

## Part Submission Warrant

|                                                                                                                                                                                                                                                                                                   |              |                                                                                                              |         |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|--------------------------------------------------------------------------------------------------------------|---------|
| Part Name <u>PP NW19 SW GES. GN.STR.</u>                                                                                                                                                                                                                                                          |              | Cust. Part Number <u>1931961</u>                                                                             |         |
| Shown on Drawing No. <u>19314903-Ford</u>                                                                                                                                                                                                                                                         |              | Org. Part Number <u>1931961</u>                                                                              |         |
| Engineering Change Level <u>"I"</u>                                                                                                                                                                                                                                                               |              | Dated <u>05.02.2013</u>                                                                                      |         |
| Additional Engineering Changes _____                                                                                                                                                                                                                                                              |              | Dated _____                                                                                                  |         |
| Safety and/or Government Regulation <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No                                                                                                                                                                                           |              | Purchase Order No. _____ Weight (kg) <u>0,038kg/m</u>                                                        |         |
| Checking Aid No. _____                                                                                                                                                                                                                                                                            |              | Checking Aid Engineering Change Level _____ Dated _____                                                      |         |
| <b>ORGANIZATION MANUFACTURING INFORMATION</b>                                                                                                                                                                                                                                                     |              | <b>CUSTOMER SUBMITTAL INFORMATION</b>                                                                        |         |
| <u>Schlemmer GmbH 53-739-7536</u>                                                                                                                                                                                                                                                                 |              | <u>Nursan Elektrik Donanım San. ve Tic. A</u>                                                                |         |
| Organization Name & Supplier/Vendor Code                                                                                                                                                                                                                                                          |              | Customer Name / Division                                                                                     |         |
| <u>Philipp-Reis-Straße 18</u>                                                                                                                                                                                                                                                                     |              | <u>Erdem ULA</u>                                                                                             |         |
| Street Address                                                                                                                                                                                                                                                                                    |              | Buyer / Buyer Code                                                                                           |         |
| <u>Haßfurt</u>                                                                                                                                                                                                                                                                                    | <u>97437</u> | <u>Germany</u>                                                                                               |         |
| City                                                                                                                                                                                                                                                                                              | Region       | Postal Code                                                                                                  | Country |
|                                                                                                                                                                                                                                                                                                   |              | Application                                                                                                  |         |
| <b>MATERIALS REPORTING:</b>                                                                                                                                                                                                                                                                       |              |                                                                                                              |         |
| Has customer-required Substances of Concern information been reported?                                                                                                                                                                                                                            |              | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> n/a             |         |
| Submitted by IMDS or other customer format:                                                                                                                                                                                                                                                       |              | <u>IMDS-ID: 122985632 / 2</u>                                                                                |         |
| Are polymeric parts identified with appropriate ISO marking codes?                                                                                                                                                                                                                                |              | <input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> n/a             |         |
| <b>REASON FOR SUBMISSION (Check at least one)</b>                                                                                                                                                                                                                                                 |              |                                                                                                              |         |
| <input checked="" type="checkbox"/> Initial submission                                                                                                                                                                                                                                            |              | <input type="checkbox"/> Change to Optional Construction or Material                                         |         |
| <input type="checkbox"/> Engineering Change(s)                                                                                                                                                                                                                                                    |              | <input type="checkbox"/> Supplier or Material Source Change                                                  |         |
| <input type="checkbox"/> Tooling: Transfer, Replacement, Refurbishment, or additional                                                                                                                                                                                                             |              | <input type="checkbox"/> Change in Part Processing                                                           |         |
| <input type="checkbox"/> Correction of Discrepancy                                                                                                                                                                                                                                                |              | <input type="checkbox"/> Parts produced at Additional Location                                               |         |
| <input type="checkbox"/> Tooling inactive > than 1 year                                                                                                                                                                                                                                           |              | <input type="checkbox"/> Other - please specify below                                                        |         |
| <b>REQUESTED SUBMISSION LEVEL (Check one)</b>                                                                                                                                                                                                                                                     |              |                                                                                                              |         |
| <input type="checkbox"/> Level 1 - Warrant only (and for designated appearance items, an Appearance Approval Report) submitted to customer.                                                                                                                                                       |              |                                                                                                              |         |
| <input type="checkbox"/> Level 2 - Warrant with product samples and limited supporting data submitted to customer.                                                                                                                                                                                |              |                                                                                                              |         |
| <input checked="" type="checkbox"/> Level 3 - Warrant with product samples and complete supporting data submitted to customer.                                                                                                                                                                    |              |                                                                                                              |         |
| <input type="checkbox"/> Level 4 - Warrant and other requirements as defined by customer.                                                                                                                                                                                                         |              |                                                                                                              |         |
| <input type="checkbox"/> Level 5 - Warrant with product samples and complete supporting data reviewed at supplier's manufacturing location.                                                                                                                                                       |              |                                                                                                              |         |
| <b>SUBMISSION RESULTS</b>                                                                                                                                                                                                                                                                         |              |                                                                                                              |         |
| The results for <input checked="" type="checkbox"/> dimensional measurements                                                                                                                                                                                                                      |              | <input checked="" type="checkbox"/> material and functional tests                                            |         |
|                                                                                                                                                                                                                                                                                                   |              | <input type="checkbox"/> appearance criteria <input checked="" type="checkbox"/> statistical process package |         |
| These results meet all design record requirements:                                                                                                                                                                                                                                                |              | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (If 'NO' - Explanation Required)         |         |
| Mold / Cavity / Production Process _____                                                                                                                                                                                                                                                          |              |                                                                                                              |         |
| <b>DECLARATION</b>                                                                                                                                                                                                                                                                                |              |                                                                                                              |         |
| I affirm that the samples represented by this warrant are representative of our parts, which were made by a process that meets all Production Part Approval Process Manual 4rd Edition Requirements. I further affirm that these samples were produced at the production rate of ____/____ hours. |              |                                                                                                              |         |
| I also certify that documented evidence of such compliance is on file and available for review. I have noted any deviations from this declaration below.                                                                                                                                          |              |                                                                                                              |         |
| EXPLANATION / COMMENTS: <u>Report: 22800</u>                                                                                                                                                                                                                                                      |              | <u>Material: PP (SRS PP 2010)</u>                                                                            |         |
| Is each Customer Tool properly tagged and numbered?                                                                                                                                                                                                                                               |              | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> n/a             |         |
| Organization Authorized Signature                                                                                                                                                                              |              | Dated <u>20.01.2017</u>                                                                                      |         |
| Print Name <u>i.A. Thomas Mergner</u>                                                                                                                                                                                                                                                             |              | Phone No. <u>+49 (0)8121/804-123</u> Fax No. _____                                                           |         |
| Title <u>GQ1</u>                                                                                                                                                                                                                                                                                  |              | E-mail <u>Thomas.Mergner@schlemmer.com</u>                                                                   |         |
| <b>FOR CUSTOMER USE ONLY (IF APPLICABLE)</b>                                                                                                                                                                                                                                                      |              |                                                                                                              |         |
| PPAP Warrant Disposition: <input type="checkbox"/> Approved <input type="checkbox"/> Rejected <input type="checkbox"/> Other                                                                                                                                                                      |              |                                                                                                              |         |
| Customer Signature _____                                                                                                                                                                                                                                                                          |              | Dated _____                                                                                                  |         |
| Print Name _____                                                                                                                                                                                                                                                                                  |              | Customer Tracking Number (optional) _____                                                                    |         |

## Production Part Approval - Dimensional Results

|                       |                |                               |                         |         |
|-----------------------|----------------|-------------------------------|-------------------------|---------|
| ORGANIZATION:         | Schlemmer GmbH | PART NUMBER:                  | 1931961                 | 1931961 |
| SUPPLIER/VENDOR CODE: | 53-739-7536    | PART NAME:                    | PP NW19 SW GES. GN.STR. |         |
| INSPECTION FACILITY:  |                | DESIGN RECORD CHANGE LEVEL:   | "I"                     |         |
|                       |                | ENGINEERING CHANCE DOCUMENTS: |                         |         |

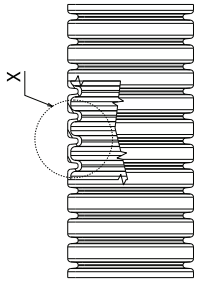
[illegible]

Blanket statements of conformance are unacceptable for any test results.

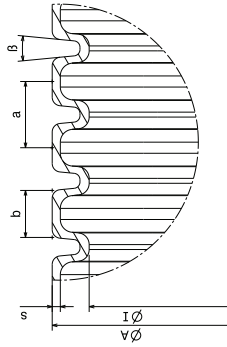


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| <u>SIGNATURE</u>    | <u>TITLE</u> | <u>DATE</u> |
|---------------------|--------------|-------------|
| i.A. Thomas Mergner | GQ1          | 20.01.2017  |



Detail X



| Toleranzen/Tolerances       |       |       |        |        |
|-----------------------------|-------|-------|--------|--------|
| Nennweiten<br>Nominal width | ØA    | ØI    | a      | b      |
| 4,5 - 16                    | ±0,3  | ±0,3  | ±0,10  | ±0,10  |
| 17 - 29                     | ±0,4  | ±0,4  | ±0,15  | ±0,15  |
| 30 - 37                     | ±0,5  | ±0,5  | ±0,20  | ±0,20  |
| 38 - 45                     | ±0,6  | ±0,6  | ±0,25  | ±0,25  |
| 46 - 53                     | ±0,7  | ±0,7  | ±0,30  | ±0,30  |
| 54 - 63                     | ±0,8  | ±0,8  | ±0,35  | ±0,35  |
| 64 - 73                     | ±0,9  | ±0,9  | ±0,40  | ±0,40  |
| 74 - 83                     | ±1,0  | ±1,0  | ±0,45  | ±0,45  |
| 84 - 93                     | ±1,1  | ±1,1  | ±0,50  | ±0,50  |
| 94 - 103                    | ±1,2  | ±1,2  | ±0,55  | ±0,55  |
| 104 - 113                   | ±1,3  | ±1,3  | ±0,60  | ±0,60  |
| 114 - 123                   | ±1,4  | ±1,4  | ±0,65  | ±0,65  |
| 124 - 133                   | ±1,5  | ±1,5  | ±0,70  | ±0,70  |
| 134 - 143                   | ±1,6  | ±1,6  | ±0,75  | ±0,75  |
| 144 - 153                   | ±1,7  | ±1,7  | ±0,80  | ±0,80  |
| 154 - 163                   | ±1,8  | ±1,8  | ±0,85  | ±0,85  |
| 164 - 173                   | ±1,9  | ±1,9  | ±0,90  | ±0,90  |
| 174 - 183                   | ±2,0  | ±2,0  | ±0,95  | ±0,95  |
| 184 - 193                   | ±2,1  | ±2,1  | ±1,00  | ±1,00  |
| 194 - 203                   | ±2,2  | ±2,2  | ±1,05  | ±1,05  |
| 204 - 213                   | ±2,3  | ±2,3  | ±1,10  | ±1,10  |
| 214 - 223                   | ±2,4  | ±2,4  | ±1,15  | ±1,15  |
| 224 - 233                   | ±2,5  | ±2,5  | ±1,20  | ±1,20  |
| 234 - 243                   | ±2,6  | ±2,6  | ±1,25  | ±1,25  |
| 244 - 253                   | ±2,7  | ±2,7  | ±1,30  | ±1,30  |
| 254 - 263                   | ±2,8  | ±2,8  | ±1,35  | ±1,35  |
| 264 - 273                   | ±2,9  | ±2,9  | ±1,40  | ±1,40  |
| 274 - 283                   | ±3,0  | ±3,0  | ±1,45  | ±1,45  |
| 284 - 293                   | ±3,1  | ±3,1  | ±1,50  | ±1,50  |
| 294 - 303                   | ±3,2  | ±3,2  | ±1,55  | ±1,55  |
| 304 - 313                   | ±3,3  | ±3,3  | ±1,60  | ±1,60  |
| 314 - 323                   | ±3,4  | ±3,4  | ±1,65  | ±1,65  |
| 324 - 333                   | ±3,5  | ±3,5  | ±1,70  | ±1,70  |
| 334 - 343                   | ±3,6  | ±3,6  | ±1,75  | ±1,75  |
| 344 - 353                   | ±3,7  | ±3,7  | ±1,80  | ±1,80  |
| 354 - 363                   | ±3,8  | ±3,8  | ±1,85  | ±1,85  |
| 364 - 373                   | ±3,9  | ±3,9  | ±1,90  | ±1,90  |
| 374 - 383                   | ±4,0  | ±4,0  | ±1,95  | ±1,95  |
| 384 - 393                   | ±4,1  | ±4,1  | ±2,00  | ±2,00  |
| 394 - 403                   | ±4,2  | ±4,2  | ±2,05  | ±2,05  |
| 404 - 413                   | ±4,3  | ±4,3  | ±2,10  | ±2,10  |
| 414 - 423                   | ±4,4  | ±4,4  | ±2,15  | ±2,15  |
| 424 - 433                   | ±4,5  | ±4,5  | ±2,20  | ±2,20  |
| 434 - 443                   | ±4,6  | ±4,6  | ±2,25  | ±2,25  |
| 444 - 453                   | ±4,7  | ±4,7  | ±2,30  | ±2,30  |
| 454 - 463                   | ±4,8  | ±4,8  | ±2,35  | ±2,35  |
| 464 - 473                   | ±4,9  | ±4,9  | ±2,40  | ±2,40  |
| 474 - 483                   | ±5,0  | ±5,0  | ±2,45  | ±2,45  |
| 484 - 493                   | ±5,1  | ±5,1  | ±2,50  | ±2,50  |
| 494 - 503                   | ±5,2  | ±5,2  | ±2,55  | ±2,55  |
| 504 - 513                   | ±5,3  | ±5,3  | ±2,60  | ±2,60  |
| 514 - 523                   | ±5,4  | ±5,4  | ±2,65  | ±2,65  |
| 524 - 533                   | ±5,5  | ±5,5  | ±2,70  | ±2,70  |
| 534 - 543                   | ±5,6  | ±5,6  | ±2,75  | ±2,75  |
| 544 - 553                   | ±5,7  | ±5,7  | ±2,80  | ±2,80  |
| 554 - 563                   | ±5,8  | ±5,8  | ±2,85  | ±2,85  |
| 564 - 573                   | ±5,9  | ±5,9  | ±2,90  | ±2,90  |
| 574 - 583                   | ±6,0  | ±6,0  | ±2,95  | ±2,95  |
| 584 - 593                   | ±6,1  | ±6,1  | ±3,00  | ±3,00  |
| 594 - 603                   | ±6,2  | ±6,2  | ±3,05  | ±3,05  |
| 604 - 613                   | ±6,3  | ±6,3  | ±3,10  | ±3,10  |
| 614 - 623                   | ±6,4  | ±6,4  | ±3,15  | ±3,15  |
| 624 - 633                   | ±6,5  | ±6,5  | ±3,20  | ±3,20  |
| 634 - 643                   | ±6,6  | ±6,6  | ±3,25  | ±3,25  |
| 644 - 653                   | ±6,7  | ±6,7  | ±3,30  | ±3,30  |
| 654 - 663                   | ±6,8  | ±6,8  | ±3,35  | ±3,35  |
| 664 - 673                   | ±6,9  | ±6,9  | ±3,40  | ±3,40  |
| 674 - 683                   | ±7,0  | ±7,0  | ±3,45  | ±3,45  |
| 684 - 693                   | ±7,1  | ±7,1  | ±3,50  | ±3,50  |
| 694 - 703                   | ±7,2  | ±7,2  | ±3,55  | ±3,55  |
| 704 - 713                   | ±7,3  | ±7,3  | ±3,60  | ±3,60  |
| 714 - 723                   | ±7,4  | ±7,4  | ±3,65  | ±3,65  |
| 724 - 733                   | ±7,5  | ±7,5  | ±3,70  | ±3,70  |
| 734 - 743                   | ±7,6  | ±7,6  | ±3,75  | ±3,75  |
| 744 - 753                   | ±7,7  | ±7,7  | ±3,80  | ±3,80  |
| 754 - 763                   | ±7,8  | ±7,8  | ±3,85  | ±3,85  |
| 764 - 773                   | ±7,9  | ±7,9  | ±3,90  | ±3,90  |
| 774 - 783                   | ±8,0  | ±8,0  | ±3,95  | ±3,95  |
| 784 - 793                   | ±8,1  | ±8,1  | ±4,00  | ±4,00  |
| 794 - 803                   | ±8,2  | ±8,2  | ±4,05  | ±4,05  |
| 804 - 813                   | ±8,3  | ±8,3  | ±4,10  | ±4,10  |
| 814 - 823                   | ±8,4  | ±8,4  | ±4,15  | ±4,15  |
| 824 - 833                   | ±8,5  | ±8,5  | ±4,20  | ±4,20  |
| 834 - 843                   | ±8,6  | ±8,6  | ±4,25  | ±4,25  |
| 844 - 853                   | ±8,7  | ±8,7  | ±4,30  | ±4,30  |
| 854 - 863                   | ±8,8  | ±8,8  | ±4,35  | ±4,35  |
| 864 - 873                   | ±8,9  | ±8,9  | ±4,40  | ±4,40  |
| 874 - 883                   | ±9,0  | ±9,0  | ±4,45  | ±4,45  |
| 884 - 893                   | ±9,1  | ±9,1  | ±4,50  | ±4,50  |
| 894 - 903                   | ±9,2  | ±9,2  | ±4,55  | ±4,55  |
| 904 - 913                   | ±9,3  | ±9,3  | ±4,60  | ±4,60  |
| 914 - 923                   | ±9,4  | ±9,4  | ±4,65  | ±4,65  |
| 924 - 933                   | ±9,5  | ±9,5  | ±4,70  | ±4,70  |
| 934 - 943                   | ±9,6  | ±9,6  | ±4,75  | ±4,75  |
| 944 - 953                   | ±9,7  | ±9,7  | ±4,80  | ±4,80  |
| 954 - 963                   | ±9,8  | ±9,8  | ±4,85  | ±4,85  |
| 964 - 973                   | ±9,9  | ±9,9  | ±4,90  | ±4,90  |
| 974 - 983                   | ±10,0 | ±10,0 | ±4,95  | ±4,95  |
| 984 - 993                   | ±10,1 | ±10,1 | ±5,00  | ±5,00  |
| 994 - 1003                  | ±10,2 | ±10,2 | ±5,05  | ±5,05  |
| 1004 - 1013                 | ±10,3 | ±10,3 | ±5,10  | ±5,10  |
| 1014 - 1023                 | ±10,4 | ±10,4 | ±5,15  | ±5,15  |
| 1024 - 1033                 | ±10,5 | ±10,5 | ±5,20  | ±5,20  |
| 1034 - 1043                 | ±10,6 | ±10,6 | ±5,25  | ±5,25  |
| 1044 - 1053                 | ±10,7 | ±10,7 | ±5,30  | ±5,30  |
| 1054 - 1063                 | ±10,8 | ±10,8 | ±5,35  | ±5,35  |
| 1064 - 1073                 | ±10,9 | ±10,9 | ±5,40  | ±5,40  |
| 1074 - 1083                 | ±11,0 | ±11,0 | ±5,45  | ±5,45  |
| 1084 - 1093                 | ±11,1 | ±11,1 | ±5,50  | ±5,50  |
| 1094 - 1103                 | ±11,2 | ±11,2 | ±5,55  | ±5,55  |
| 1104 - 1113                 | ±11,3 | ±11,3 | ±5,60  | ±5,60  |
| 1114 - 1123                 | ±11,4 | ±11,4 | ±5,65  | ±5,65  |
| 1124 - 1133                 | ±11,5 | ±11,5 | ±5,70  | ±5,70  |
| 1134 - 1143                 | ±11,6 | ±11,6 | ±5,75  | ±5,75  |
| 1144 - 1153                 | ±11,7 | ±11,7 | ±5,80  | ±5,80  |
| 1154 - 1163                 | ±11,8 | ±11,8 | ±5,85  | ±5,85  |
| 1164 - 1173                 | ±11,9 | ±11,9 | ±5,90  | ±5,90  |
| 1174 - 1183                 | ±12,0 | ±12,0 | ±5,95  | ±5,95  |
| 1184 - 1193                 | ±12,1 | ±12,1 | ±6,00  | ±6,00  |
| 1194 - 1203                 | ±12,2 | ±12,2 | ±6,05  | ±6,05  |
| 1204 - 1213                 | ±12,3 | ±12,3 | ±6,10  | ±6,10  |
| 1214 - 1223                 | ±12,4 | ±12,4 | ±6,15  | ±6,15  |
| 1224 - 1233                 | ±12,5 | ±12,5 | ±6,20  | ±6,20  |
| 1234 - 1243                 | ±12,6 | ±12,6 | ±6,25  | ±6,25  |
| 1244 - 1253                 | ±12,7 | ±12,7 | ±6,30  | ±6,30  |
| 1254 - 1263                 | ±12,8 | ±12,8 | ±6,35  | ±6,35  |
| 1264 - 1273                 | ±12,9 | ±12,9 | ±6,40  | ±6,40  |
| 1274 - 1283                 | ±13,0 | ±13,0 | ±6,45  | ±6,45  |
| 1284 - 1293                 | ±13,1 | ±13,1 | ±6,50  | ±6,50  |
| 1294 - 1303                 | ±13,2 | ±13,2 | ±6,55  | ±6,55  |
| 1304 - 1313                 | ±13,3 | ±13,3 | ±6,60  | ±6,60  |
| 1314 - 1323                 | ±13,4 | ±13,4 | ±6,65  | ±6,65  |
| 1324 - 1333                 | ±13,5 | ±13,5 | ±6,70  | ±6,70  |
| 1334 - 1343                 | ±13,6 | ±13,6 | ±6,75  | ±6,75  |
| 1344 - 1353                 | ±13,7 | ±13,7 | ±6,80  | ±6,80  |
| 1354 - 1363                 | ±13,8 | ±13,8 | ±6,85  | ±6,85  |
| 1364 - 1373                 | ±13,9 | ±13,9 | ±6,90  | ±6,90  |
| 1374 - 1383                 | ±14,0 | ±14,0 | ±6,95  | ±6,95  |
| 1384 - 1393                 | ±14,1 | ±14,1 | ±7,00  | ±7,00  |
| 1394 - 1403                 | ±14,2 | ±14,2 | ±7,05  | ±7,05  |
| 1404 - 1413                 | ±14,3 | ±14,3 | ±7,10  | ±7,10  |
| 1414 - 1423                 | ±14,4 | ±14,4 | ±7,15  | ±7,15  |
| 1424 - 1433                 | ±14,5 | ±14,5 | ±7,20  | ±7,20  |
| 1434 - 1443                 | ±14,6 | ±14,6 | ±7,25  | ±7,25  |
| 1444 - 1453                 | ±14,7 | ±14,7 | ±7,30  | ±7,30  |
| 1454 - 1463                 | ±14,8 | ±14,8 | ±7,35  | ±7,35  |
| 1464 - 1473                 | ±14,9 | ±14,9 | ±7,40  | ±7,40  |
| 1474 - 1483                 | ±15,0 | ±15,0 | ±7,45  | ±7,45  |
| 1484 - 1493                 | ±15,1 | ±15,1 | ±7,50  | ±7,50  |
| 1494 - 1503                 | ±15,2 | ±15,2 | ±7,55  | ±7,55  |
| 1504 - 1513                 | ±15,3 | ±15,3 | ±7,60  | ±7,60  |
| 1514 - 1523                 | ±15,4 | ±15,4 | ±7,65  | ±7,65  |
| 1524 - 1533                 | ±15,5 | ±15,5 | ±7,70  | ±7,70  |
| 1534 - 1543                 | ±15,6 | ±15,6 | ±7,75  | ±7,75  |
| 1544 - 1553                 | ±15,7 | ±15,7 | ±7,80  | ±7,80  |
| 1554 - 1563                 | ±15,8 | ±15,8 | ±7,85  | ±7,85  |
| 1564 - 1573                 | ±15,9 | ±15,9 | ±7,90  | ±7,90  |
| 1574 - 1583                 | ±16,0 | ±16,0 | ±7,95  | ±7,95  |
| 1584 - 1593                 | ±16,1 | ±16,1 | ±8,00  | ±8,00  |
| 1594 - 1603                 | ±16,2 | ±16,2 | ±8,05  | ±8,05  |
| 1604 - 1613                 | ±16,3 | ±16,3 | ±8,10  | ±8,10  |
| 1614 - 1623                 | ±16,4 | ±16,4 | ±8,15  | ±8,15  |
| 1624 - 1633                 | ±16,5 | ±16,5 | ±8,20  | ±8,20  |
| 1634 - 1643                 | ±16,6 | ±16,6 | ±8,25  | ±8,25  |
| 1644 - 1653                 | ±16,7 | ±16,7 | ±8,30  | ±8,30  |
| 1654 - 1663                 | ±16,8 | ±16,8 | ±8,35  | ±8,35  |
| 1664 - 1673                 | ±16,9 | ±16,9 | ±8,40  | ±8,40  |
| 1674 - 1683                 | ±17,0 | ±17,0 | ±8,45  | ±8,45  |
| 1684 - 1693                 | ±17,1 | ±17,1 | ±8,50  | ±8,50  |
| 1694 - 1703                 | ±17,2 | ±17,2 | ±8,55  | ±8,55  |
| 1704 - 1713                 | ±17,3 | ±17,3 | ±8,60  | ±8,60  |
| 1714 - 1723                 | ±17,4 | ±17,4 | ±8,65  | ±8,65  |
| 1724 - 1733                 | ±17,5 | ±17,5 | ±8,70  | ±8,70  |
| 1734 - 1743                 | ±17,6 | ±17,6 | ±8,75  | ±8,75  |
| 1744 - 1753                 | ±17,7 | ±17,7 | ±8,80  | ±8,80  |
| 1754 - 1763                 | ±17,8 | ±17,8 | ±8,85  | ±8,85  |
| 1764 - 1773                 | ±17,9 | ±17,9 | ±8,90  | ±8,90  |
| 1774 - 1783                 | ±18,0 | ±18,0 | ±8,95  | ±8,95  |
| 1784 - 1793                 | ±18,1 | ±18,1 | ±9,00  | ±9,00  |
| 1794 - 1803                 | ±18,2 | ±18,2 | ±9,05  | ±9,05  |
| 1804 - 1813                 | ±18,3 | ±18,3 | ±9,10  | ±9,10  |
| 1814 - 1823                 | ±18,4 | ±18,4 | ±9,15  | ±9,15  |
| 1824 - 1833                 | ±18,5 | ±18,5 | ±9,20  | ±9,20  |
| 1834 - 1843                 | ±18,6 | ±18,6 | ±9,25  | ±9,25  |
| 1844 - 1853                 | ±18,7 | ±18,7 | ±9,30  | ±9,30  |
| 1854 - 1863                 | ±18,8 | ±18,8 | ±9,35  | ±9,35  |
| 1864 - 1873                 | ±18,9 | ±18,9 | ±9,40  | ±9,40  |
| 1874 - 1883                 | ±19,0 | ±19,0 | ±9,45  | ±9,45  |
| 1884 - 1893                 | ±19,1 | ±19,1 | ±9,50  | ±9,50  |
| 1894 - 1903                 | ±19,2 | ±19,2 | ±9,55  | ±9,55  |
| 1904 - 1913                 | ±19,3 | ±19,3 | ±9,60  | ±9,60  |
| 1914 - 1923                 | ±19,4 | ±19,4 | ±9,65  | ±9,65  |
| 1924 - 1933                 | ±19,5 | ±19,5 | ±9,70  | ±9,70  |
| 1934 - 1943                 | ±19,6 | ±19,6 | ±9,75  | ±9,75  |
| 1944 - 1953                 | ±19,7 | ±19,7 | ±9,80  | ±9,80  |
| 1954 - 1963                 | ±19,8 | ±19,8 | ±9,85  | ±9,85  |
| 1964 - 1973                 | ±19,9 | ±19,9 | ±9,90  | ±9,90  |
| 1974 - 1983                 | ±20,0 | ±20,0 | ±9,95  | ±9,95  |
| 1984 - 1993                 | ±20,1 | ±20,1 | ±10,00 | ±10,00 |
| 1994 - 2003                 | ±20,2 | ±20,2 | ±10,05 | ±10,05 |
| 2004 - 2013                 | ±20,3 | ±20,3 | ±10,10 | ±10,10 |
| 2014 - 2023                 | ±20,4 | ±20,4 | ±10,15 | ±10,15 |
| 2024 - 2033                 | ±20,5 | ±20,5 | ±10,20 | ±10,20 |
| 2034 - 2043                 | ±20,6 | ±20,6 | ±10,25 | ±10,25 |
| 2044 - 2053                 | ±20,7 | ±20,7 | ±10,30 | ±10,30 |
| 2054 - 2063                 | ±20,8 | ±20,8 | ±10,35 | ±10,35 |
| 2064 - 2073                 | ±20,9 | ±20,9 | ±10,40 | ±10,40 |
| 2074 - 2083                 | ±21,0 | ±21,0 | ±10,45 | ±10,45 |
| 2084 - 2093                 | ±21,1 | ±21,1 | ±10,50 | ±10,50 |
| 2094 - 2103                 | ±21,2 | ±21,2 | ±10,55 | ±10,55 |
| 2104 - 2113                 | ±21,3 | ±21,3 |        |        |

## Daten und Werte

|               |                      |          |
|---------------|----------------------|----------|
| Artikel-Bez.: | WR ; PP-ST sw. NW 19 |          |
| Artikel-Nr.:  | 1931961              |          |
| Form:         | geschlitz            |          |
| Merkmal:      | Außendurchmesser     |          |
| Vorgang:      | Extrusion            |          |
| Prüfer:       | M.Schneider          |          |
| Prüfzeitraum: | 15.12.16 bis         | 15.12.16 |

|            |        |  |
|------------|--------|--|
| Nennwert:  | 24,000 |  |
| +Toleranz: | 0,400  |  |
| -Toleranz: | 0,400  |  |

## Berechnung

$$\bar{x} = \frac{\sum x}{n}$$

$$\hat{\mu} = \bar{x} = \frac{1}{k} \sum_{i=1}^k \bar{x}_i$$

$$R = x_{\max} - x_{\min}$$

$$s = \sqrt{\frac{\sum (x_i - \bar{x})^2}{n-1}}$$

$$\hat{\sigma} = \sqrt{\left(\frac{1}{k} \sum_{i=1}^k S_i\right)^2} = \sqrt{\bar{S}^2}$$

$$C_{pu} = \frac{\hat{\mu} - UGW}{3\hat{\sigma}}$$

$$C_{pk} = \min.(C_{po}, C_{pu})$$

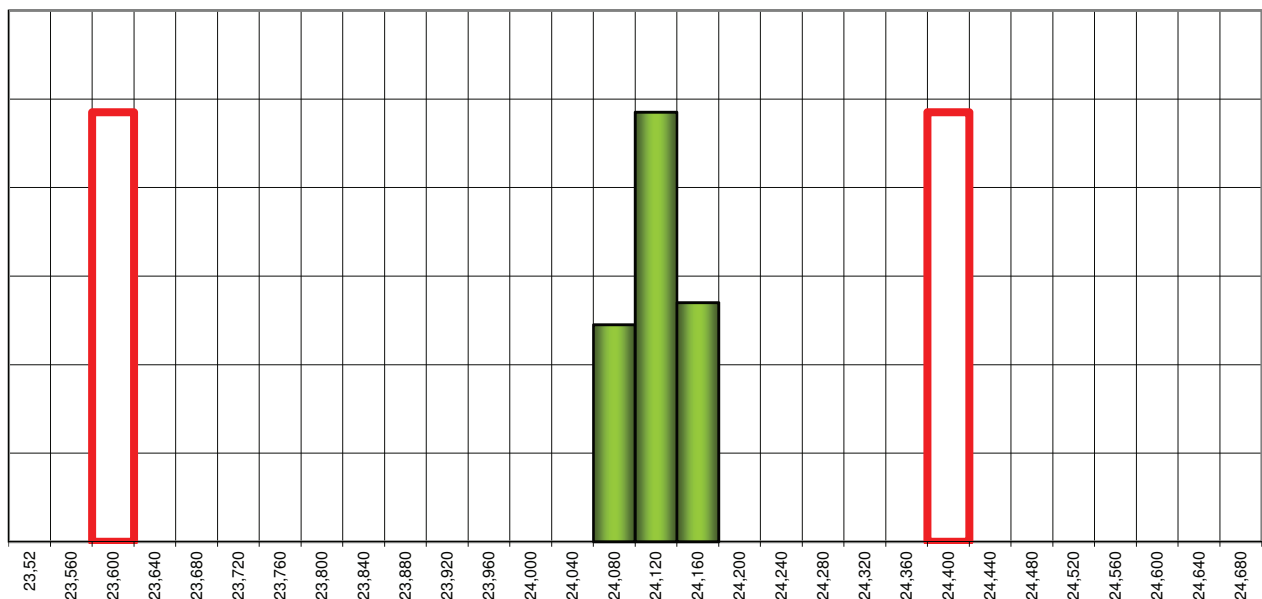
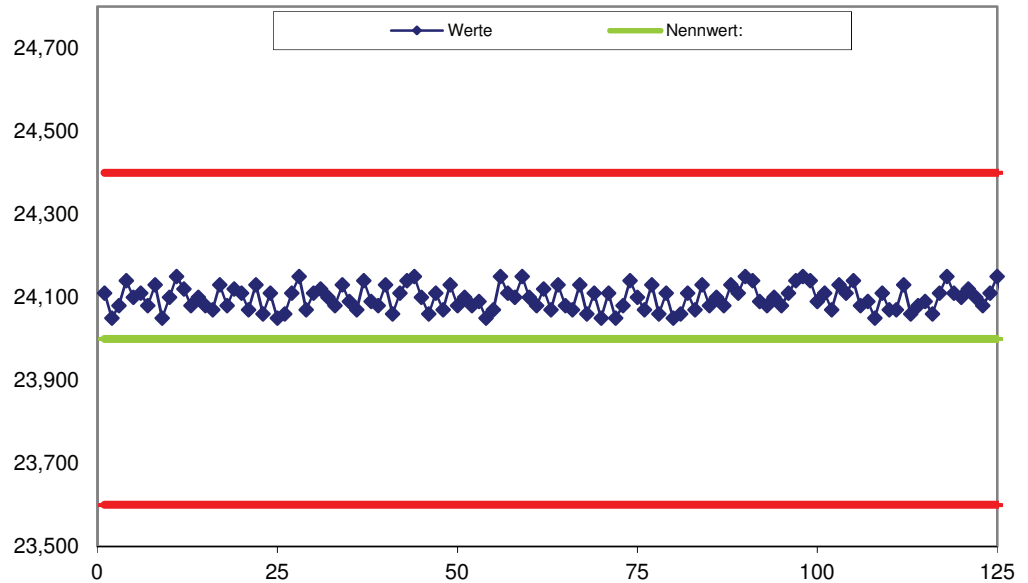
$$C_{po} = \frac{OGW - \hat{\mu}}{3\hat{\sigma}}$$

$$C_{pk} \geq 1,33$$

| Grundgesamtheit         |        |     |
|-------------------------|--------|-----|
| Stichprobe 'k'          | 40     | à 5 |
| n                       | 200    |     |
| $\hat{\mu}$             | 24,099 |     |
| max.                    | 24,150 |     |
| min.                    | 24,050 |     |
| R                       | 0,100  |     |
| $1 \times \hat{\sigma}$ | 0,026  |     |
| $6 \times \hat{\sigma}$ | 0,156  |     |
| OGW                     | 24,400 |     |
| UGW                     | 23,600 |     |

| Fehleranteil    |        |
|-----------------|--------|
| P <sub>ob</sub> | 0,000% |
| P <sub>un</sub> | 0,000% |
| P               | 0,000% |

| Prozessfähigkeit |       |
|------------------|-------|
| C <sub>po</sub>  | 3,855 |
| C <sub>pu</sub>  | 6,374 |
| C <sub>pk</sub>  | 3,855 |



## Daten und Werte

|               |                       |
|---------------|-----------------------|
| Artikel-Bez.: | WR ; PP-ST sw. NW 19  |
| Artikel-Nr.:  | 1931961               |
| Form:         | geschlitz             |
| Merkmal:      | Innendurchmesser      |
| Vorgang:      | Extrusion             |
| Prüfer:       | M.Schneider           |
| Prüfzeitraum: | 15.12.16 bis 15.12.16 |

|            |        |
|------------|--------|
| Nennwert:  | 19,400 |
| +Toleranz: | 0,400  |
| -Toleranz: | 0,400  |

## Berechnung

$$\bar{x} = \frac{\sum x}{n}$$

$$\hat{\mu} = \bar{x} = \frac{1}{k} \sum_{i=1}^k \bar{x}_i$$

$$R = x_{\max} - x_{\min}$$

$$s = \sqrt{\frac{\sum (x_i - \bar{x})^2}{n-1}}$$

$$\hat{\sigma} = \sqrt{\left(\frac{1}{k} \sum_{i=1}^k S_i\right)^2} = \sqrt{S^2}$$

$$C_{pu} = \frac{\hat{\mu} - UGW}{3\hat{\sigma}}$$

$$C_{pk} = \min.(C_{po}, C_{pu})$$

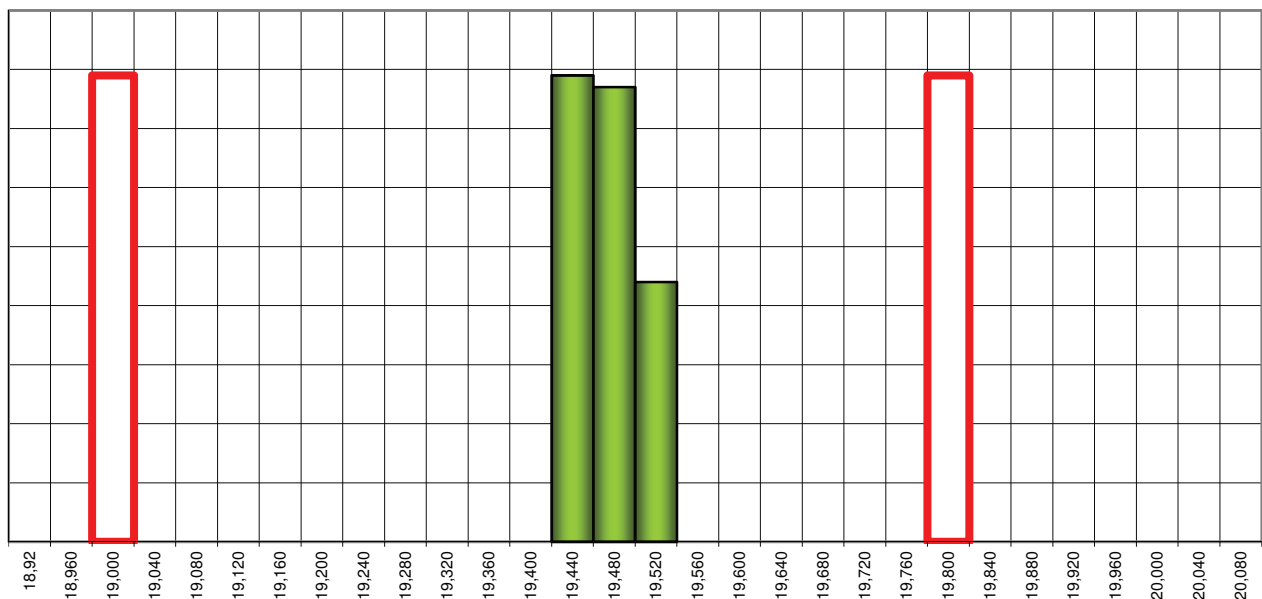
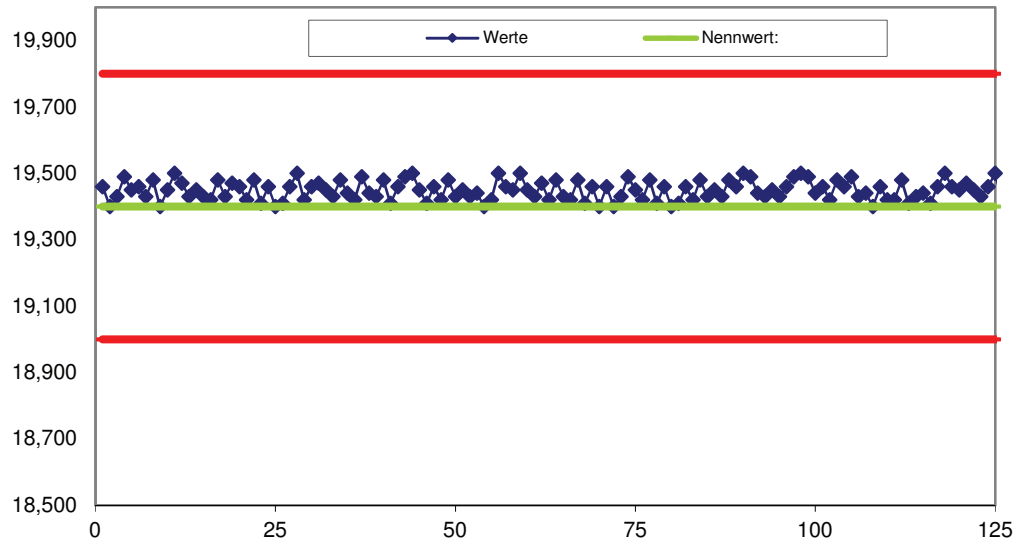
$$C_{po} = \frac{OGW - \hat{\mu}}{3\hat{\sigma}}$$

$$C_{pk} \geq 1,33$$

| Grundgesamtheit         |        |     |
|-------------------------|--------|-----|
| Stichprobe 'k'          | 40     | à 5 |
| n                       | 200    |     |
| $\hat{\mu}$             | 19,448 |     |
| max.                    | 19,500 |     |
| min.                    | 19,400 |     |
| R                       | 0,100  |     |
| $1 \times \hat{\sigma}$ | 0,026  |     |
| $6 \times \hat{\sigma}$ | 0,154  |     |
| OGW                     | 19,800 |     |
| UGW                     | 19,000 |     |

| Fehleranteil    |        |
|-----------------|--------|
| P <sub>ob</sub> | 0,000% |
| P <sub>un</sub> | 0,000% |
| P               | 0,000% |

| Prozessfähigkeit |       |
|------------------|-------|
| C <sub>po</sub>  | 4,567 |
| C <sub>pu</sub>  | 5,812 |
| C <sub>pk</sub>  | 4,567 |



# Safety Data Sheet

( according to directive 91/155/EEC )

## Schlemmer Product Name

**S.R.S. PP 2010**

### 1. Chemical product and company identification

**S.R.S. PP 2010**

---

### 2. Composition / information on ingredients

This chemical product is a composition.

Chemical name: polypropylene.

Generic name: polyolefines.

CAS-number : 9003-07-0 and 9010-79-1.

Ingredients contributing to the hazard: none.

---

### 3. Hazards identification

The most important hazards are:

#### Health hazard

Lung toxin

Skin hazard

Eye hazard

Ingestion

#### Specific hazards

When / if inhaled, fines may cause mechanical irritation of the respiratory tract.

Material is unlikely to cause irritation, but if contact with molten material occurs, treat as for thermal bum

Fines can cause mechanical irritation.

No hazard.

The material is not classified as being a dangerous preparation according to EC Directive 88/379 and the subsequent amendments.

R(isk) phrases

n/a.

---

### 4. First aid measures

Inhalation: When fumes of molten material have been inhaled:

- move person to fresh air.
- Rest in half upright position.
- Loosen clothing.
- Keep warm.

In case of respiratory problems move person to first aid station or hospital for medical treatment.

- Skin contact: Any molten material on the skin or any burns should be cooled (off) as quickly as possible by means of cold water. Cover the wound with sterile cloth and move person to first aid station or hospital for medical treatment.  
Attention: Never pull off the molten material from the wound.
- Eye contact: Any material entering the eye should be flushed out with copious volumes of water.
- Ingestion: No danger of toxicity, the material is biologically inactive.

---

## 5. Fire-fighting measures

- Extinguishing media: CO<sub>2</sub>, water, water-foam, ABC fire extinguishing powder.
- Specific hazards
- Solid: Treat the material as a solid that can burn. Moulded parts or solid granules burn slowly with a low smoke density and flaming drips, carbon monoxide and irritating oxygen containing organic substances are released.
- Product fines: A spark can ignite an explosive concentration of product fines in air.
- Vapours: Hot vapours – from heated material – plus air can be extremely inflammable in the case of stoichiometric mixtures.
- Combustion products: In case of fire, carbon monoxide and toxic and/or irritating oxygen containing organic substances are released.
- Protection of firefighters: Do not approach fire in confined space without positive pressure self contained breathing apparatus and full bunker gear i.e.: bunker coats, helmet with face shield, gloves, rubber boots.  
Note: Cool fire exposed containers with water.

---

## 6. Accidental release measures

### Personal precautions

- Apply ample grounding with respect to dust explosion dangers caused by released dust from granulate supply ( filters ).
- Protect skin, eyes and / or hands.
- Prevent generation of dust ( to be realised from powder ).
- Take great care in immediately preventing further powder or dust release in view of the formation of dust clouds in air.

### Environmental precautions

For disposal considerations see section 13.

### Cleaning-up methods

- Shovel or sweep up released material.
- Suck up fines or dust with special industrial vacuum cleaner. Avoid the generation of dust clouds. Put into containers for reclaiming or disposal.

---

## 7. Handling and storage

### Handling

#### Precautions

- General precautions: For safe polymer processing the material should be completely dry.
- Personal protection: For more information on personal protection when handling the material see section 8.
- Hygienic precautions: Adequate washing facilities, with supplies of mild soap and hand cleansers should be available at all working stations. Solvents should never be used as hand cleansers.  
Smoking, eating and drinking in working and storage areas should be prohibited.

#### Advice on technical measures

|                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Ventilation:                      | <p>A ventilation system should be installed where:</p> <ul style="list-style-type: none"> <li>- melt processing of the material is carried out,</li> <li>- solid material is being ground or machined,</li> <li>- any high temperature processing is carried out ( e.g. sealing ).</li> </ul> <p>It is advised to install local exhaust ventilation in the vicinity of processing machines.</p>                                                                                                                        |
| Prevention of dust generation:    | <p>Suppression: Optimise the piping system used for pneumatic transport ( surface, comers, length, velocities ).</p> <p>Filtering: Take extreme care of dust explosion danger and apply ample local grounding where the presence of fines plus static electricity in or near the pneumatic transport lines is very likely.</p> <p>Note: When handling the granulate normally dust will not be a problem with respect to breathing.</p> <p>During regrinding operations however, the use of a dust mask is advised.</p> |
| Prevention of fire and explosion: | See information on static discharges in section "Storage".                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Storage</b>                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Technical measures:               | Owing the electrostatic properties of the material and its fines a grounding installation for storage silos and pneumatic transport is obligatory. Other ways of prevention with respect to electrostatic properties are: Inerting i.e. lowering oxygen concentrations by means of nitrogen supply, control of transport speed, etc.                                                                                                                                                                                   |
| Storage conditions:               | <p>Avoid prolonged storage in open sunlight, high temperatures and / or high humidity as this could well speed up alteration and consequently loss of quality of the material and this could lead to unforeseen dangers.</p> <p>Keep polymer completely dry for good processing ( in spite of increased static danger ).</p> <p>Stack pallets only two high when storing, in order to prevent collapsing.</p>                                                                                                          |
| Incompatible products:            | n/a.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

## 8. Exposure controls / personal protection

|                     |                                                                                                                                                                                                                                                                                      |
|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Control parameters: | <p>Threshold Limit Value ( TLV ): A provisional TLV ( TWA 8 hours ) is advised in accordance with the TLV of non-toxic nuisance dust:</p> <ul style="list-style-type: none"> <li>- 10 mg/m<sup>3</sup> for total dust,</li> <li>- 5 mg/m<sup>3</sup> for respirable dust.</li> </ul> |
|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

### Personal protective equipment

|                           |                                                                                                                          |
|---------------------------|--------------------------------------------------------------------------------------------------------------------------|
| Respiratory protection:   | When the threshold limit value ( TLV ) is accidentally exceeded see "Prevention of dust generation".                     |
| Hand protection:          | When handling a hot melt ( e.g. during purging of a processing machine ) heat resistant gloves should be worn.           |
| Eye protection:           | When handling a hot melt ( e.g. during purging of a processing machine ) heat resistant face shields should be worn.     |
| Skin and body protection: | The use of apron, boots and / or full protective suit is not prescribed here, it is up to the decision of the processor. |

## 9. Physical and chemical properties

### Polymer properties:

|                          |                             |
|--------------------------|-----------------------------|
| Physical state:          | Solid ( at + 20°C )         |
| Form:                    | Granulate / powder          |
| Colour:                  | Coloured or natural         |
| Odour:                   | Weak paraffinic             |
| PH value:                | n/a                         |
| Relative density:        | 900 – 920 kg/m <sup>3</sup> |
| Bulk density:            | 550 – 630 kg/m <sup>3</sup> |
| Melting point / range:   | 155 - 170°C                 |
| Softening point / range: | 140 – 148°C                 |

|                                 |                                                                                                                           |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------|
| Viscosity:                      | n/a                                                                                                                       |
| Solubility in water:            | insoluble                                                                                                                 |
| Solubility in other substances: | soluble only in some aromatic hydrocarbons, chlorinated hydrocarbons and / or n-paraffines ( > C14 ) at high temperatures |
| Volume conductivity:            | Low, danger of static charges                                                                                             |

#### **Safety properties:**

|                            |         |
|----------------------------|---------|
| Decomposition temperature: | > 300°C |
| Flash point:               | > 320°C |
| Auto ignition temperature: | > 350°C |

#### **Dust explosive properties:**

|                                |                                                                 |
|--------------------------------|-----------------------------------------------------------------|
| Lower explosion limit ( LEL ): | mandatory to remain < 10g/m <sup>3</sup> air ( fines < 125 µm ) |
| Minimum ignition temperature:  | 428°C                                                           |
| Dust explosion class:          | St 1 ( fines )                                                  |

## **10. Stability and reactivity**

The material is chemically stable, however under certain conditions hazardous reactions can take place.

#### **Conditions to avoid**

|                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Material fines:             | Material fines – accidentally released in air – can result in an explosive concentration ( see sections 7 and 8 ).                                                                                                                                                                                                                                                                                                                                                                                            |
| Electrostatic loading:      | For information on safety measures regarding electrostatic loading see:<br>"Prevention of dust generation"<br>"Technical measures"                                                                                                                                                                                                                                                                                                                                                                            |
| Dust / powder air mixtures: | Working with powders always incorporates the danger of the formation of explosive mixtures in the dust and / or powder with air, in particular at concentrations above 10g/m <sup>3</sup> .<br>One spark can ignite such a mixture, other ignition sources are: hot surfaces, open flames, radiant heat, etc.<br>Fines / particle sizes 10 – 50 µm are extremely dangerous, sizes 300 – 500 µm less dangerous and sizes > 500 µm are not dangerous. Do not use an open fire during processing and demoulding. |
| Gas / vapour air mixtures:  | At high temperatures ( local hot spots ) inerting should be possible be applied, in order to strongly reduce oxygen concentrations.<br>Stabilisation of the polymer results in inflammable gases being formed only at higher than usual temperatures.                                                                                                                                                                                                                                                         |
| Processing temperatures:    | Do not exceed 320°C.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Long term exposure:         | Do not expose during long terms to temperatures above 80°C and / or UV light.                                                                                                                                                                                                                                                                                                                                                                                                                                 |

#### **Materials to avoid**

Strong oxidizing agents.

#### **Hazardous decomposition products**

At processing temperatures some degree of thermal degradation will occur. Although highly dependent on temperature and environmental conditions a variety of decomposition products may be present in small amounts, ranging from simple hydrocarbons ( e.g. methane, propane ) to toxic and / or irritating gases ( e.g. carbon monoxide, carbon dioxide, acids, ketones, aldehydes )

|                                 |                                                                                                                                                                                                                                                                                                                        |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Changes in physical appearance: | Dust fines ( and powder ) can cause extremely dangerous situations compared with base material ( see sections 5, 6, 7 and 9 ).<br>There is no possibility of degradation to unstable products under normal circumstances. Only at extreme temperatures ( above the decomposition temperature ) degradation will occur. |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

## **11. Toxicological information**

|                 |       |
|-----------------|-------|
| Acute toxicity: | None. |
| Local effects:  | None. |

Chronic short and long time toxicity:   None.  
Sensitization:                               None.  
Specific effects:                           None.  
( carcinogenicity, mutagenicity, teratogenicity, narcosis )

---

## **12. Ecological information**

mobility:                                   None.  
Persistence / degradability:       Very low UV degradability.  
Bioaccumulation:                       None.  
Ecotoxicity:                             There is no indication that this material is a risk to the environment.  
Aquatic toxicity:                       This material is a water insoluble non-toxic solid material.

---

## **13. Disposal considerations**

The disposal of this material – as well as the used packaging thereof – presents no danger regarding toxicological and / or ecological considerations. It can be burnt in a controlled way or be disposed of via landfill, or it can be recycled for less critical non-food applications.

Note: Additional national or regional provisions may be in force relevant to this matter.

---

## **14. Transport information**

General precautions:               Keep the material dry during transport.  
Special precautions:               No special precautions have to be met as the material is not classified regarding the transport of dangerous goods.

---

## **15. Regulatory information**

Labelling:                               No labelling required under EC-Directive 88/379/EEC.  
EEC classification:                   No dangerous preparation.

Note: Additional national legislation may be in force relevant to this matter.

---

## **16. Other Information**

Recommended application(s)  
Packaging, industrial, automotive.  
This material should not be used for the production and / or application in human body implants.

---

# Technisches Datenblatt

## Technical Data Sheet

### Schlemmer - Material Identification S.R.S. PP 2010 (PP-St)

| Eigenschaften /<br>Properties                                    | Prüfbedingungen /<br>Test Conditions |              | Einheit /<br>Unit | Wert /<br>Value |     |
|------------------------------------------------------------------|--------------------------------------|--------------|-------------------|-----------------|-----|
| Mechanisch / mechanical                                          |                                      |              |                   |                 |     |
| Zug-E-Modul /<br>tensile modulus                                 | 1 mm/min                             | ISO 527-1/-2 | MPa               | 1250            |     |
| Streckspannung /<br>tensile stress at yield                      | 50mm/min                             | ISO 527-1/-2 | MPa               | 23              |     |
| Streckdehnung /<br>tensile strain at yield                       | 50mm/min                             | ISO 527-1/-2 | %                 | 5               |     |
| Charpy-Kerbschlagzähigkeit /<br>charpy notched impact strength   | 23 °C                                | ISO 179/1eA  | kJ/m <sup>2</sup> | 80              |     |
|                                                                  | 0 °C                                 | ISO 179/1eA  | kJ/m <sup>2</sup> | 60              |     |
|                                                                  | -20 °C                               | ISO 179/1eA  | kJ/m <sup>2</sup> | 10              |     |
| Shore Härte<br>shore hardness                                    | ---                                  | ISO 868      | D                 | 63              |     |
| Thermisch / thermal                                              |                                      |              |                   |                 |     |
| Formbeständigkeitstemperatur /<br>temperature of heat deflection |                                      |              |                   |                 |     |
|                                                                  | Meth. A                              | 1,8 MPa      | ISO 75            | °C              | 55  |
|                                                                  | Meth. B                              | 0,45 MPa     | ISO 75            | °C              | 85  |
| Vicat-Erweichungstemperatur /<br>vicat softening temperature     |                                      |              |                   |                 |     |
|                                                                  | at 10N                               | 120 °C/h     | ISO 306           | °C              | 148 |
|                                                                  | at 50N                               | 120 °C/h     | ISO 306           | °C              | 68  |
| Allgemein / general                                              |                                      |              |                   |                 |     |
| Schmelze Massefließrate (MFR)<br>melt flow rate                  | 230 °C / 2,16kg                      | ISO 1133     | dg/min            | 1,2             |     |
| Dichte /<br>density                                              | ---                                  | ISO 1183     | g/cm <sup>3</sup> | 0,91            |     |

Die angegebenen Werte beziehen sich auf das Basispolymer der jeweiligen Mischungszusammenstellung. Die Angaben sind als Richtwerte anzusehen und nicht als garantierte Mindestwerte, da die Eigenschaften durch Werkzeuggestaltung und Verarbeitungsbedingungen erheblich beeinflusst werden können. Eine Verbindlichkeit kann hieraus nicht hergeleitet werden.

The stated values refer to the base polymer out of the mix composition. The information is meant as approximate values and does not state the minimal values, as the properties are extensively affected by the tool design and processing conditions. An obligation cannot be derived from this document.

|  |                                                 |               |
|--|-------------------------------------------------|---------------|
|  | <h1 style="margin: 0;">Messmittelfähigkeit</h1> |               |
|  |                                                 | Seite 1 von 2 |

## GAGE REPEATABILITY AND REPRODUCIBILITY DATA SHEET VARIABLE DATA RESULTS

|                                              |                                     |                                          |                    |                                   |                                   |
|----------------------------------------------|-------------------------------------|------------------------------------------|--------------------|-----------------------------------|-----------------------------------|
| Part Number<br><b>1930029</b>                |                                     | Gage Name<br><b>Meßschieber digital</b>  |                    | Appraiser A<br><b>Ferderer J.</b> |                                   |
| Part Name<br><b>PP-BS NW 29 Ringware</b>     |                                     | Gage Number<br><b>171274051</b>          |                    | Appraiser B<br><b>Zobel F.</b>    |                                   |
| Characteristic<br><b>Außen dm.</b>           | Specification<br><b>-0,4    0,4</b> | Gage Type<br><b>Handmessmittel 150mm</b> |                    | Appraiser C<br><b>Würfel V.</b>   |                                   |
| Characteristic Classification<br><b>33,9</b> | Einheit<br><b>mm</b>                | Trials<br><b>3</b>                       | Parts<br><b>10</b> | Appraisers<br><b>3</b>            | Date Performed<br><b>07.05.15</b> |

| APPRAISER/<br>TRIAL #                        | PART   |        |        |        |        |        |        |        |        |        | AVERAGE                              |
|----------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------------------------------|
|                                              | 1      | 2      | 3      | 4      | 5      | 6      | 7      | 8      | 9      | 10     |                                      |
| 1. A    1                                    | 33,80  | 33,75  | 33,88  | 33,86  | 33,77  | 33,81  | 33,84  | 33,94  | 33,82  | 33,85  | 33,832                               |
| 2        2                                   | 33,81  | 33,76  | 33,87  | 33,86  | 33,77  | 33,80  | 33,84  | 33,94  | 33,82  | 33,85  | 33,832                               |
| 3        3                                   | 33,80  | 33,75  | 33,89  | 33,87  | 33,76  | 33,80  | 33,84  | 33,94  | 33,83  | 33,84  | 33,832                               |
| 4        AVERAGE                             | 33,803 | 33,753 | 33,880 | 33,863 | 33,767 | 33,803 | 33,840 | 33,940 | 33,823 | 33,847 | $\bar{x}_a =$ 33,8320                |
| 5        R                                   | 0,010  | 0,010  | 0,020  | 0,010  | 0,010  | 0,010  | 0,000  | 0,000  | 0,010  | 0,010  | $r_a =$ 0,009                        |
| 6. B    1                                    | 33,81  | 33,75  | 33,88  | 33,86  | 33,77  | 33,81  | 33,85  | 33,94  | 33,83  | 33,85  | 33,835                               |
| 7        2                                   | 33,81  | 33,76  | 33,88  | 33,87  | 33,77  | 33,80  | 33,84  | 33,95  | 33,82  | 33,86  | 33,836                               |
| 8        3                                   | 33,80  | 33,75  | 33,89  | 33,86  | 33,77  | 33,80  | 33,84  | 33,94  | 33,83  | 33,85  | 33,833                               |
| 9        AVERAGE                             | 33,807 | 33,753 | 33,883 | 33,863 | 33,770 | 33,803 | 33,843 | 33,943 | 33,827 | 33,853 | $\bar{x}_b =$ 33,8347                |
| 10       R                                   | 0,010  | 0,010  | 0,010  | 0,010  | 0,000  | 0,010  | 0,010  | 0,010  | 0,010  | 0,010  | $r_b =$ 0,009                        |
| 11. C    1                                   | 33,80  | 33,75  | 33,88  | 33,86  | 33,77  | 33,81  | 33,84  | 33,94  | 33,82  | 33,85  | 33,832                               |
| 12       2                                   | 33,81  | 33,76  | 33,88  | 33,86  | 33,77  | 33,80  | 33,85  | 33,94  | 33,82  | 33,85  | 33,834                               |
| 13       3                                   | 33,80  | 33,75  | 33,89  | 33,86  | 33,76  | 33,80  | 33,84  | 33,94  | 33,83  | 33,84  | 33,831                               |
| 14       AVERAGE                             | 33,803 | 33,753 | 33,883 | 33,860 | 33,767 | 33,803 | 33,843 | 33,940 | 33,823 | 33,847 | $\bar{x}_c =$ 33,8323                |
| 15       R                                   | 0,010  | 0,010  | 0,010  | 0,000  | 0,010  | 0,010  | 0,010  | 0,000  | 0,010  | 0,010  | $r_c =$ 0,008                        |
| 16. PART<br>AVE                              | 33,804 | 33,753 | 33,882 | 33,862 | 33,768 | 33,803 | 33,842 | 33,941 | 33,824 | 33,849 | $\bar{X} =$ 33,8330<br>$R_p =$ 0,188 |
| 17 $(r_a + r_b + r_c) /$ (# OF APPRAISERS) = |        |        |        |        |        |        |        |        |        |        | $R =$ 0,0087                         |
| 18       (Max X - Min X) =                   |        |        |        |        |        |        |        |        |        |        | $X_{DIFF} =$ 0,0027                  |
| 19 $R \times D_4^* =$                        |        |        |        |        |        |        |        |        |        |        | $UCL_R =$ 0,0224                     |

\*  $D_4 = 3.27$  for 2 trials and  $2.58$  for 3 trials.  $UCL_R$  represents the limit of individual  $R$ 's. Circle those that are beyond this limit. Identify the cause and correct. Repeat these readings using the same appraiser and unit as originally used or discard values and re-average and recompute  $R$  and the limiting value from the remaining observations.

Notes: diese Untersuchung gilt auch für Container und Stückware.

# Messmittelfähigkeit



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## GAGE REPEATABILITY AND REPRODUCIBILITY DATA SHEET VARIABLE DATA RESULTS

|                                       |                                   |                            |
|---------------------------------------|-----------------------------------|----------------------------|
| Part Number<br>1930029                | Gage Name<br>Meßschieber digital  | Appraiser A<br>Ferderer J. |
| Part Name<br>PP-BS NW 29 Ringware     | Gage Number<br>171274051          | Appraiser B<br>Zobel F.    |
| Characteristic<br>Außen dm.           | Gage Type<br>Handmessmittel 150mm | Appraiser C<br>Würfel V.   |
| Characteristic Classification<br>33,9 | Trials<br>3                       | Parts<br>10                |
|                                       | Appraisers<br>3                   | Date Performed<br>07.05.15 |

| Measurement Unit Analysis                  |   |                                                                                             |                |                | % Tolerance (Tol)                                          |  |
|--------------------------------------------|---|---------------------------------------------------------------------------------------------|----------------|----------------|------------------------------------------------------------|--|
| Repeatability - Equipment Variation (EV)   |   |                                                                                             |                |                | % EV = 100 (EV/TV)<br>= 100(0,00512/0,05931)<br>= 8,63     |  |
|                                            |   |                                                                                             |                |                |                                                            |  |
|                                            |   |                                                                                             |                |                |                                                            |  |
| EV                                         | = | R x K <sub>1</sub>                                                                          | Trials         | K1             |                                                            |  |
|                                            | = | 0,0087 x 0,5908                                                                             | 2              | 0,8862         |                                                            |  |
|                                            | = | 0,00512                                                                                     | 3              | 0,5908         |                                                            |  |
| Reproducibility - Appraiser Variation (AV) |   |                                                                                             |                |                | % AV = 100 (AV/TV)<br>= 100(0,00104/0,05931)<br>= 1,75     |  |
| AV                                         | = | {(X <sub>DIFF</sub> x K <sub>2</sub> ) <sup>2</sup> - (EV <sup>2</sup> /nr)} <sup>1/2</sup> |                |                |                                                            |  |
|                                            | = | {(0,0027 x 0,5231) <sup>^2</sup> - (0,0051 <sup>^2</sup> /(10 x 3))} <sup>^1/2</sup>        |                |                |                                                            |  |
|                                            | = | 0,00104                                                                                     | Appraisers     | 2              | 3                                                          |  |
| n = parts                                  |   | r = trials                                                                                  | K <sub>2</sub> | 0,7071         | 0,5231                                                     |  |
| Repeatability & Reproducibility (GRR)      |   |                                                                                             |                |                | % R&R = 100 (R&R/TV)<br>= 100(0,00522/0,05931)<br>= 8,81   |  |
| GRR                                        | = | {(EV <sup>2</sup> + AV <sup>2</sup> ) <sup>^1/2</sup>                                       | Parts          | K <sub>3</sub> |                                                            |  |
|                                            | = | {(0,0051 <sup>^2</sup> + 0,0010 <sup>^2</sup> ) <sup>^1/2</sup>                             | 2              | 0,7071         |                                                            |  |
|                                            | = | 0,00522                                                                                     | 3              | 0,5231         | Gage system O.K                                            |  |
| Part Variation (PV)                        |   |                                                                                             | 4              | 0,4467         |                                                            |  |
|                                            |   |                                                                                             | 5              | 0,4030         |                                                            |  |
|                                            |   |                                                                                             | 6              | 0,3742         |                                                            |  |
| PV                                         | = | R <sub>P</sub> x K <sub>3</sub>                                                             | 7              | 0,3534         | % PV = 100 (PV/TV)<br>= 100(0,05907/0,05931)<br>= 99,61    |  |
|                                            | = | 0,1878 x 0,3146                                                                             | 8              | 0,3375         |                                                            |  |
|                                            | = | 0,05907                                                                                     | 9              | 0,3249         |                                                            |  |
| Total Variation (TV)                       |   |                                                                                             | 10             | 0,3146         | ndc = 1.41 (PV/GRR)<br>= 1.41(0,05907/0,00522)<br>= 15,000 |  |
|                                            |   |                                                                                             | TV             | =              |                                                            |  |
|                                            | = | {(0,0052 <sup>^2</sup> + 0,0591 <sup>^2</sup> ) <sup>^1/2</sup>                             |                |                |                                                            |  |
|                                            | = | 0,05931                                                                                     |                |                |                                                            |  |

Weitere Informationen zum theoretischen Ansatz und zu den in diesem Formular verwendeten Konstanten finden sich im Referenzhandbuch Measurement Systems Analysis (MSA), Vierte Ausgabe.

|  |                                                 |               |
|--|-------------------------------------------------|---------------|
|  | <h1 style="margin: 0;">Messmittelfähigkeit</h1> |               |
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## GAGE REPEATABILITY AND REPRODUCIBILITY DATA SHEET VARIABLE DATA RESULTS

|                                             |                                    |                                     |                    |                                    |                                   |
|---------------------------------------------|------------------------------------|-------------------------------------|--------------------|------------------------------------|-----------------------------------|
| Part Number<br><b>1930029</b>               |                                    | Gage Name<br><b>Profilprojektor</b> |                    | Appraiser A<br><b>Gräf H.</b>      |                                   |
| Part Name<br><b>PP-BS NW 29 Ringware</b>    |                                    | Gage Number<br><b>031059</b>        |                    | Appraiser B<br><b>Schneider M.</b> |                                   |
| Characteristic<br><b>Breite Welle</b>       | Specification<br><b>-0,15 0,15</b> | Gage Type<br><b>optisch ST 300</b>  |                    | Appraiser C<br><b>Pfaff M.</b>     |                                   |
| Characteristic Classification<br><b>2,3</b> | Einheit<br><b>mm</b>               | Trials<br><b>3</b>                  | Parts<br><b>10</b> | Appraisers<br><b>3</b>             | Date Performed<br><b>08.05.15</b> |

| APPRAISER/<br>TRIAL #                  | PART                           |       |       |       |       |       |       |       |       |       | AVERAGE                             |
|----------------------------------------|--------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------------------------------------|
|                                        | 1                              | 2     | 3     | 4     | 5     | 6     | 7     | 8     | 9     | 10    |                                     |
| 1. A 1                                 | 2,19                           | 2,16  | 2,24  | 2,30  | 2,27  | 2,32  | 2,26  | 2,23  | 2,17  | 2,19  | 2,233                               |
| 2 2                                    | 2,19                           | 2,16  | 2,24  | 2,29  | 2,27  | 2,31  | 2,26  | 2,23  | 2,18  | 2,20  | 2,233                               |
| 3 3                                    | 2,19                           | 2,17  | 2,24  | 2,30  | 2,27  | 2,32  | 2,26  | 2,23  | 2,18  | 2,19  | 2,235                               |
| 4 AVERAGE                              | 2,190                          | 2,163 | 2,240 | 2,297 | 2,270 | 2,317 | 2,260 | 2,230 | 2,177 | 2,193 | $\bar{x}_a = 2,2337$                |
| 5 R                                    | 0,000                          | 0,010 | 0,000 | 0,010 | 0,000 | 0,010 | 0,000 | 0,000 | 0,010 | 0,010 | $r_a = 0,005$                       |
| 6. B 1                                 | 2,20                           | 2,16  | 2,24  | 2,30  | 2,27  | 2,32  | 2,26  | 2,23  | 2,17  | 2,19  | 2,234                               |
| 7 2                                    | 2,19                           | 2,17  | 2,25  | 2,29  | 2,27  | 2,31  | 2,26  | 2,23  | 2,17  | 2,19  | 2,233                               |
| 8 3                                    | 2,20                           | 2,17  | 2,24  | 2,30  | 2,27  | 2,32  | 2,25  | 2,23  | 2,18  | 2,19  | 2,235                               |
| 9 AVERAGE                              | 2,197                          | 2,167 | 2,243 | 2,297 | 2,270 | 2,317 | 2,257 | 2,230 | 2,173 | 2,190 | $\bar{x}_b = 2,2340$                |
| 10 R                                   | 0,010                          | 0,010 | 0,010 | 0,010 | 0,000 | 0,010 | 0,010 | 0,000 | 0,010 | 0,000 | $r_b = 0,007$                       |
| 11. C 1                                | 2,20                           | 2,16  | 2,25  | 2,30  | 2,27  | 2,32  | 2,25  | 2,24  | 2,18  | 2,20  | 2,237                               |
| 12 2                                   | 2,19                           | 2,17  | 2,25  | 2,29  | 2,28  | 2,32  | 2,26  | 2,23  | 2,17  | 2,20  | 2,236                               |
| 13 3                                   | 2,20                           | 2,17  | 2,24  | 2,30  | 2,27  | 2,32  | 2,26  | 2,23  | 2,18  | 2,19  | 2,236                               |
| 14 AVERAGE                             | 2,197                          | 2,167 | 2,247 | 2,297 | 2,273 | 2,320 | 2,257 | 2,233 | 2,177 | 2,197 | $\bar{x}_c = 2,2363$                |
| 15 R                                   | 0,010                          | 0,010 | 0,010 | 0,010 | 0,010 | 0,000 | 0,010 | 0,010 | 0,010 | 0,010 | $r_c = 0,009$                       |
| 16. PART AVE                           | 2,194                          | 2,166 | 2,243 | 2,297 | 2,271 | 2,318 | 2,258 | 2,231 | 2,176 | 2,193 | $\bar{X} = 2,2347$<br>$R_p = 0,152$ |
| 17 $(r_a + r_b + r_c) /$               | $(\# \text{ OF APPRAISERS}) =$ |       |       |       |       |       |       |       |       |       | $R = 0,0070$                        |
| 18 $(\text{Max } X - \text{Min } X) =$ |                                |       |       |       |       |       |       |       |       |       | $X_{DIFF} = 0,0027$                 |
| 19 $R \times D_4^* =$                  |                                |       |       |       |       |       |       |       |       |       | $UCL_R = 0,0181$                    |

\*  $D_4 = 3.27$  for 2 trials and  $2.58$  for 3 trials. UCLR represents the limit of individual R's. Circle those that are beyond this limit. Identify the cause and correct. Repeat these readings using the same appraiser and unit as originally used or discard values and re-average and recompute R and the limiting value from the remaining observations.

Notes: diese Untersuchung glit auch für Container und Stückware.

|  |                              |                                                                                                      |
|--|------------------------------|------------------------------------------------------------------------------------------------------|
|  | <h1>Messmittelfähigkeit</h1> |  <b>Schlemmer</b> |
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## GAGE REPEATABILITY AND REPRODUCIBILITY DATA SHEET VARIABLE DATA RESULTS

|                                      |                              |                             |                 |                            |
|--------------------------------------|------------------------------|-----------------------------|-----------------|----------------------------|
| Part Number<br>1930029               | Gage Name<br>Profilprojektor | Appraiser A<br>Gräf H.      |                 |                            |
| Part Name<br>PP-BS NW 29 Ringware    | Gage Number<br>031059        | Appraiser B<br>Schneider M. |                 |                            |
| Characteristic<br>Breite Welle       | Gage Type<br>optisch ST 300  | Appraiser C<br>Pfaff M.     |                 |                            |
| Characteristic Classification<br>2,3 | Trials<br>3                  | Parts<br>10                 | Appraisers<br>3 | Date Performed<br>08.05.15 |

| Measurement Unit Analysis                         |            |                                                                                             |                | % Tolerance (Tol)                                                                         |  |
|---------------------------------------------------|------------|---------------------------------------------------------------------------------------------|----------------|-------------------------------------------------------------------------------------------|--|
| <b>Repeatability - Equipment Variation (EV)</b>   |            |                                                                                             |                | % EV = 100 (EV/TV)<br>= 100(0,00414/0,04808)<br>= 8,60                                    |  |
| EV                                                | =          | R x K <sub>1</sub>                                                                          |                |                                                                                           |  |
|                                                   | =          | 0,0070 x 0,5908                                                                             |                |                                                                                           |  |
|                                                   | =          | 0,00414                                                                                     |                |                                                                                           |  |
|                                                   |            |                                                                                             | Trials         | K <sub>1</sub>                                                                            |  |
|                                                   |            |                                                                                             | 2              | 0,8862                                                                                    |  |
|                                                   |            |                                                                                             | 3              | 0,5908                                                                                    |  |
| <b>Reproducibility - Appraiser Variation (AV)</b> |            |                                                                                             |                | % AV = 100 (AV/TV)<br>= 100(0,00117/0,04808)<br>= 2,44                                    |  |
| AV                                                | =          | {(X <sub>DIFF</sub> x K <sub>2</sub> ) <sup>2</sup> - (EV <sup>2</sup> /nr)} <sup>1/2</sup> |                |                                                                                           |  |
|                                                   | =          | {(0,0027 x 0,5231) <sup>2</sup> - (0,0041 <sup>2</sup> /(10 x 3))} <sup>1/2</sup>           |                |                                                                                           |  |
|                                                   | =          | 0,00117                                                                                     |                |                                                                                           |  |
| n = parts                                         | r = trials | Appraisers                                                                                  | 2              | 3                                                                                         |  |
|                                                   |            | K <sub>2</sub>                                                                              | 0,7071         | 0,5231                                                                                    |  |
| <b>Repeatability &amp; Reproducibility (GRR)</b>  |            |                                                                                             |                | % R&R = 100 (R&R/TV)<br>= 100(0,00430/0,04808)<br>= <b>8,94</b><br><b>Gage system O.K</b> |  |
| GRR                                               | =          | {(EV <sup>2</sup> + AV <sup>2</sup> ) <sup>1/2</sup>                                        |                |                                                                                           |  |
|                                                   | =          | {(0,0041 <sup>2</sup> + 0,0012 <sup>2</sup> ) <sup>1/2</sup>                                |                |                                                                                           |  |
|                                                   | =          | 0,00430                                                                                     |                |                                                                                           |  |
|                                                   |            | Parts                                                                                       | K <sub>3</sub> |                                                                                           |  |
|                                                   |            | 2                                                                                           | 0,7071         |                                                                                           |  |
|                                                   |            | 3                                                                                           | 0,5231         |                                                                                           |  |
|                                                   |            | 4                                                                                           | 0,4467         |                                                                                           |  |
|                                                   |            | 5                                                                                           | 0,4030         |                                                                                           |  |
|                                                   |            | 6                                                                                           | 0,3742         |                                                                                           |  |
|                                                   |            | 7                                                                                           | 0,3534         |                                                                                           |  |
|                                                   |            | 8                                                                                           | 0,3375         |                                                                                           |  |
|                                                   |            | 9                                                                                           | 0,3249         |                                                                                           |  |
|                                                   |            | 10                                                                                          | 0,3146         |                                                                                           |  |
| <b>Part Variation (PV)</b>                        |            |                                                                                             |                | % PV = 100 (PV/TV)<br>= 100(0,04789/0,04808)<br>= 99,60                                   |  |
| PV                                                | =          | R <sub>p</sub> x K <sub>3</sub>                                                             |                |                                                                                           |  |
|                                                   | =          | 0,1522 x 0,3146                                                                             |                |                                                                                           |  |
|                                                   | =          | 0,04789                                                                                     |                |                                                                                           |  |
| <b>Total Variation (TV)</b>                       |            |                                                                                             |                | ndc = 1.41 (PV/GRR)<br>= 1.41(0,04789/0,00430)<br>= <b>15,000</b>                         |  |
| TV                                                | =          | {(GRR <sup>2</sup> + PV <sup>2</sup> ) <sup>1/2</sup>                                       |                |                                                                                           |  |
|                                                   | =          | {(0,0043 <sup>2</sup> + 0,0479 <sup>2</sup> ) <sup>1/2</sup>                                |                |                                                                                           |  |
|                                                   | =          | 0,04808                                                                                     |                |                                                                                           |  |

Weitere Informationen zum theoretischen Ansatz und zu den in diesem Formular verwendeten Konstanten finden sich im Referenzhandbuch Measurement Systems Analysis (MSA), Vierte Ausgabe.

|                  |                            |                         |                        |            |                 |              |
|------------------|----------------------------|-------------------------|------------------------|------------|-----------------|--------------|
| Formular Nr.:199 | Ersteller: U. Fleischer QL | Geprüft: U.Fleischer QL | Freigabe: J. Bayer QMB | Index: 2.2 | Datum: 30.04.15 | Seite 2 v. 2 |
|------------------|----------------------------|-------------------------|------------------------|------------|-----------------|--------------|

## GAGE REPEATABILITY AND REPRODUCIBILITY DATA SHEET VARIABLE DATA RESULTS

|                                   |                                       |                             |
|-----------------------------------|---------------------------------------|-----------------------------|
| Part Number<br>1930029            | Gage Name<br>Profilprojektor          | Appraiser A<br>Gräf H.      |
| Part Name<br>PP-BS NW 29 Ringware | Gage Number<br>031059                 | Appraiser B<br>Schneider M. |
| Characteristic<br>FL-Winkel       | Specification<br>-4 4                 | Gage Type<br>optisch ST 300 |
| Appraiser C<br>Pfaff M.           | Characteristic Classification<br>11,0 | Einheit<br>grad             |
| Trials<br>3                       | Parts<br>10                           | Appraisers<br>3             |
| Date Performed<br>08.05.15        |                                       |                             |

| APPRAISER/<br>TRIAL #                        | PART          |        |        |        |        |        |        |        |        |        | AVERAGE                              |
|----------------------------------------------|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------------------------------|
|                                              | 1             | 2      | 3      | 4      | 5      | 6      | 7      | 8      | 9      | 10     |                                      |
| 1. A 1                                       | 10,00         | 12,50  | 11,30  | 11,50  | 12,00  | 12,00  | 11,50  | 11,00  | 13,00  | 13,00  | 11,780                               |
| 2 2                                          | 10,00         | 12,50  | 11,00  | 12,00  | 12,00  | 12,00  | 11,50  | 11,00  | 13,20  | 13,00  | 11,820                               |
| 3 3                                          | 10,00         | 12,30  | 11,00  | 11,50  | 12,00  | 11,80  | 11,50  | 11,00  | 13,20  | 13,00  | 11,730                               |
| 4 AVERAGE                                    | 10,000        | 12,433 | 11,100 | 11,667 | 12,000 | 11,933 | 11,500 | 11,000 | 13,133 | 13,000 | $\bar{x}_a =$ 11,7767                |
| 5 R                                          | 0,000         | 0,200  | 0,300  | 0,500  | 0,000  | 0,200  | 0,000  | 0,000  | 0,200  | 0,000  | $r_a =$ 0,140                        |
| 6. B 1                                       | 10,00         | 12,30  | 11,00  | 11,50  | 12,00  | 11,80  | 11,50  | 11,00  | 13,20  | 13,00  | 11,730                               |
| 7 2                                          | 10,00         | 12,50  | 11,30  | 11,50  | 12,00  | 12,00  | 11,50  | 11,00  | 13,00  | 13,20  | 11,800                               |
| 8 3                                          | 10,00         | 12,50  | 11,00  | 11,50  | 12,00  | 12,00  | 11,50  | 11,00  | 13,00  | 13,00  | 11,750                               |
| 9 AVERAGE                                    | 10,000        | 12,433 | 11,100 | 11,500 | 12,000 | 11,933 | 11,500 | 11,000 | 13,067 | 13,067 | $\bar{x}_b =$ 11,7600                |
| 10 R                                         | 0,000         | 0,200  | 0,300  | 0,000  | 0,000  | 0,200  | 0,000  | 0,000  | 0,200  | 0,200  | $r_b =$ 0,110                        |
| 11. C 1                                      | 10,00         | 12,50  | 11,00  | 12,00  | 12,00  | 12,00  | 11,50  | 11,00  | 13,20  | 13,00  | 11,820                               |
| 12 2                                         | 10,00         | 12,30  | 11,30  | 11,50  | 12,30  | 12,00  | 11,50  | 11,00  | 13,00  | 13,00  | 11,790                               |
| 13 3                                         | 10,00         | 12,50  | 11,30  | 11,50  | 12,00  | 12,00  | 11,50  | 11,00  | 13,00  | 13,20  | 11,800                               |
| 14 AVERAGE                                   | 10,000        | 12,433 | 11,200 | 11,667 | 12,100 | 12,000 | 11,500 | 11,000 | 13,067 | 13,067 | $\bar{x}_c =$ 11,8033                |
| 15 R                                         | 0,000         | 0,200  | 0,300  | 0,500  | 0,300  | 0,000  | 0,000  | 0,000  | 0,200  | 0,200  | $r_c =$ 0,170                        |
| 16. PART AVE                                 | 10,000        | 12,433 | 11,133 | 11,611 | 12,033 | 11,956 | 11,500 | 11,000 | 13,089 | 13,044 | $\bar{X} =$ 11,7800<br>$R_p =$ 3,089 |
| 17 $(r_a + r_b + r_c) /$ (# OF APPRAISERS) = |               |        |        |        |        |        |        |        |        |        | $R =$ 0,1400                         |
| 18 (Max X - Min X) =                         |               |        |        |        |        |        |        |        |        |        | $X_{DIFF} =$ 0,0433                  |
| 19 $R \times D_4^* =$                        | APPRAISER A C |        |        |        |        |        |        |        |        |        | $UCL_R =$ 0,3612                     |

\*  $D_4 = 3.27$  for 2 trials and  $2.58$  for 3 trials.  $UCL_R$  represents the limit of individual  $R$ 's. Circle those that are beyond this limit. Identify the cause and correct. Repeat these readings using the same appraiser and unit as originally used or discard values and re-average and recompute  $R$  and the limiting value from the remaining observations.

Notes: diese Untersuchung gilt auch für Container und Stückware.

# Messmittelfähigkeit



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## GAGE REPEATABILITY AND REPRODUCIBILITY DATA SHEET VARIABLE DATA RESULTS

|                                     |                              |             |                             |                            |
|-------------------------------------|------------------------------|-------------|-----------------------------|----------------------------|
| Part Number<br>1930029              | Gage Name<br>Profilprojektor |             | Appraiser A<br>Gräf H.      |                            |
| Part Name<br>PP-BS NW 29 Ringware   | Gage Number<br>031059        |             | Appraiser B<br>Schneider M. |                            |
| Characteristic<br>FL-Winkel         | Gage Type<br>optisch ST 300  |             | Appraiser C<br>Pfaff M.     |                            |
| Characteristic Classification<br>11 | Trials<br>3                  | Parts<br>10 | Appraisers<br>3             | Date Performed<br>08.05.15 |

| Measurement Unit Analysis                                                                        |   |                    |                |                | % Tolerance (Tol)                                                                  |  |
|--------------------------------------------------------------------------------------------------|---|--------------------|----------------|----------------|------------------------------------------------------------------------------------|--|
| Repeatability - Equipment Variation (EV)                                                         |   |                    |                |                | % EV = 100 (EV/TV)<br>= 100(0,08271/0,97542)<br>= 8,48                             |  |
|                                                                                                  |   |                    |                |                |                                                                                    |  |
| EV                                                                                               | = | R x K <sub>1</sub> | Trials         | K1             |                                                                                    |  |
|                                                                                                  | = | 0,1400 x 0,5908    | 2              | 0,8862         |                                                                                    |  |
|                                                                                                  | = | 0,08271            | 3              | 0,5908         |                                                                                    |  |
| Reproducibility - Appraiser Variation (AV)                                                       |   |                    |                |                | % AV = 100 (AV/TV)<br>= 100(0,01691/0,97542)<br>= 1,73                             |  |
| AV = {(X <sub>DIFF</sub> x K <sub>2</sub> ) <sup>2</sup> - (EV <sup>2</sup> /nr)} <sup>1/2</sup> |   |                    |                |                |                                                                                    |  |
| = {(0,0433 x 0,5231) <sup>2</sup> - (0,0827 <sup>2</sup> /(10 x 3))} <sup>1/2</sup>              |   |                    |                |                |                                                                                    |  |
| = 0,01691                                                                                        |   |                    | Appraisers     | 2              |                                                                                    |  |
| n = parts                                                                                        |   | r = trials         | K <sub>2</sub> | 0,7071         | 0,5231                                                                             |  |
| Repeatability & Reproducibility (GRR)                                                            |   |                    |                |                | % R&R = 100 (R&R/TV)<br>= 100(0,08442/0,97542)<br>= 8,65<br><b>Gage system O.K</b> |  |
| GRR = {(EV <sup>2</sup> + AV <sup>2</sup> ) <sup>1/2</sup>                                       |   |                    |                |                |                                                                                    |  |
| = {(0,0827 <sup>2</sup> + 0,0169 <sup>2</sup> ) <sup>1/2</sup>                                   |   |                    | Parts          | K <sub>3</sub> |                                                                                    |  |
| = 0,08442                                                                                        |   |                    | 2              | 0,7071         |                                                                                    |  |
|                                                                                                  |   |                    | 3              | 0,5231         |                                                                                    |  |
|                                                                                                  |   |                    | 4              | 0,4467         |                                                                                    |  |
| Part Variation (PV)                                                                              |   |                    | 5              | 0,4030         | % PV = 100 (PV/TV)<br>= 100(0,97176/0,97542)<br>= 99,62                            |  |
| PV = R <sub>P</sub> x K <sub>3</sub>                                                             |   |                    | 6              | 0,3742         |                                                                                    |  |
| = 3,0889 x 0,3146                                                                                |   |                    | 7              | 0,3534         |                                                                                    |  |
| = 0,97176                                                                                        |   |                    | 8              | 0,3375         |                                                                                    |  |
|                                                                                                  |   |                    | 9              | 0,3249         | ndc = 1.41 (PV/GRR)<br>= 1.41(0,97176/0,08442)<br>= 16,000                         |  |
| Total Variation (TV)                                                                             |   |                    | 10             | 0,3146         |                                                                                    |  |
| TV = {(GRR <sup>2</sup> + PV <sup>2</sup> ) <sup>1/2</sup>                                       |   |                    |                |                |                                                                                    |  |
| = {(0,0844 <sup>2</sup> + 0,9718 <sup>2</sup> ) <sup>1/2</sup>                                   |   |                    |                |                |                                                                                    |  |
| = 0,97542                                                                                        |   |                    |                |                |                                                                                    |  |

Weitere Informationen zum theoretischen Ansatz und zu den in diesem Formular verwendeten Konstanten finden sich im Referenzhandbuch Measurement Systems Analysis (MSA), vierte Ausgabe.

|  |                                                 |               |
|--|-------------------------------------------------|---------------|
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## GAGE REPEATABILITY AND REPRODUCIBILITY DATA SHEET VARIABLE DATA RESULTS

|                                              |                              |                                               |                    |                                   |                                   |
|----------------------------------------------|------------------------------|-----------------------------------------------|--------------------|-----------------------------------|-----------------------------------|
| Part Number<br><b>1930029</b>                |                              | Gage Name<br><b>Waage digital</b>             |                    | Appraiser A<br><b>Ferderer J.</b> |                                   |
| Part Name<br><b>PP-BS NW 29 Ringware</b>     |                              | Gage Number<br><b>80604645</b>                |                    | Appraiser B<br><b>Zobel F.</b>    |                                   |
| Characteristic<br><b>Gewicht: g/m</b>        | Specification<br><b>-2 2</b> | Gage Type<br><b>Sartorius, Auflösung 0,1g</b> |                    | Appraiser C<br><b>Würfel V.</b>   |                                   |
| Characteristic Classification<br><b>66,0</b> | Einheit<br><b>mm</b>         | Trials<br><b>3</b>                            | Parts<br><b>10</b> | Appraisers<br><b>3</b>            | Date Performed<br><b>08.05.15</b> |

| APPRAISER/<br>TRIAL #                        | PART   |        |        |        |        |        |        |        |        |        | AVERAGE                              |
|----------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------------------------------|
|                                              | 1      | 2      | 3      | 4      | 5      | 6      | 7      | 8      | 9      | 10     |                                      |
| 1. A 1                                       | 66,30  | 66,00  | 65,20  | 65,40  | 66,50  | 66,20  | 65,20  | 65,80  | 67,30  | 67,00  | 66,090                               |
| 2 2                                          | 66,30  | 65,90  | 65,20  | 65,30  | 66,50  | 66,10  | 65,20  | 65,80  | 67,30  | 67,00  | 66,060                               |
| 3 3                                          | 66,30  | 66,00  | 65,20  | 65,40  | 66,50  | 66,10  | 65,20  | 65,80  | 67,30  | 66,90  | 66,070                               |
| 4 AVERAGE                                    | 66,300 | 65,967 | 65,200 | 65,367 | 66,500 | 66,133 | 65,200 | 65,800 | 67,300 | 66,967 | $\bar{x}_a = 66,0733$                |
| 5 R                                          | 0,000  | 0,100  | 0,000  | 0,100  | 0,000  | 0,100  | 0,000  | 0,000  | 0,000  | 0,100  | $r_a = 0,040$                        |
| 6. B 1                                       | 66,30  | 66,00  | 65,20  | 65,40  | 66,50  | 66,10  | 65,20  | 65,80  | 67,30  | 67,00  | 66,080                               |
| 7 2                                          | 66,30  | 65,90  | 65,20  | 65,30  | 66,50  | 66,20  | 65,20  | 65,80  | 67,30  | 67,00  | 66,070                               |
| 8 3                                          | 66,30  | 66,00  | 65,20  | 65,40  | 66,50  | 66,10  | 65,20  | 65,70  | 67,30  | 67,00  | 66,070                               |
| 9 AVERAGE                                    | 66,300 | 65,967 | 65,200 | 65,367 | 66,500 | 66,133 | 65,200 | 65,767 | 67,300 | 67,000 | $\bar{x}_b = 66,0733$                |
| 10 R                                         | 0,000  | 0,100  | 0,000  | 0,100  | 0,000  | 0,100  | 0,000  | 0,100  | 0,000  | 0,000  | $r_b = 0,040$                        |
| 11. C 1                                      | 66,30  | 66,00  | 65,20  | 65,40  | 66,50  | 66,20  | 65,20  | 65,80  | 67,30  | 67,00  | 66,090                               |
| 12 2                                         | 66,30  | 65,90  | 65,20  | 65,30  | 66,50  | 66,20  | 65,20  | 65,80  | 67,30  | 67,00  | 66,070                               |
| 13 3                                         | 66,30  | 66,00  | 65,20  | 65,40  | 66,50  | 66,10  | 65,20  | 65,80  | 67,30  | 66,90  | 66,070                               |
| 14 AVERAGE                                   | 66,300 | 65,967 | 65,200 | 65,367 | 66,500 | 66,167 | 65,200 | 65,800 | 67,300 | 66,967 | $\bar{x}_c = 66,0767$                |
| 15 R                                         | 0,000  | 0,100  | 0,000  | 0,100  | 0,000  | 0,100  | 0,000  | 0,000  | 0,000  | 0,100  | $r_c = 0,040$                        |
| 16. PART AVE                                 | 66,300 | 65,967 | 65,200 | 65,367 | 66,500 | 66,144 | 65,200 | 65,789 | 67,300 | 66,978 | $\bar{X} = 66,0744$<br>$R_p = 2,100$ |
| 17 $(r_a + r_b + r_c) /$ (# OF APPRAISERS) = |        |        |        |        |        |        |        |        |        |        | $R = 0,0400$                         |
| 18 (Max X - Min X) =                         |        |        |        |        |        |        |        |        |        |        | $X_{DIFF} = 0,0033$                  |
| 19 $R \times D_4^* =$                        |        |        |        |        |        |        |        |        |        |        | $UCL_R = 0,1032$                     |

\*  $D_4 = 3.27$  for 2 trials and  $2.58$  for 3 trials. UCLR represents the limit of individual R's. Circle those that are beyond this limit. Identify the cause and correct. Repeat these readings using the same appraiser and unit as originally used or discard values and re-average and recompute R and the limiting value from the remaining observations.

Notes: diese Untersuchung glit auch für Container und Stückware.

|  |                              |                                                                                                      |
|--|------------------------------|------------------------------------------------------------------------------------------------------|
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## GAGE REPEATABILITY AND REPRODUCIBILITY DATA SHEET VARIABLE DATA RESULTS

|                                     |                                        |                            |                 |                            |
|-------------------------------------|----------------------------------------|----------------------------|-----------------|----------------------------|
| Part Number<br>1930029              | Gage Name<br>Waage digital             | Appraiser A<br>Ferderer J. |                 |                            |
| Part Name<br>PP-BS NW 29 Ringware   | Gage Number<br>80604645                | Appraiser B<br>Zobel F.    |                 |                            |
| Characteristic<br>Gewicht: g/m      | Gage Type<br>Sartorius, Auflösung 0,1g | Appraiser C<br>Würfel V.   |                 |                            |
| Characteristic Classification<br>66 | Trials<br>3                            | Parts<br>10                | Appraisers<br>3 | Date Performed<br>08.05.15 |

| Measurement Unit Analysis                         |            |                                                                                             |                | % Tolerance (Tol)                                                                         |  |
|---------------------------------------------------|------------|---------------------------------------------------------------------------------------------|----------------|-------------------------------------------------------------------------------------------|--|
| <b>Repeatability - Equipment Variation (EV)</b>   |            |                                                                                             |                | % EV = 100 (EV/TV)<br>= 100(0,02363/0,66108)<br>= 3,57                                    |  |
| EV                                                | =          | R x K <sub>1</sub>                                                                          |                |                                                                                           |  |
|                                                   | =          | 0,0400 x 0,5908                                                                             |                |                                                                                           |  |
|                                                   | =          | 0,02363                                                                                     |                |                                                                                           |  |
|                                                   |            |                                                                                             | Trials         | K <sub>1</sub>                                                                            |  |
|                                                   |            |                                                                                             | 2              | 0,8862                                                                                    |  |
|                                                   |            |                                                                                             | 3              | 0,5908                                                                                    |  |
| <b>Reproducibility - Appraiser Variation (AV)</b> |            |                                                                                             |                | % AV = 100 (AV/TV)<br>= 100(0,00000/0,66108)<br>= 0,00                                    |  |
| AV                                                | =          | {(X <sub>DIFF</sub> x K <sub>2</sub> ) <sup>2</sup> - (EV <sup>2</sup> /nr)} <sup>1/2</sup> |                |                                                                                           |  |
|                                                   | =          | {(0,0033 x 0,5231) <sup>2</sup> - (0,0236 <sup>2</sup> /(10 x 3))} <sup>1/2</sup>           |                |                                                                                           |  |
|                                                   | =          | 0,00000                                                                                     |                |                                                                                           |  |
| n = parts                                         | r = trials | Appraisers                                                                                  | 2              | 3                                                                                         |  |
|                                                   |            | K <sub>2</sub>                                                                              | 0,7071         | 0,5231                                                                                    |  |
| <b>Repeatability &amp; Reproducibility (GRR)</b>  |            |                                                                                             |                | % R&R = 100 (R&R/TV)<br>= 100(0,02363/0,66108)<br>= <b>3,57</b><br><b>Gage system O.K</b> |  |
| GRR                                               | =          | {(EV <sup>2</sup> + AV <sup>2</sup> ) <sup>1/2</sup>                                        |                |                                                                                           |  |
|                                                   | =          | {(0,0236 <sup>2</sup> + 0,0000 <sup>2</sup> ) <sup>1/2</sup>                                |                |                                                                                           |  |
|                                                   | =          | 0,02363                                                                                     |                |                                                                                           |  |
|                                                   |            | Parts                                                                                       | K <sub>3</sub> |                                                                                           |  |
|                                                   |            | 2                                                                                           | 0,7071         |                                                                                           |  |
|                                                   |            | 3                                                                                           | 0,5231         |                                                                                           |  |
|                                                   |            | 4                                                                                           | 0,4467         |                                                                                           |  |
|                                                   |            | 5                                                                                           | 0,4030         |                                                                                           |  |
|                                                   |            | 6                                                                                           | 0,3742         |                                                                                           |  |
|                                                   |            | 7                                                                                           | 0,3534         |                                                                                           |  |
|                                                   |            | 8                                                                                           | 0,3375         |                                                                                           |  |
|                                                   |            | 9                                                                                           | 0,3249         |                                                                                           |  |
|                                                   |            | 10                                                                                          | 0,3146         |                                                                                           |  |
| <b>Part Variation (PV)</b>                        |            |                                                                                             |                | % PV = 100 (PV/TV)<br>= 100(0,66066/0,66108)<br>= 99,94                                   |  |
| PV                                                | =          | R <sub>p</sub> x K <sub>3</sub>                                                             |                |                                                                                           |  |
|                                                   | =          | 2,1000 x 0,3146                                                                             |                |                                                                                           |  |
|                                                   | =          | 0,66066                                                                                     |                |                                                                                           |  |
| <b>Total Variation (TV)</b>                       |            |                                                                                             |                | ndc = 1.41 (PV/GRR)<br>= 1.41(0,66066/0,02363)<br>= <b>39,000</b>                         |  |
| TV                                                | =          | {(GRR <sup>2</sup> + PV <sup>2</sup> ) <sup>1/2</sup>                                       |                |                                                                                           |  |
|                                                   | =          | {(0,0236 <sup>2</sup> + 0,6607 <sup>2</sup> ) <sup>1/2</sup>                                |                |                                                                                           |  |
|                                                   | =          | 0,66108                                                                                     |                |                                                                                           |  |

Weitere Informationen zum theoretischen Ansatz und zu den in diesem Formular verwendeten Konstanten finden sich im Referenzhandbuch Measurement Systems Analysis (MSA), Vierte Ausgabe.

|                  |                            |                         |                        |            |                 |              |
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|--|-------------------------------------------------|---------------|
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| GAGE REPEATABILITY AND REPRODUCIBILITY DATA SHEET<br>VARIABLE DATA RESULTS |  |                                     |                                         |                                          |  |                                   |                                 |                                   |  |
|----------------------------------------------------------------------------|--|-------------------------------------|-----------------------------------------|------------------------------------------|--|-----------------------------------|---------------------------------|-----------------------------------|--|
| Part Number<br><b>1930029</b>                                              |  |                                     | Gage Name<br><b>Meßschieber digital</b> |                                          |  | Appraiser A<br><b>Ferderer J.</b> |                                 |                                   |  |
| Part Name<br><b>PP-BS NW 29 Ringware</b>                                   |  |                                     | Gage Number<br><b>171274051</b>         |                                          |  | Appraiser B<br><b>Zobel F.</b>    |                                 |                                   |  |
| Characteristic<br><b>Innen dm.</b>                                         |  | Specification<br><b>-0,4    0,4</b> |                                         | Gage Type<br><b>Handmessmittel 150mm</b> |  |                                   | Appraiser C<br><b>Würfel V.</b> |                                   |  |
| Characteristic Classification<br><b>29,3</b>                               |  | Einheit<br><b>mm</b>                |                                         | Trials<br><b>3</b>                       |  | Parts<br><b>10</b>                |                                 | Appraisers<br><b>3</b>            |  |
|                                                                            |  |                                     |                                         |                                          |  |                                   |                                 | Date Performed<br><b>07.05.15</b> |  |

| APPRAISER/<br>TRIAL #                  | PART                           |        |        |        |        |        |        |        |        |        | AVERAGE                              |
|----------------------------------------|--------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------------------------------|
|                                        | 1                              | 2      | 3      | 4      | 5      | 6      | 7      | 8      | 9      | 10     |                                      |
| 1. A    1                              | 29,18                          | 29,22  | 29,32  | 29,41  | 29,45  | 29,29  | 29,28  | 29,22  | 29,26  | 29,26  | 29,289                               |
| 2        2                             | 29,19                          | 29,23  | 29,31  | 29,40  | 29,44  | 29,28  | 29,28  | 29,21  | 29,24  | 29,25  | 29,283                               |
| 3        3                             | 29,19                          | 29,22  | 29,32  | 29,40  | 29,44  | 29,28  | 29,28  | 29,22  | 29,24  | 29,26  | 29,285                               |
| 4        AVERAGE                       | 29,187                         | 29,223 | 29,317 | 29,403 | 29,443 | 29,283 | 29,280 | 29,217 | 29,247 | 29,257 | $\bar{x}_a =$ 29,2857                |
| 5        R                             | 0,010                          | 0,010  | 0,010  | 0,010  | 0,010  | 0,010  | 0,000  | 0,010  | 0,020  | 0,010  | $r_a =$ 0,010                        |
| 6. B    1                              | 29,18                          | 29,22  | 29,32  | 29,41  | 29,45  | 29,29  | 29,28  | 29,22  | 29,26  | 29,26  | 29,289                               |
| 7        2                             | 29,19                          | 29,23  | 29,31  | 29,41  | 29,43  | 29,27  | 29,27  | 29,21  | 29,24  | 29,24  | 29,280                               |
| 8        3                             | 29,19                          | 29,22  | 29,32  | 29,40  | 29,44  | 29,28  | 29,28  | 29,22  | 29,24  | 29,26  | 29,285                               |
| 9        AVERAGE                       | 29,187                         | 29,223 | 29,317 | 29,407 | 29,440 | 29,280 | 29,277 | 29,217 | 29,247 | 29,253 | $\bar{x}_b =$ 29,2847                |
| 10       R                             | 0,010                          | 0,010  | 0,010  | 0,010  | 0,020  | 0,020  | 0,010  | 0,010  | 0,020  | 0,020  | $r_b =$ 0,014                        |
| 11. C    1                             | 29,18                          | 29,22  | 29,30  | 29,41  | 29,45  | 29,29  | 29,26  | 29,22  | 29,26  | 29,26  | 29,285                               |
| 12       2                             | 29,17                          | 29,21  | 29,31  | 29,41  | 29,44  | 29,28  | 29,28  | 29,23  | 29,25  | 29,25  | 29,283                               |
| 13       3                             | 29,19                          | 29,22  | 29,32  | 29,40  | 29,44  | 29,28  | 29,28  | 29,22  | 29,24  | 29,24  | 29,283                               |
| 14       AVERAGE                       | 29,180                         | 29,217 | 29,310 | 29,407 | 29,443 | 29,283 | 29,273 | 29,223 | 29,250 | 29,250 | $\bar{x}_c =$ 29,2837                |
| 15       R                             | 0,020                          | 0,010  | 0,020  | 0,010  | 0,010  | 0,010  | 0,020  | 0,010  | 0,020  | 0,020  | $r_c =$ 0,015                        |
| 16. PART AVE                           | 29,184                         | 29,221 | 29,314 | 29,406 | 29,442 | 29,282 | 29,277 | 29,219 | 29,248 | 29,253 | $\bar{X} =$ 29,2847<br>$R_p =$ 0,258 |
| 17 $(r_a + r_b + r_c) /$               | $(\# \text{ OF APPRAISERS}) =$ |        |        |        |        |        |        |        |        |        | $R =$ 0,0130                         |
| 18 $(\text{Max } X - \text{Min } X) =$ |                                |        |        |        |        |        |        |        |        |        | $X_{DIFF} =$ 0,0020                  |
| 19 $R \times D_4^* =$                  |                                |        |        |        |        |        |        |        |        |        | $UCL_R =$ 0,0335                     |

\*  $D_4 = 3.27$  for 2 trials and  $2.58$  for 3 trials.  $UCL_R$  represents the limit of individual  $R$ 's. Circle those that are beyond this limit. Identify the cause and correct. Repeat these readings using the same appraiser and unit as originally used or discard values and re-average and recompute  $R$  and the limiting value from the remaining observations.

Notes: diese Untersuchung gilt auch für Container und Stückware.

|                  |                            |                         |                        |            |                 |              |
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|  |                              |                                                                                                      |
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|  | <h1>Messmittelfähigkeit</h1> |  <b>Schlemmer</b> |
|  |                              | Seite 2 von 2                                                                                        |

## GAGE REPEATABILITY AND REPRODUCIBILITY DATA SHEET VARIABLE DATA RESULTS

|                                       |                                   |                            |                 |                            |
|---------------------------------------|-----------------------------------|----------------------------|-----------------|----------------------------|
| Part Number<br>1930029                | Gage Name<br>Meßschieber digital  | Appraiser A<br>Ferderer J. |                 |                            |
| Part Name<br>PP-BS NW 29 Ringware     | Gage Number<br>171274051          | Appraiser B<br>Zobel F.    |                 |                            |
| Characteristic<br>Innen dm.           | Gage Type<br>Handmessmittel 150mm | Appraiser C<br>Würfel V.   |                 |                            |
| Characteristic Classification<br>29,3 | Trials<br>3                       | Parts<br>10                | Appraisers<br>3 | Date Performed<br>07.05.15 |

| Measurement Unit Analysis                         |                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  | % Tolerance (Tol)                                                                         |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
|---------------------------------------------------|-----------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|-------------------------------------------------------------------------------------------|--|------------|----------------|---|----------------|--------|--------|---|--------|---|--------|---|--------|---|--------|---|--------|---|--------|----|--------|
| <b>Repeatability - Equipment Variation (EV)</b>   |                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  | % EV = 100 (EV/TV)<br>= 100(0,00768/0,08146)<br>= 9,43                                    |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| EV                                                | = R x K <sub>1</sub>                                                                          | <table border="1"> <tr> <th>Trials</th> <th>K1</th> </tr> <tr> <td>2</td> <td>0,8862</td> </tr> <tr> <td>3</td> <td>0,5908</td> </tr> </table>                                                                                                                                                                                                                                                                                      |  |                                                                                           |  | Trials     | K1             | 2 | 0,8862         | 3      | 0,5908 |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| Trials                                            | K1                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| 2                                                 | 0,8862                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| 3                                                 | 0,5908                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
|                                                   | = 0,0130 x 0,5908                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
|                                                   | = 0,00768                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| <b>Reproducibility - Appraiser Variation (AV)</b> |                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  | % AV = 100 (AV/TV)<br>= 100(0,00000/0,08146)<br>= 0,00                                    |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| AV                                                | = {(X <sub>DIFF</sub> x K <sub>2</sub> ) <sup>2</sup> - (EV <sup>2</sup> /nr)} <sup>1/2</sup> | <table border="1"> <tr> <th>Appraisers</th> <th>2</th> <th>3</th> </tr> <tr> <td>K<sub>2</sub></td> <td>0,7071</td> <td>0,5231</td> </tr> </table>                                                                                                                                                                                                                                                                                  |  |                                                                                           |  | Appraisers | 2              | 3 | K <sub>2</sub> | 0,7071 | 0,5231 |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| Appraisers                                        | 2                                                                                             | 3                                                                                                                                                                                                                                                                                                                                                                                                                                   |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| K <sub>2</sub>                                    | 0,7071                                                                                        | 0,5231                                                                                                                                                                                                                                                                                                                                                                                                                              |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
|                                                   | = {(0,0020 x 0,5231) <sup>2</sup> - (0,0077 <sup>2</sup> /(10 x 3))} <sup>1/2</sup>           |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
|                                                   | = 0,00000                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| n = parts                                         | r = trials                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| <b>Repeatability &amp; Reproducibility (GRR)</b>  |                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  | % R&R = 100 (R&R/TV)<br>= 100(0,00768/0,08146)<br>= <b>9,43</b><br><b>Gage system O.K</b> |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| GRR                                               | = {(EV <sup>2</sup> + AV <sup>2</sup> ) <sup>1/2</sup>                                        | <table border="1"> <tr> <th>Parts</th> <th>K<sub>3</sub></th> </tr> <tr> <td>2</td> <td>0,7071</td> </tr> <tr> <td>3</td> <td>0,5231</td> </tr> <tr> <td>4</td> <td>0,4467</td> </tr> <tr> <td>5</td> <td>0,4030</td> </tr> <tr> <td>6</td> <td>0,3742</td> </tr> <tr> <td>7</td> <td>0,3534</td> </tr> <tr> <td>8</td> <td>0,3375</td> </tr> <tr> <td>9</td> <td>0,3249</td> </tr> <tr> <td>10</td> <td>0,3146</td> </tr> </table> |  |                                                                                           |  | Parts      | K <sub>3</sub> | 2 | 0,7071         | 3      | 0,5231 | 4 | 0,4467 | 5 | 0,4030 | 6 | 0,3742 | 7 | 0,3534 | 8 | 0,3375 | 9 | 0,3249 | 10 | 0,3146 |
| Parts                                             | K <sub>3</sub>                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| 2                                                 | 0,7071                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| 3                                                 | 0,5231                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| 4                                                 | 0,4467                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| 5                                                 | 0,4030                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| 6                                                 | 0,3742                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| 7                                                 | 0,3534                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| 8                                                 | 0,3375                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| 9                                                 | 0,3249                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| 10                                                | 0,3146                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
|                                                   | = {(0,0077 <sup>2</sup> + 0,0000 <sup>2</sup> ) <sup>1/2</sup>                                |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
|                                                   | = 0,00768                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| <b>Part Variation (PV)</b>                        |                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  | % PV = 100 (PV/TV)<br>= 100(0,08110/0,08146)<br>= 99,55                                   |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| PV                                                | = R <sub>p</sub> x K <sub>3</sub>                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
|                                                   | = 0,2578 x 0,3146                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
|                                                   | = 0,08110                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| <b>Total Variation (TV)</b>                       |                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  | ndc = 1.41 (PV/GRR)<br>= 1.41(0,08110/0,00768)<br>= <b>14,000</b>                         |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| TV                                                | = {(GRR <sup>2</sup> + PV <sup>2</sup> ) <sup>1/2</sup>                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
|                                                   | = {(0,0077 <sup>2</sup> + 0,0811 <sup>2</sup> ) <sup>1/2</sup>                                |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
|                                                   | = 0,08146                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |

Weitere Informationen zum theoretischen Ansatz und zu den in diesem Formular verwendeten Konstanten finden sich im Referenzhandbuch Measurement Systems Analysis (MSA), vierte Ausgabe.

## GAGE REPEATABILITY AND REPRODUCIBILITY DATA SHEET VARIABLE DATA RESULTS

|                                      |                              |                             |
|--------------------------------------|------------------------------|-----------------------------|
| Part Number<br>1930029               | Gage Name<br>Profilprojektor | Appraiser A<br>Gräf H.      |
| Part Name<br>PP-BS NW 29 Ringware    | Gage Number<br>031059        | Appraiser B<br>Schneider M. |
| Characteristic<br>Teilung            | Specification<br>-0,15 0,15  | Gage Type<br>optisch ST 300 |
| Appraiser C<br>Pfaff M.              | Appraisers<br>3              | Date Performed<br>08.05.15  |
| Characteristic Classification<br>3,4 | Einheit<br>mm                | Trials<br>3                 |
|                                      | Parts<br>10                  |                             |

| APPRAISER/<br>TRIAL #                  | PART                           |       |       |       |       |       |       |       |       |       | AVERAGE                             |
|----------------------------------------|--------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------------------------------------|
|                                        | 1                              | 2     | 3     | 4     | 5     | 6     | 7     | 8     | 9     | 10    |                                     |
| 1. A 1                                 | 3,36                           | 3,40  | 3,45  | 3,42  | 3,48  | 3,50  | 3,51  | 3,44  | 3,47  | 3,37  | 3,440                               |
| 2 2                                    | 3,35                           | 3,41  | 3,45  | 3,42  | 3,47  | 3,49  | 3,51  | 3,44  | 3,47  | 3,38  | 3,439                               |
| 3 3                                    | 3,35                           | 3,40  | 3,45  | 3,42  | 3,48  | 3,50  | 3,51  | 3,45  | 3,46  | 3,37  | 3,439                               |
| 4 AVERAGE                              | 3,353                          | 3,403 | 3,450 | 3,420 | 3,477 | 3,497 | 3,510 | 3,443 | 3,467 | 3,373 | $\bar{x}_a = 3,4393$                |
| 5 R                                    | 0,010                          | 0,010 | 0,000 | 0,000 | 0,010 | 0,010 | 0,000 | 0,010 | 0,010 | 0,010 | $r_a = 0,007$                       |
| 6. B 1                                 | 3,36                           | 3,40  | 3,45  | 3,42  | 3,48  | 3,50  | 3,52  | 3,45  | 3,46  | 3,37  | 3,441                               |
| 7 2                                    | 3,35                           | 3,41  | 3,44  | 3,42  | 3,47  | 3,49  | 3,52  | 3,44  | 3,47  | 3,38  | 3,439                               |
| 8 3                                    | 3,35                           | 3,40  | 3,45  | 3,42  | 3,48  | 3,50  | 3,52  | 3,44  | 3,47  | 3,37  | 3,440                               |
| 9 AVERAGE                              | 3,353                          | 3,403 | 3,447 | 3,420 | 3,477 | 3,497 | 3,520 | 3,443 | 3,467 | 3,373 | $\bar{x}_b = 3,4400$                |
| 10 R                                   | 0,010                          | 0,010 | 0,010 | 0,000 | 0,010 | 0,010 | 0,000 | 0,010 | 0,010 | 0,010 | $r_b = 0,008$                       |
| 11. C 1                                | 3,36                           | 3,40  | 3,45  | 3,43  | 3,48  | 3,50  | 3,52  | 3,44  | 3,46  | 3,38  | 3,442                               |
| 12 2                                   | 3,36                           | 3,41  | 3,44  | 3,42  | 3,48  | 3,49  | 3,52  | 3,44  | 3,46  | 3,38  | 3,440                               |
| 13 3                                   | 3,36                           | 3,40  | 3,45  | 3,42  | 3,48  | 3,50  | 3,52  | 3,45  | 3,47  | 3,37  | 3,442                               |
| 14 AVERAGE                             | 3,360                          | 3,403 | 3,447 | 3,423 | 3,480 | 3,497 | 3,520 | 3,443 | 3,463 | 3,377 | $\bar{x}_c = 3,4413$                |
| 15 R                                   | 0,000                          | 0,010 | 0,010 | 0,010 | 0,000 | 0,010 | 0,000 | 0,010 | 0,010 | 0,010 | $r_c = 0,007$                       |
| 16. PART AVE                           | 3,356                          | 3,403 | 3,448 | 3,421 | 3,478 | 3,497 | 3,517 | 3,443 | 3,466 | 3,374 | $\bar{X} = 3,4402$<br>$R_p = 0,161$ |
| 17 $(r_a + r_b + r_c) /$               | $(\# \text{ OF APPRAISERS}) =$ |       |       |       |       |       |       |       |       |       | $R = 0,0073$                        |
| 18 $(\text{Max } X - \text{Min } X) =$ |                                |       |       |       |       |       |       |       |       |       | $X_{DIFF} = 0,0020$                 |
| 19 $R \times D_4^* =$                  |                                |       |       |       |       |       |       |       |       |       | $UCL_R = 0,0189$                    |

\*  $D_4 = 3.27$  for 2 trials and  $2.58$  for 3 trials. UCLR represents the limit of individual R's. Circle those that are beyond this limit. Identify the cause and correct. Repeat these readings using the same appraiser and unit as originally used or discard values and re-average and recompute R and the limiting value from the remaining observations.

Notes: diese Untersuchung glit auch für Container und Stückware.

# Messmittelfähigkeit



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## GAGE REPEATABILITY AND REPRODUCIBILITY DATA SHEET VARIABLE DATA RESULTS

|                                      |                              |             |                             |                            |
|--------------------------------------|------------------------------|-------------|-----------------------------|----------------------------|
| Part Number<br>1930029               | Gage Name<br>Profilprojektor |             | Appraiser A<br>Gräf H.      |                            |
| Part Name<br>PP-BS NW 29 Ringware    | Gage Number<br>031059        |             | Appraiser B<br>Schneider M. |                            |
| Characteristic<br>Teilung            | Gage Type<br>optisch ST 300  |             | Appraiser C<br>Pfaff M.     |                            |
| Characteristic Classification<br>3,4 | Trials<br>3                  | Parts<br>10 | Appraisers<br>3             | Date Performed<br>08.05.15 |

| Measurement Unit Analysis                  |                                                                                                                                                                                                   |                |                |                                                            | % Tolerance (Tol)                                        |  |
|--------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|----------------|------------------------------------------------------------|----------------------------------------------------------|--|
| Repeatability - Equipment Variation (EV)   |                                                                                                                                                                                                   |                |                |                                                            | % EV = 100 (EV/TV)<br>= 100(0,00433/0,05087)<br>= 8,52   |  |
| EV                                         | = R x K <sub>1</sub><br>= 0,0073 x 0,5908<br>= 0,00433                                                                                                                                            |                |                |                                                            |                                                          |  |
|                                            |                                                                                                                                                                                                   | Trials         | K1             |                                                            |                                                          |  |
|                                            |                                                                                                                                                                                                   | 2              | 0,8862         |                                                            |                                                          |  |
|                                            |                                                                                                                                                                                                   | 3              | 0,5908         |                                                            |                                                          |  |
| Reproducibility - Appraiser Variation (AV) |                                                                                                                                                                                                   |                |                |                                                            | % AV = 100 (AV/TV)<br>= 100(0,00068/0,05087)<br>= 1,35   |  |
| AV                                         | = {(X <sub>DIFF</sub> x K <sub>2</sub> ) <sup>2</sup> - (EV <sup>2</sup> /nr)} <sup>1/2</sup><br>= {(0,0020 x 0,5231) <sup>2</sup> - (0,0043 <sup>2</sup> /(10 x 3))} <sup>1/2</sup><br>= 0,00068 |                |                |                                                            |                                                          |  |
|                                            |                                                                                                                                                                                                   | Appraisers     | 2              | 3                                                          |                                                          |  |
|                                            |                                                                                                                                                                                                   | K <sub>2</sub> | 0,7071         | 0,5231                                                     |                                                          |  |
| n = parts                                  | r = trials                                                                                                                                                                                        |                |                |                                                            |                                                          |  |
| Repeatability & Reproducibility (GRR)      |                                                                                                                                                                                                   |                |                |                                                            | % R&R = 100 (R&R/TV)<br>= 100(0,00439/0,05087)<br>= 8,62 |  |
| GRR                                        | = {(EV <sup>2</sup> + AV <sup>2</sup> ) <sup>1/2</sup><br>= {(0,0043 <sup>2</sup> + 0,0007 <sup>2</sup> ) <sup>1/2</sup><br>= 0,00439                                                             |                |                |                                                            |                                                          |  |
|                                            |                                                                                                                                                                                                   | Parts          | K <sub>3</sub> |                                                            |                                                          |  |
|                                            |                                                                                                                                                                                                   | 2              | 0,7071         |                                                            |                                                          |  |
|                                            |                                                                                                                                                                                                   | 3              | 0,5231         | Gage system O.K                                            |                                                          |  |
|                                            |                                                                                                                                                                                                   | 4              | 0,4467         |                                                            |                                                          |  |
|                                            |                                                                                                                                                                                                   | 5              | 0,4030         |                                                            |                                                          |  |
|                                            |                                                                                                                                                                                                   | 6              | 0,3742         |                                                            |                                                          |  |
| Part Variation (PV)                        |                                                                                                                                                                                                   |                |                |                                                            | % PV = 100 (PV/TV)<br>= 100(0,05069/0,05087)<br>= 99,63  |  |
| PV                                         | = R <sub>P</sub> x K <sub>3</sub><br>= 0,1611 x 0,3146<br>= 0,05069                                                                                                                               |                |                |                                                            |                                                          |  |
|                                            |                                                                                                                                                                                                   | 7              | 0,3534         |                                                            |                                                          |  |
|                                            |                                                                                                                                                                                                   | 8              | 0,3375         |                                                            |                                                          |  |
|                                            |                                                                                                                                                                                                   | 9              | 0,3249         | ndc = 1.41 (PV/GRR)<br>= 1.41(0,05069/0,00439)<br>= 16,000 |                                                          |  |
|                                            |                                                                                                                                                                                                   | 10             | 0,3146         |                                                            |                                                          |  |
| Total Variation (TV)                       |                                                                                                                                                                                                   |                |                |                                                            |                                                          |  |
| TV                                         | = {(GRR <sup>2</sup> + PV <sup>2</sup> ) <sup>1/2</sup><br>= {(0,0044 <sup>2</sup> + 0,0507 <sup>2</sup> ) <sup>1/2</sup><br>= 0,05087                                                            |                |                |                                                            |                                                          |  |

Weitere Informationen zum theoretischen Ansatz und zu den in diesem Formular verwendeten Konstanten finden sich im Referenzhandbuch Measurement Systems Analysis (MSA), vierte Ausgabe.

|  |                                                 |               |
|--|-------------------------------------------------|---------------|
|  | <h1 style="margin: 0;">Messmittelfähigkeit</h1> |               |
|  |                                                 | Seite 1 von 2 |

## GAGE REPEATABILITY AND REPRODUCIBILITY DATA SHEET VARIABLE DATA RESULTS

|                                             |                                 |                                          |                    |                                   |                                   |
|---------------------------------------------|---------------------------------|------------------------------------------|--------------------|-----------------------------------|-----------------------------------|
| Part Number<br><b>1930029</b>               |                                 | Gage Name<br><b>Meßschieber digital</b>  |                    | Appraiser A<br><b>Ferderer J.</b> |                                   |
| Part Name<br><b>PP-BS NW 29 Ringware</b>    |                                 | Gage Number<br><b>171274051</b>          |                    | Appraiser B<br><b>Zobel F.</b>    |                                   |
| Characteristic<br><b>Wanddicke</b>          | Specification<br><b>0,3 0,6</b> | Gage Type<br><b>Handmessmittel 150mm</b> |                    | Appraiser C<br><b>Würfel V.</b>   |                                   |
| Characteristic Classification<br><b>0,3</b> | Einheit<br><b>mm</b>            | Trials<br><b>3</b>                       | Parts<br><b>10</b> | Appraisers<br><b>3</b>            | Date Performed<br><b>08.05.15</b> |

| APPRAISER/<br>TRIAL #                        | PART  |       |       |       |       |       |       |       |       |       | AVERAGE                             |
|----------------------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------------------------------------|
|                                              | 1     | 2     | 3     | 4     | 5     | 6     | 7     | 8     | 9     | 10    |                                     |
| 1. A 1                                       | 0,43  | 0,45  | 0,47  | 0,41  | 0,51  | 0,53  | 0,42  | 0,48  | 0,55  | 0,54  | 0,479                               |
| 2 2                                          | 0,42  | 0,45  | 0,47  | 0,42  | 0,50  | 0,53  | 0,43  | 0,47  | 0,55  | 0,55  | 0,479                               |
| 3 3                                          | 0,43  | 0,45  | 0,47  | 0,41  | 0,50  | 0,53  | 0,42  | 0,47  | 0,55  | 0,55  | 0,478                               |
| 4 AVERAGE                                    | 0,427 | 0,450 | 0,470 | 0,413 | 0,503 | 0,530 | 0,423 | 0,473 | 0,550 | 0,547 | $\bar{x}_a =$ 0,4787                |
| 5 R                                          | 0,010 | 0,000 | 0,000 | 0,010 | 0,010 | 0,000 | 0,010 | 0,010 | 0,000 | 0,010 | $r_a =$ 0,006                       |
| 6. B 1                                       | 0,44  | 0,45  | 0,47  | 0,41  | 0,51  | 0,53  | 0,42  | 0,48  | 0,55  | 0,55  | 0,481                               |
| 7 2                                          | 0,43  | 0,46  | 0,47  | 0,40  | 0,51  | 0,53  | 0,43  | 0,47  | 0,56  | 0,54  | 0,480                               |
| 8 3                                          | 0,43  | 0,45  | 0,47  | 0,40  | 0,50  | 0,53  | 0,42  | 0,47  | 0,55  | 0,55  | 0,477                               |
| 9 AVERAGE                                    | 0,433 | 0,453 | 0,470 | 0,403 | 0,507 | 0,530 | 0,423 | 0,473 | 0,553 | 0,547 | $\bar{x}_b =$ 0,4793                |
| 10 R                                         | 0,010 | 0,010 | 0,000 | 0,010 | 0,010 | 0,000 | 0,010 | 0,010 | 0,010 | 0,010 | $r_b =$ 0,008                       |
| 11. C 1                                      | 0,43  | 0,46  | 0,47  | 0,41  | 0,51  | 0,53  | 0,42  | 0,48  | 0,56  | 0,55  | 0,482                               |
| 12 2                                         | 0,42  | 0,45  | 0,47  | 0,42  | 0,52  | 0,53  | 0,43  | 0,48  | 0,55  | 0,55  | 0,482                               |
| 13 3                                         | 0,43  | 0,46  | 0,47  | 0,41  | 0,52  | 0,53  | 0,42  | 0,48  | 0,55  | 0,54  | 0,481                               |
| 14 AVERAGE                                   | 0,427 | 0,457 | 0,470 | 0,413 | 0,517 | 0,530 | 0,423 | 0,480 | 0,553 | 0,547 | $\bar{x}_c =$ 0,4817                |
| 15 R                                         | 0,010 | 0,010 | 0,000 | 0,010 | 0,010 | 0,000 | 0,010 | 0,000 | 0,010 | 0,010 | $r_c =$ 0,007                       |
| 16. PART AVE                                 | 0,429 | 0,453 | 0,470 | 0,410 | 0,509 | 0,530 | 0,423 | 0,476 | 0,552 | 0,547 | $\bar{X} =$ 0,4799<br>$R_p =$ 0,142 |
| 17 $(r_a + r_b + r_c) /$ (# OF APPRAISERS) = |       |       |       |       |       |       |       |       |       |       | $R =$ 0,0070                        |
| 18 (Max X - Min X) =                         |       |       |       |       |       |       |       |       |       |       | $X_{DIFF} =$ 0,0030                 |
| 19 $R \times D_4^* =$                        |       |       |       |       |       |       |       |       |       |       | $UCL_R =$ 0,0181                    |

\*  $D_4 = 3.27$  for 2 trials and  $2.58$  for 3 trials.  $UCL_R$  represents the limit of individual  $R$ 's. Circle those that are beyond this limit. Identify the cause and correct. Repeat these readings using the same appraiser and unit as originally used or discard values and re-average and recompute  $R$  and the limiting value from the remaining observations.

Notes: diese Untersuchung gilt auch für Container und Stückware.

|  |                              |                                                                                                      |
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|  | <h1>Messmittelfähigkeit</h1> |  <b>Schlemmer</b> |
|  |                              | Seite 2 von 2                                                                                        |

| GAGE REPEATABILITY AND REPRODUCIBILITY DATA SHEET<br>VARIABLE DATA RESULTS |                                   |             |                            |                            |
|----------------------------------------------------------------------------|-----------------------------------|-------------|----------------------------|----------------------------|
| Part Number<br>1930029                                                     | Gage Name<br>Meßschieber digital  |             | Appraiser A<br>Ferderer J. |                            |
| Part Name<br>PP-BS NW 29 Ringware                                          | Gage Number<br>171274051          |             | Appraiser B<br>Zobel F.    |                            |
| Characteristic<br>Wanddicke                                                | Gage Type<br>Handmessmittel 150mm |             | Appraiser C<br>Würfel V.   |                            |
| Characteristic Classification<br>0,3                                       | Trials<br>3                       | Parts<br>10 | Appraisers<br>3            | Date Performed<br>08.05.15 |

| Measurement Unit Analysis                                                                                                                                                                            |                |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  | % Tolerance (Tol)                                                                         |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|-------------------------------------------------------------------------------------------|--|------------|----------------|---|----------------|--------|--------|---|--------|---|--------|---|--------|---|--------|---|--------|---|--------|----|--------|
| <b>Repeatability - Equipment Variation (EV)</b>                                                                                                                                                      |                |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  | % EV = 100 (EV/TV)<br>= 100(0,00414/0,04495)<br>= 9,20                                    |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| EV = R x K <sub>1</sub><br>= 0,0070 x 0,5908<br>= 0,00414                                                                                                                                            |                | <table border="1"> <tr> <th>Trials</th> <th>K1</th> </tr> <tr> <td>2</td> <td>0,8862</td> </tr> <tr> <td>3</td> <td>0,5908</td> </tr> </table>                                                                                                                                                                                                                                                                                      |  |                                                                                           |  | Trials     | K1             | 2 | 0,8862         | 3      | 0,5908 |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| Trials                                                                                                                                                                                               | K1             |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| 2                                                                                                                                                                                                    | 0,8862         |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| 3                                                                                                                                                                                                    | 0,5908         |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
|                                                                                                                                                                                                      |                |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| <b>Reproducibility - Appraiser Variation (AV)</b>                                                                                                                                                    |                |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  | % AV = 100 (AV/TV)<br>= 100(0,00138/0,04495)<br>= 3,06                                    |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| AV = {(X <sub>DIFF</sub> x K <sub>2</sub> ) <sup>2</sup> - (EV <sup>2</sup> /nr)} <sup>1/2</sup><br>= {(0,0030 x 0,5231) <sup>2</sup> - (0,0041 <sup>2</sup> /(10 x 3))} <sup>1/2</sup><br>= 0,00138 |                | <table border="1"> <tr> <th>Appraisers</th> <th>2</th> <th>3</th> </tr> <tr> <td>K<sub>2</sub></td> <td>0,7071</td> <td>0,5231</td> </tr> </table>                                                                                                                                                                                                                                                                                  |  |                                                                                           |  | Appraisers | 2              | 3 | K <sub>2</sub> | 0,7071 | 0,5231 |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| Appraisers                                                                                                                                                                                           | 2              | 3                                                                                                                                                                                                                                                                                                                                                                                                                                   |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| K <sub>2</sub>                                                                                                                                                                                       | 0,7071         | 0,5231                                                                                                                                                                                                                                                                                                                                                                                                                              |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| n = parts                      r = trials                                                                                                                                                            |                |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
|                                                                                                                                                                                                      |                |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| <b>Repeatability &amp; Reproducibility (GRR)</b>                                                                                                                                                     |                |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  | % R&R = 100 (R&R/TV)<br>= 100(0,00436/0,04495)<br>= <b>9,70</b><br><b>Gage system O.K</b> |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| GRR = {(EV <sup>2</sup> + AV <sup>2</sup> ) <sup>1/2</sup><br>= {(0,0041 <sup>2</sup> + 0,0014 <sup>2</sup> ) <sup>1/2</sup><br>= 0,00436                                                            |                | <table border="1"> <tr> <th>Parts</th> <th>K<sub>3</sub></th> </tr> <tr> <td>2</td> <td>0,7071</td> </tr> <tr> <td>3</td> <td>0,5231</td> </tr> <tr> <td>4</td> <td>0,4467</td> </tr> <tr> <td>5</td> <td>0,4030</td> </tr> <tr> <td>6</td> <td>0,3742</td> </tr> <tr> <td>7</td> <td>0,3534</td> </tr> <tr> <td>8</td> <td>0,3375</td> </tr> <tr> <td>9</td> <td>0,3249</td> </tr> <tr> <td>10</td> <td>0,3146</td> </tr> </table> |  |                                                                                           |  | Parts      | K <sub>3</sub> | 2 | 0,7071         | 3      | 0,5231 | 4 | 0,4467 | 5 | 0,4030 | 6 | 0,3742 | 7 | 0,3534 | 8 | 0,3375 | 9 | 0,3249 | 10 | 0,3146 |
| Parts                                                                                                                                                                                                | K <sub>3</sub> |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| 2                                                                                                                                                                                                    | 0,7071         |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| 3                                                                                                                                                                                                    | 0,5231         |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| 4                                                                                                                                                                                                    | 0,4467         |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| 5                                                                                                                                                                                                    | 0,4030         |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| 6                                                                                                                                                                                                    | 0,3742         |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| 7                                                                                                                                                                                                    | 0,3534         |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| 8                                                                                                                                                                                                    | 0,3375         |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| 9                                                                                                                                                                                                    | 0,3249         |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| 10                                                                                                                                                                                                   | 0,3146         |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
|                                                                                                                                                                                                      |                |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
|                                                                                                                                                                                                      |                |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| <b>Part Variation (PV)</b>                                                                                                                                                                           |                | % PV = 100 (PV/TV)<br>= 100(0,04474/0,04495)<br>= 99,53                                                                                                                                                                                                                                                                                                                                                                             |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| PV = R <sub>p</sub> x K <sub>3</sub><br>= 0,1422 x 0,3146<br>= 0,04474                                                                                                                               |                |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
|                                                                                                                                                                                                      |                |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
|                                                                                                                                                                                                      |                |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| <b>Total Variation (TV)</b>                                                                                                                                                                          |                | ndc = 1.41 (PV/GRR)<br>= 1.41(0,04474/0,00436)<br>= <b>14,000</b>                                                                                                                                                                                                                                                                                                                                                                   |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| TV = {(GRR <sup>2</sup> + PV <sup>2</sup> ) <sup>1/2</sup><br>= {(0,0044 <sup>2</sup> + 0,0447 <sup>2</sup> ) <sup>1/2</sup><br>= 0,04495                                                            |                |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
|                                                                                                                                                                                                      |                |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
|                                                                                                                                                                                                      |                |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |

|                                                                                                                                                                                         |                            |                         |                        |            |                 |              |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|-------------------------|------------------------|------------|-----------------|--------------|
| Weitere Informationen zum theoretischen Ansatz und zu den in diesem Formular verwendeten Konstanten finden sich im Referenzhandbuch Measurement Systems Analysis (MSA), vierte Ausgabe. |                            |                         |                        |            |                 |              |
| Formular Nr.:199                                                                                                                                                                        | Ersteller: U. Fleischer QL | Geprüft: U.Fleischer QL | Freigabe: J. Bayer QMB | Index: 2.2 | Datum: 30.04.15 | Seite 2 v. 2 |

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|--|-------------------------------------------------|---------------|
|  | <h1 style="margin: 0;">Messmittelfähigkeit</h1> |               |
|  |                                                 | Seite 1 von 2 |

## GAGE REPEATABILITY AND REPRODUCIBILITY DATA SHEET VARIABLE DATA RESULTS

|                                              |                             |                                        |                    |                                   |                                   |
|----------------------------------------------|-----------------------------|----------------------------------------|--------------------|-----------------------------------|-----------------------------------|
| Part Number<br><b>1968230</b>                |                             | Gage Name<br><b>Meßschiene 1m</b>      |                    | Appraiser A<br><b>Ferderer J.</b> |                                   |
| Part Name<br><b>PP-BS NW 29 ges. Stücke</b>  |                             | Gage Number<br><b>10011</b>            |                    | Appraiser B<br><b>Zobel F.</b>    |                                   |
| Characteristic<br><b>Länge</b>               | Specification<br><b>0 7</b> | Gage Type<br><b>Stahllineal 1000mm</b> |                    | Appraiser C<br><b>Würfel V.</b>   |                                   |
| Characteristic Classification<br><b>40,0</b> | Einheit<br><b>mm</b>        | Trials<br><b>3</b>                     | Parts<br><b>10</b> | Appraisers<br><b>3</b>            | Date Performed<br><b>08.05.15</b> |

| APPRAISER/<br>TRIAL #                        | PART                            |        |        |        |        |        |        |        |        |        | AVERAGE                              |
|----------------------------------------------|---------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------------------------------|
|                                              | 1                               | 2      | 3      | 4      | 5      | 6      | 7      | 8      | 9      | 10     |                                      |
| 1. A 1                                       | 43,00                           | 45,00  | 44,00  | 45,00  | 46,00  | 45,00  | 46,00  | 44,00  | 42,00  | 43,00  | 44,300                               |
| 2 2                                          | 43,00                           | 44,50  | 44,00  | 45,00  | 46,00  | 45,00  | 46,00  | 44,50  | 42,00  | 43,00  | 44,300                               |
| 3 3                                          | 43,00                           | 45,00  | 44,00  | 45,50  | 46,00  | 45,00  | 46,00  | 44,00  | 42,00  | 43,00  | 44,350                               |
| 4 AVERAGE                                    | 43,000                          | 44,833 | 44,000 | 45,167 | 46,000 | 45,000 | 46,000 | 44,167 | 42,000 | 43,000 | $\bar{x}_a = 44,3167$                |
| 5 R                                          | 0,000                           | 0,500  | 0,000  | 0,500  | 0,000  | 0,000  | 0,000  | 0,500  | 0,000  | 0,000  | $r_a = 0,150$                        |
| 6. B 1                                       | 43,00                           | 45,00  | 44,50  | 45,00  | 46,00  | 45,00  | 46,00  | 44,00  | 42,00  | 43,00  | 44,350                               |
| 7 2                                          | 43,00                           | 44,50  | 44,00  | 45,00  | 46,00  | 45,00  | 46,00  | 44,50  | 42,00  | 43,00  | 44,300                               |
| 8 3                                          | 43,00                           | 45,00  | 44,00  | 45,00  | 46,00  | 45,00  | 46,00  | 44,00  | 42,00  | 43,00  | 44,300                               |
| 9 AVERAGE                                    | 43,000                          | 44,833 | 44,167 | 45,000 | 46,000 | 45,000 | 46,000 | 44,167 | 42,000 | 43,000 | $\bar{x}_b = 44,3167$                |
| 10 R                                         | 0,000                           | 0,500  | 0,500  | 0,000  | 0,000  | 0,000  | 0,000  | 0,500  | 0,000  | 0,000  | $r_b = 0,150$                        |
| 11. C 1                                      | 43,00                           | 45,00  | 44,00  | 45,00  | 46,00  | 45,00  | 46,00  | 44,00  | 42,00  | 43,00  | 44,300                               |
| 12 2                                         | 43,00                           | 44,50  | 44,00  | 45,50  | 46,00  | 45,00  | 46,00  | 44,00  | 42,00  | 43,50  | 44,350                               |
| 13 3                                         | 43,00                           | 45,00  | 44,00  | 45,00  | 46,00  | 45,00  | 46,00  | 44,00  | 42,00  | 43,00  | 44,300                               |
| 14 AVERAGE                                   | 43,000                          | 44,833 | 44,000 | 45,167 | 46,000 | 45,000 | 46,000 | 44,000 | 42,000 | 43,167 | $\bar{x}_c = 44,3167$                |
| 15 R                                         | 0,000                           | 0,500  | 0,000  | 0,500  | 0,000  | 0,000  | 0,000  | 0,000  | 0,000  | 0,500  | $r_c = 0,150$                        |
| 16. PART AVE                                 | 43,000                          | 44,833 | 44,056 | 45,111 | 46,000 | 45,000 | 46,000 | 44,111 | 42,000 | 43,056 | $\bar{X} = 44,3167$<br>$R_p = 4,000$ |
| 17 $(r_a + r_b + r_c) /$ (# OF APPRAISERS) = |                                 |        |        |        |        |        |        |        |        |        | $R = 0,1500$                         |
| 18 $(\text{Max } X - \text{Min } X) =$       |                                 |        |        |        |        |        |        |        |        |        | $X_{DIFF} = 0,0000$                  |
| 19 $R \times D_4^* =$                        | <b>APPRAISER    A    B    C</b> |        |        |        |        |        |        |        |        |        | $UCL_R = 0,3870$                     |

\*  $D_4 = 3.27$  for 2 trials and  $2.58$  for 3 trials.  $UCL_R$  represents the limit of individual  $R$ 's. Circle those that are beyond this limit. Identify the cause and correct. Repeat these readings using the same appraiser and unit as originally used or discard values and re-average and recompute  $R$  and the limiting value from the remaining observations.

Notes: diese Untersuchung gilt auch für Container und Stückware.

|  |                              |                                                                                                      |
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|  | <h1>Messmittelfähigkeit</h1> |  <b>Schlemmer</b> |
|  |                              | Seite 2 von 2                                                                                        |

| GAGE REPEATABILITY AND REPRODUCIBILITY DATA SHEET<br>VARIABLE DATA RESULTS |                                 |             |                            |                            |
|----------------------------------------------------------------------------|---------------------------------|-------------|----------------------------|----------------------------|
| Part Number<br>1968230                                                     | Gage Name<br>Meßschiene 1m      |             | Appraiser A<br>Ferderer J. |                            |
| Part Name<br>PP-BS NW 29 ges. Stücke                                       | Gage Number<br>10011            |             | Appraiser B<br>Zobel F.    |                            |
| Characteristic<br>Länge                                                    | Gage Type<br>Stahllineal 1000mm |             | Appraiser C<br>Würfel V.   |                            |
| Characteristic Classification<br>40                                        | Trials<br>3                     | Parts<br>10 | Appraisers<br>3            | Date Performed<br>08.05.15 |

| Measurement Unit Analysis                                                                                                          |                |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  | % Tolerance (Tol)                                                                         |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
|------------------------------------------------------------------------------------------------------------------------------------|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|-------------------------------------------------------------------------------------------|--|------------|----------------|---|----------------|--------|--------|---|--------|---|--------|---|--------|---|--------|---|--------|---|--------|----|--------|
| <b>Repeatability - Equipment Variation (EV)</b>                                                                                    |                |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  | % EV = 100 (EV/TV)<br>= 100(0,08862/1,26152)<br>= 7,02                                    |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| $EV = R \times K_1$ $= 0,1500 \times 0,5908$ $= 0,08862$                                                                           |                | <table border="1"> <tr> <th>Trials</th> <th>K1</th> </tr> <tr> <td>2</td> <td>0,8862</td> </tr> <tr> <td>3</td> <td>0,5908</td> </tr> </table>                                                                                                                                                                                                                                                                                      |  |                                                                                           |  | Trials     | K1             | 2 | 0,8862         | 3      | 0,5908 |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| Trials                                                                                                                             | K1             |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| 2                                                                                                                                  | 0,8862         |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| 3                                                                                                                                  | 0,5908         |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
|                                                                                                                                    |                |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| <b>Reproducibility - Appraiser Variation (AV)</b>                                                                                  |                |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  | % AV = 100 (AV/TV)<br>= 100(0,00000/1,26152)<br>= 0,00                                    |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| $AV = \{(X_{DIFF} \times K_2)^2 - (EV^2/nr)\}^{1/2}$ $= \{(0,0000 \times 0,5231)^2 - (0,0886^2/(10 \times 3))\}^{1/2}$ $= 0,00000$ |                | <table border="1"> <tr> <th>Appraisers</th> <th>2</th> <th>3</th> </tr> <tr> <td>K<sub>2</sub></td> <td>0,7071</td> <td>0,5231</td> </tr> </table>                                                                                                                                                                                                                                                                                  |  |                                                                                           |  | Appraisers | 2              | 3 | K <sub>2</sub> | 0,7071 | 0,5231 |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| Appraisers                                                                                                                         | 2              | 3                                                                                                                                                                                                                                                                                                                                                                                                                                   |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| K <sub>2</sub>                                                                                                                     | 0,7071         | 0,5231                                                                                                                                                                                                                                                                                                                                                                                                                              |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| n = parts                      r = trials                                                                                          |                |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
|                                                                                                                                    |                |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| <b>Repeatability &amp; Reproducibility (GRR)</b>                                                                                   |                |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  | % R&R = 100 (R&R/TV)<br>= 100(0,08862/1,26152)<br>= <b>7,02</b><br><b>Gage system O.K</b> |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| $GRR = \{(EV^2 + AV^2)\}^{1/2}$ $= \{(0,0886^2 + 0,0000^2)\}^{1/2}$ $= 0,08862$                                                    |                | <table border="1"> <tr> <th>Parts</th> <th>K<sub>3</sub></th> </tr> <tr> <td>2</td> <td>0,7071</td> </tr> <tr> <td>3</td> <td>0,5231</td> </tr> <tr> <td>4</td> <td>0,4467</td> </tr> <tr> <td>5</td> <td>0,4030</td> </tr> <tr> <td>6</td> <td>0,3742</td> </tr> <tr> <td>7</td> <td>0,3534</td> </tr> <tr> <td>8</td> <td>0,3375</td> </tr> <tr> <td>9</td> <td>0,3249</td> </tr> <tr> <td>10</td> <td>0,3146</td> </tr> </table> |  |                                                                                           |  | Parts      | K <sub>3</sub> | 2 | 0,7071         | 3      | 0,5231 | 4 | 0,4467 | 5 | 0,4030 | 6 | 0,3742 | 7 | 0,3534 | 8 | 0,3375 | 9 | 0,3249 | 10 | 0,3146 |
| Parts                                                                                                                              | K <sub>3</sub> |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| 2                                                                                                                                  | 0,7071         |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| 3                                                                                                                                  | 0,5231         |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| 4                                                                                                                                  | 0,4467         |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| 5                                                                                                                                  | 0,4030         |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| 6                                                                                                                                  | 0,3742         |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| 7                                                                                                                                  | 0,3534         |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| 8                                                                                                                                  | 0,3375         |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| 9                                                                                                                                  | 0,3249         |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| 10                                                                                                                                 | 0,3146         |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
|                                                                                                                                    |                |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
|                                                                                                                                    |                |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| <b>Part Variation (PV)</b>                                                                                                         |                |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  | % PV = 100 (PV/TV)<br>= 100(1,25840/1,26152)<br>= 99,75                                   |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| $PV = R_p \times K_3$ $= 4,0000 \times 0,3146$ $= 1,25840$                                                                         |                |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
|                                                                                                                                    |                |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
|                                                                                                                                    |                |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| <b>Total Variation (TV)</b>                                                                                                        |                |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  | ndc = 1.41 (PV/GRR)<br>= 1.41(1,25840/0,08862)<br>= <b>20,000</b>                         |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
| $TV = \{(GRR^2 + PV^2)\}^{1/2}$ $= \{(0,0886^2 + 1,2584^2)\}^{1/2}$ $= 1,26152$                                                    |                |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
|                                                                                                                                    |                |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |
|                                                                                                                                    |                |                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                           |  |            |                |   |                |        |        |   |        |   |        |   |        |   |        |   |        |   |        |    |        |

|                                                                                                                                                                                         |                            |                         |                        |            |                 |              |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|-------------------------|------------------------|------------|-----------------|--------------|
| Weitere Informationen zum theoretischen Ansatz und zu den in diesem Formular verwendeten Konstanten finden sich im Referenzhandbuch Measurement Systems Analysis (MSA), vierte Ausgabe. |                            |                         |                        |            |                 |              |
| Formular Nr.:199                                                                                                                                                                        | Ersteller: U. Fleischer QL | Geprüft: U.Fleischer QL | Freigabe: J. Bayer QMB | Index: 2.2 | Datum: 30.04.15 | Seite 2 v. 2 |



Control Plan (Corrugated tubes)      Produktlenkungsplan

No.: KP-SRP-000-1  
Part / Part Family: (Teil / Teildfamilie)  
corrugated standard hose with continuous geometry  
standard Welschlauch

|                                                                                               |                                                            |                                                                                                                                        |                                                                                  |                                           |                                              |
|-----------------------------------------------------------------------------------------------|------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|-------------------------------------------|----------------------------------------------|
| Prototype / Pre-Launch / X-Produktion<br>Stiefen-Holmann<br>all standard (für alle Standards) | Key Contact / Phone<br>Stiefen-Holmann<br>+49 8121 804 146 | Date (Orig.)<br>04.05.2001                                                                                                             | Date (Rev.)<br>29.04.2014                                                        | Created: (Erstellt:)<br>St. Holmann (CQ1) | Approved: (Freigegeben:)<br>St. Brozki (CQ1) |
| Drawing (Rev.): (Zeichnung / Index)<br>Schlemmer drawing<br>all standard (für alle Standards) | Part-Number (Supplier)<br>all                              | Part Name / Description<br>(Produktname und Bezeichnung):<br>corrugated standard hose with continuous geometry<br>Standard Welschlauch | Core Team:<br>L. Cenadi (P.), D. Kolbe (QS), J. Rühseitz (PL), St. Hofmann (CQ1) | Distribution: (Verteiler)<br>Schlemmer    |                                              |

Customer Engineering Approval Date (If Req'd):      Other Approval Date (If Req'd):  
(Freigabe durch Kunden [nur wenn gefordert])

| Part / Process Number | Process Name / Operation Description<br>Anfertigungsbeschreibung | Machine, Tool, Device, Jig<br>Anlage | Characteristics |                                                                                                    |         | Methods           |                                                                             |                                                                        |                                             | Control Method<br>Methode                                                                                                              | Documentation                           | Corrective action<br>Korrekturmaßnahmen                                                                                                           |                                                                                                                                                     |                                                                                                        |
|-----------------------|------------------------------------------------------------------|--------------------------------------|-----------------|----------------------------------------------------------------------------------------------------|---------|-------------------|-----------------------------------------------------------------------------|------------------------------------------------------------------------|---------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|
|                       |                                                                  |                                      | No.             | Product                                                                                            | Process | Spec. Char. Class | Product/Process Specification/ Tolerance                                    | Measurement equipment<br>Prüfmittel                                    | Size<br>Größe                               |                                                                                                                                        |                                         |                                                                                                                                                   | Sample Freq.<br>Frequenz                                                                                                                            | Resp.<br>Verantwortl.                                                                                  |
| 0                     | Release of tools<br>Freigabe der Werkzeuge                       | mould blocks<br>Formbacken           | 1               | contour of corrugated tube (sharp edges within the profil range)<br>Kontur Schlauch                |         | Ø                 | no sharp edges<br>no damage<br>k. scharfe Kanten<br>k. Beschädigungen       | visual check<br>visuell                                                |                                             |                                                                                                                                        | visual check                            | internal homologation of mould blocks ( every chain)<br>Measure report<br>Messbericht                                                             | document differences, detect responsibilities and start improvements<br>Abweichungen dokumentieren, Ursachen ermitteln und Maßnahmen einleiten      |                                                                                                        |
|                       |                                                                  |                                      | 2               | part formed<br>Form Teil                                                                           |         | Ø                 | Dim. according to dwg<br>Maße nach freieg. Zeichnung und Funktionsfähigkeit | caliper gauge and balance<br>Meßschieber<br>Meßmaschine                | 1 turn of mould blocks<br>1 Ketten-umlauf   | new mould blocks<br>neues Werkzeug oder -änderung                                                                                      | prod. manager<br>Prod. Manager          | Dimension check<br>Maßprüfung                                                                                                                     |                                                                                                                                                     |                                                                                                        |
| 1                     | Incoming inspection (Granulate)<br>Wareneingangsprüfung Granulat |                                      | 1               | Material                                                                                           |         | Ø                 | filling / roundness<br>Füllung / Rundheit                                   | visual check<br>visuell                                                |                                             | each delivery<br>Jede Lieferung                                                                                                        | Incoming inspection department<br>WE    | Identity check, Identifz./ Vergl. Bestelltext mit Lieferschein, Kennzeichnung                                                                     | reject delivery, claim (7-D)<br>Reklambearbeitung starten                                                                                           |                                                                                                        |
| 2                     | placing at disposal<br>Vorbereitung Material                     |                                      | 1               | Material                                                                                           |         | Ø                 | conformity from material with order<br>Konformität der Werkstoffbestellung  | visual check<br>visuell                                                |                                             | each production order<br>Jeder Fertigungsauftrag                                                                                       | shift-leader, operator<br>Schichtführer | comparison PO with material lab.<br>Verg. Arbeitsnummer im Materiallabor                                                                          | no machine release for production and start improvements<br>keine Freigabe der Maschine für Fertigung                                               |                                                                                                        |
| 3                     | corrugated tube extrusion<br>Extrusion                           | Extrusion-line<br>Rohranlage         | 2               | Material                                                                                           |         | Ø                 | production order<br>Material gemäß Produktionsauftrag                       | visual check<br>visuell                                                |                                             | each start of production<br>bei Fertigungsbeginn                                                                                       | shift-leader, operator<br>Schichtführer | release in control chart<br>QRK Freigabe                                                                                                          | No release to the machine for production, immediately action induce, find out root cause and induce action                                          |                                                                                                        |
|                       |                                                                  |                                      | 1               | mixing unit (holes in surface)<br>Mischer                                                          |         | Ø                 | Material according to production order<br>Material gemäß Produktionsauftrag | visual check<br>visuell                                                |                                             | each start of production<br>bei Fertigungsbeginn                                                                                       | shift-leader, operator<br>Schichtführer | release in control chart<br>QRK Freigabe                                                                                                          | Keine Freigabe der Maschine für Fertigung, Sofortmaßnahmen einleiten, Ursache ermitteln und Maßnahmen einleiten                                     |                                                                                                        |
|                       |                                                                  |                                      | 1               | inside diameter<br>Innendurchmesser                                                                |         | Ø                 | check according to PA 1501-02<br>Prüfung nach PA 1501-02                    | caliper gauge (multiple gauges)<br>Meßschieber                         | 1 meter                                     | After backfitting of the machine<br>respektively after new start every 4 hours<br>Nach Umbau der Maschine bzw. Neustart alle 4 Stunden | shift-leader, Schichtführer             | attributive check<br>Attributivprüfung                                                                                                            | release in control chart<br>QRK Freigabe                                                                                                            |                                                                                                        |
|                       |                                                                  |                                      | 2               | outside diameter<br>Aussendurchmesser                                                              |         | Ø                 | check according to PA 1501-02<br>Prüfung nach PA 1501-02                    | caliper gauge (multiple gauges)<br>Meßschieber                         | 1 meter                                     |                                                                                                                                        | shift-leader, Schichtführer             | attributive check<br>Attributivprüfung                                                                                                            | release in control chart<br>QRK Freigabe                                                                                                            |                                                                                                        |
|                       |                                                                  |                                      | 3               | wall thickness<br>area 1 / area 2<br>Wandsstärke zw. Bereich 1 u. 2                                |         | Ø                 | check according to PA 1501-02<br>Prüfung nach PA 1501-02                    | caliper gauge (multiple gauges)<br>Meßschieber                         | 1 meter                                     |                                                                                                                                        | shift-leader, Schichtführer             | attributive check<br>Attributivprüfung                                                                                                            | release in control chart<br>QRK Freigabe                                                                                                            |                                                                                                        |
|                       |                                                                  |                                      | 4               | Weight per meter<br>Gewicht in Meter                                                               |         |                   | Weight<br>Gewicht                                                           | balance (multiple gauges)<br>Waage                                     | 1 meter                                     |                                                                                                                                        | shift-leader, Schichtführer             | control of weight<br>Gewichtskontrolle                                                                                                            | control chart<br>QRK Freigabe                                                                                                                       |                                                                                                        |
|                       |                                                                  |                                      | 5               | printing<br>Bedruckung                                                                             |         | Ø                 | check acc. each PO<br>Prüfung n. j. Auftrag                                 | visual check<br>measuring bench (multiple gauges)                      | 4 meter                                     | printer change and change of parameter every 4 hours<br>nach Drucker-tausch oder Parameteränd. oder alle 4 Stunden                     | shift-leader, Schichtführer             | visual check<br>attributive check                                                                                                                 | control chart                                                                                                                                       |                                                                                                        |
|                       |                                                                  |                                      | 6               | sifting (if necessary)<br>Schützen (wenn gefordert)                                                |         | Ø                 | check acc. each PO<br>Prüfung n. j. Auftrag                                 | visual check<br>visuell                                                | 1 meter                                     | start of production every 4 hours<br>zu Produktionsbeginn alle 4 Stunden                                                               | shift-leader, Schichtführer             | visual check<br>attributive check                                                                                                                 | control chart<br>QRK Freigabe                                                                                                                       |                                                                                                        |
|                       |                                                                  |                                      | 7               | flamability test (if necessary)<br>Flammbarkeittest (wenn gefordert)                               |         | Ø                 | check according to PA 1501-02<br>Prüfung nach PA 1501-02                    | light (laboratory)<br>Licht                                            | 1 piece                                     |                                                                                                                                        | shift-leader, Schichtführer             | visual check<br>attributive check                                                                                                                 | control chart<br>QRK Freigabe                                                                                                                       |                                                                                                        |
|                       |                                                                  |                                      | 8               | part formed<br>Ausformung                                                                          |         | Ø                 | filling / roundness<br>Füllung / Ovalität                                   | visual check<br>visuell                                                | one turn of mould blocks<br>1 Ketten-umlauf | production start<br>zu Produktionsbeginn                                                                                               | shift-leader, Schichtführer             | visual check<br>attributive check                                                                                                                 | control chart<br>QRK Freigabe                                                                                                                       | Repair failure, check machine parameter find root cause and induce action<br>No release to the machine |
|                       |                                                                  |                                      |                 | automatic control of parameter (not for all)<br>automatische Kontrolle der Parameter (nicht aller) |         | Ø                 | data sheet<br>Datenblatt                                                    | check of electronic parameter<br>Überprüfung aller elektron. Parameter | all parameter<br>100%                       | every 4 hours<br>alle 4 Stunden                                                                                                        | operator<br>Werker                      | visuell<br>acoustically or visual interlock<br>if out of Spec<br>automatic<br>b. Abweichungen von den gesetzten Parametern<br>erschient ein Alarm | progress chart<br>none<br>Linienfreigabe<br>FB 1402-01<br>Störung beheben, Ursache ermitteln und Maßnahmen einleiten<br>keine Freigabe der Maschine |                                                                                                        |



Prototype / Pre-Launch / X Production  
all standard (for ale Standard)

Control Plan (Corrugated tubes)

Produktlenkungsplan

No.: KP SRP 000-1

Part / Part Family:  
corrugated standard hose with continuous geometry  
standard Wellenschlauch

|                                                                                                         |                            |                                                                                                               |                                                                                  |                                               |
|---------------------------------------------------------------------------------------------------------|----------------------------|---------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|-----------------------------------------------|
| Key Contact / Phone<br>Stefien Hofmann<br>+49 8121 804 148                                              | Date (Orig.)<br>04.05.2001 | Date (Rev.)<br>29.04.2014                                                                                     | Created: (Erstellt :)<br>St. Hofmann (CQ1)                                       | Approved: (Freigegeben:)<br>St. Hofmann (CQ1) |
| Part Name / Description<br>corrugated standard hose with continuous geometry<br>Standard Wellenschlauch | Part Number<br>all         | Product Name und Bezeichnung:<br>corrugated standard hose with continuous geometry<br>Standard Wellenschlauch | Core Team:<br>L. Cenadi (P.), D. Kolbe (QS), J. Rühseitz (PL), St. Hofmann (CQ1) | Distribution: (Verteiler)<br>Schlemmer        |
| Customer Quality Approval Date (If Req'd):<br>Other Approval Date (If Req'd):                           |                            |                                                                                                               |                                                                                  |                                               |

| Part / Process Number | Process Name / Operation Description<br><i>Anfertigungsbeschreibung</i> | Machine, Tool, Device, Jig<br><i>Anlage</i> | Characteristics |                                     |         | Methods          |                                                      |                                            |                      | Corrective action<br><i>Korrekturmaßnahmen</i> |                                 |                              |                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            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|                       |                                                                         |                                             | No.             | Product                             | Process | Spec Char. Class | Product/Process Specification/ Tolerance             | Measurement equipment<br><i>Prüfmittel</i> | Size<br><i>Größe</i> |                                                | Sample Freq.<br><i>Frequenz</i> | Resp.<br><i>Verantwortl.</i> | Control Method<br><i>Methode</i> | Documentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 3                     | corrugated tube extrusion<br><br><i>Extrusion</i>                       | Extrusionline<br><br><i>Rohranlage</i>      | 9               | wall thickness<br><i>Wandstärke</i> |         | Ø                | check according<br><i>Prüfung nach</i><br>PA 1501-03 | visual check                               | 1 meter              | every hour<br><i>stündlich</i>                 | operator<br><i>Werker</i>       | visual check                 | none                             | Inform supervisor,<br><i>Vorgesetzten informieren,</i><br><br>Vorgesetzten informieren,<br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br>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Control Plan (Corrugated tubes)      Produktlenkungsplan

No.: KP SRP 000-1  
Part / Part Family:  
(Teil / Teilefamilie)  
corrugated standard hose with continuous geometry  
standard Welschlauch

|                                                                                              |                                                           |                                                                                                      |                                                                                  |                                           |                                            |
|----------------------------------------------------------------------------------------------|-----------------------------------------------------------|------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|-------------------------------------------|--------------------------------------------|
| Prototype ___ Pre-Launch ___ X Production<br>___ Prototyp ___ Vorserie ___ Produktion        | Key Contact / Phone<br>Stefen Hofmann<br>+49 8121 804 148 | Date (Orig.)<br>04.05.2001                                                                           | Date (Rev.)<br>29.04.2014                                                        | Created: (Erstellt:)<br>St. Hofmann (CQ1) | Approved: (Freigegeben:)<br>St. Brodzi CQ1 |
| Drawing (Rev.): (Zeichnung / Index)<br>Schlemmer drawing<br>all standard (für alle Standard) | Part-Number (Supplier)<br>all                             | Part Name / Description<br>corrugated standard hose with continuous geometry<br>Standard Welschlauch | Core Team:<br>L. Cenadi (P.), D. Kolbe (QS), J. Rühseitz (PL), St. Hofmann (CQ1) | Distribution: (Verteiler)<br>Schlemmer    |                                            |
| Customer Quality Approval Date (If Req'd):<br>Other Approval Date (If Req'd):                |                                                           |                                                                                                      |                                                                                  |                                           |                                            |

| Part /<br>Process<br>Number | Process Name /<br>Operation Description<br>Arbeitsgangbeschreibung                  | Machine,<br>Tool,<br>Device, Jig<br>Anlage | Characteristics |                                                |         |                        | Methods                                                          |                                                                                                           |                                                                                                            |                                     |                                           |                                        | Corrective action<br>Korrekturmaßnahmen |                                                                                                                      |
|-----------------------------|-------------------------------------------------------------------------------------|--------------------------------------------|-----------------|------------------------------------------------|---------|------------------------|------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|-------------------------------------|-------------------------------------------|----------------------------------------|-----------------------------------------|----------------------------------------------------------------------------------------------------------------------|
|                             |                                                                                     |                                            | No.             | Product                                        | Process | Spec<br>Char.<br>Class | Product/Process<br>Specification/<br>Tolerance                   | Measurement<br>equipment<br>Prüfmittel                                                                    | Size<br>Größe                                                                                              | Sample<br>Freq.<br>Frequenz         | Resp.<br>Verantwortl.                     | Control<br>Method<br>Methode           |                                         | Documentation                                                                                                        |
| 4                           | final inspection (only pieces)<br><br>Abschlußüberprüfung<br>(nur für Teile gültig) |                                            | 1               | length<br>Länge                                |         | ∅                      | check according<br>Prüfung nach<br>PA 1501-01 e                  | measuring bare<br>(multiple gauges)<br>Mefschleife                                                        | sample                                                                                                     | every packing<br>jede<br>Verpackung | final control<br>Abschluß-<br>überprüfung | attributive check<br>Attributivprüfung | none                                    | claim to production<br>je nach Anfrage an die Produktion                                                             |
|                             |                                                                                     |                                            | 2               | printing<br>Bedruckung                         |         | ∅                      | check according<br>Prüfung nach<br>PA 1501-01 e                  | visual check                                                                                              | sample                                                                                                     | every packing<br>jede<br>Verpackung | final control<br>Abschluß-<br>überprüfung | visual check                           | none                                    |                                                                                                                      |
|                             |                                                                                     |                                            | 3               | slitting<br>Schlitzen                          |         | ∅                      | check according<br>Prüfung nach<br>PA 1501-01 e                  | visual check                                                                                              | sample                                                                                                     | every packing<br>jede<br>Verpackung | final control<br>Abschluß-<br>überprüfung | visual check                           | none                                    |                                                                                                                      |
|                             |                                                                                     |                                            | 4               | cut<br>Abschnitt                               |         | ∅                      | check according<br>Prüfung nach<br>PA 1501-01 e                  | visual check                                                                                              | sample                                                                                                     | every packing<br>jede<br>Verpackung | final control<br>Abschluß-<br>überprüfung | visual check                           | none                                    |                                                                                                                      |
|                             |                                                                                     |                                            | 5               | diameter<br>Durchmesser                        |         | ∅                      | check according<br>Prüfung nach<br>PA 1501-01 e                  | visual check                                                                                              | sample                                                                                                     | every packing<br>jede<br>Verpackung | final control<br>Abschluß-<br>überprüfung | visual check                           | none                                    |                                                                                                                      |
| 5                           | Requalification                                                                     |                                            | 1               | flammability                                   |         | ∅                      | drawing                                                          | burn chamber<br>(laboratory)                                                                              | 3 pcs of 3<br>diameter of each<br>material<br><br>3 Teile von je 3<br>Durchmessen<br>von jedem<br>Material | every 1 year                        | Quality group                             | attributive check                      | Excel                                   | block of stock, consultation with customer<br>and process-development                                                |
| Requalifizierung            |                                                                                     |                                            |                 | Flammbarkeitsstest                             |         | nach Zeichnung         | Brenner<br>(im QS-Labor)                                         | 2 pcs of 3<br>diameter of each<br>material<br><br>2 Teile v. je 3<br>Durchmessen<br>von jedem<br>Material | alle 1 Jahr                                                                                                | QS Hassf.                           | visuell                                   |                                        |                                         |                                                                                                                      |
|                             |                                                                                     |                                            | 2               | warm storing (short term)<br><br>Wärmelagerung |         | ∅                      | drawing + specification<br><br>nach Zeichnung und<br>Forderungen | climate chamber<br>(laboratory)<br><br>Temperofen<br>(im QS-Labor)                                        | 2 pcs of 3<br>diameter of each<br>material<br><br>2 Teile v. je 3<br>Durchmessen<br>von jedem<br>Material  | every 1 year                        | Quality group                             | visual check                           | Excel                                   | Ware ist bis zur letzten i.O.-Prüfung zu<br>sperrern sowie<br>Kunden und eigene Entwicklungsabteilung<br>informieren |

|              |              |                        |             |              |            |
|--------------|--------------|------------------------|-------------|--------------|------------|
| Number (Nr.) | BP 02_FS_022 | written (erstellt)     | St. Hofmann | Date (Datum) | 25.03.2014 |
| Version      | Rev.01       | checked (geprüft)      | H. Schmidt  | Date (Datum) | 25.03.2014 |
| Date (Datum) | 25.03.2014   | approved (freigegeben) | S. Brotzki  | Date (Datum) | 31.03.2014 |

