measuring speed if no workpiece is encountered.

(5) Positioning distance during traverse

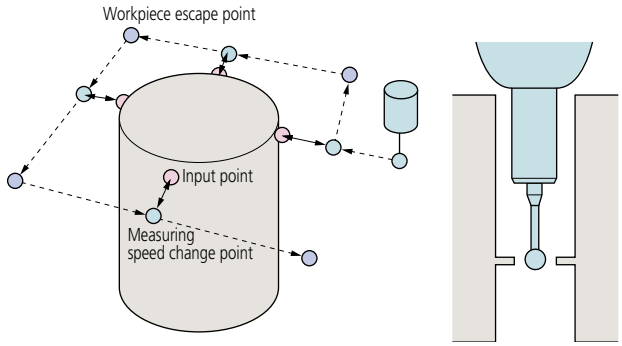
Positioning accuracy at a corner is specified by a distance during traverse.
This function is intended to reduce the traverse time and does not affect the accuracy of measurement positions.

GEOPAK

Auto Element Measurement (CNC)

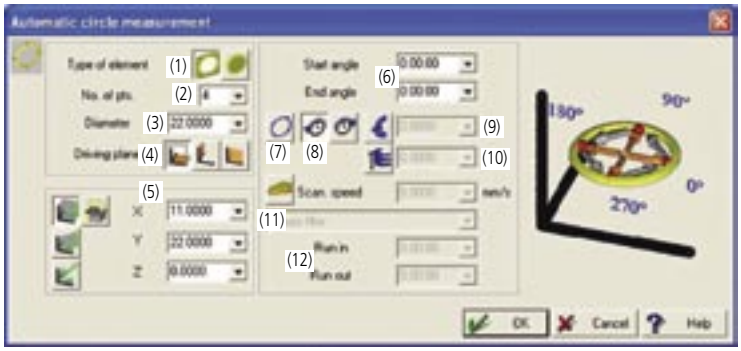
This function performs auto measurement by simple numerical input.

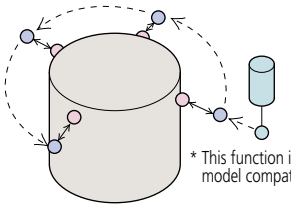
Usually, to perform auto measurement, an auto measurement part program is created by means of teaching, etc., through the remote control. If circle measurement (as shown below) is performed at this time, for example, the workpiece escape point and speed change point must be specified as well as measurement input points. The use of the auto element measurement function makes teaching (programming) unnecessary for all these points. Also, it makes it possible to perform measurements such as accurate positioning at theoretical measurement points (as shown at right)) and equally-divided point input which is difficult with teaching.



The auto element measurement function is also available for measurement of a point, line, plane, and cylinder in addition to a circle.

[Auto Circle Measurement Setup Window]





* This function is only available for a CMM model compatible with circular traverse.

(Figure 1) Auto Circle Measurement by Using the Circular Travel Function

(1) Inside/outside diameter
Specifies the inside or outside diameter of a circle to be automatically measured.

(2) Number of points for auto circle measurement
Specifies the number of points with which a circle is automatically measured.

(3) Circle diameter
Specifies the diameter of a circle to be automatically measured.

(4) Drive plane switch
Identifies the plane on which a circle is positioned.

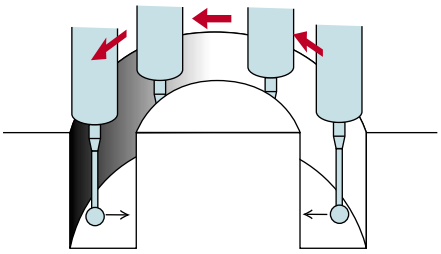
(5) Circle center coordinates
Specifies the center coordinates of a circle to be automatically measured. Cartesian, cylindrical or spherical coordinates can be used.

(6) Partial circle auto-measurement
Enables auto-measurement of a partial circle by specifying the start angle and end angle.

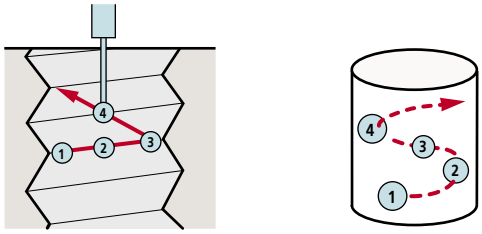
(7) Circular travel
Allows circular traverse of the probe between input points to perform circle measurement at higher speed. (See figure below.)

(8) Measuring direction
Specifies whether auto-measurement of a circle is performed clockwise or counterclockwise.

(9) Circular groove auto-measurement
Enables auto-measurement of the inside or outside diameter of a circular groove so that the probe contact point does not touch the opposite-side wall.



(10) Direct measurement of a tapped hole
If the position of a tapped hole is measured as if it were a plain hole then a large measurement error will usually occur. The conventional way of accurately measuring tapped hole position is to screw a tooling ball into the hole so that the ball can be probed instead. This function offers the faster alternative of probing the thread directly by driving the contact point in a spiral that matches the diameter and pitch. (Registered patent)

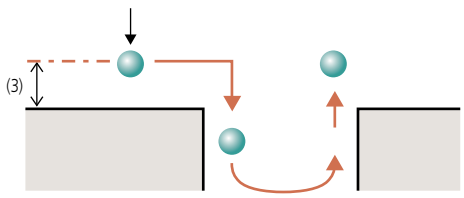


(11) Contour measurement by design value scanning (scanning probe function)
Performs design value scanning at a specified scanning speed. The function enables filter processing at the same time.

(12) Start-up/post-travel angle specification
Specifies a start-up angle and post-travel angle for contour measurement by design value scanning.

[Clearance Height]
The probe contact point can be made to return automatically to a specified height above the table after a measurement.
It is thereby possible to create more simplified part programs by omitting the input of traverse instructions conventionally specified one by one.

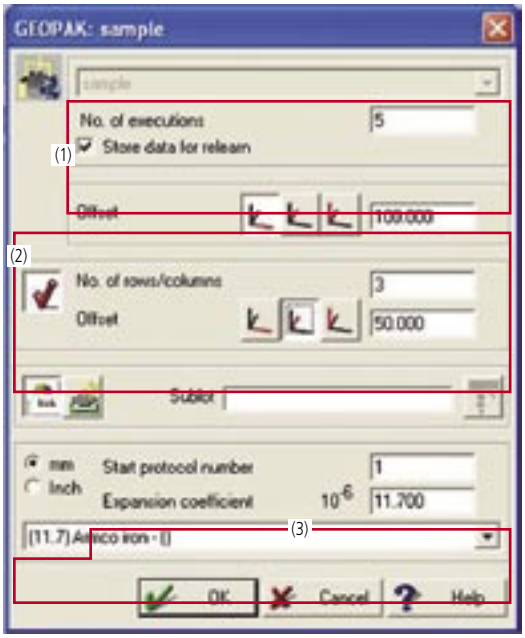
(1) Clearance height ON/OFF
(2) Travel axis selection
(3) Clearance height Z coordinate



The probe contact point travels at a clearance height before and after auto circle measurement.

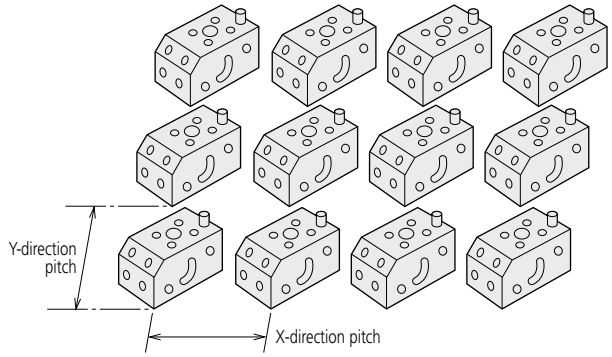
Repeat Mode

This mode implements measuring procedures based on existing part programs.



(1) Part specification
This field specifies the part program and the number of times this program is to run.

(2) Offset values
Used when a number of workpieces are to be measured with one instruction. The workpieces are arranged in a regular 2-D rectangular grid pattern in the XY, YZ or XZ planes at a specified pitch in each direction.



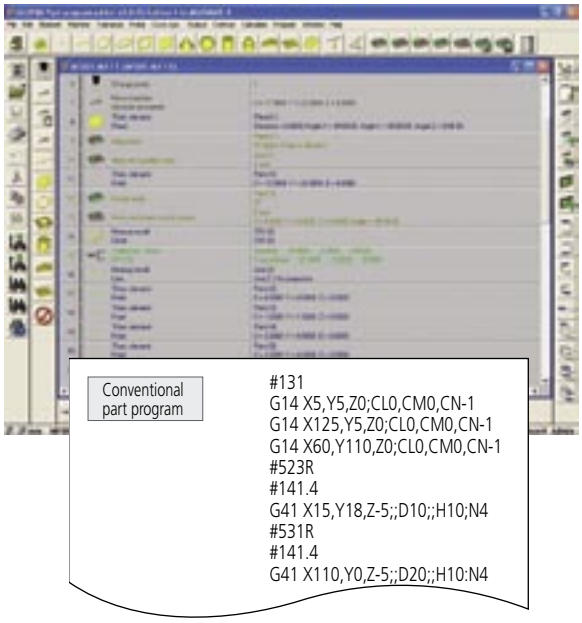
(3) Thermal expansion coefficient (effective only for a CMM equipped with the temperature compensation function)
The thermal expansion coefficient of a workpiece is specified in this field so that the CMM can convert a measurement result obtained at a temperature other than 20°C to that at 20°C.

GEOPAK

Part Program Editor

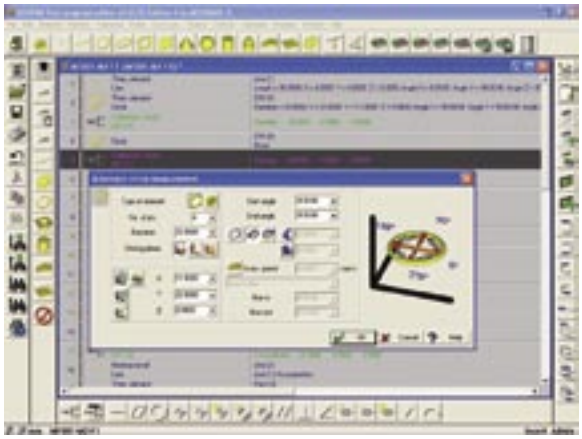
This function allows editing of a part program.
MCOSMOS part programs have a more easily understandable configuration compared with the conventional program since they are given the same icon and element name as the measurement and detailed information can also be included.

[Part Program List]



To edit a part program, highlight the line to be corrected (or inserted) and then execute the correction command. The following sub window identical to measurement will appear. Now a correction can be made to a numeric value, etc.

[Part Program Correction Example]



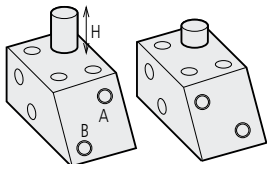
Program Control

It is possible to create a part program that can be changed according to the measurement situation by inserting various control statements.

Control statement	Control information
Loop	•Repeats a specified series of instructions for a fixed number of times. Related icons: Loop initiation, Loop termination
Branch	•Departs from the normal sequence of executing instruction according to the given condition. Related icons: Branch If, Branch initiation, Branch termination, Else
Goto	•Transfers execution from the normal sequence control to a predefined label. Related icons: Goto, Label definition
Sub-program	•Returns to the original program after executing a specified subprogram. Related icons: Subprogram initiation, Subprogram termination
Variable/ calculation	•Defines a variable or a calculation formula. Related icons: Variable definition and calculation, others

For example, the following operations can be executed with these control statements.

- If the measurement result of a certain feature is decided as NG, the part is measured three times.
  (Otherwise, the program is stopped.)
- As shown in the right figure, the workpieces, which are different only in position between holes A and B depending on pin height H on the top, are to be measured with one part program.



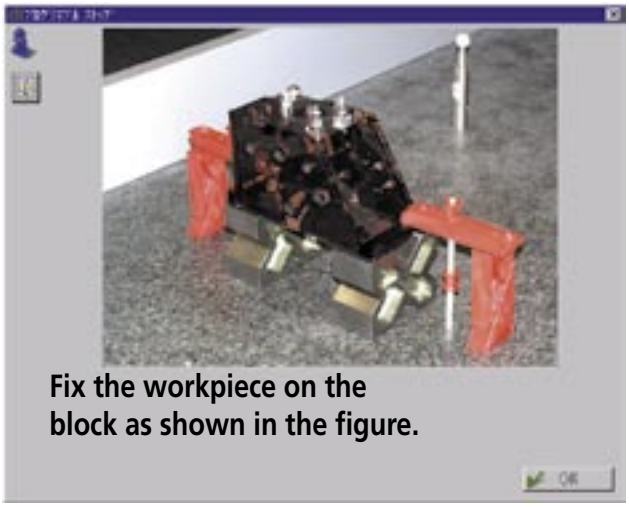
- A measurement result is to be substituted in a particular computing equation.

Mitutoyo

Graphic Display/Voice Output/ Comment Display

This function allows display of graphics (.bmp/.jpg file) that have been created beforehand in the following window. The use of this window (as shown below) will be an operating procedure guide for beginners who are unfamiliar with the operating instructions.

This window also allows comment display or voice output (.WAV file).



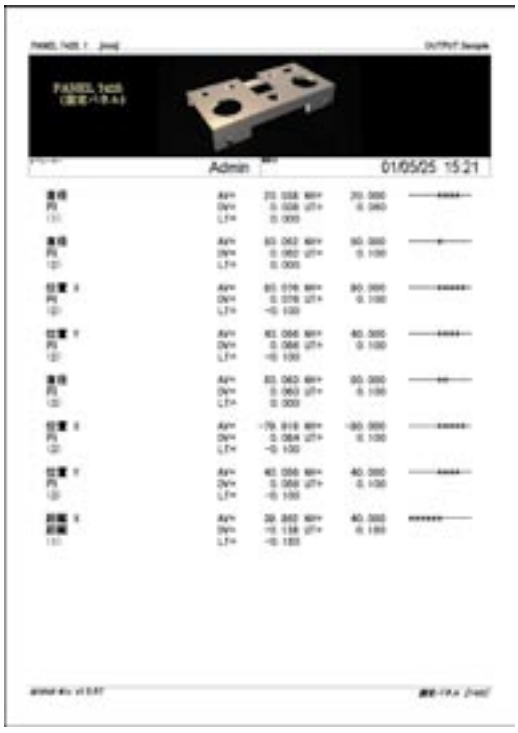
Output

Result data is output to a printer or a file.

● Output to Printer

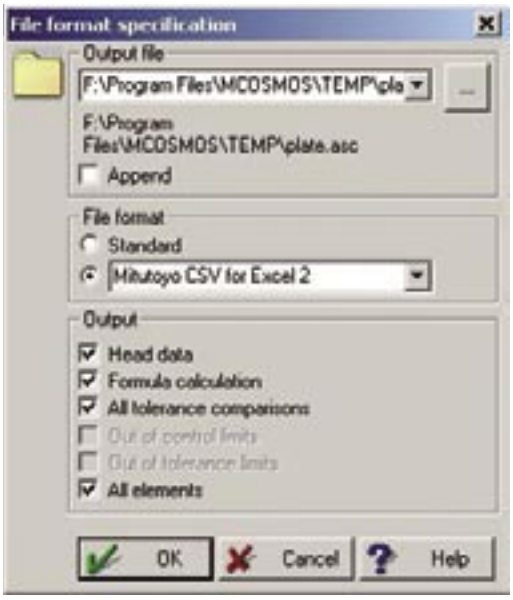
The program provides highly-flexible printouts by specifying data items such as header, footer, comment (text), all data, out-of-tolerance data only, control limit data only, etc.

[Printout Example: Tolerance Zone Measurement]

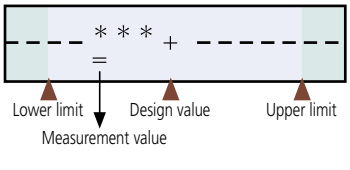


● Output to File

- The information to be displayed in the Result Display field can be stored in a specified file.
- Data items to be stored can be selected in the same manner as printouts.



At the time of tolerance zone measurement a result marking is appended to each measurement value so that any trend may be seen easily.



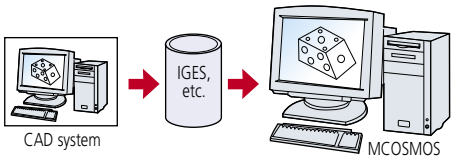
CAT1000S (Free-form Curved Surface Evaluation Program)

CAD data is loaded on MCOSMOS to perform tolerancing with measurement data.

Loading CAD Data

CAT1000S reads model data (e.g. IGES) and displays it on MCOSMOS.

The program allows mirror inversion of a model and thick plate setup (for obtaining correct errors by giving a correction for the effect of a height difference between model data and workpiece).



[Supported CAD Format]

Format	Extension	Supported version
IGES	.igs/.ige/.iges	V4.0/V5.2/V5.3
SAT	.sat	V16.0
VDAFS	.vda/.vdafs	V1.0/V2.0
STEP*	.stp/.step	AP203/AP214
CATIA V4*	.exp	V4.1.x – V4.2.4
CATIA V5*	.CATPart/.CATProduct	R2 – R17
PRO/E*	.prt.1/.prt	V16/Wildfire2/Wildfire3
Palasolid Part*	.x_t/.xmt/.x_b	10.0 – 18.0
Unigraphics*	.prt	11 – 18/NX1/NX2/NX3/NX4
SolidWorks*	.sldprt/.prt	98 – 2006

*Option

Measurement

The program performs one-point measurement of a workpiece and tolerancing compared with CAD data.

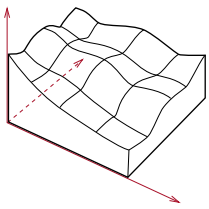
● Online Measurement (Manual/CNC)

- CAT1000S performs tolerancing of an arbitrary position (one point) measured with the Surface Measurement button of GEOPAK with CAD data real-time.

[CAT1000S Online Measurement Flow]

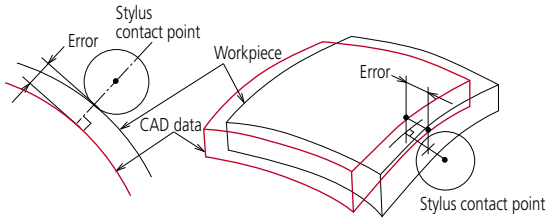
Reference Coordinate Setting

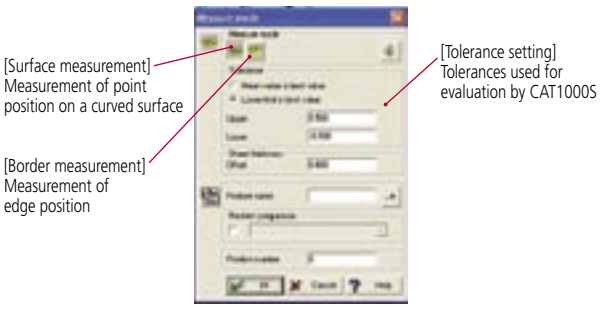
Set a reference coordinate system identical to the dimensional reference of CAD data on a workpiece.



Measurement Mode and Tolerance Setting

Switches the mode between surface measurement and border measurement, and sets tolerances.

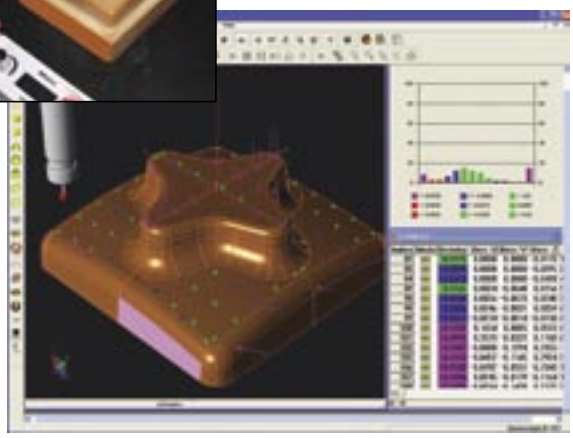




Measurement/tolerancing result display

A measured point appears in real-time on the CAD graphics of MCOSMOS.

A 3D free-form curved surface or edge can be evaluated just by probing one point at an arbitrary position, irrespective of input direction.

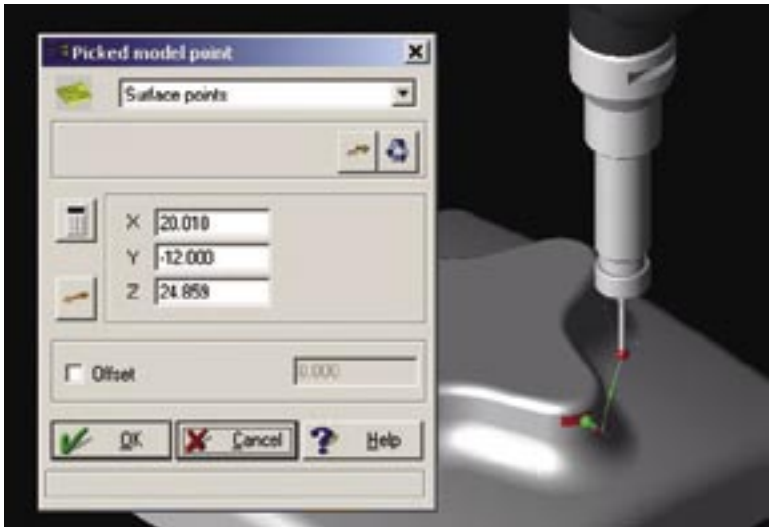


Error bands are established and marked by color coding for easy visualization. An error line or numeric value can also be appended to each band. A graph can be zoomed and rotated.

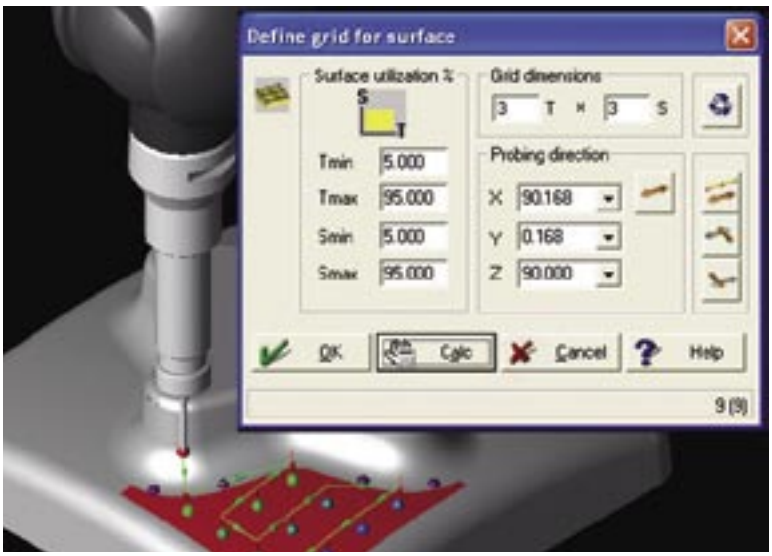
It is also possible to specify a measurement position from the CAT1000S side at the time of CNC surface measurement.

Mitutoyo

• **Surface Search**
Select an arbitrary position on a model and specify one point to be measured.

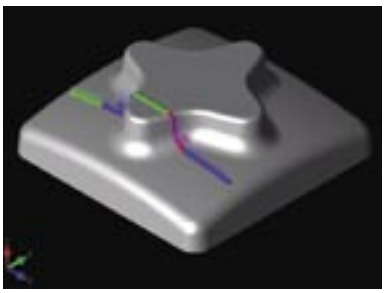


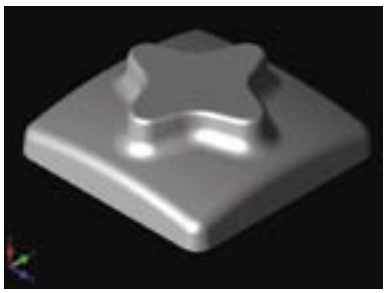
• **Surface Grid**
Select an arbitrary patch and specify the number of points arranged vertically/horizontally and the area usage rate to be set automatically in a reticular pattern.



• **Sheet model section definition**
This button creates point sequence data between two points specified arbitrarily and performs auto-measurement of relevant points. (SCANPAK is required for this processing.)


2-point specification


Cross-section data creation


Measurement and evaluation

These procedures can be stored as a part program and thereby any CNC type CMM can perform auto-measurement.

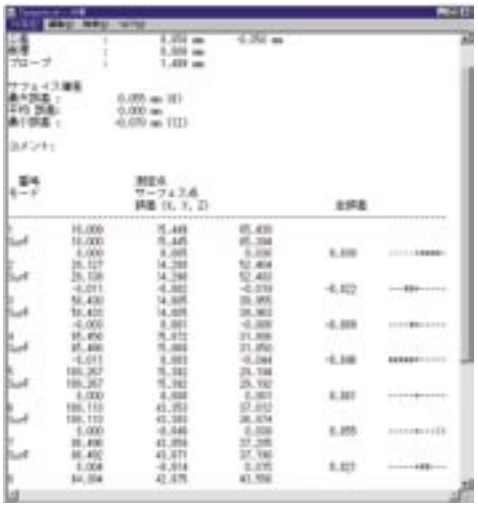
CAT1000S (Free-form Curved Surface Evaluation Program)

MiCAT
Mitutoyo Intelligent Computer Aided Technology
the standard in world metrology software
cmm

Output

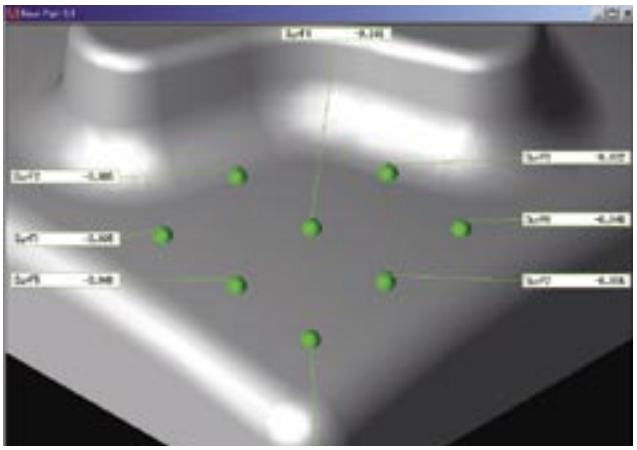
Measurement results can be output to a text file, DMIS file, and measurement data file.

[Example of Output to a Text File]



Graphic Protocol Edition

Allows a graphic of a model to be displayed and printed with numeric data attached.
The layout can also be stored (learned).



● Offline Measurement

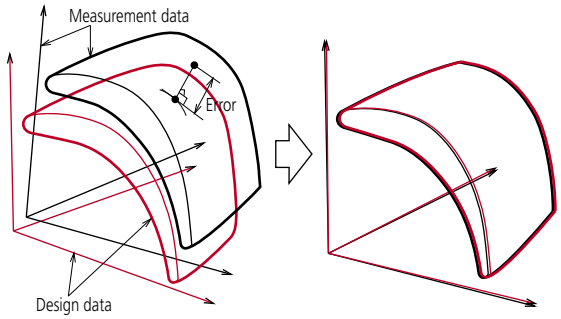
• CAT1000S can perform evaluation (calculation only) of a free-form curved surface using measurement data already stored, ASCII data from an external system, or coordinates entered from the keyboard.

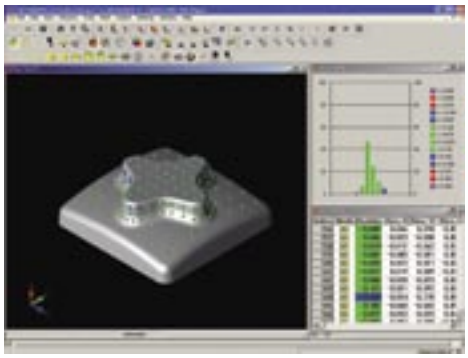
[Measurement Data]

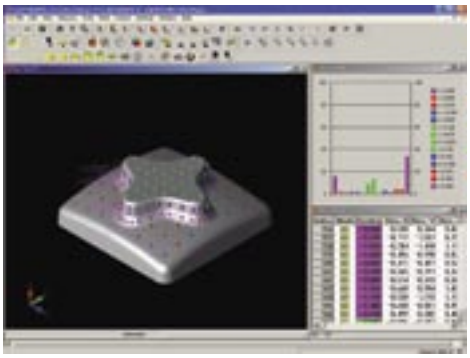
```
PR;1.999403;
EB;SF;1;Surface;
MM;SF;0.050000;-0.050000
MP;10.003000;10.005000;2.044703;0.000000;0.000000;-1.000000;
MP;30.002200;10.000000;2.018003;0.000000;0.000000;-1.000000;
MP;30.000000;30.000000;1.976403;0.000000;0.000000;-1.000000;
EF;
EB;SF2;Surface;
MP;50.002000;50.050000;2.016403;0.000000;0.000000;-1.000000;
MP;60.000000;50.000000;2.058403;0.000000;0.000000;-1.000000;
MP;60.003000;70.030000;2.002403;0.000000;0.000000;-1.000000;
EF;
```

The Best-Fit function

This function automatically positions the workpiece coordinate system so as to minimize differences (errors) between the measured and design forms. It is effective where a reference coordinate system is not well defined.




After applying the Best-Fit function


Before using Best-Fit

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CAT1000P

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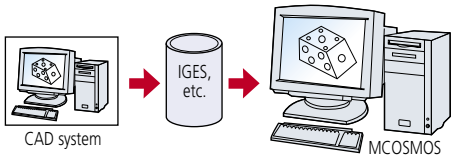
CMM

CAT1000P is a simplified online/offline teaching program for creating a GEOPAK part program from model data output from a 3D-CAD system.

Loading CAD Data

This program reads model data (e.g. IGES) and displays it through MCOSMOS.

CAT1000P allows mirror inversion of a model and thick plate setup (correcting an error by giving an offset if it is caused by a height difference between model data and the workpiece).



[Supported CAD Format]

Format	Extension	Supported version
IGES	.igs/.ige/.iges	V4.0/V5.2/V5.3
SAT	.sat	V16.0
VDAFS	.vda/.vdafs	V1.0/V2.0
STEP*	.stp/.step	AP203/AP214
CATIA V4*	.exp	V4.1.x – V4.2.4
CATIA V5*	.CATPart/.CATProduct	R2 – R17
PRO/E*	.prt.1/.prt	V16/Wildfire2/Wildfire3
Palasolid Part*	.x_t/.xmt/.x_b	10.0 – 18.0
Unigraphics*	.prt	11 – 18/NX1/NX2/NX3/NX4
SolidWorks*	.sldprt/.prt	98 – 2006

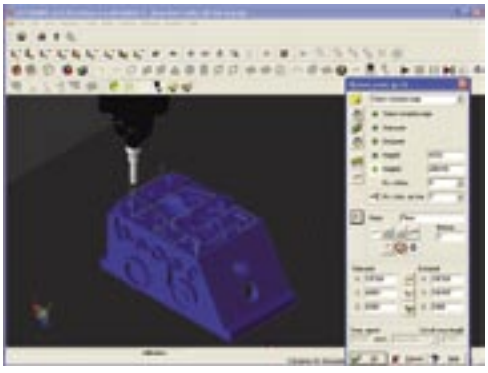
*Option

● Creating a part program from a CAD model

Instead of conventionally teaching (creating a part program) while operating the joystick, the program allows this work to be performed on a CAD model.

● Operation manner compatible with GEOPAK

The CAT1000P screen configuration is compatible with GEOPAK and allows the operator to work with almost the same operating image as seen in GEOPAK when actually measuring with a CMM.



Operating feel identical to that of GEOPAK

● A rich choice of measuring elements

•Point •Line •Circle •Plane •Cone •Cylinder
•Inclined circle •Rectangular hole •Slotted hole

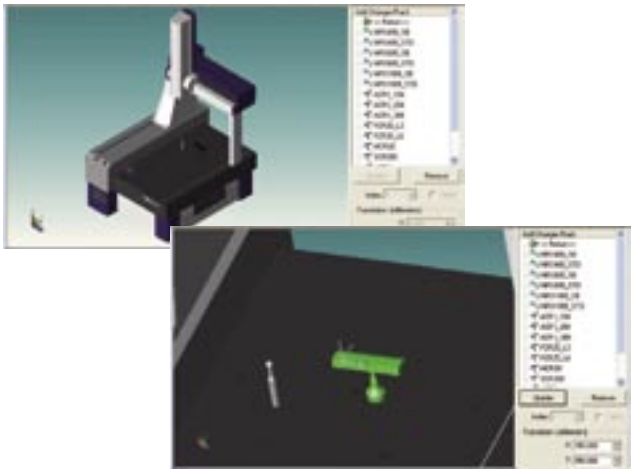
● Interference check function

Automatically determines whether or not a programmed probe motion would cause an interference situation (collision) with a workpiece. This helps create safe part programs.

Interference check function prevents collisions

● Machine builder

This builder can easily configure a CMM by selecting the CMM model, the type of a master ball, probe changer, etc. and setting the corresponding locations on the table. It is possible to perform operation simulation and interference check of probe and workpiece, for the entire system configuration that has been created.



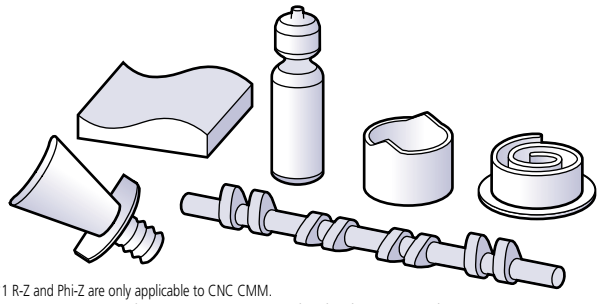
SCANPAK (Contour Measurement Program)

SCANPAK is a program for evaluating profile data obtained by GEOPAK.

Measuring Workpiece Contours

SCANPAK can evaluate 2.5D contours (3D mode), rotational body contours (R-Z mode) and cylindrical cam contours (Phi-Z mode)*1.

[Examples of Workpieces Assessable with SCANPAK]

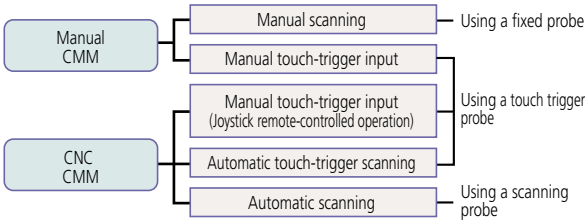


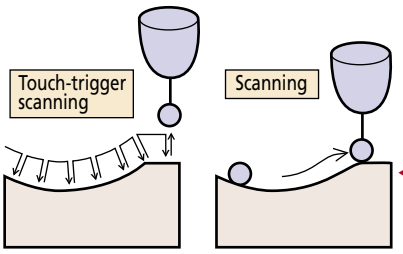
*1 R-Z and Phi-Z are only applicable to CNC CMM.
*2 CAT1000S is required for measurement/evaluation of 3D free-form curved surface.

Measuring Method

Data is acquired through the GEOPAK Contour Measurement button.

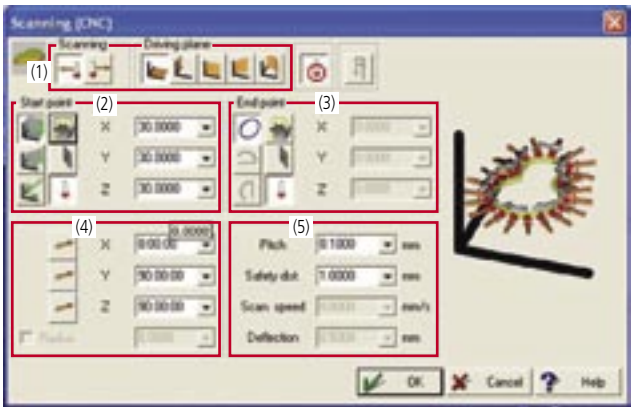
[Contour Measuring Method]





◀Automatic scanning using a scanning probe can greatly reduce the measuring time compared with touch-trigger scanning.

[Measurement Setup Window]



(1) Scanning direction/cross section
These tool buttons are used to specify a scanning direction and a cross section.

(2) (3) Start point/end point
These fields specify the start point and end point of measurement by setting each coordinate value.

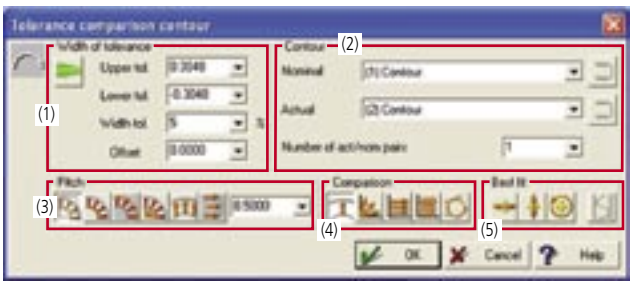
(4) Direction
This field specifies the direction the probe approaches the measurement start point.

(5) Data loading
Specifies the measurement input pitch, safe distance (approach distance), scanning speed, etc.

Contour Tolerance Zone Measurement

This function performs tolerancing by comparing measured values with the corresponding design values.

[Contour Tolerance Zone Measurement Setup Window]



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(1) Tolerance limit
Sets the upper and lower limit tolerances of a feature and specifies the width of the magnified error zone.

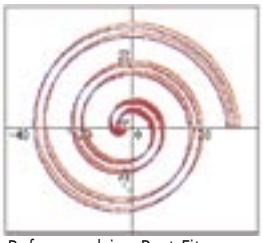
(2) Contour data specification
Specifies design data and measurement data.
Design data can be provided with point sequence (X, Y, Z) data on a contour.

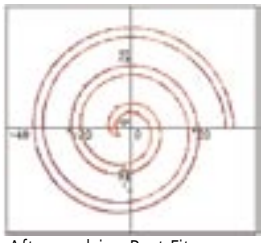
84.95687	0.01006	-6.99845
84.95563	0.36494	-6.99960
84.77160	3.28886	-6.99966
84.30990	6.17095	-6.99932
83.57109	8.99483	-6.99938
82.56004	11.73262	-6.99962
81.29150	14.36238	-6.99945
79.77063	16.85551	-6.99925
78.01538	19.18613	-6.99964
76.04346	21.33798	-6.99961
73.86841	23.28751	-6.99916
71.51881	25.01633	-6.99991
69.01574	26.50986	-6.99986
66.37367	27.74854	-6.99921
63.62563	28.72864	-6.99959

(3) Tolerancing pitch
This field specifies a tolerancing point pitch and direction.

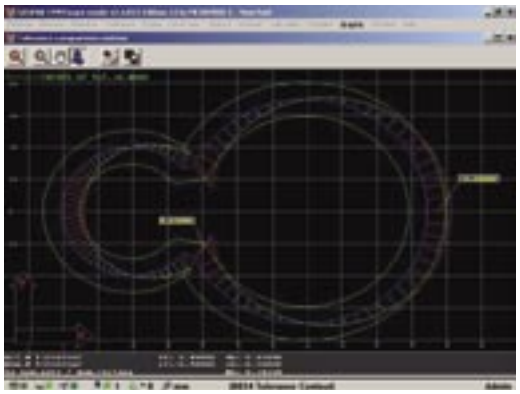
(4) Tolerancing direction
This toolbar specifies whether to perform tolerancing in the axial or the normal direction.

(5) Best-fit
This toolbar optimizes the correlation between the reference coordinates of measurement data and design data to minimize the amount of error.


Before applying Best-Fit


After applying Best-Fit

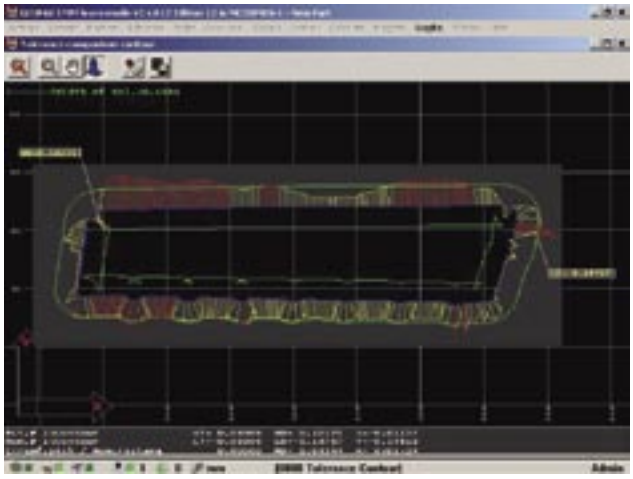
[Tolerance Zone Measurement Result Display]



A tolerancing result is displayed with graphics and "profile tolerance". If more detailed data (such as coordinates of each point) is necessary, analyze measurement data with FORMPAK-CMM (see page 28).

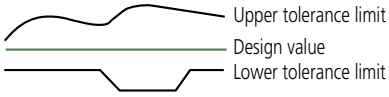
Tolerance Zone Measurement with Profile Data Specified as Tolerance Limits

[Tolerance Zone Measurement with Tolerance Variation]

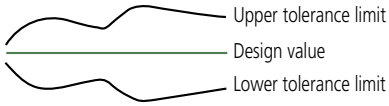

Tolerancing example (turbine blade fir-tree root)

● SCANPAK can perform non-uniform tolerancing by specifying profiles to represent the tolerance limits.

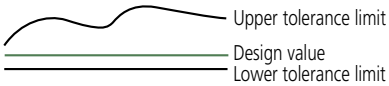
• Specifying tolerance limits with two different profiles



• Specifying tolerance limits with symmetric profiles



• Specifying tolerance limits with one profile and a limit value



Optional Program

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cmm

GEARPAK-Worm

GEARPAK-Worm is for evaluating tooth-form profile, tooth-alignment profile, etc., from the measurement data of a worm gear obtained with a CNC CMM.

● Creates a simplified part program from gear specification data

A CNC part program can be created automatically on GEARPAK-Worm just by entering the gear specification data and a measuring method. There is no need to teach the system so measurements are easily performed.

● Automatic tolerance setting compatible with various standards

GEARPAK-Worm supports various gear standards and can set tolerance just by entering the specification data and the kind and level of standard.
GEARPAK-Worm supports DIN 3974-1 and AGMA 2111-A98. Moreover, the program allows geometrical evaluation of gears with an arbitrary tolerance since a tolerance can be keyed in and edited.

Evaluation Item

Gear tooth form	Evaluation item	Total tooth form error
		Tooth-form profile error
		Tooth-form gradient error
Gear tooth alignment	Evaluation item	Total tooth alignment error
		Tooth-alignment profile error
		Tooth-alignment gradient error

* In addition to GEARPAK-Worm, Internet Explorer (5.x or later) is required for evaluation.

GEARPAK-Bevel/Hypoid

GEARPAK-Bevel/Hypoid is for evaluating tooth-plane profile, pitch error, etc., from the measurement data of a bevel gear or hypoid gear obtained with a CNC CMM.

● Creates a simplified part program from gear specification data

A CNC part program can be created automatically on GEARPAK-Bevel/Hypoid just by entering the gear specification data and a measuring method. There is no need to teach the system so measurements are easily performed.

● Determines specification data for corrected gear cutting by a unique algorithm

GEARPAK-Bevel/Hypoid determines the specification data (estimated value) that indicates good tooth contact from gear data measured with GEOPAK and gear cutting specification data (initial value) used for a gear-cutting machine.

● Supporting gears manufactured on a Gleason Corporation's gear-cutting machine

GEARPAK-Bevel/Hypoid supports ring gears and pinion gears manufactured by the Formate or Helixform methods.

* In addition to GEARPAK-Bevel/Hypoid, Internet Explore (r 5.x or later) is required for evaluation.

[Result Drawing]

GEARPAK-Cylindrical

GEARPAK-Cylindrical is for evaluating a tooth-form profile, tooth-alignment profile, etc., from the measurement data of an involute spur gear or helical gear obtained with a CNC CMM.

● Creates a simplified part program from gear specification data

A CNC part program can be created automatically on GEARPAK-Cylindical just by entering the gear specification data and a measuring method. There is no need to teach the system so measurements are easily performed.

[Result Drawing]

*The new JIS standard is supported. If evaluation is performed with the old JIS, specify a tolerance through key-in.
*In addition to GEARPAK-Cylindrical, Internet Explore (r 5.x or later) is required for evaluation.

● Automatic tolerance setting compatible with various standards

GEARPAK-Cylindrical supports various gear standards and can set tolerance just by entering the specification data and the kind and level of standard. This program supports ISO1328, JIS B 1702*, DIN 3961 ff, AGMA 2000-A88, and R01-33-001F. Moreover, the program allows geometrical evaluation of gears with an arbitrary tolerance since a tolerance can be keyed in and edited.

Evaluation Item

Gear tooth form	Tooth form correction	ANSI chart
		K chart
		Cylinder set
	Tolerance correction	ANSI chart
		K chart
	Evaluation item	Total tooth form error
		Tooth-form profile error
		Tooth-form gradient error
Gear tooth alignment	Tooth alignment correction	Crowning
		Relief
		K chart
	Evaluation item	Total tooth alignment error
		Tooth-alignment profile error
		Tooth-alignment gradient error
Pitch/tooth thickness	Evaluation item	Cumulative pitch error
		Pitch error
		Center distance error* (no graphic display)
		Tooth thickness correction/actual tooth thickness error *
		Over ball pin diameter* * (no graphic display)
		Total tangent length error (no graphic display)
Mesh error	Evaluation item	Total mesh error of single tooth plane
		One-pitch mesh error of single tooth plane

*1: One of these three items is evaluated.

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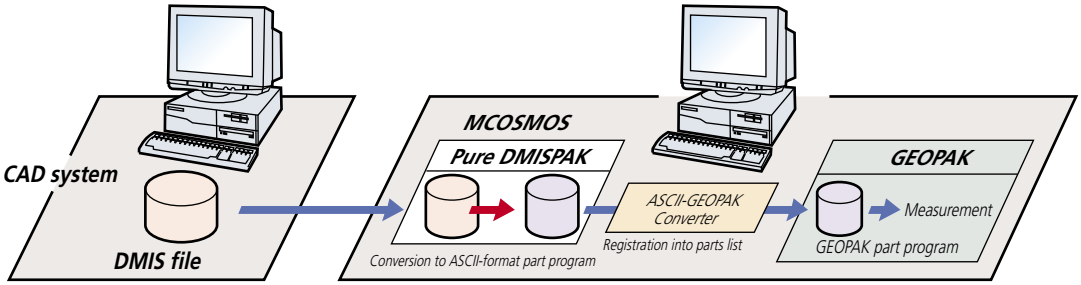
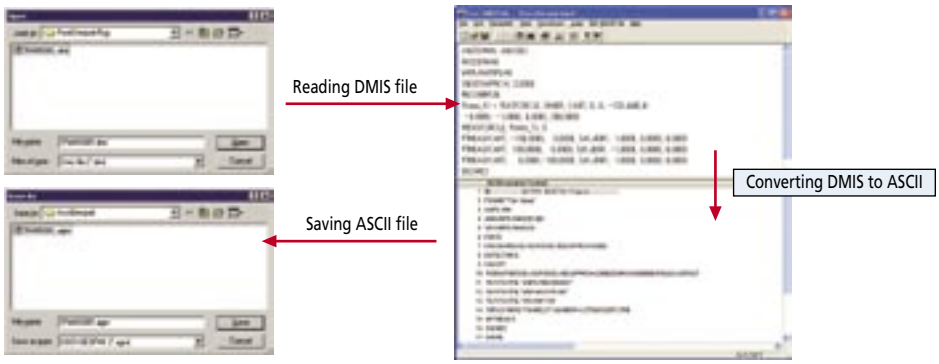
Pure DMISPAK

Pure DMISPAK converts a DMIS file created by an external system to an ASCII-format part program for GEOPAK.

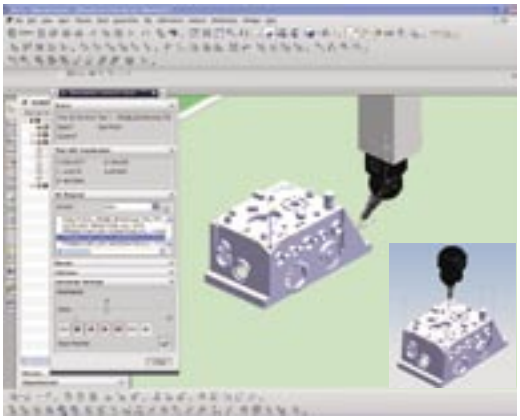




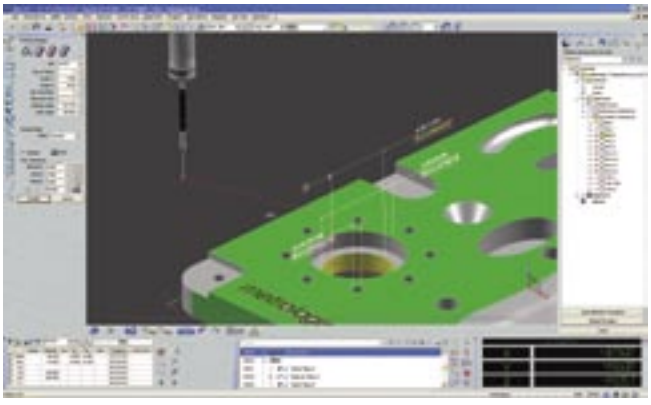
Example of Creating DMIS Files

Pure DMISPAK performs simulation, optimization, evaluation and verification of labor-saving machinery associated with robots, NC machine tools, coordinate measuring machines, physical distribution/ transfer systems, etc.

eM-Probe of Siemens PLM Software Inc.



Silma XG of Mitsui Zosen Systems Research Inc.



Optional Program

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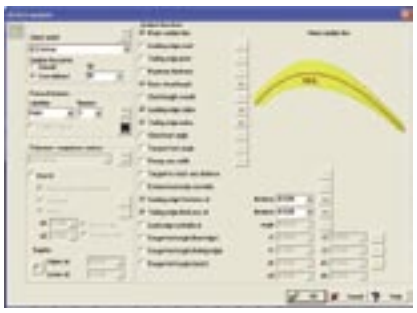
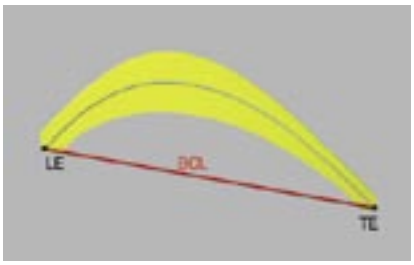
MAFIS

● **MAFIS allows airfoil-type evaluation from the data of a cross-section contour measured by SCANPAK.**

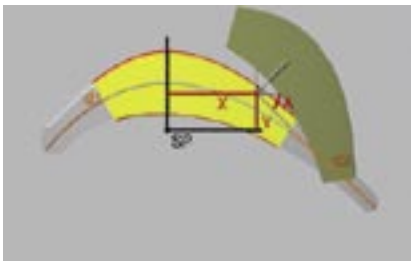
[Airfoil Analysis Window]



[Chord Length (LE – TE)]



[Partial Best-fit]



FORMPAK-CMM

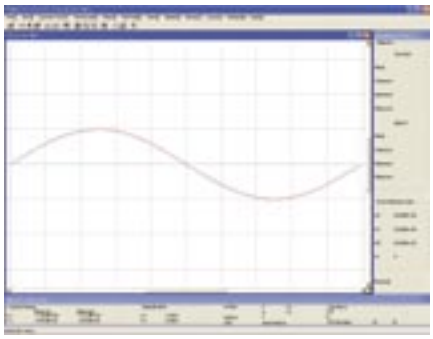
FORMPAK-CMM analyzes 2-dimensional cross-section profiles.

● Profile Analysis

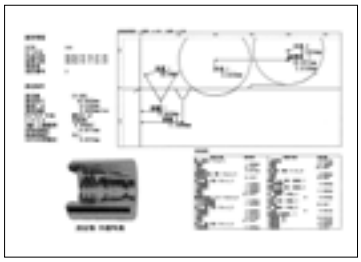
- FORMPAK-CMM performs calculations by specifying an arbitrary range with the mouse.
- It can print a drawing, measurement conditions, measurement results, comments, etc., as a report after they are laid out in a freely-definable format.

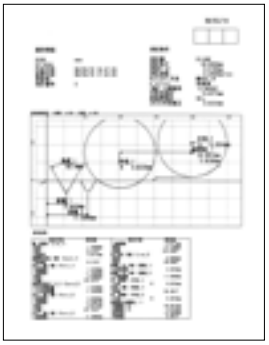
● Profile Tolerancing

- This function allows tolerancing in comparison with measurement data assuming a defined 2-dimensional curve is available as a profile (master gage).
- The Best-fit function is also installed as standard.
- A tolerancing result can be output as a text-format file as well as in report format.



[Printout Examples]





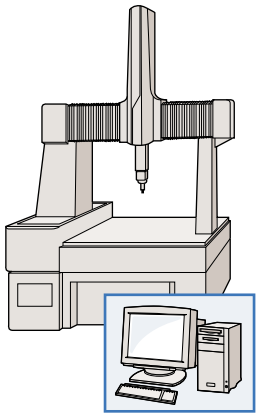
Mitutoyo

MeasureReport

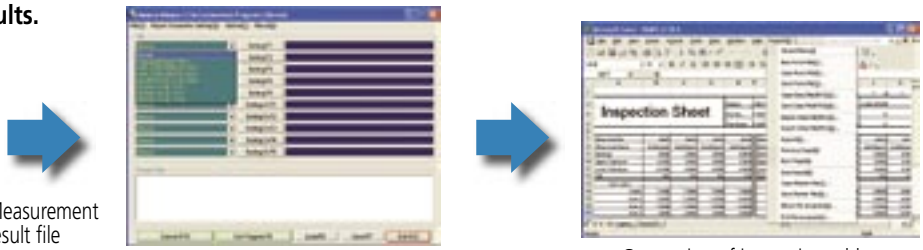
(Inspection Table Generation Program)

MeasureReport generates an inspection table in free format using data measured or acquired by GEOPAK.

- **MeasureReport can perform tolerance judgment on workpiece data and calculate mean, minimum, maximum, and range for measurement results.**



*In addition to this program, Microsoft-Excel is necessary.



- **An inspection table is generated in combination with discrete measurement results.**

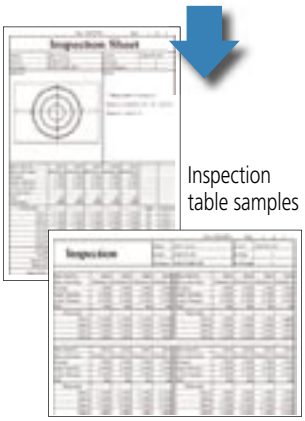
A maximum of 6 files can be combined.
Up to 200 inspection items or up to 10,000 workpieces can be combined.

- **A graphic (part drawing) and text (work instruction) can be added to a table.**

A maximum of 10 graphics and texts can be appended.
The program supports BMP-format files.

- **MeasureReport allows macro (operation) setting of inspection table generation.**

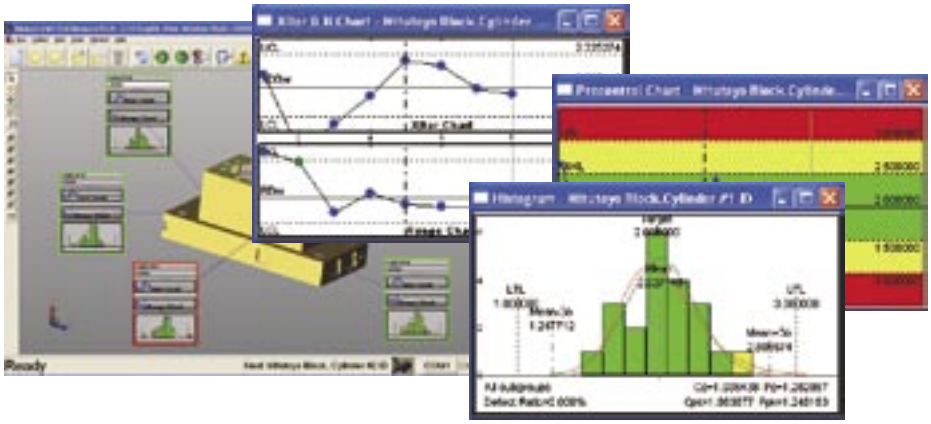
Preliminary macro settings such as auto-print, auto-termination, format specification, and calculation specification can greatly reduce inspection table generating operations.

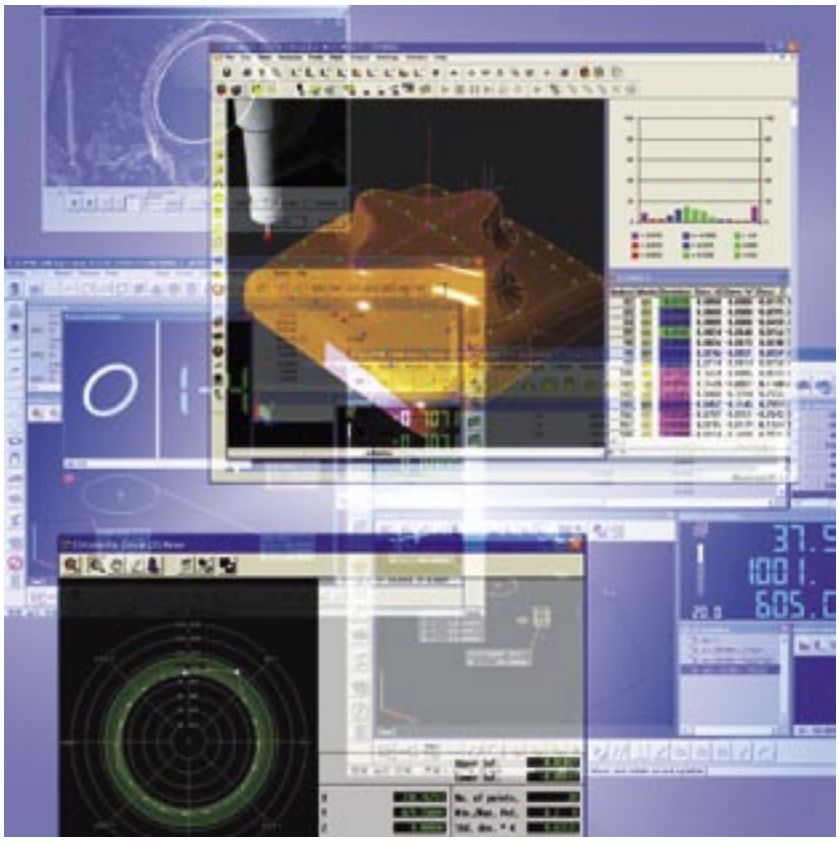


MeasurLink STATMeasure PLUS

(Statistical Processing/Process Control Program)

MeasurLink STATMeasure PLUS allows statistical processing of measurement data. Also, real-time display of control charts can promptly recognize fault conditions caused by cutting tool abrasion or damage. This allows you to implement effective countermeasures (such as change of cutting tool or machining conditions). Moreover, with this program as a terminal, it is possible to build a central control system by connecting to a higher-level network environment.





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76.83.0902 (4) C-WZJHS. Printed in Japan