SEMI® INTERNATIONAL STANDARDS

KoCoS Automation GmbH

SEMI M73 – Edge Profile Measurement Field Experiences

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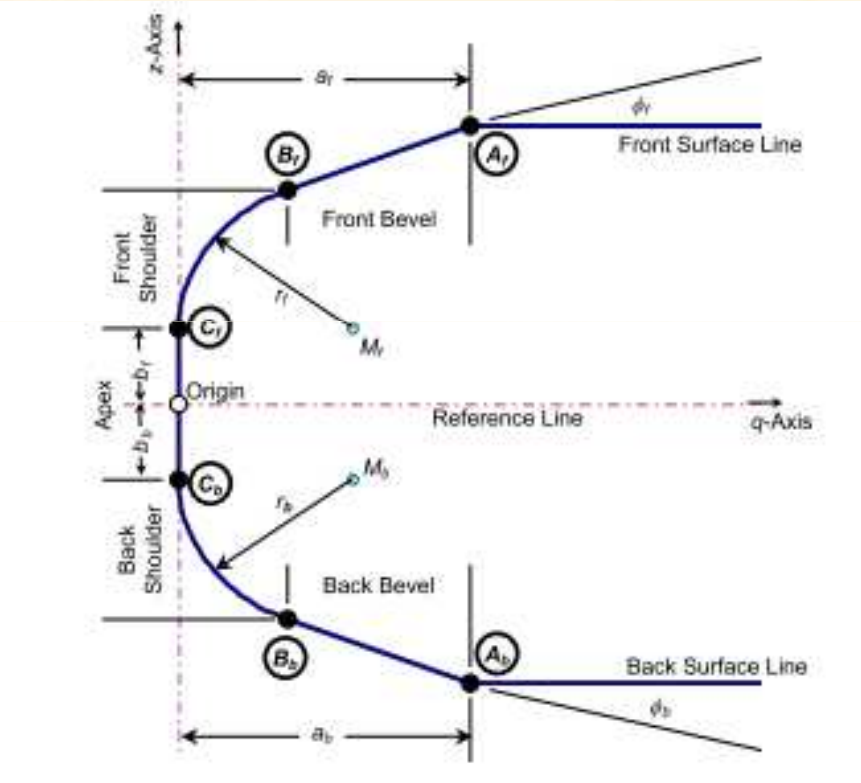
semi

Overview

- SEMI M73 Mode 1 + 2
- Theoretical expected measuring results
- Measuring Results in the field
- Summary

SEMI M73 General measurement approach



- Definition of 3 reference points for front and bottom side
  - Surface line meets bevel
  - Bevel hits shoulder
  - Shoulder hits apex

SEMI M73 Mode1 Edge-Width-Method

- Starting reference points will be calculated based on distance origin - defined edge width
- Straight lines or radii will be fittet between the reference starting points
- Intersection of the lines determine the reference points

SEMI M73 Mode 2 Slope-Change-Method

- Reference points will be determined based on slope of the given profile data (bevel angle)
- Straight lines or radii will be fitted between the reference starting points

Comparism Mode1 – Mode 2
Expected Results

- Basic approach of both methodes is the same
- Profiles of real measured wafers are not ideal
  - Particles of environment
  - Roughness of wafers
  - Grinding grooves

Comparism Mode1 – Mode 2 Expected Results

- Mode 1 less sensitive to irregularities on wafer surface
- Mode 2 First acknowledged correct slope marks bevel reference point

→ Mode 1 looks more robust to real wafer surfaces

Field expierences

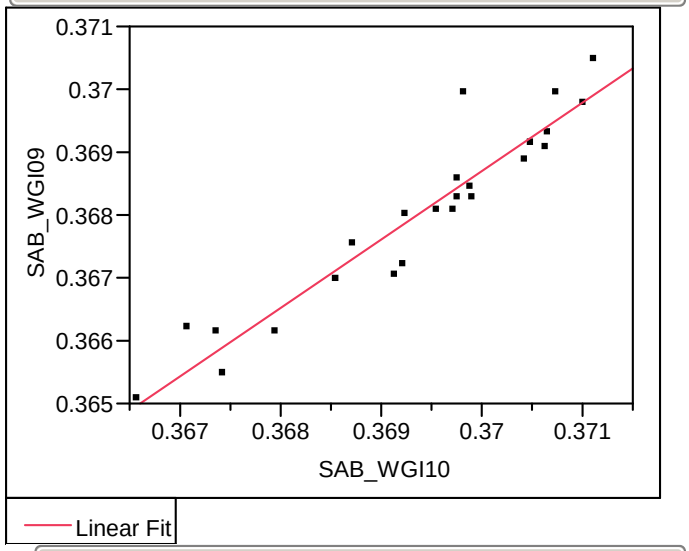
- Measurements are done at Asian customer
- Set of 25 wafers with different profiles has been measured
- Measurements on 2 KoCoS tools

Measurements on KoCoS WATOM

- SEMI M73 Mode 1 metric
- SEMI M73 Mode 2 metric

Measuring Results Mode 1 – Mode 2 Edge Width Bottom

Bivariate Fit of SAB_WGI09 By SAB_WGI10



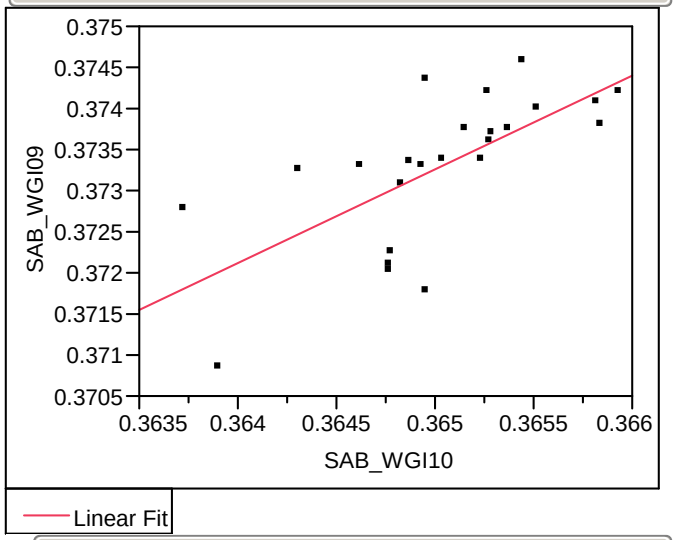
Linear Fit

SAB_WGI09 = -0.033232 + 1.0863016*SAB_WGI10

Summary of Fit

RSquare	0.903088
RSquare Adj	0.898683
Root Mean Square Error	0.000471
Mean of Response	0.367996
Observations (or Sum Wgts)	24

Bivariate Fit of SAB_WGI09 By SAB_WGI10



Linear Fit

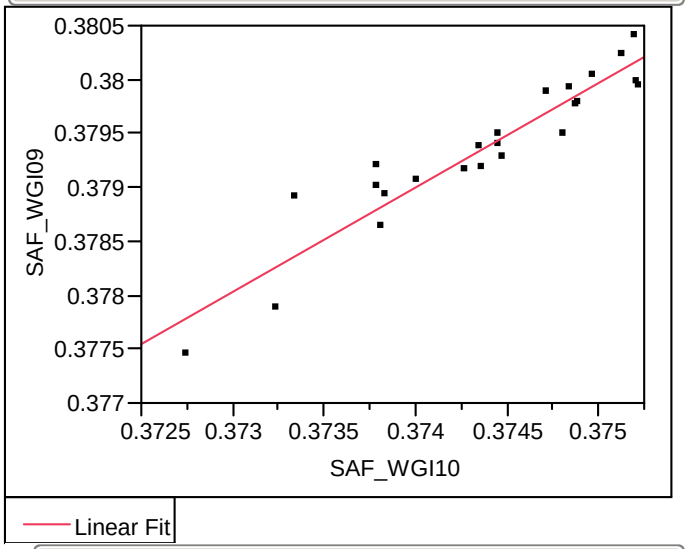
SAB_WGI09 = -0.0436 + 1.1420914*SAB_WGI10

Summary of Fit

RSquare	0.460613
RSquare Adj	0.436095
Root Mean Square Error	0.000687
Mean of Response	0.373284
Observations (or Sum Wgts)	24

Measuring Results Mode 1 – Mode 2 Edge Width Front

Bivariate Fit of SAF_WGI09 By SAF_WGI10



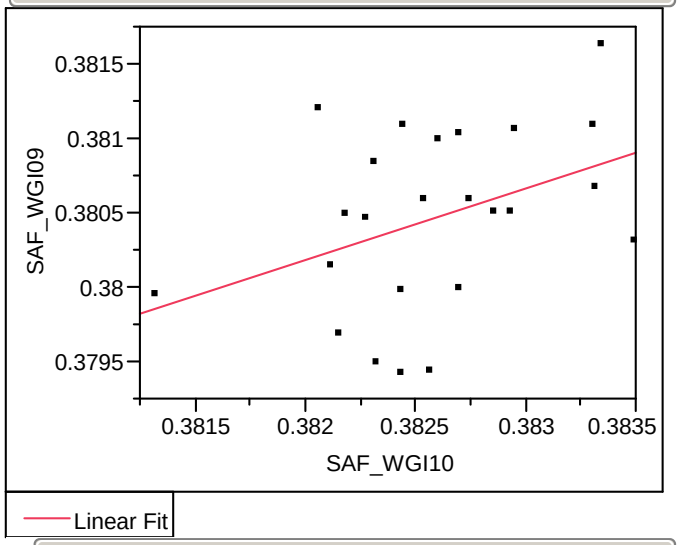
Linear Fit

SAF_WGI09 = 0.0167036 + 0.9686959*SAF_WGI10

Summary of Fit

RSquare	0.889951
RSquare Adj	0.884949
Root Mean Square Error	0.000235
Mean of Response	0.379345
Observations (or Sum Wgts)	24

Bivariate Fit of SAF_WGI09 By SAF_WGI10



Linear Fit

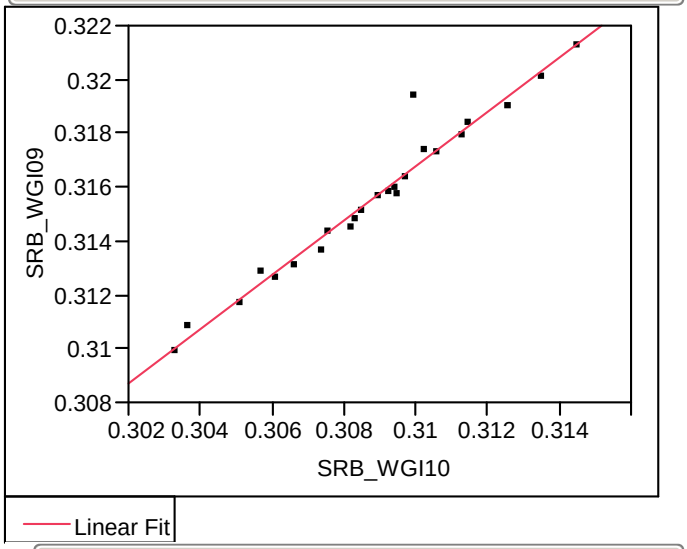
SAF_WGI09 = 0.1958789 + 0.4824566*SAF_WGI10

Summary of Fit

RSquare	0.153924
RSquare Adj	0.115465
Root Mean Square Error	0.000569
Mean of Response	0.380459
Observations (or Sum Wgts)	24

Measuring Results Mode 1 – Mode 2 Radius Bottom

Bivariate Fit of SRB_WGI09 By SRB_WGI10



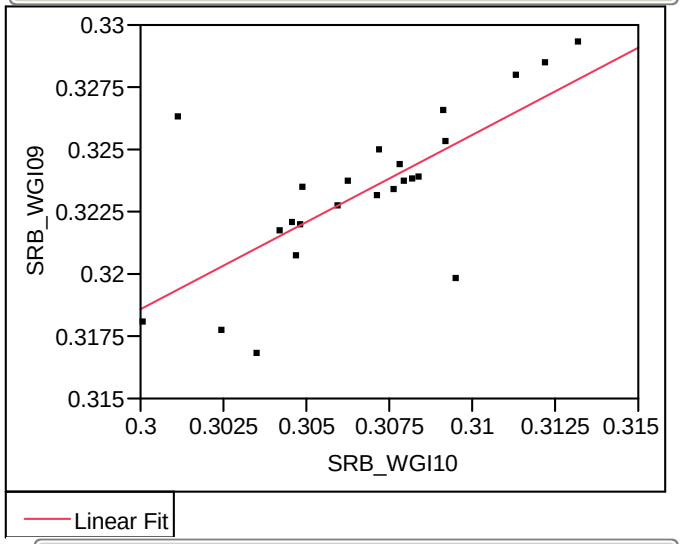
Linear Fit

SRB_WGI09 = 0.0039099 + 1.009154*SRB_WGI10

Summary of Fit

RSquare	0.956329
RSquare Adj	0.954344
Root Mean Square Error	0.000628
Mean of Response	0.315533
Observations (or Sum Wgts)	24

Bivariate Fit of SRB_WGI09 By SRB_WGI10



Linear Fit

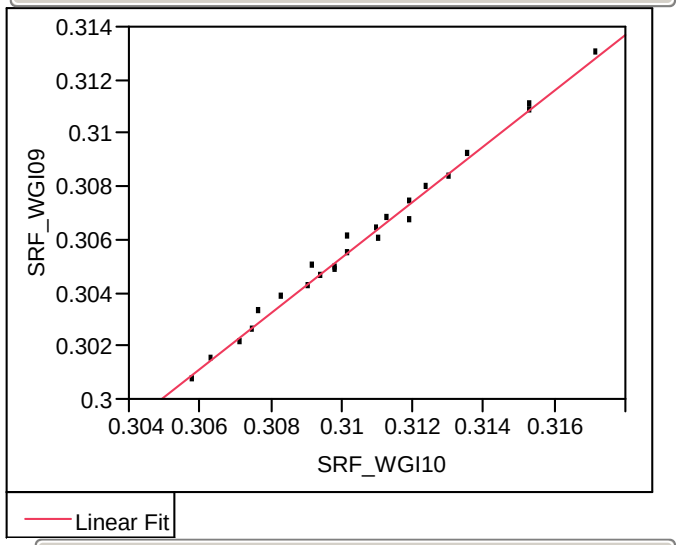
SRB_WGI09 = 0.1100326 + 0.6952675*SRB_WGI10

Summary of Fit

RSquare	0.505046
RSquare Adj	0.482548
Root Mean Square Error	0.002313
Mean of Response	0.323281
Observations (or Sum Wgts)	24

Measuring Results Mode 1 – Mode 2 Radius Front

Bivariate Fit of SRF_WGI09 By SRF_WGI10



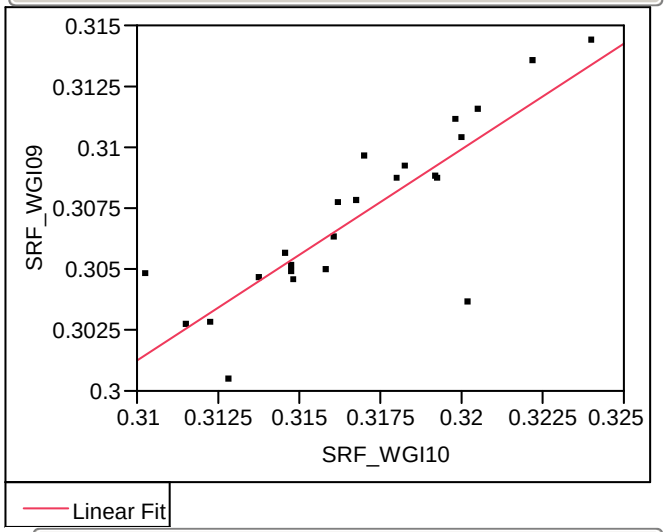
Linear Fit

SRF_WGI09 = -0.02059 + 1.0512619*SRF_WGI10

Summary of Fit

RSquare	0.991485
RSquare Adj	0.991098
Root Mean Square Error	0.000289
Mean of Response	0.305935
Observations (or Sum Wgts)	24

Bivariate Fit of SRF_WGI09 By SRF_WGI10



Linear Fit

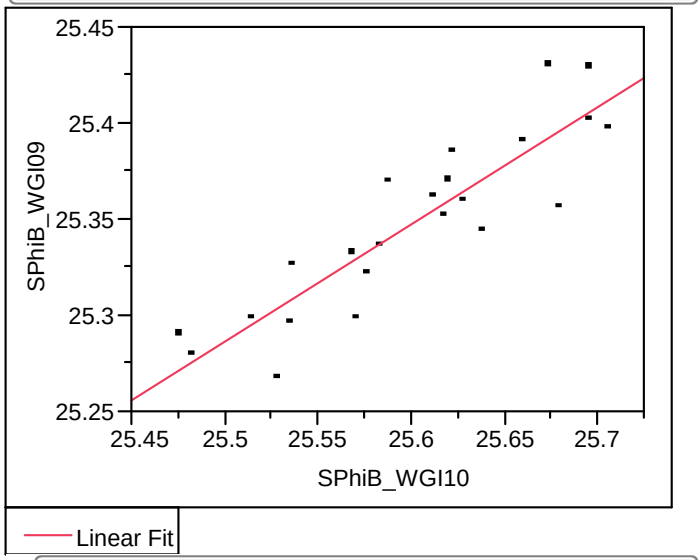
SRF_WGI09 = 0.0332903 + 0.8643931*SRF_WGI10

Summary of Fit

RSquare	0.714996
RSquare Adj	0.702041
Root Mean Square Error	0.001933
Mean of Response	0.307114
Observations (or Sum Wgts)	24

Measuring Results Mode 1 – Mode 2 Bevel angle Bottom

Bivariate Fit of SPhiB_WGI09 By SPhiB_WGI10



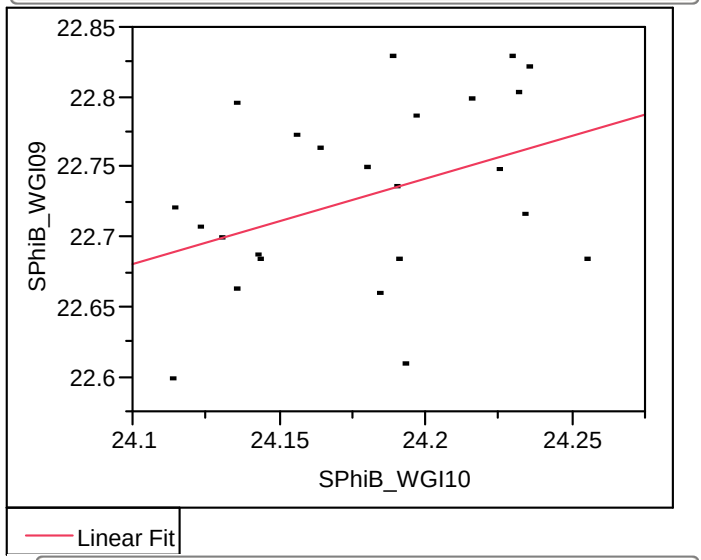
Linear Fit

SPhiB_WGI09 = 9.7895042 + 0.60772*SPhiB_WGI10

Summary of Fit

RSquare	0.794927
RSquare Adj	0.785161
Root Mean Square Error	0.021414
Mean of Response	25.34708
Observations (or Sum Wgts)	23

Bivariate Fit of SPhiB_WGI09 By SPhiB_WGI10



Linear Fit

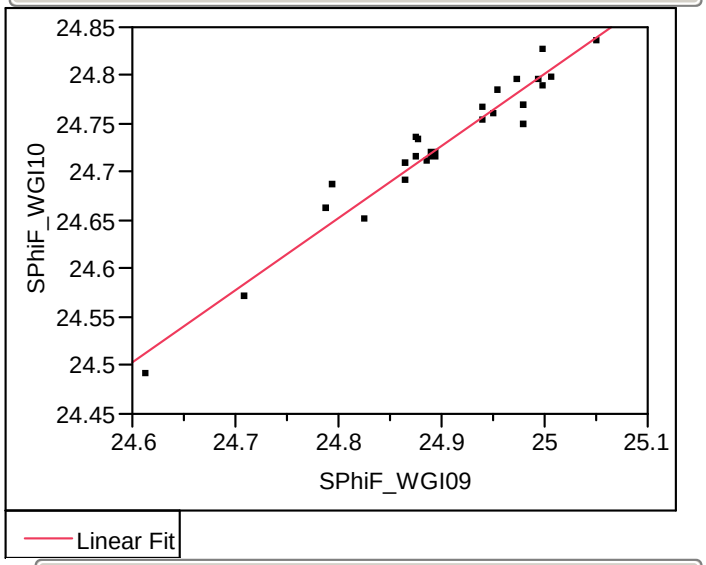
SPhiB_WGI09 = 7.9494463 + 0.6112318*SPhiB_WGI10

Summary of Fit

RSquare	0.158526
RSquare Adj	0.120278
Root Mean Square Error	0.061976
Mean of Response	22.72886
Observations (or Sum Wgts)	24

Measuring Results Mode 1 – Mode 2 Bevel angle Front

Bivariate Fit of SPhiF_WGI10 By SPhiF_WGI09



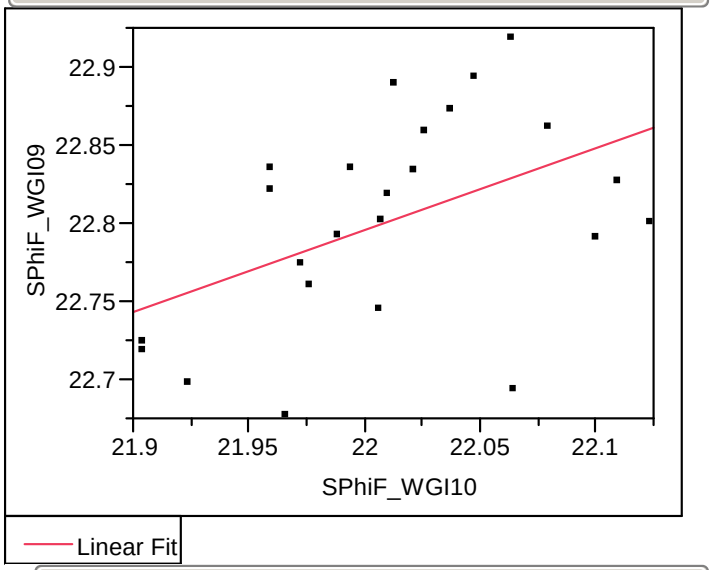
Linear Fit

SPhiF_WGI10 = 6.0830294 + 0.7487667*SPhiF_WGI09

Summary of Fit

RSquare	0.947955
RSquare Adj	0.945477
Root Mean Square Error	0.01879
Mean of Response	24.72838
Observations (or Sum Wgts)	23

Bivariate Fit of SPhiF_WGI09 By SPhiF_WGI10



Linear Fit

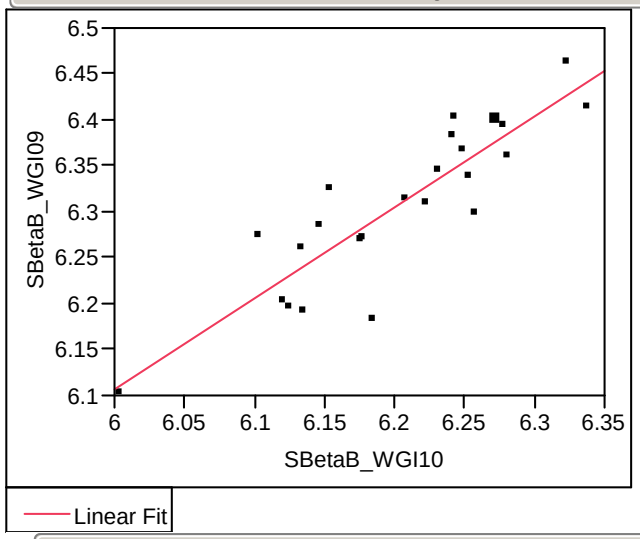
SPhiF_WGI09 = 11.31952 + 0.5216458*SPhiF_WGI10

Summary of Fit

RSquare	0.222075
RSquare Adj	0.186715
Root Mean Square Error	0.060409
Mean of Response	22.80114
Observations (or Sum Wgts)	24

Measuring Results Mode 1 – Mode 2 Apex angle Bottom

Bivariate Fit of SBetaB_WGI09 By SBetaB_WGI10



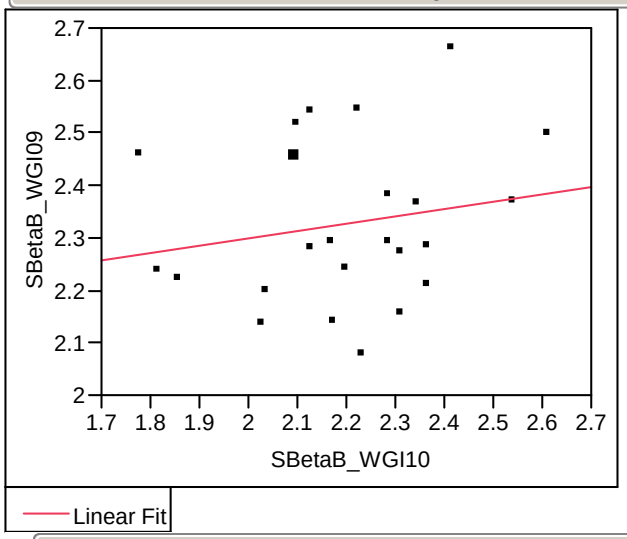
Linear Fit

SBetaB_WGI09 = 0.1572257 + 0.9914234*SBetaB_WGI10

Summary of Fit

RSquare	0.780098
RSquare Adj	0.770102
Root Mean Square Error	0.041955
Mean of Response	6.305547
Observations (or Sum Wgts)	24

Bivariate Fit of SBetaB_WGI09 By SBetaB_WGI10



Linear Fit

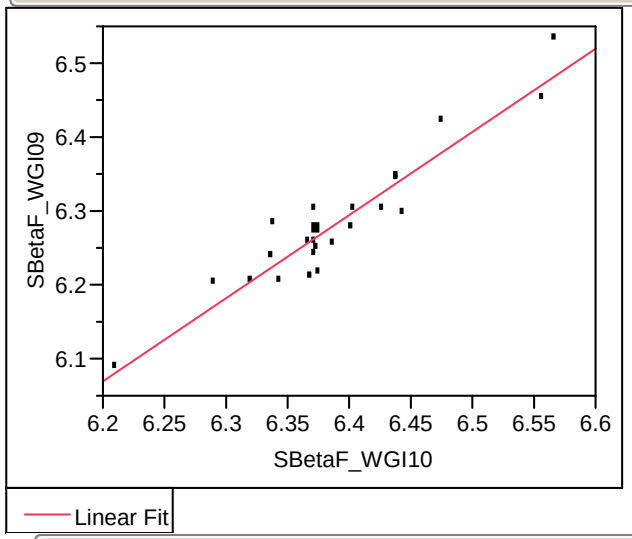
SBetaB_WGI09 = 2.0153765 + 0.1413614*SBetaB_WGI10

Summary of Fit

RSquare	0.03645
RSquare Adj	-0.00735
Root Mean Square Error	0.153668
Mean of Response	2.325974
Observations (or Sum Wgts)	24

Measuring Results Mode 1 – Mode 2 Apex angle Front

Bivariate Fit of SBetaF_WGI09 By SBetaF_WGI10



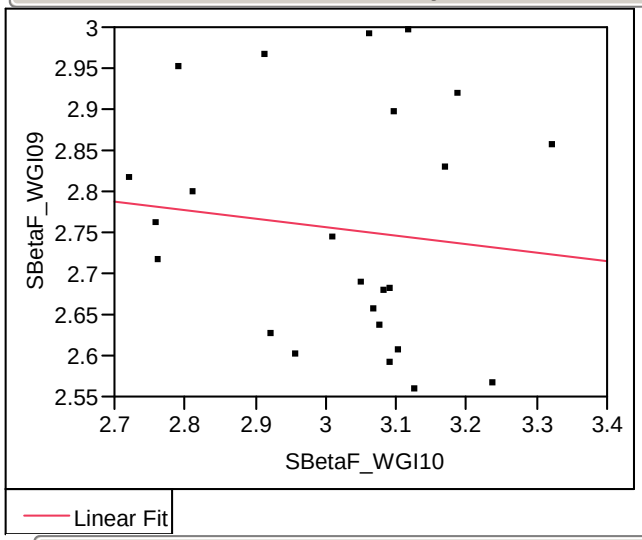
Linear Fit

SBetaF_WGI09 = -0.942167 + 1.1307002*SBetaF_WGI10

Summary of Fit

RSquare	0.890387
RSquare Adj	0.885404
Root Mean Square Error	0.030911
Mean of Response	6.28225
Observations (or Sum Wgts)	24

Bivariate Fit of SBetaF_WGI09 By SBetaF_WGI10



Linear Fit

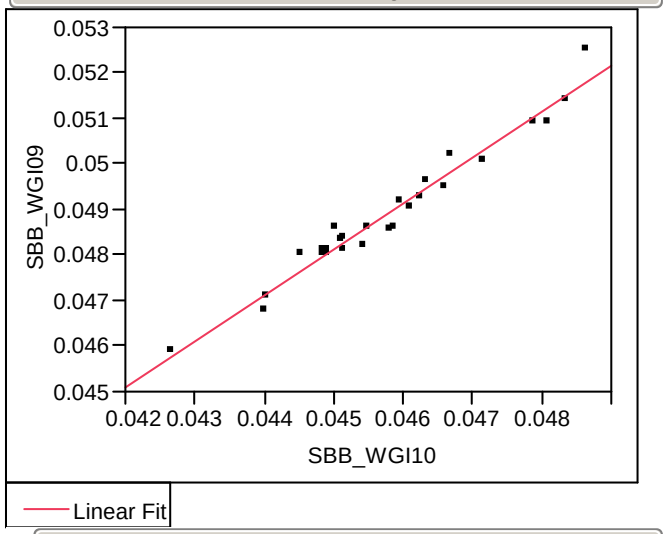
SBetaF_WGI09 = 3.0685928 - 0.1041222*SBetaF_WGI10

Summary of Fit

RSquare	0.013575
RSquare Adj	-0.03126
Root Mean Square Error	0.145189
Mean of Response	2.753953
Observations (or Sum Wgts)	24

Measuring Results Mode 1 – Mode 2 Apex length Bottom

Bivariate Fit of SBB_WGI09 By SBB_WGI10



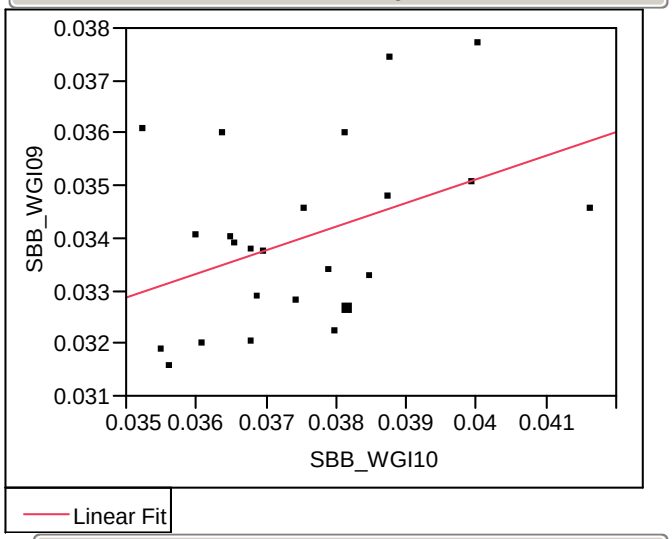
Linear Fit

SBB_WGI09 = 0.0027917 + 1.0072748*SBB_WGI10

Summary of Fit

RSquare	0.961684
RSquare Adj	0.959859
Root Mean Square Error	0.000303
Mean of Response	0.049032
Observations (or Sum Wgts)	23

Bivariate Fit of SBB_WGI09 By SBB_WGI10



Linear Fit

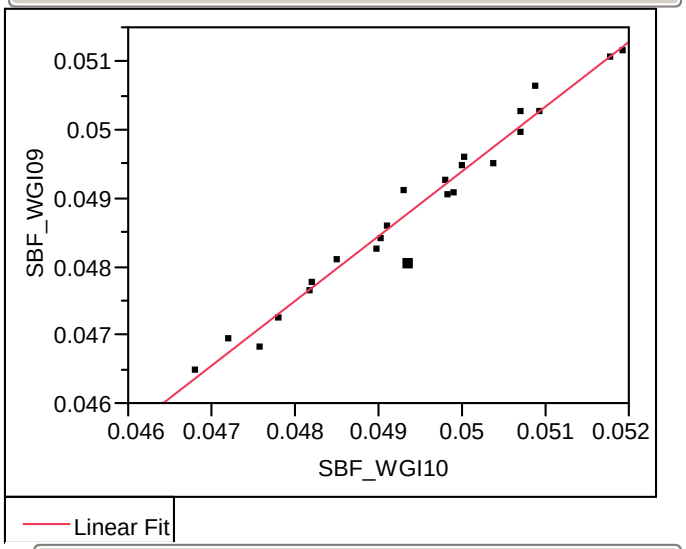
SBB_WGI09 = 0.0170481 + 0.4520113*SBB_WGI10

Summary of Fit

RSquare	0.171789
RSquare Adj	0.134143
Root Mean Square Error	0.001592
Mean of Response	0.033995
Observations (or Sum Wgts)	24

Measuring Results Mode 1 – Mode 2 Apex length Front

Bivariate Fit of SBF_WGI09 By SBF_WGI10



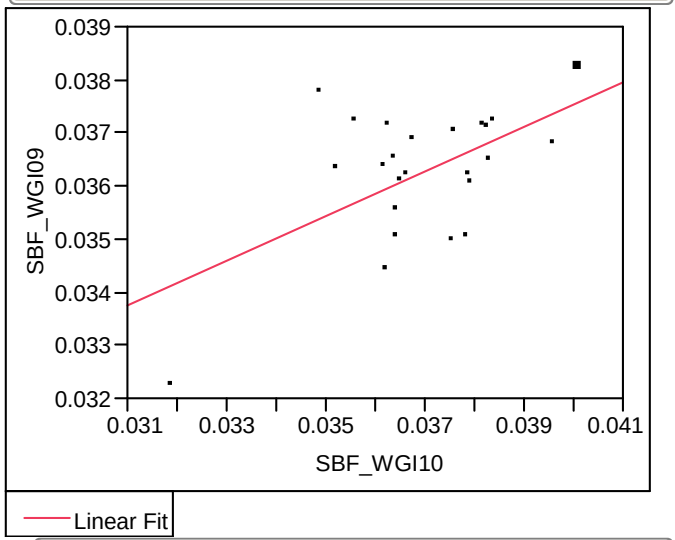
Linear Fit

SBF_WGI09 = 0.0018673 + 0.9504469*SBF_WGI10

Summary of Fit

RSquare	0.981499
RSquare Adj	0.980617
Root Mean Square Error	0.000188
Mean of Response	0.048875
Observations (or Sum Wgts)	23

Bivariate Fit of SBF_WGI09 By SBF_WGI10



Linear Fit

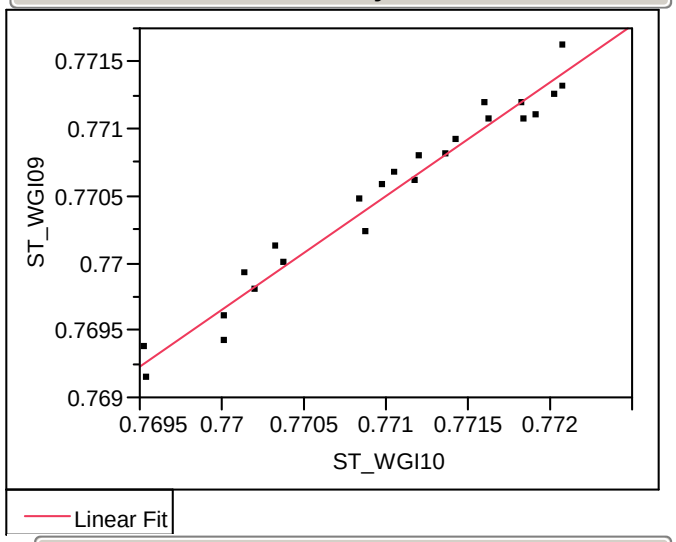
SBF_WGI09 = 0.0207672 + 0.4188928*SBF_WGI10

Summary of Fit

RSquare	0.313396
RSquare Adj	0.282187
Root Mean Square Error	0.001067
Mean of Response	0.036243
Observations (or Sum Wgts)	24

Measuring Results Mode 1 – Mode 2 Thickness

Bivariate Fit of ST_WGI09 By ST_WGI10



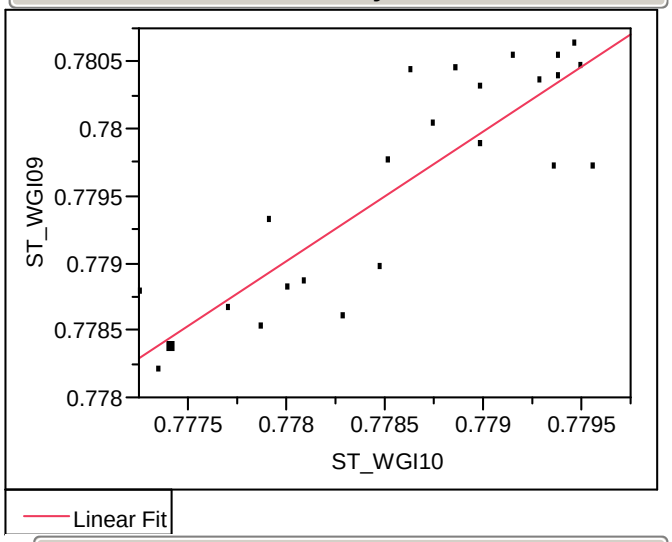
Linear Fit

ST_WGI09 = 0.1173562 + 0.8471445*ST_WGI10

Summary of Fit

RSquare	0.966465
RSquare Adj	0.964941
Root Mean Square Error	0.000131
Mean of Response	0.770505
Observations (or Sum Wgts)	24

Bivariate Fit of ST_WGI09 By ST_WGI10



Linear Fit

ST_WGI09 = 0.0286273 + 0.964516*ST_WGI10

Summary of Fit

RSquare	0.750071
RSquare Adj	0.73871
Root Mean Square Error	0.000424
Mean of Response	0.779594
Observations (or Sum Wgts)	24

Summary

- Correlation of mode 1 is pretty good
- Poor correlation of mode 2
- Matching of tools in mode 2 nearly impossible especially wafers with short apex and long shoulder
- Calibration for mode 2 very difficult
- **KoCoS recommends to use Semi M73 Mode1 for manufacturing environment**