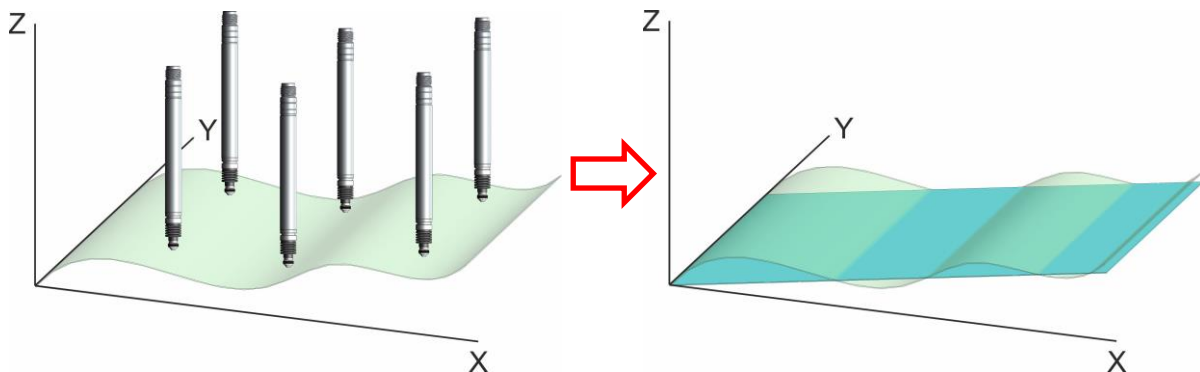


1. Introduction

The ComGage special measuring mode *Flatness Measurement* allows the calculation of *Min*, *Max* and *flatness* of a plane.



First, the measuring mode computes a correction / best-fit plane from the values of the measuring probes and puts it into the actual plane. Next, the difference to the correction / best-fit plane is calculated for each probe. The last step is to determine the *Min*, *Max*, *flatness* (*Max-Min*) or *run-out* values from these differences.

Three options are provided to collect the measuring values at the different points of the plane. All of these options are described in detail in this documentation. Additional information about determining the *run-out* can be found in chapter 4 of this documentation.

Important notes :

- The software license 72 is required for this special measuring mode.
- All characteristics that are used to collect the measuring values of the probes have to be calibrated with a master or a reference piece.

2. Comparison to the simplified method of flatness measurement

In the simplified method, each probe is assigned to one characteristic, which is calibrated with a master piece.

Via the probe mixing formula of an additional characteristic for the flatness measurement, the values for *Max* / *Min* / *flatness* (*Max-Min*) of the calibrated probes can be calculated :

CHARACTERISTICS :			Drawing Data		Statistics			Ref. Info		
No.	Name	Nominal	USL	UCL	LCL	LSL	Unit	Mea. Inputs	Mode	
C1	Calibration of probe 1	0	---	---	---	---	mm	M1	Static Measure...	
C2	Calibration of probe 2	0	---	---	---	---	mm	M2	Static Measure...	
C3	Calibration of probe 3	0	---	---	---	---	mm	M3	Static Measure...	
C4	Calibration of probe 4	0	---	---	---	---	mm	M4	Static Measure...	
C5	Max of all 4 probes	0	0.3	0.225	-0.225	-0.3	mm	MAX(C1;C2;C3;C4)	Static Measure...	
C6	Min of all 4 probes	0	0.3	0.225	-0.225	-0.3	mm	MIN(C1;C2;C3;C4)	Static Measure...	
C7	Flatness	0	0.3	0.225	-0.225	-0.3	mm	MAX(C1;C2;C3;C4)-MIN(C1;C2;C3;C4)	Static Measure...	

LIST OF CREATED FUNCTIONS						
No.	Function	Function key	Hand/Foots...	Dig. Input	Event	FP
X1	Adjustment / Calibration : C1, C2, C3, C4	F10	---	---	Clicking Button 3	3
X2	Save measured values : C5, C6, C7	F1	---	---	Clicking Button 1	6

Advantage :

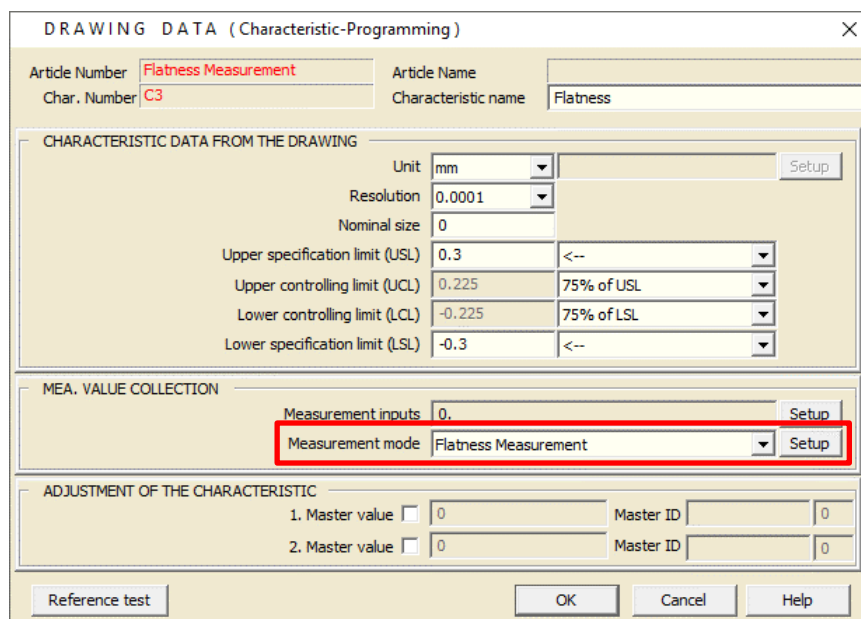
- This method can be implemented with the standard functions of ComGage Level 1 / Level 2 / Professional.
- All errors of the plane (also a tilted position) are included in the result.

Disadvantage : - A tilted position of the plane (e.g. caused by the fixture) is not compensated.

Note : Based on the task at hand, it has to be decided which is the most appropriate method of calculation.

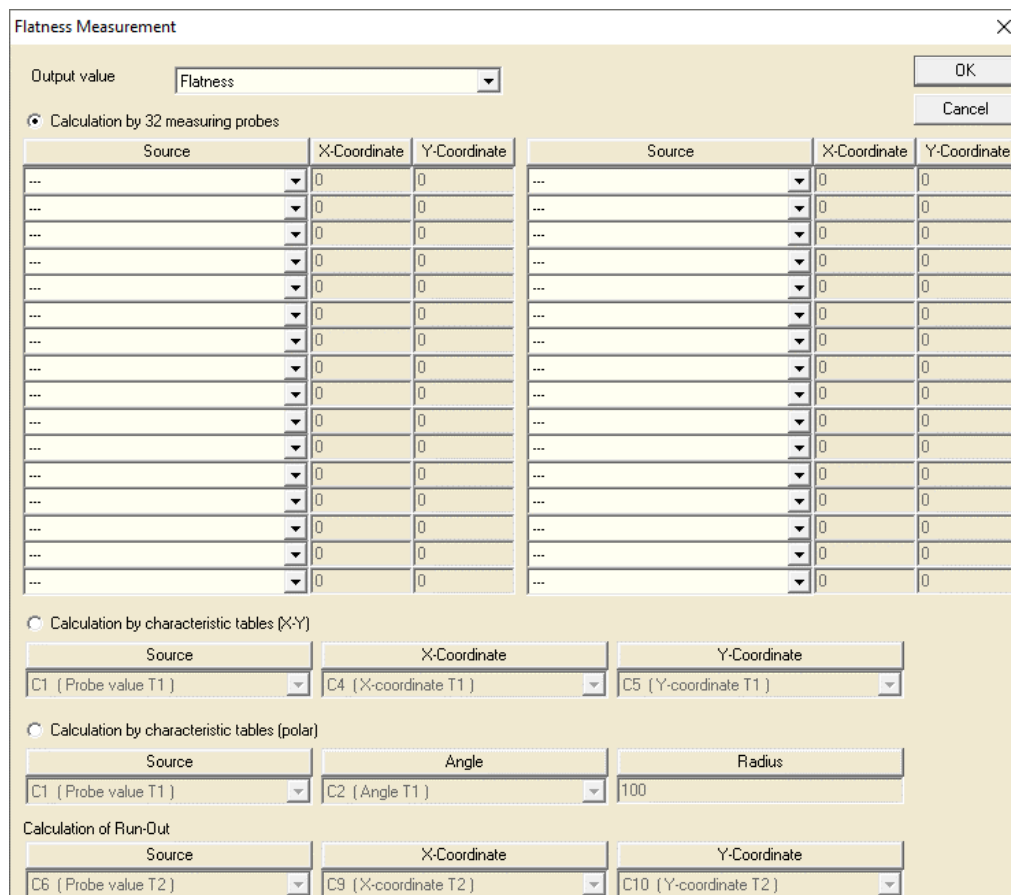
3. Configuration

The special measuring mode has to be selected in the drawing data of the related characteristic :



The settings for the measurement inputs are ignored. But because of performance reasons, we recommend the use of a constant, e.g. 0.

The special measuring mode can be configured in the following dialogue, which is opened via the *Setup* button :



Output value

Here can be selected, which value shall be calculated as measurement result :

- **Min**
The smallest distance of a measured point to the correction plane is calculated.
- **Max**
The biggest distance of a measured point to the correction plane is calculated.
- **Flatness**
The flatness in relation to the correction plane is calculated (Max-Min).
- **Run-Out**
The run-out in relation to the correction plane is calculated (see chapter 4).

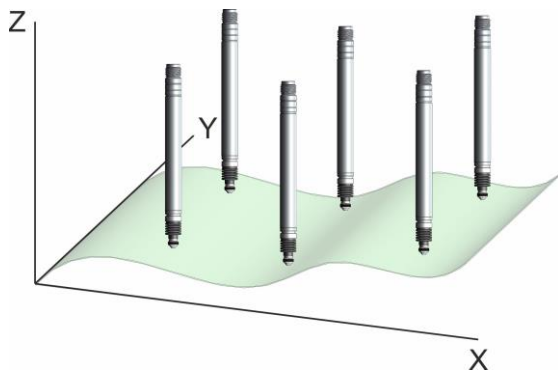
Calculation by 32 measuring probes

For this option to collect the measuring values for the computation of the correction plane, the current values of up to 32 measuring probes are used.

For each used measuring probe, a characteristic has to be created and selected here under *Source*. These characteristics have to be calibrated with the master piece.

Additionally, the position (X-Coordinate / Y-Coordinate) in relation to a common reference point has to be entered. The coordinates are specified in mm.

To compute the correction plane, the current measuring values of all characteristics are used.

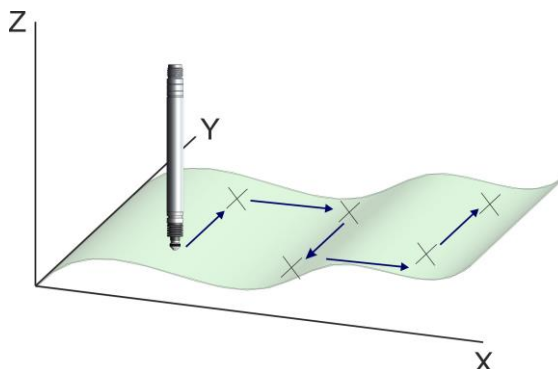


Calculation by characteristic tables (X-Y)

For this option to collect the measuring values for the computation of the correction plane, only one measuring probe is used. With this measuring probe, values (max. 1000) can be collected at any point of the plane (e.g. by a robot arm).

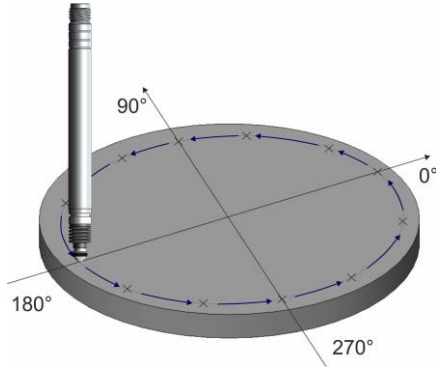
Three additional characteristics have to be created, one characteristic to save the measuring values of the probe and one characteristic each for the related X and Y coordinates. For all three characteristics, the same number of saved values have to be available. Only then, the calculations can be done correctly.

Before the start of a new measurement, the saved values of all three characteristics have to be deleted. Otherwise, the values of several measurements are mixed up. The values are saved with the standard ComGage function “Save measured values”.



Calculation by characteristic tables (polar)

For this option to collect the measuring values for the computation of the correction plane, only one measuring probe is used. With this measuring probe, values (max. 1000) can be collected with the same distance (radius) to a common reference point (e.g. with a turntable).



Two additional characteristics have to be created, one characteristic to save the measuring values of the probe and one characteristic for the related angular values. For both characteristics, the same number of saved values have to be available. Only then, the calculations can be done correctly. Additionally, the radius (= distance of the measuring probe to the centre of rotation in mm) has to be entered, at which the measuring values are collected.

Before the start of a new measurement, the saved values of both characteristics have to be deleted. Otherwise, the values of several measurements are mixed up. The values are saved with the standard ComGage function “Save measured values”.

4. Procedure for determining the run-out

Two probes are used to determine the run-out. From the measuring values of one probe (in this example T1) or several probes, a correction plane is calculated using the selected calculation method (see chapter 3). This calculated plane is used as a reference plane for the measuring values of probe 2 (T2).

The measuring values of probe 2 are compensated in relation to the correction plane. Max-Min of the compensated values of probe 2 is returned as run-out

