



## Key Features

### With AccuracyRatio you can

- Determine whether measurement accuracies are sufficient by calculating false accept risk and false reject risk.
- Define baseline risks for a given application, corporate policy requirement, contract requirement or quality objective.
- Compute risks and accuracy ratios for two-sided or single-sided tolerances
- Apply real-world parameter bias distributions to estimate bias uncertainty.
- Estimate measurement process uncertainty and factor it into false accept risk and false reject risk analyses.
- Establish guardbands consistent with risk requirements.
- Estimate true % in-tolerance from observed % in-tolerance.
- Print comprehensive analysis reports.

### Measurement Decision Risk

- The main functions and features for estimating risks and computing an equivalent accuracy ratio are accessed from AccuracyRatio's **Main Screen**.
- Maximum allowable false accept and false reject risks and corresponding accuracy ratio are defined on the **Baseline Risk Analysis Worksheet**.
- A plot of baseline false accept risk and false reject risk versus accuracy ratio can be displayed from this worksheet.

### Parameter Bias Uncertainty Analysis

- The **Parameter Bias Uncertainty Worksheet** is a useful tool for entering specifications and estimating bias uncertainties for subject (SU) and measuring (MTE) parameters.

**Subject Unit**

Manufacturer	Grace L. Ferguson	Model Number	X-Pit Probe	Description	Micrometer
Parameter Name	Micrometer Reading	Qualifier 1		Qualifier 2	

**Measuring System**

Manufacturer	Zetslaff Engineering	Model Number	1B2NMBLE	Description	Gage Block
Parameter Name	Gage Block Dimension	Qualifier 1		Qualifier 2	

**Subject Parameter Tolerance Options**

Nominal or Reading Value: 1.00024 cm  
 Upper Tolerance: 1.00124 cm  
 Lower Tolerance: 0.99974 cm  
 % In-Tolerance: 85.0000

**Expanded Uncertainty**: 2.587  
**Standard Uncertainty**: 0.799  
**Deg Freedom**: 34  
**Units**: um  
**Confidence Level**: 99.7300

**Guardbands**: Upper 1.08336697, Lower 1.08336697  
**Process Uncertainty**: 2.1543 um  
**Uncertainty Ratio**: 0.4242 : 1

**BASELINE RISKS (Consumer Option)**

False Accept Risk	0.9239	%
False Reject Risk	1.5954	%
Baseline Accuracy Ratio	4.00	: 1.00

**COMPUTED RISKS (Consumer Option)**

False Accept Risk	5.3472	%
False Reject Risk	5.3472	%
Equivalent Accuracy Ratio	0.74	: 1.00

**Analysis Baseline**

Accuracy Ratio Data: Accuracy Ratio 4.00 : 1.00  
 Subject Parameter Percent In-Tolerance: 95.0000  
 MTE Parameter Percent In-Tolerance: 95.0000

**Baseline Risks**

False Accept Risk: 0.9239 %  
 False Reject Risk: 1.5954 %

**Default Baseline**

Accuracy Ratio Data: Accuracy Ratio 4.00 : 1.00  
 Subject Parameter Percent In-Tolerance: 85.0000  
 MTE Parameter Percent In-Tolerance: 95.0000

**Baseline Risks**

False Accept Risk: 1.7572 %  
 False Reject Risk: 2.4389 %

**Subject Parameter Reliability Model Worksheet**

Select a Reliability Model, Enter an Interval, Select Units and Enter Probabilities or Coefficients

Reliability Model: Gamma  
 Reliability Function:  $R(t) = a \exp(-bt) \{ 1 + bt + [(bt)^2] / 2 + [(bt)^3] / 6 \}$   
 Cal / Test Interval (t): 18 Months

**In-Tolerance Probabilities**

Beginning of Period: 99.00 %  
 Average over Period: 95.32 %  
 End of Period: 85.00 %

**Reliability Model Coefficients**

a = 0.99  
 b = 0.110659953458607  
 c = 0

**In-tolerance Probability (R) vs. Time for the Gamma Model**

Time (t)	Reliability	Plot Limit
18	85.00	42

**Parameter Bias Uncertainty Worksheet**

**Nominal Value and Measurement Units**

Measurement Area: Length  
 Nominal Units: cm  
 Nominal or Reading Value: 1.00024

**Subject Parameter**

Upper Tolerance Limit	Fixed	% of Reading	Units
10 um	- 10	+ 0	um
Lower Tolerance Limit	-5 um	+ 5	+ 0

**Measuring Parameter**

Expanded Uncertainty	Deg. Freedom	Cor. Factor	Units
2.587	34	3.2363	um
Parameter Tolerances	Confidence (%)	Standard Uncertainty	
	99.7300	0.799 um	

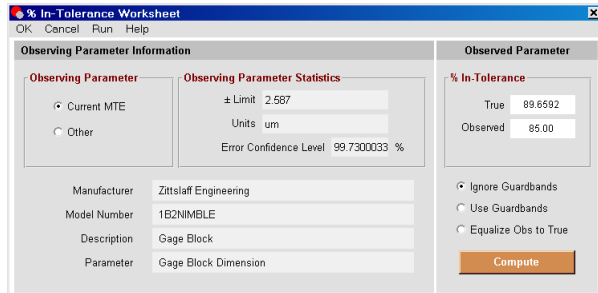
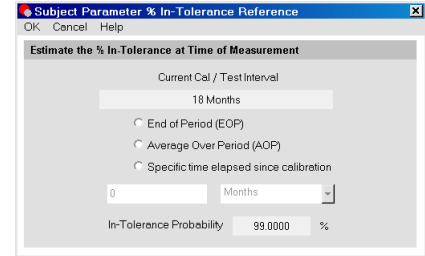
- Plots of the statistical distributions for the parameter biases can be displayed from this worksheet and from other locations within AccuracyRatio.
- The change in parameter in-tolerance probability over time elapsed since calibration can be modeled using the **Reliability Model Worksheet**.



## Key Features

### Parameter Bias Uncertainty Analysis (continued)

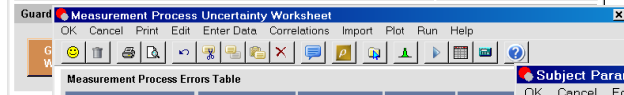
- Once the parameter reliability behavior has been modeled, the in-tolerance probability at any time elapsed since calibration can be calculated using the **% In-Tolerance Reference** dialog.
- The true MTE parameter in-tolerance probability can be estimated from an observed % in-tolerance using the **% In-Tolerance Worksheet**. Likewise, the observed % in-tolerance required to attain a specified true in-tolerance probability can be estimated using this worksheet.



- AccuracyRatio also features a Bayesian analysis method called **Statistical Measurement Process Control (SMPC)** to obtain best estimates of both subject parameter and measuring parameter biases and bias uncertainties.

### Measurement Process Uncertainty Analysis

- The uncertainties due to measurement process error sources can be estimated using the **Measurement Process Uncertainty Worksheet**. This ensures that the total measurement process uncertainty is accounted for in estimating risks.



Error Source	Error Limits	% Confidence	Deg Fdm	Uncert
MTE Bias	± 2.5870	99.7300	34.00	0.798
MTE Random		95.0000		0
SU Random	± 3.9776	95.00	8.00	1.724
MTE Resolution	0.0000	95.00		0.000
SU Resolution	2.5000	95.00	∞	1.275
Operator Bias	0.3805	95.00	∞	0.194
Stress Response	0.0000	95.00	∞	0.000
Environment	0.0078	95.00	∞	0.004
User Defined	0.0000	95.00	∞	0.000

#	Measured Deviation (um)	Mode or Nominal Value
1	1.76	1.00024 cm
2	0.76	0.837 um
3	-2.24	9
4	1.76	1.725 um
5	2.76	0.575 um
6	-1.24	
7	-0.24	
8	2.45	
9	1.76	
10		
11		
12		
13		

- The uncertainty due to random error in measurements can be computed from measurement data for the measuring parameter (MTE) and/or subject parameter (SU) using the built-in **Parameter Data Entry Worksheets**.

Variable 1	Variable 2	Correlation coefficient
MTE Bias	Operator Bias	-0.500
SU random		
MTE random		
SU Resolution		
MTE Resolution		
Operator Bias	Environment	0.750
Stress Response		
Environment		
User Defined		



**To Compute Guardbands...**

- Select either the **Equalize Risks** option or
- Select the **False Accept** or **False Reject** option and enter a risk (false accept or false reject) and a risk unit (% or ppm)
- Select **Symmetric Multipliers** and click **Compute** in the **Guardbands** panel.

**To Compute k-Factors...**

- Select either the **Equalize Risks** option or
- Select the **False Accept** or **False Reject** option and enter a risk (false accept or false reject) and a risk unit (% or ppm)
- Select **Symmetric k-Factors** and click **Compute** in the **Guardbands** panel.

**To Round Off Multipliers and k-Factors**

- Enter the desired number of digits of resolution in the **Displayed Resolution** box next to the **Round Off** button.
- Click the **Round Off** button. The multipliers and k-factors will be rounded off and risks will be recalculated.

**To Compute Risks...**

Enter Guardbands or k-factors and click the **Compute** button in the **Risks**

### SMPC

Bayesian analysis results for the subject and measuring parameters are displayed on the Measurement Process Uncertainty Worksheet.

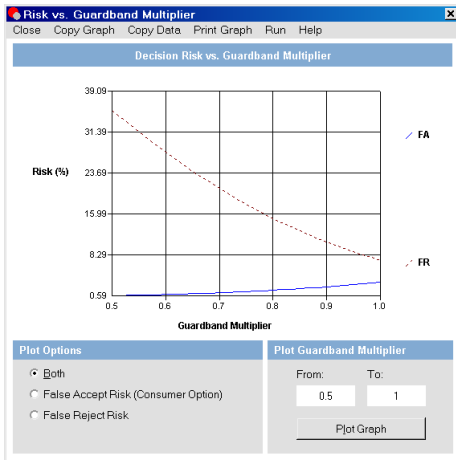
- Correlations that may exist between error sources can be accounted for in the total process uncertainty using the **Correlation Coefficients List**.

### Guardband Analysis

- The **Guardband Analysis Worksheet** is used to compute guardbands to achieve a desired level of false accept risk or false reject risk.
- Guardband calculation can be keyed on false accept risk, false reject risk or to equalize risks.



## Key Features



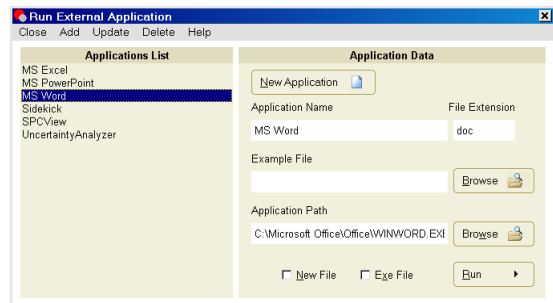
- Corresponding guardband multipliers and k-factors are also computed. The k-factor is the number of multiples of the total process uncertainty used to adjust the guardband limit relative to the parameter's tolerance limit.
- Guardband limits can be displayed on the **Risk vs. Guardband Multiplier Plot**.

### Importing from UncertaintyAnalyzer

- AccuracyRatio is designed to import data and analysis results directly from ISG's **UncertaintyAnalyzer**, the world's most powerful and versatile uncertainty analysis application. In addition, UncertaintyAnalyzer can import data and uncertainty analysis results directly from AccuracyRatio.

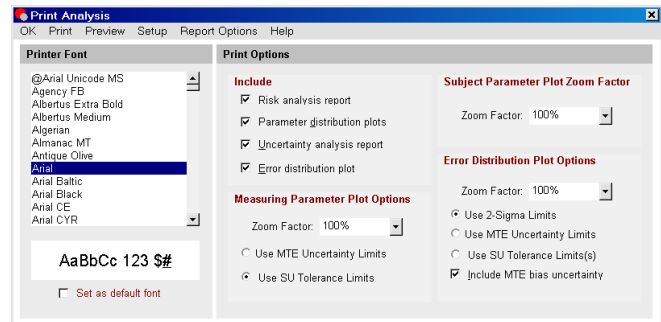
### Running External Applications

- The **Run External Application Launcher** can be used to launch external applications from within AccuracyRatio for off-line processing.



### Analysis Reports

- Hardcopy reports of risk analysis and uncertainty analysis results can be generated from the **Print Analysis Screen**. Parameter bias and process error distribution plots can be included for reference.



- Options for specifying report header information and Summary File format are available on the **Report Options Screen**.