

PLEASE SPECIFY THE FOLLOWING PARAMETERS AND COMPLETE THE FORM ACCORDINGLY

PARAMETERS ARE:

|                      |                     |                                   |           |           |
|----------------------|---------------------|-----------------------------------|-----------|-----------|
| <b>K<sub>1</sub></b> | Number of Trials    | Must be either 2 or 3             | <b>3</b>  | <b>OK</b> |
| <b>K<sub>2</sub></b> | Number of Operators | Must be either 2 or 3             | <b>2</b>  | <b>OK</b> |
| <b>K<sub>3</sub></b> | Number of Parts     | Can be any value between 2 and 10 | <b>10</b> | <b>OK</b> |

|                    |             |                   |                           |                              |              |
|--------------------|-------------|-------------------|---------------------------|------------------------------|--------------|
|                    |             |                   |                           | <b>GAGE APPROVED, USE IT</b> |              |
| Part number        | 13964789    | Part name         | Terminal                  | Plant                        | 11           |
| Characteristic     | Blade Width | Gage number       | E231014                   | Coord by                     | Randy Stitt  |
| USL                | 1.550       | LSL               | 1.450                     | Phone #                      | 330-373-3499 |
| Tolerance (To) / 6 | 0.01667     | Gage name         | OGP Flash Smart Scope 200 | Date                         | 4/13/2021    |
|                    |             | Gage ECL/revision |                           |                              |              |

| OPERATOR                                                                       |   | P       |         | A       |         | R                                                                                                                                                                                                                                                             |         | T                                    |         | RESULTS      |         |                          |         |         |   |   |                    |         |
|--------------------------------------------------------------------------------|---|---------|---------|---------|---------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|--------------------------------------|---------|--------------|---------|--------------------------|---------|---------|---|---|--------------------|---------|
| TRIAL #                                                                        |   | 1       | 2       | 3       | 4       | 5                                                                                                                                                                                                                                                             | 6       | 7                                    | 8       | 9            | 10      | AVG                      |         |         |   |   |                    |         |
| A                                                                              | 1 | 1.50755 | 1.50712 | 1.50851 | 1.50823 | 1.50658                                                                                                                                                                                                                                                       | 1.50522 | 1.5062                               | 1.50621 | 1.50215      | 1.50601 | A <sub>1</sub>           | 1.50638 |         |   |   |                    |         |
|                                                                                | 2 | 1.50405 | 1.50399 | 1.50551 | 1.50671 | 1.50441                                                                                                                                                                                                                                                       | 1.50258 | 1.50283                              | 1.50325 | 1.50504      | 1.50523 | A <sub>2</sub>           | 1.50436 |         |   |   |                    |         |
|                                                                                | 3 | 1.50349 | 1.50413 | 1.50556 | 1.50637 | 1.50483                                                                                                                                                                                                                                                       | 1.50147 | 1.50239                              | 1.50235 | 1.50396      | 1.50467 | A <sub>3</sub>           | 1.50392 |         |   |   |                    |         |
| Average                                                                        |   | 1.50503 | 1.50508 | 1.50653 | 1.5071  | 1.50527                                                                                                                                                                                                                                                       | 1.50309 | 1.50381                              | 1.50394 | 1.50372      | 1.5053  | $\bar{X}_A$              | 1.50489 |         |   |   |                    |         |
| Range                                                                          |   | 0.00406 | 0.00313 | 0.003   | 0.00186 | 0.00217                                                                                                                                                                                                                                                       | 0.00375 | 0.00381                              | 0.00386 | 0.00289      | 0.00134 | $\bar{R}_A$              | 0.00299 |         |   |   |                    |         |
| B                                                                              | 1 | 1.50342 | 1.50372 | 1.5055  | 1.50632 | 1.50513                                                                                                                                                                                                                                                       | 1.50125 | 1.50199                              | 1.50266 | 1.50367      | 1.50431 | B <sub>1</sub>           | 1.50380 |         |   |   |                    |         |
|                                                                                | 2 | 1.50318 | 1.50361 | 1.50562 | 1.506   | 1.50581                                                                                                                                                                                                                                                       | 1.501   | 1.50205                              | 1.503   | 1.50344      | 1.50374 | B <sub>2</sub>           | 1.50375 |         |   |   |                    |         |
|                                                                                | 3 | 1.50309 | 1.50276 | 1.50582 | 1.50638 | 1.50551                                                                                                                                                                                                                                                       | 1.50049 | 1.50111                              | 1.50283 | 1.50248      | 1.50359 | B <sub>3</sub>           | 1.50341 |         |   |   |                    |         |
| Average                                                                        |   | 1.50323 | 1.50336 | 1.50565 | 1.50623 | 1.50548                                                                                                                                                                                                                                                       | 1.50091 | 1.50172                              | 1.50283 | 1.5032       | 1.50388 | $\bar{X}_B$              | 1.50365 |         |   |   |                    |         |
| Range                                                                          |   | 0.00033 | 0.00096 | 0.00032 | 0.00038 | 0.00068                                                                                                                                                                                                                                                       | 0.00076 | 0.00094                              | 0.00034 | 0.00119      | 0.00072 | $\bar{R}_B$              | 0.00066 |         |   |   |                    |         |
| C                                                                              | 1 |         |         |         |         |                                                                                                                                                                                                                                                               |         |                                      |         |              |         | C <sub>1</sub>           |         |         |   |   |                    |         |
|                                                                                | 2 |         |         |         |         |                                                                                                                                                                                                                                                               |         |                                      |         |              |         | C <sub>2</sub>           |         |         |   |   |                    |         |
|                                                                                | 3 |         |         |         |         |                                                                                                                                                                                                                                                               |         |                                      |         |              |         | C <sub>3</sub>           |         |         |   |   |                    |         |
| Average                                                                        |   |         |         |         |         |                                                                                                                                                                                                                                                               |         |                                      |         |              |         | $\bar{X}_C$              |         |         |   |   |                    |         |
| Range                                                                          |   |         |         |         |         |                                                                                                                                                                                                                                                               |         |                                      |         |              |         | $\bar{R}_C$              |         |         |   |   |                    |         |
| Part Avg                                                                       |   | 1.50413 | 1.50422 | 1.50609 | 1.50667 | 1.50538                                                                                                                                                                                                                                                       | 1.502   | 1.50276                              | 1.50338 | 1.50346      | 1.50459 | $\bar{\bar{X}}_{PART}$ = | 1.50427 |         |   |   |                    |         |
| Part Range                                                                     |   |         |         |         |         |                                                                                                                                                                                                                                                               |         |                                      |         |              |         | $\bar{\bar{R}}_{PART}$ = | 0.00467 |         |   |   |                    |         |
| $\bar{R} = R_A + R_B + R_C / \text{No of operators} =$                         |   |         |         |         |         |                                                                                                                                                                                                                                                               |         |                                      |         |              |         | 0.00299                  | +       | 0.00066 | / | 2 | $\bar{\bar{R}} =$  | 0.00182 |
| $\bar{X}_{DIFF} = [\text{Max}(\bar{X})_{ABC}] - [\text{Min}(\bar{X})_{ABC}] =$ |   |         |         |         |         |                                                                                                                                                                                                                                                               |         |                                      |         |              |         | 1.50489                  | -       | 1.50365 |   |   | $\bar{X}_{DIFF} =$ | 0.00124 |
| UCL <sub>R</sub> = $\bar{R} * D_4 =$                                           |   |         |         |         |         |                                                                                                                                                                                                                                                               |         |                                      |         |              |         | 0.00182                  | *       | 2.580   |   |   | UCL <sub>R</sub> = | 0.00471 |
| LCL <sub>R</sub> = $\bar{R} * D_3 =$                                           |   |         |         |         |         |                                                                                                                                                                                                                                                               |         |                                      |         |              |         | 0.00182                  | *       | 0.000   |   |   | LCL <sub>R</sub> = | 0.00000 |
| OPERATOR                                                                       |   | NAME    |         |         |         | NOTE: The Total Tolerance Method should be used when the gage is used for product release.<br>When out of control conditions exist, analyze the data for Gage acceptability. The total variation method is generally used for variation reduction activities. |         |                                      |         |              |         |                          |         |         |   |   |                    |         |
| A                                                                              |   |         |         |         |         |                                                                                                                                                                                                                                                               |         |                                      |         |              |         |                          |         |         |   |   |                    |         |
| B                                                                              |   |         |         |         |         |                                                                                                                                                                                                                                                               |         |                                      |         |              |         |                          |         |         |   |   |                    |         |
| C                                                                              |   |         |         |         |         |                                                                                                                                                                                                                                                               |         |                                      |         |              |         |                          |         |         |   |   |                    |         |
| GOOD UNTIL GAGE ECL/revision CHANGE                                            |   |         |         |         |         |                                                                                                                                                                                                                                                               |         |                                      |         |              |         |                          |         |         |   |   |                    |         |
| FROM DATA SHEET:                                                               |   |         |         |         |         | $\bar{R} =$                                                                                                                                                                                                                                                   | 0.00182 | $\bar{X}_{DIFF} =$                   | 0.00124 | $R_{PART} =$ | 0.00467 |                          |         |         |   |   |                    |         |
| Measurement Unit Analysis                                                      |   |         |         |         |         |                                                                                                                                                                                                                                                               |         | Based on the TOLERANCE Method        |         |              |         |                          |         |         |   |   |                    |         |
| Repeatability - Equipment Variation (EV)                                       |   |         |         |         |         |                                                                                                                                                                                                                                                               |         | % EV = 100[EV/ToI]<br>% EV = 6.47    |         |              |         |                          |         |         |   |   |                    |         |
| EV = $\bar{R} * K_1$                                                           |   |         |         | Trials  |         | K <sub>1</sub>                                                                                                                                                                                                                                                |         |                                      |         |              |         |                          |         |         |   |   |                    |         |
| EV = 0.00108                                                                   |   |         |         | 3       |         | 0.5908                                                                                                                                                                                                                                                        |         |                                      |         |              |         |                          |         |         |   |   |                    |         |
| Reproducibility - Appraiser Variation (AV)                                     |   |         |         |         |         |                                                                                                                                                                                                                                                               |         | % AV = 100[AV/ToI]<br>% AV = 5.11    |         |              |         |                          |         |         |   |   |                    |         |
| AV = $\sqrt{[(\bar{X}_{DIFF} * K_2)^2 - (EV^2 / nr)]}$                         |   |         |         | Oper    |         | K <sub>2</sub>                                                                                                                                                                                                                                                |         |                                      |         |              |         |                          |         |         |   |   |                    |         |
| AV = 0.00085                                                                   |   |         |         | 2       |         | 0.71                                                                                                                                                                                                                                                          |         |                                      |         |              |         |                          |         |         |   |   |                    |         |
| Repeatability & Reproducibility (GRR)                                          |   |         |         |         |         |                                                                                                                                                                                                                                                               |         | % GRR = 100[GRR/ToI]<br>% GRR = 8.25 |         |              |         |                          |         |         |   |   |                    |         |
| GRR = $\sqrt{(EV^2 + AV^2)}$                                                   |   |         |         |         |         |                                                                                                                                                                                                                                                               |         |                                      |         |              |         |                          |         |         |   |   |                    |         |
| GRR = 0.00137                                                                  |   |         |         |         |         |                                                                                                                                                                                                                                                               |         |                                      |         |              |         |                          |         |         |   |   |                    |         |
| Part Variation (PV)                                                            |   |         |         |         |         |                                                                                                                                                                                                                                                               |         | % PV = 100[PV/ToI]<br>% PV = 99.66   |         |              |         |                          |         |         |   |   |                    |         |
| PV = SQRT(TV <sup>2</sup> -GRR <sup>2</sup> )                                  |   |         |         | Parts   |         | K <sub>3</sub>                                                                                                                                                                                                                                                |         |                                      |         |              |         |                          |         |         |   |   |                    |         |
| PV = 0.01661                                                                   |   |         |         | 10      |         | 0.31                                                                                                                                                                                                                                                          |         |                                      |         |              |         |                          |         |         |   |   |                    |         |
| Total Variation (TV)                                                           |   |         |         |         |         |                                                                                                                                                                                                                                                               |         | Number of Distinct Categories        |         |              |         |                          |         |         |   |   |                    |         |
| TV = (USL-LSL)/6                                                               |   |         |         |         |         |                                                                                                                                                                                                                                                               |         | ndc = 1.41[PV/GRR]                   |         |              |         |                          |         |         |   |   |                    |         |
| TV = 0.01667                                                                   |   |         |         |         |         |                                                                                                                                                                                                                                                               |         | ndc = 17.042 ~ 17                    |         |              |         |                          |         |         |   |   |                    |         |
|                                                                                |   |         |         |         |         |                                                                                                                                                                                                                                                               |         | should be greater than or equal to 5 |         |              |         |                          |         |         |   |   |                    |         |
|                                                                                |   |         |         |         |         |                                                                                                                                                                                                                                                               |         | Conclusion:                          |         |              |         |                          |         |         |   |   |                    |         |
|                                                                                |   |         |         |         |         |                                                                                                                                                                                                                                                               |         | GAGE IS ACCEPTED                     |         |              |         |                          |         |         |   |   |                    |         |
|                                                                                |   |         |         |         |         |                                                                                                                                                                                                                                                               |         | All ranges OK                        |         |              |         |                          |         |         |   |   |                    |         |

Guidelines for acceptance of gage repeatability and reproducibility (%R&R):

UNDER 10% ERROR: Gage system OK

10% to 30% ERROR: May be acceptable based upon importance of application. Calculate "breakpoint" = RPN x (% Gage R&R/100) and check that is less than 37.8 and (% Gage R&R) less than 30%. See next page for conclusion of usage.

OVER 30% ERROR: Gage system needs improvement. Identify the problems and have them corrected.

|                                                                                                                                                                                                      |                   |   |       |   |          |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|---|-------|---|----------|
| DETERMINE THE RISK PRIORITY NUMBER (RPN) FROM THE FMEA ASSOCIATED WITH THE DIMENSION BEING GAGED. TYPE THE RPN # UNDER THE RPN # FIELD PROVIDED (RIGHT) AND FOLLOW INSTRUCTION OF USAGE IN NEXT ROW: | <b>BREAKPOINT</b> | = | RPN # | x | %GRR/100 |
|                                                                                                                                                                                                      | 0.00              | = | 0.0   | x | 0.08246  |

For information on the theory and constants used in the form see MSA Reference Manual , 4th edition.