



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017  
& ANSI/NCSL Z540-1-1994 & ANSI/NCSL Z540-3-2006

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MICRO QUALITY CALIBRATION LLC

CALIBRATION

Valid To: [See Table Below](#)

Certificate Number: 2348.01

In recognition of the successful completion of the A2LA evaluation (including an assessment of the organization's compliance with A2LA's – R205 Calibration Program Requirements), accreditation is granted to this laboratory at the locations listed above as well as the satellite laboratory location listed below to perform the following calibrations<sup>1, 8</sup>:

I. Acoustical Quantities

| Parameter/Range                                  | Frequency                                  | CMC <sup>2, 9</sup> (±) | Comment                   | Location <sup>10</sup> |
|--------------------------------------------------|--------------------------------------------|-------------------------|---------------------------|------------------------|
| Sound Pressure Level –<br>Measuring Equipment    | 114 dB @ 251.2 Hz                          | 0.26 dB                 | Sound level<br>calibrator | ATL                    |
|                                                  | 94 dB @ 1 kHz<br>114 dB @ 1 kHz            | 0.65 dB<br>0.97 dB      |                           | HSV                    |
| Up to 150 dB<br>Measure & Measuring<br>Equipment | (19 to 16 000) Hz<br>(16 000 to 20 000) Hz | 0.25 dB<br>0.32 dB      | Acoustics<br>calibrator   | RFD                    |

II. Chemical Quantities

| Parameter/Equipment    | Range                 | CMC <sup>2</sup> (±)             | Comment                | Location <sup>10</sup> |
|------------------------|-----------------------|----------------------------------|------------------------|------------------------|
| pH Meters <sup>3</sup> | 4 pH<br>7 pH<br>10 pH | 0.025 pH<br>0.036 pH<br>0.069 pH | pH buffer<br>solutions | TPA, RDU,<br>DFW       |
|                        | 4 pH<br>7 pH<br>10 pH | 0.039 pH<br>0.03 pH<br>0.035 pH  |                        | ATL, SFL               |

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| Parameter/Equipment              | Range                                                                                                    | CMC <sup>2</sup> (±)                                                                                  | Comment                | Location <sup>10</sup> |
|----------------------------------|----------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|------------------------|------------------------|
| pH Meters <sup>3</sup> (cont)    | 4 pH<br>7 pH<br>10 pH                                                                                    | 0.035 pH<br>0.025 pH<br>0.069 pH                                                                      | pH buffer solutions    | RFD, HRT<br>HSV, COS   |
|                                  | 4 pH<br>7 pH<br>10 pH                                                                                    | 0.018 pH<br>0.017 pH<br>0.03 pH                                                                       |                        | HLR, MEL               |
| Conductivity Meters <sup>3</sup> | 2 µS/cm<br>100 µS/cm<br>1000 µS/cm<br>10 000 µS/cm<br>100 000 µS/cm<br>150 000 µS/cm                     | 0.2 µS/cm<br>0.74 µS/cm<br>3.6 µS/cm<br>35 µS/cm<br>350 µS/cm<br>580 µS/cm                            | Conductivity solutions | TPA                    |
|                                  | 100 µS/cm<br>1419 µS/cm<br>10 000 µS/cm                                                                  | 0.74 µS/cm<br>5.7 µS/cm<br>35 µS/cm                                                                   |                        | ATL                    |
|                                  | 100 µS/cm<br>1410 µS/cm<br>10 000 µS/cm                                                                  | 0.83 µS/cm<br>5.3 µS/cm<br>44 µS/cm                                                                   |                        | HSV                    |
|                                  | 2 µS/cm<br>10 µS/cm<br>100 µS/cm<br>1000 µS/cm<br>1413 µS/cm<br>10 000 µS/cm<br>100 000 µS/cm            | 0.2 µS/cm<br>0.17 µS/cm<br>0.74 µS/cm<br>3.6 µS/cm<br>5.7 µS/cm<br>36 µS/cm<br>350 µS/cm              |                        | RFD, HLR,<br>DFW       |
|                                  | 2 µS/cm<br>5 µS/cm<br>10 µS/cm<br>100 µS/cm<br>500 µS/cm<br>1 000 µS/cm<br>10 000 µS/cm<br>100 000 µS/cm | 0.2 µS/cm<br>0.2 µS/cm<br>0.17 µS/cm<br>0.74 µS/cm<br>2.3 µS/cm<br>3.6 µS/cm<br>36 µS/cm<br>350 µS/cm |                        | SEL                    |
|                                  | 84 µS/cm<br>1413 µS/cm<br>10 000 µS/cm                                                                   | 0.83 µS/cm<br>5.7 µS/cm<br>35 µS/cm                                                                   |                        | MEL                    |
|                                  |                                                                                                          |                                                                                                       |                        |                        |

| Parameter/Equipment | Range                                                                              | CMC <sup>2</sup> (±)                                                      | Comment                | Location <sup>10</sup> |
|---------------------|------------------------------------------------------------------------------------|---------------------------------------------------------------------------|------------------------|------------------------|
| Conductivity Meters | 0.65 µS/cm<br>10 µS/cm<br>100 µS/cm<br>1000 µS/cm<br>10 000 µS/cm<br>100 000 µS/cm | 0.33 µS/cm<br>0.64 µS/cm<br>2.1 µS/cm<br>5 µS/cm<br>44 µS/cm<br>400 µS/cm | Conductivity solutions | COS                    |
|                     | 10 µS/cm<br>500 µS/cm<br>1000 µS/cm                                                | 0.17 µS/cm<br>2.2 µS/cm<br>3.6 µS/cm                                      |                        | RDU                    |

### III. Dimensional

| Parameter/Equipment      | Range                                                                    | CMC <sup>2, 4</sup> (±)                                                                       | Comment                                                                                               | Location <sup>10</sup>                                  |
|--------------------------|--------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|---------------------------------------------------------|
| Gage Blocks – Length     | Up to 10 in<br>Up to 12 in                                               | (3.3 + 2.2L) µin<br>(4 + 2.3L) µin                                                            | Master gage blocks,<br>P&W universal<br>measuring machine                                             | SFL<br>ATL, HSV,<br>HRT                                 |
|                          | Up to 13 in<br>Up to 13 in                                               | (1.2 + 2.5L) µin<br>(4 + 2.3L) µin                                                            |                                                                                                       | RFD<br>HLR, MEL,<br>COS, RDU,<br>DFW                    |
|                          | Up to 20 in                                                              | (3.2 + 1.2L) µin                                                                              |                                                                                                       | TPA                                                     |
| Micrometers <sup>3</sup> | Up to 18 in                                                              | (26 + 4.7L) µin                                                                               | Gage blocks (grade 2)                                                                                 | HRT                                                     |
|                          | Up to 40 in                                                              | (27 + 4.6L) µin                                                                               |                                                                                                       | TPA, MEL,<br>COS, RDU,<br>DFW                           |
|                          | Up to 46 in                                                              | (9.3 + 7L) µin<br>(29 + 4.4L) µin                                                             |                                                                                                       | HSV<br>RFD, ATL,<br>HLR, SFL                            |
| Micrometer Standards     |                                                                          |                                                                                               |                                                                                                       |                                                         |
| Length Rods              | Up to 40 in<br>Up to 40 in<br>Up to 46 in<br>(1 to 10) in<br>Up to 13 in | (1.1 + 5.7L) µin<br>(4.3 + 3.8L) µin<br>(1 + 7.8L) µin<br>(21 + 1.4L) µin<br>(1.2 + 6.9L) µin | Gage blocks (grade 2),<br>P&W universal<br>measuring machine,<br>dial comparator, bench<br>micrometer | RFD<br>TPA<br>HSV<br>HLR, COS,<br>HRT, MEL,<br>ATL, DFW |

| Parameter/Equipment                                                                                                                                                                                                                    | Range                                                                                                                                                         | CMC <sup>2, 4</sup> (±)                                                                                                                                                                                            | Comment                 | Location <sup>10</sup>                                                                                                                              |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| Laser Micrometer <sup>3</sup>                                                                                                                                                                                                          | (0 to 1.5) in<br><br>(0 to 1.2) in<br>(0 to 10.5) mm                                                                                                          | 88 μin<br><br>72 μin<br>0.68 μm                                                                                                                                                                                    | Comparison to pin gages | HRT<br><br>COS                                                                                                                                      |
| Calipers <sup>3</sup>                                                                                                                                                                                                                  | Up to 24 in<br>(24 to 80) in<br><br>Up to 40 in<br><br>Up to 46 in<br><br>Up to 80 in                                                                         | (284 + 1.6L) μin<br>(231 + 3.6L) μin<br><br>(280 + 2L) μin<br><br>(76 + 7L) μin<br>(280 + 1.7L) μin<br><br>(280 + 3.4L) μin                                                                                        | Gage blocks (grade 2)   | HLR<br><br>TPA, HRT,<br>MEL, COS,<br>RDU, DFW<br><br>ATL<br>RFD, SFL<br><br>HSV                                                                     |
| Dial Indicators <sup>3</sup><br><br>Resolution:<br>≥ 50 μin<br><br><br><br><br><br><br><br><br><br><div style="display: flex; justify-content: space-between; width: 100%;"> <span>&lt; 50 μin</span> <span>Up to 0.1 in</span> </div> | Up to 10 in<br><br><br><br><br><br><br><br><br><br><div style="display: flex; justify-content: space-between; width: 100%;"> <span>Up to 0.1 in</span> </div> | (26 + 3.9L) μin<br><br><br><br><br><br><br><br><br><br><div style="display: flex; justify-content: space-between; width: 100%;"> <span>7 μin<br/>7.7 μin<br/>8.3 μin</span> <span>9.4 μin<br/>10 μin</span> </div> | Gage blocks (grade 2)   | TPA, ATL,<br>HSV, RFD,<br>HRT, HLR,<br>SFL, MEL,<br>COS, RDU,<br>DFW<br><br>RFD<br>TPA<br>ATL, COS,<br>RDU, DFW<br><br>HLR, SFL<br>HSV, HRT,<br>MEL |



| Parameter/Equipment        | Range                                                                  | CMC <sup>2, 4</sup> (±)                                                     | Comment                                | Location <sup>10</sup>                                                   |
|----------------------------|------------------------------------------------------------------------|-----------------------------------------------------------------------------|----------------------------------------|--------------------------------------------------------------------------|
| Height Gages <sup>3</sup>  | Up to 40 in<br>Up to 40 in                                             | (110 + 3.3L) μin<br>(94 + 2.9L) μin                                         | Gage blocks (grade 2)                  | TPA<br>RFD, COS,<br>HRT, MEL,<br>RDU, DFW                                |
|                            | Up to 46 in<br>Up to 46 in<br>Up to 46 in<br>Up to 46 in               | (100 + 1.6L) μin<br>(78 + 5.3L) μin<br>(150 + 2.4L) μin<br>(240 + 1.5L) μin |                                        | ATL<br>HSV<br>HLR<br>SFL                                                 |
| Protractors <sup>3</sup>   | (0 to 360)°                                                            | 0.008° (29 s)<br>0.015° (54 s)<br>0.019° (68 s)<br>0.013° (47 s)            | Angle blocks, gage<br>blocks, sine bar | TPA, HSV,<br>RFD<br>HRT<br>MEL<br><br>ATL, SFL,<br>COS, RDU,<br>HLR, DFW |
| Rulers <sup>3</sup>        | Up to 46 in                                                            | 0.009 in                                                                    | Gage blocks (grade 2)                  | TPA, ATL,<br>HSV, HLR,<br>SFL, MEL,<br>COS, RDU,<br>HRT, DFW             |
|                            | Up to 72 in                                                            | 0.009 in                                                                    |                                        | RFD                                                                      |
| Radius Gages               | (0.016 to 1) in<br>(0.016 to 1) in<br>(0.01 to 1) in<br>(0.01 to 1) in | 220 μin<br>240 μin<br>290 μin<br>300 μin                                    | Optical comparator                     | TPA<br>ATL, RFD<br>HLR<br>MEL, DFW                                       |
| Tape Measures <sup>3</sup> | Up to 100 ft                                                           | (0.00026F + 0.026) in                                                       | Standard rule                          | MEL, RFD,<br>SFL, TPA,<br>HLR, COS,<br>RDU, HSV,<br>DFW                  |
|                            | Up to 150 ft                                                           | (0.00028F + 0.024) in                                                       |                                        | HRT                                                                      |
| Feeler Gage                | Up to 1 in                                                             | 31 μin                                                                      | Supermicrometer™ C                     | TPA, ATL,<br>RFD, SFL,<br>COS, RDU,<br>DFW                               |
|                            | Up to 1 in<br>Up to 1 in<br>Up to 1 in                                 | 36 μin<br>45 μin<br>52 μin                                                  |                                        | HSV<br>HRT, MEL<br>HLR                                                   |

| Parameter/Equipment              | Range                                                                                                                                                     | CMC <sup>2, 4</sup> (±)                                                                                                                                                                                                                                                               | Comment                                                        | Location <sup>10</sup>                                                  |
|----------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|-------------------------------------------------------------------------|
| Bore Micrometers                 |                                                                                                                                                           |                                                                                                                                                                                                                                                                                       |                                                                |                                                                         |
| 2 Point                          | Up to 8 in<br>Up to 12 in<br><br>Up to 12 in                                                                                                              | (7 + 2 <i>L</i> ) μin<br>(22 + 3.9 <i>L</i> ) μin<br><br>(56 + 3.2 <i>L</i> ) μin                                                                                                                                                                                                     | Master gage blocks,<br>P&W universal<br>measuring machine      | RFD<br>TPA, ATL,<br>HLR, MEL<br>HSV, COS,<br>RDU, DFW                   |
| 3 Point                          | Up to 12 in<br>Up to 12 in<br>Up to 8 in<br>Up to 3 in<br>(0.125 to 3.5) in<br>(0.25 to 3.2) in<br>(0.125 to 2) in                                        | (8.8 + 42 <i>L</i> ) μin<br>(64 + 3.1 <i>L</i> ) μin<br>(42 + 1.4 <i>L</i> ) μin<br>(57 + 2.8 <i>L</i> ) μin<br>(29 + 5.9 <i>L</i> ) μin<br>(23 + 26 <i>L</i> ) μin<br>(15 + 8.8 <i>L</i> ) μin                                                                                       | Master ring                                                    | TPA<br>HSV<br>RFD<br>COS, DFW<br>ATL<br>HLR<br>MEL                      |
| Cylindrical Gages –              |                                                                                                                                                           |                                                                                                                                                                                                                                                                                       |                                                                |                                                                         |
| Plain Rings                      | Up to 14 in<br>Up to 14 in<br>(0.04 to 14) in<br>(0.02 to 8) in<br>Up to 13 in<br>Up to 10 in<br>Up to 12 in<br>(0.04 to 14) in                           | (8.1 + 2.9 <i>D</i> ) μin<br>(9.8 + 3 <i>D</i> ) μin<br>(9.6 + 2.1 <i>D</i> ) μin<br>(11 + 2.2 <i>D</i> ) μin<br>(9.3 + 1.5 <i>D</i> ) μin<br>(14 + 2 <i>D</i> ) μin<br>(8.1 + 2.1 <i>D</i> ) μin<br>(11 + 3.2 <i>D</i> ) μin                                                         | Master gage blocks,<br>P&W universal<br>measuring machine      | TPA<br>HSV<br>RFD<br>HRT, DFW<br>HLR<br>SFL<br>ATL<br>MEL, COS,<br>RDU  |
| Plain Pin, Plugs                 | Up to 13 in<br>Up to 13 in<br>Up to 13 in<br>Up to 14 in<br>Up to 8 in<br>Up to 13 in<br>Up to 10 in<br>Up to 11 in<br>(0.04 to 14) in<br>(0.04 to 13) in | (6.8 + 3.3 <i>D</i> ) μin<br>(10 + 3.1 <i>D</i> ) μin<br>(11 + 2.5 <i>D</i> ) μin<br>(4.8 + 2.3 <i>D</i> ) μin<br>(10 + 3 <i>D</i> ) μin<br>(4.2 + 3.4 <i>D</i> ) μin<br>(10 + 2.9 <i>D</i> ) μin<br>(5.2 + 2.1 <i>D</i> ) μin<br>(14 + 2 <i>D</i> ) μin<br>(5.3 + 2.3 <i>D</i> ) μin |                                                                | RDU<br>COS<br>MEL<br>HLR<br>HRT, DFW<br>RFD<br>HSV<br>SFL<br>ATL<br>TPA |
| NPT Thread Plugs                 |                                                                                                                                                           |                                                                                                                                                                                                                                                                                       |                                                                |                                                                         |
| Major Diameter<br>Pitch Diameter | Up to 12 in<br>Up to 12 in                                                                                                                                | 85 μin<br>120 μin                                                                                                                                                                                                                                                                     | Bench micrometer,<br>Thread wire set, pipe<br>taper sine block | TPA, RFD,<br>MEL, COS,<br>DFW                                           |
| Parallelism & Straightness       | (0 to 0.01) in<br>(0 to 4) in                                                                                                                             | 13 μin<br>110 μin                                                                                                                                                                                                                                                                     | Gage amplifier, surface<br>plate                               | RFD<br>MEL, DFW                                                         |

| Parameter/Equipment                  | Range            | CMC <sup>2, 4</sup> (±) | Comment                                                                              | Location <sup>10</sup>                          |
|--------------------------------------|------------------|-------------------------|--------------------------------------------------------------------------------------|-------------------------------------------------|
| Thread Plugs –                       |                  |                         |                                                                                      |                                                 |
| Major Diameter                       | Up to 12 in      | 36 µin                  | B & S 599-246-00,<br>thread wire set, gage<br>blocks, Labmaster,<br>Supermicrometer™ | TPA                                             |
| Pitch Diameter                       | Up to 12 in      | 92 µin                  |                                                                                      |                                                 |
| Major Diameter                       | Up to 12 in      | 50 µin                  |                                                                                      | ATL                                             |
| Pitch Diameter                       | Up to 12 in      | 97 µin                  |                                                                                      |                                                 |
| Major Diameter                       | Up to 12 in      | 40 µin                  |                                                                                      | HSV                                             |
| Pitch Diameter                       | Up to 12 in      | 92 µin                  |                                                                                      |                                                 |
| Major Diameter                       | Up to 12 in      | 44 µin                  |                                                                                      | RFD                                             |
| Pitch Diameter                       | Up to 12 in      | 79 µin                  |                                                                                      |                                                 |
| Major Diameter                       | Up to 12 in      | 65 µin                  |                                                                                      | HLR                                             |
| Pitch Diameter                       | Up to 12 in      | 110 µin                 |                                                                                      |                                                 |
| Major Diameter                       | Up to 10 in      | 43 µin                  |                                                                                      | HRT                                             |
| Pitch Diameter                       | Up to 10 in      | 94 µin                  |                                                                                      |                                                 |
| Major Diameter                       | Up to 12 in      | 62 µin                  |                                                                                      | MEL                                             |
| Pitch Diameter                       | Up to 12 in      | 99 µin                  |                                                                                      |                                                 |
| Major Diameter                       | Up to 10 in      | 50 µin                  |                                                                                      | SFL                                             |
| Pitch Diameter                       | Up to 10 in      | 97 µin                  |                                                                                      |                                                 |
| Major Diameter                       | Up to 10 in      | 44 µin                  |                                                                                      | COS, DFW                                        |
| Pitch Diameter                       | Up to 10 in      | 79 µin                  |                                                                                      |                                                 |
| Major Diameter                       | Up to 10 in      | 53 µin                  |                                                                                      | RDU                                             |
| Pitch Diameter                       | Up to 10 in      | 98 µin                  |                                                                                      |                                                 |
| Solid Thread Rings                   | (0.625 to 12) in | 110 µin                 | Labmaster, measuring<br>machine                                                      | RFD                                             |
| Pitch Diameter                       | Up to 12 in      | 110 µin                 |                                                                                      | TPA                                             |
|                                      | Up to 12 in      | 98 µin                  |                                                                                      | COS, DFW                                        |
|                                      | Up to 12 in      | 120 µin                 |                                                                                      | RDU                                             |
| Adjustable Thread Rings              |                  |                         |                                                                                      |                                                 |
| Pitch Diameter (Tactile<br>Fit)      | Up to 12 in      | (350 + 47D) µin         | Thread setting plug<br>gages                                                         | TPA, ATL,<br>RFD, RDU,<br>MEL, COS,<br>HLR, DFW |
| Rotary Encoders – Angle <sup>3</sup> | (0 to 360)°      | 24 arc sec              | Rotary encoder                                                                       | COS                                             |

| Parameter/Equipment                                                                                                                                                                                            | Range <sup>4</sup>                                                                                                                                                                                                                                                       | CMC <sup>2</sup> (±)                                                                                                                                                                                | Comment                                                                | Location <sup>10</sup>                                                                                                                               |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| Thread Wires                                                                                                                                                                                                   | Up to 0.5D<br>Up to 0.5D                                                                                                                                                                                                                                                 | 10 µin<br>11 µin                                                                                                                                                                                    | Master gage blocks,<br>P&W universal<br>measuring machine              | TPA, RFD<br>HSV, COS,<br>RDU, DFW                                                                                                                    |
| Surface Plates <sup>3</sup> –<br><br>Local Area Flatness<br><br>Overall Flatness                                                                                                                               | <br><br>(-0.001 to 0.001) in<br>(-0.001 to 0.001) in<br><br>(12 x 12) in to (6 x 12) ft<br>(12 x 12) in to (6 x 12) ft<br><br>(12 x 12) in to (6 x 12) ft<br>(12 x 12) in to (6 x 12) ft<br>(12 x 12) in to (6 x 12) ft                                                  | <br><br>72 µin<br>68 µin<br><br>110 µin<br>130 µin<br><br>79 µin<br>66 µin<br>86 µin                                                                                                                | <br><br>Repeat-o-meter<br>Planekator,<br>leveling system               | <br><br>RDU<br>TPA, ATL,<br>HSV, HLR,<br>RFD, HRT,<br>MEL, COS,<br>DFW<br><br>MEL<br>TPA<br><br>ATL, HLR,<br>HSV, RFD<br>HRT<br><br>COS, RDU,<br>DFW |
| Optical Comparators <sup>3</sup> –<br><br>Angle<br>Linearity<br>Magnification<br><br>Angle<br>Linearity<br>Magnification<br><br>Angle<br>Linearity<br>Magnification<br><br>Angle<br>Linearity<br>Magnification | <br><br>Up to 360 °<br>Up to 20 in<br>(20 to 40) in<br>10x to 100x<br><br>Up to 360 °<br>Up to 20 in<br>(20 to 40) in<br>10x to 100x<br><br>Up to 360 °<br>Up to 20 in<br>(20 to 40) in<br>10x to 100x<br><br>Up to 360 °<br>Up to 20 in<br>(20 to 40) in<br>10x to 100x | <br><br>0.0087 °<br>210 µin<br>450 µin<br>340 µin<br><br>0.008 7 °<br>320 µin<br>630 µin<br>420 µin<br><br>0.042 °<br>320 µin<br>630 µin<br>420 µin<br><br>0.016 °<br>320 µin<br>630 µin<br>430 µin | <br><br>Gage blocks, angle<br>blocks, glass scales,<br>precision balls | <br><br>TPA<br><br>HSV<br><br>RFD<br><br>COS, RDU,<br>DFW<br><br>MEL                                                                                 |



| Parameter/Equipment                                                           | Range                                                                                                           | CMC <sup>2, 9</sup> (±)                                 | Comment                                                           | Location <sup>10</sup>                     |
|-------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|-------------------------------------------------------------------|--------------------------------------------|
| Roughness – Measure                                                           | 123 µin Ra<br>117 µin Ra<br>116 µin Ra<br>3 µm Ra                                                               | 3.2 µin<br>2.5 µin<br>2.9 µin<br>0.06 µm                | Mitutoyo SV-3200H4 surface measuring system & roughness specimens | RFD                                        |
| Roughness Testers <sup>3</sup>                                                | 117 µin Ra<br>370 µin Rmax                                                                                      | 1.3 µin                                                 | Comparison to roughness specimen                                  | HSV                                        |
| Coating Thickness Gages <sup>3</sup><br><br>Eddy Current & Magnetic Induction | (0.737 to 100) mils<br>(100 to 243) mils<br><br>(14 to 202) mils<br>(0.9 to 20) mils<br><br>(0.48 to 38.9) mils | 26 µin<br>240 µin<br><br>63 µin<br>62 µin<br><br>69 µin | Coating thickness standards, Foils, Supermicrometers™             | TPA<br><br>HLR<br>MEL<br><br>HSV           |
| Ultrasonic Thickness Gauges <sup>3</sup>                                      | Up to 10 in<br>Up to 10 in                                                                                      | 110 µin<br>590 µin                                      | Gage blocks                                                       | TPA, HSV<br>MEL                            |
| Coating Thickness Shims                                                       | (0 to 243) mils<br>(0 to 243) mils                                                                              | 57 µin<br>69 µin                                        | Supermicrometer™ Model C                                          | TPA, HSV<br>HLR, MEL,<br>DFW               |
| Crimp Tools <sup>3</sup>                                                      | (0.011 to 1) in<br>(0.011 to 0.5) in                                                                            | 150 µin<br>240 µin                                      | Micrometer, pin gages                                             | TPA, HLR,<br>HSV, HRT,<br>COS, MEL,<br>DFW |
| Pi Tapes <sup>3</sup>                                                         | Up to 3 in                                                                                                      | 450 µin                                                 | Comparison to plug gages                                          | HRT                                        |
| Microscopes                                                                   | Up to 2 in<br><br>Up to 1 in<br>Up to 25mm                                                                      | 100 µin<br><br>100 µin<br>2.6 µm                        | Comparison to stage micrometer                                    | HRT, HSV<br><br>COS                        |

#### IV. Dimensional Testing<sup>5</sup>

| Parameter/Equipment | Range                                              | CMC <sup>2, 4</sup> ( $\pm$ )                       | Comment                     | Location <sup>10</sup> |
|---------------------|----------------------------------------------------|-----------------------------------------------------|-----------------------------|------------------------|
| Length              | X Axis (0.01 to 10) in<br>Y Axis (0.01 to 6) in    | 162 $\mu$ in<br>123 $\mu$ in                        | Optical comparator          | TPA, RFD,<br>MEL       |
|                     | X Axis (0.01 to 8) in<br>Y Axis (0.01 to 4) in     | 160 $\mu$ in<br>120 $\mu$ in                        |                             | ATL                    |
|                     | X Axis (0.01 to 5.0) in<br>Y Axis (0.01 to 3.0) in | 340 $\mu$ in<br>340 $\mu$ in                        |                             | HSV                    |
|                     | X Axis (0.01 to 8) in<br>Y Axis (0.01 to 4) in     | 180 $\mu$ in<br>180 $\mu$ in                        |                             | HLR                    |
|                     | (0 to 480) in                                      | (0.8 + 2.6L) $\mu$ in                               | Laser measurement<br>system | COS                    |
| Angle               | Up to 360 °                                        | 0.004 °                                             | Optical comparator          | TPA, RFD,<br>HLR       |
|                     | Up to 360 °                                        | 0.006 °                                             |                             | ATL, MEL               |
| General Inspection  |                                                    |                                                     |                             |                        |
| X Axis              | (0 to 33) in<br>(0 to 838) mm                      | (80 + 3.6L) $\mu$ in<br>(2.1 + 0.003 6L) $\mu$ m    | CMM                         | RFD                    |
| Y Axis              | (0 to 60) in<br>(0 to 1524) mm                     | (200 + 0.13L) $\mu$ in<br>(5.1 + 0.000 13L) $\mu$ m |                             |                        |
| Z Axis              | (0 to 20) in<br>(0 to 508) mm                      | (200 + 0.13L) $\mu$ in<br>(5.1 + 0.000 13L) $\mu$ m |                             |                        |

V. Electrical – DC/Low Frequency

| Parameter/Range                                                                        | Frequency                                                                                                                                                                                          | CMC <sup>2, 7</sup> (±)                                                      | Comment                                    | Location <sup>10</sup>                                |
|----------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|--------------------------------------------|-------------------------------------------------------|
| Phase Angle <sup>3</sup> – Generate                                                    | <b>(-180 to 180) °</b><br>(10 to 65) Hz<br>(65 to 500) Hz<br>500 Hz to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz<br>(10 to 30) kHz                                                                    | 0.08°<br>0.19°<br>0.38°<br>1.9°<br>3.8°<br>7.6°                              | Fluke 5560A, 5522A multiproduct calibrator | TPA, ATL, RFD, HRT, MEL, COS, RDU, HSV, SFL, HLR, DFW |
| Phase Angle – Generate,<br><br>5 V Equal Amplitude<br>50 mV to 120 V Unequal Amplitude | <b>(0 to 360)°</b><br>1 Hz to 1 kHz<br>(1 to 6.25) kHz<br>(6.25 to 50) kHz<br>(50 to 200) kHz<br><br><b>(0 to 360)°</b><br>1 Hz to 1 kHz<br>(1 to 6.25) kHz<br>(6.25 to 50) kHz<br>(50 to 200) kHz | 0.005°<br>0.01°<br>0.015°<br>0.04°<br><br>0.005°<br>0.01°<br>0.015°<br>0.04° | Clarke-Hess 5600, 5500-2 phase standard    | TPA, RFD                                              |

| Parameter/Range                             | Frequency                                                                                                                                                                    | CMC <sup>2, 7</sup> (±)                                                                             | Comment                                                                                                                                                      | Location <sup>10</sup>                     |
|---------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|
| Phase Angle – Measure<br><br>10 mV to 630 V | <b>(0 to 360)°</b><br>5 Hz to 2 kHz<br>(2 to 5) kHz<br>(5 to 10) kHz<br>(10 to 50) kHz<br>(50 to 100) kHz<br>(100 to 200) kHz                                                | 0.02°<br>0.03°<br>0.04°<br>0.05°<br>0.1°<br>0.2°                                                    | Clarke-Hess<br>6000A phase meter                                                                                                                             | TPA, RFD                                   |
| Phase Angle – Measure<br><br>50 mV to 120 V | <b>(0 to 360)°</b><br>1 Hz to 1 kHz<br>(1 to 50) kHz<br><br>(1 to 50) kHz<br>(50 to 200) kHz<br><br>(5 to 50) kHz<br>(50 to 200) kHz<br><br>(5 to 50) kHz<br>(50 to 200) kHz | 0.001°<br>0.002°<br><br>0.002°<br>0.008°<br><br>0.002°<br>0.008°<br><br>0.002°<br>0.008°            | Clarke-Hess 5002A<br>phase bridge<br><br>Clarke-Hess 5002B<br>phase bridge<br><br>Clarke-Hess 5002C<br>phase bridge<br><br>Clarke-Hess 5002D<br>phase bridge | TPA, RFD                                   |
| DC Current – Generate <sup>3</sup>          | (1 to 1.2) nA<br>(1.2 to 12) nA<br>(12 to 120) nA<br>(0.12 to 1.2) µA<br>(1.2 to 10) µA                                                                                      | 92 µA/A + 0.007 nA<br>92 µA/A + 0.007 nA<br>92 µA/A + 0.01 nA<br>36 µA/A + 0.1 nA<br>13 µA/A + 1 nA | Fluke 5730A<br>multifunction calibrator<br>& Fluke 5560A<br>multiproduct calibrator                                                                          | TPA, RFD,<br>MEL, RDU,<br>COS, DFW,<br>HSV |
|                                             | (1 to 1.2) nA<br>(1.2 to 12) nA<br>(12 to 120) nA<br>(0.12 to 1.2) µA<br>(1.2 to 10) µA                                                                                      | 92 µA/A + 0.007 nA<br>92 µA/A + 0.007 nA<br>92 µA/A + 0.01 nA<br>36 µA/A + 0.1 nA<br>19 µA/A + 1 nA | Fluke 5720A<br>multifunction calibrator<br>& Fluke 5560A<br>multiproduct calibrator                                                                          | ATL                                        |
|                                             | (1 to 1.2) nA<br>(1.2 to 12) nA<br>(12 to 120) nA<br>(0.12 to 1.2) µA<br>(1.2 to 10) µA                                                                                      | 93 µA/A + 0.007 nA<br>92 µA/A + 0.007 nA<br>92 µA/A + 0.01 nA<br>36 µA/A + 0.1 nA<br>15 µA/A + 1 nA | Fluke 5730A<br>multifunction calibrator<br>& Fluke 5522A<br>multiproduct calibrator                                                                          | HSV                                        |

| Parameter/Equipment                | Range                                                                                                                      | CMC <sup>2, 7</sup> (±)                                                                                                            | Comment                                                                                    | Location <sup>10</sup>                                       |
|------------------------------------|----------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|--------------------------------------------------------------|
| DC Current – Generate <sup>3</sup> | (1 to 1.2) nA<br>(1.2 to 12) nA<br>(12 to 120) nA<br>(0.12 to 1.2) µA<br>(1.2 to 10) µA                                    | 99 µA/A + 0.007 nA<br>99 µA/A + 0.007 nA<br>99 µA/A + 0.01 nA<br>36 µA/A + 0.1 nA<br>19 µA/A + 1 nA                                | Fluke 5700A<br>multifunction<br>calibrator & Fluke<br>5560A multiproduct<br>calibrator     | HRT                                                          |
|                                    | (1 to 1.2) nA<br>(1.2 to 12) nA<br>(12 to 120) nA<br>(0.12 to 1.2) µA<br>(1.2 to 10) µA                                    | 93 µA/A + 0.007 nA<br>92 µA/A + 0.007 nA<br>92 µA/A + 0.01 nA<br>36 µA/A + 0.1 nA<br>20 µA/A + 1 nA                                | Fluke 5720A<br>multifunction<br>calibrator & Fluke<br>5522A multiproduct<br>calibrator     | HLR, SFL                                                     |
|                                    | (10 to 220) µA<br>220 µA to 2.2 mA<br>(2.2 to 22) mA<br>(22 to 100) mA<br>(100 to 220) mA<br>(0.22 to 1) A<br>(1 to 2.2) A | 38 µA/A + 5 nA<br>30 µA/A + 7 nA<br>30 µA/A + 44 nA<br>38 µA/A + 0.7 µA<br>45 µA/A + 0.7 µA<br>68 µA/A + 12 µA<br>110 µA/A + 12 µA | Fluke 5720A,<br>5730A<br>multifunction<br>calibrator                                       | TPA, ATL,<br>HSV, RFD,<br>HLR, SFL,<br>MEL, COS,<br>RDU, DFW |
|                                    | (10 to 220) µA<br>220 µA to 2.2 mA<br>(2.2 to 22) mA<br>(22 to 100) mA<br>(100 to 220) mA<br>(0.22 to 1) A<br>(1 to 2.2) A | 46 µA/A + 8 nA<br>46 µA/A + 8 nA<br>46 µA/A + 82 nA<br>53 µA/A + 0.9 µA<br>61 µA/A + 0.9 µA<br>72 µA/A + 23 µA<br>110 µA/A + 23 µA | Fluke 5700A<br>multifunction<br>calibrator                                                 | HRT                                                          |
| DC Current – Generate <sup>3</sup> | (2.2 to 11) A                                                                                                              | 270 µA/A + 370 µA                                                                                                                  | Fluke 5720A,<br>5730A multifunction<br>calibrator w/5725A<br>transconductance<br>amplifier | HSV, HLR,<br>SFL                                             |
|                                    | (11 to 20.5) A                                                                                                             | 760 µA/A + 580 µA                                                                                                                  | Fluke 5522A<br>multiproduct<br>calibrator                                                  |                                                              |
|                                    | (2.2 to 3.1) A<br>(3.1 to 12) A<br>(12 to 30) A                                                                            | 230 µA/A + 120 µA<br>230 µA/A + 190 µA<br>760 µA/A + 390 µA                                                                        | Fluke 5560A<br>multiproduct<br>calibrator                                                  | TPA, RFD,<br>MEL, ATL,<br>RDU, COS,<br>HRT, HSV,<br>DFW      |
|                                    | (12 to 20) A<br>(20 to 100) A                                                                                              | 76 µA/A + 0.76 mA<br>76 µA/A + 3.8 mA                                                                                              | Fluke 5560A<br>/52120A amplifier                                                           | TPA, RFD                                                     |

| Parameter/Equipment                                          | Range                             | CMC <sup>2, 7</sup> (±)                                  | Comment                                                     | Location <sup>10</sup>            |
|--------------------------------------------------------------|-----------------------------------|----------------------------------------------------------|-------------------------------------------------------------|-----------------------------------|
| DC Current – Clamp Meters <sup>3</sup>                       | (1.2 to 200) A<br>(6 to 1000) A   | 0.21 % of output + 0.008 A<br>0.21 % of output + 0.024 A | Fluke 5560A multiproduct calibrator w/9100-200 x10/x50 coil | COS, HRT, HSV                     |
|                                                              | (1.2 to 200) A<br>(6 to 1000) A   | 0.21 % of output + 0.028 A<br>0.21 % of output + 0.04 A  | Fluke 5522A multiproduct calibrator w/9100-200 x10/x50 coil | SFL, HLR                          |
|                                                              | (3.1 to 300.2) A                  | 0.65 % of output + 0.014 A                               | Fluke 5560A multiproduct calibrator w/55xxA x1/x2/x10 coil  | RDU                               |
| DC Current – Clamp Meters <sup>3</sup><br><br>Toroidal-Wound | (0.6 to 600) A<br>(600 to 1000) A | 0.19 % of output + 0.04 A<br>0.20 % of output + 0.04 A   | Fluke 5560A multiproduct calibrator w/5500A coil x50        | TPA, RFD, MEL, ATL, COS, HSV, DFW |
|                                                              | (0 to 1025) A                     | 0.2 % of output + 0.05 A                                 | Fluke 5522A multiproduct Calibrator w/5500A coil x50        | HSV                               |
| DC Current – Clamp Meters Other <sup>3</sup>                 | (0.6 to 600) A<br>(600 to 1000) A | 0.38 % of output + 0.38 A<br>0.39 % of output + 0.38 A   | Fluke 5560A multiproduct calibrator w/5500A coil x50        | TPA, RFD, MEL, ATL, COS, HSV, DFW |
|                                                              | (0 to 1025) A                     | 0.39 % of output + 0.38 A                                | Fluke 5522A multiproduct calibrator w/5500A coil x50        | HSV                               |

| Parameter/Equipment               | Range                                                                                                                                                            | CMC <sup>2,7</sup> (±)                                                                                                                                                          | Comment                                                                                 | Location <sup>10</sup>                   |
|-----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|------------------------------------------|
| DC Current – Measure <sup>3</sup> | (1 to 10) nA<br>(10 to 100) nA<br>(0.1 to 1) µA<br>(1 to 10) µA<br>(10 to 100) µA<br>(0.1 to 1) mA<br>(1 to 10) mA<br>(10 to 100) mA                             | 18 µA/A + 0.15 pA<br>6.0 µA/A + 1.5 pA<br>4.8 µA/A + 0.015 nA<br>4.4 µA/A + 0.015 nA<br>4.4 µA/A + 0.15 nA<br>4.4 µA/A + 0.0015 µA<br>4.4 µA/A + 0.015 µA<br>9.9 µA/A + 0.15 µA | Agilent 3458A<br>multimeter option<br>002, Fluke 5450A<br>resistance<br>calibrator      | TPA, RFD                                 |
|                                   | (1 to 10) nA<br>(10 to 100) nA<br>(0.1 to 1) µA<br>(1 to 10) µA                                                                                                  | 35 µA/A + 0.1 pA<br>12 µA/A + 1 pA<br>8.3 µA/A + 0.01 nA<br>6.9 µA/A + 0.1 nA                                                                                                   | Fluke 5730A<br>multifunction<br>calibrator Agilent<br>3458A option 002<br>multimeter    | MEL, COS<br>RDU, HSV,<br>DFW             |
|                                   | (1 to 10) nA<br>(10 to 100) nA<br>(0.1 to 1) µA<br>(1 to 10) µA                                                                                                  | 35 µA/A + 0.1 pA<br>18 µA/A + 1 pA<br>10 µA/A + 0.01 nA<br>8.3 µA/A + 0.1 nA                                                                                                    | Fluke 5720A<br>multifunction<br>calibrator, Agilent<br>3458A multimeter<br>option 002   | ATL, HLR,<br>SFL                         |
|                                   | (1 to 10) nA<br>(10 to 100) nA<br>(0.1 to 1) µA<br>(1 to 10) µA                                                                                                  | 35 µA/A + 0.12 pA<br>18 µA/A + 1.2 pA<br>13 µA/A + 0.01 nA<br>12 µA/A + 0.12 nA                                                                                                 | Fluke 5700A/03<br>multifunction<br>calibrator Agilent<br>3458A option 002<br>multimeter | HRT                                      |
|                                   | (10 to 100) µA<br>(0.1 to 1) mA<br>(1 to 10) mA<br>(10 to 100) mA<br>(0.1 to 1) A                                                                                | 13 µA/A + 0.5 nA<br>13 µA/A + 3 nA<br>13 µA/A + 0.03 µA<br>23 µA/A + 0.3 µA<br>72 µA/A + 6.6 µA                                                                                 | Agilent 3458A<br>multimeter                                                             | TPA, MEL,<br>COS, HSV<br>HRT, HLR<br>SFL |
|                                   | (0.1 to 20.2) µA<br>(20.2 to 202) µA<br>(0.202 to 2.02) mA<br>(2.02 to 20.2) mA<br>(20.2 to 202) mA<br>(0.202 to 2.02) A<br>(2.02 to 20.2) A<br>(20.2 to 30.2) A | 26 µA/A + 0.4 nA<br>9.9 µA/A + 0.4 nA<br>9.1 µA/A + 4 nA<br>14 µA/A + 0.04 µA<br>56 µA/A + 1.0 µA<br>130 µA/A + 0.2 mA<br>230 µA/A + 0.5 mA<br>540 µA/A + 4.3 mA                | Fluke 8588A<br>multimeter                                                               | RFD, ATL,<br>DFW                         |
|                                   | (0.1 to 20.2) µA<br>(20.2 to 202) µA<br>(0.202 to 2.02) mA<br>(2.02 to 20.2) mA<br>(20.2 to 202) mA<br>(0.202 to 2.02) A                                         | 30 µA/A + 0.4 nA<br>11 µA/A + 0.5 nA<br>11 µA/A + 5 nA<br>15 µA/A + 0.05 µA<br>58 µA/A + 1.5 µA<br>150 µA/A + 0.2 mA                                                            | Fluke 8558A<br>multimeter                                                               | RDU                                      |

| Parameter/Equipment               | Range                                          | CMC <sup>2, 6, 7</sup> (±)                                 | Comment                                                                                  | Location <sup>10</sup> |
|-----------------------------------|------------------------------------------------|------------------------------------------------------------|------------------------------------------------------------------------------------------|------------------------|
| DC Current – Measure <sup>3</sup> | (1 to 10) A<br>(10 to 100) A<br>(100 to 300) A | 7.3 µA/A + 3.4 µA<br>7.3 µA/A + 34 µA<br>7.3 µA/A + 340 µA | Agilent 3458A<br>multimeter option<br>002, MI 6311A<br>current divider                   | TPA                    |
|                                   | (1 to 10) A<br>(10 to 100) A                   | 46 µA/A + 90 µA<br>47 µA/A + 0.09 mA                       | Agilent 3458A option<br>002 multimeter<br>standard resistor<br>L&N 4361 current<br>shunt | ATL                    |
|                                   | (1 to 10) A<br>(10 to 100) A                   | 45 µA/A + 90 µA<br>46 µA/A + 0.09 mA                       |                                                                                          | COS, DFW               |
|                                   | (1 to 10) A<br>(10 to 100) A                   | 35 µA/A + 85 µA<br>44 µA/A + 0.09 mA                       |                                                                                          | RFD                    |
|                                   | (1 to 10) A<br>(10 to 100) A                   | 34 µA/A + 90 µA<br>39 µA/A + 0.09 mA                       |                                                                                          | MEL                    |
|                                   | (1 to 3) A<br>(3 to 10) A                      | 760 µA/A + 460 µA<br>1.1 mA/A + 610 µA                     | Fluke 8845A<br>multimeter                                                                | RDU, HSV,<br>HRT       |
|                                   | (300 to 1 000) A                               | 0.25 % of rdg + 8 mA                                       | Agilent 3458A<br>multimeter option<br>002, Empro current<br>shunts                       | TPA                    |
|                                   | (10 to 250) A                                  | 0.25 % of rdg + 0.02 A                                     |                                                                                          | RDU                    |
|                                   | (1 to 1000) A                                  | 0.25 % of rdg                                              |                                                                                          | MEL, COS,<br>DFW       |
|                                   | (1 to 500) A                                   | 0.26 % of rdg                                              |                                                                                          | SFL                    |
|                                   | (1 to 1000) A                                  | 0.26 % of rdg                                              |                                                                                          | HLR                    |
|                                   | (10 to 100) A                                  | 0.25 % of rdg                                              |                                                                                          | HRT                    |
|                                   | (1 to 1000) A                                  | 0.25 % of rdg                                              |                                                                                          | RFD                    |
|                                   | (1 to 500) A                                   | 0.27 % of rdg                                              |                                                                                          | ATL                    |
|                                   | (1 to 600) A                                   | 0.27 % of rdg                                              |                                                                                          | HSV                    |



| Parameter/Equipment                     | Range                                                                                                 | CMC <sup>2, 7</sup> (±)                                                                                                       | Comment                                                                                                           | Location <sup>10</sup>                                               |
|-----------------------------------------|-------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|
| DC Voltage – Generate <sup>3</sup>      | (0 to 220) mV<br>220 mV to 2.2 V<br>(2.2 to 11) V<br>(11 to 22) V<br>(22 to 220) V<br>(220 to 1100) V | 6.8 µV/V + 0.8 µV<br>4.6 µV/V + 0.9 µV<br>3 µV/V + 2.5 µV<br>3 µV/V + 3.9 µV<br>4.6 µV/V + 38 µV<br>6.1 µV/V + 390 µV         | Fluke 5720A, 5730A<br>multifunction calibrator                                                                    | TPA, ATL,<br>HSV, RFD,<br>HLR, SFL,<br>MEL, COS,<br>RDU, DFW         |
|                                         | (0 to 220) mV<br>220 mV to 2.2 V<br>(2.2 to 11) V<br>(11 to 22) V<br>(22 to 220) V<br>(220 to 1000) V | 6.8 µV/V + 0.9 µV<br>6.1 µV/V + 0.9 µV<br>6.1 µV/V + 3.2 µV<br>6.1 µV/V + 6.2 µV<br>6.8 µV/V + 76 µV<br>8.4 µV/V + 460 µV     | Fluke 5700A<br>multifunction calibrator                                                                           | HRT                                                                  |
| High Voltage –<br>Generate <sup>3</sup> | (1 to 6) kV                                                                                           | 2.4 % of output + 10 V                                                                                                        | 3565D tester high<br>voltage                                                                                      | HLR                                                                  |
| DC Voltage – Measure <sup>3</sup>       | (0 to 100) mV<br>100 mV to 1 V<br>(1 to 10) V<br>(10 to 100) V<br>(100 to 1000) V                     | 3.3 µV/V + 1 µV<br>2.6 µV/V + 1 µV<br>2.6 µV/V + 1.5 µV<br>3.9 µV/V + 20 µV<br>3.9 µV/V + 66 µV + 12<br>µV/V x (Vin/1 000) ^2 | Agilent 3458A<br>multimeter option 002                                                                            | TPA, ATL,<br>HSV, RFD,<br>HRT, HLR,<br>MEL, COS,<br>RDU, SFL,<br>DFW |
|                                         | (0 to 220) mV<br>(0.202 to 2.02) V<br>(2.02 to 20.2) V<br>(20.2 to 202) V<br>(202 to 1000) V          | 7.3 µV/V + 0.7 µV<br>2.8 µV/V + 0.8 µV<br>2.8 µV/V + 0.8 µV<br>4.2 µV/V + 30 µV<br>4.3 µV/V + 0.49 mV                         | Fluke 8588A multimeter                                                                                            | ATL, RFD,<br>DFW                                                     |
|                                         | (0 to 220) mV<br>(0.202 to 2.02) V<br>(2.02 to 20.2) V<br>(20.2 to 202) V<br>(202 to 1000)            | 8.1 µV/V + 0.7 µV<br>5.2 µV/V + 0.8 µV<br>5.2 µV/V + 0.9 µV<br>8.3 µV/V + 34 µV<br>8.4 µV/V + 1.3 mV                          | Fluke 8558A multimeter                                                                                            | RDU                                                                  |
|                                         | (1 to 60) kV<br><br>(12 to 120) kV                                                                    | 0.035 % of rdg<br><br>0.018 % of rdg                                                                                          | Ross VD60 HV divider,<br>Agilent 3458A<br>multimeter<br><br>Ross VD120 HV<br>divider, Agilent 3458A<br>multimeter | TPA                                                                  |

| Parameter/Equipment                    | Range         | CMC <sup>2, 6, 7</sup> (±)                              | Comment                                                  | Location <sup>10</sup>  |
|----------------------------------------|---------------|---------------------------------------------------------|----------------------------------------------------------|-------------------------|
| DC High Voltage – Measure <sup>3</sup> | (0 to 1) kV   | 0.03 % of rdg + 0.000032 kV                             | Vitrek 4700 Digital HV Meter                             | DFW                     |
|                                        | (1 to 10) kV  | 0.03 % of rdg + 0.000 12 kV + 1.5 µV/V x (Vin/1 000) ^2 |                                                          |                         |
|                                        | (10 to 70) kV | 0.04% of rdg + 0.001kV + 0.14 µV/V x (Vin/1 000) ^2     | Vitrek 4700 Digital HV Meter w/HVL-70 High Voltage Probe |                         |
|                                        | (1 to 60) kV  | 0.1 % of rdg                                            | Ross VD60 HV divider, Agilent 34401A multimeter          | ATL, HRT, HLR, MEL, COS |
|                                        | (1 to 150) kV | 0.1 % of rdg                                            | Ross VD150 HV divider, Agilent 34401A multimeter         | HSV                     |
|                                        | (1 to 30) kV  | 0.1 % of rdg                                            | Ross VD30 HV divider, Fluke 89 IV multimeter             |                         |
|                                        | (1 to 30) kV  | 0.1 % of rdg                                            | Ross VD30 HV divider, Fluke 287 multimeter               | COS                     |
|                                        | (1 to 30) kV  | 0.1 % of rdg                                            | Ross VD30 HV divider, Agilent 34401A multimeter          | RDU                     |
|                                        | (0 to 1) kV   | 0.03 % of rdg + 0.000 032 kV                            | Vitrek 4700 digital HV meter                             | RFD                     |
|                                        | (1 to 10) kV  | 0.03 % of rdg + 0.000 12 kV + 1.5 µV/V x (Vin/1 000) ^2 |                                                          |                         |
|                                        | (1 to 60) kV  | 0.1 % of rdg                                            | Ross VD60 HV divider, Agilent 34401A multimeter          |                         |
|                                        | (1 to 120) kV | 0.1 % of rdg                                            | Ross VD60, VD120 HV divider, Agilent 34401A multimeter   |                         |
|                                        | (1 to 40) kV  | 2.3 % of rdg                                            | Fluke 80k-40 HV probe, Agilent 34401A multimeter         | SFL                     |



| Parameter/Range                    | Frequency                                                                                                                                                                                                                                                                                                                                                        | CMC <sup>2, 7</sup> (±)                                                                                                                                                                                                                                                                                                                  | Comment                                                      | Location <sup>10</sup>                                       |
|------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|--------------------------------------------------------------|
| DC Voltage – Measure Fixed Points  | 100 mV<br>1 V<br>10 V<br>100 V<br>1000 V                                                                                                                                                                                                                                                                                                                         | 3.1 µV/V<br>0.46 µV/V<br>0.3 µV/V<br>0.34 µV/V<br>0.48 µV/V                                                                                                                                                                                                                                                                              | Fluke 732B<br>reference standard,<br>752A voltage<br>divider | TPA                                                          |
|                                    | 100 mV<br>1 V<br>10 V<br>100 V<br>1000 V                                                                                                                                                                                                                                                                                                                         | 3.1 µV/V<br>0.61 µV/V<br>0.5 µV/V<br>0.52 µV/V<br>0.63 µV/V                                                                                                                                                                                                                                                                              | Fluke 732A<br>reference standard,<br>752A voltage<br>divider | RFD                                                          |
| AC Voltage – Generate <sup>3</sup> | <b>(0.22 to 2.2) mV</b><br>(10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 300) kHz<br>(300 to 500) kHz<br>500 kHz to 1 MHz<br><br><b>(2.2 to 22) mV</b><br>(10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 300) kHz<br>(300 to 500) kHz<br>500 kHz to 1 MHz | 230 µV/V + 3.9 µV<br>88 µV/V + 3.9 µV<br>76 µV/V + 3.9 µV<br>190 µV/V + 3.9 µV<br>460 µV/V + 4.6 µV<br>990 µV/V + 9.2 µV<br>1.3 mV/V + 19 µV<br>2.6 mV/V + 19 µV<br><br>230 µV/V + 3.9 µV<br>88 µV/V + 3.9 µV<br>76 µV/V + 3.9 µV<br>190 µV/V + 3.9 µV<br>460 µV/V + 4.6 µV<br>990 µV/V + 9.2 µV<br>1.3 mV/V + 19 µV<br>2.6 mV/V + 19 µV | Fluke<br>5720A, 5730A<br>multifunction<br>calibrator         | TPA, MEL,<br>HSV, RFD,<br>COS, RDU,<br>ATL, SFL,<br>HLR, DFW |
|                                    | <b>(22 to 220) mV</b><br>(10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 300) kHz<br>(300 to 500) kHz<br>500 kHz to 1 MHz<br><br><b>220 mV to 2.2 V</b><br>(10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 300) kHz<br>(300 to 500) kHz<br>500 kHz to 1 MHz  | 230 µV/V + 11.4 µV<br>88 µV/V + 6.1 µV<br>53 µV/V + 6.1 µV<br>110 µV/V + 6.1 µV<br>300 µV/V + 15 µV<br>610 µV/V + 19 µV<br>1.3 mV/V + 23 µV<br>2.5 mV/V + 46 µV<br><br>228 µV/V + 38 µV<br>84 µV/V + 15 µV<br>37 µV/V + 8 µV<br>61 µV/V + 9 µV<br>76 µV/V + 30 µV<br>304 µV/V + 76 µV<br>913 µV/V + 190 µV<br>1.5 mV/V + 304 µV          | Fluke 5730A<br>multifunction<br>calibrator                   | TPA, MEL,<br>HSV, RFD,<br>COS, RDU,<br>DFW                   |

| Parameter/Range                    | Frequency                                                                                                                                                                                                                                                                                        | CMC <sup>2, 7</sup> (±)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Comment                                                                    | Location <sup>10</sup>                                      |
|------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------|-------------------------------------------------------------|
| AC Voltage – Generate <sup>3</sup> | <b>(22 to 220) mV</b><br>(10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 300) kHz<br>(300 to 500) kHz<br>500 kHz to 1 MHz                                                                                                                      | 230 $\mu\text{V/V} + 11 \mu\text{V}$<br>88 $\mu\text{V/V} + 6.1 \mu\text{V}$<br>76 $\mu\text{V/V} + 6.1 \mu\text{V}$<br>190 $\mu\text{V/V} + 6.1 \mu\text{V}$<br>460 $\mu\text{V/V} + 15 \mu\text{V}$<br>840 $\mu\text{V/V} + 19 \mu\text{V}$<br>1.3 mV/V + 23 $\mu\text{V}$<br>2.5 mV/V + 46 $\mu\text{V}$                                                                                                                                                                                                      | Fluke 5720A, multifunction calibrator                                      | ATL, SFL<br>HLR                                             |
|                                    | <b>220 mV to 2.2 V</b><br>(10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 300) kHz<br>(300 to 500) kHz<br>500 kHz to 1 MHz                                                                                                                     | 230 $\mu\text{V/V} + 38 \mu\text{V}$<br>84 $\mu\text{V/V} + 15 \mu\text{V}$<br>40 $\mu\text{V/V} + 8 \mu\text{V}$<br>68 $\mu\text{V/V} + 9 \mu\text{V}$<br>99 $\mu\text{V/V} + 30 \mu\text{V}$<br>380 $\mu\text{V/V} + 76 \mu\text{V}$<br>910 $\mu\text{V/V} + 190 \mu\text{V}$<br>1.5 mV/V + 300 $\mu\text{V}$                                                                                                                                                                                                  |                                                                            |                                                             |
|                                    | <b>(2.2 to 22) V</b><br>(10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 300) kHz<br>(300 to 500) kHz<br>500 kHz to 1 MHz<br><br><b>(22 to 220) V</b><br>(10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz<br>(50 to 100) kHz | 230 $\mu\text{V/V} + 380 \mu\text{V}$<br>84 $\mu\text{V/V} + 152 \mu\text{V}$<br>37 $\mu\text{V/V} + 54 \mu\text{V}$<br>61 $\mu\text{V/V} + 91 \mu\text{V}$<br>76 $\mu\text{V/V} + 190 \mu\text{V}$<br>230 $\mu\text{V/V} + 610 \mu\text{V}$<br>910 $\mu\text{V/V} + 1.9 \text{ mV}$<br>1.4 mV/V + 3 mV<br><br>230 $\mu\text{V/V} + 3.8 \text{ mV}$<br>84 $\mu\text{V/V} + 1.5 \text{ mV}$<br>49 $\mu\text{V/V} + 0.6 \text{ mV}$<br>76 $\mu\text{V/V} + 0.9 \text{ mV}$<br>140 $\mu\text{V/V} + 2.3 \text{ mV}$ | Fluke 5720A, 5730A multifunction calibrator                                | TPA, MEL, HSV, RFD<br>COS, RDU, ATL, SFL<br>HLR, DFW        |
|                                    | <b>(220 to 750) V</b><br>40 Hz to 1 kHz<br>(1 to 20) kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br><br><b>(750 to 1000) V</b><br>40 Hz to 1 kHz<br>(1 to 20) kHz<br>(20 to 30) kHz                                                                                                                 | 68 $\mu\text{V/V} + 3 \text{ mV}$<br>130 $\mu\text{V/V} + 5 \text{ mV}$<br>460 $\mu\text{V/V} + 8 \text{ mV}$<br>1.8 mV/V + 34 mV<br><br>68 $\mu\text{V/V} + 3 \text{ mV}$<br>130 $\mu\text{V/V} + 5 \text{ mV}$<br>460 $\mu\text{V/V} + 8 \text{ mV}$                                                                                                                                                                                                                                                           | Fluke 5700A, 5720A, 5730A multifunction calibrator / Fluke 5725A amplifier | TPA, MEL, HSV, RFD<br>COS, RDU<br>ATL, SFL<br>HLR, HRT, DFW |

| Parameter/Range                    | Frequency                                | CMC <sup>2, 7</sup> (±) | Comment                                    | Location <sup>10</sup> |
|------------------------------------|------------------------------------------|-------------------------|--------------------------------------------|------------------------|
| AC Voltage – Generate <sup>3</sup> | <b>(0.22 to 2.2) mV</b><br>(10 to 20) Hz | 460 µV/V + 3.9 µV       | Fluke 5700A<br>multifunction<br>calibrator | HRT                    |
|                                    | (20 to 40) Hz                            | 180 µV/V + 3.9 µV       |                                            |                        |
|                                    | 40 Hz to 20 kHz                          | 91 µV/V + 3.9 µV        |                                            |                        |
|                                    | (20 to 50) kHz                           | 310 µV/V + 3.9 µV       |                                            |                        |
|                                    | (50 to 100) kHz                          | 720 µV/V + 6.1 µV       |                                            |                        |
|                                    | (100 to 300) kHz                         | 990 µV/V + 11 µV        |                                            |                        |
|                                    | (300 to 500) kHz                         | 1.4 mV/V + 23 µV        |                                            |                        |
|                                    | 500 kHz to 1 MHz                         | 3.7 mV/V + 30 µV        |                                            |                        |
|                                    | <b>(2.2 to 22) mV</b><br>(10 to 20) Hz   | 460 µV/V + 4.6 µV       |                                            |                        |
|                                    | (20 to 40) Hz                            | 180 µV/V + 4.6 µV       |                                            |                        |
|                                    | 40 Hz to 20 kHz                          | 91 µV/V + 4.6 µV        |                                            |                        |
|                                    | (20 to 50) kHz                           | 310 µV/V + 4.6 µV       |                                            |                        |
|                                    | (50 to 100) kHz                          | 720 µV/V + 6.1 µV       |                                            |                        |
|                                    | (100 to 300) kHz                         | 990 µV/V + 11 µV        |                                            |                        |
|                                    | (300 to 500) kHz                         | 1.4 mV/V + 23 µV        |                                            |                        |
|                                    | 500 kHz to 1 MHz                         | 3.7 mV/V + 30 µV        |                                            |                        |
|                                    | <b>(22 to 220) mV</b><br>(10 to 20) Hz   | 460 µV/V + 12 µV        |                                            |                        |
|                                    | (20 to 40) Hz                            | 180 µV/V + 7.6 µV       |                                            |                        |
|                                    | 40 Hz to 20 kHz                          | 84 µV/V + 7.6 µV        |                                            |                        |
|                                    | (20 to 50) kHz                           | 270 µV/V + 7.6 µV       |                                            |                        |
|                                    | (50 to 100) kHz                          | 690 µV/V + 23 µV        |                                            |                        |
|                                    | (100 to 300) kHz                         | 840 µV/V + 23 µV        |                                            |                        |
|                                    | (300 to 500) kHz                         | 1.4 mV/V + 30 µV        |                                            |                        |
|                                    | 500 kHz to 1 MHz                         | 2.7 mV/V + 76 µV        |                                            |                        |
|                                    | <b>220 mV to 2.2 V</b><br>(10 to 20) Hz  | 460 µV/V + 8 µV         |                                            |                        |
|                                    | (20 to 40) Hz                            | 140 µV/V + 23 µV        |                                            |                        |
|                                    | 40 Hz to 20 kHz                          | 65 µV/V + 5 µV          |                                            |                        |
|                                    | (20 to 50) kHz                           | 110 µV/V + 15 µV        |                                            |                        |
|                                    | (50 to 100) kHz                          | 210 µV/V + 61 µV        |                                            |                        |
|                                    | (100 to 300) kHz                         | 370 µV/V + 110 µV       |                                            |                        |
|                                    | (300 to 500) kHz                         | 910 µV/V + 300 µV       |                                            |                        |
|                                    | 500 kHz to 1 MHz                         | 1.8 mV/V + 761 µV       |                                            |                        |
|                                    | <b>(2.2 to 22) V</b><br>(10 to 20) Hz    | 460 µV/V + 760 µV       |                                            |                        |
|                                    | (20 to 40) Hz                            | 140 µV/V + 230 µV       |                                            |                        |
|                                    | 40 Hz to 20 kHz                          | 65 µV/V + 54 µV         |                                            |                        |
|                                    | (20 to 50) kHz                           | 110 µV/V + 150 µV       |                                            |                        |
|                                    | (50 to 100) kHz                          | 210 µV/V + 300 µV       |                                            |                        |
|                                    | (100 to 300) kHz                         | 460 µV/V + 1300 µV      |                                            |                        |
|                                    | (300 to 500) kHz                         | 1.1 mV/V + 3800 µV      |                                            |                        |
|                                    | 500 kHz to 1 MHz                         | 2.3 mV/V + 6800 µV      |                                            |                        |
|                                    | <b>(22 to 220) V</b><br>(10 to 20) Hz    | 457 µV/V + 7.6 mV       |                                            |                        |
|                                    | (20 to 40) Hz                            | 137 µV/V + 2.4 mV       |                                            |                        |
|                                    | 40 Hz to 20 kHz                          | 68 µV/V + 1.0 mV        |                                            |                        |
|                                    | (20 to 50) kHz                           | 190 µV/V + 3.1 mV       |                                            |                        |
|                                    | (50 to 100) kHz                          | 457 µV/V + 7.6 mV       |                                            |                        |

| Parameter/Range                                         | Frequency                               | CMC <sup>2, 7</sup> (±)   | Comment                                                        | Location <sup>10</sup>                                              |
|---------------------------------------------------------|-----------------------------------------|---------------------------|----------------------------------------------------------------|---------------------------------------------------------------------|
| AC Voltage – Generate<br>Wideband Absolute <sup>3</sup> | <b>(0.3 to 1.1) mV</b><br>(10 to 30) Hz | 0.65 % of output + 1.5 µV | Fluke<br>5700A, 5720A,<br>5730A<br>multifunction<br>calibrator | TPA, ATL<br>HSV, RFD,<br>HRT, HLR,<br>SFL, MEL,<br>COS, RDU,<br>DFW |
|                                                         | 30 Hz to 500 kHz                        | 0.61 % of output + 1.5 µV |                                                                |                                                                     |
|                                                         | (0.5 to 1.2) MHz                        | 0.63 % of output + 3.8 µV |                                                                |                                                                     |
|                                                         | (1.2 to 2) MHz                          | 0.63 % of output + 3.8 µV |                                                                |                                                                     |
|                                                         | (2 to 12) MHz                           | 0.68 % of output + 3.8 µV |                                                                |                                                                     |
|                                                         | (12 to 20) MHz                          | 0.76 % of output + 3.8 µV |                                                                |                                                                     |
|                                                         | (20 to 30) MHz                          | 1.3 % of output + 13 µV   |                                                                |                                                                     |
|                                                         | <b>(1.1 to 3.3) mV</b><br>(10 to 30) Hz | 0.58 % of output + 2.3 µV |                                                                |                                                                     |
|                                                         | 30 Hz to 500 kHz                        | 0.53 % of output + 2.3 µV |                                                                |                                                                     |
|                                                         | (0.5 to 1.2) MHz                        | 0.54 % of output + 4.6 µV |                                                                |                                                                     |
|                                                         | (1.2 to 2) MHz                          | 0.54 % of output + 4.6 µV |                                                                |                                                                     |
|                                                         | (2 to 12) MHz                           | 0.58 % of output + 4.6 µV |                                                                |                                                                     |
|                                                         | (12 to 20) MHz                          | 0.65 % of output + 4.6 µV |                                                                |                                                                     |
|                                                         | (20 to 30) MHz                          | 1.3 % of output + 4.6 µV  |                                                                |                                                                     |
|                                                         | <b>(3.3 to 11) mV</b><br>(10 to 30) Hz  | 0.58 % of output + 6.1 µV |                                                                |                                                                     |
|                                                         | 30 Hz to 500 kHz                        | 0.53 % of output + 6.1 µV |                                                                |                                                                     |
|                                                         | (0.5 to 1.2) MHz                        | 0.54 % of output + 8.4 µV |                                                                |                                                                     |
|                                                         | (1.2 to 2) MHz                          | 0.54 % of output + 8.4 µV |                                                                |                                                                     |
|                                                         | (2 to 12) MHz                           | 0.55 % of output + 8.4 µV |                                                                |                                                                     |
|                                                         | (12 to 20) MHz                          | 0.61 % of output + 8.4 µV |                                                                |                                                                     |
|                                                         | (20 to 30) MHz                          | 0.93 % of output + 8.4 µV |                                                                |                                                                     |
|                                                         | <b>(11 to 33) mV</b><br>(10 to 30) Hz   | 0.52 % of output + 12 µV  |                                                                |                                                                     |
|                                                         | 30 Hz to 500 kHz                        | 0.46 % of output + 12 µV  |                                                                |                                                                     |
|                                                         | (0.5 to 1.2) MHz                        | 0.47 % of output + 14 µV  |                                                                |                                                                     |
|                                                         | (1.2 to 2) MHz                          | 0.47 % of output + 14 µV  |                                                                |                                                                     |
|                                                         | (2 to 12) MHz                           | 0.49 % of output + 14 µV  |                                                                |                                                                     |
|                                                         | (12 to 20) MHz                          | 0.55 % of output + 14 µV  |                                                                |                                                                     |
|                                                         | (20 to 30) MHz                          | 0.89 % of output + 14 µV  |                                                                |                                                                     |
|                                                         | <b>(33 to 110) mV</b><br>(10 to 30) Hz  | 0.52 % of output + 30 µV  |                                                                |                                                                     |
|                                                         | 30 Hz to 500 kHz                        | 0.46 % of output + 30 µV  |                                                                |                                                                     |
|                                                         | (0.5 to 1.2) MHz                        | 0.47 % of output + 33 µV  |                                                                |                                                                     |
|                                                         | (1.2 to 2) MHz                          | 0.47 % of output + 33 µV  |                                                                |                                                                     |
|                                                         | (2 to 12) MHz                           | 0.49 % of output + 33 µV  |                                                                |                                                                     |
|                                                         | (12 to 20) MHz                          | 0.55 % of output + 33 µV  |                                                                |                                                                     |
|                                                         | (20 to 30) MHz                          | 0.89 % of output + 33 µV  |                                                                |                                                                     |
|                                                         | <b>(110 to 330) mV</b><br>(10 to 30) Hz | 0.45 % of output + 0.1 mV |                                                                |                                                                     |
|                                                         | 30 Hz to 500 kHz                        | 0.38 % of output + 0.1 mV |                                                                |                                                                     |
|                                                         | (0.5 to 1.2) MHz                        | 0.4 % of output + 0.1 mV  |                                                                |                                                                     |
|                                                         | (1.2 to 2) MHz                          | 0.4 % of output + 0.1 mV  |                                                                |                                                                     |
|                                                         | (2 to 12) MHz                           | 0.42 % of output + 0.1 mV |                                                                |                                                                     |
|                                                         | (12 to 20) MHz                          | 0.49 % of output + 0.1 mV |                                                                |                                                                     |
|                                                         | (20 to 30) MHz                          | 0.85 % of output + 0.1 mV |                                                                |                                                                     |

| Parameter/Range                                         | Frequency                                                                                                                                                                  | CMC <sup>2, 7</sup> (±)                                                                                                                                                                                | Comment                                                        | Location <sup>10</sup>                                               |
|---------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|----------------------------------------------------------------------|
| AC Voltage – Generate<br>Wideband Absolute <sup>3</sup> | <b>(0.33 to 1.1) V</b><br>(10 to 30) Hz<br>30 Hz to 500 kHz<br>(0.5 to 1.2) MHz<br>(1.2 to 2) MHz<br>(2 to 12) MHz<br>(12 to 20) MHz<br>(20 to 30) MHz                     | 0.45 % of output + 0.3 mV<br>0.38 % of output + 0.3 mV<br>0.4 % of output + 0.3 mV<br>0.4 % of output + 0.3 mV<br>0.42 % of output + 0.3 mV<br>0.49 % of output + 0.3 mV<br>0.85 % of output + 0.3 mV  | Fluke<br>5700A, 5720A,<br>5730A<br>multifunction<br>calibrator | TPA, ATL,<br>HSV, RFD,<br>HRT, HLR,<br>SFL, MEL,<br>COS, RDU,<br>DFW |
|                                                         | <b>(1.1 to 3.5) V</b><br>(10 to 30) Hz<br>30 Hz to 500 kHz<br>(0.5 to 1.2) MHz<br>(1.2 to 2) MHz<br>(2 to 12) MHz<br>(12 to 20) MHz<br>(20 to 30) MHz                      | 0.39 % of output + 0.4 mV<br>0.3 % of output + 0.4 mV<br>0.32 % of output + 0.4 mV<br>0.32 % of output + 0.4 mV<br>0.35 % of output + 0.4 mV<br>0.44 % of output + 0.4 mV<br>0.82 % of output + 0.4 mV |                                                                |                                                                      |
| AC Voltage – Measure <sup>3</sup>                       | <b>Up to 2.2 mV</b><br>(10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 300) kHz<br>(300 to 500) kHz<br>500 kHz to 1 MHz  | 1.3 mV/V + 1.2 µV<br>560 µV/V + 1.2 µV<br>320 µV/V + 1.2 µV<br>620 µV/V + 1.7 µV<br>910 µV/V + 2 µV<br>1.8 mV/V + 3.1 µV<br>1.8 mV/V + 6.1 µV<br>2.7 mV/V + 6.1 µV                                     | Fluke 5790B<br>AC/DC transfer<br>standard                      | TPA, RFD                                                             |
|                                                         | <b>(2.2 to 7) mV</b><br>(10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 300) kHz<br>(300 to 500) kHz<br>500 kHz to 1 MHz | 650 µV/V + 1.2 µV<br>280 µV/V + 1.2 µV<br>160 µV/V + 1.2 µV<br>300 µV/V + 1.7 µV<br>460 µV/V + 2 µV<br>910 µV/V + 3.1 µV<br>990 µV/V + 6.1 µV<br>1.8 mV/V + 6.1 µV                                     |                                                                |                                                                      |
|                                                         | <b>(7 to 22) mV</b><br>(10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 300) kHz<br>(300 to 500) kHz<br>500 kHz to 1 MHz  | 220 µV/V + 1.2 µV<br>150 µV/V + 1.2 µV<br>84 µV/V + 1.2 µV<br>160 µV/V + 1.7 µV<br>240 µV/V + 2 µV<br>620 µV/V + 3.1 µV<br>680 µV/V + 6.1 µV<br>1.3 mV/V + 6.1 µV                                      |                                                                |                                                                      |

| Parameter/Range                   | Frequency              | CMC <sup>2, 7</sup> (±) | Comment                                   | Location <sup>10</sup> |
|-----------------------------------|------------------------|-------------------------|-------------------------------------------|------------------------|
| AC Voltage – Measure <sup>3</sup> | <b>(22 to 70) mV</b>   |                         | Fluke 5790B<br>AC/DC transfer<br>standard | TPA, RFD               |
|                                   | (10 to 20) Hz          | 180 µV/V + 1.3 µV       |                                           |                        |
|                                   | (20 to 40) Hz          | 91 µV/V + 1.3 µV        |                                           |                        |
|                                   | 40 Hz to 20 kHz        | 49 µV/V + 1.3 µV        |                                           |                        |
|                                   | (20 to 50) kHz         | 99 µV/V + 1.7 µV        |                                           |                        |
|                                   | (50 to 100) kHz        | 200 µV/V + 2 µV         |                                           |                        |
|                                   | (100 to 300) kHz       | 390 µV/V + 3.1 µV       |                                           |                        |
|                                   | (300 to 500) kHz       | 510 µV/V + 6.1 µV       |                                           |                        |
|                                   | 500 kHz to 1 MHz       | 840 µV/V + 6.1 µV       |                                           |                        |
|                                   | <b>(70 to 220) mV</b>  |                         |                                           |                        |
|                                   | (10 to 20) Hz          | 160 µV/V + 1.3 µV       |                                           |                        |
|                                   | (20 to 40) Hz          | 65 µV/V + 1.3 µV        |                                           |                        |
|                                   | 40 Hz to 20 kHz        | 29 µV/V + 1.3 µV        |                                           |                        |
|                                   | (20 to 50) kHz         | 53 µV/V + 1.7 µV        |                                           |                        |
|                                   | (50 to 100) kHz        | 120 µV/V + 2 µV         |                                           |                        |
|                                   | (100 to 300) kHz       | 190 µV/V + 3.1 µV       |                                           |                        |
|                                   | (300 to 500) kHz       | 290 µV/V + 6.1 µV       |                                           |                        |
|                                   | 500 kHz to 1 MHz       | 760 µV/V + 6.1 µV       |                                           |                        |
|                                   | <b>(220 to 700) mV</b> |                         |                                           |                        |
|                                   | (10 to 20) Hz          | 160 µV/V + 1.3 µV       |                                           |                        |
|                                   | (20 to 40) Hz          | 58 µV/V + 1.3 µV        |                                           |                        |
|                                   | 40 Hz to 20 kHz        | 25 µV/V + 1.3 µV        |                                           |                        |
|                                   | (20 to 50) kHz         | 39 µV/V + 1.7 µV        |                                           |                        |
|                                   | (50 to 100) kHz        | 60 µV/V + 2 µV          |                                           |                        |
|                                   | (100 to 300) kHz       | 140 µV/V + 3.1 µV       |                                           |                        |
|                                   | (300 to 500) kHz       | 230 µV/V + 6.1 µV       |                                           |                        |
|                                   | 500 kHz to 1 MHz       | 730 µV/V + 6.1 µV       |                                           |                        |
|                                   | <b>700 mV to 2.2 V</b> |                         |                                           |                        |
|                                   | (10 to 20) Hz          | 150 µV/V + 0.7 µV       |                                           |                        |
|                                   | (20 to 40) Hz          | 50 µV/V + 0.7 µV        |                                           |                        |
|                                   | 40 Hz to 20 kHz        | 18 µV/V + 0.7 µV        |                                           |                        |
|                                   | (20 to 50) kHz         | 35 µV/V + 0.7 µV        |                                           |                        |
|                                   | (50 to 100) kHz        | 54 µV/V + 0.7 µV        |                                           |                        |
|                                   | (100 to 300) kHz       | 120 µV/V + 0.7 µV       |                                           |                        |
|                                   | (300 to 500) kHz       | 200 µV/V + 0.7 µV       |                                           |                        |
|                                   | 500 kHz to 1 MHz       | 690 µV/V + 0.7 µV       |                                           |                        |
|                                   | <b>(2.2 to 7) V</b>    |                         |                                           |                        |
|                                   | (10 to 20) Hz          | 150 µV/V + 0.9 µV       |                                           |                        |
|                                   | (20 to 40) Hz          | 51 µV/V + 0.9 µV        |                                           |                        |
|                                   | 40 Hz to 20 kHz        | 18 µV/V + 0.9 µV        |                                           |                        |
|                                   | (20 to 50) kHz         | 37 µV/V + 0.9 µV        |                                           |                        |
|                                   | (50 to 100) kHz        | 62 µV/V + 0.9 µV        |                                           |                        |
|                                   | (100 to 300) kHz       | 150 µV/V + 0.9 µV       |                                           |                        |
|                                   | (300 to 500) kHz       | 300 µV/V + 0.9 µV       |                                           |                        |
|                                   | 500 kHz to 1 MHz       | 910 µV/V + 0.9 µV       |                                           |                        |



| Parameter/Range                        | Frequency                                                                                                                                                                | CMC <sup>2, 7</sup> (±)                                                                                                                                          | Comment                                                | Location <sup>10</sup>                    |
|----------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|-------------------------------------------|
| AC Voltage – Measure <sup>3</sup>      | <b>(7 to 22) V</b><br>(10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 300) kHz<br>(300 to 500) kHz<br>500 kHz to 1 MHz | 150 µV/V + 0.9 µV<br>51 µV/V + 0.9 µV<br>21 µV/V + 0.9 µV<br>37 µV/V + 0.9 µV<br>62 µV/V + 0.9 µV<br>150 µV/V + 0.9 µV<br>300 µV/V + 0.9 µV<br>910 µV/V + 0.9 µV | Fluke 5790B<br>AC/DC transfer<br>standard              | TPA, RFD                                  |
|                                        | <b>(22 to 70) V</b><br>(10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 300) kHz                                        | 150 µV/V + 5.7 µV<br>52 µV/V + 5.7 µV<br>24 µV/V + 5.7 µV<br>43 µV/V + 5.7 µV<br>72 µV/V + 5.7 µV<br>150 µV/V + 5.7 µV                                           |                                                        |                                           |
|                                        | <b>(70 to 220) V</b><br>(10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz<br>(50 to 100) kHz                                                           | 150 µV/V + 5.7 µV<br>52 µV/V + 5.7 µV<br>24 µV/V + 5.7 µV<br>53 µV/V + 5.7 µV<br>75 µV/V + 5.7 µV                                                                |                                                        |                                           |
|                                        | <b>(220 to 700) V</b><br>40 Hz to 20 kHz<br>(20 to 50) kHz<br>(50 to 100) kHz                                                                                            | 31 µV/V + 57 µV<br>99 µV/V + 57 µV<br>380 µV/V + 57 µV                                                                                                           |                                                        |                                           |
|                                        | <b>(700 to 1000) V</b><br>40 Hz to 20 kHz<br>(20 to 30) kHz                                                                                                              | 29 µV/V + 57 µV<br>99 µV/V + 57 µV                                                                                                                               |                                                        |                                           |
| AC High Voltage – Measure <sup>3</sup> | <b>60 Hz</b><br>(1 to 10) kV<br>(10 to 42) kV                                                                                                                            | 0.5 % of rdg + 0.002 kV<br>0.5 % of rdg + 0.02 kV                                                                                                                | Ross VD60 HV<br>divider, Agilent<br>34401A multimeter  | TPA, RFD<br>ATL, HRT,<br>HLR,<br>MEL, COS |
|                                        | <b>60 Hz</b><br>(1 to 10) kV<br>(10 to 85) kV                                                                                                                            | 0.5 % of rdg + 0.002 kV<br>0.5 % of rdg + 0.02 kV                                                                                                                | Ross VD120 HV<br>divider, Agilent<br>34401A multimeter | TPA, RFD                                  |
|                                        | <b>60Hz</b><br>(1 to 28) kV                                                                                                                                              | 5.8 % of rdg                                                                                                                                                     | Fluke 80k-40 HV<br>probe, Agilent<br>34401A multimeter | SFL                                       |
|                                        | <b>60Hz</b><br>(1 to 5) kV<br>(5 to 21) kV                                                                                                                               | 0.5 % of rdg<br>0.5 % of rdg                                                                                                                                     | Ross VD30 HV<br>divider, Fluke 287<br>multimeter       | COS                                       |

| Parameter/Range                        | Frequency                                                                                                               | CMC <sup>2,7</sup> (±)                                                                                                                                                               | Comment                                                                                                             | Location <sup>10</sup> |
|----------------------------------------|-------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|------------------------|
| AC High Voltage – Measure <sup>3</sup> | <b>(0 to 1) kV</b><br>(30 to 200) Hz<br>(200 to 450) Hz                                                                 | 0.12 % of rdg + 0.000 1 kV<br>0.12 % of rdg + 0.000 15 kV<br>+ 0.14 µV/V x (Vin/1 000) ^2                                                                                            | Vitretek 4700 Digital HV Meter                                                                                      | DFW                    |
|                                        | <b>(1 to 10) kV</b><br>(30 to 200) Hz<br>(200 to 450) Hz                                                                | 0.4 % of rdg + 0.000 1 kV<br>0.4 % of rdg + 0.000 15 kV<br>+0.14 µV/V x (Vin/1 000) ^2                                                                                               |                                                                                                                     |                        |
|                                        | <b>(10 to 70) kV</b><br>(30 to 100) Hz<br>(100 to 200) Hz<br>(200 to 450) Hz                                            | 0.12 % of rdg + 0.001 kV<br>0.6 % of rdg + 0.001 kV<br>2.5 % of rdg + 0.001 kV +<br>+0.14 µV/V x (Vin/1 000) ^2                                                                      | Vitretek 4700 Digital HV Meter w/HVL-70 High Voltage Probe                                                          |                        |
|                                        | <b>(0 to 1) kV</b><br>(30 to 200) Hz<br>(200 to 450) Hz<br><br><b>(1 to 10) kV</b><br>(30 to 200) Hz<br>(200 to 450) Hz | 0.12 % of rdg + 0.0001 kV<br>0.12 % of rdg + 0.000 15 kV<br>+ 1.5 µV/V x (Vin/1 000) ^2<br><br>0.4 % of rdg + 0.0001 kV<br>0.4 % of rdg + 0.000 15 kV +<br>1.5 µV/V x (Vin/1 000) ^2 | Vitretek 4700 HV meter                                                                                              | RFD                    |
|                                        | <b>60 Hz</b><br>(0 to 5) kV<br>(5 to 21) kV                                                                             | 0.5 % of rdg<br>0.5 % of rdg                                                                                                                                                         | Ross VD30 HV divider, Agilent 34401A multimeter                                                                     | RDU                    |
|                                        | <b>60 Hz</b><br>(1 to 21) kV<br><br><b>60 Hz</b><br>(1 to 100) kV                                                       | 0.5 % of rdg + 0.002 kV<br><br>0.5 % of rdg + 0.02 kV                                                                                                                                | Ross VD30 high voltage divider, Fluke 89 IV multimeter<br><br>Ross VD150 high voltage divider, HP 34401A multimeter | HSV                    |

| Parameter/Range                   | Frequency                                                                                                                                                                                                              | CMC <sup>2, 7</sup> (±)                                                                                                                                                                                                                                                                    | Comment                     | Location <sup>10</sup>                                               |
|-----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|----------------------------------------------------------------------|
| AC Voltage – Measure <sup>3</sup> | <b>(1 to 10) mV</b><br>(1 to 40) Hz<br>40 Hz to 1 kHz<br>(1 to 20) kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>100 kHz to 1 MHz<br>(1 to 4) MHz<br>(4 to 8) MHz                                                        | 0.02 % of rdg + 2.0 µV<br>0.013 % of rdg + 0.7 µV<br>0.02 % of rdg + 0.7 µV<br>0.065 % of rdg + 0.7 µV<br>0.33 % of rdg + 0.7 µV<br>0.78 % of rdg + 3.3 µV<br>4.6 % of rdg + 4.6 µV<br>13 % of rdg + 5.3 µV                                                                                | Agilent 3458A<br>multimeter | TPA, ATL,<br>HSV, RFD,<br>HRT, HLR,<br>MEL, COS,<br>RDU, SFL,<br>DFW |
|                                   | <b>(10 to 100) mV</b><br>(1 to 40) Hz<br>40 Hz to 1 kHz<br>(1 to 20) kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 300) kHz<br>300 kHz to 1 MHz<br>(1 to 2) MHz<br>(2 to 4) MHz<br>(4 to 8) MHz<br>(8 to 10) MHz | 0.005 % of rdg + 2.6 µV<br>0.005 % of rdg + 1.3 µV<br>0.009 % of rdg + 1.3 µV<br>0.02 % of rdg + 1.3 µV<br>0.052 % of rdg + 1.3 µV<br>0.20 % of rdg + 6.5 µV<br>0.70 % of rdg + 6.5 µV<br>0.98 % of rdg + 46 µV<br>2.6 % of rdg + 46 µV<br>2.6 % of rdg + 52 µV<br>9.8 % of rdg + 65 µV    |                             |                                                                      |
|                                   | <b>(0.1 to 1) V</b><br>(1 to 40) Hz<br>40 Hz to 1 kHz<br>(1 to 20) kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 300) kHz<br>300 kHz to 1 MHz<br>(1 to 2) MHz<br>(2 to 4) MHz<br>(4 to 8) MHz<br>(8 to 10) MHz   | 0.005 % of rdg + 26 µV<br>0.005 % of rdg + 13 µV<br>0.009 % of rdg + 13 µV<br>0.02 % of rdg + 13 µV<br>0.052 % of rdg + 13 µV<br>0.2 % of rdg + 65 µV<br>0.65 % of rdg + 65 µV<br>0.98 % of rdg + 0.5 mV<br>2.6 % of rdg + 0.5 mV<br>2.6 % of rdg + 0.5 mV<br>9.8 % of rdg + 0.7 mV        |                             |                                                                      |
|                                   | <b>(1 to 10) V</b><br>(1 to 40) Hz<br>40 Hz to 1 kHz<br>(1 to 20) kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 300) kHz<br>300 kHz to 1 MHz<br>(1 to 2) MHz<br>(2 to 4) MHz<br>(4 to 8) MHz<br>(8 to 10) MHz    | 0.005 % of rdg + 0.3 mV<br>0.005 % of rdg + 0.1 mV<br>0.009 % of rdg + 0.1 mV<br>0.02 % of rdg + 0.1 mV<br>0.052 % of rdg + 0.1 mV<br>0.2 % of rdg + 0.7 mV<br>0.65 % of rdg + 0.7 mV<br>0.98 % of rdg + 4.6 mV<br>2.6 % of rdg + 4.6 mV<br>2.6 % of rdg + 5.2 mV<br>9.8 % of rdg + 6.5 mV |                             |                                                                      |

| Parameter/Range                   | Frequency                                                                                                                                                                                                  | CMC <sup>2, 7</sup> (±)                                                                                                                                                                                                                                                | Comment                     | Location <sup>10</sup>                                               |
|-----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|----------------------------------------------------------------------|
| AC Voltage – Measure <sup>3</sup> | <b>(10 to 100) V</b><br>(1 to 40) Hz<br>40 Hz to 1 kHz<br>(1 to 20) kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 300) kHz<br>300 kHz to 1 MHz                                                       | 0.013 % of rdg + 2.6 mV<br>0.013 % of rdg + 1.3 mV<br>0.013 % of rdg + 1.3 mV<br>0.023 % of rdg + 1.3 mV<br>0.08 % of rdg + 1.3 mV<br>0.26 % of rdg + 6.5 mV<br>0.98 % of rdg + 6.5 mV                                                                                 | Agilent 3458A<br>multimeter | TPA, ATL,<br>HSV, RFD,<br>HRT, HLR,<br>MEL, COS,<br>RDU, SFL,<br>DFW |
|                                   | <b>(100 to 700) V</b><br>(1 to 40) Hz<br>40 Hz to 1 kHz<br>(1 to 20) kHz<br>(20 to 50) kHz<br>(50 to 100) kHz                                                                                              | 0.026 % of rdg + 26 mV<br>0.026 % of rdg + 13 mV<br>0.039 % of rdg + 13 mV<br>0.078 % of rdg + 13 mV<br>0.20 % of rdg + 13 mV                                                                                                                                          |                             |                                                                      |
|                                   | <b>(1.2 to 12.12) mV</b><br>(1 to 2 000) Hz<br>(2 to 10) kHz<br>(10 to 30) kHz<br>(30 to 100) kHz<br>(100 to 300) kHz<br>(0.3 to 1) MHz                                                                    | 0.028 % of rdg + 1.2 µV<br>0.036 % of rdg + 1.2 µV<br>0.037 % of rdg + 1.2 µV<br>0.30 % of rdg + 0.9 µV<br>0.99 % of rdg + 3.9 µV<br>2 % of rdg + 3.9 µV                                                                                                               |                             |                                                                      |
|                                   | <b>(12.12 to 121.2) mV</b><br>(1 to 2 000) Hz<br>(2 to 10) kHz<br>(10 to 30) kHz<br>(30 to 100) kHz<br>(100 to 300) kHz<br>(0.3 to 1 MHz)<br>(1 to 2) MHz<br>(2 to 4) MHz<br>(4 to 8) MHz<br>(8 to 10) MHz | 0.009 % of rdg + 0.6 µV<br>0.013 % of rdg + 0.6 µV<br>0.023 % of rdg + 1.1 µV<br>0.052 % of rdg + 5.1 µV<br>0.21 % of rdg + 31 µV<br>0.99 % of rdg + 0.1 mV<br>1.5 % of rdg + 0.5 mV<br>4 % of rdg + 1.0 mV<br>8.2 % of rdg + 1.0 mV<br>16 % of rdg + 1.0 mV           |                             |                                                                      |
|                                   | <b>(0.1212 to 1.212) V</b><br>(1 to 2 000) Hz<br>(2 to 10) kHz<br>(10 to 30) kHz<br>(30 to 100) kHz<br>(100 to 300) kHz<br>(0.3 to 1) MHz<br>(1 to 2) MHz<br>(2 to 4) MHz<br>(4 to 8) MHz<br>(8 to 10) MHz | 0.007 % of rdg + 0.006 mV<br>0.012 % of rdg + 0.006 mV<br>0.023 % of rdg + 0.011 mV<br>0.052 % of rdg + 0.05 mV<br>0.21 % of rdg + 0.31 mV<br>0.99 % of rdg + 0.99 mV<br>1.5 % of rdg + 4.9 mV<br>4 % of rdg + 9.8 mV<br>8.1 % of rdg + 9.8 mV<br>15 % of rdg + 9.8 mV |                             |                                                                      |
|                                   |                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                        | Fluke 8588A<br>multimeter   | ATL, RFD,<br>DFW                                                     |

| Parameter/Range                   | Frequency                                                                                                                                                                                                | CMC <sup>2, 7</sup> (±)                                                                                                                                                                                                                                      | Comment                   | Location <sup>10</sup> |
|-----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|------------------------|
| AC Voltage – Measure <sup>3</sup> | <b>(1.212 to 12.12) V</b><br>(1 to 2000) Hz<br>(2 to 10) kHz<br>(10 to 30) kHz<br>(30 to 100) kHz<br>(100 to 300) kHz<br>(0.3 to 1) MHz<br>(1 to 2) MHz<br>(2 to 4) MHz<br>(4 to 8) MHz<br>(8 to 10) MHz | 0.007 % of rdg + 0.06mV<br>0.012 % of rdg + 0.06 mV<br>0.023 % of rdg + 0.11 mV<br>0.052 % of rdg + 0.52 mV<br>0.21 % of rdg + 3.1 mV<br>0.99 % of rdg + 9.9 mV<br>1.5 % of rdg + 49 mV<br>4 % of rdg + 98 mV<br>8.1 % of rdg + 98 mV<br>15 % of rdg + 98 mV | Fluke 8588A<br>multimeter | ATL, RFD,<br>DFW       |
|                                   | <b>(12.12 to 121.2) V</b><br>(1 to 2000) Hz<br>(2 to 10) kHz<br>(10 to 30) kHz<br>(30 to 100) kHz<br>(100 to 200) kHz                                                                                    | 0.009 % of rdg + 0.6 mV<br>0.011 % of rdg + 0.6 mV<br>0.023 % of rdg + 1.1 mV<br>0.058 % of rdg + 5.1 mV<br>0.37 % of rdg + 46 mV                                                                                                                            |                           |                        |
|                                   | <b>(121.2 to 1050) V</b><br>(1 to 2000) Hz<br>(2 to 10) kHz<br>(10 to 30) kHz                                                                                                                            | 0.011 % of rdg + 26 mV<br>0.011 % of rdg + 26 mV<br>0.023 % of rdg + 26 mV                                                                                                                                                                                   |                           |                        |
| AC Voltage – Measure <sup>3</sup> | <b>(1.2 to 12.12) mV</b><br>(1 to 2000) Hz<br>(2 to 10) kHz<br>(10 to 30) kHz<br>(30 to 100) kHz<br>(100 to 300) kHz<br>(0.3 to 1 MHz)                                                                   | 0.06 % of rdg + 2.0 µV<br>0.045 % of rdg + 2.0 µV<br>0.046 % of rdg + 2.0 µV<br>0.42 % of rdg + 2.0 µV<br>1.6 % of rdg + 5.9 µV<br>2.5 % of rdg + 5.9 µV                                                                                                     | Fluke 8558A<br>multimeter | RDU                    |
|                                   | <b>12.12 to 121.2) mV</b><br>(1 to 2000) Hz<br>(2 to 10) kHz<br>(10 to 30) kHz<br>(30 to 100) kHz<br>(100 to 300) kHz<br>(0.3 to 1 MHz)<br>(1 to 2) MHz<br>(2 to 4) MHz<br>(4 to 8) MHz<br>(8 to 10) MHz | 0.011 % of rdg + 1.0 µV<br>0.015 % of rdg + 1.0 µV<br>0.025 % of rdg + 2.0 µV<br>0.057 % of rdg + 20 µV<br>0.34 % of rdg + 50 µV<br>1.4 % of rdg + 0.2 mV<br>1.6 % of rdg + 0.7mV<br>4.6 % of rdg + 1.2 mV<br>9.2 % of rdg + 1.2 mV<br>18 % of rdg + 1.2 mV  |                           |                        |

| Parameter/Range                                                             | Frequency                                                                                                                                                                                                 | CMC <sup>2, 7</sup> (±)                                                                                                                                                                                                                                      | Comment                                   | Location <sup>10</sup> |
|-----------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|------------------------|
| AC Voltage – Measure <sup>3</sup>                                           | <b>(0.1212 to 1.212) V</b><br>(1 to 2000) Hz<br>(2 to 10) kHz<br>(10 to 30) kHz<br>(30 to 100) kHz<br>(100 to 300) kHz<br>(0.3 to 1 MHz)<br>(1 to 2) MHz<br>(2 to 4) MHz<br>(4 to 8) MHz<br>(8 to 10) MHz | 0.010 % of rdg + 0.01mV<br>0.014 % of rdg + 0.01 mV<br>0.025 % of rdg + 0.02 mV<br>0.057 % of rdg + 0.20 mV<br>0.26 % of rdg + 0.5 mV<br>1.4 % of rdg + 2 mV<br>1.6 % of rdg + 7 mV<br>4.6 % of rdg + 12 mV<br>9.1 % of rdg + 12 mV<br>18 % of rdg + 12 mV   | Fluke 8558A<br>multimeter                 | RDU                    |
|                                                                             | <b>(1.212 to 12.12) V</b><br>(1 to 2000) Hz<br>(2 to 10) kHz<br>(10 to 30) kHz<br>(30 to 100) kHz<br>(100 to 300) kHz<br>(0.3 to 1 MHz)<br>(1 to 2) MHz<br>(2 to 4) MHz<br>(4 to 8) MHz<br>(8 to 10) MHz  | 0.010 % of rdg + 0.1mV<br>0.014 % of rdg + 0.1 mV<br>0.025 % of rdg + 0.2 mV<br>0.057 % of rdg + 2.0 mV<br>0.26 % of rdg + 5.0 mV<br>1.38 % of rdg + 20 mV<br>1.6 % of rdg + 70 mV<br>4.6 % of rdg + 120 mV<br>9.1 % of rdg + 120 mV<br>18 % of rdg + 120 mV |                                           |                        |
|                                                                             | <b>(12.12 to 121.2) V</b><br>(1 to 2000) Hz<br>(2 to 10) kHz<br>(10 to 30) kHz<br>(30 to 100) kHz<br>(100 to 200) kHz                                                                                     | 0.011 % of rdg + 1.0mV<br>0.015 % of rdg + 1.0 mV<br>0.025 % of rdg + 2.0 mV<br>0.063 % of rdg + 20 mV<br>0.43 % of rdg + 100 mV                                                                                                                             |                                           |                        |
|                                                                             | <b>(121.2 to 1050) V</b><br>(1 to 1000) Hz<br>(2 to 10) kHz<br>(10 to 30) kHz                                                                                                                             | 0.016 % of rdg + 30mV<br>0.018 % of rdg + 30 mV<br>0.032 % of rdg + 30 mV                                                                                                                                                                                    |                                           |                        |
| AC Voltage – Measure<br>Wideband Flatness Relative<br>to 1 kHz <sup>3</sup> | <b>(0.6 to 2.2) mV</b><br>(10 to 30) Hz<br>30 Hz to 120 kHz<br>120 kHz 2 MHz<br>(2 to 10) MHz<br>(10 to 20) MHz<br>(20 to 30) MHz                                                                         | 0.08 % of rdg + 0.1 µV<br>0.04 % of rdg + 0.1 µV<br>0.05 % of rdg + 0.8 µV<br>0.13 % of rdg + 0.8 µV<br>0.23 % of rdg + 0.8 µV<br>0.53 % of rdg + 1.6 µV                                                                                                     | Fluke 5790B<br>AC/DC transfer<br>standard | TPA, RFD               |
|                                                                             | <b>(2.2 to 7) mV</b><br>(10 to 30) Hz<br>30 Hz to 120 kHz<br>120 kHz 2 MHz<br>(2 to 10) MHz<br>(10 to 20) MHz<br>(20 to 30) MHz                                                                           | 0.08 % of rdg + 0.1 µV<br>0.04 % of rdg + 0.1 µV<br>0.05 % of rdg + 0.8 µV<br>0.08 % of rdg + 0.8 µV<br>0.13 % of rdg + 0.8 µV<br>0.28 % of rdg + 0.8 µV                                                                                                     |                                           |                        |

| Parameter/Range                                                             | Frequency                               | CMC <sup>2, 6, 7</sup> (±) | Comment                                   | Location <sup>10</sup> |
|-----------------------------------------------------------------------------|-----------------------------------------|----------------------------|-------------------------------------------|------------------------|
| AC Voltage – Measure<br>Wideband Flatness Relative<br>to 1 kHz <sup>3</sup> | <b>(7 to 22) mV</b><br>(10 to 30) Hz    | 0.08 % of rdg + 0.1 µV     | Fluke 5790B<br>AC/DC transfer<br>standard | TPA, RFD               |
|                                                                             | 30 Hz to 120 kHz                        | 0.04 % of rdg + 0.1 µV     |                                           |                        |
|                                                                             | 120 kHz to 2 MHz                        | 0.05 % of rdg + 0.1 µV     |                                           |                        |
|                                                                             | (2 to 10) MHz                           | 0.08 % of rdg + 0.1 µV     |                                           |                        |
|                                                                             | (10 to 20) MHz                          | 0.13 % of rdg + 0.1 µV     |                                           |                        |
|                                                                             | (20 to 30) MHz                          | 0.28 % of rdg + 0.1 µV     |                                           |                        |
|                                                                             | <b>(22 to 70) mV</b><br>(10 to 30) Hz   | 0.08 % of rdg + 0.6 µV     |                                           |                        |
|                                                                             | (30 Hz to 2 MHz)                        | 0.04 % of rdg + 0.6 µV     |                                           |                        |
|                                                                             | (2 to 10) MHz                           | 0.08 % of rdg + 0.6 µV     |                                           |                        |
|                                                                             | (10 to 20) MHz                          | 0.11 % of rdg + 0.6 µV     |                                           |                        |
|                                                                             | (20 to 30) MHz                          | 0.27 % of rdg + 0.6 µV     |                                           |                        |
|                                                                             | <b>(70 to 220) mV</b><br>(10 to 30) Hz  | 0.08 % of rdg              |                                           |                        |
|                                                                             | 30 Hz to 500 kHz                        | 0.03 % of rdg              |                                           |                        |
|                                                                             | 500 kHz to 2 MHz                        | 0.04 % of rdg              |                                           |                        |
|                                                                             | (2 to 10) MHz                           | 0.08 % of rdg              |                                           |                        |
|                                                                             | (10 to 20) MHz                          | 0.11 % of rdg              |                                           |                        |
|                                                                             | (20 to 30) MHz                          | 0.27 % of rdg              |                                           |                        |
|                                                                             | <b>(220 to 700) mV</b><br>(10 to 30) Hz | 0.08 % of rdg              |                                           |                        |
|                                                                             | 30 Hz to 500 kHz                        | 0.02 % of rdg              |                                           |                        |
|                                                                             | 500 kHz to 2 MHz                        | 0.04 % of rdg              |                                           |                        |
|                                                                             | (2 to 10) MHz                           | 0.08 % of rdg              |                                           |                        |
|                                                                             | (10 to 20) MHz                          | 0.11 % of rdg              |                                           |                        |
|                                                                             | (20 to 30 MHz)                          | 0.27 % of rdg              |                                           |                        |
|                                                                             | <b>(0.7 to 2) V</b><br>(10 to 30) Hz    | 0.08 % of rdg              |                                           |                        |
|                                                                             | 30 Hz to 500 kHz                        | 0.02 % of rdg              |                                           |                        |
|                                                                             | 500 kHz to 2 MHz                        | 0.04 % of rdg              |                                           |                        |
|                                                                             | (2 to 10) MHz                           | 0.08 % of rdg              |                                           |                        |
|                                                                             | (10 to 20) MHz                          | 0.11 % of rdg              |                                           |                        |
|                                                                             | (20 to 30) MHz                          | 0.27 % of rdg              |                                           |                        |
|                                                                             | <b>(2.2 to 7) V</b><br>(10 to 30) Hz    | 0.08 % of rdg              |                                           |                        |
|                                                                             | 30 Hz to 500 kHz                        | 0.02 % of rdg              |                                           |                        |
|                                                                             | 500 kHz to 2 MHz                        | 0.04 % of rdg              |                                           |                        |
|                                                                             | (2 to 10) MHz                           | 0.08 % of rdg              |                                           |                        |
|                                                                             | (10 to 20) MHz                          | 0.11 % of rdg              |                                           |                        |
|                                                                             | (20 to 30) MHz                          | 0.27 % of rdg              |                                           |                        |

| Parameter/Range                    | Frequency                                                                                                                                                                                                                                                                                                                                                                                                                                                         | CMC <sup>2, 7</sup> (±)                                                                                                                                                                                                                                                                                                                                                                                              | Comment                              | Location <sup>10</sup>            |
|------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|-----------------------------------|
| AC Current – Generate <sup>3</sup> | <b>(9 to 220) µA</b><br>(10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz<br><br><b>(0.22 to 2.2) mA</b><br>(10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz<br><br><b>(2.2 to 22) mA</b><br>(10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz<br><br><b>(22 to 220) mA</b><br>(10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz | 230 µA/A + 15 nA<br>150 µA/A + 10 nA<br>91 µA/A + 8 nA<br>270 µA/A + 12 nA<br>990 µA/A + 61 nA<br><br>230 µA/A + 39 nA<br>150 µA/A + 31 nA<br>91 µA/A + 31 nA<br>180 µA/A + 99 nA<br>990 µA/A + 610 nA<br><br>230 µA/A + 390 nA<br>150 µA/A + 310 nA<br>91 µA/A + 310 nA<br>180 µA/A + 540 nA<br>990 µA/A + 4.6 µA<br><br>230 µA/A + 4 µA<br>150 µA/A + 3 µA<br>91 µA/A + 2 µA<br>180 µA/A + 3 µA<br>990 µA/A + 9 µA | Fluke 5730A multifunction calibrator | TPA, HSV, RFD, MEL, COS, RDU, DFW |
|                                    | <b>(9 to 220) µA</b><br>(10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz<br><br><b>(0.22 to 2.2) mA</b><br>(10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz<br><br><b>(2.2 to 22) mA</b><br>(10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz                                                                                                                   | 220 µA/A + 15 nA<br>150 µA/A + 10 nA<br>110 µA/A + 8 nA<br>270 µA/A + 12 nA<br>990 µA/A + 61 nA<br><br>230 µA/A + 39 nA<br>150 µA/A + 31 nA<br>110 µA/A + 31 nA<br>180 µA/A + 99 nA<br>990 µA/A + 610 nA<br><br>230 µA/A + 390 nA<br>150 µA/A + 310 nA<br>110 µA/A + 310 nA<br>180 µA/A + 540 nA<br>990 µA/A + 4.6 µA                                                                                                | Fluke 5720A multifunction calibrator | ATL, SFL, HLR                     |





| Parameter/Range                    | Frequency                                                                                                                                                                                                                                                                                                                                                                                                                                                         | CMC <sup>2, 7</sup> (±)                                                                                                                                                                                                                                                                                                                                                                                                           | Comment                              | Location <sup>10</sup>                                 |
|------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|--------------------------------------------------------|
| AC Current – Generate <sup>3</sup> | <b>(22 to 220) mA</b><br>(10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz                                                                                                                                                                                                                                                                                                                                                        | 230 µA/A + 4 µA<br>150 µA/A + 3 µA<br>110 µA/A + 2 µA<br>180 µA/A + 3 µA<br>990 µA/A + 9 µA                                                                                                                                                                                                                                                                                                                                       | Fluke 5720A multifunction calibrator | ATL, SFL<br>HLR                                        |
|                                    | <b>(9 to 220) µA</b><br>(10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz<br><br><b>(0.22 to 2.2) mA</b><br>(10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz<br><br><b>(2.2 to 22) mA</b><br>(10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz<br><br><b>(22 to 220) mA</b><br>(10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz | 610 µA/A + 23 nA<br>320 µA/A + 19 nA<br>120 µA/A + 15 nA<br>530 µA/A + 38 nA<br>1400 µA/A + 760 nA<br><br>610 µA/A + 39 nA<br>320 µA/A + 31 nA<br>120 µA/A + 31 nA<br>530 µA/A + 380 nA<br>1400 µA/A + 760 nA<br><br>610 µA/A + 390 nA<br>320 µA/A + 310 nA<br>120 µA/A + 310 nA<br>530 µA/A + 3.8 µA<br>1400 µA/A + 7.6 µA<br><br>610 µA/A + 4 µA<br>320 µA/A + 3 µA<br>140 µA/A + 3 µA<br>530 µA/A + 38 µA<br>1400 µA/A + 76 µA | Fluke 5700A multifunction calibrator | HRT                                                    |
|                                    | <b>(0.22 to 1.2) A</b><br>(3 to 45) Hz<br>45 to 1000 Hz<br>(1 to 5) kHz<br>(5 to 10) kHz<br>(10 to 30) kHz<br><br><b>(1.2 to 3.1) A</b><br>(3 to 45) Hz<br>45 to 1000 Hz<br>(1 to 5) kHz<br>(5 to 10) kHz<br><br><b>(3.1 to 12) A</b><br>(3 to 45) Hz<br>45 to 1000 Hz<br>(1 to 5) kHz<br>(5 to 10) kHz                                                                                                                                                           | 0.019 % of output + 0.08 mA<br>0.019 % of output + 0.04 mA<br>0.019 % of output + 0.06 mA<br>0.19 % of output + 0.23 mA<br>0.38 % of output + 0.23 mA<br><br>0.029 % of output + 0.4 mA<br>0.023 % of output + 0.27 mA<br>0.029 % of output + 0.27 mA<br>0.19 % of output + 0.40 mA<br><br>0.029 % of output + 0.8 mA<br>0.023 % of output + 0.4 mA<br>0.029 % of output + 0.6 mA<br>0.19 % of output + 0.8 mA                    | Fluke 5560A multiproduct calibrator  | COS, HRT,<br>MEL, ATL<br>RDU, TPA,<br>RFD, HSV,<br>DFW |

| Parameter/Range                                    | Frequency                                                                                                                                                | CMC <sup>2, 7</sup> (±)                                                                                                                      | Comment                                                                                | Location <sup>10</sup>                                 |
|----------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|--------------------------------------------------------|
| AC Current – Generate <sup>3</sup>                 | <b>(12 to 30.2) A</b><br>(3 to 45) Hz<br>45 to 1000 Hz<br>(1 to 5) kHz                                                                                   | 0.076 % of output + 7.7 mA<br>0.053 % of output + 6.2 mA<br>0.038 % of output + 6.2 mA                                                       | Fluke 5560A<br>multiproduct<br>calibrator                                              | COS, HRT,<br>MEL, ATL<br>RDU, TPA,<br>RFD, HSV,<br>DFW |
|                                                    | <b>(30.2 to 120) A</b><br>(10 to 65) Hz<br>(65 to 300) Hz<br>300 Hz to 1 kHz<br>(1 to 3) kHz<br>(3 to 6) kHz<br>(6 to 10) kHz                            | 160 µA/A + 19 mA<br>250 µA/A + 28 mA<br>770 µA/A + 92 mA<br>0.23 % of output + 230 mA<br>0.76 % of output + 410 mA<br>3 % of output + 690 mA | Fluke 5560A<br>multiproduct<br>calibrator,<br>52120A<br>transconductanc<br>e amplifier | TPA, RFD                                               |
|                                                    | <b>(0.22 to 2.2) A</b><br>20 Hz to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz<br><br><b>(2.2 to 11) A</b><br>40 Hz to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz | 230 µA/A + 31 µA<br>380 µA/A + 76 µA<br>6.1 mA/A + 150 µA<br><br>350 µA /A + 141 µA<br>720 µA /A + 300 µA<br>2.7 mA /A + 570 µA              | Fluke 5720A,<br>5730A<br>multifunction<br>calibrator                                   | SFL, HLR,<br>HSV                                       |
|                                                    | <b>(11 to 20.5) A</b><br>45 Hz to 100 Hz<br>100 Hz to 1 kHz<br>(1 to 5) kHz                                                                              | 0.09 % of output + 5 mA<br>0.11 % of output + 5 mA<br>2.3 % of output + 5 mA                                                                 | Fluke 5522A<br>multiproduct<br>calibrator                                              |                                                        |
| AC Current – Generate<br>Clamp Meters <sup>3</sup> | <b>(3.1 to 300.2) A</b><br>(3 to 440) Hz                                                                                                                 | 0.65 % of output + 0.077 A                                                                                                                   | Fluke 5560A,<br>w/55xxA<br>x1/2/10 coil                                                | RDU                                                    |
|                                                    | <b>(3.3 to 30) A</b><br>(10 to 100) Hz<br>(100 to 440) Hz<br><br><b>(30 to 200) A</b><br>10 to 100 Hz<br>(100 to 440) Hz                                 | 0.22 % of output + 0.028 A<br>0.3 % of output + 0.07 A<br><br>0.22 % of output + 0.032 A<br>0.79 % of output + 0.08 A                        | Fluke 5522A<br>multiproduct,<br>w/9100-200 x10<br>coil                                 | HLR, SFL                                               |
|                                                    | <b>(6 to 150) A</b><br>(10 to 100) Hz<br>(100 to 440) Hz<br><br><b>(150 to 1 000) A</b><br>(10 to 100) Hz<br>(100 to 440) Hz                             | 0.22 % of output + 0.029 A<br>0.3 % of output + 0.08 A<br><br>0.22 % of output + 0.81 A<br>0.79 % of output + 0.2 A                          | Fluke 5522A<br>multiproduct,<br>w/9100-200 x50<br>coil                                 |                                                        |
|                                                    |                                                                                                                                                          |                                                                                                                                              |                                                                                        |                                                        |



| Parameter/Range                                               | Frequency                                | CMC <sup>2, 7</sup> (±)    | Comment                                                             | Location <sup>10</sup>                    |
|---------------------------------------------------------------|------------------------------------------|----------------------------|---------------------------------------------------------------------|-------------------------------------------|
| AC Current – Generate<br>Clamp Meters <sup>3</sup>            | <b>(1.2 to 30) A</b><br>(10 to 440) Hz   | 0.2 % of output + 0.005 A  | Fluke 5560A<br>multiproduct<br>calibrator /<br>9100-200 x10<br>coil | HRT, COS,<br>HSV                          |
|                                                               | <b>(30 to 120) A</b><br>(10 to 440) Hz   | 0.20 % of output + 0.008 A |                                                                     |                                           |
|                                                               | <b>(120 to 200) A</b><br>10 to 440 Hz    | 0.21 % of output + 0.076 A |                                                                     |                                           |
|                                                               | <b>(6 to 150) A</b><br>(10 to 100) Hz    | 0.2 % of output + 0.02 A   | Fluke 5560A<br>multiproduct<br>calibrator /<br>9100-200 x50<br>coil |                                           |
|                                                               | <b>(150 to 600) A</b><br>(10 to 100) Hz  | 0.2 % of output + 0.04 A   |                                                                     |                                           |
|                                                               | <b>(600 to 1000) A</b><br>(10 to 100) Hz | 0.21 % of output + 0.31 A  |                                                                     |                                           |
| AC Current Clamps –<br>Toroidal-Wound <sup>3</sup>            | <b>(0.6 to 600) A</b><br>(45 to 65) Hz   | 0.21 % of output + 71 mA   | Fluke 5560A<br>multiproduct<br>calibrator /x50<br>coil              | TPA, RFD<br>MEL, ATL,<br>COS, DFW,<br>HSV |
|                                                               | <b>(600 to 1000) A</b><br>(45 to 65) Hz  | 0.22 % of output + 0.311 A |                                                                     |                                           |
|                                                               | <b>(0.6 to 155) A</b><br>(65 to 440) Hz  | 0.6 % of output + 77 mA    |                                                                     |                                           |
| AC Current Clamps –<br>Other <sup>3</sup>                     | <b>(0.6 to 600) A</b><br>(45 to 65) Hz   | 0.43 % of output + 0.53 A  |                                                                     |                                           |
|                                                               | <b>(600 to 1000) A</b><br>(45 to 65) Hz  | 0.43 % of output + 0.61 A  |                                                                     |                                           |
|                                                               | <b>(0.6 to 155) A</b><br>(65 to 440) Hz  | 0.76 % of output + 0.69 A  |                                                                     |                                           |
| AC Current – Generate <sup>3</sup><br>Clamps – Toroidal-Wound | <b>(16.5 to 150) A</b><br>(45 to 65) Hz  | 0.22 % of output + 69 mA   | Fluke 5522A<br>multiproduct<br>calibrator,<br>5500A/coil x50        | HSV                                       |
|                                                               | <b>(150 to 1 000) A</b><br>(45 to 65) Hz | 0.23 % of output + 0.2 A   |                                                                     |                                           |
|                                                               | <b>(16.5 to 150) A</b><br>(65 to 440) Hz | 0.64 % of output + 0.085 A |                                                                     |                                           |
| AC Current – Generate <sup>3</sup><br>Clamps – Other          | <b>(16.5 to 1025) A</b><br>(45 to 65) Hz | 0.44 % of output + 0.57 A  |                                                                     |                                           |
|                                                               | <b>(16.5 to 150) A</b><br>(65 to 440) Hz | 0.79 % of output + 0.69 A  |                                                                     |                                           |

| Parameter/Range                           | Frequency                                                                                    | CMC <sup>2, 7</sup> (±)                                  | Comment                                                                                             | Location <sup>10</sup> |  |
|-------------------------------------------|----------------------------------------------------------------------------------------------|----------------------------------------------------------|-----------------------------------------------------------------------------------------------------|------------------------|--|
| AC Current Clamps – Rogowski <sup>3</sup> | <b>(10 to 100) A</b><br>(10 to 1000) Hz<br>(1 to 3) kHz                                      | 0.53 % of output + 0.011 A<br>0.61 % of output + 0.015 A | Fluke 5560A multiproduct calibrator, Fluke 52120A transconductance amplifier, coil 6KA current coil | TPA, RFD               |  |
|                                           | <b>(100 to 1000) A</b><br>(10 to 1000) Hz<br>(1 to 3) kHz                                    | 0.53 % of output + 0.11 A<br>0.61 % of output + 0.15 A   |                                                                                                     |                        |  |
|                                           | <b>(1000 to 6000) A</b><br>(10 to 1000) Hz                                                   | 0.53 % of output + 0.68 A                                |                                                                                                     |                        |  |
|                                           | <b>(1000 to 3500) A</b><br>(1 to 3) kHz                                                      | 0.61 % of output + 0.95 A                                |                                                                                                     |                        |  |
| AC Current – Measure <sup>3</sup>         | <b>(2 to 200) µA</b><br>10 Hz to 10 kHz                                                      | 0.047 % of rdg + 0.018 µA                                | Fluke 8508A multimeter                                                                              | TPA                    |  |
|                                           | <b>200 µA to 2 mA</b><br>10 Hz to 10 kHz                                                     | 0.028 % of rdg + 0.18 µA                                 | Agilent 3458A multimeter/<br>Fluke A40 current shunts                                               |                        |  |
|                                           | <b>(0.19 to 1) mA</b><br>(10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz | 200 µA/A<br>200 µA/A<br>170 µA/A<br>280 µA/A             |                                                                                                     |                        |  |
|                                           | <b>(1 to 10) mA</b><br>(10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz   | 160 µA/A<br>70 µA/A<br>40 µA/A<br>65 µA/A                |                                                                                                     |                        |  |
|                                           | <b>(10 to 50) mA</b><br>(10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz  | 170 µA/A<br>69 µA/A<br>39 µA/A<br>66 µA/A                |                                                                                                     |                        |  |
|                                           | <b>(50 to 500) mA</b><br>(10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz | 170 µA/A<br>70 µA/A<br>40 µA/A<br>72 µA/A                |                                                                                                     |                        |  |
|                                           | <b>(0.5 to 2) A</b><br>(10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz   | 170 µA/A<br>77 µA/A<br>62 µA/A<br>110 µA/A               |                                                                                                     |                        |  |
|                                           |                                                                                              |                                                          |                                                                                                     |                        |  |
|                                           |                                                                                              |                                                          |                                                                                                     |                        |  |
|                                           |                                                                                              |                                                          |                                                                                                     |                        |  |
|                                           |                                                                                              |                                                          |                                                                                                     |                        |  |
|                                           |                                                                                              |                                                          |                                                                                                     |                        |  |

| Parameter/Range                   | Frequency                                                                                                                                                                                                                                                                                                                                                                                                 | CMC <sup>2, 7</sup> (±)                                                                                                                                                                                                                  | Comment                                                                     | Location <sup>10</sup> |
|-----------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|------------------------|
| AC Current – Measure <sup>3</sup> | <b>(2 to 10) A</b><br>(10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz                                                                                                                                                                                                                                                                                                                 | 180 µA/A<br>94 µA/A<br>79 µA/A<br>130 µA/A                                                                                                                                                                                               | Fluke 5790B<br>AC/DC transfer<br>standard / Fluke<br>A40 current<br>shunts  | TPA                    |
|                                   | <b>(10 to 20) A</b><br>(10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 1 kHz<br>(1 to 5) kHz                                                                                                                                                                                                                                                                                                                   | 310 µA/A<br>310 µA/A<br>270 µA/A<br>380 µA/A                                                                                                                                                                                             | Agilent 3458A<br>multimeter /<br>Fluke Y5020<br>current shunt               | TPA, RFD,<br>ATL       |
|                                   | <b>(1 to 10) A</b><br>(10 to 1000) Hz<br><br><b>(10 to 100) A</b><br>(10 to 1000) Hz<br><br><b>(100 to 300) A</b><br>(10 to 1000) Hz                                                                                                                                                                                                                                                                      | 50 µA/A + 130 µA<br><br>50 µA/A + 1.3 mA<br><br>50 µA/A + 13 mA                                                                                                                                                                          | Agilent 3458A<br>multimeter, MI<br>6311A current<br>divider                 | TPA                    |
|                                   | <b>(0.22 to 10) mA</b><br>(10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz<br><br><b>(10 to 50) mA</b><br>(10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz<br><br><b>(50 to 100) mA</b><br>(10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz<br><br><b>(100 to 250) mA</b><br>(10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz | 190 µA/A + 0.002 µA<br>90 µA/A + 0.002 µA<br>44 µA/A + 0.002 µA<br>76 µA/A + 0.002 µA<br><br>190 µA/A<br>87 µA/A<br>42 µA/A<br>71 µA/A<br><br>190 µA/A<br>88 µA/A<br>45 µA/A<br>77 µA/A<br><br>190 µA/A<br>91 µA/A<br>42 µA/A<br>82 µA/A | Fluke 5790A<br>AC/DC transfer<br>standard / Holt<br>HCS-1 current<br>shunts | RFD                    |

| Parameter/Range                   | Frequency                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | CMC <sup>2, 7</sup> (±)                                                                                                                                                                                                                                                                                | Comment                                                                     | Location <sup>10</sup>                                           |
|-----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|------------------------------------------------------------------|
| AC Current – Measure <sup>3</sup> | <b>(250 to 500) mA</b><br>(10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz<br><br><b>(0.5 to 1) A</b><br>(10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz<br><br><b>(1 to 2.5) A</b><br>(10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz<br><br><b>(2.5 to 5) A</b><br>(10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz<br><br><b>(5 to 10) A</b><br>(10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz | 190 µA/A<br>91 µA/A<br>42 µA/A<br>82 µA/A<br><br>190 µA/A<br>92 µA/A<br>59 µA/A<br>120 µA/A<br><br>200 µA/A<br>110 µA/A<br>78 µA/A<br>130 µA/A<br><br>200 µA/A<br>110 µA/A<br>85 µA/A<br>180 µA/A<br><br>210 µA/A<br>130 µA/A<br>100 µA/A<br>150 µA/A                                                  | Fluke 5790A<br>AC/DC transfer<br>standard / Holt<br>HCS-1 current<br>shunts | RFD                                                              |
|                                   | <b>(5 to 100) µA</b><br>(10 to 20) Hz<br>(20 to 45) Hz<br>45 Hz to 1 kHz<br><br><b>(0.1 to 1) mA</b><br>(10 to 20) Hz<br>(20 to 45) Hz<br>(45 to 100) Hz<br>100 Hz to 5 kHz<br><br><b>(1 to 10) mA</b><br>(10 to 20) Hz<br>(20 to 45) Hz<br>(45 to 100) Hz<br>100 Hz to 5 kHz                                                                                                                                                                                                                        | 0.26 % of rdg + 0.02 µA<br>0.1 % of rdg + 0.02 µA<br>0.04 % of rdg + 0.02 µA<br><br>0.26 % of rdg + 0.13 µA<br>0.1 % of rdg + 0.13 µA<br>0.04 % of rdg + 0.13 µA<br>0.02 % of rdg + 0.13 µA<br><br>0.26 % of rdg + 1.3 µA<br>0.1 % of rdg + 1.3 µA<br>0.04 % of rdg + 1.3 µA<br>0.02 % of rdg + 1.3 µA | Agilent 3458A<br>multimeter                                                 | TPA, MEL<br>ATL, RFD<br>HSV, COS<br>HRT, RDU<br>SFL, HLR,<br>DFW |

| Parameter/Range                   | Frequency                                                                                                                                                                                                                                                                                                                                   | CMC <sup>2, 7</sup> (±)                                                                                                                                                                                                                                                                                                                   | Comment                  | Location <sup>10</sup>                                           |
|-----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|------------------------------------------------------------------|
| AC Current – Measure <sup>3</sup> | <b>(10 to 100) mA</b><br>(10 to 20) Hz<br>(20 to 45) Hz<br>(45 to 100) Hz<br>100 Hz to 5 kHz<br><br><b>(0.1 to 1) A</b><br>(10 to 20) Hz<br>(20 to 45) Hz<br>(45 to 100) Hz<br>100 Hz to 5 kHz                                                                                                                                              | 0.26 % of rdg + 13 µA<br>0.1 % of rdg + 13 µA<br>0.04 % of rdg + 13 µA<br>0.02 % of rdg + 13 µA<br><br>0.26 % of rdg + 0.13 mA<br>0.1 % of rdg + 0.13 mA<br>0.04 % of rdg + 0.13 mA<br>0.02 % of rdg + 0.13 mA                                                                                                                            | Agilent 3458A multimeter | TPA, MEL<br>ATL, RFD<br>HSV, COS<br>HRT, RDU<br>SFL, HLR,<br>DFW |
|                                   | <b>(2.02 to 20.2) µA</b><br>(1 to 2000) Hz<br>(2 to 10) kHz<br>(10 to 30) kHz<br><br><b>(0.202 to 2.02) mA</b><br>(1 to 2000) Hz<br>(2 to 10) kHz<br>(10 to 30) kHz<br><br><b>2.02 to 20.2) mA</b><br>(1 to 2000) Hz<br>(2 to 10) kHz<br>(10 to 30) kHz<br><br><b>(20.2 to 202) mA</b><br>(1 to 2000) Hz<br>(2 to 10) kHz<br>(10 to 30) kHz | 0.20 % of rdg + 2.5 nA<br>0.20 % of rdg + 2.5 nA<br>0.20 % of rdg + 2.5 nA<br><br>0.027 % of rdg + 49 nA<br>0.052 % of rdg + 49 nA<br>0.073 % of rdg + 49 nA<br><br>0.027 % of rdg + 0.49 µA<br>0.052 % of rdg + 0.49 µA<br>0.073 % of rdg + 0.49 µA<br><br>0.027 % of rdg + 4.9 µA<br>0.051 % of rdg + 4.9 µA<br>0.073 % of rdg + 4.9 µA | 8588A multimeter         | RFD, ATL,<br>DFW                                                 |
|                                   | <b>(0.202 to 2.02) A</b><br>(1 to 2000) Hz<br>(2 to 10) kHz<br>(10 to 30) kHz<br><br><b>(2.02 to 20.2) A</b><br>(10 to 2000) Hz<br>(2 to 10) kHz<br><br><b>(20.2 to 30.2) A</b><br>(10 to 2000) Hz<br>(2 to 10) kHz                                                                                                                         | 0.029 % of rdg + 98 µA<br>0.054 % of rdg + 98 µA<br>0.078 % of rdg + 98 µA<br><br>0.082 % of rdg + 0.49 mA<br>0.082 % of rdg + 0.49 mA<br><br>0.082 % of rdg + 12 mA<br>0.122 % of rdg + 12 mA                                                                                                                                            | 8588A multimeter         | RFD, ATL,<br>DFW                                                 |

| Parameter/Range                   | Frequency                                                                                                                                                                       | CMC <sup>2, 7</sup> (±)                                                                                                                                                                                        | Comment                             | Location <sup>10</sup>                        |
|-----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|-----------------------------------------------|
| AC Current – Measure <sup>3</sup> | <b>(2.02 to 20.2) µA</b><br>(1 to 2000) Hz<br>(2 to 10) kHz<br>(10 to 30) kHz                                                                                                   | 0.38 % of rdg + 2.9 nA<br>0.38 % of rdg + 2.9 nA<br>0.38 % of rdg + 2.9 nA                                                                                                                                     | Fluke 8558A<br>multimeter           | RDU                                           |
|                                   | <b>(2.02 to 20.2) µA</b><br>(1 to 2000) Hz<br>(2 to 10) kHz<br>(10 to 30) kHz                                                                                                   | 0.044 % of rdg + 9.8 nA<br>0.087 % of rdg + 9.8 nA<br>0.11 % of rdg + 9.8 nA                                                                                                                                   |                                     |                                               |
|                                   | <b>(0.202 to 2.02) mA</b><br>(1 to 2000) Hz<br>(2 to 10) kHz<br>(10 to 30) kHz                                                                                                  | 0.044 % of rdg + 98 nA<br>0.087 % of rdg + 98 nA<br>0.11 % of rdg + 98 nA                                                                                                                                      |                                     |                                               |
|                                   | <b>(2.02 to 20.2) mA</b><br>(1 to 2000) Hz<br>(2 to 10) kHz<br>(10 to 30) kHz                                                                                                   | 0.044 % of rdg + 0.98 µA<br>0.087 % of rdg + 0.98 µA<br>0.11 % of rdg + 0.98 µA                                                                                                                                |                                     |                                               |
|                                   | <b>(20.2 to 202) mA</b><br>(1 to 2 000) Hz<br>(2 to 10) kHz<br>(10 to 30) kHz                                                                                                   | 0.044 % of rdg + 9.8 µA<br>0.087 % of rdg + 9.8 µA<br>0.11 % of rdg + 9.8 µA                                                                                                                                   |                                     |                                               |
|                                   | <b>(0.202 to 2.02) A</b><br>(1 to 2000) Hz<br>(2 to 10) kHz<br>(10 to 30) kHz                                                                                                   | 0.044 % of rdg + 148 µA<br>0.076 % of rdg + 148 µA<br>0.12 % of rdg + 148 µA                                                                                                                                   |                                     |                                               |
|                                   | <b>(1 to 3) A</b><br>(3 to 5) Hz<br>(5 to 10) Hz<br>10 Hz to 5 kHz                                                                                                              | 0.72 % of rdg + 1.2 mA<br>0.23 % of rdg + 1.2 mA<br>0.1 % of rdg + 1.2 mA                                                                                                                                      | Agilent<br>34401A<br>multimeter     | MEL, ATL,<br>SFL, HSV                         |
|                                   | <b>(1 to 3) A</b><br>(3 to 5) Hz<br>(5 to 10) Hz<br>10 Hz to 5 kHz<br>(5 to 10) kHz<br><br><b>(3 to 10) A</b><br>(3 to 5) Hz<br>(5 to 10) Hz<br>10 Hz to 5 kHz<br>(5 to 10) kHz | 0.84 % of rdg + 1.4 mA<br>0.27 % of rdg + 1.4 mA<br>0.11 % of rdg + 1.4 mA<br>0.27 % of rdg + 16 mA<br><br>0.84 % of rdg + 4.6 mA<br>0.27 % of rdg + 4.6 mA<br>0.11 % of rdg + 4.6 mA<br>0.27 % of rdg + 53 mA | Fluke<br>8845A, 8846A<br>multimeter | RFD, HLR<br>RDU, HRT<br>TPA, COS,<br>HSV, DFW |



| Parameter/Range                                     | Frequency                                                                            | CMC <sup>2, 6, 7</sup> (±)                                     | Comment                                                             | Location <sup>10</sup>            |
|-----------------------------------------------------|--------------------------------------------------------------------------------------|----------------------------------------------------------------|---------------------------------------------------------------------|-----------------------------------|
| AC Current – Measure <sup>3</sup>                   | <b>(3 to 30) A</b><br>40 Hz to 1 kHz<br>(1 to 5) kHz                                 | 0.3 % of rdg + 0.07 A<br>5 % of rdg + 0.14 A                   | Agilent 3458A<br>multimeter,<br>Keysight<br>34330A current<br>shunt | ATL, HSV<br>RFD, HLR<br>SFL, MEL  |
|                                                     | <b>(10 to 100) A</b><br>(50 to 1000) Hz<br><b>(100 to 600) A</b><br>(50 to 1000) Hz  | 2 % of rdg + 0.02 A<br>2 % of rdg + 0.2 A                      | Fluke 80i-600<br>clamp meter /<br>Agilent 3458A<br>multimeter       | ATL                               |
|                                                     | <b>(10 to 2 000) A</b><br>55 to 65 Hz<br><b>(2 000 to 6 000) A</b><br>55 to 65 Hz    | 1.5 % of rdg + 0.5A<br>1 % of rdg + 3.9 A                      | PEM CWT600B<br>Rogowski coil /<br>Agilent 34401A<br>multimeter      | ATL, TPA                          |
|                                                     | <b>(10 to 1 000) A</b><br>(10 to 100) Hz<br>(100 to 500) Hz                          | 1.5 % of rdg + 0.9 A<br>1.9 % of rdg + 6.6 A                   | Fluke 376 clamp<br>meter                                            | TPA, MEL<br>RFD, HRT,<br>HSV, DFW |
| AC Current – Measure <sup>3</sup>                   | <b>(200 to 600) A</b><br>(10 to 500) Hz<br><b>(600 to 2 500) A</b><br>(10 to 500) Hz | 2.3 % of rdg + 0.9 A<br>2.3 % of rdg + 6.6 A                   | Fluke 376 clamp<br>meter i2500 flex<br>probe                        | TPA, MEL<br>HRT, HSV              |
|                                                     | <b>(30 to 600) A</b><br>(10 to 100) Hz<br>(100 to 400) Hz                            | 1.5 % of rdg + 1.1 A<br>4.6 % of rdg + 1.1 A                   | Fluke 336 clamp<br>meter                                            | SFL                               |
| Resistance – Generate,<br>Fixed Points <sup>3</sup> | 1 mΩ<br>10 mΩ<br>100 mΩ                                                              | 10 μΩ/Ω<br>6.6 μΩ/Ω<br>25.3 μΩ/Ω                               | LN 422x<br>resistance<br>standards                                  | TPA, RFD                          |
|                                                     | 100 μΩ<br>1 mΩ<br>10 mΩ<br>100 mΩ<br>1 Ω<br>10 Ω                                     | 0.053 %<br>0.039 %<br>0.016 %<br>0.014 %<br>0.009 %<br>0.008 % | Burster 1240<br>series resistance<br>standards                      | HSV                               |

| Parameter/Equipment                                | Range                                                                                                                                    | CMC <sup>2, 7</sup> (±)                                                                                                                                                                                                           | Comment                                     | Location <sup>10</sup>                        |
|----------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|-----------------------------------------------|
| Resistance – Generate <sup>3</sup><br>Fixed Points | 1 mΩ<br>10 mΩ<br>100 mΩ                                                                                                                  | 100 μΩ/Ω<br>100 μΩ/Ω<br>100 μΩ/Ω                                                                                                                                                                                                  | Standard resistors                          | MEL                                           |
|                                                    | 1 Ω<br>10 Ω<br>100 Ω<br>1 kΩ<br>10 kΩ<br>100 kΩ<br>1 MΩ<br>10 MΩ<br>100 MΩ<br>1 GΩ                                                       | 1 μΩ/Ω<br>2 μΩ/Ω<br>0.44 μΩ/Ω<br>0.67 μΩ/Ω<br>0.86 μΩ/Ω<br>1.2 μΩ/Ω<br>2 μΩ/Ω<br>2.5 μΩ/Ω<br>19 μΩ/Ω<br>84 μΩ/Ω                                                                                                                   | Fluke 742A, IET SRL<br>resistance standards | TPA                                           |
|                                                    | 1 Ω<br>10 kΩ                                                                                                                             | 2.6 μΩ/Ω<br>0.93 μΩ/Ω                                                                                                                                                                                                             | Fluke 742A resistance<br>standards          | RFD                                           |
|                                                    | <b>100 V</b><br>100 kΩ<br><br><b>(100 to 1000) V</b><br>1 MΩ<br>10 MΩ<br>100 MΩ<br>1 GΩ<br>10 GΩ                                         | 1 % of output<br><br>1 % of output<br>1 % of output<br>1 % of output<br>1 % of output<br>1.2 % of output                                                                                                                          | TMI RB resistance<br>standard               | TPA, HSV<br>MEL, HLR<br>HRT, SFL,<br>COS, DFW |
|                                                    | <b>(100 to 1000) V</b><br>100 GΩ                                                                                                         | 3.2 % of output                                                                                                                                                                                                                   |                                             | TPA, MEL<br>HSV, DFW                          |
|                                                    | (1, 1.9) Ω<br>(10, 19) Ω<br>(100, 190) Ω<br>(1, 1.9) kΩ<br>(10, 19) kΩ<br>100 kΩ<br>190 kΩ<br>1 MΩ<br>1.9 MΩ<br>10 MΩ<br>19 MΩ<br>100 MΩ | 84 μΩ/Ω + 0.1 μΩ<br>21 μΩ/Ω + 1 μΩ<br>9.1 μΩ/Ω + 6 μΩ<br>6.1 μΩ/Ω + 60 μΩ<br>6.1 μΩ/Ω + 0.6 mΩ<br>7.6 μΩ/Ω + 6 mΩ<br>9.1 μΩ/Ω + 6 mΩ<br>11 μΩ/Ω + 60 mΩ<br>16 μΩ/Ω + 60 mΩ<br>35 μΩ/Ω + 0.6 Ω<br>42 μΩ/Ω + 0.6 Ω<br>91 μΩ/Ω + 6 Ω | Fluke 5730A<br>multifunction<br>calibrator  | COS, HSV<br>MEL, RDU<br>RFD, TPA,<br>DFW      |

| Parameter/Equipment                                | Range                                                                                                                                                                                                                                                                                  | CMC <sup>2, 7</sup> ( $\pm$ )                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Comment                                    | Location <sup>10</sup> |
|----------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|------------------------|
| Resistance – Generate <sup>3</sup><br>Fixed Points | (1, 1.9) $\Omega$<br>(10, 19) $\Omega$<br>(100, 190) $\Omega$<br>(1, 1.9) k $\Omega$<br>(10, 19) k $\Omega$<br>(100, 190) k $\Omega$<br>1 M $\Omega$<br>1.9 M $\Omega$<br>10 M $\Omega$<br>19 M $\Omega$<br>100 M $\Omega$                                                             | 84 $\mu\Omega/\Omega + 0.1 \mu\Omega$<br>21 $\mu\Omega/\Omega + 1 \mu\Omega$<br>9.1 $\mu\Omega/\Omega + 6 \mu\Omega$<br>7.6 $\mu\Omega/\Omega + 60 \mu\Omega$<br>7.6 $\mu\Omega/\Omega + 0.6 \text{ m}\Omega$<br>9.9 $\mu\Omega/\Omega + 6 \text{ m}\Omega$<br>18 $\mu\Omega/\Omega + 60 \text{ m}\Omega$<br>18 $\mu\Omega/\Omega + 60 \text{ m}\Omega$<br>35 $\mu\Omega/\Omega + 0.6 \Omega$<br>42 $\mu\Omega/\Omega + 0.6 \Omega$<br>91 $\mu\Omega/\Omega + 6 \Omega$                                                                                                                                                                                                                                                               | Fluke 5720A<br>multifunction<br>calibrator | HLR, SFL,<br>ATL       |
|                                                    | (1, 1.9) $\Omega$<br>(10, 19) $\Omega$<br>(100, 190) $\Omega$<br>(1, 1.9) k $\Omega$<br>(10, 19) k $\Omega$<br>(100, 190) k $\Omega$<br><br>1 M $\Omega$<br>1.9 M $\Omega$<br>10 M $\Omega$<br>19 M $\Omega$<br>100 M $\Omega$                                                         | 84 $\mu\Omega/\Omega + 0.1 \mu\Omega$<br>25 $\mu\Omega/\Omega + 1 \mu\Omega$<br>15 $\mu\Omega/\Omega + 6 \mu\Omega$<br>11 $\mu\Omega/\Omega + 60 \mu\Omega$<br>11 $\mu\Omega/\Omega + 0.6 \text{ m}\Omega$<br>12 $\mu\Omega/\Omega + 6 \text{ m}\Omega$<br><br>18 $\mu\Omega/\Omega + 60 \text{ m}\Omega$<br>18 $\mu\Omega/\Omega + 60 \text{ m}\Omega$<br>35 $\mu\Omega/\Omega + 0.6 \Omega$<br>42 $\mu\Omega/\Omega + 0.6 \Omega$<br>99 $\mu\Omega/\Omega + 6 \Omega$                                                                                                                                                                                                                                                               | Fluke 5700A<br>multifunction<br>calibrator | HRT                    |
|                                                    | 1 $\Omega$<br>1.9 $\Omega$<br>10 $\Omega$<br>19 $\Omega$<br>100 $\Omega$<br>190 $\Omega$<br>1 k $\Omega$<br>1.9 k $\Omega$<br>10 k $\Omega$<br>19 k $\Omega$<br>100 k $\Omega$<br>190 k $\Omega$<br>1 M $\Omega$<br>1.9 M $\Omega$<br>10 M $\Omega$<br>19 M $\Omega$<br>100 M $\Omega$ | 13 $\mu\Omega/\Omega + 0.6 \mu\Omega$<br>8.7 $\mu\Omega/\Omega + 0.6 \mu\Omega$<br>5.6 $\mu\Omega/\Omega + 6 \mu\Omega$<br>6.7 $\mu\Omega/\Omega + 6 \mu\Omega$<br>4.7 $\mu\Omega/\Omega + 60 \mu\Omega$<br>4.5 $\mu\Omega/\Omega + 60 \mu\Omega$<br>1.2 $\mu\Omega/\Omega + 0.6 \text{ m}\Omega$<br>1.1 $\mu\Omega/\Omega + 0.6 \text{ m}\Omega$<br>3 $\mu\Omega/\Omega + 0.6 \text{ m}\Omega$<br>2 $\mu\Omega/\Omega + 6 \text{ m}\Omega$<br>1.9 $\mu\Omega/\Omega + 60 \text{ m}\Omega$<br>1.7 $\mu\Omega/\Omega + 60 \text{ m}\Omega$<br>3.4 $\mu\Omega/\Omega + 0.6 \Omega$<br>2.8 $\mu\Omega/\Omega + 0.6 \Omega$<br>7.3 $\mu\Omega/\Omega + 6 \Omega$<br>11 $\mu\Omega/\Omega + 6 \Omega$<br>49 $\mu\Omega/\Omega + 60 \Omega$ | Fluke 5450A<br>resistance<br>calibrator    | RFD                    |

| Parameter/Equipment                    | Range                                                                                                                                                                                                                                                                                                             | CMC <sup>2,7</sup> (±)                                                                                                                                                                                                                                                                                                                                        | Comment                             | Location <sup>10</sup>                               |
|----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|------------------------------------------------------|
| Resistance – Fixed Points <sup>3</sup> | (0.01, 0.1, 1.0) Ω                                                                                                                                                                                                                                                                                                | 34 μΩ/Ω                                                                                                                                                                                                                                                                                                                                                       | Leeds & Northrup resistor set       | ATL                                                  |
|                                        | 1 mΩ<br>10 mΩ<br>10 mΩ<br>1 Ω<br>10 Ω<br>100 Ω<br>1 kΩ<br>10 kΩ<br>100 kΩ                                                                                                                                                                                                                                         | 0.033 % of Output<br>0.019 % of Output<br>0.029 % of Output<br>0.014 % of Output<br>0.013 % of Output<br>0.013 % of Output<br>0.013 % of Output<br>0.013 % of Output<br>0.013 % of Output                                                                                                                                                                     | Keysight 42030A resistor set fixed  | COS                                                  |
| Resistance – Generate <sup>3</sup>     | Up to 12 Ω<br>(12 to 120) Ω<br>(0.12 to 1.20) kΩ<br>(1.2 to 12.0) kΩ<br>(12 to 120) kΩ<br>(0.12 to 1.2) MΩ<br>(1.2 to 12) MΩ<br>(12 to 120) MΩ<br>(120 to 1200) MΩ                                                                                                                                                | 19 μΩ/Ω + 0.001 Ω<br>19 μΩ/Ω + 0.001 Ω<br>19 μΩ/Ω + 0.002 Ω<br>19 μΩ/Ω + 0.02 Ω<br>19 μΩ/Ω + 0.2 Ω<br>19 μΩ/Ω + 2 Ω<br>27 μΩ/Ω + 24 Ω<br>330 μΩ/Ω + 2 kΩ<br>3 mΩ/Ω + 76 Ω                                                                                                                                                                                     | Fluke 5560A multiproduct calibrator | COS, HRT<br>MEL, ATL<br>RDU, RFD<br>TPA, HSV,<br>DFW |
|                                        | (0 to 11) Ω<br>(11 to 33) Ω<br>(33 to 110) Ω<br>(110 to 330) Ω<br>(0.33 to 1.1) kΩ<br>(1.1 to 3.3) kΩ<br>(3.3 to 11) kΩ<br>(11 to 33) kΩ<br>(33 to 110) kΩ<br>(110 to 330) kΩ<br>0.33 kΩ to 1.1 MΩ<br>(1.1 to 3.3) MΩ<br>(3.3 to 11) MΩ<br>(11 to 33) MΩ<br>(33 to 110) MΩ<br>(110 to 330) MΩ<br>330 MΩ to 1.1 GΩ | 30 μΩ/Ω + 0.001 Ω<br>23 μΩ/Ω + 0.001 Ω<br>21 μΩ/Ω + 0.001 Ω<br>21 μΩ/Ω + 0.002 Ω<br>21 μΩ/Ω + 0.002 Ω<br>21 μΩ/Ω + 0.02 Ω<br>21 μΩ/Ω + 0.02 Ω<br>21 μΩ/Ω + 0.2 Ω<br>21 μΩ/Ω + 0.2 Ω<br>24 μΩ/Ω + 2 Ω<br>24 μΩ/Ω + 2 Ω<br>46 μΩ/Ω + 23 Ω<br>99 μΩ/Ω + 38 Ω<br>190 μΩ/Ω + 1.9 k Ω<br>380 μΩ/Ω + 2.3 k Ω<br>0.23 % of setting + 76 k Ω<br>1.1 % of rdg + 380 k Ω | Fluke 5522A multiproduct calibrator | SFL, HLR<br>HSV                                      |

| Parameter/Equipment                               | Range                                                                                                                                                                                                                        | CMC <sup>2, 7</sup> (±)                                                                                                                                                                                                | Comment                                                                   | Location <sup>10</sup> |
|---------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|------------------------|
| Resistance – Measure <sup>3</sup><br>Fixed Points | (1, 1.9) Ω<br>(10, 19) Ω<br>(100, 190) Ω<br>(1, 1.9) kΩ<br>(10, 19) kΩ<br>(100, 190) kΩ<br>(1, 1.9) MΩ<br>(10, 19) MΩ<br>100 MΩ<br>1 GΩ                                                                                      | 4.8 μΩ/Ω<br>2.6 μΩ/Ω<br>0.7 μΩ/Ω<br>0.9 μΩ/Ω<br>1 μΩ/Ω<br>1.3 μΩ/Ω<br>2.3 μΩ/Ω<br>2.9 μΩ/Ω<br>22 μΩ/Ω<br>120 μΩ/Ω                                                                                                      | Fluke 8508A<br>multimeter, Fluke<br>742A, IET SRL<br>resistance standards | TPA                    |
| Resistance – Measure <sup>3</sup>                 | Up to 2 Ω<br>(2 to 20) Ω<br>(20 to 200) Ω<br>200 Ω to 2 kΩ<br>(2 to 20) kΩ<br>(20 to 200) kΩ<br>200 kΩ to 2 MΩ<br>(2 to 20) MΩ<br>(20 to 200) MΩ<br>200 MΩ to 2 GΩ<br>(2 to 20) GΩ                                           | 15 μΩ/Ω + 3.8 μΩ<br>8.8 μΩ/Ω + 14 μΩ<br>7.2 μΩ/Ω + 46 μΩ<br>7.2 μΩ/Ω + 457 μΩ<br>7.2 μΩ/Ω + 4.6 mΩ<br>7.2 μΩ/Ω + 46 mΩ<br>8 μΩ/Ω + 0.9 Ω<br>15 μΩ/Ω + 9 Ω<br>57 μΩ/Ω + 0.9 kΩ<br>150 μΩ/Ω + 91 kΩ<br>510 μΩ/Ω + 9.1 MΩ | Fluke 8508A<br>multimeter                                                 | TPA                    |
|                                                   | Up to 2.02 Ω<br>(2.02 to 20.2) Ω<br>(20.2 to 202) Ω<br>(0.202 to 2.02) kΩ<br>(2.02 to 20.2) kΩ<br>(20.2 to 202) kΩ<br>(0.202 to 2.02) MΩ<br>(2.02 to 20.2) MΩ<br>(20.2 to 202) MΩ<br>(0.202 to 2.02) GΩ<br>(2.02 to 20.2) GΩ | 16 μΩ/Ω + 4 μΩ<br>9.6 μΩ/Ω + 14 μΩ<br>9.0 μΩ/Ω + 48 μΩ<br>8.9 μΩ/Ω + 0.46 mΩ<br>9 μΩ/Ω + 4.6 mΩ<br>9.1 μΩ/Ω + 46 mΩ<br>10 μΩ/Ω + 1 Ω<br>17 μΩ/Ω + 9.8 Ω<br>67 μΩ/Ω + 0.98 kΩ<br>0.23 μΩ/Ω + 98 kΩ<br>1.3 mΩ/Ω + 9.8 MΩ | Fluke 8588A<br>multimeter                                                 | RFD, ATL,<br>DFW       |
|                                                   | Up to 2.02 Ω<br>2.02 to 20.2 Ω<br>(20.2 to 202) Ω<br>(0.202 to 2.02) kΩ<br>(2.02 to 20.2) kΩ<br>(20.2 to 202) kΩ<br>(0.202 to 2.02) MΩ<br>(2.02 to 20.2) MΩ<br>(20.2 to 202) MΩ<br>(0.202 to 2.02) GΩ<br>(2.02 to 20.2) GΩ   | 21 μΩ/Ω + 4.4 μΩ<br>15 μΩ/Ω + 20 μΩ<br>12 μΩ/Ω + 53 μΩ<br>12 μΩ/Ω + 0.53 mΩ<br>12 μΩ/Ω + 5.3 mΩ<br>12 μΩ/Ω + 53 mΩ<br>13 μΩ/Ω + 1.0 Ω<br>17 μΩ/Ω + 9.8 Ω<br>67 μΩ/Ω + 0.98 kΩ<br>23 μΩ/Ω + 98 kΩ<br>1.3 mΩ/Ω + 9.8 MΩ  | Fluke 8558A<br>multimeter                                                 | RDU                    |

| Parameter/Equipment               | Range                                                                                                                                                                                                                                                                                                                                                                                        | CMC <sup>2, 7</sup> (±)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Comment                      | Location <sup>10</sup>                                               |
|-----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|----------------------------------------------------------------------|
| Resistance – Measure <sup>3</sup> | Up to 12 Ω<br>(10 to 120) Ω<br>(0.1 to 1.2) kΩ<br>(1 to 12) kΩ<br>(10 to 120) kΩ<br>(0.1 to 1.2) MΩ<br>(1 to 12) MΩ<br>(10 to 120) MΩ<br>(0.1 to 1.2) GΩ                                                                                                                                                                                                                                     | 9.8 μΩ/Ω + 38 μΩ<br>7.8 μΩ/Ω + 0.3 mΩ<br>6.5 μΩ/Ω + 0.4 mΩ<br>6.5 μΩ/Ω + 3.8 mΩ<br>6.5 μΩ/Ω + 38 mΩ<br>9.8 μΩ/Ω + 1.5 Ω<br>33 μΩ/Ω + 100 Ω<br>330 μΩ/Ω + 1 kΩ<br>0.33 % of rdg + 70 kΩ                                                                                                                                                                                                                                                                                                                                                                        | Agilent 3458A<br>multimeter  | TPA, ATL,<br>HSV, RFD,<br>HLR, SFL,<br>MEL, COS,<br>RDU,<br>HRT, DFW |
|                                   | <b>100 V</b><br>100 kΩ<br><br><b>(100, 1000) V</b><br>1 MΩ<br>10 MΩ<br>100 MΩ<br>1 GΩ<br>10 GΩ<br><br><b>(500, 1000) V</b><br>100 GΩ<br><br><b>1000 V</b><br>1 TΩ<br>10 TΩ                                                                                                                                                                                                                   | 0.53 % of rdg<br><br>0.5 % of rdg<br>0.5 % of rdg<br>0.5 % of rdg<br>0.5 % of rdg<br>0.52 % of rdg<br><br>0.59 % of rdg<br><br>0.7 % of rdg<br>2.5 % of rdg                                                                                                                                                                                                                                                                                                                                                                                                   | Quadtech 1865<br>megohmmeter | TPA                                                                  |
|                                   | <b>50 Hz</b><br>(1 to 10) Ω<br>(10 to 100) Ω<br>(100 to 1000) Ω<br>(1 to 10) kΩ<br>(10 to 100) kΩ<br>(0.1 to 1) MΩ<br>(1 to 10) MΩ<br><br><b>100/120 Hz</b><br>(1 to 10) Ω<br>(10 to 100) Ω<br>(100 to 1000) Ω<br>(1 to 10) kΩ<br>(10 to 100) kΩ<br>(0.1 to 1) MΩ<br>(1 to 10) MΩ<br><br><b>1000 Hz</b><br>(1 to 10) Ω<br>(10 to 100) Ω<br>(100 to 1000) Ω<br>(1 to 10) kΩ<br>(10 to 100) kΩ | 0.17 % of rdg + 0.003 Ω<br>0.062 % of rdg + 0.006 Ω<br>0.051 % of rdg + 0.06 Ω<br>0.05 % of rdg + 0.0006 kΩ<br>0.054 % of rdg + 0.006 kΩ<br>0.09 % of rdg + 0.00006 MΩ<br>0.45 % of rdg + 0.0006 MΩ<br><br>0.13 % of rdg + 0.003 Ω<br>0.049 % of rdg + 0.006 Ω<br>0.041 % of rdg + 0.06 Ω<br>0.04 % of rdg + 0.0006 kΩ<br>0.043 % of rdg + 0.006 kΩ<br>0.07 % of rdg + 0.000 06 MΩ<br>0.34 % of rdg + 0.0006 MΩ<br><br>0.05 % of rdg + 0.003 Ω<br>0.02 % of rdg + 0.006 Ω<br>0.02 % of rdg + 0.06 Ω<br>0.02 % of rdg + 0.000 6 kΩ<br>0.02 % of rdg + 0.006 kΩ | IET 1693 RLC<br>meter        | TPA, RFD<br>COS                                                      |

| Parameter/Equipment                 | Range                                                                                                                                                                            | CMC <sup>2,7</sup> (±)                                                                                                                                                                                                                                               | Comment                                   | Location <sup>10</sup>                               |
|-------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|------------------------------------------------------|
| Resistance – Measure <sup>3</sup>   | <b>1000 Hz</b><br>(0.1 to 1) MΩ<br>(1 to 10) MΩ                                                                                                                                  | 0.03 % of rdg + 0.000 06 MΩ<br>0.12 % of rdg + 0.0006 MΩ                                                                                                                                                                                                             | IET 1693 LCR meter                        | TPA.RFD<br>COS                                       |
|                                     | <b>10 kHz</b><br>(1 to 10) Ω<br>(10 to 100) Ω<br>(100 to 1000) Ω<br>(1 to 10) kΩ<br>(10 to 25.6) kΩ<br>(25.6 to 100) kΩ<br>(0.1 to 1) MΩ<br>(1 to 10) MΩ                         | 0.17 % of rdg + 0.003 Ω<br>0.062 % of rdg + 0.006 Ω<br>0.051 % of rdg + 0.06 Ω<br>0.05 % of rdg + 0.0006 kΩ<br>0.051 % of rdg + 0.006 kΩ<br>0.19 % of rdg + 0.006 kΩ<br>0.33 % of rdg + 0.000 06 MΩ<br>1.8 % of rdg + 0.0006 MΩ                                      |                                           |                                                      |
|                                     | <b>100 kHz</b><br>(1 to 10) Ω<br>(10 to 100) Ω<br>(100 to 1000) Ω<br>(1 to 10) kΩ<br>(10 to 100) kΩ<br>(0.1 to 1) MΩ                                                             | 0.77 % of rdg + 0.003 Ω<br>0.26 % of rdg + 0.006 Ω<br>0.21 % of rdg + 0.06 Ω<br>0.23 % of rdg + 0.0006 kΩ<br>0.52 % of rdg + 0.006 kΩ<br>3.4 % of rdg + 0.000 06 MΩ                                                                                                  |                                           |                                                      |
| Capacitance – Generate <sup>3</sup> | (0.2 to 1.2) nF<br>(1.2 to 12.0) nF<br>(12 to 120.0) nF<br>(0.12 to 1.2) μF<br>(1.2 to 12.0) μF<br>(12 to 120.0) μF<br>(0.12 to 1.2) mF<br>(1.2 to 12.0) mF<br>(12 to 120.0) mF  | 0.09 % of output + 1.5 pF<br>0.09 % of output + 0.004 nF<br>0.10 % of output + 0.023 nF<br>0.10 % of output + 0.23 nF<br>0.10 % of output + 2.3 nF<br>0.11 % of output + 19 nF<br>0.19 % of output + 190 nF<br>0.19 % of output + 2.3 μF<br>0.38 % of output + 23 μF | Fluke 5560A<br>multiproduct<br>calibrator | COS, HRT<br>MEL, ATL<br>RDU, RFD<br>TPA, HSV,<br>DFW |
|                                     | (220 to 400) pF<br>(0.4 to 3.2999) nF<br>(3.3 to 10.9999) nF<br>(11 to 32.9999) nF<br>(33 to 109.999) nF<br>(110 to 329.999) nF<br>(0.33 to 1.099 99) μF<br>(1.1 to 3.299 99) μF | 0.38 % of output + 7.6 pF<br>0.38 % of output + 0.01 nF<br>0.19 % of output + 0.01 nF<br>0.19 % of output + 0.08 nF<br>0.19 % of output + 0.08 nF<br>0.19 % of output + 0.23 nF<br>0.19 % of output + 0.76 nF<br>0.19 % of output + 2.3 nF                           | Fluke 5522A<br>multiproduct<br>calibrator | HSV, SFL<br>HLR                                      |

| Parameter/Equipment                                 | Range                                                                                                                                                                                                    | CMC <sup>2, 7</sup> (±)                                                                                                                                                                                                                                       | Comment                               | Location <sup>10</sup> |
|-----------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|------------------------|
| Capacitance – Generate <sup>3</sup>                 | (3.3 to 10.999 9) µF<br>(11 to 32.999 9) µF<br>(33 to 109.999) µF<br>(110 to 329.999) µF<br>(0.33 to 1.099 99) mF<br>(1.1 to 3.299 99) mF<br>(3.3 to 10.9999) mF<br>(11 to 32.9999) mF<br>(33 to 110) mF | 0.19 % of output + 7.6 nF<br>0.3 % of output + 23 nF<br>0.34 % of output + 76 nF<br>0.34 % of output + 230 nF<br>0.34 % of output + 0.76 µF<br>0.34 % of output + 2.3 µF<br>0.34 % of output + 7.6 µF<br>0.57 % of output + 23 µF<br>0.84 % of output + 76 µF | Fluke 5522A multiproduct calibrator   | HSV, SFL<br>HLR        |
| Capacitance – Generate <sup>3</sup><br>Fixed Points | <b>1 pF</b><br>1 kHz<br>1 MHz<br>2 MHz<br>3 MHz<br>4 MHz<br>5 MHz<br>10 MHz<br>13 MHz                                                                                                                    | 0.028 % of output<br>0.028 % of output<br>0.034 % of output<br>0.047 % of output<br>0.069 % of output<br>0.096 % of output<br>0.31 % of output<br>0.5 % of output                                                                                             | Agilent 16381A capacitor fixed        | TPA, ATL               |
|                                                     | <b>10 pF</b><br>1 kHz<br>1 MHz<br>2 MHz<br>3 MHz<br>4 MHz<br>5 MHz<br>10 MHz<br>13 MHz                                                                                                                   | 0.019 % of output<br>0.019 % of output<br>0.019 % of output<br>0.019 % of output<br>0.019 % of output<br>0.019 % of output<br>0.022 % of output<br>0.024 % of output                                                                                          | Agilent 16382A capacitor fixed        |                        |
|                                                     | <b>100 pF</b><br>1 kHz<br>1 MHz<br>2 MHz<br>3 MHz<br>4 MHz<br>5 MHz<br>10 MHz<br>13 MHz                                                                                                                  | 0.017 % of output<br>0.017 % of output<br>0.018 % of output<br>0.018 % of output<br>0.02 % of output<br>0.024 % of output<br>0.053 % of output<br>0.083 % of output                                                                                           | Agilent 16383A standard air capacitor |                        |



| Parameter/Range                                     | Frequency                                                                                | CMC <sup>2, 7</sup> (±)                                                                                                                                              | Comment                                     | Location <sup>10</sup> |
|-----------------------------------------------------|------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|------------------------|
| Capacitance – Generate <sup>3</sup><br>Fixed Points | <b>1000 pF</b><br>1 kHz<br>1 MHz<br>2 MHz<br>3 MHz<br>4 MHz<br>5 MHz<br>10 MHz<br>13 MHz | 0.018 % of output<br>0.019 % of output<br>0.024 % of output<br>0.035 % of output<br>0.051 % of output<br>0.069 % of output<br>0.22 % of output<br>0.32 % of output   | Agilent 16384A<br>standard air<br>capacitor | TPA, ATL               |
|                                                     | 1 pF<br>10 pF<br>100 pF<br>1 000 pF                                                      | 0.17 % of rdg<br>0.17 % of rdg<br>0.17 % of rdg<br>0.17 % of rdg                                                                                                     | Agilent 16380A<br>capacitor set             | RFD                    |
|                                                     | <b>1 pF</b><br>1 kHz<br>1 MHz<br>2 MHz<br>3 MHz<br>4 MHz<br>5 MHz<br>10 MHz<br>13 MHz    | 0.038 % of output<br>0.038 % of output<br>0.044 % of output<br>0.055 % of output<br>0.073 % of output<br>0.096 % of output<br>0.25 % of output<br>0.37 % of output   | Agilent 16381A<br>capacitor fixed           |                        |
|                                                     | <b>10 pF</b><br>1 kHz<br>1 MHz<br>2 MHz<br>3 MHz<br>4 MHz<br>5 MHz<br>10 MHz<br>13 MHz   | 0.035 % of output<br>0.035 % of output<br>0.035 % of output<br>0.035 % of output<br>0.035 % of output<br>0.035 % of output<br>0.036 % of output<br>0.038 % of output | Agilent 16382A<br>capacitor fixed           |                        |
|                                                     | <b>100 pF</b><br>1 kHz<br>1 MHz<br>2 MHz<br>3 MHz<br>4 MHz<br>5 MHz<br>10 MHz<br>13 MHz  | 0.035 % of output<br>0.035 % of output<br>0.035 % of output<br>0.035 % of output<br>0.035 % of output<br>0.037 % of output<br>0.048 % of output<br>0.06 % of output  | Agilent 16383A<br>capacitor fixed           |                        |



| Parameter/Range                                     | Frequency                                                                                | CMC <sup>2, 7</sup> (±)                                                                                                                                            | Comment                        | Location <sup>10</sup> |
|-----------------------------------------------------|------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|------------------------|
| Capacitance – Generate <sup>3</sup><br>Fixed Points | <b>1000 pF</b><br>1 kHz<br>1 MHz<br>2 MHz<br>3 MHz<br>4 MHz<br>5 MHz<br>10 MHz<br>13 MHz | 0.035 % of output<br>0.035 % of output<br>0.037 % of output<br>0.044 % of output<br>0.056 % of output<br>0.071 % of output<br>0.19 % of output<br>0.28 % of output | Agilent 16384A capacitor fixed | RFD                    |
|                                                     | <b>0.01 µF</b><br>0.12 kHz<br>1 kHz<br>10 kHz<br>100 kHz                                 | 0.02 % of output<br>0.02 % of output<br>0.02 % of output<br>0.02 % of output                                                                                       | Agilent 16385A capacitor fixed |                        |
|                                                     | <b>0.1 µF</b><br>0.12 kHz<br>1 kHz<br>10 kHz<br>100 kHz                                  | 0.02 % of output<br>0.02 % of output<br>0.02 % of output<br>0.02 % of output                                                                                       | Agilent 16386A capacitor fixed |                        |
|                                                     | <b>1 µF</b><br>0.12 kHz<br>1 kHz<br>10 kHz<br>100 kHz                                    | 0.021 % of output<br>0.02 % of output<br>0.02 % of output<br>0.021 % of output                                                                                     | Agilent 16387A capacitor fixed |                        |
|                                                     | <b>1 pF</b><br>1 kHz<br>1 MHz<br>2 MHz<br>3 MHz<br>4 MHz<br>5 MHz<br>10 MHz<br>13 MHz    | 0.038 % of output<br>0.038 % of output<br>0.044 % of output<br>0.055 % of output<br>0.073 % of output<br>0.096 % of output<br>0.25 % of output<br>0.37 % of output | Agilent 16381A capacitor fixed | COS                    |

| Parameter/Range                                     | Frequency                                                                                                                                  | CMC <sup>2, 7</sup> (±)                                                                                                                                                                                  | Comment                                                                  | Location <sup>10</sup>                        |
|-----------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|-----------------------------------------------|
| Capacitance – Generate <sup>3</sup><br>Fixed Points | <b>10 pF</b><br>1 kHz<br>1 MHz<br>2 MHz<br>3 MHz<br>4 MHz<br>5 MHz<br>10 MHz<br>13 MHz                                                     | 0.035 % of output<br>0.035 % of output<br>0.035 % of output<br>0.035 % of output<br>0.035 % of output<br>0.035 % of output<br>0.036 % of output<br>0.038 % of output                                     | Agilent 16382A<br>capacitor fixed                                        | COS                                           |
|                                                     | <b>1000 pF</b><br>1 kHz<br>1 MHz<br>2 MHz<br>3 MHz<br>4 MHz<br>5 MHz<br>10 MHz<br>13 MHz                                                   | 0.035 % of output<br>0.035 % of output<br>0.037 % of output<br>0.044 % of output<br>0.056 % of output<br>0.071 % of output<br>0.19 % of output<br>0.28 % of output                                       | Agilent 16384A,<br>capacitor fixed                                       |                                               |
|                                                     | <b>100 &amp; 120 Hz</b><br>10 µF<br>100 µF<br>1000 µF<br>10 mF<br>100 mF<br>1 F<br><br><b>1 kHz</b><br>10 µF<br>100 µF<br>1000 µF<br>10 mF | 0.35 % of output<br>0.35 % of output<br>0.35 % of output<br>0.35 % of output<br>0.36 % of output<br>0.43 % of output<br><br>0.35 % of output<br>0.35 % of output<br>0.36 % of output<br>0.4 % of output  | Agilent 16385A,<br>16386A, 16387A,<br>GR 1417<br>capacitance<br>standard |                                               |
| Capacitance – Generate<br>1 kHz                     | 1 pF to 1.111 11 µF                                                                                                                        | 0.05 % of output + 0.5 pF                                                                                                                                                                                | GR 1413 decade<br>capacitor                                              | MEL, COS                                      |
| Inductance – Generate <sup>3</sup>                  | (13 to 120.0) µH<br>(0.12 to 1.2) mH<br>(1.2 to 12.0) mH<br>(12 to 120.0) mH<br>(0.12 to 1.2) H<br>(1.2 to 12.0) H<br>(12 to 120.0) H      | 0.15 % of output + 0.15 µH<br>0.09 % of output + 0.76 µH<br>0.09 % of output + 7.6 µH<br>0.09 % of output + 76 µH<br>0.11 % of output + 0.76 mH<br>0.15 % of output + 7.6 mH<br>0.19 % of output + 76 mH | Fluke 5560A<br>multiproduct<br>calibrator                                | COS, HRT<br>MEL, ATL<br>RDU, RFD,<br>DFW, HSV |

| Parameter/Equipment                               | Range                            | CMC <sup>2, 7</sup> (±) | Comment                        | Location <sup>10</sup> |
|---------------------------------------------------|----------------------------------|-------------------------|--------------------------------|------------------------|
| Inductance – Generate <sup>3</sup><br>Fixed Point | <b>100 µH</b><br>10 kHz          | 0.25µH                  | GR 1482-B<br>standard inductor | RFD                    |
|                                                   | <b>100 mH</b><br>100 Hz          | 0.047 mH                | GR 1482-L<br>standard inductor |                        |
|                                                   | <b>500 µH</b><br>1 kHz           | 0.35 µH                 | GR 1482-D<br>tandard inductor  | ATL                    |
|                                                   | <b>20 mH</b><br>1 kHz            | 0.008 mH                | GR 1482-J<br>standard Inductor |                        |
|                                                   | <b>200 mH</b><br>100 Hz          | 0.11 mH                 | GR 1482-M<br>standard inductor |                        |
|                                                   | <b>2 H</b><br>100 Hz             | 0.8 mH                  | GR 1482-Q<br>standard inductor |                        |
|                                                   | <b>50 mH</b><br>100 Hz<br>1 kHz  | 0.028 mH<br>0.021 mH    | GR 1482-K<br>standard inductor | TPA                    |
|                                                   | <b>100 mH</b><br>100 Hz<br>1 kHz | 0.069 mH<br>0.063 mH    | GR 1481-G<br>standard inductor |                        |
|                                                   | <b>200 mH</b><br>100 Hz<br>1 kHz | 0.09 mH<br>0.06 mH      | GR 1482-M<br>standard inductor |                        |
|                                                   | <b>500 mH</b><br>100 Hz<br>1 kHz | 0.23 mH<br>0.15 mH      | GR 1482-N<br>standard inductor |                        |
|                                                   | <b>5 H</b><br>100 Hz<br>1 kHz    | 0.021 H<br>0.021 H      | GR 1482-R<br>standard inductor |                        |

| Parameter/Range                                   | Frequency                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | CMC <sup>2, 7</sup> (±)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Comment                                                | Location <sup>10</sup> |
|---------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|------------------------|
| Inductance – Generate <sup>3</sup><br>Fixed Point | <b>1000 Hz</b><br>5 mH                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 0.0018 mH                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | GR 1482-G<br>standard<br>inductor                      | COS                    |
|                                                   | <b>(100 to 1000) Hz</b><br>100 mH                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 0.13mH                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | GR LSB-<br>100mH<br>standard<br>inductor               |                        |
|                                                   | <b>1kHz</b><br>(1 to 10) mH<br>(1 to 100) mH<br>(100 to 1 000) mH<br>(1 to 10) H                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 2 % of output<br>1 % of output<br>0.5 % of output<br>0.25 % of output                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Bundy<br>Electronics<br>BEC-700-032<br>decade inductor | MEL                    |
| Capacitance – Measure <sup>3</sup>                | <b>50 Hz</b><br>(50 to 100) pF<br>(100 to 400) pF<br>(400 to 1000) pF<br>(1 to 10) nF<br>(10 to 100) nF<br>(100 to 1000) nF<br>(0.1 to 1) µF<br>(1 to 10) µF<br>(10 to 100) µF<br>(100 to 1000) µF<br><br><b>100 Hz</b><br>(20 to 100) pF<br>(100 to 400) pF<br>(400 to 1000) pF<br>(1 to 10) nF<br>(10 to 100) nF<br>(100 to 1000) nF<br>(0.1 to 1) µF<br>(1 to 10) µF<br>(10 to 100) µF<br>(100 to 1 000) µF<br><br><b>120 Hz</b><br>(20 to 100) pF<br>(100 to 400) pF<br>(400 to 1000) pF<br>(1 to 10) nF<br>(10 to 100) nF<br>(100 to 1000) nF<br>(0.1 to 1) µF<br>(1 to 10) µF<br>(10 to 100) µF<br>(100 to 1000) µF | 2.6 % of rdg + 0.015 pF<br>1.3 % of rdg + 0.06 pF<br>0.37 % of rdg + 0.06 pF<br>0.18 % of rdg + 0.0006 nF<br>0.063 % of rdg + 0.006 nF<br>0.051 % of rdg + 0.06 nF<br>0.051 % of rdg + 0.000 06 µF<br>0.05 % of rdg + 0.0006 µF<br>0.054 % of rdg + 0.006 µF<br>0.09 % of rdg + 0.06 µF<br><br>2.4 % of rdg + 0.015 pF<br>0.52 % of rdg + 0.06 pF<br>0.16 % of rdg + 0.06 pF<br>0.088 % of rdg + 0.0006 nF<br>0.045 % of rdg + 0.006 nF<br>0.041 % of rdg + 0.06 nF<br>0.041 % of rdg + 0.000 06 µF<br>0.046 % of rdg + 0.006 µF<br>0.1 % of rdg + 0.06 µF<br><br>2 % of rdg + 0.015 pF<br>0.44 % of rdg + 0.06 pF<br>0.14 % of rdg + 0.06 pF<br>0.08 % of rdg + 0.0006 nF<br>0.044 % of rdg + 0.006 nF<br>0.04 % of rdg + 0.06 nF<br>0.04 % of rdg + 0.000 06 µF<br>0.041 % of rdg + 0.0006 µF<br>0.047 % of rdg + 0.006 µF<br>0.11 % of rdg + 0.06 µF | IET 1693 LCR<br>meter                                  | TPA, RFD<br>COS        |

| Parameter/Range                    | Frequency                                                                                                                                                                                                                              | CMC <sup>2, 7</sup> (±)                                                                                                                                                                                                                                                                                                                         | Comment               | Location <sup>10</sup> |
|------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|------------------------|
| Capacitance – Measure <sup>3</sup> | <b>1000 Hz</b><br>(1 to 10) pF<br>(10 to 20) pF<br>(20 to 100) pF<br>(100 to 400) pF<br>(400 to 1000) pF<br>(1 to 10) nF<br>(10 to 100) nF<br>(100 to 1 000) nF<br>(0.1 to 1) µF<br>(1 to 10) µF<br>(10 to 100) µF<br>(100 to 1000) µF | 1.6 % of rdg + 0.014 pF<br>0.18 % of rdg + 0.015 pF<br>0.1 % of rdg + 0.015 pF<br>0.036 % of rdg + 0.06 pF<br>0.024 % of rdg + 0.06 pF<br>0.022 % of rdg + 0.0006 nF<br>0.02 % of rdg + 0.006 nF<br>0.02 % of rdg + 0.06 nF<br>0.02 % of rdg + 0.000 06 µF<br>0.022 % of rdg + 0.0006 µF<br>0.04 % of rdg + 0.006 µF<br>0.22 % of rdg + 0.06 µF | IET 1693 LCR<br>meter | TPA, RFD<br>COS        |
|                                    | <b>10 kHz</b><br>(20 to 100) pF<br>(100 to 622) pF<br>(622 to 1000) pF<br>(1 to 10) nF<br>(10 to 100) nF<br>(100 to 1 000) nF<br>(0.1 to 1) µF<br>(1 to 10) µF<br>(10 to 100) µF<br>(100 to 500) µF                                    | 0.3 % of rdg + 0.015 pF<br>0.2 % of rdg + 0.06 pF<br>0.051 % of rdg + 0.06 pF<br>0.051 % of rdg + 0.0006 nF<br>0.051 % of rdg + 0.006 nF<br>0.058 % of rdg + 0.06 nF<br>0.058 % of rdg + 0.000 06 µF<br>0.13 % of rdg + 0.0006 µF<br>0.85 % of rdg + 0.006 µF<br>4.1 % of rdg + 0.06 µF                                                         |                       |                        |
|                                    | <b>100 kHz</b><br>(20 to 100) pF<br>(100 to 400) pF<br>(400 to 1000) pF<br>(1 to 10) nF<br>(10 to 100) nF<br>(100 to 1000) nF<br>(0.1 to 1) µF<br>(1 to 10) µF                                                                         | 0.49 % of rdg + 0.015 pF<br>0.26 % of rdg + 0.06 pF<br>0.21 % of rdg + 0.06 pF<br>0.21 % of rdg + 0.0006 nF<br>0.24 % of rdg + 0.006 nF<br>0.58 % of rdg + 0.06 nF<br>0.58 % of rdg + 0.000 06 µF<br>4 % of rdg + 0.0006 µF                                                                                                                     |                       |                        |

| Parameter/Range                    | Frequency                               | CMC <sup>2, 7</sup> (±) | Comment                    | Location <sup>10</sup> |
|------------------------------------|-----------------------------------------|-------------------------|----------------------------|------------------------|
| Capacitance – Measure <sup>3</sup> | <b>100 Hz /120 Hz</b><br>(16 to 400) pF | 2 % of rdg + 0.3 pF     | Agilent 4263B<br>LCR meter | SFL, HSV               |
|                                    | (0.4 to 1) nF                           | 0.17 % of rdg           |                            |                        |
|                                    | (1 to 100) nF                           | 0.13 % of rdg           |                            |                        |
|                                    | (0.1 to 1) µF                           | 0.12 % of rdg           |                            |                        |
|                                    | (1 to 100) µF                           | 0.18 % of rdg           |                            |                        |
|                                    | (0.1 to 1) mF                           | 0.20 % of rdg           |                            |                        |
|                                    | <b>1000 Hz</b><br>(16 to 400) pF        | 0.43 % of rdg + 0.3 pF  |                            |                        |
|                                    | (0.4 to 1) nF                           | 0.1 % of rdg            |                            |                        |
|                                    | (1 to 100) nF                           | 0.08 % of rdg           |                            |                        |
|                                    | (0.1 to 1) µF                           | 0.07 % of rdg           |                            |                        |
|                                    | (1 to 100) µF                           | 0.13 % of rdg           |                            |                        |
|                                    | (0.1 to 1) mF                           | 0.45 % of rdg           |                            |                        |
|                                    | <b>10 kHz</b><br>(16 to 400) pF         | 0.56 % of rdg + 0.3 pF  |                            |                        |
|                                    | (0.4 to 1) nF                           | 0.15 % of rdg           |                            |                        |
|                                    | (1 to 100) nF                           | 0.12 % of rdg           |                            |                        |
|                                    | (0.1 to 1) µF                           | 0.17 % of rdg           |                            |                        |
|                                    | (1 to 100) µF                           | 0.69 % of rdg           |                            |                        |
|                                    | (0.1 to 1) mF                           | 3.5 % of rdg            |                            |                        |
|                                    | <b>20 kHz</b><br>(16 to 400) pF         | 1.2 % of rdg + 0.3 pF   |                            |                        |
|                                    | (0.4 to 1) nF                           | 0.62 % of rdg           |                            |                        |
|                                    | (1 to 100) nF                           | 0.62 % of rdg           |                            |                        |
|                                    | (0.1 to 1) µF                           | 0.43 % of rdg           |                            |                        |
|                                    | (1 to 100) µF                           | 1.7 % of rdg            |                            |                        |
|                                    | <b>100 kHz</b><br>(16 to 400) pF        | 1.6 % of rdg + 0.3 pF   |                            |                        |
|                                    | (0.4 to 1) nF                           | 1 % of rdg              |                            |                        |
|                                    | (1 to 100) nF                           | 0.98 % of rdg           |                            |                        |
|                                    | (0.1 to 1) µF                           | 1.4 % of rdg            |                            |                        |
|                                    | (1 to 10) µF                            | 4.1 % of rdg            |                            |                        |

| Parameter/Range                    | Frequency               | CMC <sup>2,7</sup> (±) | Comment | Location <sup>10</sup> |
|------------------------------------|-------------------------|------------------------|---------|------------------------|
| Capacitance – Measure <sup>3</sup> | <b>(10 to 100) nF</b>   |                        |         |                        |
|                                    | (20 to 100) Hz          | 0.3 % of rdg           |         |                        |
|                                    | (100 to 1000) Hz        | 0.1 % of rdg           |         |                        |
|                                    | (1 to 10) kHz           | 0.1 % of rdg           |         |                        |
|                                    | (10 to 100) kHz         | 0.1 % of rdg           |         |                        |
|                                    | (0.1 to 1) MHz          | 0.3 % of rdg           |         |                        |
|                                    | (1 to 2) MHz            | 1 % of rdg             |         |                        |
|                                    | <b>(100 to 1000) nF</b> |                        |         |                        |
|                                    | (20 to 100) Hz          | 0.3 % of rdg           |         |                        |
|                                    | (100 to 1000) Hz        | 0.1 % of rdg           |         |                        |
|                                    | (1 to 10) kHz           | 0.3 % of rdg           |         |                        |
|                                    | (10 to 100) kHz         | 0.3 % of rdg           |         |                        |
|                                    | (0.1 to 1) MHz          | 1 % of rdg             |         |                        |
|                                    | (1 to 2) MHz            | 1 % of rdg             |         |                        |
|                                    | <b>(1 to 10) µF</b>     |                        |         |                        |
|                                    | (20 to 100) Hz          | 0.3 % of rdg           |         |                        |
|                                    | (100 to 1000) Hz        | 0.12 % of rdg          |         |                        |
|                                    | (1 to 10) kHz           | 0.3 % of rdg           |         |                        |
|                                    | (10 to 100) kHz         | 0.7 % of rdg           |         |                        |
|                                    | (0.1 to 1) MHz          | 5 % of rdg             |         |                        |
|                                    | (1 to 2) MHz            | 7 % of rdg             |         |                        |
|                                    | <b>(10 to 100) µF</b>   |                        |         |                        |
|                                    | (20 to 100) Hz          | 0.3 % of rdg           |         |                        |
|                                    | (100 to 1000) Hz        | 0.3 % of rdg           |         |                        |
|                                    | (1 to 10) kHz           | 0.7 % of rdg           |         |                        |
|                                    | (10 to 100) kHz         | 5 % of rdg             |         |                        |
|                                    | <b>(100 to 1000) µF</b> |                        |         |                        |
|                                    | (20 to 100) Hz          | 0.3 % of rdg           |         |                        |
|                                    | (100 to 1000) Hz        | 1 % of rdg             |         |                        |
|                                    | (1 to 10) kHz           | 5 % of rdg             |         |                        |
|                                    | <b>(1 to 10) mF</b>     |                        |         |                        |
|                                    | (20 to 100) Hz          | 1.2 % of rdg           |         |                        |
|                                    | (100 to 1000) Hz        | 10 % of rdg            |         |                        |
|                                    | <b>(10 to 100) mF</b>   |                        |         |                        |
|                                    | (20 to 100) Hz          | 10 % of rdg            |         |                        |

Agilent  
E4980A LCR  
meter

MEL, TPA  
RDU



| Parameter/Range                   | Frequency                                                                                                                                                                                                                   | CMC <sup>2, 7</sup> (±)                                                                                                                                                                                                                                                                                                                                   | Comment               | Location <sup>10</sup> |
|-----------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|------------------------|
| Inductance – Measure <sup>3</sup> | <b>100 Hz</b><br>(40 to 100) µH<br>(0.1 to 0.4) mH<br>(0.4 to 1) mH<br>(1 to 10) mH<br>(10 to 100) mH<br>(0.1 to 1) H<br>(1 to 10) H<br>(10 to 100) H                                                                       | 3.8 % of rdg + 0.006 µH<br>1.6 % of rdg + 0.000 06 mH<br>0.42 % of rdg + 0.000 06 mH<br>0.19 % of rdg + 0.0006 mH<br>0.056 % of rdg + 0.006 mH<br>0.042 % of rdg + 0.000 06 H<br>0.041 % of rdg + 0.0006 H<br>0.042 % of rdg + 0.006 H                                                                                                                    | IET 1693 LCR<br>meter | TPA, RFD<br>COS        |
|                                   | <b>1 000 Hz</b><br>(4 to 10) µH<br>(10 to 40) µH<br>(40 to 100) µH<br>(0.1 to 0.4) mH<br>(0.4 to 1) mH<br>(1 to 10) mH<br>(10 to 100) mH<br>(0.1 to 1) H<br>(1 to 10) H<br>(10 to 100) H                                    | 1.3 % of rdg + 0.003 µH<br>0.53 % of rdg + 0.006 µH<br>0.15 % of rdg + 0.006 µH<br>0.071 % of rdg + 0.000 06 mH<br>0.033 % of rdg + 0.000 06 mH<br>0.025 % of rdg + 0.0006 mH<br>0.021 % of rdg + 0.006 mH<br>0.02 % of rdg + 0.000 06 H<br>0.021 % of rdg + 0.0006 H<br>0.026 % of rdg + 0.006 H                                                         |                       |                        |
|                                   | <b>10 kHz</b><br>(1 to 4) µH<br>(4 to 10) µH<br>(10 to 40) µH<br>(40 to 100) µH<br>(0.1 to 0.4) mH<br>(0.4 to 1) mH<br>(1 to 10) mH<br>(10 to 100) mH<br>(0.1 to 0.407) H<br>(0.407 to 1) H<br>(1 to 10) H<br>(10 to 100) H | 2.1 % of rdg + 0.003 µH<br>0.56 % of rdg + 0.003 µH<br>0.25 % of rdg + 0.006 µH<br>0.1 % of rdg + 0.006 µH<br>0.071 % of rdg + 0.000 06 mH<br>0.056 % of rdg + 0.000 06 mH<br>0.052 % of rdg + 0.0006 mH<br>0.051 % of rdg + 0.006 mH<br>0.051 % of rdg + 0.000 06 mH<br>0.18 % of rdg + 0.000 06 H<br>0.27 % of rdg + 0.0006 H<br>1.2 % of rdg + 0.006 H |                       |                        |
|                                   | <b>100 kHz</b><br>(1 to 4) µH<br>(4 to 10) µH<br>(10 to 40) µH<br>(40 to 100) µH<br>(0.1 to 0.4) mH<br>(0.4 to 1) mH<br>(1 to 10) mH<br>(10 to 100) mH<br>(0.1 to 1) H                                                      | 1.2 % of rdg + 0.003 µH<br>0.44 % of rdg + 0.003 µH<br>0.3 % of rdg + 0.006 µH<br>0.23 % of rdg + 0.006 µH<br>0.21 % of rdg + 0.000 06 mH<br>0.21 % of rdg + 0.000 06 mH<br>0.22 % of rdg + 0.0006 mH<br>0.39 % of rdg + 0.006 mH<br>2.1 % of rdg + 0.000 06 H                                                                                            |                       |                        |

| Parameter/Range                   | Frequency             | CMC <sup>2, 7</sup> (±) | Comment                       | Location <sup>10</sup> |
|-----------------------------------|-----------------------|-------------------------|-------------------------------|------------------------|
| Inductance – Measure <sup>3</sup> | <b>100 Hz /120 Hz</b> |                         |                               |                        |
|                                   | (4 to 10) µH          | 3.4 % of rdg + 0.03 µH  |                               |                        |
|                                   | (10 to 40) µH         | 1.5 % of rdg + 0.03 µH  |                               |                        |
|                                   | (40 to 100) µH        | 0.57 % of rdg + 0.03 µH |                               |                        |
|                                   | (0.1 to 0.4) mH       | 0.4 % of rdg            |                               |                        |
|                                   | (0.4 to 1) mH         | 0.32 % of rdg           |                               |                        |
|                                   | (1 to 10) mH          | 0.28 % of rdg           |                               |                        |
|                                   | (10 to 100) mH        | 0.23 % of rdg           |                               |                        |
|                                   | (0.1 to 1) H          | 0.18 % of rdg           |                               |                        |
|                                   | (1 to 10) H           | 0.22 % of rdg           |                               |                        |
|                                   | <b>1000 Hz</b>        |                         |                               |                        |
|                                   | (1 to 4) µH           | 1.0 % of rdg + 0.03 µH  |                               |                        |
|                                   | (4 to 10) µH          | 0.46 % of rdg + 0.03 µH |                               |                        |
|                                   | (10 to 40) µH         | 0.49 % of rdg + 0.03 µH |                               |                        |
|                                   | (40 to 100) µH        | 0.35 % of rdg + 0.03 µH |                               |                        |
|                                   | (0.1 to 0.4) mH       | 0.30 % of rdg           |                               |                        |
|                                   | (0.4 to 1) mH         | 0.11 % of rdg           |                               |                        |
|                                   | (1 to 10) mH          | 0.12 % of rdg           |                               |                        |
|                                   | (10 to 100) mH        | 0.10 % of rdg           |                               |                        |
|                                   | (0.1 to 1) H          | 0.10 % of rdg           |                               |                        |
|                                   | (1 to 10) H           | 0.12 % of rdg           |                               |                        |
|                                   | <b>10 kHz</b>         |                         |                               |                        |
|                                   | (1 to 4) µH           | 0.62 % of rdg + 0.03 µH |                               |                        |
|                                   | (4 to 10) µH          | 0.40 % of rdg + 0.03 µH |                               |                        |
|                                   | (10 to 40) µH         | 0.32 % of rdg + 0.03 µH |                               |                        |
|                                   | (40 to 100) µH        | 0.18 % of rdg + 0.03 µH |                               |                        |
|                                   | (0.1 to 0.4) mH       | 0.20 % of rdg           |                               |                        |
|                                   | (0.4 to 1) mH         | 0.14 % of rdg           |                               |                        |
|                                   | (1 to 10) mH          | 0.17 % of rdg           |                               |                        |
|                                   | (10 to 100) mH        | 0.20 % of rdg           |                               |                        |
|                                   | (0.1 to 1) H          | 0.20 % of rdg           |                               |                        |
|                                   | (1 to 10) H           | 0.44 % of rdg           |                               |                        |
|                                   | <b>20 kHz</b>         |                         |                               |                        |
|                                   | (1 to 4) µH           | 1.3 % of rdg + 0.03 µH  |                               |                        |
|                                   | (4 to 10) µH          | 0.68 % of rdg + 0.03 µH |                               |                        |
|                                   | (10 to 40) µH         | 0.63 % of rdg + 0.03 µH |                               |                        |
|                                   | (40 to 100) µH        | 0.53 % of rdg + 0.03 µH |                               |                        |
|                                   | (0.1 to 0.4) mH       | 0.49 % of rdg           |                               |                        |
|                                   | (0.4 to 1) mH         | 0.48 % of rdg           |                               |                        |
|                                   | (1 to 10) mH          | 0.65 % of rdg           |                               |                        |
|                                   | (10 to 100) mH        | 0.66 % of rdg           |                               |                        |
|                                   | (0.1 to 1) H          | 1.2 % of rdg            |                               |                        |
|                                   | (1 to 10) H           | 3.3 % of rdg            |                               |                        |
|                                   |                       |                         | Agilent<br>4263B LCR<br>meter | SFL, HSV               |



| Parameter/Range                   | Frequency                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | CMC <sup>2,7</sup> (±)                                                                                                                                                                                                                             | Comment                        | Location <sup>10</sup> |
|-----------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|------------------------|
| Inductance – Measure <sup>3</sup> | <b>100 kHz</b><br>(1 to 4) μH<br>(4 to 10) μH<br>(10 to 40) μH<br>(40 to 100) μH<br>(0.1 to 0.4) mH<br>(0.4 to 1) mH<br>(1 to 10) mH<br>(10 to 100) mH<br>(0.1 to 1) H                                                                                                                                                                                                                                                                                                                                                            | 1.8 % of rdg + 0.03 μH<br>0.86 % of rdg + 0.03 μH<br>1.20 % of rdg + 0.03 μH<br>0.68 % of rdg + 0.03 μH<br>0.90 % of rdg<br>1.1 % of rdg<br>1.3 % of rdg<br>1.4 % of rdg<br>6.3 % of rdg                                                           | Agilent<br>4263B LCR<br>meter  | SFL, HSV               |
|                                   | <b>(100 to 1000) nH</b><br>(10 to 100) kHz<br>(0.1 to 1) MHz<br>(1 to 2) MHz<br><br><b>(1 to 10) μH</b><br>(2 to 10) kHz<br>(10 to 100) kHz<br>(0.1 to 1) MHz<br>(1 to 2) MHz<br><br><b>(10 to 100) μH</b><br>(250 to 1000) Hz<br>(1 to 2) kHz<br>(2 to 10) kHz<br>(10 to 100) kHz<br>(0.1 to 1) MHz<br>(1 to 2) MHz<br><br><b>(100 to 1000) μH</b><br>(50 to 100) Hz<br>(100 to 250) Hz<br>(250 to 1000) Hz<br><br><b>(100 to 1000) μH</b><br>(1 to 2) kHz<br>(2 to 10) kHz<br>(10 to 100) kHz<br>(0.1 to 1) MHz<br>(1 to 2) MHz | 10 % of rdg<br>1 % of rdg<br>1 % of rdg<br><br><br>10 % of rdg<br>1 % of rdg<br>0.3 % of rdg<br>1 % of rdg<br><br><br>10 % of rdg<br>10 % of rdg<br>1 % of rdg<br><br><br>1 % of rdg<br>0.3 % of rdg<br>0.3 % of rdg<br>0.3 % of rdg<br>1 % of rdg | Agilent<br>E4980A<br>LCR meter | MEL, TPA<br>RDU        |

| Parameter/Range                   | Frequency                                                                                                                                                                             | CMC <sup>2, 7</sup> (±)                                                                                                                 | Comment                     | Location <sup>10</sup> |
|-----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|------------------------|
| Inductance – Measure <sup>3</sup> | <b>(1 to 10) mH</b><br>(20 to 50) Hz<br>(50 to 100) Hz<br>(100 to 250) Hz<br>(250 to 1000) Hz<br>(1 to 2) kHz<br>(2 to 10) kHz<br>(10 to 100) kHz<br>(0.1 to 1) MHz<br>(1 to 2) MHz   | 10 % of rdg<br>1 % of rdg<br>1 % of rdg<br>0.3 % of rdg<br>0.3 % of rdg<br>0.3 % of rdg<br>0.1 % of rdg<br>0.3 % of rdg<br>1 % of rdg   | Agilent E4980A LCR<br>meter | MEL, TPA<br>RDU        |
|                                   | <b>(10 to 100) mH</b><br>(20 to 50) Hz<br>(50 to 100) Hz<br>(100 to 250) Hz<br>(250 to 1000) Hz<br>(1 to 2) kHz<br>(2 to 10) kHz<br>(10 to 100) kHz<br>(0.1 to 1) MHz<br>(1 to 2) MHz | 1 % of rdg<br>0.3 % of rdg<br>0.3 % of rdg<br>0.3 % of rdg<br>0.3 % of rdg<br>0.1 % of rdg<br>0.1 % of rdg<br>1 % of rdg<br>10 % of rdg |                             |                        |
|                                   | <b>(100 to 1000) mH</b><br>(20 to 50) Hz<br>(50 to 100) Hz<br>(100 to 250) Hz<br>(250 to 1000) Hz<br>(1 to 2) kHz<br>(2 to 10) kHz<br>(10 to 100) kHz<br>(0.1 to 1) MHz               | 0.3 % of rdg<br>0.3 % of rdg<br>0.1 % of rdg<br>0.1 % of rdg<br>0.1 % of rdg<br>0.1 % of rdg<br>0.3 % of rdg<br>10 % of rdg             |                             |                        |
|                                   | <b>(1 to 10) H</b><br>(20 to 50) Hz<br>(50 to 100) Hz<br>(100 to 250) Hz<br>(250 to 1000) Hz<br>(1 to 2) kHz<br>(2 to 10) kHz<br>(10 to 100) kHz                                      | 0.3 % of rdg<br>0.3 % of rdg<br>0.1 % of rdg<br>0.1 % of rdg<br>0.1 % of rdg<br>0.3 % of rdg<br>1 % of rdg                              |                             |                        |

| Parameter/Equipment                                                     | Range                                                                                                                                                                                                                                                                                                                          | CMC <sup>2,7</sup> (±)                                                                                                                     | Comment                                                    | Location <sup>10</sup>                       |
|-------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------|----------------------------------------------|
| Oscilloscopes Calibration <sup>3</sup> –<br>Generate                    |                                                                                                                                                                                                                                                                                                                                |                                                                                                                                            |                                                            |                                              |
| Voltage<br>DC – 50Ω                                                     | (1 to 24.999) mV<br>(25 to 109.99) mV<br>110 mV to 2.1999 V<br>(2.2 to 6.6) V                                                                                                                                                                                                                                                  | 0.19 % of Output + 31 μV<br>0.19 % of Output + 36 μV<br>0.19 % of Output + 87 μV<br>0.19 % of Output + 0.6 mV                              |                                                            |                                              |
| DC – 1MΩ                                                                | (1 to 24.999) mV<br>(25 to 109.99) mV<br>110 mV to 2.1999 V<br>(2.2 to 10.999) V<br>(11 to 130) V                                                                                                                                                                                                                              | 0.019 % of rdg + 20 μV<br>0.019 % of rdg + 25 μV<br>0.019 % of rdg + 76 μV<br>0.019 % of rdg + 0.6 mV<br>0.019 % of rdg + 6.0 mV           |                                                            |                                              |
| Square Wave<br>10 Hz to 10 kHz – 50 Ω                                   | (1 to 24.999) mVpp<br>(25 to 109.99) mVpp<br>(110mV to 2.1999) Vpp<br>(2.2 to 6.6) Vpp                                                                                                                                                                                                                                         | 0.19 % of Output + 31 μV<br>0.19 % of Output + 36 μV<br>0.19 % of Output + 87 μV<br>0.19 % of Output + 0.6 mV                              |                                                            |                                              |
| Square Wave 10 Hz to<br>1 kHz – 1 MΩ                                    | (1 to 24.999) mV<br>(25 to 109.99) mV<br>(110mV to 2.1999) V<br>(2.2 to 10.999) V<br>(11 to 130) V                                                                                                                                                                                                                             | 0.038 % of rdg + 4 μV<br>0.038 % of rdg + 9 μV<br>0.038 % of rdg + 60 μV<br>0.038 % of rdg + 0.6 mV<br>0.038 % of rdg + 6.0 mV             |                                                            |                                              |
| Square Wave<br>(1 to 10) kHz – 1 MΩ                                     | (1 to 24.999) mV<br>(25 to 109.99) mV<br>(110mV to 2.1999) V<br>(2.2 to 10.999) V<br>(11 to 130) V                                                                                                                                                                                                                             | 0.19 % of rdg + 31 μV<br>0.19 % of rdg + 36 μV<br>0.19 % of rdg + 87 μV<br>0.19 % of rdg + 0.6 mV<br>0.19 % of rdg + 6.0 mV                |                                                            |                                              |
| Leveled Sine Flatness <sup>3</sup><br><br>50 kHz to 10 MHz<br>Reference | <b>3 dB Bandwidth</b><br>(5 to 50) mVpp<br>50 kHz to 100 MHz<br>(100 to 300) MHz<br>(300 to 500) MHz<br>(500 to 600) MHz<br>(600 to 1600) MHz<br>(1600 to 2100) MHz<br><br><b>50 mV to 3.5 Vpp</b><br>50 kHz to 100 MHz<br>(100 to 300) MHz<br>(300 to 500) MHz<br>(500 to 600) MHz<br>(600 to 1600) MHz<br>(1600 to 2100) MHz | <br><br>0.34 dB<br>0.36 dB<br>0.42 dB<br>0.46 dB<br>0.5 dB<br>0.56 dB<br><br>0.24 dB<br>0.24 dB<br>0.32 dB<br>0.34 dB<br>0.4 dB<br>0.44 dB | Fluke 5820A<br>oscilloscope<br>calibrator w/<br>GHz option | COS, MEL<br>ATL, TPA<br>HSV, HRT<br>SFL, HLR |

| Parameter/Equipment                                                                                                                        | Range                                                                                                                | CMC <sup>2, 7</sup> (±)                                                                      | Comment                                                                 | Location <sup>10</sup>                                           |
|--------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|------------------------------------------------------------------|
| Leveled Sine Flatness <sup>3</sup><br>50 kHz to 10 MHz<br>Reference                                                                        | <b>(3.5 to 5) Vpp</b><br>50 kHz to 100 MHz<br>(100 to 300) MHz<br>(300 to 500) MHz<br>(500 to 600) MHz               | 0.24 dB<br>0.24 dB<br>0.32 dB<br>0.34 dB                                                     | Fluke 5820A<br>oscilloscope<br>calibrator w/<br>GHz option              | COS, MEL<br>ATL, TPA<br>HSV, HRT<br>SFL, HLR                     |
| Oscilloscope Calibration<br>Generate <sup>3</sup><br>Leveled Sine Flatness                                                                 | <b>3 dB Bandwidth</b><br><b>50 mV to 3.5 Vpp</b><br>(1100 to 4000) MHz<br>(4000 to 8000) MHz<br>(8000 to 18 000) MHz | 0.25 dB<br>0.35 dB<br>0.46 dB                                                                | Agilent EPM<br>series power<br>meter<br>w/E9304A<br>H18 power<br>sensor | COS, MEL<br>ATL, TPA<br>HSV, HRT<br>SFL, HLR<br>RFD, RDU,<br>DFW |
| Oscilloscope Calibration –<br>Generate <sup>3</sup><br><br>Time Marker                                                                     | 500 ps to 20 ms<br>50 ms to 5 s                                                                                      | 0.25 µs/s<br>1.9 µs/s + 3.8 µHz                                                              | Fluke 5820A<br>oscilloscope<br>calibrator w/<br>GHz option              | COS, MEL<br>ATL, TPA<br>HSV, HRT<br>SFL, HLR                     |
| Oscilloscope Calibration –<br>Measure <sup>3</sup><br>Resistance<br><br>Leakage                                                            | (40 to 60) Ω<br>500 kΩ to 1.5 MΩ<br>(0 to 5.99) V                                                                    | 0.08 % of rdg<br>0.08 % of rdg<br>0.038 % of rdg + 1.3 mV                                    |                                                                         |                                                                  |
| Oscilloscopes Calibration <sup>3</sup><br>– Generate<br><br>Voltage<br>DC – 50 Ω<br>DC – 1 MΩ<br><br>Square Wave<br>10 Hz to 10 kHz – 1 MΩ | 1 mV to 5 V<br>1 mV to 200 V<br><br>1 mV to 200 Vpp                                                                  | 0.025 % of output + 25uV<br>0.025 % of output + 25uV<br><br>0.1 % of output + 10uV           | Fluke 9500B<br>w/ 9510 active<br>head                                   | COS, MEL<br>ATL, TPA<br>HSV, RFD                                 |
| Oscilloscopes Calibration <sup>3</sup><br>– Generate<br><br>Time Marker                                                                    | 9 ns to 55 s                                                                                                         | 0.25 µs/s                                                                                    |                                                                         |                                                                  |
| Oscilloscopes Calibration <sup>3</sup><br>– Measure<br><br>Input Impedance<br>Resistance                                                   | (10 to 40) Ω<br>(40 to 90) Ω<br>(90 to 150) Ω<br>(50 to 800) KΩ<br>(0.8 to 1.2) MΩ<br>(1.2 to 12) MΩ                 | 0.5 % of rdg<br>0.1 % of rdg<br>0.5 % of rdg<br>0.5 % of rdg<br>0.1 % of rdg<br>0.5 % of rdg |                                                                         |                                                                  |

| Parameter/Equipment                                                                                                                                             | Range                                                                                                                                                                                                            | CMC <sup>2, 7</sup> (±)                                                                                                                                            | Comment                               | Location <sup>10</sup>           |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|----------------------------------|
| Oscilloscopes Calibration <sup>3</sup> –<br>Generate<br><br>Leveled Sine Flatness<br>50 kHz to 10 MHz Ref                                                       | <b>(5mV to 5Vpp)</b><br>0.1 Hz to 300 MHz<br>(300 to 550) MHz<br><br><b>(5 mV to 3Vpp)</b><br>(550 to 1100) MHz                                                                                                  | 0.18 dB<br>0.22 dB<br><br>0.3 dB                                                                                                                                   | Fluke 9500B<br>w/ 9510 active<br>head | COS, MEL<br>ATL, TPA<br>HSV, RFD |
| Oscilloscopes Calibration <sup>3</sup> –<br>Generate<br><br>Voltage<br>DC – 50 Ω<br>DC – 1 MΩ<br><br>Square Wave 10 Hz to 10<br>kHz<br>50Ω<br>50Ω<br>1MΩ<br>1MΩ | 1 mV to 5 V<br>1 mV to 200 V<br><br>40 μV to 1 mVpp<br>1 mV to 5 Vpp<br>40 μV to 1 mVpp<br>1 mV to 200 Vpp                                                                                                       | 0.025 % of output + 25uV<br>0.010 % of output + 10uV<br><br>1.0 % of output + 10uV<br>0.10 % of output + 10uV<br>1.0 % of output + 10uV<br>0.10 % of output + 10uV | Fluke 9500C<br>w/9540C<br>active head | RDU, ATL,<br>DFW, HSV            |
| Oscilloscopes Calibration <sup>3</sup> –<br>Generate<br><br>Leveled Sine Flatness<br>50 kHz Reference                                                           | <b>(5mV to 5Vpp)</b><br>(0.1 Hz to 100) MHz<br>(100 to 500) MHz<br>(500 to 1100) MHz<br>(1100 to 2020) MHz<br><br><b>(5 mV to 3Vpp)</b><br>(2020 to 3200) MHz<br><br><b>(5 mV to 2Vpp)</b><br>(3200 to 4200) MHz | 0.18 dB<br>0.24 dB<br>0.28 dB<br>0.34 dB<br><br>0.42 dB<br><br>0.52 dB                                                                                             |                                       |                                  |
| Oscilloscopes Calibration <sup>3</sup> –<br>Generate<br><br>Time Marker                                                                                         | 240 pS ns to 55 s                                                                                                                                                                                                | 0.15 μs/s                                                                                                                                                          |                                       |                                  |
| Oscilloscopes Calibration <sup>3</sup> –<br>Measure<br><br>Input Impedance<br>Resistance                                                                        | (10 to 40) Ω<br>(40 to 90) Ω<br>(0.09 to 800) KΩ<br>(0.8 to 1.2) MΩ<br>(1.2 to 12) MΩ                                                                                                                            | 0.5 % of rdg<br>0.1 % of rdg<br>0.5 % of rdg<br>0.1 % of rdg<br>0.5 % of rdg                                                                                       |                                       |                                  |

| Parameter/Range                                                             | Frequency                                                                                   | CMC <sup>2, 7</sup> (±)                                                                                             | Comment                                   | Location <sup>10</sup>                               |
|-----------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|-------------------------------------------|------------------------------------------------------|
| AC Power – Generate <sup>3</sup><br><br>(12 to 120) mV<br>Power Factor = 1  | <b>(1.2 to 12) mA</b><br>(10 to 40) Hz<br>(40 to 1000) Hz<br>(1 to 5) kHz<br>(5 to 10) kHz  | 0.022 % of Output + 0.1 µW<br>0.022 % of Output + 0.1 µW<br>0.022 % of Output + 0.1 µW<br>0.12 % of Output + 0.1 µW | Fluke 5560A<br>multiproduct<br>calibrator | COS, HRT<br>MEL, ATL<br>RDU, RFD<br>TPA, HSV,<br>DFW |
|                                                                             | <b>(12 to 120) mA</b><br>(10 to 40) Hz<br>(40 to 1000) Hz<br>(1 to 5) kHz<br>(5 to 10) kHz  | 0.022 % of Output + 1.1 µW<br>0.016 % of Output + 0.7 µW<br>0.022 % of Output + 0.9 µW<br>0.12 % of Output + 1.1 µW |                                           |                                                      |
|                                                                             | <b>(0.12 to 1.2) A</b><br>(10 to 40) Hz<br>(40 to 1000) Hz<br>(1 to 5) kHz<br>(5 to 10) kHz | 0.022 % of Output + 11 µW<br>0.022 % of Output + 7.2 µW<br>0.022 % of Output + 9.2 µW<br>0.19 % of Output + 28 µW   |                                           |                                                      |
|                                                                             | <b>(1.2 to 3.1) A</b><br>(10 to 40) Hz<br>(40 to 1000) Hz<br>(1 to 5) kHz<br>(5 to 10) kHz  | 0.03 % of Output + 48 µW<br>0.025 % of Output + 31 µW<br>0.03 % of Output + 31 µW<br>0.19 % of Output + 48 µW       |                                           |                                                      |
|                                                                             | <b>(3.1 to 12) A</b><br>(10 to 40) Hz<br>(40 to 1000) Hz<br>(1 to 5) kHz<br>(5 to 10) kHz   | 0.03 % of Output + 110 µW<br>0.025 % of Output + 72 µW<br>0.03 % of Output + 92 µW<br>0.19 % of Output + 110 µW     |                                           |                                                      |
| AC Power – Generate <sup>3</sup><br><br>(0.12 to 1.2) V<br>Power Factor = 1 | <b>(12 to 30.2) A</b><br>(10 to 40) Hz<br>(40 to 1000) Hz<br>(1 to 5) kHz                   | 0.077 % of Output + 0.92 mW<br>0.054 % of Output + 0.74 mW<br>0.38 % of Output + 0.74 mW                            | Fluke 5560A<br>multiproduct<br>calibrator | COS, HRT<br>MEL, ATL<br>RDU, RFD<br>TPA, HSV,<br>DFW |
|                                                                             | <b>(1.2 to 12) mA</b><br>(10 to 40) Hz<br>(40 to 1000) Hz<br>(1 to 5) kHz<br>(5 to 10) kHz  | 0.022 % of Output + 0.9 µW<br>0.022 % of Output + 0.9 µW<br>0.022 % of Output + 0.9 µW<br>0.12 % of Output + 0.9 µW |                                           |                                                      |
|                                                                             | <b>(12 to 120) mA</b><br>(10 to 40) Hz<br>(40 to 1000) Hz<br>(1 to 5) kHz<br>(5 to 10) kHz  | 0.022 % of Output + 9.2 µW<br>0.016 % of Output + 4.7 µW<br>0.022 % of Output + 7.4 µW<br>0.12 % of Output + 9.2 µW |                                           |                                                      |
|                                                                             | <b>(0.12 to 1.2) A</b><br>(10 to 40) Hz<br>(40 to 1000) Hz<br>(1 to 5) kHz<br>(5 to 10) kHz | 0.022 % of Output + 92 µW<br>0.022 % of Output + 47 µW<br>0.022 % of Output + 74 µW<br>0.19 % of Output + 0.27 mW   |                                           |                                                      |



| Parameter/Range                                                             | Frequency                                                                                   | CMC <sup>2, 7</sup> (±)                                                                                                | Comment                                   | Location <sup>10</sup>                               |
|-----------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|------------------------------------------------------|
| AC Power – Generate <sup>3</sup><br><br>(0.12 to 1.2) V<br>Power Factor = 1 | <b>(1.2 to 3.1) A</b><br>(10 to 40) Hz<br>(40 to 1000) Hz<br>(1 to 5) kHz<br>(5 to 10) kHz  | 0.03 % of Output + 0.46 mW<br>0.025 % of Output + 0.27 mW<br>0.03 % of Output + 0.27 mW<br>0.19 % of Output + 0.46 mW  | Fluke 5560A<br>multiproduct<br>calibrator | COS, HRT<br>MEL, ATL<br>RDU, RFD<br>TPA, HSV,<br>DFW |
|                                                                             | <b>(3.1 to 12) A</b><br>(10 to 40) Hz<br>(40 to 1000) Hz<br>(1 to 5) kHz<br>(5 to 10) kHz   | 0.03 % of Output + 0.92 mW<br>0.025 % of Output + 0.47 mW<br>0.030 % of Output + 0.74 mW<br>0.19 % of Output + 0.92 mW |                                           |                                                      |
|                                                                             | <b>(12 to 30.2) A</b><br>(10 to 40) Hz<br>(40 to 1000) Hz<br>(1 to 5) kHz                   | 0.077 % of Output + 9.1 mW<br>0.054 % of Output + 7.3 mW<br>0.38 % of Output + 7.3 mW                                  |                                           |                                                      |
| AC Power – Generate <sup>3</sup><br><br>(1.2 to 12) V<br>Power Factor = 1   | <b>(1.2 to 12) mA</b><br>(10 to 40) Hz<br>(40 to 1000) Hz<br>(1 to 5) kHz<br>(5 to 10) kHz  | 0.022 % of Output + 9.2 µW<br>0.022 % of Output + 9.2 µW<br>0.022 % of Output + 9.2 µW<br>0.12 % of Output + 9.2 µW    |                                           |                                                      |
|                                                                             | <b>(12 to 120) mA</b><br>(10 to 40) Hz<br>(40 to 1000) Hz<br>(1 to 5) kHz<br>(5 to 10) kHz  | 0.022 % of Output + 92 µW<br>0.016 % of Output + 46 µW<br>0.022 % of Output + 74 µW<br>0.12 % of Output + 92 µW        |                                           |                                                      |
|                                                                             | <b>(0.12 to 1.2) A</b><br>(10 to 40) Hz<br>(40 to 1000) Hz<br>(1 to 5) kHz<br>(5 to 10) kHz | 0.022 % of Output + 0.92 mW<br>0.022 % of Output + 0.46 mW<br>0.022 % of Output + 0.74 mW<br>0.19 % of Output + 2.7 mW |                                           |                                                      |
|                                                                             | <b>(1.2 to 3.1) A</b><br>(10 to 40) Hz<br>(40 to 1000) Hz<br>(1 to 5) kHz<br>(5 to 10) kHz  | 0.03 % of Output + 4.6 mW<br>0.025 % of Output + 2.7 mW<br>0.03 % of Output + 2.7 mW<br>0.19 % of Output + 4.6 mW      |                                           |                                                      |
|                                                                             | <b>(3.1 to 12) A</b><br>(10 to 40) Hz<br>(40 to 1000) Hz<br>(1 to 5) kHz<br>(5 to 10) kHz   | 0.03 % of Output + 9.2 mW<br>0.025 % of Output + 4.6 mW<br>0.03 % of Output + 7.4 mW<br>0.19 % of Output + 9.2 mW      |                                           |                                                      |
|                                                                             | <b>(12 to 30.2) A</b><br>(10 to 40) Hz<br>(40 to 1000) Hz<br>(1 to 5) kHz                   | 0.077 % of Output + 91 mW<br>0.054 % of Output + 73 mW<br>0.38 % of Output + 73 mW                                     |                                           |                                                      |
|                                                                             |                                                                                             |                                                                                                                        |                                           |                                                      |
|                                                                             |                                                                                             |                                                                                                                        |                                           |                                                      |
|                                                                             |                                                                                             |                                                                                                                        |                                           |                                                      |
|                                                                             |                                                                                             |                                                                                                                        |                                           |                                                      |

| Parameter/Range                                                            | Frequency                                                                                   | CMC <sup>2, 7</sup> (±)                                                                                                 | Comment                                   | Location <sup>10</sup>                               |
|----------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|------------------------------------------------------|
| AC Power – Generate <sup>3</sup><br><br>(12 to 120) V<br>Power Factor = 1  | <b>(1.2 to 12) mA</b><br>(10 to 40) Hz<br>(40 to 1000) Hz<br>(1 to 5) kHz<br>(5 to 10) kHz  | 0.022 % of Output + 92 µW<br>0.022 % of Output + 92 µW<br>0.022 % of Output + 92 µW<br>0.12 % of Output + 92 µW         | Fluke 5560A<br>multiproduct<br>calibrator | COS, HRT<br>MEL, ATL<br>RDU, RFD<br>TPA, HSV,<br>DFW |
|                                                                            | <b>(12 to 120) mA</b><br>(10 to 40) Hz<br>(40 to 1000) Hz<br>(1 to 5) kHz<br>(5 to 10) kHz  | 0.022 % of Output + 0.92 mW<br>0.016 % of Output + 0.46 mW<br>0.022 % of Output + 0.74 mW<br>0.12 % of Output + 0.92 mW |                                           |                                                      |
|                                                                            | <b>(0.12 to 1.2) A</b><br>(10 to 40) Hz<br>(40 to 1000) Hz<br>(1 to 5) kHz<br>(5 to 10) kHz | 0.022 % of Output + 9.2 mW<br>0.022 % of Output + 4.6 mW<br>0.022 % of Output + 7.4 mW<br>0.19 % of Output + 27 mW      |                                           |                                                      |
|                                                                            | <b>(1.2 to 3.1) A</b><br>(10 to 40) Hz<br>(40 to 1000) Hz<br>(1 to 5) kHz<br>(5 to 10) kHz  | 0.03 % of Output + 46 mW<br>0.025 % of Output + 27 mW<br>0.03 % of Output + 27 mW<br>0.19 % of Output + 46 mW           |                                           |                                                      |
|                                                                            | <b>(3.1 to 12) A</b><br>(10 to 40) Hz<br>(40 to 1000) Hz<br>(1 to 5) kHz<br>(5 to 10) kHz   | 0.03 % of Output + 92 mW<br>0.025 % of Output + 46 mW<br>0.03 % of Output + 74 mW<br>0.19 % of Output + 92 mW           |                                           |                                                      |
|                                                                            | <b>(12 to 30.2) A</b><br>(10 to 40) Hz<br>(40 to 1 000) Hz<br>(1 to 5) kHz                  | 0.077 % of Output + 0.91 W<br>0.054 % of Output + 0.73 W<br>0.38 % of Output + 0.73 W                                   |                                           |                                                      |
| AC Power – Generate <sup>3</sup><br><br>(120 to 330) V<br>Power Factor = 1 | <b>(1.2 to 12) mA</b><br>(10 to 40) Hz<br>(40 to 1000) Hz<br>(1 to 5) kHz<br>(5 to 10) kHz  | 0.022 % of Output + 0.26 mW<br>0.022 % of Output + 0.26 mW<br>0.022 % of Output + 0.26 mW<br>0.12 % of Output + 0.26 mW |                                           |                                                      |
|                                                                            | <b>(12 to 120) mA</b><br>(10 to 40) Hz<br>(40 to 1000) Hz<br>(1 to 5) kHz<br>(5 to 10) kHz  | 0.022 % of Output + 2.6 mW<br>0.016 % of Output + 1.5 mW<br>0.022 % of Output + 2.1 mW<br>0.12 % of Output + 2.6 mW     |                                           |                                                      |
|                                                                            | <b>(0.12 to 1.2) A</b><br>(10 to 40) Hz<br>(40 to 1000) Hz<br>(1 to 5) kHz<br>(5 to 10) kHz | 0.022 % of Output + 26 mW<br>0.022 % of Output + 15 mW<br>0.022 % of Output + 21 mW<br>0.19 % of Output + 76 mW         |                                           |                                                      |

| Parameter/Range                                                             | Frequency                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | CMC <sup>2, 7</sup> (±)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Comment                                   | Location <sup>10</sup>                               |
|-----------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|------------------------------------------------------|
| AC Power – Generate <sup>3</sup><br><br>(120 to 330) V<br>Power Factor = 1  | <b>(1.2 to 3.1) A</b><br>(10 to 40) Hz<br>(40 to 1000) Hz<br>(1 to 5) kHz<br>(5 to 10) kHz<br><br><b>(3.1 to 12) A</b><br>(10 to 40) Hz<br>(40 to 1000) Hz<br>(1 to 5) kHz<br>(5 to 10) kHz<br><br><b>(12 to 30.2) A</b><br>(10 to 40) Hz<br>(40 to 1000) Hz<br>(1 to 5) kHz                                                                                                                                                                                                                                                                                                        | 0.03 % of Output + 0.13 W<br>0.025 % of Output + 0.08 W<br>0.030 % of Output + 0.08 W<br>0.19 % of Output + 0.13 W<br><br>0.03 % of Output + 0.26 W<br>0.025 % of Output + 0.15 W<br>0.03 % of Output + 0.21 W<br>0.19 % of Output + 0.26 W<br><br>0.077 % of Output + 2.5 W<br>0.054 % of Output + 2.0 W<br>0.38 % of Output + 2.0 W                                                                                                                                                                                                                                                                                                                                                                         | Fluke 5560A<br>multiproduct<br>calibrator | COS, HRT<br>MEL, ATL<br>RDU, RFD<br>TPA, HSV,<br>DFW |
| AC Power – Generate <sup>3</sup><br><br>(330 to 1020) V<br>Power Factor = 1 | <b>(1.2 to 12) mA</b><br>(10 to 40) Hz<br>(40 to 1000) Hz<br>(1 to 5) kHz<br>(5 to 10) kHz<br><br><b>(12 to 120) mA</b><br>(10 to 40) Hz<br>(40 to 1000) Hz<br>(1 to 5) kHz<br>(5 to 10) kHz<br><br><b>(0.12 to 1.2) A</b><br>(10 to 40) Hz<br>(40 to 1000) Hz<br>(1 to 5) kHz<br>(5 to 10) kHz<br><br><b>(1.2 to 3.1) A</b><br>(10 to 40) Hz<br>(40 to 1000) Hz<br>(1 to 5) kHz<br>(5 to 10) kHz<br><br><b>(3.1 to 12) A</b><br>(10 to 40) Hz<br>(40 to 1000) Hz<br>(1 to 5) kHz<br>(5 to 10) kHz<br><br><b>(12 to 30.2) A</b><br>(10 to 40) Hz<br>(40 to 1000) Hz<br>(1 to 5) kHz | 0.022 % of Output + 1.1 mW<br>0.022 % of Output + 1.1 mW<br>0.022 % of Output + 1.1 mW<br>0.12 % of Output + 1.1 mW<br><br>0.022 % of Output + 11 mW<br>0.016 % of Output + 8.3 mW<br>0.022 % of Output + 9.6 mW<br>0.12 % of Output + 11 mW<br><br>0.022 % of Output + 110 mW<br>0.022 % of Output + 83 mW<br>0.022 % of Output + 96 mW<br>0.19 % of Output + 240 mW<br><br>0.03 % of Output + 0.43 W<br>0.025 % of Output + 0.30 W<br>0.03 % of Output + 0.30 W<br>0.19 % of Output + 0.43 W<br><br>0.03 % of Output + 1.1 W<br>0.025 % of Output + 0.8 W<br>0.03 % of Output + 1.0 W<br>0.19 % of Output + 1.1 W<br><br>0.077 % of Output + 8.0 W<br>0.054 % of Output + 6.5 W<br>0.38 % of Output + 6.5 W |                                           |                                                      |

| Parameter/Range                                                                  | Frequency                                                       | CMC <sup>2, 7</sup> (±)                                   | Comment                     | Location <sup>10</sup> |
|----------------------------------------------------------------------------------|-----------------------------------------------------------------|-----------------------------------------------------------|-----------------------------|------------------------|
| AC Power – Generate <sup>3</sup><br><br>(33 to 329.999) mV<br>Power Factor = 1   | <b>(3.3 to 32.999 9) mA</b><br>(20 to 45) Hz<br>(45 to 1000) Hz | 0.072 % of Output + 0.5 µW<br>0.032 % of Output + 0.5 µW  | Fluke 5522A<br>multiproduct | SFL, HLR<br>HSV        |
|                                                                                  | <b>(33 to 329.999) mA</b><br>(20 to 45) Hz<br>(45 to 1000) Hz   | 0.072 % of Output + 5.4 µW<br>0.032 % of Output + 5.4 µW  |                             |                        |
|                                                                                  | <b>(0.33 to 1.099 99) A</b><br>(10 to 45) Hz<br>(45 to 1000) Hz | 0.14 % of Output + 26 µW<br>0.04 % of Output + 26 µW      |                             |                        |
|                                                                                  | <b>(1.1 to 2.999 99) A</b><br>(10 to 45) Hz<br>(45 to 1000) Hz  | 0.14 % of Output + 31 µW<br>0.044 % of Output + 31 µW     |                             |                        |
|                                                                                  | <b>(3 to 10.9999) A</b><br>(45 to 100) Hz<br>(100 to 1000) Hz   | 0.047 % of Output + 0.5 mW<br>0.077 % of Output + 0.5 mW  |                             |                        |
|                                                                                  | <b>(11 to 20.5) A</b><br>(45 to 100) Hz<br>(100 to 1000) Hz     | 0.092 % of Output + 1.3 mW<br>0.12 % of Output + 1.3 mW   |                             |                        |
| AC Power – Generate <sup>3</sup><br><br>(0.33 to 3.299 99) V<br>Power Factor = 1 | <b>(3.3 to 32.9999) mA</b><br>(20 to 45) Hz<br>(45 to 1000) Hz  | 0.072 % of Output + 5.2 µW<br>0.033 % of Output + 5.2 µW  | Fluke 5522A<br>multiproduct | SFL, HLR<br>HSV        |
|                                                                                  | <b>(33 to 329.999) mA</b><br>(20 to 45) Hz<br>(45 to 1000) Hz   | 0.072 % of Output + 52 µW<br>0.033 % of Output + 52 µW    |                             |                        |
|                                                                                  | <b>(0.33 to 1.09999) A</b><br>(10 to 45) Hz<br>(45 to 1000) Hz  | 0.14 % of Output + 26 µW<br>0.04 % of Output + 26 µW      |                             |                        |
|                                                                                  | <b>(1.1 to 2.999 99) A</b><br>(10 to 45) Hz<br>(45 to 1000) Hz  | 0.14 % of Output + 0.28 mW<br>0.047 % of Output + 0.29 mW |                             |                        |
|                                                                                  | <b>(3 to 10.999 9) A</b><br>(45 to 100) Hz<br>(100 to 1000) Hz  | 0.047 % of Output + 5.1 mW<br>0.077 % of Output + 5.1 mW  |                             |                        |
|                                                                                  | <b>(11 to 20.5) A</b><br>(45 to 100) Hz<br>(100 to 1000) Hz     | 0.092 % of Output + 13 mW<br>0.12 % of Output + 13 mW     |                             |                        |

| Parameter/Range                                                                 | Frequency                                                       | CMC <sup>2, 7</sup> (±)                                  | Comment                                   | Location <sup>10</sup> |
|---------------------------------------------------------------------------------|-----------------------------------------------------------------|----------------------------------------------------------|-------------------------------------------|------------------------|
| AC Power – Generate <sup>3</sup><br><br>(3.3 to 32.999 9) V<br>Power Factor = 1 | <b>(3.3 to 32.999 9) mA</b><br>(20 to 45) Hz<br>(45 to 1000) Hz | 0.072 % of Output + 53 µW<br>0.033 % of Output + 53 µW   | Fluke 5522A<br>multiproduct<br>calibrator | SFL, HLR<br>HSV        |
|                                                                                 | <b>(33 to 329.999) mA</b><br>(20 to 45) Hz<br>(45 to 1000) Hz   | 0.072 % of Output + 0.5 mW<br>0.033 % of Output + 0.5 mW |                                           |                        |
|                                                                                 | <b>(0.33 to 1.099 99) A</b><br>(10 to 45) Hz<br>(45 to 1000) Hz | 0.14 % of Output + 2.6 mW<br>0.04 % of Output + 2.6 mW   |                                           |                        |
|                                                                                 | <b>(1.1 to 2.999 99) A</b><br>(10 to 45) Hz<br>(45 to 1000) Hz  | 0.14 % of Output + 2.9 mW<br>0.047 % of Output + 2.9 mW  |                                           |                        |
|                                                                                 | <b>(3 to 10.9999) A</b><br>(45 to 100) Hz<br>(100 to 1000) Hz   | 0.047 % of Output + 51 mW<br>0.077 % of Output + 51 mW   |                                           |                        |
|                                                                                 | <b>(11 to 20.5) A</b><br>(45 to 100) Hz<br>(100 to 1000) Hz     | 0.092 % of Output + 0.13 W<br>0.12 % of Output + 0.13 W  |                                           |                        |
| AC Power – Generate <sup>3</sup><br><br>(33 to 329.999) V<br>Power Factor = 1   | <b>(3.3 to 32.999 9) mA</b><br>(45 to 1000) Hz                  | 0.034 % of Output + 0.5 mW                               |                                           |                        |
|                                                                                 | <b>(33 to 329.999) mA</b><br>(45 to 1000) Hz                    | 0.034 % of Output + 5.1 mW                               |                                           |                        |
|                                                                                 | <b>(0.33 to 1.099 99) A</b><br>(45 to 1000) Hz                  | 0.041 % of Output + 25 mW                                |                                           |                        |
|                                                                                 | <b>(1.1 to 2.999 99) A</b><br>(45 to 1000) Hz                   | 0.048 % of Output + 26 mW                                |                                           |                        |
|                                                                                 | <b>(3 to 10.9999) A</b><br>(45 to 100) Hz<br>(100 to 1000) Hz   | 0.048 % of Output + 0.5 W<br>0.077 % of Output + 0.5 W   |                                           |                        |
|                                                                                 | <b>(11 to 20.5) A</b><br>(45 to 100) Hz<br>(100 to 1000) Hz     | 0.092 % of Output + 1.3 W<br>0.12 % of Output + 1.3 W    |                                           |                        |

| Parameter/Range                                                              | Frequency                                                      | CMC <sup>2,7</sup> (±)                                 | Comment                                   | Location <sup>10</sup>                               |
|------------------------------------------------------------------------------|----------------------------------------------------------------|--------------------------------------------------------|-------------------------------------------|------------------------------------------------------|
| AC Power – Generate <sup>3</sup><br><br>(330 to 1 020) V<br>Power Factor = 1 | <b>(3.3 to 32.999 9) mA</b><br>(45 to 1000) Hz                 | 0.036 % of Output + 1.6 mW                             | Fluke 5522A<br>multiproduct<br>calibrator | SFL, HLR<br>HSV                                      |
|                                                                              | <b>(33 to 329.999) mA</b><br>(45 to 1000) Hz                   | 0.036 % of Output + 16 mW                              |                                           |                                                      |
|                                                                              | <b>(0.33 to 1.099 99) A</b><br>(45 to 1000) Hz                 | 0.043 % of Output + 78 mW                              |                                           |                                                      |
|                                                                              | <b>(1.1 to 2.999 99) A</b><br>(45 to 1000) Hz                  | 0.049 % of Output + 81 mW                              |                                           |                                                      |
|                                                                              | <b>(3 to 10.999 9) A</b><br>(45 to 100) Hz<br>(100 to 1000) Hz | 0.051 % of Output + 1.6 W<br>0.078 % of Output + 1.6 W |                                           |                                                      |
|                                                                              | <b>(11 to 20.5) A</b><br>(45 to 100) Hz<br>(100 to 1000) Hz    | 0.094 % of Output + 3.9 W<br>0.12 % of Output + 3.9W   |                                           |                                                      |
| Electrical Calibration of<br>Thermocouple Indicators <sup>3</sup>            | <b>Type B</b><br>(600 to 800) °C                               | 0.27 °C                                                | Fluke 7526A<br>process<br>calibrator      | COS, MEL<br>RDU, RFD<br>TPA, SFL<br>HSV, HLR,<br>DFW |
|                                                                              | (800 to 1 550) °C                                              | 0.21 °C                                                |                                           |                                                      |
|                                                                              | (1 550 °C to 1 820) °C                                         | 0.17 °C                                                |                                           |                                                      |
|                                                                              | <b>Type BP</b><br>(0 to 200) °C                                | 0.14 °C                                                |                                           |                                                      |
|                                                                              | (200 to 600) °C                                                | 0.12 °C                                                |                                           |                                                      |
|                                                                              | (600 to 800) °C                                                | 0.13 °C                                                |                                           |                                                      |
|                                                                              | (800 to 1600) °C                                               | 0.18 °C                                                |                                           |                                                      |
|                                                                              | (1600 to 2000) °C                                              | 0.21 °C                                                |                                           |                                                      |
|                                                                              | (2000 to 2500) °C                                              | 0.3 °C                                                 |                                           |                                                      |
|                                                                              | <b>Type C</b><br>(0 to 1000) °C                                | 0.12 °C                                                |                                           |                                                      |
|                                                                              | (1000 to 1800) °C                                              | 0.18 °C                                                |                                           |                                                      |
|                                                                              | (1800 to 2000) °C                                              | 0.20 °C                                                |                                           |                                                      |
|                                                                              | (2000 to 2316) °C                                              | 0.27 °C                                                |                                           |                                                      |
|                                                                              | <b>Type D</b><br>(0 to 150) °C                                 | 0.19 °C                                                |                                           |                                                      |
|                                                                              | (150 to 650) °C                                                | 0.16 °C                                                |                                           |                                                      |
|                                                                              | (650 to 1000) °C                                               | 0.2 °C                                                 |                                           |                                                      |
|                                                                              | (1000 to 1800) °C                                              | 0.33 °C                                                |                                           |                                                      |
|                                                                              | (1800 to 2315) °C                                              | 0.59 °C                                                |                                           |                                                      |
|                                                                              | <b>Type E</b><br>(-250 to -200) °C                             | 0.19 °C                                                |                                           |                                                      |
|                                                                              | (-200 to -100) °C                                              | 0.09 °C                                                |                                           |                                                      |
|                                                                              | (-100 to 0) °C                                                 | 0.07 °C                                                |                                           |                                                      |
|                                                                              | (0 to 600) °C                                                  | 0.06 °C                                                |                                           |                                                      |
|                                                                              | (600 to 1000) °C                                               | 0.08 °C                                                |                                           |                                                      |

| Parameter/Equipment                                            | Range                               | CMC <sup>2</sup> (±) | Comment                        | Location <sup>10</sup>                               |
|----------------------------------------------------------------|-------------------------------------|----------------------|--------------------------------|------------------------------------------------------|
| Electrical Calibration of Thermocouple Indicators <sup>3</sup> | <b>Type J</b><br>(-210 to -100) °C  | 0.11 °C              | Fluke 7526A process calibrator | COS, MEL<br>RDU, RFD<br>TPA, SFL<br>HSV, HLR,<br>DFW |
|                                                                | (-100 to 800) °C                    | 0.07 °C              |                                |                                                      |
|                                                                | (800 to 1200) °C                    | 0.08 °C              |                                |                                                      |
|                                                                | <b>Type K</b><br>(-250 to -200) °C  | 0.35 °C              |                                |                                                      |
|                                                                | (-200 to -100) °C                   | 0.12 °C              |                                |                                                      |
|                                                                | (-100 to 800) °C                    | 0.08 °C              |                                |                                                      |
|                                                                | (800 to 1372) °C                    | 0.1 °C               |                                |                                                      |
|                                                                | <b>Type XK</b><br>(-250 to -100) °C | 0.08 °C              |                                |                                                      |
|                                                                | (-100 to 0) °C                      | 0.07 °C              |                                |                                                      |
|                                                                | (0 to 600) °C                       | 0.06 °C              |                                |                                                      |
|                                                                | (600 to 800) °C                     | 0.07 °C              |                                |                                                      |
|                                                                | <b>Type L</b><br>(-200 to -100) °C  | 0.08 °C              |                                |                                                      |
|                                                                | (-100 to 900) °C                    | 0.07 °C              |                                |                                                      |
|                                                                | <b>Type N</b><br>(-250 to -200) °C  | 0.56 °C              |                                |                                                      |
|                                                                | (-200 to -100) °C                   | 0.18 °C              |                                |                                                      |
|                                                                | (-100 to 0) °C                      | 0.09 °C              |                                |                                                      |
|                                                                | (0 to 100) °C                       | 0.08 °C              |                                |                                                      |
|                                                                | (100 to 800) °C                     | 0.08 °C              |                                |                                                      |
|                                                                | (800 to 1300) °C                    | 0.09 °C              |                                |                                                      |
|                                                                | <b>Type R</b><br>(-50 to -25) °C    | 0.42 °C              |                                |                                                      |
|                                                                | (-25 to 0) °C                       | 0.34 °C              |                                |                                                      |
|                                                                | (0 to 100) °C                       | 0.3 °C               |                                |                                                      |
|                                                                | (100 to 400) °C                     | 0.21 °C              |                                |                                                      |
|                                                                | (400 to 600) °C                     | 0.17 °C              |                                |                                                      |
|                                                                | (600 to 1000) °C                    | 0.16 °C              |                                |                                                      |
|                                                                | (1000 to 1600) °C                   | 0.14 °C              |                                |                                                      |
|                                                                | (1600 to 1767) °C                   | 0.18 °C              |                                |                                                      |
|                                                                | <b>Type S</b><br>(-50 to -25) °C    | 0.39 °C              |                                |                                                      |
|                                                                | (-25 to 0) °C                       | 0.33 °C              |                                |                                                      |
|                                                                | (0 to 100) °C                       | 0.29 °C              |                                |                                                      |
|                                                                | (100 to 400) °C                     | 0.22 °C              |                                |                                                      |
|                                                                | (400 to 600) °C                     | 0.18 °C              |                                |                                                      |
|                                                                | (600 to 1600) °C                    | 0.17 °C              |                                |                                                      |
|                                                                | (1600 to 1767) °C                   | 0.20 °C              |                                |                                                      |
|                                                                | <b>Type T</b><br>(-250 to -200) °C  | 0.27 °C              |                                |                                                      |
|                                                                | (-200 to -100) °C                   | 0.12 °C              |                                |                                                      |
|                                                                | (-100 to 0) °C                      | 0.08 °C              |                                |                                                      |
|                                                                | (0 to 400) °C                       | 0.07 °C              |                                |                                                      |
|                                                                | <b>Type U</b><br>(-200 to 0) °C     | 0.13 °C              |                                |                                                      |
|                                                                | (0 to 600) °C                       | 0.08 °C              |                                |                                                      |

| Parameter/Equipment                                              | Range                                                      | CMC <sup>2</sup> (±) | Comment                           | Location <sup>10</sup>                               |
|------------------------------------------------------------------|------------------------------------------------------------|----------------------|-----------------------------------|------------------------------------------------------|
| Electrical Calibration of<br>RTD Indicating Devices <sup>3</sup> | <b>Pt 100 (385)</b><br>(-200 to 800) °C                    | 0.04 °C              | Fluke 7526A process<br>calibrator | COS, MEL<br>RDU, RFD<br>TPA, SFL<br>HSV, HLR,<br>DFW |
|                                                                  | <b>Pt 100 (3916)</b><br>(-200 to 630) °C                   | 0.04 °C              |                                   |                                                      |
|                                                                  | <b>Pt 100 (3926)</b><br>(-200 to 630) °C                   | 0.04 °C              |                                   |                                                      |
|                                                                  | <b>Pt 200 (385)</b><br>(-200 to 400) °C<br>(400 to 630) °C | 0.30 °C<br>0.38 °C   |                                   |                                                      |
|                                                                  | <b>Pt 500 (385)</b><br>(-200 to 630) °C                    | 0.13 °C              |                                   |                                                      |
|                                                                  | <b>Pt 1 000 (385)</b><br>(-200 to 630) °C                  | 0.07 °C              |                                   |                                                      |
|                                                                  | <b>Cu 10 (427)</b><br>(-100 to 260) °C                     | 0.29 °C              |                                   |                                                      |
|                                                                  | <b>Ni 120 (672)</b><br>(-80 to 260) °C                     | 0.29 °C              |                                   |                                                      |



| Parameter/Equipment                                                    | Range             | CMC <sup>2</sup> (±) | Comment                             | Location <sup>10</sup>                      |
|------------------------------------------------------------------------|-------------------|----------------------|-------------------------------------|---------------------------------------------|
| Electrical Calibration of Thermocouple Indicating Devices <sup>3</sup> | <b>Type B</b>     |                      | Fluke 5560A multiproduct calibrator | HRT, ATL, TPA, HSV, RFD, MEL, COS, RDU, DFW |
|                                                                        | (600 to 800) °C   | 0.33 °C              |                                     |                                             |
|                                                                        | (800 to 1000) °C  | 0.26 °C              |                                     |                                             |
|                                                                        | (1000 to 1550) °C | 0.23 °C              |                                     |                                             |
|                                                                        | (1550 to 1820) °C | 0.25 °C              |                                     |                                             |
|                                                                        | <b>Type C</b>     |                      |                                     |                                             |
|                                                                        | (0 to 150) °C     | 0.19 °C              |                                     |                                             |
|                                                                        | (150 to 650) °C   | 0.16 °C              |                                     |                                             |
|                                                                        | (650 to 1000) °C  | 0.2 °C               |                                     |                                             |
|                                                                        | (1000 to 1800) °C | 0.34 °C              |                                     |                                             |
|                                                                        | (1800 to 2315) °C | 0.60 °C              |                                     |                                             |
|                                                                        | <b>Type D</b>     |                      |                                     |                                             |
|                                                                        | (0 to 150) °C     | 0.19 °C              |                                     |                                             |
|                                                                        | (150 to 650) °C   | 0.16 °C              |                                     |                                             |
|                                                                        | (650 to 1000) °C  | 0.2 °C               |                                     |                                             |
|                                                                        | (1000 to 1800) °C | 0.33 °C              |                                     |                                             |
|                                                                        | (1800 to 2315) °C | 0.59 °C              |                                     |                                             |
|                                                                        | <b>Type E</b>     |                      |                                     |                                             |
|                                                                        | (-250 to -150) °C | 0.3 °C               |                                     |                                             |
|                                                                        | (-150 to -25) °C  | 0.11 °C              |                                     |                                             |
|                                                                        | (-25 to 350) °C   | 0.08 °C              |                                     |                                             |
|                                                                        | (350 to 650) °C   | 0.12 °C              |                                     |                                             |
|                                                                        | (650 to 1000) °C  | 0.16 °C              |                                     |                                             |
|                                                                        | <b>Type G</b>     |                      |                                     |                                             |
|                                                                        | (0 to 150) °C     | 0.38 °C              |                                     |                                             |
|                                                                        | (150 to 650) °C   | 0.25 °C              |                                     |                                             |
|                                                                        | (650 to 1000) °C  | 0.2 °C               |                                     |                                             |
|                                                                        | (1000 to 1800) °C | 0.33 °C              |                                     |                                             |
|                                                                        | (1800 to 2315) °C | 0.59 °C              |                                     |                                             |
|                                                                        | <b>Type J</b>     |                      |                                     |                                             |
|                                                                        | (-210 to -100) °C | 0.18 °C              |                                     |                                             |
|                                                                        | (-100 to -30) °C  | 0.1 °C               |                                     |                                             |
|                                                                        | (-30 to 150) °C   | 0.08 °C              |                                     |                                             |
|                                                                        | (150 to 760) °C   | 0.11 °C              |                                     |                                             |
|                                                                        | (760 to 1200) °C  | 0.15 °C              |                                     |                                             |
|                                                                        | <b>Type K</b>     |                      |                                     |                                             |
|                                                                        | (-200 to -100) °C | 0.21 °C              |                                     |                                             |
|                                                                        | (-100 to -25) °C  | 0.1 °C               |                                     |                                             |
|                                                                        | (-25 to 120) °C   | 0.08 °C              |                                     |                                             |
|                                                                        | (120 to 1000) °C  | 0.16 °C              |                                     |                                             |
|                                                                        | (1000 to 1372) °C | 0.27 °C              |                                     |                                             |
|                                                                        | <b>Type L</b>     |                      |                                     |                                             |
|                                                                        | (-200 to -100) °C | 0.24 °C              |                                     |                                             |
|                                                                        | (-100 to 800) °C  | 0.15 °C              |                                     |                                             |
|                                                                        | (800 to 900) °C   | 0.08 °C              |                                     |                                             |

| Parameter/Equipment                                                    | Range                                   | CMC <sup>2</sup> (±) | Comment                                | Location <sup>10</sup>                                  |
|------------------------------------------------------------------------|-----------------------------------------|----------------------|----------------------------------------|---------------------------------------------------------|
| Electrical Calibration of Thermocouple Indicating Devices <sup>3</sup> | <b>Type N</b><br>(-200 to -100) °C      | 0.25 °C              | Fluke 5560A<br>multiproduct calibrator | HRT, ATL,<br>TPA, HSV,<br>RFD, MEL,<br>COS, RDU,<br>DFW |
|                                                                        | (-100 to -25) °C                        | 0.11 °C              |                                        |                                                         |
|                                                                        | (-25 to 120) °C                         | 0.09 °C              |                                        |                                                         |
|                                                                        | (120 to 410) °C                         | 0.08 °C              |                                        |                                                         |
|                                                                        | (410 to 1300) °C                        | 0.15 °C              |                                        |                                                         |
|                                                                        | <b>Type R</b><br>(0 to 250) °C          | 0.39 °C              |                                        |                                                         |
|                                                                        | (250 to 400) °C                         | 0.22 °C              |                                        |                                                         |
|                                                                        | (400 to 1000) °C                        | 0.21 °C              |                                        |                                                         |
|                                                                        | (1000 to 1767) °C                       | 0.26 °C              |                                        |                                                         |
|                                                                        | <b>Type S</b><br>(0 to 250) °C          | 0.32 °C              |                                        |                                                         |
| Electrical Calibration of RTD Indicators <sup>3</sup>                  | (250 to 1000) °C                        | 0.24 °C              |                                        |                                                         |
|                                                                        | (1000 to 1400) °C                       | 0.24 °C              |                                        |                                                         |
|                                                                        | (1400 to 1767) °C                       | 0.31 °C              |                                        |                                                         |
|                                                                        | <b>Type T</b><br>(-250 to -150) °C      | 0.46 °C              |                                        |                                                         |
|                                                                        | (-150 to 0) °C                          | 0.16 °C              |                                        |                                                         |
|                                                                        | (0 to 120) °C                           | 0.1 °C               |                                        |                                                         |
|                                                                        | (120 to 400) °C                         | 0.08 °C              |                                        |                                                         |
|                                                                        | <b>Type U</b><br>(-200 to 0) °C         | 0.3 °C               |                                        |                                                         |
|                                                                        | (0 to 600) °C                           | 0.08 °C              |                                        |                                                         |
|                                                                        | <b>Type BP</b><br>(0 to 1000) °C        | 0.3 °C               |                                        |                                                         |
| Electrical Calibration of Thermocouple Indicating Devices <sup>3</sup> | (1000 to 2000) °C                       | 0.46 °C              | Fluke 5560A<br>multiproduct calibrator | HRT, ATL,<br>TPA, HSV,<br>RFD, MEL,<br>COS, RDU,<br>DFW |
|                                                                        | (2000 to 2500) °C                       | 0.61 °C              |                                        |                                                         |
|                                                                        | <b>Type XK</b><br>(-200 to 300) °C      | 0.15 °C              |                                        |                                                         |
|                                                                        | (300 to 800) °C                         | 0.23 °C              |                                        |                                                         |
|                                                                        | <b>Cu 10 (427)</b><br>(-80 to 260) °C   | 0.23 °C              |                                        |                                                         |
|                                                                        | <b>Cu 50 (428)</b><br>(-180 to 200) °C  | 0.3 °C               |                                        |                                                         |
|                                                                        | <b>Cu 100 (428)</b><br>(-180 to -40) °C | 0.3 °C               |                                        |                                                         |
|                                                                        | (-40 to 200) °C                         | 0.49 °C              |                                        |                                                         |
|                                                                        | <b>Ni 120 (672)</b><br>(-80 to 0) °C    | 0.06 °C              |                                        |                                                         |
|                                                                        | (0 to 100) °C                           | 0.06 °C              |                                        |                                                         |
|                                                                        | (100 to 260) °C                         | 0.11 °C              |                                        |                                                         |

| Parameter/Equipment                                      | Range                | CMC <sup>2</sup> (±) | Comment                                | Location <sup>10</sup>                                  |
|----------------------------------------------------------|----------------------|----------------------|----------------------------------------|---------------------------------------------------------|
| Electrical Calibration of<br>RTD Indicators <sup>3</sup> | <b>Pt 100 (385)</b>  |                      |                                        |                                                         |
|                                                          | (-200 to -80) °C     | 0.04 °C              |                                        |                                                         |
|                                                          | (-80 to 0) °C        | 0.04 °C              |                                        |                                                         |
|                                                          | (0 to 100) °C        | 0.05 °C              |                                        |                                                         |
|                                                          | (100 to 300) °C      | 0.07 °C              |                                        |                                                         |
|                                                          | (300 to 400) °C      | 0.08 °C              |                                        |                                                         |
|                                                          | (400 to 630) °C      | 0.09 °C              |                                        |                                                         |
|                                                          | (630 to 800) °C      | 0.18 °C              |                                        |                                                         |
|                                                          | <b>Pt 100 (3916)</b> |                      |                                        |                                                         |
|                                                          | (-200 to -190) °C    | 0.19 °C              |                                        |                                                         |
|                                                          | (-190 to -80) °C     | 0.03 °C              |                                        |                                                         |
|                                                          | (-80 to 0) °C        | 0.04 °C              |                                        |                                                         |
|                                                          | (0 to 100) °C        | 0.05 °C              |                                        |                                                         |
|                                                          | (100 to 260) °C      | 0.05 °C              |                                        |                                                         |
|                                                          | (260 to 300) °C      | 0.06 °C              |                                        |                                                         |
|                                                          | (300 to 400) °C      | 0.07 °C              |                                        |                                                         |
|                                                          | (400 to 600) °C      | 0.08 °C              |                                        |                                                         |
|                                                          | (600 to 630) °C      | 0.18 °C              |                                        |                                                         |
|                                                          | <b>Pt 100 (3926)</b> |                      |                                        |                                                         |
|                                                          | (-200 to -80) °C     | 0.04 °C              |                                        |                                                         |
|                                                          | (-80 to 0) °C        | 0.04 °C              |                                        |                                                         |
|                                                          | (0 to 100) °C        | 0.05 °C              |                                        |                                                         |
|                                                          | (100 to 300) °C      | 0.07 °C              |                                        |                                                         |
|                                                          | (300 to 400) °C      | 0.08 °C              |                                        |                                                         |
|                                                          | (400 to 630) °C      | 0.09 °C              |                                        |                                                         |
|                                                          | <b>Pt 200 (385)</b>  |                      |                                        |                                                         |
|                                                          | (-200 to -80) °C     | 0.03 °C              |                                        |                                                         |
|                                                          | (-80 to 0) °C        | 0.03 °C              |                                        |                                                         |
|                                                          | (0 to 100) °C        | 0.03 °C              |                                        |                                                         |
|                                                          | (100 to 260) °C      | 0.04 °C              |                                        |                                                         |
|                                                          | (260 to 300) °C      | 0.09 °C              |                                        |                                                         |
|                                                          | (300 to 400) °C      | 0.1 °C               |                                        |                                                         |
|                                                          | (400 to 600) °C      | 0.11 °C              |                                        |                                                         |
|                                                          | (600 to 630) °C      | 0.12 °C              |                                        |                                                         |
|                                                          | <b>Pt 500 (385)</b>  |                      |                                        |                                                         |
|                                                          | (-200 to -80) °C     | 0.03 °C              |                                        |                                                         |
|                                                          | (-80 to 0) °C        | 0.04 °C              |                                        |                                                         |
|                                                          | (0 to 100) °C        | 0.04 °C              |                                        |                                                         |
|                                                          | (100 to 260) °C      | 0.05 °C              |                                        |                                                         |
|                                                          | (260 to 300) °C      | 0.06 °C              |                                        |                                                         |
|                                                          | (300 to 400) °C      | 0.06 °C              |                                        |                                                         |
|                                                          | (400 to 600) °C      | 0.07 °C              |                                        |                                                         |
|                                                          | (600 to 630) °C      | 0.08 °C              |                                        |                                                         |
|                                                          | <b>Pt 1000 (385)</b> |                      |                                        |                                                         |
|                                                          | (-200 to -80) °C     | 0.02 °C              |                                        |                                                         |
|                                                          | (-80 to 0) °C        | 0.02 °C              |                                        |                                                         |
|                                                          | (0 to 100) °C        | 0.03 °C              |                                        |                                                         |
|                                                          | (100 to 260) °C      | 0.04 °C              |                                        |                                                         |
|                                                          | (260 to 300) °C      | 0.05 °C              |                                        |                                                         |
|                                                          | (300 to 400) °C      | 0.05 °C              |                                        |                                                         |
|                                                          | (400 to 600) °C      | 0.05 °C              |                                        |                                                         |
|                                                          | (600 to 630) °C      | 0.18 °C              |                                        |                                                         |
|                                                          |                      |                      | Fluke 5560A<br>multiproduct calibrator | HRT, ATL,<br>TPA, HSV,<br>RFD, MEL,<br>COS, RDU,<br>DFW |

VI. Electrical – RF/Microwave

| Parameter/Range                    | Frequency                                                                                               | CMC <sup>2, 7</sup> (±)                  | Comment                                                        | Location <sup>10</sup>                                           |
|------------------------------------|---------------------------------------------------------------------------------------------------------|------------------------------------------|----------------------------------------------------------------|------------------------------------------------------------------|
| RF Flatness – Measure <sup>3</sup> | <b>9 kHz to 2 000MHz</b><br>(20 to -10) dBm<br>(-10 to -30) dBm<br>(-30 to -40) dBm<br>(-40 to -42) dBm | 0.1 dB<br>0.1 dB<br>0.11 dB<br>0.12 dB   | Agilent EPM series<br>power meter w/E9304A<br>H18 power sensor | COS, MEL<br>RDU, RFD<br>TPA, SFL<br>HSV, HLR<br>HRT, ATL,<br>DFW |
|                                    | <b>(2 to 14) GHz</b><br>(20 to -10) dBm<br>(-10 to -30) dBm<br>(-30 to -40) dBm<br>(-40 to -42) dBm     | 0.10 dB<br>0.09 dB<br>0.1 dB<br>0.11 dB  |                                                                |                                                                  |
|                                    | <b>(14 to 18) GHz</b><br>(20 to -10) dBm<br>(-10 to -30) dBm<br>(-30 to -40) dBm<br>(-40 to -42) dBm    | 0.11 dB<br>0.12 dB<br>0.12 dB<br>0.13 dB |                                                                |                                                                  |
| RF Power – Measure <sup>3</sup>    | <b>9 kHz to 14 000 MHz</b><br>(20 to 0) dB<br>(0 to -40) dB<br>(-40 to -50) dB<br>(-50 to -55) dB       | 0.13 dB<br>0.15 dB<br>0.34 dB<br>0.93 dB |                                                                |                                                                  |
|                                    | <b>(14 000 to 18 000) MHz</b><br>(20 to 0) dB<br>(0 to -40) dB<br>(-40 to -50) dB<br>(-50 to -55) dB    | 0.12 dB<br>0.16 dB<br>0.35 dB<br>0.93 dB |                                                                |                                                                  |

| Parameter/Range                 | Frequency                                                                                                             | CMC <sup>2, 7</sup> (±)                             | Comment                                                       | Location <sup>10</sup>           |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|---------------------------------------------------------------|----------------------------------|
| RF Power – Measure <sup>3</sup> | <b>(10 to 100) MHz</b><br>(20 to 10) dB<br>(10 to 0) dB<br>(0 to -10) dB<br>(-10 to -20) dB<br>(-20 to -25) dB        | 0.07 dB<br>0.06 dB<br>0.06 dB<br>0.06 dB<br>0.11 dB | Agilent EPM series power meter RF power Keysight N8485A power | RFD, ATL                         |
|                                 | <b>(100 to 2 000) MHz</b><br>(20 to 10) dB<br>(10 to 0) dB<br>(0 to -10) dB<br>(-10 to -20) dB<br>(-20 to -25) dB     | 0.07 dB<br>0.07 dB<br>0.06 dB<br>0.07 dB<br>0.11 dB |                                                               |                                  |
|                                 | <b>(2 000 to 12 400) MHz</b><br>(20 to 10) dB<br>(10 to 0) dB<br>(0 to -10) dB<br>(-10 to -20) dB<br>(-20 to -25) dB  | 0.08 dB<br>0.08 dB<br>0.08 dB<br>0.08 dB<br>0.12 dB |                                                               |                                  |
|                                 | <b>(12 400 to 18 000) MHz</b><br>(20 to 10) dB<br>(10 to 0) dB<br>(0 to -10) dB<br>(-10 to -20) dB<br>(-20 to -25) dB | 0.09 dB<br>0.08 dB<br>0.08 dB<br>0.09 dB<br>0.12 dB |                                                               |                                  |
|                                 | <b>(18 000 to 26 500) MHz</b><br>(20 to 10) dB<br>(10 to 0) dB<br>(0 to -10) dB<br>(-10 to -20) dB<br>(-20 to -25) dB | 0.12 dB<br>0.12 dB<br>0.12 dB<br>0.12 dB<br>0.15 dB |                                                               |                                  |
|                                 | <b>(50 to 100) MHz</b><br>(20 to 10) dB<br>(10 to 0) dB<br>(0 to -10) dB<br>(-10 to -20) dB<br>(-20 to -25) dB        | 0.08 dB<br>0.07 dB<br>0.07 dB<br>0.07 dB<br>0.11 dB | Agilent EPM series power meter N8487A power sensor            | MEL, RFD<br>TPA, HSV<br>COS, RDU |
|                                 | <b>(100 to 6000) MHz</b><br>(20 to 10) dB<br>(10 to 0) dB<br>(0 to -10) dB<br>(-10 to -20) dB<br>(-20 to -25) dB      | 0.08 dB<br>0.07 dB<br>0.07 dB<br>0.08 dB<br>0.11 dB |                                                               |                                  |

| Parameter/Range                 | Frequency                      | CMC <sup>2, 7</sup> (±) | Comment                                                     | Location <sup>10</sup>           |
|---------------------------------|--------------------------------|-------------------------|-------------------------------------------------------------|----------------------------------|
| RF Power – Measure <sup>3</sup> | <b>(6000 to 12 400) MHz</b>    |                         |                                                             |                                  |
|                                 | (20 to 10) dB                  | 0.08 dB                 |                                                             |                                  |
|                                 | (10 to 0) dB                   | 0.08 dB                 |                                                             |                                  |
|                                 | (0 to -10) dB                  | 0.08 dB                 |                                                             |                                  |
|                                 | (-10 to -20) dB                | 0.08 dB                 |                                                             |                                  |
|                                 | (-20 to -25) dB                | 0.12 dB                 |                                                             |                                  |
|                                 | <b>(12 400 to 18 000) MHz</b>  |                         |                                                             |                                  |
|                                 | (20 to 10) dB                  | 0.09 dB                 |                                                             |                                  |
|                                 | (10 to 0) dB                   | 0.09 dB                 |                                                             |                                  |
|                                 | (0 to -10) dB                  | 0.08 dB                 |                                                             |                                  |
|                                 | (-10 to -20) dB                | 0.09 dB                 |                                                             |                                  |
|                                 | (-20 to -25) dB                | 0.12 dB                 |                                                             |                                  |
|                                 | <b>(18 000 to 26 500) MHz</b>  |                         |                                                             |                                  |
|                                 | (20 to 10) dB                  | 0.11 dB                 |                                                             |                                  |
|                                 | (10 to 0) dB                   | 0.11 dB                 |                                                             |                                  |
|                                 | (0 to -10) dB                  | 0.10 dB                 |                                                             |                                  |
|                                 | (-10 to -20) dB                | 0.11 dB                 |                                                             |                                  |
|                                 | (-20 to -25) dB                | 0.14 dB                 |                                                             |                                  |
|                                 | <b>(26 5000 to 33 000) MHz</b> |                         |                                                             |                                  |
|                                 | (20 to 10) dB                  | 0.12 dB                 |                                                             |                                  |
|                                 | (10 to 0) dB                   | 0.12 dB                 |                                                             |                                  |
|                                 | (0 to -10) dB                  | 0.12 dB                 |                                                             |                                  |
|                                 | (-10 to -20) dB                | 0.12 dB                 |                                                             |                                  |
|                                 | (-20 to -25) dB                | 0.15 dB                 |                                                             |                                  |
|                                 | <b>(33 000 to 40 000) MHz</b>  |                         |                                                             |                                  |
|                                 | (20 to 10) dB                  | 0.13 dB                 |                                                             |                                  |
|                                 | (10 to 0) dB                   | 0.13 dB                 |                                                             |                                  |
|                                 | (0 to -10) dB                  | 0.12 dB                 |                                                             |                                  |
|                                 | (-10 to -20) dB                | 0.13 dB                 |                                                             |                                  |
|                                 | (-20 to -25) dB                | 0.15 dB                 |                                                             |                                  |
|                                 | <b>(40 000 to 50 000) MHz</b>  |                         |                                                             |                                  |
|                                 | (20 to 10) dB                  | 0.19 dB                 |                                                             |                                  |
|                                 | (10 to 0) dB                   | 0.18 dB                 |                                                             |                                  |
|                                 | (0 to -10) dB                  | 0.18 dB                 |                                                             |                                  |
|                                 | (-10 to -20) dB                | 0.19 dB                 |                                                             |                                  |
|                                 | (-20 to -25) dB                | 0.2 dB                  |                                                             |                                  |
|                                 |                                |                         | Agilent EPM series<br>power meter<br>N8487A power<br>sensor | MEL, RFD<br>TPA, HSV<br>COS, RDU |

| Parameter/Range                 | Frequency                     | CMC <sup>2, 7</sup> (±) | Comment                                                 | Location <sup>10</sup> |
|---------------------------------|-------------------------------|-------------------------|---------------------------------------------------------|------------------------|
| RF Power – Measure <sup>3</sup> | <b>(100 to 2000) MHz</b>      |                         | Agilent EPM series<br>power meter 8487A<br>power sensor | ATL                    |
|                                 | (20 to 10) dB                 | 0.14 dB                 |                                                         |                        |
|                                 | (10 to 0) dB                  | 0.06 dB                 |                                                         |                        |
|                                 | (0 to -10) dB                 | 0.07 dB                 |                                                         |                        |
|                                 | (-10 to -20) dB               | 0.08 dB                 |                                                         |                        |
|                                 | (-20 to -25) dB               | 0.15 dB                 |                                                         |                        |
|                                 | <b>(2000 to 12 400) MHz</b>   |                         |                                                         |                        |
|                                 | (20 to 10) dB                 | 0.15 dB                 |                                                         |                        |
|                                 | (10 to 0) dB                  | 0.07 dB                 |                                                         |                        |
|                                 | (0 to -10) dB                 | 0.07 dB                 |                                                         |                        |
|                                 | (-10 to -20) dB               | 0.08 dB                 |                                                         |                        |
|                                 | (-20 to -25) dB               | 0.15 dB                 |                                                         |                        |
|                                 | <b>(12 400 to 18 000) MHz</b> |                         |                                                         |                        |
|                                 | (20 to 10) dB                 | 0.15 dB                 |                                                         |                        |
|                                 | (10 to 0) dB                  | 0.08 dB                 |                                                         |                        |
|                                 | (0 to -10) dB                 | 0.08 dB                 |                                                         |                        |
|                                 | (-10 to -20) dB               | 0.09 dB                 |                                                         |                        |
|                                 | (-20 to -25) dB               | 0.15 dB                 |                                                         |                        |
|                                 | <b>(18 000 to 26 500) MHz</b> |                         |                                                         |                        |
|                                 | (20 to 10) dB                 | 0.16 dB                 |                                                         |                        |
|                                 | (10 to 0) dB                  | 0.1 dB                  |                                                         |                        |
|                                 | (0 to -10) dB                 | 0.1 dB                  |                                                         |                        |
|                                 | (-10 to -20) dB               | 0.11 dB                 |                                                         |                        |
|                                 | (-20 to -25) dB               | 0.16 dB                 |                                                         |                        |
|                                 | <b>(26 500 to 40 000) MHz</b> |                         |                                                         |                        |
|                                 | (20 to 10) dB                 | 0.17 dB                 |                                                         |                        |
|                                 | (10 to 0) dB                  | 0.12 dB                 |                                                         |                        |
|                                 | (0 to -10) dB                 | 0.12 dB                 |                                                         |                        |
|                                 | (-10 to -20) dB               | 0.13 dB                 |                                                         |                        |
|                                 | (-20 to -25) dB               | 0.18 dB                 |                                                         |                        |
|                                 | <b>(40 000 to 50 000) MHz</b> |                         |                                                         |                        |
|                                 | (20 to 10) dB                 | 0.22 dB                 |                                                         |                        |
|                                 | (10 to 0) dB                  | 0.19 dB                 |                                                         |                        |
|                                 | (0 to -10) dB                 | 0.19 dB                 |                                                         |                        |
|                                 | (-10 to -20) dB               | 0.19 dB                 |                                                         |                        |
|                                 | (-20 to -25) dB               | 0.23 dB                 |                                                         |                        |

| Parameter/Range                 | Frequency                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | CMC <sup>2, 7</sup> (±)                                                                                                                                                                                                                                                      | Comment                                                         | Location <sup>10</sup>                            |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------|---------------------------------------------------|
| RF Power – Measure <sup>3</sup> | <b>(50 to 26 500) MHz</b><br>(20 to 10) dB<br>(10 to -50) dB<br>(-50 to -60) dB<br>(-60 to -65) dB                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 0.25 dB<br>0.22 dB<br>0.37 dB<br>0.94 dB                                                                                                                                                                                                                                     | Agilent EPM series power meter w/E4413A power sensor            | MEL, TPA, COS                                     |
|                                 | <b>100 kHz to 30 MHz</b><br>(20 to 0) dB<br>(0 to -58) dB<br>(-58 to -78) dB<br>(-78 to -110) dB<br>(-110 to -115) dB<br>(-115 to -120) dB<br>(-120 to -125) dB                                                                                                                                                                                                                                                                                                                                                                                                   | 0.13 dB<br>0.13 dB<br>0.15 dB<br>0.2 dB<br>0.26 dB<br>0.39 dB<br>0.59 dB                                                                                                                                                                                                     | Agilent N5531S measuring receiver N1912A w/E9304A power sensor  | COS, MEL RDU, RFD TPA, SFL HSV, HLR HRT, ATL, DFW |
|                                 | <b>(30 to 2000) MHz</b><br>(30 to 20) dB<br>(20 to 0) dB<br>(0 to -58) dB<br>(-58 to -78) dB<br>(-78 to -110) dB<br>(-110 to -115) dB<br>(-115 to -120) dB<br>(-120 to -125) dB<br><br><b>(2000 to 3050) MHz</b><br>(30 to 20) dB<br>(20 to 0) dB<br>(0 to -58) dB<br>(-58 to -78) dB<br>(-78 to -110) dB<br>(-110 to -115) dB<br>(-115 to -120) dB<br>(-120 to -125) dB<br><br><b>(3050 to 6600) MHz</b><br>(30 to 20) dB<br>(20 to 0) dB<br>(0 to -58) dB<br>(-58 to -78) dB<br>(-78 to -110) dB<br>(-110 to -115) dB<br>(-115 to -120) dB<br>(-120 to -125) dB | 0.36 dB<br>0.20 dB<br>0.22 dB<br>0.23 dB<br>0.25 dB<br>0.27 dB<br>0.33 dB<br>0.46 dB<br><br>0.42 dB<br>0.30 dB<br>0.31 dB<br>0.32 dB<br>0.34 dB<br>0.35 dB<br>0.40 dB<br>0.51 dB<br><br>0.42 dB<br>0.30 dB<br>0.31 dB<br>0.32 dB<br>0.34 dB<br>0.38 dB<br>0.48 dB<br>0.64 dB | Agilent N5531S measuring receiver w/N5532A Opt 526 power sensor | SFL, HLR, HRT                                     |



| Parameter/Range                 | Frequency                     | CMC <sup>2, 7</sup> (±) | Comment                                                                  | Location <sup>10</sup> |
|---------------------------------|-------------------------------|-------------------------|--------------------------------------------------------------------------|------------------------|
| RF Power – Measure <sup>3</sup> | <b>(6600 to 13 200) MHz</b>   |                         | Agilent N5531S<br>measuring receiver<br>w/N5532A Opt 526<br>power sensor | SFL, HLR,<br>HRT       |
|                                 | (30 to 20) dB                 | 0.42 dB                 |                                                                          |                        |
|                                 | (20 to 0) dB                  | 0.30 dB                 |                                                                          |                        |
|                                 | (0 to -58) dB                 | 0.31 dB                 |                                                                          |                        |
|                                 | (-58 to -78) dB               | 0.32 dB                 |                                                                          |                        |
|                                 | (-78 to -100) dB              | 0.34 dB                 |                                                                          |                        |
|                                 | (-100 to -105) dB             | 0.37 dB                 |                                                                          |                        |
|                                 | (-105 to -110) dB             | 0.45 dB                 |                                                                          |                        |
|                                 | (-110 to -115) dB             | 0.60 dB                 |                                                                          |                        |
|                                 | (-115 to -120) dB             | 0.82 dB                 |                                                                          |                        |
|                                 | <b>(13 200 to 18 000) MHz</b> |                         |                                                                          |                        |
|                                 | (30 to 20) dB                 | 0.42 dB                 |                                                                          |                        |
|                                 | (20 to 0) dB                  | 0.30 dB                 |                                                                          |                        |
|                                 | (0 to -58) dB                 | 0.31 dB                 |                                                                          |                        |
|                                 | (-58 to -78) dB               | 0.32 dB                 |                                                                          |                        |
|                                 | (-78 to -90) dB               | 0.33 dB                 |                                                                          |                        |
|                                 | (-90 to -95) dB               | 0.35 dB                 |                                                                          |                        |
|                                 | (-95 to -100) dB              | 0.41 dB                 |                                                                          |                        |
|                                 | (-100 to -105) dB             | 0.53 dB                 |                                                                          |                        |
|                                 | (-105 to -110) dB             | 0.72 dB                 |                                                                          |                        |
|                                 | <b>(18 000 to 19 200) MHz</b> |                         |                                                                          |                        |
|                                 | (30 to 20) dB                 | 0.48 dB                 |                                                                          |                        |
|                                 | (20 to 0) dB                  | 0.38 dB                 |                                                                          |                        |
|                                 | (0 to -58) dB                 | 0.39 dB                 |                                                                          |                        |
|                                 | (-58 to -78) dB               | 0.40 dB                 |                                                                          |                        |
|                                 | (-78 to -90) dB               | 0.41 dB                 |                                                                          |                        |
|                                 | (-90 to -95) dB               | 0.42 dB                 |                                                                          |                        |
|                                 | (-95 to -100) dB              | 0.47 dB                 |                                                                          |                        |
|                                 | (-100 to -105) Db             | 0.58 dB                 |                                                                          |                        |
|                                 | (-105 to -110) dB             | 0.75 dB                 |                                                                          |                        |
|                                 | <b>19 200 to 26 500) MHz</b>  |                         |                                                                          |                        |
|                                 | (30 to 20) dB                 | 0.48 dB                 |                                                                          |                        |
|                                 | (20 to 0) dB                  | 0.38 dB                 |                                                                          |                        |
|                                 | (0 to -58) dB                 | 0.39 dB                 |                                                                          |                        |
|                                 | (-58 to -78) dB               | 0.4 dB                  |                                                                          |                        |
|                                 | (-78 to -90) dB               | 0.43 dB                 |                                                                          |                        |
|                                 | (-90 to -95) dB               | 0.50 dB                 |                                                                          |                        |
|                                 | (-95 to -100) dB              | 0.63 dB                 |                                                                          |                        |
|                                 | (-100 to -105) dB             | 0.84 dB                 |                                                                          |                        |
|                                 | (-105 to -110) dB             | 1.1 dB                  |                                                                          |                        |

| Parameter/Range                 | Frequency                     | CMC <sup>2, 7</sup> (±) | Comment                                                                  | Location <sup>10</sup>                       |
|---------------------------------|-------------------------------|-------------------------|--------------------------------------------------------------------------|----------------------------------------------|
| RF Power – Measure <sup>3</sup> | <b>(30 to 2000) MHz</b>       |                         |                                                                          |                                              |
|                                 | (30 to 20) dB                 | 0.36 dB                 |                                                                          |                                              |
|                                 | (20 to 0) dB                  | 0.20 dB                 |                                                                          |                                              |
|                                 | (0 to -58) dB                 | 0.22 dB                 |                                                                          |                                              |
|                                 | (-58 to -78) dB               | 0.23 dB                 |                                                                          |                                              |
|                                 | (-78 to -110) dB              | 0.25 dB                 |                                                                          |                                              |
|                                 | (-110 to -115) dB             | 0.27 dB                 |                                                                          |                                              |
|                                 | (-115 to -120) dB             | 0.33 dB                 |                                                                          |                                              |
|                                 | (-120 to -125) dB             | 0.70 dB                 |                                                                          |                                              |
|                                 | <b>(2000 to 3050) MHz</b>     |                         |                                                                          |                                              |
|                                 | (30 to 20) dB                 | 0.37 dB                 |                                                                          |                                              |
|                                 | (20 to 0) dB                  | 0.21 dB                 |                                                                          |                                              |
|                                 | (0 to -58) dB                 | 0.23 dB                 |                                                                          |                                              |
|                                 | (-58 to -78) dB               | 0.24 dB                 |                                                                          |                                              |
|                                 | (-78 to -110) dB              | 0.26 dB                 |                                                                          |                                              |
|                                 | (-110 to -115) dB             | 0.28 dB                 |                                                                          |                                              |
|                                 | (-115 to -120) dB             | 0.34 dB                 |                                                                          |                                              |
|                                 | (-120 to -125) dB             | 0.70 dB                 |                                                                          |                                              |
|                                 | <b>(3050 to 6600) MHz</b>     |                         |                                                                          |                                              |
|                                 | (30 to 20) dB                 | 0.37 dB                 |                                                                          |                                              |
|                                 | (20 to 0) dB                  | 0.21 dB                 |                                                                          |                                              |
|                                 | (0 to -58) dB                 | 0.23 dB                 |                                                                          |                                              |
|                                 | (-58 to -78) dB               | 0.24 dB                 |                                                                          |                                              |
|                                 | (-78 to -110) dB              | 0.29 dB                 |                                                                          |                                              |
|                                 | (-110 to -115) dB             | 0.38 dB                 |                                                                          |                                              |
|                                 | (-115 to -120) dB             | 0.53 dB                 |                                                                          |                                              |
|                                 | <b>(6600 to 13 200) MHz</b>   |                         |                                                                          |                                              |
|                                 | (30 to 20) dB                 | 0.37 dB                 |                                                                          |                                              |
|                                 | (20 to 0) dB                  | 0.21 dB                 |                                                                          |                                              |
|                                 | (0 to -58) dB                 | 0.23 dB                 |                                                                          |                                              |
|                                 | (-58 to -78) dB               | 0.24 dB                 |                                                                          |                                              |
|                                 | (-78 to -110) dB              | 0.34 dB                 |                                                                          |                                              |
|                                 | (-110 to -115) dB             | 0.46 dB                 |                                                                          |                                              |
|                                 | (-115 to -120) dB             | 0.65 dB                 |                                                                          |                                              |
|                                 | <b>(13 200 to 18 000) MHz</b> |                         |                                                                          |                                              |
|                                 | (30 to 20) dB                 | 0.37 dB                 |                                                                          |                                              |
|                                 | (20 to 0) dB                  | 0.21 dB                 |                                                                          |                                              |
|                                 | (0 to -58) dB                 | 0.23 dB                 |                                                                          |                                              |
|                                 | (-58 to -78) dB               | 0.24 dB                 |                                                                          |                                              |
|                                 | (-78 to -90) dB               | 0.26 dB                 |                                                                          |                                              |
|                                 | (-90 to -95) dB               | 0.26 dB                 |                                                                          |                                              |
|                                 | (-95 to -100) dB              | 0.26 dB                 |                                                                          |                                              |
|                                 | (-100 to -105) dB             | 0.29 dB                 |                                                                          |                                              |
|                                 | (-105 to -110) dB             | 0.38 dB                 |                                                                          |                                              |
|                                 | (-110 to -115) dB             | 0.53 dB                 |                                                                          |                                              |
|                                 | (-115 to -120) dB             | 0.75 dB                 |                                                                          |                                              |
|                                 |                               |                         | Agilent N5531S<br>measuring receiver<br>w/N5532A Opt 550<br>power sensor | MEL, RFD<br>TPA, HSV<br>COS, RDU<br>ATL, DFW |

| Parameter/Range                 | Frequency                     | CMC <sup>2,7</sup> (±) | Comment                                                                  | Location <sup>10</sup>                       |
|---------------------------------|-------------------------------|------------------------|--------------------------------------------------------------------------|----------------------------------------------|
| RF Power – Measure <sup>3</sup> | <b>(18 000 to 19 200) MHz</b> |                        | Agilent N5531S<br>measuring receiver<br>w/N5532A Opt 550<br>power sensor | MEL, RFD<br>TPA, HSV<br>COS, RDU<br>ATL, DFW |
|                                 | (30 to 20) dB                 | 0.39 dB                |                                                                          |                                              |
|                                 | (20 to 0) dB                  | 0.25 dB                |                                                                          |                                              |
|                                 | (0 to -58) dB                 | 0.24 dB                |                                                                          |                                              |
|                                 | (-58 to -78) dB               | 0.25 dB                |                                                                          |                                              |
|                                 | (-78 to -90) dB               | 0.27 dB                |                                                                          |                                              |
|                                 | (-90 to -95) dB               | 0.27 dB                |                                                                          |                                              |
|                                 | (-95 to -100) dB              | 0.27 dB                |                                                                          |                                              |
|                                 | (-100 to -105) dB             | 0.30 dB                |                                                                          |                                              |
|                                 | (-105 to -110) dB             | 0.38 dB                |                                                                          |                                              |
|                                 | (-110 to -115) dB             | 0.53 dB                |                                                                          |                                              |
|                                 | (-115 to -120) dB             | 0.75 dB                |                                                                          |                                              |
|                                 | <b>(19 200 to 26 500) MHz</b> |                        |                                                                          |                                              |
|                                 | (30 to 20) dB                 | 0.39 dB                |                                                                          |                                              |
|                                 | (20 to 0) dB                  | 0.25 dB                |                                                                          |                                              |
|                                 | (0 to -58) dB                 | 0.24 dB                |                                                                          |                                              |
|                                 | (-58 to -78) dB               | 0.25 dB                |                                                                          |                                              |
|                                 | (-78 to -90) dB               | 0.28 dB                |                                                                          |                                              |
|                                 | (-90 to -95) dB               | 0.33 dB                |                                                                          |                                              |
|                                 | (-95 to -100) dB              | 0.43 dB                |                                                                          |                                              |
|                                 | (-100 to -105) dB             | 0.61 dB                |                                                                          |                                              |
|                                 | (-105 to -110) dB             | 0.85 dB                |                                                                          |                                              |
|                                 | (-110 to -115) dB             | 1.20 dB                |                                                                          |                                              |
|                                 | (-115 to -120) dB             | 1.50 dB                |                                                                          |                                              |
|                                 | <b>(26 500 to 31 150) MHz</b> |                        |                                                                          |                                              |
|                                 | (30 to 20) dB                 | 0.42 dB                |                                                                          |                                              |
|                                 | (20 to 0) dB                  | 0.30 dB                |                                                                          |                                              |
|                                 | (0 to -58) dB                 | 0.34 dB                |                                                                          |                                              |
|                                 | (-58 to -78) dB               | 0.34 dB                |                                                                          |                                              |
|                                 | (-78 to -90) dB               | 0.36 dB                |                                                                          |                                              |
|                                 | (-90 to -95) dB               | 0.39 dB                |                                                                          |                                              |
|                                 | (-95 to -100) dB              | 0.46 dB                |                                                                          |                                              |
|                                 | (-100 to -105) dB             | 0.61 dB                |                                                                          |                                              |
|                                 | (-105 to -110) dB             | 0.82 dB                |                                                                          |                                              |
|                                 | (-110 to -115) dB             | 1.1 dB                 |                                                                          |                                              |
|                                 | <b>(31 150 to 41 000) MHz</b> |                        |                                                                          |                                              |
|                                 | (30 to 20) dB                 | 0.42 dB                |                                                                          |                                              |
|                                 | (20 to 0) dB                  | 0.30 dB                |                                                                          |                                              |
|                                 | (0 to -58) dB                 | 0.34 dB                |                                                                          |                                              |
|                                 | (-58 to -78) dB               | 0.35 dB                |                                                                          |                                              |
|                                 | (-78 to -90) dB               | 0.48 dB                |                                                                          |                                              |
|                                 | (-90 to -95) dB               | 0.64 dB                |                                                                          |                                              |
|                                 | (-95 to -100) dB              | 0.87 dB                |                                                                          |                                              |
|                                 | (-100 to -105) dB             | 1.2 dB                 |                                                                          |                                              |
|                                 | (-105 to -110) dB             | 1.5 dB                 |                                                                          |                                              |

| Parameter/Range                 | Frequency                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | CMC <sup>2, 7</sup> (±)                                                                                                                                                                                                                         | Comment                                                                  | Location <sup>10</sup>                       |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|----------------------------------------------|
| RF Power – Measure <sup>3</sup> | <b>(41 000 to 45 000) MHz</b><br>(30 to 20) dB<br>(20 to 0) dB<br>(0 to -58) dB<br>(-58 to -78) dB<br>(-78 to -90) dB<br>(-90 to -95) dB<br>(-95 to -100) dB<br>(-100 to -105) dB<br><br><b>(45 000 to 50 000) MHz</b><br>(30 to 20) dB<br>(20 to 0) dB<br>(0 to -58) dB<br>(-58 to -78) dB<br>(-78 to -90) dB                                                                                                                                                                                                         | 0.42 dB<br>0.30 dB<br>0.34 dB<br>0.38 dB<br>0.68 dB<br>0.93 dB<br>1.2 dB<br>1.6 dB<br><br>0.42 dB<br>0.30 dB<br>0.34 dB<br>0.67 dB<br>1.4 dB                                                                                                    | Agilent N5531S<br>measuring receiver<br>w/N5532A Opt 550<br>power sensor | MEL, RFD<br>TPA, HSV<br>COS, RDU<br>ATL, DFW |
|                                 | <b>(10 to 100) MHz</b><br>(20 to 10) dB<br>(10 to 0) dB<br>(0 to -10) dB<br>(-10 to -20) dB<br>(-20 to -25) dB<br>(-25 to -30) dB<br>(-30 to -35) dB<br><br><b>(100 to 2400) MHz</b><br>(20 to 10) dB<br>(10 to 0) dB<br>(0 to -10) dB<br>(-10 to -20) dB<br>(-20 to -25) dB<br>(-25 to -30) dB<br>(-30 to -35) dB<br><br><b>(2400 to 12 400) MHz</b><br>(20 to 10) dB<br>(10 to 0) dB<br>(0 to -10) dB<br>(-10 to -20) dB<br><br><b>(2400 to 12 400) MHz</b><br>(-20 to -25) dB<br>(-25 to -30) dB<br>(-30 to -35) dB | 0.09 dB<br>0.08 dB<br>0.08 dB<br>0.09 dB<br>0.12 dB<br>0.29 dB<br>0.82 dB<br><br>0.10 dB<br>0.10 dB<br>0.09 dB<br>0.10 dB<br>0.13 dB<br>0.29 dB<br>0.83 dB<br><br>0.10 dB<br>0.10 dB<br>0.09 dB<br>0.10 dB<br><br>0.13 dB<br>0.29 dB<br>0.83 dB | Agilent EPM series<br>power meter N8488A<br>power sensor                 | COS, DFW                                     |

| Parameter/Range                 | Frequency                     | CMC <sup>2, 7</sup> (±) | Comment                                                  | Location <sup>10</sup> |
|---------------------------------|-------------------------------|-------------------------|----------------------------------------------------------|------------------------|
| RF Power – Measure <sup>3</sup> | <b>(12 400 to 18 000) MHz</b> |                         |                                                          |                        |
|                                 | (20 to 10) dB                 | 0.10 dB                 |                                                          |                        |
|                                 | (10 to 0) dB                  | 0.10 dB                 |                                                          |                        |
|                                 | (0 to -10) dB                 | 0.10 dB                 |                                                          |                        |
|                                 | (-10 to -20) dB               | 0.10 dB                 |                                                          |                        |
|                                 | (-20 to -25) dB               | 0.13 dB                 |                                                          |                        |
|                                 | (-25 to -30) dB               | 0.29 dB                 |                                                          |                        |
|                                 | (-30 to -35) dB               | 0.83 dB                 |                                                          |                        |
|                                 | <b>(18 000 to 26 500) MHz</b> |                         |                                                          |                        |
|                                 | (20 to 10) dB                 | 0.12 dB                 |                                                          |                        |
|                                 | (10 to 0) dB                  | 0.12 dB                 |                                                          |                        |
|                                 | (0 to -10) dB                 | 0.12 dB                 |                                                          |                        |
|                                 | (-10 to -20) dB               | 0.12 dB                 |                                                          |                        |
|                                 | (-20 to -25) dB               | 0.15 dB                 |                                                          |                        |
|                                 | (-25 to -30) dB               | 0.30 dB                 |                                                          |                        |
|                                 | (-30 to -35) dB               | 0.83 dB                 |                                                          |                        |
|                                 | <b>(26 500 to 40 000) MHz</b> |                         |                                                          |                        |
|                                 | (20 to 10) dB                 | 0.15 dB                 |                                                          |                        |
|                                 | (10 to 0) dB                  | 0.15 dB                 |                                                          |                        |
|                                 | (0 to -10) dB                 | 0.15 dB                 |                                                          |                        |
|                                 | (-10 to -20) dB               | 0.15 dB                 |                                                          |                        |
|                                 | (-20 to -25) dB               | 0.17 dB                 |                                                          |                        |
|                                 | (-25 to -30) dB               | 0.31 dB                 |                                                          |                        |
|                                 | (-30 to -35) dB               | 0.83 dB                 |                                                          |                        |
|                                 | <b>(40 000 to 67 000) MHz</b> |                         |                                                          |                        |
|                                 | (20 to 10) dB                 | 0.22 dB                 |                                                          |                        |
|                                 | (10 to 0) dB                  | 0.22 dB                 |                                                          |                        |
|                                 | (0 to -10) dB                 | 0.22 dB                 |                                                          |                        |
|                                 | (-10 to -20) dB               | 0.22 dB                 |                                                          |                        |
|                                 | (-20 to -25) dB               | 0.24 dB                 |                                                          |                        |
|                                 | (-25 to -30) dB               | 0.35 dB                 |                                                          |                        |
|                                 | (-30 to -35) dB               | 0.85 dB                 |                                                          |                        |
|                                 | <b>(67 000 to 70 000) MHz</b> |                         |                                                          |                        |
|                                 | (20 to 10) dB                 | 0.25 dB                 |                                                          |                        |
|                                 | (10 to 0) dB                  | 0.25 dB                 |                                                          |                        |
|                                 | (0 to -10) dB                 | 0.25 dB                 |                                                          |                        |
|                                 | (-10 to -20) dB               | 0.25 dB                 |                                                          |                        |
|                                 | (-20 to -25) dB               | 0.26 dB                 |                                                          |                        |
|                                 | (-25 to -30) dB               | 0.37 dB                 |                                                          |                        |
|                                 | (-30 to -35) dB               | 0.85 dB                 |                                                          |                        |
|                                 |                               |                         | Agilent EPM series<br>power meter N8488A<br>power sensor | COS, DFW               |

| Parameter/Range                  | Frequency                                                                                                                    | CMC <sup>2, 7</sup> (±)                             | Comment                                                              | Location <sup>10</sup> |
|----------------------------------|------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|----------------------------------------------------------------------|------------------------|
| RF Power – Measure <sup>3</sup>  | <b>100 kHz to 2000 MHz</b><br>(5 to 10) dB<br>(10 to 20) dB<br>(20 to 30) dB<br>(30 to 35) dB<br>(35 to 44) dB               | 0.15 dB<br>0.08 dB<br>0.07 dB<br>0.07 dB<br>0.18 dB | Agilent EPM series<br>power meter RF power/<br>HP 8482A power sensor | TPA                    |
|                                  | <b>(2000 to 4200) MHz</b><br>(5 to 10) dB<br>(10 to 20) dB<br>(20 to 30) dB<br>(30 to 35) dB<br>(35 to 44) dB                | 0.15 dB<br>0.08 dB<br>0.07 dB<br>0.07 dB<br>0.18 dB |                                                                      |                        |
| RF Power – Generate <sup>3</sup> | <b>10 Hz to 100 kHz</b><br>(24 to -48) dBm                                                                                   | 0.06 dB                                             | Fluke 9640A-LPNX RF<br>reference source                              | TPA, RFD               |
|                                  | <b>100 kHz to 9.99 MHz</b><br>(24 to -48) dBm<br>(-48 to -74) dBm<br>(-74 to -94) dBm                                        | 0.07 dB<br>0.16 dB<br>0.39 dB                       |                                                                      |                        |
|                                  | <b>(10 to 128) MHz</b><br>(24 to -48) dBm<br>(-48 to -84) dBm<br>(-84 to -94) dBm<br>(-94 to -124) dBm                       | 0.07 dB<br>0.09 dB<br>0.24 dB<br>0.54 dB            |                                                                      |                        |
|                                  | <b>(128 to 300) MHz</b><br>(20 to -48) dBm<br>(-48 to -74) dBm<br>(-74 to -84) dBm<br>(-84 to -94) dBm<br>(-94 to -124) dBm  | 0.08 dB<br>0.09 dB<br>0.24 dB<br>0.39 dB<br>1.2 dB  |                                                                      |                        |
|                                  | <b>(300 to 1400) MHz</b><br>(20 to -48) dBm<br>(-48 to -74) dBm<br>(-74 to -84) dBm<br>(-84 to -94) dBm<br>(-94 to -124) dBm | 0.16 dB<br>0.31 dB<br>0.39 dB<br>0.77 dB<br>1.2 dB  |                                                                      |                        |
|                                  | <b>(1.4 to 3.0) GHz</b><br>(14 to -48) dBm<br>(-48 to -74) dBm<br>(-74 to -94) dBm<br>(-94 to -124) dBm                      | 0.24 dB<br>0.39 dB<br>0.77 dB<br>1.2 dB             |                                                                      |                        |



| Parameter/Range                  | Frequency                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | CMC <sup>2, 7</sup> (±)                                                                                                                                                                                                                                                                                                                             | Comment                                                                                              | Location <sup>10</sup> |
|----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|------------------------|
| RF Power Generate <sup>3</sup>   | <b>10 to 30 MHz</b><br>(0 to -58) dB<br>(-58 to -78) dB<br>(-78 to -110) dB<br>(-110 to -120) dB                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0.23 dB<br>0.25 dB<br>0.27 dB<br>0.43 dB                                                                                                                                                                                                                                                                                                            | Agilent N5531S<br>measuring receiver<br>N1912A w/E9304A<br>power sensor, 83630B<br>signal generator  | SFL, HRT<br>HLR, RDU   |
| RF Power – Generate <sup>3</sup> | <b>(30 to 2000) MHz</b><br>(20 to 0) dB<br>(0 to -58) dB<br>(-58 to -78) dB<br>(-78 to -110) dB<br>(-110 to -120) dB<br><br><b>(2000 to 3050) MHz</b><br>(20 to 0) dB<br>(0 to -58) dB<br>(-58 to -78) dB<br>(-78 to -110) dB<br>(-110 to -120) dB<br><br><b>(3050 to 6600) MHz</b><br>(20 to 0) dB<br>(0 to -58) dB<br>(-58 to -78) dB<br>(-78 to -110) dB<br>(-110 to -120) dB<br><br><b>(6600 to 13 200) MHz</b><br>(20 to 0) dB<br>(0 to -58) dB<br>(-58 to -78) dB<br>(-78 to -110) dB<br>(-110 to -120) dB<br><br><b>(13 200 to 18 000) MHz</b><br>(20 to 0) dB<br>(0 to -58) dB<br>(-58 to -78) dB<br>(-78 to -110) dB<br>(-110 to -120) dB<br><br><b>(18 000 to 19 200) MHz</b><br>(20 to 0) dB<br>(0 to -58) dB<br>(-58 to -78) dB<br>(-78 to -110) dB<br>(-110 to -120) dB | 0.26 dB<br>0.28 dB<br>0.29 dB<br>0.3 dB<br>0.37 dB<br><br>0.37 dB<br>0.38 dB<br>0.38 dB<br>0.4 dB<br>0.52 dB<br><br>0.37 dB<br>0.38 dB<br>0.38 dB<br>0.4 dB<br>0.52 dB<br><br>0.37 dB<br>0.38 dB<br>0.38 dB<br>0.49 dB<br>0.84 dB<br><br>0.37 dB<br>0.38 dB<br>0.38 dB<br>0.75 dB<br>1.3 dB<br><br>0.49 dB<br>0.5 dB<br>0.5 dB<br>0.81 dB<br>1.4 dB | Agilent N5531S<br>measuring receiver<br>w/N5532A Opt 526<br>power sensor, 83630B<br>signal generator | SFL, HRT<br>HLR        |

| Parameter/Range                  | Frequency                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | CMC <sup>2, 7</sup> (±)                                                                                                                                                                                                                                                                                                           | Comment                                                                                              | Location <sup>10</sup> |
|----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|------------------------|
| RF Power – Generate <sup>3</sup> | <b>(19 200 to 26 500) MHz</b><br>(20 to 0) dB<br>(0 to -58) dB<br>(-58 to -78) dB<br>(-78 to -110) dB<br>(-110 to -120) dB                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 0.49 dB<br>0.5 dB<br>0.5 dB<br>1.2 dB<br>1.9 dB                                                                                                                                                                                                                                                                                   | Agilent N5531S<br>measuring receiver<br>w/N5532A Opt 526<br>power sensor, 83630B<br>signal generator | SFL, HRT<br>HLR        |
| RF Power – Generate <sup>3</sup> | <b>(30 to 2000) MHz</b><br>(0 to -58) dB<br>(-58 to -78) dB<br>(-78 to -110) dB<br><br><b>(2000 to 3050) MHz</b><br>(0 to -58) dB<br>(-58 to -78) dB<br>(-78 to -110) dB<br><br><b>(3050 to 6600) MHz</b><br>(0 to -58) dB<br>(-58 to -78) dB<br>(-78 to -110) dB<br><br><b>(6600 to 13 200) MHz</b><br>(0 to -58) dB<br>(-58 to -78) dB<br>(-78 to -110) dB<br><br><b>(13 200 to 18 000) MHz</b><br>(0 to -58) dB<br>(-58 to -78) dB<br>(-78 to -110) dB<br><br><b>(18 000 to 19 200) MHz</b><br>(0 to -58) dB<br>(-58 to -78) dB<br>(-78 to -110) dB<br><br><b>(19 200 to 26 500) MHz</b><br>(0 to -58) dB<br>(-58 to -78) dB<br>(-78 to -110) dB<br><br><b>(26 500 to 31 150) MHz</b><br>(-3 to -58) dB<br>(-58 to -78) dB<br>(-78 to -110) dB<br><br><b>(31 150 to 41 000) MHz</b><br>(-6 to -58) dB<br>(-58 to -78) dB<br>(-78 to -100) dB | 0.3 dB<br>0.31 dB<br>0.32 dB<br><br>0.35 dB<br>0.36 dB<br>0.37 dB<br><br>0.35 dB<br>0.36 dB<br>0.39 dB<br><br>0.35 dB<br>0.36 dB<br>0.42 dB<br><br>0.35 dB<br>0.36 dB<br>0.46 dB<br><br>0.41 dB<br>0.42 dB<br>0.5 dB<br><br>0.41 dB<br>0.42 dB<br>0.9 dB<br><br>0.63 dB<br>0.64 dB<br>0.96 dB<br><br>0.83 dB<br>0.84 dB<br>1.1 dB | Agilent N5531S<br>measuring receiver<br>w/N5532A Opt 550<br>power sensor, 83650B<br>signal generator | RDU                    |



| Parameter/Range                  | Frequency                                                                                                            | CMC <sup>2, 7</sup> (±)                             | Comment                                                                                              | Location <sup>10</sup>                       |
|----------------------------------|----------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|------------------------------------------------------------------------------------------------------|----------------------------------------------|
| RF Power – Generate <sup>3</sup> | <b>(41 000 to 45 000) MHz</b><br>(-6 to -58) dB<br>(-58 to -78) dB<br>(-78 to -100) dB                               | 0.83 dB<br>0.85 dB<br>1.4 dB                        | Agilent N5531S<br>measuring receiver<br>w/N5532A Opt 550<br>power sensor, 83650B<br>signal generator | RDU                                          |
|                                  | <b>(45 000 to 50 000) MHz</b><br>(-6 to -58) dB<br>(-58 to -78) dB<br>(-78 to -90) dB                                | 0.83 dB<br>1.0 dB<br>1.5 dB                         |                                                                                                      |                                              |
| RF Power – Generate <sup>3</sup> | <b>(0.25 to 30) MHz</b><br>(10 to 0) dB<br>(0 to -58) dB<br>(-58 to -78) dB<br>(-78 to -110) dB<br>(-110 to -120) dB | 0.23 dB<br>0.23 dB<br>0.25 dB<br>0.27 dB<br>0.43 dB | Agilent N5531S<br>Measuring Receiver<br>N1912A w/E9304A<br>Power Sensor, E8257D<br>Signal Generator  | MEL, TPA<br>RFD, HSV<br>ATL, COS<br>SFL, DFW |
|                                  | <b>(30 to 2000) MHz</b><br>(20 to 0) dB<br>(0 to -58) dB<br>(-58 to -78) dB<br>(-78 to -110) dB                      | 0.29 dB<br>0.30 dB<br>0.31 dB<br>0.32 dB            |                                                                                                      | MEL, TPA<br>RFD, HSV<br>ATL, COS,<br>DFW     |
|                                  | <b>(2000 to 3050) MHz</b><br>(20 to 0) dB<br>(0 to -58) dB<br>(-58 to -78) dB<br>(-78 to -110) dB                    | 0.34 dB<br>0.35 dB<br>0.36 dB<br>0.37 dB            |                                                                                                      |                                              |
|                                  | <b>(3050 to 6600) MHz</b><br>(20 to 0) dB<br>(0 to -58) dB<br>(-58 to -78) dB<br>(-78 to -110) dB                    | 0.34 dB<br>0.35 dB<br>0.36 dB<br>0.37 dB            |                                                                                                      |                                              |
|                                  | <b>(6600 to 13 200) MHz</b><br>(20 to 0) dB<br>(0 to -58) dB<br>(-58 to -78) dB<br>(-78 to -110) dB                  | 0.34 dB<br>0.35 dB<br>0.36 dB<br>0.42 dB            |                                                                                                      |                                              |
|                                  | <b>(13 200 to 18 000) MHz</b><br>(15 to 0) dB<br>(0 to -58) dB<br>(-58 to -78) dB<br>(-78 to -110) dB                | 0.34 dB<br>0.35 dB<br>0.36 dB<br>0.46 dB            |                                                                                                      |                                              |

| Parameter/Range                  | Frequency                                                                                                | CMC <sup>2, 7</sup> (±)                  | Comment                                                                                              | Location <sup>10</sup>                   |
|----------------------------------|----------------------------------------------------------------------------------------------------------|------------------------------------------|------------------------------------------------------------------------------------------------------|------------------------------------------|
| RF Power – Generate <sup>3</sup> | <b>(18 000 to 19 200) MHz</b><br>(15 to 0) dB<br>(0 to -58) dB<br>(-58 to -78) dB<br>(-78 to -110) dB    | 0.41 dB<br>0.41 dB<br>0.42 dB<br>0.5 dB  | Agilent N5531S<br>measuring receiver<br>w/N5532A Opt 550<br>power sensor, E8257D<br>signal generator | MEL, TPA<br>RFD, HSV<br>ATL, COS,<br>DFW |
|                                  | <b>(19 200 to 26 500) MHz</b><br>(15 to 0) dB<br>(0 to -58) dB<br>(-58 to -78) dB<br>(-78 to -110) dB    | 0.41 dB<br>0.41 dB<br>0.42 dB<br>0.9 dB  |                                                                                                      |                                          |
|                                  | <b>(26 500 to 31 150) MHz</b><br>(15 to 0) dB<br>(0 to -58) dB<br>(-58 to -78) dB<br>(-78 to -110) dB    | 0.62 dB<br>0.63 dB<br>0.64 dB<br>0.96 dB |                                                                                                      |                                          |
|                                  | <b>(31 150 to 41 000) MHz</b><br>(10 to 0) dB<br>(0 to -58) dB<br>(-58 to -78) dB<br>(-78 to -100) dB    | 0.82 dB<br>0.83 dB<br>0.84 dB<br>1.1 dB  |                                                                                                      |                                          |
|                                  | <b>(41 000 to 45 000) MHz</b><br>(10 to 0) dB<br>(0 to -58) dB<br>(-58 to -78) dB<br>(-78 to -100) dB    | 0.82 dB<br>0.83 dB<br>0.85 dB<br>1.4 dB  |                                                                                                      |                                          |
|                                  | <b>(45 000 to 50 000) MHz</b><br>(10 to 0) dB<br>(0 to -58) dB<br>(-58 to -78) dB<br>(-78 to -90) dB     | 0.82 dB<br>0.83 dB<br>1.0 dB<br>1.5 dB   |                                                                                                      |                                          |
|                                  | <b>(50 000 to 65 000) MHz</b><br>(0 to -20) dB<br>(-20 to -25) dB<br>(-25 to -30) dB<br>(-30 to -35) dB  | 0.86 dB<br>0.86 dB<br>0.89 dB<br>1.2 dB  | Agilent EPM series<br>power meter N8488A<br>power sensor, E8257D<br>Op 567 signal generator          | COS, DFW                                 |
|                                  | <b>(65 000 to 67 000) MHz</b><br>(-2 to -20) dB<br>(-20 to -25) dB<br>(-25 to -30) dB<br>(-30 to -35) dB | 0.88 dB<br>0.88 dB<br>0.91 dB<br>1.2 dB  |                                                                                                      |                                          |



| Parameter/Range                           | Frequency                    | CMC <sup>2, 7</sup> (±) | Comment                                                         | Location <sup>10</sup> |
|-------------------------------------------|------------------------------|-------------------------|-----------------------------------------------------------------|------------------------|
| Thermal Noise – Measure, ENR <sup>3</sup> | <b>5 dB, 15 dB, or 21 dB</b> |                         |                                                                 |                        |
|                                           | 0.1 GHz                      | 0.21 dB                 |                                                                 |                        |
|                                           | 1 GHz                        | 0.21 dB                 |                                                                 |                        |
|                                           | 2 GHz                        | 0.22 dB                 |                                                                 |                        |
|                                           | 3 GHz                        | 0.23 dB                 |                                                                 |                        |
|                                           | 4 GHz                        | 0.24 dB                 |                                                                 |                        |
|                                           | 5 GHz                        | 0.25 dB                 |                                                                 |                        |
|                                           | 6 GHz                        | 0.26 dB                 |                                                                 |                        |
|                                           | 7 GHz                        | 0.27 dB                 |                                                                 |                        |
|                                           | 8 GHz                        | 0.28 dB                 |                                                                 |                        |
|                                           | 9 GHz                        | 0.29 dB                 |                                                                 |                        |
|                                           | 10 GHz                       | 0.30 dB                 |                                                                 |                        |
|                                           | 11 GHz                       | 0.31 dB                 |                                                                 |                        |
|                                           | 12 GHz                       | 0.32 dB                 |                                                                 |                        |
|                                           | 13 GHz                       | 0.33 dB                 |                                                                 |                        |
|                                           | 14 GHz                       | 0.34 dB                 |                                                                 |                        |
|                                           | 15 GHz                       | 0.35 dB                 |                                                                 |                        |
|                                           | 16 GHz                       | 0.36 dB                 |                                                                 |                        |
|                                           | 17 GHz                       | 0.37 dB                 |                                                                 |                        |
|                                           | 18 GHz                       | 0.38 dB                 |                                                                 |                        |
|                                           | 19 GHz                       | 0.39 dB                 |                                                                 |                        |
|                                           | 20 GHz                       | 0.40 dB                 |                                                                 |                        |
|                                           | 21 GHz                       | 0.41 dB                 |                                                                 |                        |
|                                           | 22 GHz                       | 0.42 dB                 |                                                                 |                        |
|                                           | 23 GHz                       | 0.43 dB                 |                                                                 |                        |
|                                           | 24 GHz                       | 0.44 dB                 |                                                                 |                        |
|                                           | 25 GHz                       | 0.45 dB                 |                                                                 |                        |
|                                           | 26 GHz                       | 0.46 dB                 |                                                                 |                        |
|                                           | 26.5 GHz                     | 0.47 dB                 |                                                                 |                        |
| RF Attenuation – Measure <sup>3</sup>     | <b>(30 to 3050) MHz</b>      |                         |                                                                 |                        |
|                                           | (0 to 10) dB                 | 0.02 dB                 |                                                                 |                        |
|                                           | (10 to 20) dB                | 0.025 dB                |                                                                 |                        |
|                                           | (20 to 30) dB                | 0.03 dB                 |                                                                 |                        |
|                                           | (30 to 40) dB                | 0.035 dB                |                                                                 |                        |
|                                           | (40 to 50) dB                | 0.04 dB                 |                                                                 |                        |
|                                           | (50 to 60) dB                | 0.076 dB                |                                                                 |                        |
|                                           | (60 to 70) dB                | 0.081 dB                |                                                                 |                        |
|                                           | (70 to 80) dB                | 0.12 dB                 |                                                                 |                        |
|                                           | (80 to 90) dB                | 0.12 dB                 |                                                                 |                        |
|                                           | (90 to 100) dB               | 0.13 dB                 |                                                                 |                        |
|                                           | (100 to 110) dB              | 0.13 dB                 |                                                                 |                        |
|                                           | (110 to 120) dB              | 0.26 dB                 |                                                                 |                        |
|                                           |                              |                         | Agilent 346C noise source – option H13                          | TPA                    |
|                                           |                              |                         | Agilent N5531S measuring receiver w/N5532A Opt 526 power sensor | SFL, HRT<br>HLR        |

| Parameter/Range                       | Frequency                     | CMC <sup>2, 7</sup> (±) | Comment                                                                  | Location <sup>10</sup> |
|---------------------------------------|-------------------------------|-------------------------|--------------------------------------------------------------------------|------------------------|
| RF Attenuation – Measure <sup>3</sup> | <b>(3050 to 6600) MHz</b>     |                         |                                                                          |                        |
|                                       | (0 to 10) dB                  | 0.02 dB                 |                                                                          |                        |
|                                       | (10 to 20) dB                 | 0.025 dB                |                                                                          |                        |
|                                       | (20 to 30) dB                 | 0.03 dB                 |                                                                          |                        |
|                                       | (30 to 40) dB                 | 0.035 dB                |                                                                          |                        |
|                                       | (40 to 50) dB                 | 0.04 dB                 |                                                                          |                        |
|                                       | (50 to 60) dB                 | 0.076 dB                |                                                                          |                        |
|                                       | (60 to 70) dB                 | 0.081 dB                |                                                                          |                        |
|                                       | (70 to 80) dB                 | 0.12 dB                 |                                                                          |                        |
|                                       | (80 to 90) dB                 | 0.12 dB                 |                                                                          |                        |
|                                       | (90 to 100) dB                | 0.13 dB                 |                                                                          |                        |
|                                       | (100 to 110) dB               | 0.15 dB                 |                                                                          |                        |
|                                       | (110 to 120) dB               | 0.37 dB                 |                                                                          |                        |
|                                       | <b>(6600 to 13 200) MHz</b>   |                         |                                                                          |                        |
|                                       | (0 to 10) dB                  | 0.02 dB                 |                                                                          |                        |
|                                       | (10 to 20) dB                 | 0.025 dB                |                                                                          |                        |
|                                       | (20 to 30) dB                 | 0.03 dB                 |                                                                          |                        |
|                                       | (30 to 40) dB                 | 0.035 dB                |                                                                          |                        |
|                                       | (40 to 50) dB                 | 0.04 dB                 |                                                                          |                        |
|                                       | (50 to 60) dB                 | 0.076 dB                |                                                                          |                        |
|                                       | (60 to 70) dB                 | 0.081 dB                |                                                                          |                        |
|                                       | (70 to 80) dB                 | 0.12 dB                 |                                                                          |                        |
|                                       | (80 to 90) dB                 | 0.12 dB                 |                                                                          |                        |
|                                       | (90 to 100) dB                | 0.14 dB                 |                                                                          |                        |
|                                       | (100 to 110) dB               | 0.34 dB                 |                                                                          |                        |
|                                       | (110 to 120) dB               | 0.77 dB                 |                                                                          |                        |
|                                       | <b>(13 200 to 19 200) MHz</b> |                         |                                                                          |                        |
|                                       | (0 to 10) dB                  | 0.02 dB                 |                                                                          |                        |
|                                       | (10 to 20) dB                 | 0.025 dB                |                                                                          |                        |
|                                       | (20 to 30) dB                 | 0.03 dB                 |                                                                          |                        |
|                                       | (30 to 40) dB                 | 0.035 dB                |                                                                          |                        |
|                                       | (40 to 50) dB                 | 0.04 dB                 |                                                                          |                        |
|                                       | (50 to 60) dB                 | 0.076 dB                |                                                                          |                        |
|                                       | (60 to 70) dB                 | 0.081 dB                |                                                                          |                        |
|                                       | (70 to 80) dB                 | 0.12 dB                 |                                                                          |                        |
|                                       | (80 to 90) dB                 | 0.12 dB                 |                                                                          |                        |
|                                       | (90 to 100) dB                | 0.27 dB                 |                                                                          |                        |
|                                       | (100 to 110) dB               | 0.66 dB                 |                                                                          |                        |
|                                       | <b>(19 200 to 26 500) MHz</b> |                         |                                                                          |                        |
|                                       | (0 to 10) dB                  | 0.02 dB                 |                                                                          |                        |
|                                       | (10 to 20) dB                 | 0.025 dB                |                                                                          |                        |
|                                       | (20 to 30) dB                 | 0.03 dB                 |                                                                          |                        |
|                                       | (30 to 40) dB                 | 0.035 dB                |                                                                          |                        |
|                                       | (40 to 50) dB                 | 0.04 dB                 |                                                                          |                        |
|                                       | (50 to 60) dB                 | 0.076 dB                |                                                                          |                        |
|                                       | (60 to 70) dB                 | 0.081 dB                |                                                                          |                        |
|                                       | (70 to 80) dB                 | 0.12 dB                 |                                                                          |                        |
|                                       | (80 to 90) dB                 | 0.2 dB                  |                                                                          |                        |
|                                       | (90 to 100) dB                | 0.5 dB                  |                                                                          |                        |
|                                       | (100 to 110) dB               | 1.1 dB                  |                                                                          |                        |
|                                       |                               |                         | Agilent N5531S<br>measuring receiver<br>w/N5532A Opt 526<br>power sensor | SFL, HRT<br>HLR        |



| Parameter/Range                       | Frequency                     | CMC <sup>2, 7</sup> (±) | Comment                                                                  | Location <sup>10</sup>                   |
|---------------------------------------|-------------------------------|-------------------------|--------------------------------------------------------------------------|------------------------------------------|
| RF Attenuation – Measure <sup>3</sup> | <b>(30 to 3050) MHz</b>       |                         |                                                                          |                                          |
|                                       | (0 to 10) dB                  | 0.02 dB                 |                                                                          |                                          |
|                                       | (10 to 20) dB                 | 0.025 dB                |                                                                          |                                          |
|                                       | (20 to 30) dB                 | 0.03 dB                 |                                                                          |                                          |
|                                       | (30 to 40) dB                 | 0.035 dB                |                                                                          |                                          |
|                                       | (40 to 50) dB                 | 0.04 dB                 |                                                                          |                                          |
|                                       | (50 to 60) dB                 | 0.076 dB                |                                                                          |                                          |
|                                       | (60 to 70) dB                 | 0.081 dB                |                                                                          |                                          |
|                                       | (70 to 80) dB                 | 0.12 dB                 |                                                                          |                                          |
|                                       | (80 to 90) dB                 | 0.12 dB                 |                                                                          |                                          |
|                                       | (90 to 100) dB                | 0.13 dB                 |                                                                          |                                          |
|                                       | (100 to 110) dB               | 0.13 dB                 |                                                                          |                                          |
|                                       | <b>(3050 to 6600) MHz</b>     |                         |                                                                          |                                          |
|                                       | (0 to 10) dB                  | 0.02 dB                 |                                                                          |                                          |
|                                       | (10 to 20) dB                 | 0.025 dB                |                                                                          |                                          |
|                                       | (20 to 30) dB                 | 0.03 dB                 |                                                                          |                                          |
|                                       | (30 to 40) dB                 | 0.035 dB                |                                                                          |                                          |
|                                       | (40 to 50) dB                 | 0.04 dB                 |                                                                          |                                          |
|                                       | (50 to 60) dB                 | 0.076 dB                |                                                                          |                                          |
|                                       | (60 to 70) dB                 | 0.081 dB                |                                                                          |                                          |
|                                       | (70 to 80) dB                 | 0.12 dB                 |                                                                          |                                          |
|                                       | (80 to 90) dB                 | 0.12 dB                 |                                                                          |                                          |
|                                       | (90 to 100) dB                | 0.13 dB                 |                                                                          |                                          |
|                                       | (100 to 110) dB               | 0.19 dB                 |                                                                          |                                          |
|                                       | <b>(6600 to 13 200) MHz</b>   |                         |                                                                          |                                          |
|                                       | (0 to 10) dB                  | 0.02 dB                 |                                                                          |                                          |
|                                       | (10 to 20) dB                 | 0.025 dB                |                                                                          |                                          |
|                                       | (20 to 30) dB                 | 0.03 dB                 |                                                                          |                                          |
|                                       | (30 to 40) dB                 | 0.035 dB                |                                                                          |                                          |
|                                       | (40 to 50) dB                 | 0.04 dB                 |                                                                          |                                          |
|                                       | (50 to 60) dB                 | 0.076 dB                |                                                                          |                                          |
|                                       | (60 to 70) dB                 | 0.081 dB                |                                                                          |                                          |
|                                       | (70 to 80) dB                 | 0.12 dB                 |                                                                          |                                          |
|                                       | (80 to 90) dB                 | 0.12 dB                 |                                                                          |                                          |
|                                       | (90 to 100) dB                | 0.13 dB                 |                                                                          |                                          |
|                                       | (100 to 110) dB               | 0.25 dB                 |                                                                          |                                          |
|                                       | <b>(13 200 to 19 200) MHz</b> |                         |                                                                          |                                          |
|                                       | (0 to 10) dB                  | 0.02 dB                 |                                                                          |                                          |
|                                       | (10 to 20) dB                 | 0.025 dB                |                                                                          |                                          |
|                                       | (20 to 30) dB                 | 0.03 dB                 |                                                                          |                                          |
|                                       | (30 to 40) dB                 | 0.035 dB                |                                                                          |                                          |
|                                       | (40 to 50) dB                 | 0.04 dB                 |                                                                          |                                          |
|                                       | (50 to 60) dB                 | 0.076 dB                |                                                                          |                                          |
|                                       | (60 to 70) dB                 | 0.081 dB                |                                                                          |                                          |
|                                       | (70 to 80) dB                 | 0.12 dB                 |                                                                          |                                          |
|                                       | (80 to 90) dB                 | 0.12 dB                 |                                                                          |                                          |
|                                       | (90 to 100) dB                | 0.13 dB                 |                                                                          |                                          |
|                                       | (100 to 110) dB               | 0.31 dB                 |                                                                          |                                          |
|                                       |                               |                         | Agilent N5531S<br>measuring receiver<br>w/N5532B Opt 550<br>power sensor | MEL, RFD<br>TPA, HSV<br>COS, RDU,<br>DFW |

| Parameter/Range                       | Frequency                     | CMC <sup>2,7</sup> (±) | Comment                                                                  | Location <sup>10</sup>                   |
|---------------------------------------|-------------------------------|------------------------|--------------------------------------------------------------------------|------------------------------------------|
| RF Attenuation – Measure <sup>3</sup> | <b>(19 200 to 26 500) MHz</b> |                        | Agilent N5531S<br>measuring receiver<br>w/N5532B Opt 550<br>power sensor | MEL, RFD<br>TPA, HSV<br>COS, RDU,<br>DFW |
|                                       | (0 to 10) dB                  | 0.02 dB                |                                                                          |                                          |
|                                       | (10 to 20) dB                 | 0.025 dB               |                                                                          |                                          |
|                                       | (20 to 30) dB                 | 0.03 dB                |                                                                          |                                          |
|                                       | (30 to 40) dB                 | 0.035 dB               |                                                                          |                                          |
|                                       | (40 to 50) dB                 | 0.04 dB                |                                                                          |                                          |
|                                       | (50 to 60) dB                 | 0.076 dB               |                                                                          |                                          |
|                                       | (60 to 70) dB                 | 0.081 dB               |                                                                          |                                          |
|                                       | (70 to 80) dB                 | 0.12 dB                |                                                                          |                                          |
|                                       | (80 to 90) dB                 | 0.14 dB                |                                                                          |                                          |
|                                       | (90 to 100) dB                | 0.36 dB                |                                                                          |                                          |
|                                       | (100 to 110) dB               | 0.82 dB                |                                                                          |                                          |
|                                       | <b>(26 500 to 31 150) MHz</b> |                        |                                                                          |                                          |
|                                       | (0 to 10) dB                  | 0.02 dB                |                                                                          |                                          |
|                                       | (10 to 20) dB                 | 0.025 dB               |                                                                          |                                          |
|                                       | (20 to 30) dB                 | 0.03 dB                |                                                                          |                                          |
|                                       | (30 to 40) dB                 | 0.035 dB               |                                                                          |                                          |
|                                       | (40 to 50) dB                 | 0.04 dB                |                                                                          |                                          |
|                                       | (50 to 60) dB                 | 0.076 dB               |                                                                          |                                          |
|                                       | (60 to 70) dB                 | 0.081 dB               |                                                                          |                                          |
|                                       | (70 to 80) dB                 | 0.12 dB                |                                                                          |                                          |
|                                       | (80 to 90) dB                 | 0.13 dB                |                                                                          |                                          |
|                                       | (90 to 100) dB                | 0.33 dB                |                                                                          |                                          |
|                                       | (100 to 110) dB               | 0.77 dB                |                                                                          |                                          |
|                                       | <b>(31 150 to 41 000) MHz</b> |                        |                                                                          |                                          |
|                                       | (0 to 10) dB                  | 0.02 dB                |                                                                          |                                          |
|                                       | (10 to 20) dB                 | 0.025 dB               |                                                                          |                                          |
|                                       | (20 to 30) dB                 | 0.03 dB                |                                                                          |                                          |
|                                       | (30 to 40) dB                 | 0.035 dB               |                                                                          |                                          |
|                                       | (40 to 50) dB                 | 0.04 dB                |                                                                          |                                          |
|                                       | (50 to 60) dB                 | 0.076 dB               |                                                                          |                                          |
|                                       | (60 to 70) dB                 | 0.081 dB               |                                                                          |                                          |
|                                       | (70 to 80) dB                 | 0.14 dB                |                                                                          |                                          |
|                                       | (80 to 90) dB                 | 0.36 dB                |                                                                          |                                          |
|                                       | <b>(41 000 to 45 000) MHz</b> |                        |                                                                          |                                          |
|                                       | (0 to 10) dB                  | 0.02 dB                |                                                                          |                                          |
|                                       | (10 to 20) dB                 | 0.025 dB               |                                                                          |                                          |
|                                       | (20 to 30) dB                 | 0.03 dB                |                                                                          |                                          |
|                                       | (30 to 40) dB                 | 0.035 dB               |                                                                          |                                          |
|                                       | (40 to 50) dB                 | 0.04 dB                |                                                                          |                                          |
|                                       | (50 to 60) dB                 | 0.076 dB               |                                                                          |                                          |
|                                       | (60 to 70) dB                 | 0.11 dB                |                                                                          |                                          |
|                                       | (70 to 80) dB                 | 0.24 dB                |                                                                          |                                          |
|                                       | (80 to 90) dB                 | 0.6 dB                 |                                                                          |                                          |
|                                       | <b>(45 000 to 50 000) MHz</b> |                        |                                                                          |                                          |
|                                       | (0 to 10) dB                  | 0.02 dB                |                                                                          |                                          |
|                                       | (10 to 20) dB                 | 0.025 dB               |                                                                          |                                          |
|                                       | (20 to 30) dB                 | 0.03 dB                |                                                                          |                                          |
|                                       | (30 to 40) dB                 | 0.035 dB               |                                                                          |                                          |
|                                       | (40 to 50) dB                 | 0.04 dB                |                                                                          |                                          |
|                                       | (50 to 60) dB                 | 0.11 dB                |                                                                          |                                          |
|                                       | (60 to 70) dB                 | 0.29 dB                |                                                                          |                                          |
|                                       | (70 to 80) dB                 | 0.7 dB                 |                                                                          |                                          |
|                                       | (80 to 90) dB                 | 1.4 dB                 |                                                                          |                                          |

| Parameter/Range                                                                 | Frequency                                                                                                                                                                                                                                                                           | CMC <sup>2</sup> (±)                                                                                                                                                                                                                                                                                                                                                                                                                                     | Comment                                                                    | Location <sup>10</sup> |
|---------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------|------------------------|
| RF Power – Power<br>Sensor (Cal Factor)<br><br>M is the mismatch<br>Uncertainty | <b>Type-N (50 Ω)</b><br>0.1 MHz<br>0.3 MHz<br>0.5 MHz<br>1 MHz<br>3 MHz<br>5 MHz<br>10 MHz<br>30 MHz<br>50 MHz<br>100 MHz<br>300 MHz<br>500 MHz<br>1000 MHz<br>1500 MHz<br>2000 MHz<br>2500 MHz<br>3000 MHz<br>3500 MHz<br>3700 MHz<br>4000 MHz<br>4200 MHz<br>5000 MHz<br>6000 MHz | 1.2 % of rdg + M<br>1 % of rdg + M<br>1 % of rdg + M<br>1 % of rdg + M<br>1 % of rdg + M<br>1 % of rdg + M<br>0.97 % of rdg + M<br>0.95 % of rdg + M<br>0.85 % of rdg + M<br>0.85 % of rdg + M<br>0.89 % of rdg + M<br>0.89 % of rdg + M<br>0.89 % of rdg + M<br>0.89 % of rdg + M<br>0.88 % of rdg + M<br>0.88 % of rdg + M<br>0.9 % of rdg + M<br>0.9 % of rdg + M<br>0.92 % of rdg + M<br>0.93 % of rdg + M<br>0.93 % of rdg + M<br>0.93 % of rdg + M | Agilent EPM series<br>power meter<br>w/Keysight N8482A<br>H84 power sensor | RFD                    |
|                                                                                 | <b>Type-N (50 Ω)</b><br>0.1 MHz<br>0.3 MHz<br>0.5 MHz<br>1 MHz<br>3 MHz<br>5 MHz<br>10 MHz<br>30 MHz<br>50 MHz<br>100 MHz<br>300 MHz<br>500 MHz<br>1000 MHz<br>1500 MHz<br>2000 MHz<br>2500 MHz<br>3000 MHz<br>3500 MHz<br>3700 MHz<br>4000 MHz<br>4200 MHz                         | 1.1 % of rdg + M<br>0.94 % of rdg + M<br>0.93 % of rdg + M<br>0.93 % of rdg + M<br>0.9 % of rdg + M<br>0.9 % of rdg + M<br>0.89 % of rdg + M<br>0.89 % of rdg + M<br>0.91 % of rdg + M<br>0.89 % of rdg + M<br>0.94 % of rdg + M<br>0.94 % of rdg + M<br>0.96 % of rdg + M<br>0.96 % of rdg + M<br>0.96 % of rdg + M<br>1.1 % of rdg + M<br>1.2 % of rdg + M<br>1.2 % of rdg + M<br>1.2 % of rdg + M<br>1.4 % of rdg + M<br>1.4 % of rdg + M             | Agilent EPM series<br>power meter<br>w/Keysight 8482A<br>H84 power sensor  | TPA                    |

| Parameter/Range                                                                 | Frequency                                                                                                                                                                                                                                                                                                                                                                      | CMC <sup>2</sup> (±)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Comment                                                                       | Location <sup>10</sup> |
|---------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|------------------------|
| RF Power – Power<br>Sensor (Cal Factor)<br><br>M is the mismatch<br>Uncertainty | <b>Type-N (50 Ω)</b><br>10 MHz<br>30 MHz<br>50 MHz<br>100 MHz<br>300 MHz<br>500 MHz<br>800 MHz<br>1000 MHz<br>1200 MHz<br>1500 MHz<br>2000 MHz<br>3000 MHz<br>4000 MHz<br>5000 MHz<br>6000 MHz<br>7000 MHz<br>8000 MHz<br>9000 MHz<br>10 000 MHz<br>11 000 MHz<br>12 000 MHz<br>12 400 MHz<br>13 000 MHz<br>14 000 MHz<br>15 000 MHz<br>16 000 MHz<br>17 000 MHz<br>18 000 MHz | 1.3 % of rdg + M<br>1.3 % of rdg + M<br>1.2 % of rdg + M<br>1.2 % of rdg + M<br>1.2 % of rdg + M<br>1.2 % of rdg + M<br>1.2 % of rdg + M<br>1.2 % of rdg + M<br>1.2 % of rdg + M<br>1.2 % of rdg + M<br>1.2 % of rdg + M<br>1.2 % of rdg + M<br>1.2 % of rdg + M<br>1.2 % of rdg + M<br>1.3 % of rdg + M<br>1.3 % of rdg + M<br>1.3 % of rdg + M<br>1.3 % of rdg + M<br>1.4 % of rdg + M<br>1.4 % of rdg + M<br>1.4 % of rdg + M<br>1.4 % of rdg + M<br>1.4 % of rdg + M<br>1.5 % of rdg + M<br>1.5 % of rdg + M<br>1.5 % of rdg + M<br>1.6 % of rdg + M<br>1.6 % of rdg + M<br>1.6 % of rdg + M | Agilent EPM series<br>power meter<br>w/Keysight<br>N8481A H84<br>power sensor | RFD                    |
|                                                                                 | <b>Type-N (50 Ω)</b><br>100 MHz<br>500 MHz<br>1000 MHz<br>2000 MHz<br>3000 MHz<br>4000 MHz<br>5000 MHz<br>6000 MHz<br>7000 MHz<br>8000 MHz<br>9000 MHz<br>10 000 MHz<br>11 000 MHz<br>12 000 MHz<br>13 000 MHz<br>14 000 MHz<br>15 000 MHz<br>16 000 MHz<br>17 000 MHz<br>18 000 MHz                                                                                           | 1.2 % of rdg + M<br>1.2 % of rdg + M<br>1.2 % of rdg + M<br>1.2 % of rdg + M<br>1.3 % of rdg + M<br>1.3 % of rdg + M<br>1.4 % of rdg + M<br>1.4 % of rdg + M<br>1.4 % of rdg + M<br>1.4 % of rdg + M<br>1.5 % of rdg + M<br>1.5 % of rdg + M<br>1.5 % of rdg + M<br>1.5 % of rdg + M<br>1.5 % of rdg + M<br>1.5 % of rdg + M<br>1.7 % of rdg + M<br>1.7 % of rdg + M<br>1.7 % of rdg + M<br>1.7 % of rdg + M<br>1.8 % of rdg + M<br>1.8 % of rdg + M<br>1.8 % of rdg + M<br>1.9 % of rdg + M                                                                                                     | Agilent EPM series<br>power meter<br>w/Keysight 8481A<br>H84 power sensor     | TPA                    |



| Parameter/Range                                                                 | Frequency                                                                                                                                                                                                                                                                                                                                                                                                                                                        | CMC <sup>2</sup> (±)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Comment                                                                         | Location <sup>10</sup> |
|---------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|------------------------|
| RF Power – Power<br>Sensor (Cal Factor)<br><br>M is the mismatch<br>Uncertainty | <b>3.5 mm (50Ω)</b><br>50 MHz<br>100 MHz<br>300 MHz<br>500 MHz<br>1000 MHz<br>1500 MHz<br>2000 MHz<br>3000 MHz<br>4000 MHz<br>5000 MHz<br>6000 MHz<br>7000 MHz<br>8000 MHz<br>9000 MHz<br>10 000 MHz<br>11 000 MHz<br>12 000 MHz<br>12 400 MHz<br>13 000 MHz<br>14 000 MHz<br>15 000 MHz<br>16 000 MHz<br>17 000 MHz<br>18 000 MHz<br>19 000 MHz<br>20 000 MHz<br>21 000 MHz<br>22 000 MHz<br>23 000 MHz<br>24 000 MHz<br>25 000 MHz<br>26 000 MHz<br>26 500 MHz | .3 % of rdg + M<br>1.2 % of rdg + M<br>1.2 % of rdg + M<br>1.3 % of rdg + M<br>1.3 % of rdg + M<br>1.3 % of rdg + M<br>1.2 % of rdg + M<br>1.3 % of rdg + M<br>1.3 % of rdg + M<br>1.3 % of rdg + M<br>1.4 % of rdg + M<br>1.4 % of rdg + M<br>1.5 % of rdg + M<br>1.6 % of rdg + M<br>1.6 % of rdg + M<br>1.5 % of rdg + M<br>1.5 % of rdg + M<br>1.6 % of rdg + M<br>1.6 % of rdg + M<br>1.9 % of rdg + M<br>1.7 % of rdg + M<br>1.6 % of rdg + M<br>1.8 % of rdg + M<br>1.7 % of rdg + M<br>2 % of rdg + M<br>2.2 % of rdg + M<br>2.1 % of rdg + M<br>2.5 % of rdg + M<br>2.7 % of rdg + M<br>2.3 % of rdg + M<br>2 % of rdg + M<br>2 % of rdg + M<br>2.3 % of rdg + M | Agilent EPM series<br>power meter power<br>w/Keysight 8485A<br>H84 power sensor | TPA                    |
|                                                                                 | <b>2.4 mm (50 Ω)</b><br>50 MHz<br>100 MHz<br>300 MHz<br>500 MHz<br>1000 MHz<br>2000 MHz<br>3000 MHz<br>4000 MHz<br>5000 MHz<br>6000 MHz<br>7000 MHz<br>8000 MHz<br>9000 MHz                                                                                                                                                                                                                                                                                      | 1.1 % of rdg + M<br>1.1 % of rdg + M<br>1.1 % of rdg + M<br>1.2 % of rdg + M<br>1.2 % of rdg + M<br>1.2 % of rdg + M<br>1.2 % of rdg + M<br>1.2 % of rdg + M<br>1.2 % of rdg + M<br>1.3 % of rdg + M<br>1.3 % of rdg + M<br>1.3 % of rdg + M<br>1.4 % of rdg + M<br>1.5 % of rdg + M                                                                                                                                                                                                                                                                                                                                                                                      | Agilent EPM series<br>power meter<br>w/Keysight N8487A<br>H84 power sensor      |                        |

| Parameter/Range                                                                 | Frequency            | CMC <sup>2</sup> (±) | Comment                                                                    | Location <sup>10</sup> |
|---------------------------------------------------------------------------------|----------------------|----------------------|----------------------------------------------------------------------------|------------------------|
| RF Power – Power<br>Sensor (Cal Factor)<br><br>M is the mismatch<br>Uncertainty | <b>2.4 mm (50 Ω)</b> |                      |                                                                            |                        |
|                                                                                 | 10 000 MHz           | 1.5 % of rdg + M     |                                                                            |                        |
|                                                                                 | 11 000 MHz           | 1.5 % of rdg + M     |                                                                            |                        |
|                                                                                 | 12 000 MHz           | 1.5 % of rdg + M     |                                                                            |                        |
|                                                                                 | 13 000 MHz           | 1.5 % of rdg + M     |                                                                            |                        |
|                                                                                 | 14 000 MHz           | 1.6 % of rdg + M     |                                                                            |                        |
|                                                                                 | 15 000 MHz           | 1.6 % of rdg + M     |                                                                            |                        |
|                                                                                 | 16 000 MHz           | 1.7 % of rdg + M     |                                                                            |                        |
|                                                                                 | 17 000 MHz           | 1.7 % of rdg + M     |                                                                            |                        |
|                                                                                 | 18 000 MHz           | 1.7 % of rdg + M     |                                                                            |                        |
|                                                                                 | 19 000 MHz           | 1.9 % of rdg + M     |                                                                            |                        |
|                                                                                 | 20 000 MHz           | 1.9 % of rdg + M     |                                                                            |                        |
|                                                                                 | 21 000 MHz           | 1.9 % of rdg + M     |                                                                            |                        |
|                                                                                 | 22 000 MHz           | 1.9 % of rdg + M     |                                                                            |                        |
|                                                                                 | 23 000 MHz           | 1.9 % of rdg + M     |                                                                            |                        |
|                                                                                 | 24 000 MHz           | 1.9 % of rdg + M     |                                                                            |                        |
|                                                                                 | 25 000 MHz           | 1.9 % of rdg + M     |                                                                            |                        |
|                                                                                 | 26 000 MHz           | 1.9 % of rdg + M     |                                                                            |                        |
|                                                                                 | 27 000 MHz           | 2.4 % of rdg + M     |                                                                            |                        |
|                                                                                 | 28 000 MHz           | 2.4 % of rdg + M     |                                                                            |                        |
|                                                                                 | 29 000 MHz           | 2.4 % of rdg + M     |                                                                            |                        |
|                                                                                 | 30 000 MHz           | 2.4 % of rdg + M     |                                                                            |                        |
|                                                                                 | 31 000 MHz           | 2.4 % of rdg + M     |                                                                            |                        |
|                                                                                 | 32 000 MHz           | 2.4 % of rdg + M     |                                                                            |                        |
|                                                                                 | 33 000 MHz           | 2.4 % of rdg + M     |                                                                            |                        |
|                                                                                 | 34 000 MHz           | 2.5 % of rdg + M     |                                                                            |                        |
|                                                                                 | 34 500 MHz           | 2.5 % of rdg + M     |                                                                            |                        |
|                                                                                 | 35 000 MHz           | 2.5 % of rdg + M     |                                                                            |                        |
|                                                                                 | 36 000 MHz           | 2.6 % of rdg + M     |                                                                            |                        |
|                                                                                 | 37 000 MHz           | 2.6 % of rdg + M     |                                                                            |                        |
|                                                                                 | 38 000 MHz           | 2.6 % of rdg + M     |                                                                            |                        |
|                                                                                 | 39 000 MHz           | 2.9 % of rdg + M     |                                                                            |                        |
|                                                                                 | 40 000 MHz           | 3.0 % of rdg + M     |                                                                            |                        |
|                                                                                 | 41 000 MHz           | 3.2 % of rdg + M     |                                                                            |                        |
|                                                                                 | 42 000 MHz           | 3.2 % of rdg + M     |                                                                            |                        |
|                                                                                 | 43 000 MHz           | 3.2 % of rdg + M     |                                                                            |                        |
|                                                                                 | 44 000 MHz           | 3.2 % of rdg + M     |                                                                            |                        |
|                                                                                 | 45 000 MHz           | 3.2 % of rdg + M     |                                                                            |                        |
|                                                                                 | 46 000 MHz           | 3.2 % of rdg + M     |                                                                            |                        |
|                                                                                 | 47 000 MHz           | 3.2 % of rdg + M     |                                                                            |                        |
|                                                                                 | 48 000 MHz           | 3.3 % of rdg + M     |                                                                            |                        |
|                                                                                 | 49 000 MHz           | 3.4 % of rdg + M     |                                                                            |                        |
|                                                                                 | 50 000 MHz           | 3.4 % of rdg + M     |                                                                            |                        |
|                                                                                 |                      |                      | Agilent EPM series<br>power meter<br>w/Keysight N8487A<br>H84 power sensor | TPA                    |

| Parameter/Equipment                          | Range                                                                                                                                                                                                                                                  | CMC <sup>2, 7</sup> (±)                                                                | Comment                                                | Location <sup>10</sup>                                           |
|----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|--------------------------------------------------------|------------------------------------------------------------------|
| RF Power – Measure <sup>3</sup><br>50 MHz    | 1.0 mW                                                                                                                                                                                                                                                 | 0.32 % of rdg                                                                          | HP 432A PM<br>w/478A Opt H76<br>thermistor mount       | TPA, COS,<br>HSV, DFW                                            |
| Attenuation Generate<br>@ 30 MHz             | 10 dB<br>20 dB<br>30 dB<br>40 dB<br>50 dB                                                                                                                                                                                                              | 5.6 mdB<br>7.6 mdB<br>6.4 mdB<br>7.4 mdB<br>8.6 mdB                                    | HP 11812A<br>calibration kit                           | TPA, RFD                                                         |
| Phase Noise <sup>3</sup><br>Offset Frequency | <b>5 MHz &lt; f ≤ 18 GHz</b><br>≤ 100 kHz<br>100 kHz to 40 MHz                                                                                                                                                                                         | 2.3 dB<br>4.6 dB                                                                       | HP 3048A<br>phase noise<br>system w/866xA<br>RF source | MEL, COS<br>TPA                                                  |
| Total Harmonic Distortion<br>(THD)           | <b>(0 to 65) dB</b><br><b>20 Hz to 20 kHz</b><br>(0 to 40) dB<br>(40 to 50) dB<br>(50 to 60) dB<br>(60 to 65) dB<br><b>(20 to 50) kHz</b><br>(0 to 40) dB<br>(40 to 50) dB<br>(50 to 60) dB<br><b>(50 to 100) kHz</b><br>(0 to 40) dB<br>(40 to 50) Db | 1.0 dB<br>1.0 dB<br>1.3 dB<br>1.7 dB<br>2.0 dB<br>2.1 dB<br>3.0 dB<br>2.0 dB<br>2.4 dB | HP 8903B audio<br>analyzer                             | COS, HSV<br>MEL, ATL<br>RDU, RFD<br>TPA, SFL<br>HLR, HRT,<br>DFW |

| Parameter/Range                             | Frequency                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | CMC <sup>2, 7</sup> (±)                                                                                                                                    | Comment                           | Location <sup>10</sup>                            |
|---------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|---------------------------------------------------|
| Harmonics Measure <sup>3</sup>              | <b>(-80 to -10) dB</b><br><b>2<sup>nd</sup> through 5<sup>th</sup> Harmonic</b><br>1 kHz to 600 MHz<br>(600 to 1 320) MHz<br>(1 320 to 2 200) MHz<br>(2 200 to 3 000) MHz<br>(3 000 to 4 400) MHz<br>(4 400 to 5 300) MHz<br><b>2<sup>nd</sup> through 4<sup>th</sup> Harmonic</b><br>(5 300 to 6 625) MHz<br><b>2<sup>nd</sup> through 3<sup>rd</sup> Harmonic</b><br>(6 625 to 8 833) MHz<br><b>2<sup>nd</sup> Harmonic</b><br>(8 833 to 13 250) MHz                             | 0.37 dB<br>1.1 dB<br>1.4 dB<br>1.4 dB<br>1.7 dB<br>1.9 dB<br>2.1 dB<br>2.1 dB<br>2.1 dB                                                                    | Agilent E4440A Measuring Receiver | HLR, HRT SFL                                      |
|                                             | <b>(-10 to -80) dB</b><br><b>2<sup>nd</sup> through 5<sup>th</sup> Harmonic</b><br>1kHz to 600MHz<br>(600 to 1 320) MHz<br>(1 320 to 2 200) MHz<br>(2 200 to 3 000) MHz<br>(3 000 to 4 400) MHz<br>(4 400 to 5 300) MHz<br>(5 300 to 10 000) MHz<br><b>2<sup>nd</sup> through 4<sup>th</sup> Harmonic</b><br>(10 000 to 12 500) MHz<br><b>2<sup>nd</sup> through 3<sup>rd</sup> Harmonic</b><br>(12 500 to 16 667) MHz<br><b>2<sup>nd</sup> Harmonic</b><br>(16 667 to 25 000) MHz | 0.37 dB<br>1.1 dB<br>1.4 dB<br>1.4 dB<br>1.7 dB<br>1.9 dB<br>2.1 dB<br>2.1 dB<br>2.1 dB<br>2.3 dB                                                          | Agilent E4448A Measuring Receiver | COS, HSV MEL, ATL RDU, RFD TPA, DFW               |
| Amplitude Modulation – Measure <sup>3</sup> | <b>100 kHz to 10 MHz</b><br><b>Rate 50 Hz to 10 kHz</b><br>(5 to 99) % Depth<br><br><b>10 MHz to 3 GHz</b><br><b>Rate 50 Hz to 100 kHz</b><br>(5 to 20) % Depth<br>(20 to 99) % Depth<br><br><b>(3 to 26.5) GHz</b><br><b>Rate 50 Hz to 100 kHz</b><br>(5 to 20) % Depth<br>(20 to 99) % Depth                                                                                                                                                                                     | 0.75 % of rdg + 0.3 digits<br><br><br>2.5 % of rdg + 0.4 digits<br>1.5 % of rdg + 0.4 digits<br><br>4.5 % of rdg + 0.4 digits<br>1.5 % of rdg + 0.4 digits | Agilent N5531S measuring receiver | COS, HSV MEL, ATL RDU, RFD TPA, SFL HLR, HRT, DFW |

| Parameter/Range                                             | Frequency                                                                                                                                                                  | CMC <sup>2, 7</sup> (±)                                | Comment                                                                                  | Location <sup>10</sup>                                           |
|-------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|------------------------------------------------------------------------------------------|------------------------------------------------------------------|
| Amplitude Modulation – Measure <sup>3</sup>                 | <b>(26.5 to 31.15) GHz</b><br><b>Rate 50 Hz to 100 kHz</b><br>(5 to 20) % Depth<br>(20 to 99) % Depth                                                                      | 6.8 % of rdg + 0.4 digits<br>1.9 % of rdg + 0.4 digits | Agilent<br>N5531S<br>measuring<br>receiver<br>Agilent<br>N5531S<br>measuring<br>Receiver | COS, HSV<br>MEL, ATL<br>RDU, RFD<br>TPA, DFW                     |
|                                                             | <b>(31.15 to 50) GHz</b><br><b>Rate 50 Hz to 100 kHz</b><br>(5 to 20) % Depth<br>(20 to 99) % Depth                                                                        | 26 % of rdg + 0.4 digits<br>6 % of rdg + 0.4 digits    |                                                                                          |                                                                  |
| AM Distortion – Measure <sup>3</sup><br>Rate 20 Hz to 1 kHz | <b>(0.1 to 10) MHz</b><br><b>AM Depth &gt; 1%</b><br>(0 to -20) dB<br>(-20 to -30) dB<br><b>AM Depth &gt; 3%</b><br>(0 to -20) dB<br>(-20 to -30) dB<br>(-30 to -40) dB    | 1.2 dB<br>2.2 dB<br>1.0 dB<br>1.3 dB<br>2.4 dB         |                                                                                          | COS, HSV<br>MEL, ATL<br>RDU, RFD<br>TPA, SFL<br>HLR, HRT,<br>DFW |
|                                                             | <b>10 MHz to 26.5 GHz</b><br><b>AM Depth &gt; 1%</b><br>(0 to -20) dB<br>(-20 to -30) dB<br><b>AM Depth &gt; 3%</b><br>(0 to -20) dB<br>(-20 to -30) dB<br>(-30 to -40) dB | 1.3 dB<br>2.5 dB<br>1.1 dB<br>1.4 dB<br>3.0 dB         |                                                                                          |                                                                  |
|                                                             | <b>(26.5 MHz to 50.0 GHz)</b><br><b>AM Depth &gt; 3 %</b><br>(0 to -20) dB<br><b>AM Depth &gt; 5%</b><br>(0 to -20) dB<br>(-20 to -30) dB                                  | 1.8 dB<br>1.5 dB<br>3.5 dB                             |                                                                                          | COS, HSV<br>MEL, ATL<br>RDU, RFD<br>TPA, DFW                     |

| Parameter/Range                                                                 | Frequency                                                                                                                                                                                                         | CMC <sup>2, 7</sup> (±)                                                                                      | Comment                                    | Location <sup>10</sup>                                           |
|---------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|--------------------------------------------|------------------------------------------------------------------|
| Frequency Modulation<br>—<br>Measure <sup>3</sup><br>$\beta$ = deviation / rate | <b>250 kHz to 10 MHz</b><br>Rates 20 Hz to 10 kHz<br>Peak Dev 200 Hz to 40 kHz                                                                                                                                    | $\beta > 0.2 - 1.5 \% \text{ of rdg} + 2 \text{ Hz}$<br>$\beta > 1.2 - 1 \% \text{ of rdg} + 2 \text{ Hz}$   | Agilent<br>N5531S<br>measuring<br>receiver | COS, HSV<br>MEL, ATL<br>RDU, RFD<br>TPA, SFL<br>HLR, HRT,<br>DFW |
|                                                                                 | <b>10 MHz to 6.6 GHz</b><br>Rates 50 Hz to 200 kHz<br>Peak Dev 250 Hz to 400 kHz                                                                                                                                  | $\beta > 0.20 - 1.5 \% \text{ of rdg} + 2 \text{ Hz}$<br>$\beta > 0.45 - 1 \% \text{ of rdg} + 2 \text{ Hz}$ |                                            |                                                                  |
|                                                                                 | <b>(6.6 to 13.2) GHz</b><br>Rates 50 Hz to 200 kHz<br>Peak Dev 250 Hz to 400 kHz                                                                                                                                  | $\beta > 0.2 - 2.5 \% \text{ of rdg} + 4 \text{ Hz}$<br>$\beta > 8.0 - 1 \% \text{ of rdg} + 4 \text{ Hz}$   |                                            |                                                                  |
|                                                                                 | <b>(13.2 to 26.5) GHz</b><br>Rates 50 Hz to 200 kHz<br>Peak Dev 250 Hz to 400 kHz                                                                                                                                 | $\beta > 0.2 - 3.8 \% \text{ of rdg} + 9 \text{ Hz}$<br>$\beta > 16 - 1 \% \text{ of rdg} + 9 \text{ Hz}$    |                                            |                                                                  |
| FM Distortion –<br>Measure <sup>3</sup><br>Rate 20 Hz to 1 kHz                  | <b>(26.5 to 31.15) GHz</b><br>Rates 50 Hz to 200 kHz<br>Peak Dev 250 Hz to 400 kHz                                                                                                                                | $\beta > 0.2 - 3.8 \% \text{ of rdg} + 9 \text{ Hz}$<br>$\beta > 16 - 1 \% \text{ of rdg} + 9 \text{ Hz}$    | Agilent<br>N5531S<br>measuring<br>receiver | COS, HSV<br>MEL, ATL<br>RDU, RFD<br>TPA, DFW                     |
|                                                                                 | <b>(31.15 to 50) GHz</b><br>Rates 50 Hz to 200 kHz<br>Peak Dev 250 Hz to 400 kHz                                                                                                                                  | $\beta > 0.2 - 8.5 \% \text{ of rdg} + 17 \text{ Hz}$<br>$\beta > 16 - 1 \% \text{ of rdg} + 17 \text{ Hz}$  |                                            |                                                                  |
|                                                                                 | <b>(1 to 6 600) MHz</b><br><b>Dev 500 Hz to 2 kHz</b><br>(0 to -20) dB<br>(-20 to -30) dB<br>(-30 to -40) dB<br><b>Dev &gt; 2 kHz</b><br>(0 to -20) dB<br>(-20 to -30) dB<br>(-30 to -40) dB<br>(-40 to -50) dB   | 0.26 dB<br>0.79 dB<br>2.3 dB<br>0.09 dB<br>0.27 dB<br>0.83 dB<br>2.4 dB                                      |                                            | COS, HSV<br>MEL, ATL<br>RDU, RFD<br>TPA, SFL<br>HLR, HRT,<br>DFW |
|                                                                                 | <b>(6.6 to 13.2) GHz</b><br><b>Dev &gt; 2.3 kHz</b><br>(0 to -20) dB<br>(-20 to -30) dB<br>(-30 to -40) dB<br><b>Dev &gt; 4.5 K kHz</b><br>(0 to -20) dB<br>(-20 to -30) dB<br>(-30 to -40) dB<br>(-40 to -50) dB | 0.26 dB<br>0.79 dB<br>2.3 dB<br>0.09 dB<br>0.27 dB<br>0.83 dB<br>2.4 dB                                      |                                            |                                                                  |
|                                                                                 | <b>(13.2 to 26.5) GHz</b><br><b>Dev &gt; 2.7 kHz</b><br>(0 to -20) dB<br>(-20 to -30) dB<br>(-30 to -40) dB                                                                                                       | 0.26 dB<br>0.79 dB<br>2.3 dB                                                                                 | Agilent<br>N5531S<br>measuring<br>receiver |                                                                  |
|                                                                                 |                                                                                                                                                                                                                   |                                                                                                              |                                            |                                                                  |

| Parameter/Range                                             | Frequency                                                                                                                                                                                                                                                                                                                                                                                                                               | CMC <sup>2, 7</sup> (±)                                                                                                                                          | Comment                                 | Location <sup>10</sup>                                           |
|-------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|------------------------------------------------------------------|
| FM Distortion – Measure <sup>3</sup><br>Rate 20 Hz to 1 kHz | <b>(13.2 to 26.5) GHz</b><br><b>Dev &gt; 6.0 kHz</b><br>(0 to -20) dB<br>(-20 to -30) dB<br>(-30 to -40) dB<br>(-40 to -50) dB                                                                                                                                                                                                                                                                                                          | 0.09 dB<br>0.27 dB<br>0.83 dB<br>2.4 dB                                                                                                                          | Agilent N5531S<br>measuring<br>receiver | COS, HSV<br>MEL, ATL<br>RDU, RFD<br>TPA, SFL<br>HLR, HRT,<br>DFW |
|                                                             | <b>(26.5 to 31.15) GHz</b><br><b>Dev &gt; 2.7 kHz</b><br>(0 to -20) dB<br>(-20 to -30) dB<br>(-30 to -40) dB<br><b>Dev &gt; 6.0 kHz</b><br>(0 to -20) dB<br>(-20 to -30) dB<br>(-30 to -40) dB<br>(-40 to -50) dB<br><br><b>(31.15 to 50.0) GHz</b><br><b>Dev &gt; 4 kHz</b><br>(0 to -20) dB<br>(-20 to -30) dB<br>(-30 to -40) dB<br><b>Dev &gt; 12 kHz</b><br>(0 to -20) dB<br>(-20 to -30) dB<br>(-30 to -40) dB<br>(-40 to -50) dB | 0.26 dB<br>0.79 dB<br>2.3 dB<br><br>0.09 dB<br>0.27 dB<br>0.83 dB<br>2.4 dB<br><br>0.26 dB<br>0.79 dB<br>2.3 dB<br><br>0.09 dB<br>0.27 dB<br>0.83 dB<br>2.4 dB   |                                         | COS, HSV<br>MEL, ATL<br>RDU, RFD<br>TPA, DFW                     |
| Phase Modulation –<br>Measure <sup>3</sup>                  | <b>100 kHz to 6.6 GHz</b><br>Deviations > 0.3 rad<br>Deviations > 0.7 rad<br><br><b>(6.6 to 13.2) GHz</b><br>Deviations > 0.6 rad<br>Deviations > 2.0 rad<br><br><b>(13.2 to 26.5) GHz</b><br>Deviations: > 1.2 rad<br>Deviations > 4.0 rad                                                                                                                                                                                             | 3 % of rdg + 0.002 rad<br>1 % of rdg + 0.002 rad<br><br>3 % of rdg + 0.005 rad<br>1 % of rdg + 0.005 rad<br><br>3 % of rdg + 0.009 rad<br>1 % of rdg + 0.009 rad |                                         | COS, HSV<br>MEL, ATL<br>RDU, RFD<br>TPA, SFL<br>HLR, HRT,<br>DFW |
|                                                             | <b>(26.5 to 31.15) GHz</b><br>Deviations: > 1.3 rad<br>Deviations > 4.0 rad<br><br><b>(31.15 to 50) GHz</b><br>Deviations: > 2.4 rad<br>Deviations > 8.0 rad                                                                                                                                                                                                                                                                            | 3 % of rdg + 0.009 rad<br>1 % of rdg + 0.009 rad<br><br>3 % of rdg + 0.018 rad<br>1 % of rdg + 0.018 rad                                                         |                                         | COS, HSV<br>MEL, ATL<br>RDU, RFD<br>TPA, DFW                     |

| Parameter/Range                      | Frequency                     | CMC <sup>2, 7</sup> (±) | Comment                              | Location <sup>10</sup>                                           |
|--------------------------------------|-------------------------------|-------------------------|--------------------------------------|------------------------------------------------------------------|
| PM Distortion – Measure <sup>3</sup> | <b>(1 to 6 600) MHz</b>       |                         |                                      |                                                                  |
|                                      | <b>Rate (20 to 500) Hz</b>    |                         |                                      |                                                                  |
|                                      | <b>Dev &gt; 0.8 rad</b>       |                         |                                      |                                                                  |
|                                      | (0 to -20) dB                 | 0.26 dB                 |                                      |                                                                  |
|                                      | (-20 to -30) dB               | 0.79 dB                 |                                      |                                                                  |
|                                      | (-30 to -40) dB               | 2.3 dB                  |                                      |                                                                  |
|                                      | <b>Dev &gt; 2.5 rad</b>       |                         |                                      |                                                                  |
|                                      | (0 to -20) dB                 | 0.09 dB                 |                                      |                                                                  |
|                                      | (-20 to -30) dB               | 0.27 dB                 |                                      |                                                                  |
|                                      | (-30 to -40) dB               | 0.83 dB                 |                                      |                                                                  |
|                                      | (-40 to -50) dB               | 2.4 dB                  |                                      |                                                                  |
|                                      | <b>Rate (500 to 1 000) Hz</b> |                         |                                      |                                                                  |
|                                      | <b>Dev &gt; 0.4 rad</b>       |                         |                                      |                                                                  |
|                                      | (0 to -20) dB                 | 0.26 dB                 |                                      |                                                                  |
|                                      | (-20 to -30) dB               | 0.79 dB                 |                                      |                                                                  |
|                                      | (-30 to -40) dB               | 2.3 dB                  |                                      |                                                                  |
|                                      | <b>Dev &gt; 1.0 rad</b>       |                         |                                      |                                                                  |
|                                      | (0 to -20) dB                 | 0.09 dB                 |                                      |                                                                  |
|                                      | (-20 to -30) dB               | 0.27 dB                 |                                      |                                                                  |
|                                      | (-30 to -40) dB               | 0.83 dB                 |                                      |                                                                  |
|                                      | (-40 to -50) dB               | 2.4 dB                  |                                      |                                                                  |
|                                      | <b>(6.6 to 13.2) GHz</b>      |                         |                                      |                                                                  |
|                                      | <b>Rate (20 to 500) Hz</b>    |                         |                                      |                                                                  |
|                                      | <b>Dev &gt; 1.8 rad</b>       |                         |                                      |                                                                  |
|                                      | (0 to -20) dB                 | 0.26 dB                 |                                      |                                                                  |
|                                      | (-20 to -30) dB               | 0.79 dB                 |                                      |                                                                  |
|                                      | (-30 to -40) dB               | 2.3 dB                  |                                      |                                                                  |
|                                      | <b>Dev &gt; 5.5 rad</b>       |                         |                                      |                                                                  |
|                                      | (0 to -20) dB                 | 0.09 dB                 |                                      |                                                                  |
|                                      | (-20 to -30) dB               | 0.27 dB                 |                                      |                                                                  |
|                                      | (-30 to -40) dB               | 0.83 dB                 |                                      |                                                                  |
|                                      | (-40 to -50) dB               | 2.4 dB                  |                                      |                                                                  |
|                                      | <b>Rate (500 to 1000) Hz</b>  |                         |                                      |                                                                  |
|                                      | <b>Dev &gt; 0.8 rad</b>       |                         |                                      |                                                                  |
|                                      | (0 to -20) dB                 | 0.26 dB                 |                                      |                                                                  |
|                                      | (-20 to -30) dB               | 0.79 dB                 |                                      |                                                                  |
|                                      | (-30 to -40) dB               | 2.3 dB                  |                                      |                                                                  |
|                                      | <b>Dev &gt; 2.5 rad</b>       |                         |                                      |                                                                  |
|                                      | (0 to -20) dB                 | 0.09 dB                 |                                      |                                                                  |
|                                      | (-20 to -30) dB               | 0.27 dB                 |                                      |                                                                  |
|                                      | (-30 to -40) dB               | 0.83 dB                 |                                      |                                                                  |
|                                      | (-40 to -50) dB               | 2.4 dB                  |                                      |                                                                  |
|                                      |                               |                         | Agilent N5531S<br>measuring receiver | COS, HSV<br>MEL, ATL<br>RDU, RFD<br>TPA, SFL<br>HLR, HRT,<br>DFW |



| Parameter/Range                      | Frequency                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | CMC <sup>2, 7</sup> (±)                                                                                                                                        | Comment                              | Location <sup>10</sup>                                           |
|--------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|------------------------------------------------------------------|
| PM Distortion – Measure <sup>3</sup> | <b>(13.2 to 26.5) GHz</b><br><b>Rate (20 to 500) Hz</b><br><b>Dev &gt; 3.5 rad</b><br>(0 to -20) dB<br>(-20 to -30) dB<br>(-30 to -40) dB<br><b>Dev &gt; 10.0 rad</b><br>(0 to -20) dB<br>(-20 to -30) dB<br>(-30 to -40) dB<br>(-40 to -50) dB<br><br><b>Rate (500 to 1000) Hz</b><br><b>Dev &gt; 1.2 rad</b><br>(0 to -20) dB<br>(-20 to -30) dB<br>(-30 to -40) dB<br><b>Dev &gt; 4.0 rad</b><br>(0 to -20) dB<br>(-20 to -30) dB<br>(-30 to -40) dB<br>(-40 to -50) dB   | 0.26 dB<br>0.79 dB<br>2.3 dB<br><br>0.09 dB<br>0.27 dB<br>0.83 dB<br>2.4 dB<br><br>0.26 dB<br>0.79 dB<br>2.3 dB<br><br>0.09 dB<br>0.27 dB<br>0.83 dB<br>2.4 dB | Agilent N5531S<br>measuring receiver | COS, HSV<br>MEL, ATL<br>RDU, RFD<br>TPA, SFL<br>HLR, HRT,<br>DFW |
|                                      | <b>(26.5 to 31.15) GHz</b><br><b>Rate (20 to 500) Hz</b><br><b>Dev &gt; 3.5 rad</b><br>(0 to -20) dB<br>(-20 to -30) dB<br>(-30 to -40) dB<br><b>Dev &gt; 10.0 rad</b><br>(0 to -20) dB<br>(-20 to -30) dB<br>(-30 to -40) dB<br>(-40 to -50) dB<br><br><b>Rate (500 to 1 000) Hz</b><br><b>Dev &gt; 1.2 rad</b><br>(0 to -20) dB<br>(-20 to -30) dB<br>(-30 to -40) dB<br><b>Dev &gt; 4.0 rad</b><br>(0 to -20) dB<br>(-20 to -30) dB<br>(-30 to -40) dB<br>(-40 to -50) dB | 0.26 dB<br>0.79 dB<br>2.3 dB<br><br>0.09 dB<br>0.27 dB<br>0.83 dB<br>2.4 dB<br><br>0.26 dB<br>0.79 dB<br>2.3 dB<br><br>0.09 dB<br>0.27 dB<br>0.83 dB<br>2.4 dB |                                      | MEL, RFD<br>TPA, HSV<br>COS, RDU,<br>DFW                         |

| Parameter/Range                                                                                                                  | Frequency                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | CMC <sup>2</sup> (±)                                                                                                                                           | Comment                                                                                                                                           | Location <sup>10</sup>                   |
|----------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|
| PM Distortion – Measure <sup>3</sup>                                                                                             | <b>(31.15 to 50.0) GHz</b><br><b>Rate 20 to 500 Hz</b><br><b>Dev &gt; 7.5 rad</b><br>(0 to -20) dB<br>(-20 to -30) dB<br>(-30 to -40) dB<br><b>Dev &gt; 19.0 rad</b><br>(0 to -20) dB<br>(-20 to -30) dB<br>(-30 to -40) dB<br>(-40 to -50) dB<br><br><b>(31.15 to 50.0) GHz</b><br><b>Rate (500 to 1 000) Hz</b><br><b>Dev &gt; 3.0 rad</b><br>(0 to -20) dB<br>(-20 to -30) dB<br>(-30 to -40) dB<br><br><b>Dev &gt; 8.0 rad</b><br>(0 to -20) dB<br>(-20 to -30) dB<br>(-30 to -40) dB<br>(-40 to -50) dB | 0.26 dB<br>0.79 dB<br>2.3 dB<br><br>0.09 dB<br>0.27 dB<br>0.83 dB<br>2.4 dB<br><br>0.26 dB<br>0.79 dB<br>2.3 dB<br><br>0.09 dB<br>0.27 dB<br>0.83 dB<br>2.4 dB | Agilent N5531S<br>measuring receiver                                                                                                              | MEL, RFD<br>TPA, HSV<br>COS, RDU,<br>DFW |
| Return Loss (VSWR)<br>5 Hz to 45 MHz<br>45 MHz to 50 GHz                                                                         | (0 to 40) dB<br>(0 to 40) dB                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 1.1 dB<br>0.41 dB                                                                                                                                              | HP 8751A, HP 85107B<br>network analyzers                                                                                                          | TPA                                      |
| ISN –<br>Relative Amplitude (dB)<br>Insertion Loss<br><br>Impedance Magnitude ( $\Omega$ )<br><br>Impedance Phase ( $^{\circ}$ ) | <b>(0 to 120) dB</b><br>150 kHz to 80 MHz<br><br><b>(0 to 1) k<math>\Omega</math></b><br>150 kHz to 80 MHz<br><br><b>(-180 to 180)<math>^{\circ}</math></b><br>150 kHz to 80 MHz                                                                                                                                                                                                                                                                                                                             | 0.59 dB<br><br>2 % of rdg<br><br>1.8 $^{\circ}$                                                                                                                | CISPR 22, CISPR 32,<br>CISPR 16-1-2<br>HP 8751A network<br>analyzer & HP 87512A<br>transmission/reflection<br>test set, 85032B<br>calibration kit |                                          |

| Parameter/Range                                                                                                                                                                                                                                            | Frequency                                                                                                                                                                                                                                                                                                     | CMC <sup>2</sup> (±)                                                                                   | Comment                                                                                                                                             | Location <sup>10</sup> |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| CDN's & Adapters –<br>(50 to 150) $\Omega$<br><br>Relative Amplitude (dB)<br>Adapter Insertion Loss<br><br>Relative Amplitude (dB)<br>Coupling Factor<br><br>Impedance Magnitude<br>( $\Omega$ )<br><br>Relative Amplitude (dB)<br>Voltage Division Factor | <b>(0 to 120) dB</b><br>10 kHz to 230 MHz<br><br><b>(0 to 120) dB</b><br>10 kHz to 230 MHz<br><br><b>(0 to 1) k<math>\Omega</math></b><br>10 kHz to 230 MHz<br><br><b>(0 to 120) dB</b><br>10 kHz to 230 MHz                                                                                                  | 1.3 dB<br><br>1.3 dB<br><br>2 % rdg<br><br>0.59 dB                                                     | IEC/EN 61000-4-6<br>CISPR 16-1-2<br>HP 8751A network<br>analyzer & HP<br>87512A<br>transmission/reflection<br>test set, 85032B<br>calibration kit   | TPA                    |
| LISN –<br><br>Relative Amplitude (dB)<br>Insertion Loss<br><br>Impedance Magnitude ( $\Omega$ )<br><br>Impedance – Phase ( $^{\circ}$ )<br><br>Relative Amplitude (dB)<br>Isolation                                                                        | <b>(0 to 120) dB</b><br>9 kHz to 100 MHz<br>(100 to 300) MHz<br>(300 to 500) MHz<br><br><b>(0 to 1) k<math>\Omega</math></b><br>9 kHz to 500 MHz<br><br><b>(-180 to 180)<math>^{\circ}</math></b><br>9 kHz to 500 MHz<br><br><b>(0 to 120) dB</b><br>9 kHz to 100 MHz<br>(100 to 300) MHz<br>(300 to 500) MHz | 0.59 dB<br>1.3 dB<br>1.8 dB<br><br>2 % of rdg<br><br>1.8 $^{\circ}$<br><br>0.59 dB<br>1.3 dB<br>1.8 dB | ANSI C63.4, CISPR<br>25, CISPR 16-1-2<br>HP 8751A network<br>analyzer & HP 87512A<br>transmission/reflection<br>test set, 85032B<br>calibration kit |                        |
| Current Probes & Bulk<br>Current Injection Probes<br>Insertion Loss & Transfer<br>Impedance Relative<br>Amplitude (dB)                                                                                                                                     | <b>(0 to 120) dB</b><br>20 Hz to 100 MHz<br>(100 to 300) MHz<br>(300 to 500) MHz                                                                                                                                                                                                                              | 0.59 dB<br>1.3 dB<br>1.8 dB                                                                            | CISPR 16-1-2<br>IEC/EN 61000-4-6<br>HP 8751A network<br>analyzer & HP 87512A<br>transmission/reflection<br>test set, 85032B<br>calibration kit      |                        |
| EFT/Burst Generator –<br><br>Voltage (+/-)<br>Risetime<br>Impulse Duration<br>Burst Duration<br>Burst Period                                                                                                                                               | 10 V to 8 kV<br>5 ns +/- 30 %<br>50 ns +/- 30 %<br>15 ms +/- 20 %<br>300 ms +/- 20 %                                                                                                                                                                                                                          | 2.6 % of rdg<br>0.003 % of rdg<br>0.003 % of rdg<br>0.003 % of rdg<br>0.003 % of rdg                   | IEC/EN 61000-4-4<br>Tektronix TDS784C<br>oscilloscope, EFT<br>attenuator set                                                                        | COS                    |



| Parameter/Equipment                                                                                                                                                                                               | Range                                                                                                                                 | CMC <sup>2</sup> (±)                                                                                                         | Comment                                                                                                                                                                                                                                | Location <sup>10</sup> |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| Surge Generator –<br>Front Time (+/-)<br>Risetime<br>Open/Short Circuit (+/-)<br>Time to Half Value (+/-)<br>Open Circuit Voltage (+/-)<br>Short Circuit Voltage (+/-)<br>Ring Wave Voltage<br>Ring Wave Risetime | (0.1 to 50) µs<br>(0.1 to 50) µs<br><br>(20 to 1 500) µs<br>10 V to 8 kV<br>(0.125 to 3) kA<br><br>1 kV +/- 10 %<br>1.5 µs +/- 0.5 µs | 0.008 % of rdg<br>0.008 % of rdg<br><br>0.008 % of rdg<br>2.9 % of rdg<br>2.9 % of rdg<br><br>2.9 % of rdg<br>0.008 % of rdg | IEC/EN 61000-4-5<br>IEC/EN 61000-4-8<br>IEC/EN 61000-4-9<br>IEC/EN 61000-4-10<br>IEC/EN 61000-4-11<br>IEC/EN 61000-4-12<br>Tektronix TDS784C<br>Oscilloscope,<br>Tektronix P5210 high<br>voltage probe<br>Pearson 411 current<br>probe | COS                    |
| Source Errors for CISPR<br>Bands A, B, C & D for<br>Impulse Spectral Amplitude<br>Absolute Amplitude Pulse<br>Response & Relative Ratio                                                                           | <b>Band A (0 to 120) dB</b><br>(10 to 150) kHz<br><br><b>Band B (0 to 120) dB</b><br>(0.15 to 30) MHz                                 | 0.82 dB<br><br>0.82 dB                                                                                                       | IGUU 2918 pulse<br>generator CISPR 16-1-<br>1<br>signal generator,<br>Agilent 33250A<br>waveform generator                                                                                                                             |                        |
| Source Errors for CISPR<br>Bands A, B, C & D for<br>Impulse Spectral Amplitude<br>Absolute Amplitude Pulse<br>Response & Relative Ratio                                                                           | <b>Band C &amp; D</b><br>(0 to 120) dB<br>(30 to 1 000) MHz<br>(0 to 120) dB<br><b>Band E</b><br>(1 to 18) GHz                        | 1.5 dB<br><br>0.77 dB                                                                                                        | IGUU 2918 pulse<br>generator CISPR 16-1-<br>1<br>signal generator,<br>Agilent 33250A<br>waveform generator                                                                                                                             |                        |
| Source Errors for Sinewave<br>output for CISPR Checks<br>(at 60 dBµV)<br>Absolute Amplitude                                                                                                                       | <b>60 dBµV</b><br>Band A through D<br>Band E                                                                                          | 0.58 dB<br>0.58 dB                                                                                                           | CISPR 16-1-1<br>Agilent E8257D signal<br>generator, Agilent<br>33250A waveform<br>generator                                                                                                                                            |                        |
| QuasiPeak to Peak &<br>Average Detector Response<br>Relative Amplitude Ratio                                                                                                                                      | <b>(-60 to 60) dB</b><br>Band A through D                                                                                             | 1.3 dB                                                                                                                       | IGUU 2918 pulse<br>generator                                                                                                                                                                                                           |                        |
| Return Loss (VSWR)<br><br>30 kHz to 6 GHz<br><br>6 GHz to 18 GHz                                                                                                                                                  | <br>(0 to 80) dB<br><br>(0 to 50) dB                                                                                                  | <br>2.4 dB<br><br>0.32 dB                                                                                                    | <br>Agilent 8753ES<br>network analyzers,<br>Wiltron 87A50<br>VSWR bridge                                                                                                                                                               |                        |
| ESD Simulators<br><br>Contact Voltage<br>(Positive & Negative)<br><br>Risetime<br>Peak Current<br>30 ns Current<br>60 ns Current                                                                                  | <br>(0 to 20) kV<br>(20 to 30) kV<br><br>(0 to 5) ns<br>(0 to 60) A<br>(0 to 60) A<br>(0 to 60) A                                     | <br>1.2 % of rdg + 2V<br>1.2 % of rdg + 20V<br><br>31.5 ps<br>2.1 % of rdg<br>2.9 % of rdg<br>6.3 % of rdg                   | IEC 61000-4-2<br>ISO 10605<br>MIL STD 331<br><br>ESVM<br><br>Agilent 54855A<br>oscilloscope, IEC ESD<br>target                                                                                                                         |                        |



# VII. Mechanical

| Parameter/Equipment                                                                                                                                                                                                       | Range                                                                                                                                                                                                                                                                                                                          | CMC <sup>2</sup> (±)                                                                                                                                                                                                                                                                                                                                                                                                                                  | Comment                                                                                                                                                                                                                                                                         | Location <sup>10</sup>                                                                               |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|
| Accelerometers –<br><br>(7 < 10) Hz<br>(10 < 30) Hz<br>(30 < 2000) Hz<br>(2 to 10) kHz<br><br>(7 < 10) Hz<br>(10 < 30) Hz<br>(30 < 2000) Hz<br>(2 to 10) kHz<br><br>(7 to 100) Hz<br>(100 to 2 500) Hz<br>(2.5 to 10) kHz | (0.01 to 10) g<br><br>(0.01 to 10) g<br><br>(1.01 to 10) g                                                                                                                                                                                                                                                                     | 2 % of rdg<br>1.5 % of rdg<br>1 % of rdg<br>2.5 % of rdg<br><br>4 % of rdg<br>3 % of rdg<br>1.5 % of rdg<br>4 % of rdg<br><br>1.5 % of rdg<br>1.2 % of rdg<br>2.5 % of rdg                                                                                                                                                                                                                                                                            | Accelerometer calibrator<br><br><br><br><br>Portable vibration calibrator<br><br><br><br><br>Accelerometer calibrator                                                                                                                                                           | TPA<br><br><br><br><br>ATL, HRT, HLR, SFL, MEL, COS<br><br><br><br><br>HSV                           |
| Accelerometers –<br><br>(7 < 10) Hz<br>(10 < 100) Hz<br>(100 to 920) Hz<br>(> 920 to 5000) Hz<br>(> 5 to 10) kHz                                                                                                          | (0.2 to 1) g                                                                                                                                                                                                                                                                                                                   | 1.7 % of rdg<br>1.2 % of rdg<br>1 % of rdg<br>1.4 % of rdg<br>1.9 % of rdg                                                                                                                                                                                                                                                                                                                                                                            | Accelerometer calibrator                                                                                                                                                                                                                                                        | RFD                                                                                                  |
| Scales & Balances <sup>3</sup>                                                                                                                                                                                            | 1 mg to 5000 g<br>(0.001 to 100) lb<br><br>Up to 1 000 lb<br><br>1 g to 40 kg<br><br>Up to 1100 lb<br>Up to 500 kg<br><br>1 mg to 600 g<br>1 mg to 22 Kg<br><br>10 mg to 40 kg<br>(0.022 to 2000) lb<br><br>1 mg to 220 g<br><br>Up to 1000 lb<br>Up to 454 kg<br><br>500 mg to 15 kg<br><br>Up to 28 kg<br><br>Up to 1 600 lb | (0.049 + 0.003X) mg<br>(3.2 E <sup>-6</sup> + 3.1 E <sup>-6</sup> W) lb<br><br>(0.000 2 + 0.000 12W) lb<br><br>(0.042 + 0.0045X) mg<br><br>(0.0003 + 0.000 12W) lb<br>(0.13 + 0.00012X) g<br><br>(0.014 + 0.001 5X) mg<br>(0.04 + 0.003 1X) mg<br><br>(7.7 + 0.12X) mg<br>(0.000 04 + 0.000 12W) lb<br><br>(0.048 + 0.003 1X) mg<br><br>(0.000 12W) lb<br>(0.000 12X) g<br><br>(1 + 0.0042X) mg<br><br>(8.5 + 0.12X) mg<br><br>(0.005 + 0.000 13W) lb | Class 1 weights<br><br>Class F weights<br><br>Class 1 weights<br>Class F weights<br><br>Class 0 weights<br>Class 1 weights<br><br>Class F weights<br><br>ASTM E617 Class 1 weights<br>NIST Class F weights<br><br>Class 1 & 2 weights<br>Class F & 2 weights<br>Class F weights | TPA, RFD<br><br><br><br><br>ATL<br><br><br><br><br>HSV<br><br><br><br><br>HRT<br><br><br><br><br>HLR |



| Parameter/Equipment                           | Range                                           | CMC <sup>2</sup> (±)                                  | Comment                                | Location <sup>10</sup> |
|-----------------------------------------------|-------------------------------------------------|-------------------------------------------------------|----------------------------------------|------------------------|
| Scales & Balances <sup>3</sup><br>(continued) | 0.01 g to 10 kg<br>Up to 400 lb<br>Up to 181 kg | (0.15 + 0.003X) mg<br>(0.000 12W) lb<br>(0.000 12X) g | Class 1 weights<br>Class F weights     | SFL, DFW<br>SFL        |
|                                               | (1 to 400) g                                    | (0.001 5X + 0.019) mg                                 | Class 0 weights                        | MEL                    |
|                                               | (1 to 1000) g<br>(1000 to 40 000) g             | (0.0031X + 0.04) mg<br>(0.003 3X) mg                  | Class 1 weights                        |                        |
|                                               | (1 to 9100) g<br>(0.002 to 1000) lb             | (0.12X + 9.3) mg<br>(0.000 12W + 0.000 04) lb         | Class F weights                        |                        |
|                                               | 1 mg to 420 g                                   | (0.021 + 0.003 4X) mg                                 | Class 1 weights                        | COS, DFW               |
|                                               | Up to 100 kg<br>Up to 1000 lb                   | (0.0017 + 0.000 12X) g<br>(0.0021 + 0.000 12W) lb     | Class F weights                        |                        |
|                                               | 500 g to 41 kg                                  | (0.015 + 0.024X) mg                                   | Class 1 Weights                        | COS                    |
|                                               | 1 g to 11 kg<br>(0.001 to 71) lb                | (0.16 + 0.003 X) mg<br>(0.000 004 7 W) lb             | Class 6 Weights                        | RDU                    |
|                                               | 1 g to 11 kg<br>0.02 (0.001 to 531) lb          | (0.75 + 0.12 X) mg<br>(0.000 12 W) lb                 |                                        |                        |
| Banding Tools                                 | Up to 180 lbf                                   | 1.2 lbf                                               | Glenair Bandmaster calibration fixture | MEL, COS               |

| Parameter/Equipment                    | Range                                                                                       | CMC <sup>2,4</sup> (±)                                                                                                                  | Comment                                                      | Location <sup>10</sup> |
|----------------------------------------|---------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|------------------------|
| Force                                  |                                                                                             |                                                                                                                                         |                                                              |                        |
| Tension & Compression                  | (0.5 to 750) lbf                                                                            | 0.09 % of rdg                                                                                                                           | Class F weights <sup>3</sup>                                 | TPA                    |
|                                        | (20 to 1000) lbf<br>(200 to 10 000) lbf<br>(10 000 to 25 000) lbf<br>(25 000 to 50 000) lbf | The greater of:<br>0.012 % of rdg or 0.023 lbf<br>0.012 % of rdg or 0.24 lbf<br>0.012 % of rdg or 0.5 lbf<br>0.012 % of rdg or 0.77 lbf | Morehouse press with load cells                              |                        |
|                                        | 10 mgf to 540 lbf                                                                           | 0.061 % of rdg                                                                                                                          | Class 1 & Class F weights <sup>3</sup>                       | ATL                    |
|                                        | (0.01 to 500) lbf                                                                           | 0.063 % of rdg                                                                                                                          | Class F weights <sup>3</sup>                                 | RFD                    |
|                                        | (50 to 2000) lbf<br>(200 to 10 000) lbf<br>(500 to 25 000) lbf                              | 0.068 % of rdg<br>0.044 % of rdg<br>0.087 % of rdg                                                                                      | Morehouse press with load cells                              |                        |
|                                        | Up to 10 kgf<br>(0.1 to 300) lbf                                                            | (6.1 + 0.002 9X) mg<br>0.086 % of rdg                                                                                                   | Class 1 weights <sup>3</sup><br>Class F weights <sup>3</sup> | SFL                    |
|                                        | (0.5 to 500) lbf                                                                            | 0.06 % of rdg                                                                                                                           | Class F weights <sup>3</sup>                                 | MEL                    |
|                                        | (0.5 to 500) lbf                                                                            | 0.02 % of rdg                                                                                                                           | Class F weights <sup>3</sup>                                 | COS, RDU, DFW          |
|                                        | (200 to 25 000) lbf                                                                         | 0.017 % of rdg                                                                                                                          | Morehouse load cells <sup>3</sup>                            | COS                    |
|                                        | (0.5 to 500) lbf<br>220 gf to 23 kgf                                                        | (0.000 06 + 0.000 12W) lbf <sup>2</sup><br>(0.03 + 0.000 12M) g <sup>2</sup>                                                            | Class F weights <sup>3</sup>                                 | HRT                    |
| Tension                                | (1000 to 50 000) lbf                                                                        | 0.021 % of rdg                                                                                                                          | Morehouse load cells                                         | HSV                    |
|                                        | (10 to 200) mgf<br>(0.2 to 1) gf<br>(1 to 10) gf<br>(10 to 500) gf<br>(1 to 540) lbf        | 0.45 mgf<br>1.2 mgf<br>0.037 % of rdg<br>0.024 % of rdg<br>0.017 % of rdg                                                               | Class F weights <sup>3</sup>                                 |                        |
| Compression                            | (200 to 10 000) lbf<br>(500 to 25 000) lbf<br>(1000 to 50 000) lbf                          | 0.014 % of rdg<br>0.018 % of rdg<br>0.034 % of rdg                                                                                      | Morehouse load cells                                         |                        |
| Force Gages, Load Cells & Dynamometers |                                                                                             |                                                                                                                                         |                                                              |                        |
| Tension/Compression                    | 10 g to 10 kg<br>(0.5 to 500) lb                                                            | 0.024 % of rdg<br>0.031 % of rdg                                                                                                        | Class F weights <sup>3</sup>                                 | HLR                    |

| Parameter/Equipment              | Range                                        | CMC <sup>2,9</sup> (±)                                              | Comment                                                                         | Location <sup>10</sup> |
|----------------------------------|----------------------------------------------|---------------------------------------------------------------------|---------------------------------------------------------------------------------|------------------------|
| Pressure – Generate <sup>3</sup> | (0 to 24) inH <sub>2</sub> O                 | 0.001 5 inH <sub>2</sub> O                                          | Dwyer 1425-25 hook gage                                                         | TPA                    |
|                                  | (60 to 110) kPa<br>(8.7 to 16) psia          | 0.027 kPa<br>0.004 psi                                              | ADT783 pressure controller ADT151-BP                                            |                        |
|                                  | (-15 to 15) psi<br>(> 15 to 30) psi          | 0.0018 psi<br>0.012 % of rdg                                        | ADT783 pressure controller ADT151-01RD-CP30M                                    |                        |
|                                  | (-15 to 150) psi<br>(> 150 to 300) psi       | 0.0018 psi<br>0.012 % of rdg                                        | ADT783 pressure controller ADT151-01RD-CP300M                                   |                        |
|                                  | (-15 to 500) psi<br>(> 500 to 1000) psi      | 0.059 psi<br>0.012 % of rdg                                         | ADT783 pressure controller with ADT151-01RD-CP1KM                               |                        |
|                                  | (10 to 16 000) psi                           | 0.019 % of rdg                                                      | Fluke P3125-PSI dead weight tester                                              |                        |
|                                  | (16 000 to 40 000) psi                       | 25 psi                                                              | Additel ADT672-10-GP40K Pressure Calibrator                                     |                        |
|                                  | (0 to 30) inH <sub>2</sub> O                 | The greater of<br>0.0073 % of rdg or<br>0.000 55 inH <sub>2</sub> O | Ruska 7250LP                                                                    | ATL                    |
|                                  | (0 to 23) psia<br>(0 to 30) inHg             | 0.005 psi<br>0.01 inHg                                              | Paroscientific 760-23A                                                          |                        |
|                                  | (-15 to 300) psig<br>(-15 to 1000) psig      | 0.07 psi<br>0.24 psi                                                | Additel ADT761A-1K                                                              |                        |
|                                  | (10 to 16 000) psi                           | The greater of<br>0.019 % of rdg or<br>0.0075 psi                   | Fluke P3125-PSI deadweight tester                                               |                        |
|                                  | (10 to 16 000) psi                           | 0.019 % of rdg                                                      | Dead weight Fluke P3125                                                         | RFD                    |
|                                  | (-14.75 to 1015) psig<br>(0.75 to 1015) psia | 0.002 % of rdg                                                      | Fluke PG7601 piston gauge, PC-7100/7600-1 PC-7200-2 & PC-7300-5 piston-cylinder | ATL                    |
|                                  | (60 to 13 000) psig<br>(72 to 13 000) psia   | 0.0035 % of rdg                                                     |                                                                                 |                        |
|                                  | (145 to 29 000) psig<br>(160 to 29 000) psia | 0.0035 % of rdg                                                     |                                                                                 |                        |
|                                  | (0 to 12) inH <sub>2</sub> O                 | 0.0025 inH <sub>2</sub> O                                           | Dwyer 1425-25 hook gage                                                         | HLR                    |



| Parameter/Equipment                        | Range                                     | CMC <sup>2,9</sup> (±)          | Comment                                                  | Location <sup>10</sup> |
|--------------------------------------------|-------------------------------------------|---------------------------------|----------------------------------------------------------|------------------------|
| Pressure – Generate <sup>3</sup><br>(cont) | (10 to 500) psi<br>(200 to 10 000) psi    | 0.008 % of rdg<br>0.01 % of rdg | *Whichever is greater<br>Fluke P3224-PSI                 | MEL                    |
|                                            | (0.2 to 1000) psi                         | 0.0022 % of rdg                 | Ruska 2468A deadweight tester                            | SFL                    |
|                                            | Up to 2900 psig<br>Up to 10 000 psig      | 0.37 psi<br>1.3 psi             | ADT 762                                                  | COS                    |
|                                            | (0.01 to 17.4) psia                       | *0.00073 psi or<br>0.0084 % rdg | Fluke 6270A pressure controller & modules<br>PM500-A120K | COS, DFW               |
|                                            | (-15 to 15) psi                           | 0.00088 psi                     | PM500-BG100K                                             |                        |
|                                            | (0 to 30) psi                             | *0.0012 psi or<br>0.0083 % rdg  | PM500-G200K                                              |                        |
|                                            | (0 to 100) psi                            | *0.0043 psi or<br>0.0083 % rdg  | PM500-G700K                                              |                        |
|                                            | (-15 to 600) psi                          | *0.025 psi or<br>0.0084 % rdg   | PM500-BG4M                                               |                        |
|                                            | (-15 to 1500) psi                         | *0.062 psi or<br>0.0084 % rdg   | PM500-BG10M                                              |                        |
|                                            | (0 to 6000) psi<br>(0 to 15 000) psi      | 0.72 psi<br>2 psi               | ADT783 w/<br>ADT151-01-GP15K                             |                        |
|                                            | (60 to 110) kPa<br>(8.7 to 16) psia       | 0.027 kPa<br>0.004 psi          | ADT783 w/ ADT151-BP                                      | RDU                    |
|                                            | (-15 to 15) psi<br>(> 15 to 100) psi      | 0.005 9 psi<br>0.012 % of rdg   | ADT783 pressure controller w ADT151-BP                   |                        |
|                                            | (-15 to 150) psi<br>(> 150 to 300) psi    | 0.018 psi<br>0.012 % of rdg     | ADT783 pressure controller w/ ADT151-01RD-CP100M         |                        |
|                                            | (-15 to 500) psi<br>(> 500 to 1000) psi   | 0.059 psi<br>0.012 % of rdg     | ADT783 w/ ADT151-01RD-CP300M                             |                        |
|                                            | (-15 to 1800) psi<br>(> 1800 to 3600) psi | 0.059 psi<br>0.012 % of rdg     | ADT783 pressure controller w/ ADT151-01RD-CP1KM          |                        |

| Parameter/Equipment             | Range                            | CMC <sup>2, 9</sup> (±)    | Comment                           | Location <sup>10</sup> |
|---------------------------------|----------------------------------|----------------------------|-----------------------------------|------------------------|
| Pressure – Measure <sup>3</sup> | (-150 to 150) inH <sub>2</sub> O | 0.07 inH <sub>2</sub> O    | Additel ADT686-DP150,             | ATL                    |
|                                 | (0 to 30) psig                   | 0.007 psi                  | Additel ADT686-GP30               |                        |
|                                 | (0 to 50) psia                   | 0.029 psi                  | Additel ADT681-05-AP50            |                        |
|                                 | (0 to 150) psia                  | 0.093 psi                  | Additel ADT681-05-AP150           |                        |
|                                 | (0 to 5000) psig                 | 1.2 psi                    | Additel ADT686-GP5K,              |                        |
|                                 | (0 to 10 000) psig               | 2.3 psi                    | Additel ADT686-GP10K              |                        |
|                                 | (0 to 30) psia                   | 0.018 psi                  | Fluke 700GA5                      | HSV                    |
|                                 | (0 to 61) inHg                   | 0.037 inHg                 |                                   |                        |
|                                 | (-15 to 15) psi                  | 0.007 psi                  | Additel 681-GP15                  |                        |
|                                 | (0 to 30) psi                    | 0.009 psi                  | Additel 681-GP30                  |                        |
|                                 | (-15 to 100) psi                 | 0.027 psi                  | Additel 681- GP100                |                        |
|                                 | (0 to 300) psi                   | 0.08 psi                   | Additel 681- GP300                |                        |
|                                 | (0 to 1000) psi                  | 0.24 psi                   | Additel 681- GP1K                 |                        |
|                                 | (0 to 3000) psi                  | 0.7 psi                    | Additel 681- GP3K                 |                        |
|                                 | (0 to 10 000) psi                | 2.5 psi                    | Additel 681- GP10K                |                        |
|                                 | (-150 to 150) inH <sub>2</sub> O | 0.094 inH <sub>2</sub> O   | Additel 681-DP150                 |                        |
|                                 | (-20 to 20) inH <sub>2</sub> O   | 0.013 inH <sub>2</sub> O   | Additel 681-DP20                  |                        |
|                                 | (-1 to 1) inH <sub>2</sub> O     | 0.001 5 inH <sub>2</sub> O | ADT681-05-DP1-inH <sub>2</sub> O  | RFD                    |
|                                 | (-5 to 5) inH <sub>2</sub> O     | 0.008 inH <sub>2</sub> O   | ADT681-05-DP5-inH <sub>2</sub> O  |                        |
|                                 | (-50 to 50) inH <sub>2</sub> O   | 0.061 inH <sub>2</sub> O   | ADT681-05-DP50-inH <sub>2</sub> O |                        |
|                                 | (-15 to 0) psi                   | 0.008 9 psi                | Fluke 2700G-BG100K                |                        |
|                                 | (0 to 15) psi                    | 0.004 psi                  | Fluke 2700G-BG100K                |                        |
|                                 | (0 to 30) psi                    | 0.007 8 psi                | Additel ADT681-GP30               |                        |
|                                 | (0 to 100) psi                   | 0.028 psi                  | Fluke 2700G-BG700K                |                        |
|                                 | (0 to 300) psi                   | 0.064 psi                  | Fluke 2700G-BG2M                  |                        |
|                                 | (0 to 1000) psi                  | 0.23 psi                   | Fluke 2700G-BG7M                  |                        |
|                                 | (0 to 3000) psi                  | 0.97 psi                   | Additel ADT681-GP3K               |                        |
|                                 | (0 to 10 000) psi                | 3.3 psi                    | Additel ADT681-GP10K              |                        |
|                                 | (-1 to 1) inH <sub>2</sub> O     | 0.004 inH <sub>2</sub> O   | Additel ADT155-DPI-760            | HRT                    |
|                                 | (-15 to 100) psig                | 0.027 psi                  | ADT681-02-GP100-PSI               |                        |
|                                 | Up to 500 psig                   | 0.12 psi                   | ADT681-02-GP500-PSI               |                        |
|                                 | Up to 1000 psig                  | 0.26 psi                   | ADT681-02-GP1K-PSI                |                        |
|                                 | Up to 10 000 psig                | 2.5 psi                    | ADT681-02-GP10K-PSI               |                        |
|                                 | (0 to 15) psi                    | 0.004 psi                  | Additel 681                       | HLR                    |
|                                 | (-15 to 100) psi                 | 0.03 psi                   | ADT681-02-GP15-PSI                |                        |
|                                 | (0 to 500) psi                   | 1.2 psi                    | ADT681-02-CP100-PSI               |                        |
|                                 | (0 to 10 000) psi                | 2.3 psi                    | ADT681-20-GP500-PSI               |                        |
|                                 |                                  |                            | ADT681-02-GP10K-PS                |                        |

| Parameter/Equipment                       | Range                                                                         | CMC <sup>2,9</sup> (±)                                                                                       | Comment                            | Location <sup>10</sup> |
|-------------------------------------------|-------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|------------------------------------|------------------------|
| Pressure – Measure <sup>3</sup><br>(cont) | (-1 to 1) inH <sub>2</sub> O                                                  | 0.0017 inH <sub>2</sub> O                                                                                    | Additel ADT681-05-DP1              | MEL                    |
|                                           | (-50 to 50) inH <sub>2</sub> O                                                | 0.058 inH <sub>2</sub> O                                                                                     | Additel ADT681-05-DP50             |                        |
|                                           | (-30 to 0) inHg                                                               | 0.022 inHg                                                                                                   | Additel ADT681-02-CP30             |                        |
|                                           | (-15 to 30) psi                                                               | 0.011 psi                                                                                                    | Additel ADT681-02-CP30             |                        |
|                                           | (0 to 100) psi                                                                | 0.032 psi                                                                                                    | Additel ADT681-02-GP100            |                        |
|                                           | (0 to 300) psi                                                                | 0.07 psi                                                                                                     | Additel ADT681-02-GP300            |                        |
|                                           | (0 to 500) psi                                                                | 0.12 psi                                                                                                     | Additel ADT681-02-GP500            |                        |
|                                           | (0 to 1000) psi                                                               | 0.3 psi                                                                                                      | Additel ADT681-02-GP1K             |                        |
|                                           | (0 to 3000) psi                                                               | 0.9 psi                                                                                                      | Additel ADT681-02-GP3K             |                        |
|                                           | (0 to 5000) psi                                                               | 1.5 psi                                                                                                      | Additel ADT681-02-GP5K             |                        |
|                                           | (0 to 15 000) psi                                                             | 8.7 psi                                                                                                      | Additel ADT681-05-GP15K            |                        |
|                                           | (-15 to 100) psi                                                              | 0.082 psi                                                                                                    | Fluke 74x w/700PD6 pressure module | SFL                    |
|                                           | (0 to 500) psi                                                                | 0.31 psi                                                                                                     | Fluke 700G07                       |                        |
|                                           | (-150 to 150) inH <sub>2</sub> O                                              | 0.07 inH <sub>2</sub> O                                                                                      | Additel 681                        |                        |
|                                           | (0 to 15) psi                                                                 | 0.004 psi                                                                                                    |                                    |                        |
|                                           | (0 to 100) psi                                                                | 0.02 psi                                                                                                     |                                    |                        |
|                                           | (0 to 1000) psi                                                               | 0.6 psi                                                                                                      |                                    | COS                    |
|                                           | (0 to 10 000) psi                                                             | 5.9 psi                                                                                                      |                                    |                        |
|                                           | (-150 to 150) inH <sub>2</sub> O                                              | 0.07 inH <sub>2</sub> O                                                                                      | ADT681-02-DP150                    |                        |
|                                           | Up to 30 psia                                                                 | 0.035 psi                                                                                                    | ADT681-10AP30                      |                        |
|                                           | (-30 to 0) inHg                                                               | 0.023 inHg                                                                                                   | ADT681-02-CP30                     |                        |
|                                           | (-15 to 30) psig                                                              | 0.011 psi                                                                                                    | ADT681-02-CP30                     |                        |
|                                           | Up to 100 psig                                                                | 0.025 psi                                                                                                    | ADT681-02-GP100                    |                        |
|                                           | (-15 to 300) psig                                                             | 0.077 psi                                                                                                    | ADT681-02-CP300                    |                        |
|                                           | Up to 1000 psig                                                               | 0.25 psi                                                                                                     | ADT681-02-GP1K                     |                        |
|                                           | Up to 5000 psig                                                               | 1.5 psi                                                                                                      | ADT681-02-GP5K                     |                        |
|                                           | Up to 10 000 psig                                                             | 3.1 psi                                                                                                      | ADT681-02-GP10K                    |                        |
|                                           | Up to 15 000 psig                                                             | 3.6 psi                                                                                                      | ADT681-05-GP15K                    |                        |
|                                           | (-150 to 150) inH <sub>2</sub> O                                              | 0.07 inH <sub>2</sub> O                                                                                      | Additel 681                        | DFW                    |
|                                           | (-30 to 0) inHg                                                               | 0.023 inHg                                                                                                   | ADT681A-02-DP150                   |                        |
|                                           | (-15 to 30) psig                                                              | 0.011 psi                                                                                                    | ADT681-02-CP30                     |                        |
|                                           | (-15 to 300) psig                                                             | 0.025 psi                                                                                                    | ADT681-02-CP30                     |                        |
|                                           | Up to 100 psig                                                                | 0.077 psi                                                                                                    | ADT681-02-GP100                    |                        |
|                                           | Up to 1000 psig                                                               | 0.25 psi                                                                                                     | ADT681-02-CP300                    |                        |
|                                           | Up to 1000 psig                                                               | 0.25 psi                                                                                                     | ADT681-02-GP1K                     |                        |
|                                           | Up to 5000 psig                                                               | 1.5 psi                                                                                                      | ADT681-02-GP5K                     |                        |
|                                           | Up to 10 000 psig                                                             | 3.1 psi                                                                                                      | ADT681-02-GP10K                    |                        |
|                                           | Up to 15 000 psig                                                             | 3.6 psi                                                                                                      | ADT681-05-GP15K                    |                        |
| Rotary Torque - Angle<br><sub>3</sub>     | (0 to 360)°                                                                   | 24 arc sec                                                                                                   | Rotary encoder                     | COS                    |
| Vacuum Gages                              | (100 to 1000) torr<br>(10 to 100) torr<br>(1 to 10) torr<br>(10 to 100) mtorr | 0.084 % rdg + 0.25 torr<br>0.093 % rdg + 0.025 torr<br>0.094 % rdg + 0.0025 torr<br>0.29 % rdg + 0.025 mtorr | MKS 960A vacuum transducers        | ATL                    |

| Parameter/Equipment       | Range                                                                                  | CMC <sup>2</sup> (±)                                             | Comment                                               | Location <sup>10</sup>                          |
|---------------------------|----------------------------------------------------------------------------------------|------------------------------------------------------------------|-------------------------------------------------------|-------------------------------------------------|
| Pipette                   | (10 to 100) µL<br>(100 to 1000) µL<br>(1 to 10) mL                                     | (0.58 + 0.004V) µL<br>(0.6 + 0.001V) µL<br>(2.6 + 0.0012V) µL    | Mass balance                                          | TPA, RDU,<br>COS, DFW                           |
| Torque Tools <sup>3</sup> | (10 to 100) ozf·in<br>64 ozf·in to 1000 lbf·ft                                         | 0.6 % of rdg<br>0.32 % of rdg                                    | CDI 1001 torque tester<br>CDI 5000 ST torque analyzer | TPA, RFD,<br>HRT, HLR,<br>SFL, MEL,<br>COS, RDU |
|                           | (4 to 1000) lbf·in<br>(25 to 1000) lbf·ft                                              | 0.4 % of rdg<br>0.49 % of rdg                                    | CDI torque system                                     | ATL, DFW                                        |
|                           | (10 to 100) ozf·in<br>(5 to 1000) lbf·in<br>(25 to 250) lbf·ft<br>(250 to 2000) lbf·ft | 0.59 % of rdg<br>0.35 % of rdg<br>0.35 % of rdg<br>0.6 % of rdg  |                                                       | HSV                                             |
|                           | (0.5 to 2.5) ozf·in<br>(2 to 10) ozf·in<br>(6 to 43) ozf·in<br>(30 to 215) ozf·in      | 0.18 % of rdg<br>0.18 % of rdg<br>0.18 % of rdg<br>0.18 % of rdg | Waters torque analyzer                                | RFD, COS                                        |
|                           | (1 to 10) ozf·in                                                                       | 0.63 % of rdg                                                    | AWS QCMIO-10                                          | MEL                                             |
| Torque Analyzers          | 1 lbf·in to 1000 lbf·ft                                                                | 0.075 % of rdg                                                   | Torque arm/ Class F weights                           | TPA                                             |
|                           | 1 ozf·in to 250 lbf·ft                                                                 | 0.11 % of rdg                                                    |                                                       | ATL                                             |
|                           | (5 to 80) ozf·in<br>(5 to 600) lbf·in<br>(50 to 2000) lbf·ft                           | 0.16 % of rdg<br>0.15 % of rdg<br>0.14 % of rdg                  |                                                       | HSV                                             |
|                           | 0.4 ozf·in to 1000 lbf·ft                                                              | 0.065 % of rdg                                                   |                                                       | RFD                                             |
|                           | 5 lbf·in to 1000 lbf·ft                                                                | 0.06 % of rdg                                                    |                                                       | HLR                                             |
|                           | (1 to 20) ozf·in<br>(20 to 100) ozf·in<br>(4 to 150) lbf·in<br>(12.5 to 250) lbf·ft    | 0.25 % of rdg<br>0.12 % of rdg<br>0.04 % of rdg<br>0.16 % of rdg |                                                       | MEL                                             |
|                           | Up to 200 ozf·in<br>(4 to 150) lbf·in<br>(12.5 to 1000) lbf·ft                         | 0.1 % of rdg<br>0.064 % of rdg<br>0.036 % of rdg                 |                                                       | COS, RDU,<br>DFW                                |

| Parameter/Equipment                    | Range                                                                              | CMC <sup>2</sup> (±)                   | Comment                               | Location <sup>10</sup> |
|----------------------------------------|------------------------------------------------------------------------------------|----------------------------------------|---------------------------------------|------------------------|
| Rockwell Hardness Testers <sup>3</sup> | HBRW<br>( $< 60$ ) HRBW<br>( $\geq 60$ to $< 80$ ) HRBW<br>( $\geq 80$ ) HRBW      | 3 HRBW<br>3 HRBW<br>1.3 HRBW           | Indirect verification<br>per ASTM E18 | TPA                    |
|                                        | HRC<br>( $< 35$ ) HRC<br>( $\geq 35$ to $< 60$ ) HRC<br>( $\geq 60$ ) HRC          | 1.3 HRC<br>1.2 HRC<br>0.7 HRC          |                                       |                        |
|                                        | HREW<br>( $< 84$ ) HREW<br>( $\geq 84$ to $< 93$ ) HREW<br>( $\geq 93$ ) HREW      | 1.3 HREW<br>1.3 HREW<br>1.3 HREW       |                                       |                        |
|                                        | HR15TW<br>( $< 81$ ) HR15TW<br>( $\geq 81$ to $< 87$ ) HR15TW<br>( $> 87$ ) HR15TW | 1.8 HR15TW<br>1.3 HR15TW<br>1.3 HR15TW |                                       |                        |
|                                        | HRA<br>(20 to 69) HRA<br>(70 to 79) HRA<br>(80 to 86) HRA                          | 0.62 HRA<br>0.52 HRA<br>0.33 HRA       |                                       |                        |
|                                        | HRBW<br>(0 to 59) HRBW<br>(60 to 79) HRBW<br>(80 to 100) HRBW                      | 0.9 HRBW<br>0.62 HRBW<br>0.42 HRBW     |                                       |                        |
|                                        | HRC<br>(20 to 39) HRC<br>(40 to 59) HRC<br>(60 to 70) HRC                          | 0.36 HRC<br>0.33 HRC<br>0.21 HRC       | Indirect verification per<br>ASTM E18 | ATL                    |
|                                        | HRBW<br>( $< 60$ ) HRBW<br>( $\geq 60$ to $< 80$ ) HRBW<br>( $\geq 80$ ) HRBW      | 3 HRBW<br>3 HRBW<br>1.4 HRBW           |                                       |                        |
|                                        | HRC<br>( $< 35$ ) HRC<br>( $\geq 35$ to $< 60$ ) HRC<br>( $\geq 60$ ) HRC          | 1.3 HRC<br>1.3 HRC<br>0.73 HRC         |                                       |                        |
|                                        | HR15TW<br>( $< 81$ ) HR15TW<br>( $\geq 81$ to $< 87$ ) HR15TW<br>( $> 87$ ) HR15TW | 1.8 HR15TW<br>1.3 HR15TW<br>1.3 HR15TW |                                       |                        |
|                                        |                                                                                    |                                        |                                       | RFD                    |

| Parameter/Equipment                              | Range                                                                 | CMC <sup>2</sup> (±)               | Comment                               | Location <sup>10</sup> |
|--------------------------------------------------|-----------------------------------------------------------------------|------------------------------------|---------------------------------------|------------------------|
| Rockwell Hardness Testers <sup>3</sup><br>(cont) | HRBW<br>( $< 60$ ) HRBW<br>( $\geq 60$ to $< 80$ ) HRBW               | 3.1 HRBW<br>3 HRBW                 | Indirect verification per<br>ASTM E18 | HSV                    |
|                                                  | HRC<br>( $\geq 35$ to $< 60$ ) HRC<br>( $\geq 60$ ) HRC               | 1.2 HRC<br>0.7 HRC                 |                                       |                        |
|                                                  | HA<br>$< 70$ HA<br>$> 80$ HA                                          | 1.4 HRA<br>0.7 HRA                 |                                       |                        |
|                                                  | HRA<br>(20 to 65) HRA<br>(70 to 78) HRA<br>(80 to 84) HRA             | 0.53 HRA<br>0.36 HRA<br>0.29 HRA   |                                       | HLR                    |
|                                                  | HRBW<br>(40 to 59) HRBW<br>(60 to 79) HRBW<br>(80 to 100) HRBW        | 0.57 HRBW<br>0.62 HRBW<br>0.4 HRBW |                                       |                        |
|                                                  | HRC<br>(20 to 30) HRC<br>(35 to 55) HRC<br>(56 to 65) HRC             | 0.42 HRC<br>0.26 HRC<br>0.23 HRC   |                                       |                        |
|                                                  | HRBW<br>(0 to 59) HRBW<br>(60 to 79) HRBW<br>(80 to 100) HRBW         | 0.82 HRBW<br>0.8 HRBW<br>0.55 HRBW |                                       |                        |
|                                                  | HRC<br>(20 to 39) HRC<br>(40 to 59) HRC<br>(60 to 70) HRC             | 0.47 HRC<br>0.45 HRC<br>0.39 HRC   |                                       |                        |
|                                                  | HRA<br>(20 to 65) HRA<br>(70 to 78) HRA<br>(80 to 84) HRA             | 0.45 HRA<br>0.39 HRA<br>0.32 HRA   |                                       |                        |
|                                                  | HRBW<br>$< 60$ HRBW<br>( $\geq 60$ to $< 80$ ) HRBW<br>$\geq 80$ HRBW | 0.8 HRBW<br>0.85 HRBW<br>0.69 HRBW |                                       |                        |
|                                                  | HRC<br>$< 35$ HRC<br>( $\geq 35$ to $< 60$ ) HRC<br>$\geq 60$ HRC     | 0.58 HRC<br>0.54 HRC<br>0.39 HRC   |                                       |                        |
|                                                  |                                                                       |                                    |                                       | MEL                    |
|                                                  |                                                                       |                                    |                                       | RDU                    |

| Parameter/Equipment                                                      | Range                                                                                                                                                                   | CMC <sup>2</sup> (±)                                                                                   | Comment                               | Location <sup>10</sup> |
|--------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|---------------------------------------|------------------------|
| Rockwell Hardness Testers <sup>3</sup><br>(cont)                         | HRBW<br>< 60 HRBW<br>(≥ 60 to < 80) HRBW<br>≥ 80 HRBW<br><br>HRC<br>< 35 HRC<br>(≥ 35 to < 60) HRC<br>≥ 60 HRC<br><br>HRA<br>< 70 HRA<br>(≥ 70 to < 80) HRA<br>≥ 80 HRA | 3 HRBW<br>3 HRBW<br>1.3 HRBW<br><br>1.3 HRC<br>1.2 HRC<br>0.7 HRC<br><br>1.3 HRA<br>1.2 HRA<br>0.7 HRA | Indirect verification per<br>ASTM E18 | COS                    |
| Durometers<br>Scale (Force) Accuracy                                     |                                                                                                                                                                         |                                                                                                        | Direct verification                   | RFD                    |
| Types A, B, E, O,C, D,<br>DO<br>Type M<br>Types OO, OOO<br>Types CF & SL | (0 to 100) duros                                                                                                                                                        | 0.06 duros<br><br>0.07 duros<br>0.08 duros<br>0.06 duros                                               | Master balance                        |                        |
| Indenter Geometry<br>Length<br>Diameter<br>Angle                         | 0.1 in<br>0.05 in<br>(30 to 35) °                                                                                                                                       | 130 μin<br>130 μin<br>0.085 °                                                                          | Optical comparator                    |                        |
| Types A, B, C, D, DO, O<br>Type M<br>Types O, OO                         | (0 to 100) duros                                                                                                                                                        | 0.06 duros<br>0.07 duros<br>0.08 duros                                                                 | Master balance                        | TPA                    |
| Indenter Geometry<br>Length<br>Diameter<br>Angle                         | 0.1 in<br>0.05 in<br>(30 to 35) °                                                                                                                                       | 130 μin<br>130 μin<br>0.12°                                                                            | Optical comparator                    |                        |
| Types A, B, C, D, DO, O<br>Type M,<br>Types OO, OOO                      | (0 to 100) duros                                                                                                                                                        | 0.06 duros<br>0.09 duros<br>0.07 duros                                                                 | Master balance                        | ATL, HLR               |
| Indenter Geometry<br>Length<br>Diameter<br>Angle                         | 0.1 in<br>0.05 in<br>(30 to 35) °                                                                                                                                       | 180 μin<br>180 μin<br>0.006°                                                                           | Optical comparator                    |                        |
| Types A, B, C, D, DO, E,<br>O                                            | (0 to 100) duros                                                                                                                                                        | 0.06 duros                                                                                             | Master balance                        | HSV                    |
| Indenter Geometry<br>Length<br>Diameter<br>Angle                         | 0.1 in<br>0.05 in<br>(30 to 35)°                                                                                                                                        | 140 μin<br>140 μin<br>0.13°                                                                            | Optical comparator                    |                        |

| Parameter/Equipment | Range                  | CMC <sup>2</sup> (±) | Comment                   | Location <sup>10</sup> |
|---------------------|------------------------|----------------------|---------------------------|------------------------|
| Mass – Fixed Points | (1, 2, 5, 10) mg       | 0.027 mg             | ASTM E617 Class 1 weights | TPA                    |
|                     | (20, 50, 100, 500) mg  | 0.027 mg             |                           |                        |
|                     | (1, 2, 5) g            | 0.08 mg              |                           |                        |
|                     | 10 g                   | 0.13 mg              |                           |                        |
|                     | 20 g                   | 0.11 mg              |                           |                        |
|                     | 50 g                   | 0.22 mg              |                           |                        |
|                     | 100 g                  | 0.36 mg              |                           |                        |
|                     | 200 g                  | 0.64 mg              |                           |                        |
|                     | 500 g                  | 29 mg                |                           |                        |
|                     | 1 kg                   | 30 mg                |                           |                        |
|                     | 5 kg                   | 31 mg                |                           |                        |
|                     | (0.001, 0.002) lb      | 0.18 mg              |                           |                        |
|                     | (0.005, 0.01, 0.02) lb | 0.19 mg              |                           |                        |
|                     | 0.05 lb                | 0.24 mg              |                           |                        |
|                     | 0.1 lb                 | 0.29 mg              |                           |                        |
|                     | 0.2 lb                 | 0.39 mg              |                           |                        |
|                     | (0.5, 1, 2) lb         | 27 mg                |                           |                        |
|                     | 5 lb                   | 28 mg                |                           |                        |
|                     | 10 lb                  | 28 mg                |                           |                        |
|                     | 25 lb                  | 0.23 g               |                           |                        |
|                     | 50 lb                  | 0.23 g               |                           |                        |
|                     | (1,2,5) g              | 0.07 mg              | ASTM E617 Class 1 weights | ATL                    |
|                     | 10 g                   | 0.15 mg              |                           |                        |
|                     | 20 g                   | 0.19 mg              |                           |                        |
|                     | 50 g                   | 0.23 mg              |                           |                        |
|                     | 100 g                  | 0.45 mg              |                           |                        |
|                     | 200 g                  | 0.99 mg              |                           |                        |
|                     | 500 g                  | 6.5 mg               |                           |                        |
|                     | 1 kg                   | 10 mg                |                           |                        |
|                     | 2 kg                   | 14 mg                |                           |                        |
|                     | 5 kg                   | 31 mg                |                           |                        |
|                     | 10 kg                  | 82 mg                | ASTM E617 Class 4 weights |                        |
|                     | 20 kg                  | 114 mg               |                           |                        |
|                     | 200 g                  | 0.73 mg              | ASTM E617 Class 1 weights | RFD                    |
|                     | 500 g                  | 29 mg                |                           |                        |
|                     | 1 kg                   | 30 mg                |                           |                        |
|                     | 5 kg                   | 30 mg                |                           |                        |
|                     | (1, 2, 3, 5, 10) mg    | 0.013 mg             |                           | COS                    |
|                     | (20, 30, 50, 100) mg   | 0.013 mg             |                           |                        |
|                     | (200, 300, 500) mg     | 0.013 mg             |                           |                        |
|                     | (1, 2, 3, 5) g         | 0.049 mg             |                           |                        |
|                     | (10, 20, 30) g         | 0.068 mg             |                           |                        |
|                     | 50 g                   | 0.072 mg             |                           |                        |
|                     | 100 g                  | 0.23 mg              |                           |                        |
|                     | 200 g                  | 0.38 mg              |                           |                        |
|                     | 500 g                  | 5.8 mg               |                           |                        |
|                     | (1, 2, 3) kg           | 58 mg                |                           |                        |
|                     | (5, 10, 20) kg         | 58 mg                |                           |                        |



| Parameter/Equipment           | Range                                                                                                                                                                                     | CMC <sup>2</sup> (±)                                                                                                                                                | Comment                                                                                            | Location <sup>10</sup> |
|-------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|------------------------|
| Mass – Fixed Points<br>(cont) | (0.001, 0.002) lb<br>(0.005, 0.01, 0.02) lb<br>0.05 lb<br>0.1 lb<br>0.2 lb<br>(0.5, 1, 2) lb<br>(5, 10) lb<br>50 lb                                                                       | 0.13 mg<br>0.14 mg<br>0.2 mg<br>0.3 mg<br>0.34 mg<br>27 mg<br>28 mg<br>230 mg                                                                                       | ASTM E617 Class 1<br>weights                                                                       | RDU                    |
|                               | (1, 2, 5) g<br>10 g<br>20g<br>50 g<br>100 g<br>200 g<br>500 g<br>(1, 2, 5) kg                                                                                                             | 0.14 mg<br>0.19 mg<br>0.18 mg<br>0.25 mg<br>0.45 mg<br>0.65 mg<br>29 mg<br>31 mg                                                                                    |                                                                                                    |                        |
| Avoirdupois                   | (1, 2, 3, 5, 10, 20, 30) mg<br>(50, 100, 200) mg<br>300 mg<br>500 mg<br>(1, 2, 5) g<br>10 g<br>20 g<br>50 g<br>100 g<br>200 g<br>500 g<br>1 kg<br>2 kg<br>5 kg<br>10 kg<br>20 kg<br>25 kg | 1.8 µg<br>1.8 µg<br>2 µg<br>1.8 µg<br>5.2 µg<br>8.2 µg<br>10 µg<br>21 µg<br>41 µg<br>61 µg<br>0.16 mg<br>0.31 mg<br>0.61 mg<br>2.1 mg<br>3.1 mg<br>8.1 mg<br>8.1 mg | ASTM E617;<br>Class 0 weights,<br>OIML Class E2 weights<br>precision mass<br>comparators, balances | HLR                    |
|                               | (0.001, 0.002) lb<br>0.005 lb<br>0.01 lb<br>0.02 lb<br>0.05 lb<br>0.1 lb<br>0.2 lb<br>(0.5, 1) lb<br>2 lb<br>5 lb<br>10 lb<br>20 lb<br>25 lb<br>50 lb                                     | 2.5 µg<br>6.1 µg<br>6.2 µg<br>7.3 µg<br>15 µg<br>20 µg<br>38 µg<br>0.25 mg<br>0.33 mg<br>1.2 mg<br>2.1 mg<br>4.1 mg<br>4.2 mg<br>14 mg                              | ASTM E617<br>Class 1 weights<br><br>Precision mass<br>Comparators<br>Balances                      | HLR                    |

| Parameter/Equipment | Range                                            | CMC <sup>2</sup> (±)                           | Comment           | Location <sup>10</sup> |
|---------------------|--------------------------------------------------|------------------------------------------------|-------------------|------------------------|
| Mass – (cont)       |                                                  |                                                |                   |                        |
| Class F             | (5 to 225) g<br>(1 to 10) lb<br>(220 to 50) lb   | 1.2 mg<br>0.034 g<br>0.33 g                    | Master balances   | ATL                    |
|                     | (0.5 to 10) lb<br>(10 to 50) lb                  | 0.03 g, (0.000 066) lb<br>0.27 g, (0.000 6) lb |                   | HSV                    |
|                     | (1 to 220) g<br>(220 to 6400) g<br>(6 to 34) kg  | 0.42 mg<br>36 mg<br>0.31 g                     |                   | MEL                    |
|                     | (1 to 200) g<br>(200 to 2 500) g<br>(1 to 34) kg | 0.69 mg<br>0.026 g<br>0.25 g                   | Precision balance | RFD                    |
| Gloss Meters        | (20, 60, 85)°<br>(0 to 100) GU                   | 0.71 GU                                        | Gloss standards   | HLR                    |

#### VIII. Fluid Quantities

| Parameter/Equipment | Range                                   | CMC <sup>2</sup> (±)          | Comment                | Location <sup>10</sup> |
|---------------------|-----------------------------------------|-------------------------------|------------------------|------------------------|
| Gas Flow            | (1 to 10 000) sccm<br>(10 to 1000) slpm | 0.2 % of rdg<br>0.26 % of rdg | Molbloc flow standards | TPA                    |

#### IX. Thermodynamics

| Parameter/Equipment             | Range          | CMC <sup>2, 9</sup> (±) | Comment                                     | Location <sup>10</sup>                                       |
|---------------------------------|----------------|-------------------------|---------------------------------------------|--------------------------------------------------------------|
| Relative Humidity –<br>Generate | (10 to 95) %RH | 0.5 % RH                | Thunder Scientific 2500<br>humidity chamber | COS, RDU,<br>TPA, RFD,<br>HRT, HLR,<br>SFL, MEL,<br>ATL, DFW |

| Parameter/Equipment                    | Range                                                                                                             | CMC <sup>2,9</sup> (±)                                            | Comment                                                | Location <sup>10</sup>       |
|----------------------------------------|-------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|--------------------------------------------------------|------------------------------|
| Relative Humidity Measure <sup>3</sup> | (0 to 90) %RH<br>(90 to 100) %RH                                                                                  | 1.2 % RH<br>2 % RH                                                | Vaisala MI70/HMP76 humidity indicator & probe          | COS, RDU, TPA, RFD, SFL, ATL |
|                                        | (0 to 90) %RH                                                                                                     | 1.6 % RH                                                          | Vaisala M170/HMP75 humidity indicator & probe          | HRT, MEL                     |
|                                        | (0 to 90) % RH                                                                                                    | 1.2 % RH                                                          | Vaisala HM170/HMP77B humidity indicator & probe        | HSV                          |
|                                        | (10 to 90) %RH                                                                                                    | 1.3 % RH                                                          | Comparison to Vaisala MI70 Indicator & HMP77B Probe    | HLR                          |
|                                        | (9 to 85) %RH                                                                                                     | 2.1 % RH                                                          | Vaisala HM46 humidity indicator & probe                | DFW                          |
| Temperature – Measure <sup>3</sup>     | (-196 to 230) °C<br>(-321 to 446) °F<br>(230 to 420) °C<br>(446 to 788) °F<br>(420 to 660) °C<br>(788 to 1220) °F | 0.023 °C<br>0.042 °F<br>0.04 °C<br>0.072 °F<br>0.056 °C<br>0.1 °F | Hart 1502A indicator with 5616 & 5609 PRT              | TPA                          |
|                                        | (800 to 1550) °C                                                                                                  | 2 °C                                                              | Type B thermocouple                                    |                              |
|                                        | (-196 to 230) °C<br>(230 to 420) °C                                                                               | 0.03 °C<br>0.041 °C                                               | Hart 1502 indicator with Fluke 5615 PRT                | ATL                          |
|                                        | (-200 to 420) °C                                                                                                  | 0.036 °C                                                          | Hart 1502A indicator with Burnes Engineering 12005 PRT | RFD                          |
|                                        | (-196 to 200) °C<br>(200 to 400) °C<br>(400 to 660) °C                                                            | 0.018 °C<br>0.03 °C<br>0.043 °C                                   | PRT w/ Additel reference thermometer readout           | HSV                          |
|                                        | (-196 to 0.01) °C<br>(0.01 to 660) °C                                                                             | 0.0043 °C<br>(0.0043 + 0.000 001T) °C                             | Fluke 5699 SPRT & Fluke 1594A Super-Thermometer        | HRT                          |
|                                        | (-196 to 200) °C<br>(200 to 420) °C                                                                               | 0.045 °C<br>0.59 °C                                               | Hart 1502 Indicator, ASL T100 PRT                      | HLR                          |
|                                        | (-200 to 300) °C                                                                                                  | 0.031 °C                                                          | Hart 1502 indicator with 5622 PRT                      | SFL                          |
|                                        | (-196 to 232) °C<br>(-321 to 450) °F<br>(232 to 420) °C<br>(450 to 788) °F                                        | 0.018 °C<br>0.032 °F<br>0.025 °C<br>0.044 °F                      | Comparison to Hart 1502A indicator with 5615 PRT       | MEL                          |
|                                        |                                                                                                                   |                                                                   |                                                        |                              |

| Parameter/Equipment                                  | Range                                                  | CMC <sup>2, 9</sup> (±)          | Comment                                                                  | Location <sup>10</sup> |
|------------------------------------------------------|--------------------------------------------------------|----------------------------------|--------------------------------------------------------------------------|------------------------|
| Temperature Measure <sup>3</sup><br>(cont)           | (-200 to 400) °C<br>(400 to 660) °C                    | 0.024 °C<br>0.069 °C             | Secondary PRT                                                            | COS                    |
|                                                      | (-200 to 200) °C<br>(200 to 400) °C<br>(400 to 660) °C | 0.015 °C<br>0.023 °C<br>0.035 °C | Secondary PRT w/<br>Additel reference<br>thermometer readout             | RDU, DFW               |
| Temperature –<br>Measuring<br>Equipment <sup>3</sup> | (-40 to 160) °C<br>(160 to 420) °C                     | 0.056 °C<br>0.067 °C             | Hart 1502 indicator with<br>Fluke 5615 PRT &<br>Additel dry well         | ATL                    |
|                                                      | (420 to 660) °C                                        | 0.31 °C                          | Additel dry well                                                         |                        |
|                                                      | (-40 to 155) °C<br>(155 to 660) °C                     | 0.037 °C<br>0.14 °C              | PRT w/ Additel reference<br>thermometer readout &<br>dry block           | HSV                    |
|                                                      | (-25 to 350) °C                                        | 0.087 °C                         | Hart 1502A indicator<br>with Burnes Engineering<br>12005 PRT & dry block | RFD                    |
|                                                      | (-25 to 140) °C<br>(140 to 300) °C                     | 0.13 °C<br>0.42 °C               | Hart 1502 indicator with<br>5622 PRT & dry block                         | SFL                    |
|                                                      | (-25 to 140) °C                                        | 0.08 °C                          | Hart 1502A w/ 5615 PRT<br>Fluke 9103 dry block                           | MEL                    |
|                                                      | (140 to 375) °C                                        | 0.19 °C                          | Fluke 9100S dry block                                                    |                        |
|                                                      | (-5 to 125) °C                                         | 0.051 °C                         | Hart 1502A w/ 5615 PRT<br>Fluke 7102 microbath                           |                        |
|                                                      | (-40 to 660) °C                                        | 0.18 °C                          | Dry well calibrators                                                     | COS, DFW               |
|                                                      | (-40 to 160) °C<br>(33 to 700) °C                      | 0.13 °C<br>(0.21 + 0.00042T) °C  |                                                                          | RDU                    |
| Temperature – Source                                 | (-196 to 300) °C<br>(> 300 to 500) °C                  | 0.014 °C<br>0.02 °C              | Fluke 5699 SPRT, Fluke<br>1594ASuperthermometer<br>& temperature baths   | HRT                    |
| Temperature – Source<br>Fix Point                    | 0.01 °C                                                | 0.0026 °C                        | Triple point of water                                                    | HRT                    |

| Parameter/Equipment                         | Range                                                                   | CMC <sup>2</sup> (±)               | Comment                                                                                             | Location <sup>10</sup>                                               |
|---------------------------------------------|-------------------------------------------------------------------------|------------------------------------|-----------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|
| Temperature Uniformity Surveys <sup>3</sup> |                                                                         |                                    | Datalogger & thermocouples                                                                          |                                                                      |
| Type J                                      | (100 to 900) °F                                                         | 1.8 °F                             |                                                                                                     | TPA                                                                  |
| Type K                                      | (100 to 1000) °F<br>(1000 to 2000) °F<br>(2000 to 2200) °F              | 2 °F<br>2.1 °F<br>2.7 °F           |                                                                                                     | TPA, HSV,<br>COS                                                     |
| Type T                                      | (32 to 400) °F                                                          | 1.6 °F                             |                                                                                                     | HSV                                                                  |
| Infrared (IR) Thermometry <sup>3</sup>      | (20 to 100) °C<br>(100 to 300) °C<br>(300 to 420) °C<br>(420 to 500) °C | 1.5 °C<br>4.3 °C<br>6 °C<br>7.7 °C | Fluke 9132 infrared calibrator<br>$\lambda = (8 \text{ to } 14) \mu\text{m}$ ,<br>$\epsilon = 0.95$ | TPA, ATL,<br>HSV, RFD,<br>HLR, SFL,<br>MEL, COS,<br>RDU, HRT,<br>DFW |

## VII. Time & Frequency

| Parameter/Equipment               | Range                                                                                                                     | CMC <sup>2,9</sup> (±)                                                                                                                                                                                                                                                               | Comment                                                            | Location <sup>10</sup>                       |
|-----------------------------------|---------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|----------------------------------------------|
| Frequency – Generate <sup>3</sup> | 10 MHz                                                                                                                    | 1 x 1 <sup>-9</sup> Hz/Hz                                                                                                                                                                                                                                                            | HP Z3801A GPS receiver                                             | HSV, HLR<br>HRT                              |
|                                   |                                                                                                                           | 1 x 1 <sup>-12</sup> Hz/Hz                                                                                                                                                                                                                                                           | HP 58503A, Z3805A GPS receiver                                     | TPA, MEL<br>RFD, COS<br>SFL, ATL<br>RDU, DFW |
|                                   | (1 to 10) Hz<br>(10 to 100) Hz<br>(100 to 1000) Hz<br>(1 to 10) kHz<br>(10 to 100) kHz<br>(0.1 to 1) MHz<br>(1 to 10) MHz | 1 x 1 <sup>-9</sup> Hz/Hz + 0.57 µHz<br>1 x 1 <sup>-9</sup> Hz/Hz + 5.7 µHz<br>1 x 1 <sup>-9</sup> Hz/Hz + 57 µHz<br>1 x 1 <sup>-9</sup> Hz/Hz + 0.57 mHz<br>1 x 1 <sup>-9</sup> Hz/Hz + 5.7 mHz<br>1 x 1 <sup>-9</sup> Hz/Hz + 57 mHz<br>1 x 1 <sup>-9</sup> Hz/Hz + 0.57 Hz        | Agilent 33250A function generator / HP Z3801A GPS receiver         | HSV, HLR<br>HRT                              |
|                                   |                                                                                                                           | 1 x 1 <sup>-12</sup> Hz/Hz + 0.57 µHz<br>1 x 1 <sup>-12</sup> Hz/Hz + 5.7 µHz<br>1 x 1 <sup>-12</sup> Hz/Hz + 57 µHz<br>1 x 1 <sup>-12</sup> Hz/Hz + 0.57 mHz<br>1 x 1 <sup>-12</sup> Hz/Hz + 5.7 mHz<br>1 x 1 <sup>-12</sup> Hz/Hz + 57 mHz<br>1 x 1 <sup>-12</sup> Hz/Hz + 0.57 Hz | Agilent 33250A function generator / HP 58503A, Z3805A GPS receiver | TPA, MEL<br>RFD, COS<br>SFL, ATL<br>RDU, DFW |
|                                   |                                                                                                                           |                                                                                                                                                                                                                                                                                      |                                                                    |                                              |
|                                   |                                                                                                                           |                                                                                                                                                                                                                                                                                      |                                                                    |                                              |

| Parameter/Equipment               | Range                                                                                                                           | CMC <sup>2,9</sup> (±)                                                                                                                                                                                             | Comment                                                                  | Location <sup>10</sup>       |
|-----------------------------------|---------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|------------------------------|
| Frequency – Generate <sup>3</sup> | (10 to 20 000) MHz                                                                                                              | $1 \times 10^{-12}$ Hz/Hz + 0.57 mHz                                                                                                                                                                               | Agilent E8257D Opt 520 / HP 58503A GPS receiver                          | SFL                          |
|                                   | (10 to 26 500) MHz                                                                                                              | $1 \times 10^{-12}$ Hz/Hz + 0.57 Hz                                                                                                                                                                                | HP 83630B Opt 008 / HP 58503A GPS receiver                               |                              |
|                                   |                                                                                                                                 | $1 \times 10^{-9}$ Hz/Hz + 0.57 kHz                                                                                                                                                                                | HP 83630B / HP Z3801A GPS receiver                                       | HLR, HRT                     |
|                                   | (10 to 50 000) MHz                                                                                                              | $1 \times 10^{-12}$ Hz/Hz + 0.57 Hz                                                                                                                                                                                | Agilent 83650B Opt 008 / HP Z3805A GPS receiver                          | RDU                          |
|                                   |                                                                                                                                 | $1 \times 10^{-9}$ Hz/Hz + 0.57mHz                                                                                                                                                                                 | Agilent E8257D Opt 550 / HP Z3801A GPS receiver                          | HSV                          |
|                                   |                                                                                                                                 | $1 \times 10^{-12}$ Hz/Hz + 0.57mHz                                                                                                                                                                                | Agilent E8257D Opt 550 / HP 58503A GPS receiver                          | TPA, COS, MEL, ATL, RFD, DFW |
|                                   | (50 000 to 67 000) MHz                                                                                                          | $1 \times 10^{-12}$ Hz/Hz + 0.57mHz                                                                                                                                                                                | Agilent E8257D Opt 567 / HP 58503A GPS receiver                          | COS, DFW                     |
| Frequency – Measure <sup>3</sup>  | (1 to 10) Hz<br>(10 to 100) Hz<br>(100 to 1000) Hz<br>(1 to 10) kHz<br>(10 to 100) kHz<br>(100 to 200) kHz<br>(0.2 to 3000) MHz | $5.2 \times 10^{-9}$ Hz/Hz<br>$2.5 \times 10^{-9}$ Hz/Hz<br>$1.6 \times 10^{-9}$ Hz/Hz<br>$1.3 \times 10^{-9}$ Hz/Hz<br>$1.2 \times 10^{-9}$ Hz/Hz<br>$1. \times 10^{-9}$ Hz/Hz<br>$1.21 \times 10^{-9}$ Hz/Hz     | Agilent 53131A Opt 030 frequency counter / HP Z3801A GPS receiver        | HLR, HRT, HSV                |
|                                   |                                                                                                                                 | $4.2 \times 10^{-9}$ Hz/Hz<br>$1.5 \times 10^{-9}$ Hz/Hz<br>$0.6 \times 10^{-9}$ Hz/Hz<br>$0.33 \times 10^{-9}$ Hz/Hz<br>$0.24 \times 10^{-9}$ Hz/Hz<br>$0.21 \times 10^{-9}$ Hz/Hz<br>$0.21 \times 10^{-9}$ Hz/Hz | Agilent 53131A Opt 030 frequency counter / HP 58503A,Z3805A GPS receiver | SFL, RDU, ATL, DFW           |

| Parameter/Equipment              | Range                                                                                                                           | CMC <sup>2,9</sup> (±)                                                                                                                                                                                                          | Comment                                                                    | Location <sup>10</sup>                        |
|----------------------------------|---------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------|-----------------------------------------------|
| Frequency – Measure <sup>3</sup> | (1 to 10) Hz<br>(10 to 100) Hz<br>(100 to 1000) Hz<br>(1 to 10) kHz<br>(10 to 100) kHz<br>(100 to 200) kHz<br>(0.2 to 3000) MHz | 1.82 x 1 <sup>e-9</sup> Hz/Hz<br>0.59 x 1 <sup>e-9</sup> Hz/Hz<br>0.20 x 1 <sup>e-9</sup> Hz/Hz<br>74 x 1 <sup>e-12</sup> Hz/Hz<br>35 x 1 <sup>e-12</sup> Hz/Hz<br>23 x 1 <sup>e-12</sup> Hz/Hz<br>20 x 1 <sup>e-12</sup> Hz/Hz | Agilent 53132A Opt<br>030 frequency<br>counter / HP 58503A<br>GPS receiver | TPA, MEL<br>RFD, COS                          |
|                                  | (10 to 26 500) MHz                                                                                                              | 1 x 1 <sup>e-9</sup> Hz/Hz + 0.1 Hz                                                                                                                                                                                             | Agilent E4440A<br>spectrum analyzer /<br>HP Z3801A GPS<br>receiver         | HRT, HLR                                      |
|                                  |                                                                                                                                 | 1 x 1 <sup>e-12</sup> Hz/Hz + 0.1 Hz                                                                                                                                                                                            | Agilent E4440A<br>spectrum analyzer /<br>HP 58503A GPS<br>receiver         | SFL                                           |
|                                  | (500 to 46 000) MHz                                                                                                             | 1 x 1 <sup>e-9</sup> Hz/Hz + 1.0 Hz                                                                                                                                                                                             | Agilent 5352B<br>frequency counter /<br>HP Z3801A GPS<br>receiver          | HSV                                           |
|                                  |                                                                                                                                 | 1 x 1 <sup>e-12</sup> Hz/Hz + 1.6 Hz                                                                                                                                                                                            | Agilent 53152A<br>frequency counter /<br>HP 58503A GPS<br>receiver         | TPA                                           |
|                                  | (10 to 50 000) MHz                                                                                                              | 1 x 1 <sup>e-9</sup> Hz/Hz + 0.1 Hz                                                                                                                                                                                             | Agilent E4448A<br>spectrum analyzer /<br>HP Z3801A GPS<br>receiver         | HSV                                           |
|                                  |                                                                                                                                 | 1 x 1 <sup>e-12</sup> Hz/Hz + 0.1 Hz                                                                                                                                                                                            | Agilent E4448A<br>spectrum analyzer /<br>HP 58503A,Z3805A<br>GPS receiver  | TPA, RFD,<br>MEL, COS,<br>RDU, ATL,<br>DFW    |
| Time – Generate                  | 1 pps                                                                                                                           | 1 x 1 <sup>e-12</sup> s/s + 750 ps                                                                                                                                                                                              | HP 58503A GPS<br>receiver                                                  | TPA, MEL<br>RFD, COS<br>SFL, ATL,<br>RDU, DFW |

| Parameter/Equipment                      | Range                                        | CMC <sup>2,4</sup> ( $\pm$ )   | Comment                                               | Location <sup>10</sup>                                           |
|------------------------------------------|----------------------------------------------|--------------------------------|-------------------------------------------------------|------------------------------------------------------------------|
| Timer - Stopwatch <sup>3</sup>           | 10 s to 24 hr                                | 34 ms                          | Totalize method with counter                          | SFL, HLR<br>COS, RDU<br>HRT, ATL,<br>RFD, DFW                    |
| Type I (digital) Timers <sup>3</sup>     | (0 to 19.99) sec/day<br>(0 to 599) sec/month | 0.031 sec/day<br>1.1 sec/month | Helmut Klein<br>Timometer 4500                        | TPA, RFD<br>MEL, HSV                                             |
| Type II (mechanical) Timers <sup>3</sup> | (0 to 320) sec/day                           | 0.6 sec/day                    |                                                       |                                                                  |
| Tachometers – RPM <sup>3</sup>           | Up to 100 000 RPM                            | 0.001 % of rdg + 0.6R          | Comparison to HP 3325B, 33250A signal generator & LED | HRT, RDU<br>HLR, TPA<br>SFL, RFD<br>ATL, MEL<br>COS, HSV,<br>DFW |

<sup>1</sup> This laboratory offers commercial calibration service and field calibration service.

<sup>2</sup> Calibration and Measurement Capability Uncertainty (CMC) is the smallest uncertainty of measurement that a laboratory can achieve within its scope of accreditation when performing more or less routine calibrations of nearly ideal measurement standards or nearly ideal measuring equipment. CMCs represent expanded uncertainties expressed at approximately the 95 % level of confidence, usually using a coverage factor of  $k = 2$ . The actual measurement uncertainty of a specific calibration performed by the laboratory may be greater than the CMC due to the behavior of the customer's device and to influences from the circumstances of the specific calibration.

<sup>3</sup> Field calibration service is available for this calibration. Please note the actual measurement uncertainties achievable on a customer's site can normally be expected to be larger than the CMC found on the A2LA Scope. Allowance must be made for aspects such as the environment at the place of calibration and for other possible adverse effects such as those caused by transportation of the calibration equipment. The usual allowance for the actual uncertainty introduced by the item being calibrated, (e.g., resolution) must also be considered and this, on its own, could result in the actual measurement uncertainty achievable on a customer's site being larger than the CMC.

<sup>4</sup> In the statement of CMC,  $L$  is the numerical value of the nominal length of the device measured in micro-inches.  $R$  is the resolution of the unit under test.  $D$  is the numerical value of the nominal diameter of the device measured in micro-inches,  $M$  represents mismatch,  $X$  is mass in gram and  $W$  is mass in pounds and  $F$  is length in feet.

<sup>5</sup> This laboratory meets R205 – *Specific Requirements: Calibration Laboratory Accreditation Program* for the types of dimensional tests listed above and is considered equivalent to that of a calibration.

<sup>6</sup> In the statement of CMC, percentages are of rdg unless otherwise noted.





<sup>7</sup> The stated measured values are determined using the indicated instrument (see Comments). This capability is suitable for the calibration of the devices intended to measure or generate the measured value in the ranges indicated. CMC's are expressed as either a specific value that covers the full range or as a percentage or fraction of the rdg plus a fixed floor specification.

<sup>8</sup> This scope meets A2LA's *P112 Flexible Scope Policy*.

<sup>9</sup> The type of instrument or material being calibrated is defined by the parameter. This indicates the laboratory is capable of calibrating instruments that measure or generate the values in the ranges indicated for the listed measurement parameter.

<sup>10</sup> The locations of the laboratories that can perform the calibrations are given by a three-letter code with valid to dates given in the table below:

<sup>11</sup> The name and contact information under each laboratory's address "below" represents the point-of-contact for that respective laboratory

| <sup>10, 11</sup> Location                                                                                                                                                                      | Initials | Expiration         |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|--------------------|
| 12530 Telecom Drive, Temple Terrace, FL 33637<br>Wally Gynn - 813-978-3054 - <a href="mailto:wally.gynn@tmicalibration.com">wally.gynn@tmicalibration.com</a>                                   | TPA      | September 30, 2027 |
| 1801 Royal Lane, Suite 100, Dallas, TX 75229<br>Kyle Huitt - 469-779-0107 - <a href="mailto:kyle.huitt@tmicalibration.com">kyle.huitt@tmicalibration.com</a>                                    | DFW      | September 30, 2027 |
| 117 Jetplex Circle Suite C4, Madison, AL 35758<br>Donny Prax - 256-772-4115 - <a href="mailto:donny.prax@tmicalibration.com">donny.prax@tmicalibration.com</a>                                  | HSV      | September 30, 2027 |
| 3248 Forest View Road, Rockford, IL 61109<br>Brian Schickowski - 779-774-3877 - <a href="mailto:brian.schickowski@tmicalibration.com">brian.schickowski@tmicalibration.com</a>                  | RFD      | September 30, 2027 |
| 425 Hayden Station Suite B, Windsor, CT 06095<br>Matt Nicewicz - 860-219-0046 - <a href="mailto:matt.nicewicz@tmicalibration.com">matt.nicewicz@tmicalibration.com</a>                          | HRT      | September 30, 2027 |
| 3000 Northwoods Parkway Suite 270, Peachtree Corners, GA 30071<br>Milt Mosher - 888-497-1448 - <a href="mailto:milt.mosher@tmicalibration.com">milt.mosher@tmicalibration.com</a>               | ATL      | September 30, 2026 |
| 4613 Northwest Parkway, Hilliard, OH 43026<br>Matt Ayres - 614-850-9940 - <a href="mailto:matt.ayres@tmicalibration.com">matt.ayres@tmicalibration.com</a>                                      | HLR      | September 30, 2026 |
| 2100 Park Central Blvd. North Suite 300, Pompano Beach, FL 33064<br>Wesley Gonzalez - 954-252-2223 - <a href="mailto:wesley.gonzalez@tmicalibration.com">wesley.gonzalez@tmicalibration.com</a> | SFL      | September 30, 2026 |
| 3060 Venture Lane Suite 106, Melbourne, FL 32934<br>Schuyler Cournoyer - 321-242-0890 - <a href="mailto:schuyler.cournoyer@tmicalibration.com">schuyler.cournoyer@tmicalibration.com</a>        | MEL      | September 30, 2026 |
| 1355 Garden of the Gods Road, Suite 100, Colorado Springs, CO 80907<br>Glenn Curtis - 719-424-7068 - <a href="mailto:glenn.r.curtis@tmicalibration.com">glenn.r.curtis@tmicalibration.com</a>   | COS      | September 30, 2027 |
| 2200 Gateway Centre Blvd. #208, Morrisville, NC 27560<br>Taylor Floyd - 919-234-1291 - <a href="mailto:taylor.floyd@tmicalibration.com">taylor.floyd@tmicalibration.com</a>                     | RDU      | February 28, 2026  |

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SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017  
& ANSI/NCSL Z540-1-1994

MICRO QUALITY CALIBRATION LLC  
9168 De Soto Ave  
Chatsworth, CA 91311-4408  
Konstantin Gontmaher Phone: 818 701 4969 ext 218

CALIBRATION

Valid To: November 30, 2026

Certificate Number: 2348.01

In recognition of the successful completion of the A2LA evaluation process (including an assessment of the organization's compliance with A2LA's – R205 Calibration Program Requirements), accreditation is granted to this laboratory at the location listed above to perform the following calibrations <sup>i, 10</sup>:

I. Acoustical

| Parameter/Equipment               | Frequency                     | CMC <sup>2</sup> (±) | Comments           |
|-----------------------------------|-------------------------------|----------------------|--------------------|
| Sound Level Meters <sup>3</sup> – |                               |                      |                    |
| 94 dB                             | 31.5 Hz to 12.5 kHz<br>16 kHz | 0.31 dB<br>0.32 dB   | Briel & Kjaer 4226 |
| 104 dB                            | 31.5 Hz to 12.5 kHz<br>16 kHz | 0.30 dB<br>0.34 dB   |                    |
| 114 dB                            | 31.5 Hz to 12.5 kHz<br>16 kHz | 0.30 dB<br>0.57 dB   |                    |

II. Chemical

| Parameter/Equipment                   | Range                          | CMC <sup>2, 8</sup> (±)          | Comments         |
|---------------------------------------|--------------------------------|----------------------------------|------------------|
| pH – Measuring Equipment <sup>3</sup> | 4.00 pH<br>7.00 pH<br>10.00 pH | 0.012 pH<br>0.012 pH<br>0.012 pH | Buffer solutions |

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(A2LA Cert. No. 2348.01) Revised 12/30/2025

| Parameter/Equipment                             | Range                                                                   | CMC <sup>2, 5, 8</sup> ( $\pm$ )                                   | Comments                                                                    |
|-------------------------------------------------|-------------------------------------------------------------------------|--------------------------------------------------------------------|-----------------------------------------------------------------------------|
| Conductivity – Measuring Equipment <sup>3</sup> | 10 $\mu$ S/cm<br>100 $\mu$ S/cm<br>1410 $\mu$ S/cm<br>10 000 $\mu$ S/cm | 0.65 $\mu$ S/cm<br>2.2 $\mu$ S/cm<br>6 $\mu$ S/cm<br>41 $\mu$ S/cm | Laboratory standard conductivity solution                                   |
| Aerosol Particle Counters                       | (0.3 to 10) $\mu$ m                                                     | 2.9 %                                                              | TSI electrostatic classifier 3082<br>TSI condensation particle counter 3772 |

### III. Dimensional

| Parameter/Equipment                          | Range                          | CMC <sup>2, 6</sup> ( $\pm$ )                  | Comments                                           |
|----------------------------------------------|--------------------------------|------------------------------------------------|----------------------------------------------------|
| Gage Blocks                                  | Up to 4 in<br>(> 4 to 20) in   | (2.9 + 0.7L) $\mu$ in<br>(3.1 + 1.3L) $\mu$ in | Electronic comparator,<br>master steel gage blocks |
| Caliper <sup>3</sup>                         | Up to 20 in<br>(> 20 to 40) in | (4.8L + 0.6R) $\mu$ in<br>(370 + 6L) $\mu$ in  | Gage blocks                                        |
| Micrometer <sup>3</sup>                      | Up to 12 in<br>(> 12 to 36) in | (4.8L + 0.6R) $\mu$ in<br>(43 + 8.8L) $\mu$ in | Gage blocks                                        |
| Bench Micrometers                            | Up to 20 in                    | (12 + 1.3L) $\mu$ in                           | Gage blocks                                        |
| Dial, Digital, & Test Indicator <sup>3</sup> | Up to 4 in                     | (4.8L + 0.6R) $\mu$ in                         | Gage blocks                                        |
| Height Gages <sup>3</sup>                    | Up to 40 in                    | (4.8L + 0.6R) $\mu$ in                         | Gage blocks                                        |
| Optical Flats                                | (1 to 8) in                    | 6.2 $\mu$ in                                   | Standard optical flat                              |



| Parameter/Equipment                                                                            | Range                                                                                              | CMC <sup>2, 6</sup> (±)                                                                                                | Comments                                                                                                                          |
|------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| Measuring Microscopes <sup>3</sup>                                                             | Up to 12 in                                                                                        | (95 + 3.0L) μin                                                                                                        | Glass scale                                                                                                                       |
| Cylindrical Gages –<br><br>Plug & Pin Gages<br><br>Plain Ring Gages                            | Up to 1 in<br>(> 1 to 4) in<br>(> 4 to 16) in<br><br>Up to 1 in<br>(> 1 to 4) in<br>(> 4 to 16) in | (6.8 + 0.7D) μin<br>(5.4 + 2.2D) μin<br>(10 + 1.7D) μin<br><br>(13 + 0.9D) μin<br>(13 + 1.2D) μin<br>(12 + 2.2D) μin   | Universal measuring<br>standard-Supra-500<br><br>Universal measuring<br>standard-Supra-500<br>w/ID probes                         |
| Thread Wires                                                                                   | (4 to 20) TPI<br>(> 20 to 80) TPI                                                                  | 17 μin<br>12 μin                                                                                                       | Supermicrometer™<br>Universal measuring<br>standard-Supra-500                                                                     |
| Thread Plug Gage<br><br>Pitch Diameter<br><br>Major Diameter                                   | (4 to 20) TPI<br>(> 20 to 80) TPI<br><br>Up to 16 in                                               | (28 + 1.5D) μin<br>(24 + 0.5D) μin<br><br>(11 + 1.5D) μin                                                              | Supermicrometer™<br>Universal measuring<br>standard-Supra-500 w/<br>thread wires<br><br>Universal measuring<br>standard-Supra-500 |
| Thread Plug Gage –<br><br>Minor<br>Lead<br>Angle<br><br>Major<br>Minor<br>Pitch<br>Flank Angle | (4 to 80) TPI<br><br><br><br>Up to 6 in                                                            | (95 + 5.4D) μin<br>(31 + 2.6D) μin<br>0.054°<br><br>(80 + 4.5L) μin<br>(84 + 3.8L) μin<br>(50 + 5.5L) μin<br>0° 6' 32' | Quest thread view<br>machine<br><br>MicroScanner™                                                                                 |
| Thread Ring Gage –<br><br>Major<br>Minor<br>Pitch<br>Flank Angle                               | (80 to 4.5) TPI<br><br>Up to 6 in                                                                  | (67 + 0.5D) μin<br><br>(83 + 4.2L) μin<br>(81 + 4.9L) μin<br>(51 + 7.7L) μin<br>0° 6' 32' 3'                           | Universal measuring<br>standard-Supra-500 w/<br>probe<br>MicroScanner™                                                            |

| Parameter/Equipment                                            | Range                                               | CMC <sup>2, 6</sup> (±)                   | Comments                                             |
|----------------------------------------------------------------|-----------------------------------------------------|-------------------------------------------|------------------------------------------------------|
| Surface Plate <sup>3</sup> –<br>Flatness<br>Repeatability      | (18 x 18) in<br>(36 x 72) in                        | 13 µin<br>28 µin                          | Autocollimator,<br>repeat-o-meter                    |
| Optical Comparator <sup>3</sup> –<br>X Axis<br>Y Axis<br>Angle | Up to 12 in<br>Up to 12 in<br>Up to 360°            | (46 + 4L) µin<br>(47 + 3L) µin<br>2.5 min | Gage blocks, angle<br>blocks                         |
| Angle Blocks <sup>3</sup>                                      | Up to 45°                                           | 2.1 arc sec                               | Sine plate, gage<br>blocks & electronic<br>indicator |
| Crimping Tools <sup>3</sup>                                    | Up to 1 in diameter                                 | 200 µin                                   | Pin gages, optical<br>comparator & pull<br>tester    |
| Precision Levels <sup>3</sup>                                  | (2 to 15) in                                        | 150 µin                                   | Gage blocks                                          |
| Protractors/Clinometer <sup>3</sup>                            | Up to 180°                                          | 1.3 arc sec + 0.6R                        | Sine plate w/ angle<br>blocks                        |
| Surface Roughness<br>Specimens                                 | Up to 400 µin                                       | 0.62 µin                                  | SurfTest w/ reference<br>specimen                    |
| Profilometers                                                  | Up to 400 µin                                       | 0.55 µin                                  | Surface roughness<br>specimen                        |
| Rotary Table                                                   | (1 to 360) °                                        | 4.1 arc sec                               | Renishaw laser                                       |
| Steel Rules & Tapes –<br>Steel Rules Measuring<br>Tapes        | Up to 72 in<br>Up to 1200 in<br>(in 40 in segments) | 0.0027 in<br>(6600 + 16L) µin             | Kudale TSCU                                          |

#### IV. Dimensional Testing<sup>1</sup>

| Parameter/Range          | Range        | CMC <sup>2, 6</sup> ( $\pm$ ) | Comments                                           |
|--------------------------|--------------|-------------------------------|----------------------------------------------------|
| Length – 1D <sup>9</sup> | Up to 40 in  | 5.2 $\mu\text{in/in}$         | Gage blocks, CMM, Supra 500, etc<br>Renishaw laser |
|                          | Up to 110 in | $(12 + 0.8L) \mu\text{in}$    |                                                    |

#### V. Electrical – DC/Low Frequency

| Parameter/Equipment                | Range                                                                                                                             | CMC <sup>2, 4</sup> ( $\pm$ )                                                                                                                                                                                                                       | Comments                                     |
|------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|
| DC Voltage – Generate <sup>3</sup> | 10 V                                                                                                                              | 0.52 $\mu\text{V/V}$                                                                                                                                                                                                                                | Fluke 732B                                   |
|                                    | Up to 220 mV<br>220 mV to 2.2V<br>(2.2 to 11) V<br>(11 to 22) V<br>(22 to 220) V<br>(220 to 1100) V                               | 7.5 $\mu\text{V/V} + 0.39 \mu\text{V}$<br>4.6 $\mu\text{V/V} + 0.62 \mu\text{V}$<br>3.1 $\mu\text{V/V} + 2.3 \mu\text{V}$<br>3.2 $\mu\text{V/V} + 3.9 \mu\text{V}$<br>4.7 $\mu\text{V/V} + 39 \mu\text{V}$<br>6.2 $\mu\text{V/V} + 0.39 \text{ mV}$ | Fluke 5730A                                  |
| DC Voltage – Measure <sup>3</sup>  | Up to 100 mV<br>(0.1 to 1) V<br>(1 to 10) V<br>(10 to 100) V<br>(100 to 1000) V                                                   | 5.7 $\mu\text{V/V} + 0.2 \mu\text{V}$<br>2.8 $\mu\text{V/V} + 0.3 \mu\text{V}$<br>2.8 $\mu\text{V/V} + 0.5 \mu\text{V}$<br>4.1 $\mu\text{V/V} + 30 \mu\text{V}$<br>4.3 $\mu\text{V/V} + 0.5 \text{ mV}$                                             | FLUKE 8588A                                  |
| High Voltage                       | (1000 to 10 000) V<br>(10 000 to 70 000) V                                                                                        | 0.042 % + 0.6R<br>0.048 % + 0.6R                                                                                                                                                                                                                    | Vitrek 4700/HLV-70                           |
| DC Current – Generate <sup>3</sup> | 20 nA to 220 $\mu\text{A}$<br>220 $\mu\text{A}$ to 2.2 mA<br>(2.2 to 22) mA<br>(22 to 220) mA<br>220 mA to 2.2 A<br>(2.2 to 11) A | 39 $\mu\text{A/A} + 5.4 \text{ nA}$<br>31 $\mu\text{A/A} + 6.2 \text{ nA}$<br>32 $\mu\text{A/A} + 40 \text{ nA}$<br>46 $\mu\text{A/A} + 0.70 \mu\text{A}$<br>85 $\mu\text{A/A} + 12 \mu\text{A}$<br>0.28 mA/A + 0.37 mA                             | Fluke 5730A,<br><br>Fluke 5730A, Fluke 5725A |
|                                    | (11 to 20) A                                                                                                                      | 1.1 mA/A + 0.75 mA                                                                                                                                                                                                                                  | Fluke 5522A                                  |
|                                    | (20 to 700) A                                                                                                                     | 1.5 mA/A + 0.52 A                                                                                                                                                                                                                                   | Keysight 6680A HP<br>3458A, current shunts   |
|                                    | (20.5 to 120) A                                                                                                                   | 0.8 mA/A + 5.3 mA                                                                                                                                                                                                                                   | Fluke 5730A, 52120A                          |

| Parameter/Equipment               | Range                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | CMC <sup>2, 4, 5</sup> ( $\pm$ )                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Comments                                                                                      |
|-----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|
| DC Current – Clamp Meters         | (16.5 to 150) A<br>(150 to 1000) A<br>(1 to 5) kA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 0.51 % + 0.15 A<br>0.52 % + 0.54 A<br>0.6 % + 1 A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Fluke 5522A w/ Fluke 5500 coils<br>Fluke 5730A/52120A/<br>6KA coil                            |
| DC Current – Measure <sup>3</sup> | (10 to 20) pA<br>(20 to 200) pA<br>(0.2 to 2) nA<br>(2 to 20) nA<br><br>(20 to 100) nA<br>100 nA to 1 $\mu$ A<br>(1 to 10) $\mu$ A<br>(10 to 100) $\mu$ A<br>100 $\mu$ A to 1 mA<br>(1 to 10) mA<br>(10 to 100) mA<br>100 mA to 1A<br><br>(1 to 10) A<br>(10 to 30) A<br><br>(30 to 100) A<br>(100 to 700) A                                                                                                                                                                                                                                | 1.2 % + 3.5 fA<br>1.2 % + 6 fA<br>0.27 % + 0.32 pA<br>0.24 % + 0.6 pA<br><br>0.018 % + 60 pA<br>35 $\mu$ A/A + 60 pA<br>27 $\mu$ A/A + 0.14 nA<br>31 $\mu$ A/A + 1 nA<br>29 $\mu$ A/A + 7 nA<br>30 $\mu$ A/A + 70 nA<br>48 $\mu$ A/A + 0.7 $\mu$ A<br>0.014 % + 13 $\mu$ A<br><br>0.028 % + 0.43 mA<br>0.07 % + 4.4 mA<br><br>0.026 %<br>0.038 %                                                                                                                                                                                                                                                                                                                                                                          | Keithley 6517A<br><br>HP 3458A, option 002<br><br>Fluke 8588A<br><br>HP 3458A, current shunts |
| Resistance – Generate             | (0 to 10.9999) $\Omega$<br>(11 to 32.9999) $\Omega$<br>(33 to 109.9999) $\Omega$<br>(110 to 329.9999) $\Omega$<br>(0.33 to 1.099 999) k $\Omega$<br>(1.1 to 3.299 999) k $\Omega$<br>(3.3 to 10.999 99) k $\Omega$<br>(11 to 32.999 99) k $\Omega$<br>(33 to 109.9999) k $\Omega$<br>(110 to 329.9999) k $\Omega$<br>(0.33 to 1.099 999) M $\Omega$<br>(1.1 to 3.299 999) M $\Omega$<br>(3.3 to 10.999 99) M $\Omega$<br>(11 to 32.999 99) M $\Omega$<br>(33 to 109.9999) M $\Omega$<br>(110 to 330) M $\Omega$<br>(330 to 1100) M $\Omega$ | 32 $\mu\Omega/\Omega$ + 0.8 m $\Omega$<br>24 $\mu\Omega/\Omega$ + 1.2 m $\Omega$<br>22 $\mu\Omega/\Omega$ + 1.1 m $\Omega$<br>23 $\mu\Omega/\Omega$ + 1.6 m $\Omega$<br>22 $\mu\Omega/\Omega$ + 1.6 m $\Omega$<br>22 $\mu\Omega/\Omega$ + 16 m $\Omega$<br>22 $\mu\Omega/\Omega$ + 16 m $\Omega$<br>22 $\mu\Omega/\Omega$ + 0.16 $\Omega$<br>22 $\mu\Omega/\Omega$ + 0.16 $\Omega$<br>26 $\mu\Omega/\Omega$ + 5.4 $\Omega$<br>25 $\mu\Omega/\Omega$ + 5.4 $\Omega$<br>47 $\mu\Omega/\Omega$ + 39 $\Omega$<br>0.1 m $\Omega/\Omega$ + 54 $\Omega$<br>0.22 m $\Omega/\Omega$ + 2.1 k $\Omega$<br>0.39 m $\Omega/\Omega$ + 2.5 k $\Omega$<br>2.3 m $\Omega/\Omega$ + 79 k $\Omega$<br>12 m $\Omega/\Omega$ + 0.39 M $\Omega$ | Fluke 5522A                                                                                   |
| Fixed Points                      | 1 $\Omega$<br>10 k $\Omega$<br>19 k $\Omega$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 10 $\mu\Omega/\Omega$<br>5 $\mu\Omega/\Omega$<br>5.2 $\mu\Omega/\Omega$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Fluke 742A                                                                                    |



| Parameter/Equipment                                   | Range                                                                                                                                                                                                                                                                       | CMC <sup>2, 4</sup> (±)                                                                                                                                                                                                                                                                        | Comments                                                    |
|-------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------|
| Resistance – Generate (cont)                          |                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                |                                                             |
| Fixed Points                                          | 0 Ω<br>1 Ω<br>1.9 Ω<br>10 Ω<br>19 Ω<br>100 Ω<br>190 Ω<br>1 kΩ<br>1.9 kΩ<br>10 kΩ<br>19 kΩ<br>100 kΩ<br>190 kΩ<br>1 MΩ<br>1.9 MΩ<br>10 MΩ<br>19 MΩ<br>100 MΩ                                                                                                                 | 39 μΩ<br>85 μΩ/Ω<br>85 μΩ/Ω<br>21 μΩ/Ω<br>21 μΩ/Ω<br>9.3 μΩ/Ω<br>9.5 μΩ/Ω<br>6.3 μΩ/Ω<br>6.2 μΩ/Ω<br>6.3 μΩ/Ω<br>6.3 μΩ/Ω<br>7.8 μΩ/Ω<br>10 μΩ/Ω<br>12 μΩ/Ω<br>17 μΩ/Ω<br>36 μΩ/Ω<br>44 μΩ/Ω<br>98 μΩ/Ω                                                                                        | Fluke 5730A                                                 |
| High Resistance – Generate, Fixed Points <sup>3</sup> | 1 MΩ<br>10 MΩ<br>100 MΩ<br>1 GΩ<br>10 GΩ<br>100 GΩ<br>1 TΩ<br>10 TΩ                                                                                                                                                                                                         | 11 μΩ/Ω<br>16 μΩ/Ω<br>26 μΩ/Ω<br>46 μΩ/Ω<br>0.1 mΩ/Ω<br>0.14 mΩ/Ω<br>4 mΩ/Ω<br>12 mΩ/Ω                                                                                                                                                                                                         | Ohm-Labs high resistors                                     |
| Resistance – Measure <sup>3</sup>                     | (0 to 2) Ω<br>(2 to 20) Ω<br>(20 to 200) Ω<br>200 Ω to 2 kΩ<br>(2 to 20) kΩ<br>(20 to 200) kΩ<br>200 kΩ to 2 MΩ<br>(2 to 20) MΩ<br>(20 to 200) MΩ<br>200 MΩ to 2 GΩ<br>(2 to 20) GΩ<br><br>(0.1 to 2) GΩ<br>(2 to 20) GΩ<br>(20 to 200) GΩ<br>(0.2 to 2) TΩ<br>(2 to 10) TΩ | 12 μΩ/Ω + 4 μΩ<br>8.2 μΩ/Ω + 14 μΩ<br>7.2 μΩ/Ω + 0.05 mΩ<br>7.2 μΩ/Ω + 0.5 mΩ<br>7.2 μΩ/Ω + 5 mΩ<br>8.9 μΩ/Ω + 1 Ω<br>17 μΩ/Ω + 10 Ω<br>68 μΩ/Ω + 1 kΩ<br>0.02 μΩ/Ω + 0.1 MΩ<br>0.0053 % + 10 MΩ<br><br>0.27 % + 20 kΩ<br>0.27 % + 0.2 MΩ<br>0.44 % + 2 MΩ<br>0.44 % + 20 MΩ<br>1.3 % + 0.2 GΩ | Fluke 8588A<br><br>*High voltage mode<br><br>Keithley 6517A |



| Parameter/Equipment                                                                                                                      | Range                                                                                                                                                                                                                                                                                                                                          | CMC <sup>2, 4</sup> (±)                                                                                                                                                                                                                                                                                                     | Comments                                              |
|------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|
| Electrical Simulation of Thermocouple <sup>3</sup> –<br><br>Type J<br>Type K<br>Type T<br>Type N<br>Type E<br>Type B<br>Type S<br>Type R | <br><br>(-210 to 1200) °C<br>(-200 to 1372) °C<br>(-250 to 400) °C<br>(-200 to 1300) °C<br>(-250 to 1000) °C<br>(600 to 1820) °C<br>(0 to 1767) °C<br>(0 to 1767) °C                                                                                                                                                                           | <br><br>0.13 °C<br>0.13 °C<br>0.13 °C<br>0.14 °C<br>0.14 °C<br>0.15 °C<br>0.15 °C<br>0.15 °C                                                                                                                                                                                                                                | <br><br>Fluke 5522A w/ zero reference junction & SPRT |
| Capacitance – Measure <sup>3</sup>                                                                                                       | (0.1 to 1) nF<br>(1 to 10) nF<br>(10 to 100) nF<br>(0.1 to 1) µF<br>(1 to 10) µF<br>(10 to 100) µF<br>(0.1 to 1) mF<br>(1 to 10) mF<br>(10 to 100) mF                                                                                                                                                                                          | 0.12 % + 0.1 pF<br>0.066 % + 2 pF<br>0.041 % + 10 pF<br>0.042 % + 0.1 nF<br>0.044 % + 1 nF<br>0.062 % + 10 nF<br>0.063 % + 0.1 µF<br>0.075 % + 1 µF<br>0.074 % + 10 µF                                                                                                                                                      | Fluke 8588A                                           |
| Capacitance – Generate <sup>3</sup>                                                                                                      | (0.22 to 0.4) nF<br>(0.40 to 1.1) nF<br>(1.1 to 3.3) nF<br>(3.3 to 11) nF<br>(11 to 33) nF<br>(33 to 110) nF<br>(0.11 to 0.33) µF<br>(0.33 to 1.1) µF<br>(1.1 to 3.3) µF<br>(3.3 to 11) µF<br>(11 to 33) µF<br>(33 to 110) µF<br>(0.11 to 0.33) mF<br>(0.33 to 1.1) mF<br>(1.1 to 3.3) mF<br>(3.3 to 11) mF<br>(11 to 33) mF<br>(33 to 110) mF | 0.45 % + 8 pF<br>0.39 % + 8 pF<br>0.46 % + 8 pF<br>0.2 % + 8 pF<br>0.2 % + 80 pF<br>0.2 % + 80 pF<br>0.2 % + 0.24 nF<br>0.2 % + 0.8 nF<br>0.2 % + 2.4 nF<br>0.2 % + 8 nF<br>0.31 % + 24 nF<br>0.35 % + 80 nF<br>0.35 % + 0.24 µF<br>0.35 % + 0.8 µF<br>0.35 % + 2.4 µF<br>0.35 % + 8 µF<br>0.58 % + 24 µF<br>0.85 % + 80 µF | Fluke 5522A                                           |

| Parameter/Range                   | Frequency                                                              | CMC <sup>2, 4, 5</sup> (±)                                              | Comments       |
|-----------------------------------|------------------------------------------------------------------------|-------------------------------------------------------------------------|----------------|
| Capacitance Generate <sup>3</sup> |                                                                        |                                                                         |                |
| Fixed Point:                      |                                                                        |                                                                         |                |
| 1 pF                              | 1 kHz to 1 MHz<br>2 MHz<br>3 MHz<br>4 MHz<br>5 MHz<br>10 MHz<br>13 MHz | 0.037 %<br>0.027 %<br>0.044 %<br>0.065 %<br>0.089 %<br>0.25 %<br>0.37 % | Agilent 16380A |
| 10 pF                             | 1 kHz to 1 MHz<br>2 MHz/3 MHz<br>4 MHz/5 MHz<br>10 MHz<br>13 MHz       | 0.011 %<br>0.011 %<br>0.012 %<br>0.016 %<br>0.019 %                     |                |
| 100 pF                            | 1 kHz to 1 MHz<br>2 MHz/3 MHz<br>4 MHz<br>5 MHz<br>10 MHz<br>13 MHz    | 0.011 %<br>0.012 %<br>0.014 %<br>0.017 %<br>0.035 %<br>0.050 %          |                |
| 1000 pF                           | 1 kHz to 1 MHz<br>2 MHz<br>3 MHz<br>4 MHz<br>5 MHz<br>10 MHz<br>13 MHz | 0.012 %<br>0.015 %<br>0.030 %<br>0.046 %<br>0.063 %<br>0.19 %<br>0.28 % |                |
|                                   |                                                                        |                                                                         |                |
| 10 nF                             | (100/120) Hz<br>(1/10/100) kHz                                         | 0.014 %<br>0.014 %                                                      | Agilent 16380C |
| 100 nF                            | (100/120) Hz<br>(1/10/100) kHz                                         | 0.014 %<br>0.014 %                                                      |                |
| 1000 nF                           | (100/120) Hz/1 kHz<br>10 kHz<br>100 kHz                                | 0.014 %<br>0.021 %<br>0.70 %                                            |                |
|                                   |                                                                        |                                                                         |                |

| Parameter/Range                    | Frequency                                                                                                                                          | CMC <sup>2, 4</sup> ( $\pm$ )                                                                                                                                                                                             | Comments                 |
|------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| AC Voltage – Generate <sup>3</sup> |                                                                                                                                                    |                                                                                                                                                                                                                           |                          |
| 300 $\mu$ V to 2.2 mV              | (10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 300) kHz<br>(300 to 500) kHz<br>(0.5 to 1.0) MHz | 0.25 mV/V + 4.0 $\mu$ V<br>90 $\mu$ V/V + 4.0 $\mu$ V<br>90 $\mu$ V/V + 4.0 $\mu$ V<br>0.20 mV/V + 4.0 $\mu$ V<br>0.50 mV/V + 5.0 $\mu$ V<br>1.0 mV/V + 10 $\mu$ V<br>1.4 mV/V + 20 $\mu$ V<br>2.7 mV/V + 20 $\mu$ V      | Fluke 5730A, Fluke 5725A |
| (2.2 to 22) mV                     | (10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 300) kHz<br>(300 to 500) kHz<br>(0.5 to 1.0) MHz | 0.24 mV/V + 4.0 $\mu$ V<br>90 $\mu$ V/V + 4.0 $\mu$ V<br>80 $\mu$ V/V + 4.0 $\mu$ V<br>0.20 mV/V + 4.0 $\mu$ V<br>0.47 mV/V + 4.0 $\mu$ V<br>1.0 mV/V + 10 $\mu$ V<br>1.4 mV/V + 20 $\mu$ V<br>1.4 mV/V + 20 $\mu$ V      |                          |
| (22 to 220) mV                     | (10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 300) kHz<br>(300 to 500) kHz<br>(0.5 to 1.0) MHz | 0.24 mV/V + 12 $\mu$ V<br>90 $\mu$ V/V + 6.2 $\mu$ V<br>54 $\mu$ V/V + 6.2 $\mu$ V<br>0.12 mV/V + 6.2 $\mu$ V<br>0.31 mV/V + 16 $\mu$ V<br>0.62 mV/V + 20 $\mu$ V<br>1.4 mV/V + 24 $\mu$ V<br>2.7 mV/V + 47 $\mu$ V       |                          |
| 220 mV to 2.2 V                    | (10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 300) kHz<br>(300 to 500) kHz<br>(0.5 to 1.0) MHz | 0.24 mV/V + 40 $\mu$ V<br>85 $\mu$ V/V + 16 $\mu$ V<br>37 $\mu$ V/V + 8 $\mu$ V<br>62 $\mu$ V/V + 10 $\mu$ V<br>77 $\mu$ V/V + 31 $\mu$ V<br>0.31 mV/V + 80 $\mu$ V<br>0.93 mV/V + 0.2 $\mu$ V<br>1.6 mV/V + 0.31 $\mu$ V |                          |
| (2.2 to 22) V                      | (10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 300) kHz<br>(300 to 500) kHz<br>(0.5 to 1.0) MHz | 0.24 mV/V + 0.4 mV<br>85 $\mu$ V/V + 0.16 mV<br>38 $\mu$ V/V + 54 $\mu$ V<br>62 $\mu$ V/V + 93 $\mu$ V<br>77 $\mu$ V/V + 0.2 mV<br>0.24 mV/V + 0.62 mV<br>0.93 mV/V + 2 mV<br>1.4 mV/V + 3.1 mV                           |                          |
| (22 to 220) V                      | (10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz<br>(50 to 100) kHz                                                             | 0.24 mV/V + 4 mV<br>0.85 mV/V + 1.5 mV<br>51 $\mu$ V/V + 0.5 mV<br>80 $\mu$ V/V + 1 mV<br>0.15 mV/V + 2.4 mV                                                                                                              |                          |

| Parameter/Range                           | Frequency                                                                                                    | CMC <sup>2, 4, 6</sup> ( $\pm$ )                                                                                                          | Comments                 |
|-------------------------------------------|--------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| AC Voltage – Generate <sup>3</sup> (cont) |                                                                                                              |                                                                                                                                           |                          |
| (220 to 750) V                            | 40 Hz to 1 kHz<br>(1 to 20) kHz<br>(20 to 50) kHz<br>(50 to 100) kHz                                         | 72 $\mu$ V/V + 3.1 mV<br>0.13 mV/V + 4.7 mV<br>0.47 mV/V + 8.5 mV<br>0.2 % + 35 mV                                                        | Fluke 5730A, Fluke 5725A |
| (750 to 1100) V                           | 40 Hz to 1 kHz<br>(1 to 20) kHz<br>(20 to 30) kHz                                                            | 70 $\mu$ V/V + 3.1 mV<br>0.13mV/V + 4.7 mV<br>0.47mV/V + 8.5 mV                                                                           |                          |
| AC Voltage – Measure <sup>3</sup>         |                                                                                                              |                                                                                                                                           |                          |
| Up to 10 mV                               | 1 Hz to 2 kHz<br>(2 to 10) kHz<br>(10 to 30) kHz<br>(30 to 100) kHz<br>(100 to 300) kHz<br>(300 to 1000) kHz | 0.026 % + 1.1 $\mu$ V<br>0.034 % + 1.1 $\mu$ V<br>0.035 % + 1.1 $\mu$ V<br>0.03 % + 0.8 $\mu$ V<br>1 % + 4 $\mu$ V<br>2.1 % + 3.8 $\mu$ V | Fluke 8588A              |
| (10 to 100) mV                            | 1 Hz to 2 kHz<br>(2 to 10) kHz<br>(10 to 30) kHz<br>(30 to 100) kHz<br>(100 to 300) kHz<br>(300 to 1000) kHz | 0.007 % + 0.5 $\mu$ V<br>0.012 % + 0.5 $\mu$ V<br>0.024 % + 1 $\mu$ V<br>0.055 % + 5 $\mu$ V<br>0.23 % + 31 $\mu$ V<br>1.2 % + 0.1 mV     |                          |
| 100 mV to 1 V                             | 1 Hz to 2 kHz<br>(2 to 10) kHz<br>(10 to 30) kHz<br>(30 to 100) kHz<br>(100 to 300) kHz<br>(300 to 1000) kHz | 0.0073 % + 5 $\mu$ V<br>0.012 % + 5 $\mu$ V<br>0.022 % + 0.01 mV<br>0.053 % + 0.05 mV<br>0.21 % + 0.3 mV<br>1 % + 1 mV                    |                          |
| (1 to 10) V                               | 1 Hz to 2 kHz<br>(2 to 10) kHz<br>(10 to 30) kHz<br>(30 to 100) kHz<br>(100 to 300) kHz<br>(300 to 1000) kHz | 0.0066 % + 0.05 mV<br>0.012 % + 0.05 mV<br>0.022 % + 0.1 mV<br>0.052 % + 0.5 mV<br>0.21 % + 3.1 mV<br>1.1 % + 10 mV                       |                          |

| Parameter/Range                                             | Frequency                                                                                                                                          | CMC <sup>2, 4</sup> ( $\pm$ )                                                                                                                                                                                            | Comments            |
|-------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| AC Voltage – Measure <sup>3</sup> (cont)                    |                                                                                                                                                    |                                                                                                                                                                                                                          |                     |
| (10 to 100) V                                               | 1 Hz to 2 kHz<br>(2 to 10) kHz<br>(10 to 30) kHz<br>(30 to 100) kHz<br>(100 to 300) kHz<br>(300 to 1000) kHz                                       | 0.007 % + 0.5 mV<br>0.0091 % + 0.5 mV<br>0.022 % + 1 mV<br>0.052 % + 5 mV<br>0.35 % + 47 mV<br>1.1 % + 0.5 V                                                                                                             | Fluke 8588A         |
| (100 to 1000) V                                             | 1 Hz to 2 kHz<br>(2 to 10) kHz<br>(10 to 30) kHz<br>(30 to 100) kHz                                                                                | 0.0094 % + 25 mV<br>0.0093 % + 25 mV<br>0.023 % + 25 mV<br>0.054 % + 0.1 V                                                                                                                                               | Fluke 8588A         |
| High Voltage:<br>(1000 to 10 000) V<br>(10 000 to 50 000) V | 60 Hz<br>60 Hz                                                                                                                                     | 0.18 % + 0.6R<br>0.14 % + 0.6R                                                                                                                                                                                           | Vitrek 4700/HLV- 70 |
| 2.2 mV                                                      | (10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 300) kHz<br>(300 to 500) kHz<br>(0.5 to 1.0) MHz | 1.4 mV/V + 1 $\mu$ V<br>0.58 mV/V + 1 $\mu$ V<br>0.33 mV/V + 1 $\mu$ V<br>0.62 mV/V + 1.6 $\mu$ V<br>0.93 mV/V + 2 $\mu$ V<br>1.8 mV/V + 3.1 $\mu$ V<br>1.9 mV/V + 6.2 $\mu$ V<br>2.7 mV/V + 6.2 $\mu$ V                 | Fluke 5790B         |
| (2.2 to 7) mV                                               | (10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 300) kHz<br>(300 to 500) kHz<br>(0.5 to 1.0) MHz | 0.66 mV/V + 1 $\mu$ V<br>0.29 mV/V + 1 $\mu$ V<br>0.17 mV/V + 1 $\mu$ V<br>0.32 mV/V + 1.5 $\mu$ V<br>0.48 mV/V + 2 $\mu$ V<br>0.93 mV/V + 3.1 $\mu$ V<br>1 mV/V + 6.2 $\mu$ V<br>1.8 mV/V + 6.2 $\mu$ V                 |                     |
| (7 to 22) mV                                                | (10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 300) kHz<br>(300 to 500) kHz<br>(0.5 to 1.0) MHz | 0.24 mV/V + 1 $\mu$ V<br>0.15 mV/V + 1 $\mu$ V<br>85 $\mu$ V/V + 1 $\mu$ V<br>0.17 mV/V + 1.6 $\mu$ V<br>0.25 mV/V + 2 $\mu$ V<br>0.63 mV/V + 3.1 $\mu$ V<br>0.7 mV/V + 6.2 $\mu$ V<br>1.4 mV/V + 6.2 $\mu$ V            |                     |
| (22 to 70) mV                                               | (10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 300) kHz<br>(300 to 500) kHz<br>(0.5 to 1.0) MHz | 0.19 mV/V + 1.2 $\mu$ V<br>93 $\mu$ V/V + 1.2 $\mu$ V<br>51 $\mu$ V/V + 1.2 $\mu$ V<br>0.17 mV/V + 1.5 $\mu$ V<br>0.25 mV/V + 2 $\mu$ V<br>0.63 mV/V + 3.1 $\mu$ V<br>0.52 mV/V + 6.2 $\mu$ V<br>0.86 mV/V + 6.2 $\mu$ V |                     |

| Parameter/Range                          | Frequency                                                                                                                                          | CMC <sup>2, 4</sup> (±)                                                                                                                                            | Comments    |
|------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| AC Voltage – Measure <sup>3</sup> (cont) |                                                                                                                                                    |                                                                                                                                                                    |             |
| (70 to 220) mV                           | (10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 300) kHz<br>(300 to 500) kHz<br>(0.5 to 1.0) MHz | 0.18 mV/V + 1.2 µV<br>66 µV/V + 1.2 µV<br>30 µV/V + 1.2 µV<br>54 µV/V + 1.6 µV<br>0.13 mV/V + 2 µV<br>0.2 mV/V + 3.1 µV<br>0.3 mV/V + 6.2 µV<br>0.78 mV/V + 6.2 µV | Fluke 5790B |
| (220 to 700) mV                          | (10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 300) kHz<br>(300 to 500) kHz<br>(0.5 to 1.0) MHz | 0.17 mV/V + 1.2 µV<br>60 µV/V + 1.2 µV<br>26 µV/V + 1.2 µV<br>40 µV/V + 1.5 µV<br>62 µV/V + 2 µV<br>0.14 mV/V + 3.1 µV<br>0.24 mV/V + 6.2 µV<br>0.75 mV/V + 6.2 µV |             |
| 700 mV to 2.2 V                          | (10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 300) kHz<br>(300 to 500) kHz<br>(0.5 to 1.0) MHz | 0.16 mV/V<br>52 µV/V<br>20 µV/V<br>36 µV/V<br>55 µV/V<br>0.13 mV/V<br>0.2 mV/V<br>0.7 mV/V                                                                         |             |
| (2.2 to 7) V                             | (10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 300) kHz<br>(300 to 500) kHz<br>(0.5 to 1.0) MHz | 0.16 mV/V<br>52 µV/V<br>19 µV/V<br>38 µV/V<br>64 µV/V<br>0.15 mV/V<br>0.32 mV/V<br>0.94 mV/V                                                                       |             |
| (7 to 22) V                              | (10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 300) kHz<br>(300 to 500) kHz<br>(0.5 to 1.0) MHz | 0.16 mV/V<br>52 µV/V<br>21 µV/V<br>37 µV/V<br>64 µV/V<br>0.15 mV/V<br>0.31 mV/V<br>0.95 mV/V                                                                       |             |

| Parameter/Range                          | Frequency                                                                                                                                          | CMC <sup>2, 4, 5</sup> ( $\pm$ )                                                                                                        | Comments    |
|------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|-------------|
| AC Voltage – Measure <sup>3</sup> (cont) |                                                                                                                                                    |                                                                                                                                         |             |
| (22 to 70) V                             | (10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 300) kHz<br>(300 to 500) kHz<br>(0.5 to 1.0) MHz | 0.16 mV/V<br>54 $\mu$ V/V<br>26 $\mu$ V/V<br>44 $\mu$ V/V<br>74 $\mu$ V/V<br>0.16 mV/V<br>1.4 mV/V<br>1.4 mV/V                          | Fluke 5790B |
| (70 to 220) V                            | (10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 300) kHz<br>(300 to 500) kHz                     | 0.16 mV/V<br>55 $\mu$ V/V<br>25 $\mu$ V/V<br>55 $\mu$ V/V<br>80 $\mu$ V/V<br>1.4 mV/V<br>1.4 mV/V                                       |             |
| (220 to 700) V                           | (15 to 50) Hz<br>50 Hz to 1 kHz<br>(1 to 20) kHz<br>(20 to 50) kHz<br>(50 to 100) kHz                                                              | 1.6 mV/V<br>80 $\mu$ V/V<br>32 $\mu$ V/V<br>0.11 mV/V<br>0.4 mV/V                                                                       |             |
| (700 to 1000) V                          | (15 to 50) Hz<br>50 Hz to 1 kHz<br>(1 to 20) kHz<br>(20 to 50) kHz<br>(50 to 100) kHz                                                              | 1.4 mV/V<br>80 $\mu$ V/V<br>30 $\mu$ V/V<br>1.4 mV/V<br>1.4 mV/V                                                                        |             |
| AC Voltage Flatness Measure <sup>3</sup> |                                                                                                                                                    |                                                                                                                                         |             |
| 2.2 mV                                   | 30 Hz<br>120 kHz<br>2 MHz<br>10 MHz<br>20 MHz<br>30 MHz<br>50 MHz                                                                                  | 0.08 %<br>0.04 %<br>0.06 % + 0.8 $\mu$ V<br>0.14 % + 0.8 $\mu$ V<br>0.24 % + 0.8 $\mu$ V<br>0.54 % + 1.6 $\mu$ V<br>0.8 % + 1.6 $\mu$ V | Fluke 5790B |
| (2.2 to 7) mV                            | 30 Hz<br>120 kHz<br>2 MHz<br>10 MHz<br>20 MHz<br>30 MHz<br>50 MHz                                                                                  | 0.08 %<br>0.04 %<br>0.06 % + 0.8 $\mu$ V<br>0.08 % + 0.8 $\mu$ V<br>0.14 % + 0.8 $\mu$ V<br>0.3 % + 0.8 $\mu$ V<br>0.4 % + 0.8 $\mu$ V  |             |



| Parameter/Range                                    | Frequency                                                         | CMC <sup>2, 4, 5</sup> (±)                                          | Comments    |
|----------------------------------------------------|-------------------------------------------------------------------|---------------------------------------------------------------------|-------------|
| AC Voltage Flatness Measure <sup>3</sup><br>(cont) |                                                                   |                                                                     |             |
| (7 to 22) mV                                       | 30 Hz<br>120 kHz<br>2 MHz<br>10 MHz<br>20 MHz<br>30 MHz<br>50 MHz | 0.08 %<br>0.04 %<br>0.054 %<br>0.08 %<br>0.14 %<br>0.29 %<br>0.47 % | Fluke 5790B |
| (22 to 70) mV                                      | 30 Hz<br>2 MHz<br>10 MHz<br>20 MHz<br>30 MHz<br>50 MHz            | 0.08 %<br>0.04 %<br>0.08 %<br>0.12 %<br>0.27 %<br>0.47 %            |             |
| (70 to 220) mV                                     | 30 Hz<br>500kHz<br>2 MHz<br>10 MHz<br>20 MHz<br>30 MHz<br>50 MHz  | 0.08 %<br>0.04 %<br>0.04 %<br>0.08 %<br>0.12 %<br>0.27 %<br>0.47 %  |             |
| (220 to 700) mV                                    | 30 Hz<br>500kHz<br>2 MHz<br>10 MHz<br>20 MHz<br>30 MHz<br>50 MHz  | 0.08 %<br>0.03 %<br>0.04 %<br>0.08 %<br>0.12 %<br>0.27 %<br>0.47 %  |             |
| 700 mV to 2.2 V                                    | 30 Hz<br>500kHz<br>2 MHz<br>10 MHz<br>20 MHz<br>30 MHz<br>50 MHz  | 0.08 %<br>0.03 %<br>0.04 %<br>0.08 %<br>0.12 %<br>0.27 %<br>0.47 %  |             |
| (2.2 to 7) V                                       | 30 Hz<br>500kHz<br>2 MHz<br>10 MHz<br>20 MHz<br>30 MHz<br>50 MHz  | 0.08 %<br>0.03 %<br>0.04 %<br>0.08 %<br>0.12 %<br>0.27 %<br>0.47 %  |             |



| Parameter/Range                                                                                                            | Frequency                                                                                                                                                  | CMC <sup>2</sup> -4 (±)                                                                                                                                           | Comments               |
|----------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| AC Current – Generate <sup>3</sup>                                                                                         |                                                                                                                                                            |                                                                                                                                                                   |                        |
| (29 to 330) µA<br>(0.33 to 3.3) mA<br>(3.3 to 33) mA<br>(33 to 330) mA<br>(0.33 to 1.1) A<br>(1.1 to 3) A<br>(3 to 20.5) A | (10 to 30) kHz<br>(10 to 30) kHz<br>(10 to 30) kHz<br>(10 to 30) kHz<br>(10 to 45) Hz<br>(10 to 45) Hz<br>(45 to 100) Hz<br>100 Hz to 1kHz<br>(1 to 5) kHz | 1.3 % + 0.31 µA<br>0.77 % + 0.47 µA<br>0.31 % + 3.1 µA<br>0.31 % + 0.16 mA<br>0.14 % + 77 µA<br>0.14 % + 77 µA<br>0.093 % + 5 mA<br>0.12 % + 5 mA<br>2.4 % + 5 mA | Fluke 5522A            |
| Up to 220 µA                                                                                                               | (10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz                                                                          | 0.024 % + 16 nA<br>0.016 % + 10 nA<br>0.01 % + 8 nA<br>0.028 % + 12 nA<br>0.1 % + 62 nA                                                                           | Fluke5730A/5725A       |
| 220 µA to 2.2 mA                                                                                                           | (10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz                                                                          | 0.024 % + 39 nA<br>0.016 % + 31 nA<br>0.01 % + 31 nA<br>0.019 % + 0.1 µA<br>0.1 % + 0.62 µA                                                                       |                        |
| (2.2 to 22) mA                                                                                                             | (10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz                                                                          | 0.024 % + 0.39 µA<br>0.016 % + 0.31 µA<br>0.01 % + 0.31 µA<br>0.019 % + 0.54 µA<br>0.1 % + 4.7 µA                                                                 |                        |
| (22 to 220) mA                                                                                                             | (10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz                                                                          | 0.024 % + 3.8 µA<br>0.016 % + 3.1 µA<br>0.01 % + 2.4 µA<br>0.019 % + 3.1 µA<br>0.1 % + 9.3 µA                                                                     |                        |
| 220 mA to 2.2 A                                                                                                            | 20 Hz to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz                                                                                                            | 0.024 % + 31 µA<br>0.039 % + 77 µA<br>0.62 % + 0.16 mA                                                                                                            |                        |
| (2.2 to 11) A                                                                                                              | 20 Hz to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz                                                                                                            | 0.036 % + 0.14 mA<br>0.078 % + 0.3 mA<br>0.28 % + 0.6 mA                                                                                                          |                        |
| Up to 120 A                                                                                                                | (10 to 65) Hz<br>(65 to 300) Hz<br>(0.3 to 1) kHz                                                                                                          | 0.026 % + 29 mA<br>0.024 % + 46 mA<br>0.077 % + 0.13 mA                                                                                                           | Fluke 5730A<br>/52120A |

| Parameter/Range      | Frequency                                                           | CMC <sup>2, 4</sup> (±)                                                   | Comments                        |
|----------------------|---------------------------------------------------------------------|---------------------------------------------------------------------------|---------------------------------|
| Clamp On Meters      |                                                                     |                                                                           |                                 |
| (16.5 to 150) A      | (45 to 65) Hz<br>(65 to 400) Hz                                     | 0.31 % + 0.03 A<br>0.86 % + 0.032 A                                       | Fluke 5522A<br>w/5500 coil      |
| (150 to 1025) A      | (45 to 5) Hz<br>(65 to 400) Hz                                      | 0.34 % + 0.19 A<br>1.2 % + 0.35 A                                         |                                 |
| (1000 to 6000) A     | (10 to 1000) Hz                                                     | 0.58 % + 1 A                                                              | Fluke 5730A/<br>52120A/6KA coil |
| AC Current – Measure |                                                                     |                                                                           |                                 |
| Up to 20 µA          | 1 Hz to 2 kHz<br>(2 to 10) kHz<br>(10 to 30) kHz                    | 0.2 % + 2.5 nA<br>0.20 % + 2.5 nA<br>0.23 % + 2.5 nA                      | Fluke 8588A                     |
| (20 to 200) µA       | 1 Hz to 2 kHz<br>(2 to 10) kHz<br>(10 to 30) kHz<br>(30 to 100) kHz | 0.026 % + 5 nA<br>0.051 % + 5 nA<br>0.072 % + 5 nA<br>0.45 % + 10 nA      |                                 |
| 200 µA to 2 mA       | 1 Hz to 2 kHz<br>(2 to 10) kHz<br>(10 to 30) kHz<br>(30 to 100) kHz | 0.026 % + 50 nA<br>0.051 % + 50 nA<br>0.072 % + 50 nA<br>0.45 % + 0.1 µA  |                                 |
| (2 to 20) mA         | 1 Hz to 2 kHz<br>(2 to 10) kHz<br>(10 to 30) kHz<br>(30 to 100) kHz | 0.026 % + 0.5 µA<br>0.051 % + 0.5 µA<br>0.072 % + 0.5 µA<br>0.46 % + 1 µA |                                 |
| (20 to 200) mA       | 1 Hz to 2 kHz<br>(2 to 10) kHz<br>(10 to 30) kHz                    | 0.026 % + 5 µA<br>0.05 % + 5 µA<br>0.07 % + 5 µA                          |                                 |
| 200 mA to 2 A        | 1 Hz to 2 kHz<br>2 to 10) kHz<br>(10 to 30) kHz                     | 0.026 % + 0.1 mA<br>0.051 % + 0.1 mA<br>0.084 % + 0.1 mA                  |                                 |
| (2 to 20) A          | 10 Hz to 2 kHz<br>(2 to 10) kHz                                     | 0.08 % + 0.5 mA<br>0.08 % + 0.5 mA                                        |                                 |
| (20 to 30) A         | 10 Hz to 2 kHz<br>(2 to 5) kHz                                      | 0.08 % + 12 mA<br>0.12 % + 12 mA                                          |                                 |

| Parameter/Range             | Frequency                                                                                                                                  | CMC <sup>2, 4, 5</sup> (±)                                                              | Comments            |
|-----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|---------------------|
| AC Current – Measure (cont) |                                                                                                                                            |                                                                                         |                     |
| Up to 1 mA                  | (10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 1 kHz<br>(1 to 10) kHz<br>(10 to 30) kHz<br>(30 to 50) kHz<br>(50 to 100) kHz                   | 0.017 %<br>0.0075 %<br>0.006 %<br>0.0078 %<br>0.0083 %<br>0.016 %<br>0.017 %            | Fluke 8588A         |
| (1 to 10) mA                | (10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz<br>(50 to 100) kHz                                                     | 0.016 %<br>0.0058 %<br>0.0033 %<br>0.0044 %<br>0.0069 %                                 |                     |
| (10 to 200) mA              | (10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz<br>(50 to 100) kHz                                                     | 0.016 %<br>0.0058 %<br>0.0033 %<br>0.0044 %<br>0.006 %                                  | Fluke<br>5790B/A40B |
| (0.2 to 2) A                | (10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 1 kHz<br>(1 to 10) kHz<br>(10 to 30) kHz<br>(30 to 50) kHz<br>(50 to 100) kHz                   | 0.016 %<br>0.0058 %<br>0.0035 %<br>0.0038 %<br>0.0085 %<br>0.0068 %<br>0.008 %          |                     |
| (2 to 20) A                 | (10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 1 kHz<br>(1 to 10) kHz<br>(10 to 20) kHz<br>(20 to 30) kHz<br>(30 to 100) kHz                   | 0.017 %<br>0.0068 %<br>0.0048 %<br>0.0057 %<br>0.0079 %<br>0.0085 %<br>0.013 %          |                     |
| (20 to 100) A               | (10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 1 kHz<br>(1 to 10) kHz<br>(10 to 20) kHz<br>(20 to 30) kHz<br>(30 to 50) kHz<br>(50 to 100) kHz | 0.018 %<br>0.0085 %<br>0.0069 %<br>0.0095 %<br>0.011 %<br>0.011 %<br>0.018 %<br>0.019 % |                     |

| Parameter/Equipment                                                              | Range                                                                            | CMC <sup>2, 4, 5</sup> ( $\pm$ )                                                         | Comments                     |
|----------------------------------------------------------------------------------|----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|------------------------------|
| Oscilloscopes <sup>3</sup> –                                                     |                                                                                  |                                                                                          |                              |
| Amplitude DC Signal:<br>Into 50 $\Omega$ Load<br>Into 1 M $\Omega$ Load          | (-6.6 to 6.6) V<br>(-130 to 130) V                                               | 0.25 % + 40 $\mu$ V<br>0.050 % + 40 $\mu$ V                                              | Fluke<br>5522A/SC1100        |
| Rise Time                                                                        | < 300 ps                                                                         | +0 ps/-100 ps                                                                            |                              |
| Leveled Sine Wave<br>Flatness, Relative to<br>50 kHz, 5 mV(p-p) to<br>5.5 V(p-p) | 50 Hz to 100 MHz<br>(100 to 300) MHz<br>(300 to 600) MHz<br>600 MHz to 1.1 GHz   | 1.5 % + 100 $\mu$ V<br>2.0 % + 100 $\mu$ V<br>4.0 % + 100 $\mu$ V<br>5.0 % + 100 $\mu$ V |                              |
| Time Marker<br>Into 50 $\Omega$ Load                                             | (5 to 50) ms<br>20 ms to 2 ns                                                    | (25 + 1000t) parts in 10 <sup>6</sup><br>2.5 parts in 10 <sup>6</sup>                    | t is time in seconds         |
| Bandwidth                                                                        | (0.1 to 300) MHz<br>(300 to 550) MHz<br>550 MHz to 1.1 GHz<br>1.1 GHz to 3.2 GHz | 2 %<br>2.7 %<br>3.3 %<br>4.1 %                                                           | Fluke 9500B/9530             |
| Time Marker                                                                      | 9.0091 ns to 83 $\mu$ s<br>83 $\mu$ s to 55 s                                    | 0.22 $\mu$ s/s<br>2.4 $\mu$ s/s                                                          |                              |
| Voltage:                                                                         |                                                                                  |                                                                                          |                              |
| DC Into 1 M $\Omega$                                                             | $\pm$ 1 mV to 200 V                                                              | 0.024 % + 20 $\mu$ V                                                                     |                              |
| DC Into 50 $\Omega$                                                              | $\pm$ 1 mV to 5 V                                                                | 0.024 % + 20 $\mu$ V                                                                     |                              |
| Squarewave Into 1 M $\Omega$                                                     | 40 $\mu$ V + 200 Vp-p                                                            | 0.08 % + 8 $\mu$ V                                                                       |                              |
| Squarewave Into 50 $\Omega$                                                      | 40 $\mu$ V + 5 Vp-p                                                              | 0.08 % + 8 $\mu$ V                                                                       |                              |
| Risetime                                                                         | 10 Hz to 2 MHz                                                                   | 22 ps                                                                                    |                              |
| Tachometers <sup>3</sup>                                                         | (6 to 99 999) RPM                                                                | 0.004 %                                                                                  | Frequency standard<br>w/ LED |
| Phase – Measure (0 to 360) <sup>3</sup>                                          | 5 Hz to 2 kHz<br>(2 to 5) kHz<br>(5 to 10) kHz<br>(10 to 50) kHz                 | 0.03°<br>0.04°<br>0.05°<br>0.06°                                                         | Clark Hess 6000A             |

# VI. Electrical – RF/Microwave

| Parameter/Range                                                                                                                                                                                                                                                                              | Frequency                                                                                   | CMC <sup>2, 4, 5</sup> (±)                                                                                                       | Comments                                                            |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|
| Power Sensor – Calibration Factors<br><br>(-30 to 20) dBm<br>(-30 to 20) dBm                                                                                                                                                                                                                 | 0.1 MHz to 4.2 GHz<br>50 MHz to 26.5 GHz                                                    | 2.8 % CF<br>3.5 % CF                                                                                                             | Agilent power sensors 8482A & 8485A<br><br>CF is calibration factor |
| Amplitude Modulation <sup>3</sup> –<br><br>Carrier: (0.15 to 10) MHz<br>Depth: Up to 99 %<br><br>Carrier: 10 MHz to 1.3 GHz<br>Depth: Up to 99 %                                                                                                                                             | (20 to 50) Hz<br>50 Hz to 10 kHz<br><br>(20 to 50) Hz<br>50 Hz to 50 kHz<br>(50 to 100) kHz | 3.8 %<br>2.7 %<br><br>3.8 %<br>1.6 %<br>3.8 %                                                                                    | HP 8902A measuring receiver w/ 11722A power sensor                  |
| Frequency Modulation <sup>3</sup> –<br><br>Carrier: 250 kHz to 10 MHz<br>Dev: Up to 40 kHz<br><br>Carrier: 10 MHz to 1.3 GHz<br>Dev: Up to 400 kHz                                                                                                                                           | 20 Hz to 10 kHz<br><br>(20 to 50) Hz<br>50 Hz to 100 kHz<br>(100 to 200) kHz                | 2.9 %<br><br>5.9 %<br>1.3 %<br>5.9 %                                                                                             | HP 8902A measuring receiver w/ 11722A power sensor                  |
| Phase Modulation <sup>3</sup> –<br><br>Carrier: 150 kHz to 10 MHz<br>Carrier: 10 MHz to 1.3 GHz                                                                                                                                                                                              | 200 Hz to 10 kHz<br>200 Hz to 20 kHz                                                        | 4.8 %<br>3.7 %                                                                                                                   | HP 8902A measuring receiver w/ 11722A power sensor                  |
| Absolute Power – Measure <sup>3</sup><br><br>(0 to -10) dBm<br>(-10 to -20) dBm<br>(-20 to -30) dBm<br>(-30 to -40) dBm<br>(-40 to -50) dBm<br>(-50 to -60) dBm<br>(-60 to -70) dBm<br>(-70 to -80) dBm<br>(-80 to -90) dBm<br>(-90 to -100) dBm<br>(-100 to -110) dBm<br>(-110 to -120) dBm | 10 MHz to 26.5 GHz                                                                          | 0.08 dB<br>0.10 dB<br>0.12 dB<br>0.13 dB<br>0.15 dB<br>0.17 dB<br>0.20 dB<br>0.23 dB<br>0.28 dB<br>0.33 dB<br>0.39 dB<br>0.43 dB | HP 8902A measuring receiver w/ 11722A & 11792A power sensors        |



## VII. Fluid Quantities

| Parameter/Equipment        | Range <sup>7</sup>                                                                                                                | CMC <sup>2, 5, 8</sup> (±)                                                                  | Comments                                                              |
|----------------------------|-----------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|
| Flow – Gas <sup>3</sup>    | (0.5 to 5) sccm<br>(5 to 50) sccm<br>(0.05 to 0.5) lpm<br>(0.5 to 5) lpm<br>(3 to 30) lpm<br>(30 to 100) lpm<br>(100 to 2500) lpm | 1.2 % Rdg<br>1.2 % Rdg<br>0.28 % Rdg<br>0.26 % Rdg<br>0.42 % Rdg<br>0.65 % Rdg<br>1.2 % Rdg | DH instruments flow meter calibrator Molbox1<br><br>Alicat MCR2500SLM |
| Flow – Liquid <sup>3</sup> | (0.02 to 3) gpm<br>(0.5 to 60.0) gpm<br>(1.5 to 160) gpm<br><br>(0.1 to 10) gpm<br>(10 to 400) gpm                                | 0.11 % Rdg<br>0.09 % Rdg<br>0.09 % Rdg<br><br>0.067 % Rdg<br>0.079 % Rdg                    | Flow technology turbine meter<br><br>Compuflow test stand             |

## VIII. Magnetic Quantities

| Parameter/Equipment      | Range <sup>7</sup> | CMC <sup>2, 5, 8</sup> (±) | Comments                           |
|--------------------------|--------------------|----------------------------|------------------------------------|
| Gauss Meter <sup>3</sup> | (1 to 200) Gauss   | 0.88 %                     | Helmholtz coil, zero gauss chamber |

## IX. Optical Quantities

| Parameter/Equipment              | Range <sup>7</sup>                    | CMC <sup>2, 5, 8</sup> (±) | Comments                                    |
|----------------------------------|---------------------------------------|----------------------------|---------------------------------------------|
| Illuminance – Light Meters       | (5 to 200) fc<br>(200 to 2000) fc     | 2.8 %<br>3.1 %             | Hoffman light source w/ PCS 600 light meter |
| Optical Wavelength – Measure     | (700 to 1650) nm                      | 0.000 48 %                 | Keysight 86120A                             |
| Optical Absolute Power – Measure | -20 dBm @ 850 nm<br>-20 dBm @ 1550 nm | 0.091 dBm<br>0.090 dBm     | Agilent 81624A                              |

| Parameter/Equipment               | Range                                                        | CMC <sup>2, 8</sup> (±)                                                    | Comments       |
|-----------------------------------|--------------------------------------------------------------|----------------------------------------------------------------------------|----------------|
| Optical Power Linearity – Measure |                                                              |                                                                            |                |
| 850 nm                            | 0 dBm<br>-10 dBm<br>-20 dBm<br>-30 dBm<br>-40 dBm<br>-50 dBm | 0.022 dBm<br>0.024 dBm<br>0.023 dBm<br>0.024 dBm<br>0.024 dBm<br>0.029 dBm | Agilent 81624A |
| 1310 nm                           | 0 dBm<br>-10 dBm<br>-20 dBm<br>-30 dBm<br>-40 dBm<br>-50 dBm | 0.023 dBm<br>0.024 dBm<br>0.025 dBm<br>0.025 dBm<br>0.027 dBm<br>0.030 dBm |                |
| 1550 nm                           | 0 dBm<br>-10 dBm<br>-20 dBm<br>-30 dBm<br>-40 dBm<br>-50 dBm | 0.022 dBm<br>0.025 dBm<br>0.023 dBm<br>0.024 dBm<br>0.024 dBm<br>0.030 dBm |                |

#### X. Mechanical

| Parameter/Equipment                                | Range                                                                                       | CMC <sup>2, 5</sup> (±)                                                                                                             | Comments                                                                |
|----------------------------------------------------|---------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|
| Pressure Gauges & Transducer / Vacuum <sup>3</sup> |                                                                                             |                                                                                                                                     |                                                                         |
| Vacuum                                             | Up to 1 Torr<br>(1 to 1000) Torr                                                            | 0.0008 Torr<br>0.26 Torr                                                                                                            | INFICON CDGsci<br>DH Instrument PPC3                                    |
| Pneumatic                                          | (0 to 17) psia<br>Up to 600 psig<br>Up to 3000 psig<br>Up to 6000 psig<br>Up to 10 000 psig | 0.002 % Rdg + 0.001 psia<br>0.010 % Rdg + 0.001 psig<br>0.010 % Rdg + 0.01 psig<br>0.011 % Rdg + 0.1 psig<br>0.021 % Rdg + 0.1 psig | Mensor CPC 8000<br><br>DH Instruments<br>pressure calibrator,<br>PPCH-G |
| Hydraulic                                          | (5 to 40 000) psig<br>(725 to 72 500) psi                                                   | 0.030 % Rdg<br>0.030 % Rdg                                                                                                          | Ruska Model 2450-701<br>DH-Budenberg 5306                               |



| Parameter/Equipment                    | Range                                                                                                                                                 | CMC <sup>2, 5</sup> (±)                                                                             | Comments                                                                                                   |
|----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|
| Torque Analyzers <sup>3</sup>          | (1 to 10) ozf·in<br>(10 to 100) ozf·in<br>(4 to 50) lbf·in<br>(30 to 400) lbf·in<br>(80 to 1000) lbf·in<br>(20 to 250) lbf·ft<br>(200 to 2000) lbf·ft | 0.16 % Rdg<br>0.12 % Rdg<br>0.065 % Rdg<br>0.025 % Rdg<br>0.026 % Rdg<br>0.017 % Rdg<br>0.086 % Rdg | Torque arms w/ Class F weights                                                                             |
| Torque Tools <sup>3</sup>              | (1 to 10) ozf·in<br>(10 to 100) ozf·in<br>(4 to 50) lbf·in<br>(30 to 400) lbf·in<br>(80 to 1000) lbf·in<br>(20 to 250) lbf·ft<br>(200 to 2000) lbf·ft | 0.11 % Rdg<br>0.01 % Rdg<br>0.19 % Rdg<br>0.51 % Rdg<br>0.34 % Rdg<br>0.34 % Rdg<br>0.36 % Rdg      | Mountz<br>MTX10Z AWS:<br>QC10-100<br><br>CDI torque, force & tension calibration system, Model: 200-400-02 |
| Air Velocity Instruments               | (25 to 350) fpm<br>(350 to 1000) fpm<br>(1000 to 9000) fpm                                                                                            | 2.6 % Rdg<br>2.4 % Rdg<br>1.3 % Rdg                                                                 | Omega WT4401-D petit tube                                                                                  |
| Fume Hood                              |                                                                                                                                                       |                                                                                                     |                                                                                                            |
| Anemometer                             | (25 to 500) fpm                                                                                                                                       | 4.9 % Rdg                                                                                           | Testo anemometer                                                                                           |
| Air Volume Flow                        | (200 to 400) cfm                                                                                                                                      | 9 cfm                                                                                               | Testo flow hood systems                                                                                    |
| Force Gages & Transducers <sup>3</sup> | Up to 1 lbf<br>(1 to 100) lbf<br>(1 to 1000) lbf<br>(350 to 1000) lbf<br><br>(1000 to 30 000) lbf<br>(30 000 to 100 000) lbf                          | 0.064 % Rdg<br>0.049 % Rdg<br>0.037 % Rdg<br>0.12 % Rdg<br><br>0.026 % Rdg + 1.5 lbf<br>0.028 % Rdg | Dead weights<br><br><br><br>Morehouse force machine w/ load cell                                           |
| Durometer Calibrator –                 |                                                                                                                                                       |                                                                                                     |                                                                                                            |
| A Scale                                | (56.08 to 820.87) g                                                                                                                                   | 2.6 g                                                                                               | 25 lbf load cell                                                                                           |
| D Scale                                | (0 to 4.53) kg                                                                                                                                        | 0.012 kg                                                                                            |                                                                                                            |



| Parameter/Equipment                                                                                                  | Range                                                                                                                               | CMC <sup>2, 8</sup> (±)                                                                                                                                           | Comments                                                    |
|----------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------|
| Pipettes                                                                                                             | ≤ 1 µL<br>≤ 10 µL<br>≤ 100 µL<br>≤ 1000 µL<br>≤ 5 mL<br>≤ 10 mL                                                                     | 0.007 µL<br>0.008 µL<br>0.017 µL<br>0.040 µL<br>0.045 µL<br>0.66 µL                                                                                               | Sartorius CC111,<br>Sartorius WZA 225-CW<br>mass comparator |
| Volumetric – Measure                                                                                                 | Up to 5 L                                                                                                                           | 0.094 mL/L                                                                                                                                                        | Sartorius mass<br>comparator                                |
| Durometers –<br><br>Type A, B, O<br>Type C, D, DO<br><br>Indenter Geometry:<br>Length<br>Diameter<br>Angle<br>Radius | (0 to 100) DUROS<br>(0 to 100) DUROS<br><br>Up to 0.2 in<br>Up to 1 in<br>(0 to 90)°<br>Up to 1 in                                  | 0.52 DUROS<br>0.46 DUROS<br><br>0.58 m·in<br>0.41 m·in<br>0.049°<br>0.18 m·in                                                                                     | REX-1 durometer<br>calibrator<br><br>Optical comparator     |
| Indirect Verification of<br>Rockwell Hardness<br>Testers <sup>3</sup>                                                | HRA:<br>Low<br>Mid<br>High<br><br>HRBW:<br>Low<br>Mid<br>High<br><br>HRC:<br>Low<br>Mid<br>High<br><br>HR15N:<br>Low<br>Mid<br>High | 0.31 HRA<br>0.22 HRA<br>0.19 HRA<br><br>0.60 HRBW<br>0.50 HRBW<br>0.68 HRBW<br><br>0.56 HRC<br>0.46 HRC<br>0.40 HRC<br><br>0.54 HR15N<br>0.47 HR15N<br>0.61 HR15N | ASTM E18                                                    |

| Parameter/Equipment                                                    | Range                                                                                                                                                                           | CMC <sup>2, 5</sup> (±)                                                                                                                                                                                                                 | Comments                             |
|------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|
| Indirect Verification of Rockwell Hardness Testers <sup>3</sup> (cont) | HR15TW:<br>Low<br>Mid<br>High<br><br>HR30N:<br>Low<br>Mid<br>High<br><br>HR30TW:<br>Low<br>Mid<br>High<br><br>HR45N:<br>Low<br>Mid<br>High<br><br>HR45TW:<br>Low<br>Mid<br>High | 0.29 HR15TW<br>0.29 HR15TW<br>0.47 HR15TW<br><br>0.35 HR30N<br>0.52 HR30N<br>0.57 HR30N<br><br>0.40 HR30TW<br>0.38 HR30TW<br>0.34 HR30TW<br><br>0.56 HR45N<br>0.35 HR45N<br>0.29 HR45N<br><br>0.89 HR45TW<br>0.62 HR45TW<br>0.61 HR45TW | ASTM E18                             |
| Direct Verification of Rockwell Hardness Testers                       |                                                                                                                                                                                 |                                                                                                                                                                                                                                         |                                      |
| Verification of Test Force                                             | (15 to 150) kgf                                                                                                                                                                 | 0.08 % + 0.01 kgf                                                                                                                                                                                                                       | Load cell                            |
| Verification of Depth Measuring Device                                 | (0 to 260) µm                                                                                                                                                                   | 0.17 µm                                                                                                                                                                                                                                 | Digital indicator system             |
| Accelerometers –                                                       |                                                                                                                                                                                 |                                                                                                                                                                                                                                         |                                      |
| Vibration:<br>Sensitivity/Frequency Response                           | (0.5 to 10) Hz<br>(5 to 10 000) Hz<br>(10 000 to 15 000) Hz                                                                                                                     | 1.7 % Rdg<br>1.9 % Rdg<br>2.2 % Rdg                                                                                                                                                                                                     | Modal shop 9155w/ PCB accelerometers |
| Shock:<br>Linearity                                                    | Up to 10 000 g                                                                                                                                                                  | 2.3 % Rdg                                                                                                                                                                                                                               |                                      |
| Dynamic Pressure:<br>Linearity                                         | Up to 15 000 psi                                                                                                                                                                | 3.1 % Rdg                                                                                                                                                                                                                               |                                      |



| Parameter/Equipment             | Range                                                                                                                                                                                                                                                                       | CMC <sup>2, 6, 8</sup> ( $\pm$ )                                                                                                                                                                                                                                                                                                                                                                                                | Comments                                   |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|
| Balances <sup>3</sup>           | Up to 310 g<br>Up to 4100 g<br>Up to 15 kg                                                                                                                                                                                                                                  | 0.3 mg + 0.6R<br>48 mg + 0.6R<br>0.52 g + 0.6R                                                                                                                                                                                                                                                                                                                                                                                  | Class 1 master weights                     |
| Scales <sup>3</sup>             | Up to 100 lb<br>Up to 1000 lb<br>Up to 7200 lb                                                                                                                                                                                                                              | 7.7 g + 0.6R<br>0.12 kg + 0.6R<br>0.051 % + 0.6R                                                                                                                                                                                                                                                                                                                                                                                | Class 4 master weights<br>Standard weights |
| Mass – Measure                  | 30 kg<br>25 kg<br>20 kg<br>10 kg<br>5 kg<br>3 kg<br>2 kg<br>1 kg<br>500g<br>300 g<br>200 g<br>100 g<br>50 g<br>30 g<br>20 g<br>10 g<br>5 g<br>3 g<br>2 g<br>1 g<br>500 mg<br>300 mg<br>200 mg<br>100 mg<br>50 mg<br>30 mg<br>20 mg<br>10 mg<br>5 mg<br>3 mg<br>2 mg<br>1 mg | 15 mg<br>13 mg<br>10 mg<br>5.5 mg<br>2.5 mg<br>4.9 mg<br>2.3 mg<br>1.6 mg<br>0.57 mg<br>0.36 mg<br>0.19 mg<br>0.19 mg<br>73 $\mu$ g<br>64 $\mu$ g<br>9.3 $\mu$ g<br>6.1 $\mu$ g<br>4.6 $\mu$ g<br>4.2 $\mu$ g<br>4.6 $\mu$ g<br>4.6 $\mu$ g<br>3.3 $\mu$ g<br>3.2 $\mu$ g<br>2.9 $\mu$ g<br>2.9 $\mu$ g<br>2.5 $\mu$ g<br>3.0 $\mu$ g<br>2.5 $\mu$ g<br>2.5 $\mu$ g<br>2.5 $\mu$ g<br>2.9 $\mu$ g<br>2.5 $\mu$ g<br>2.5 $\mu$ g | Double substitution                        |
| Mass – Measure<br>(Avoirdupois) | 1 lb<br>5 lb<br>10 lb<br>25 lb<br>50 lb<br><br>500 lb<br>1000 lb                                                                                                                                                                                                            | 5.3 $\mu$ lb (2.4 mg)<br>5.3 $\mu$ lb (2.4 mg)<br>2.1 $\mu$ lb (9.5 mg)<br>11 $\mu$ lb (4.8 mg)<br>33 $\mu$ lb (15 mg)<br><br>0.026 lb (12 g)<br>0.068 lb (31 g)                                                                                                                                                                                                                                                                | Double substitution<br><br>Load cell       |

# X. Thermodynamics

| Parameter/Equipment                                                                             | Range                                                                                                                                                               | CMC <sup>2, 5, 6, 8</sup> ( $\pm$ )                                                                                  | Comments                                                                                                                                                                          |
|-------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Temperature – Measure & Measuring Equipment                                                     | (-196 to -80) °C<br>(-80 to 100) °C<br>(100 to 660) °C<br><br>(400 to 1600) °C                                                                                      | 0.034 °C<br>0.021 °C<br>0.039 °C<br><br>0.27 % + 0.6R                                                                | Fluke 1560 w/SPRT, TempSens cal-sys -196/-80 & Fluke 7380<br><br>Type R TC w/ Tempsens cal-sys 1700                                                                               |
| Infrared / Pyrometers <sup>3</sup>                                                              | (50 to 500) °C<br><br>(150 to 1200) °C<br><br>(-30 to 150) °C                                                                                                       | 1.4 °C + 0.6R<br><br>0.48 % + 0.6R<br><br>0.8 °C                                                                     | Fluke 9132<br>$\varepsilon = 0.95$<br>(8 to 14) mm<br><br>IsoTech Pegasus R970<br>$\varepsilon = 0.995$<br>(9 to 14) mm<br><br>Fluke 9133<br>$\varepsilon = 0.95$<br>(8 to 14) mm |
| Humidity – Measuring Equipment, (10 to 30) °C                                                   | (5 to 15) % RH<br>(5 to 25) % RH<br>(25 to 35) % RH<br>(35 to 50) % RH<br>(50 to 65) % RH<br>(65 to 80) % RH<br>(80 to 95) % RH                                     | 0.40 % RH<br>0.49 % RH<br>0.52 % RH<br>0.59 % RH<br>0.62 % RH<br>0.66 % RH<br>0.83 % RH                              | Rotronic HC2-SH & GEO 2000                                                                                                                                                        |
| Temperature – Measuring Equipment, Fixed Point                                                  | Triple Point of Water<br><br>Liquid Nitrogen                                                                                                                        | 8.3 mK<br><br>7.5 mK                                                                                                 | Pond Engineering TPW                                                                                                                                                              |
| Humidity – Measure <sup>3</sup><br><br>(-50 to 90) °C<br><br>(10 to 30) °C<br><br>(10 to 30) °C | Frost Point<br>Dew Point<br><br>(5 to 15) % RH<br>(5 to 25) % RH<br>(25 to 35) % RH<br><br>(35 to 50) % RH<br>(50 to 65) % RH<br>(65 to 80) % RH<br>(80 to 95) % RH | 1.1 °C<br>0.14 °C<br><br>0.20 % RH<br>0.36 % RH<br>0.40 % RH<br><br>0.47 % RH<br>0.51 % RH<br>0.56 % RH<br>0.77 % RH | Chilled mirror<br><br>Rotronic HC2-SH<br><br>Rotronic HC2-SH                                                                                                                      |

| Parameter/Equipment                                                                       | Range            | CMC <sup>2</sup> (±) | Comments                         |
|-------------------------------------------------------------------------------------------|------------------|----------------------|----------------------------------|
| Dew Point                                                                                 | (100 to -65) °C  | 0.35 °C              | Edge tech 1500                   |
| Environmental Chambers,<br>Ovens, Furnaces, Freezers,<br>Temperature Baths & Dry<br>Wells | (-80 to 1000) °C | 2.0 °C               | Type K TCs & Vaisala<br>RH probe |

#### XI. Time & Frequency

| Parameter/Equipment               | Range                      | CMC <sup>2, 8</sup> (±)                                           | Comments                                                                                  |
|-----------------------------------|----------------------------|-------------------------------------------------------------------|-------------------------------------------------------------------------------------------|
| Frequency –Measuring<br>Equipment | 10 MHz Reference<br>Signal | 2.0 parts in 10 <sup>10</sup> Hz                                  | Datum 9390-6000 w/<br>GPS                                                                 |
| Frequency – Measure               | 1 MHz to 40 GHz            | 9.3 parts in 10 <sup>9</sup> Hz<br>1.4 part in 10 <sup>7</sup> Hz | 10 MHz signal from<br>Datum 9390-6000<br>w/GPS to:<br><br>53131 counter<br>53152A counter |
| Stopwatches                       | Up to 24 hrs               | 0.048 s/day                                                       | Timometer 4500                                                                            |

SATELLITE

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I. Acoustical

| Parameter/Equipment                         | Range                                       | CMC <sup>2</sup> (±)                                | Comments                                           |
|---------------------------------------------|---------------------------------------------|-----------------------------------------------------|----------------------------------------------------|
| Sound Level Meters 3 –<br>125 Hz to 4000 Hz | 114 dB<br>104 dB<br>94 dB<br>84 dB<br>74 dB | 0.26 dB<br>0.38 dB<br>0.39 dB<br>0.48 dB<br>0.86 dB | IET Labs 1986<br>omnical sound level<br>calibrator |

II. Chemical

| Parameter/Equipment                                          | Range                                                                                                 | CMC <sup>2, 8</sup> (±)                                                                             | Comments                                     |
|--------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|----------------------------------------------|
| Conductivity –<br>Liquid Measuring<br>Equipment <sup>3</sup> | 84 µS/cm<br>1413 µS/cm<br>12 880 µS/cm                                                                | 0.8 µs/cm<br>4.0 µs/cm<br>50 µs/cm                                                                  | Laboratory standard<br>conductivity solution |
| Conductivity – Metal<br>Measuring<br>Equipment <sup>3</sup>  | 9.33 %IACS<br>14.92 %IACS<br>25.80 %IACS<br>32.56 %IACS<br>44.92 %IACS<br>59.42 %IACS<br>100.97 %IACS | 0.2 % IACS<br>0.35 % IACS<br>0.31 % IACS<br>0.38 % IACS<br>0.37 % IACS<br>0.47 % IACS<br>1.5 % IACS | Metal conductivity<br>standards              |
| Metal Conductivity<br>Standards                              | Up to 102 %IACS                                                                                       | 0.013 % + 0.2 % IACS                                                                                | Conductivity meter                           |
| pH – Measuring<br>Equipment <sup>3</sup>                     | 4 pH<br>7 pH<br>10 pH                                                                                 | 0.01 pH<br>0.01 pH<br>0.01 pH                                                                       | Buffer solutions                             |



### III. Dimensional

| Parameter/Equipment   | Range                                                                                                                                                                                                                                                                                                                                                                               | CMC <sup>2, 8</sup> ( $\pm$ )                                                                                                                                                                                                                                                                                                                                                                                               | Comments                                   |
|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|
| Angle Blocks          | Up to 90°                                                                                                                                                                                                                                                                                                                                                                           | 0.0015°                                                                                                                                                                                                                                                                                                                                                                                                                     | Angle blocks                               |
| Angle Gages           | Up to 120°                                                                                                                                                                                                                                                                                                                                                                          | 0.0058°                                                                                                                                                                                                                                                                                                                                                                                                                     | Video measuring system                     |
| Bore Gages/Intramics  | (0.150 to 1.000) in<br>(3.810 to 25.400) mm<br><br>(1.000 to 2.000) in<br>(25.4025 to 50.800) mm<br><br>(2.000 to 3.000) in<br>(50.8025 to 76.200) mm<br><br>(3.000 to 4.000) in<br>(76.2025 to 101.600) mm<br><br>(4.000 to 5.000) in<br>(101.6025 to 127.000) mm<br><br>(5.000 to 6.000) in<br>(127.0025 to 152.40) mm<br><br>(6.000 to 7.000) in<br>(152.4025 to 177.800) mm     | (4.2 + 1.4D) $\mu$ in<br>(110 + 1.4D) nm<br><br>(3.5 + 2.1D) $\mu$ in<br>(89 + 2.1D) nm<br><br>(3.1 + 2.3D) $\mu$ in<br>(79 + 2.3D) nm<br><br>(4 + 2D) $\mu$ in<br>(100 + 2.0D) nm<br><br>(12 + 6D) $\mu$ in<br>(300 + 6.0D) nm<br><br>(8 + 2D) $\mu$ in<br>(200 + 2.0D) nm<br><br>(8 + 2D) $\mu$ in<br>(200 + 2.0D) nm                                                                                                     | Lab Master, gage blocks, cylindrical rings |
| Calipers <sup>3</sup> | Up to 6 in<br>Up to 150 mm<br><br>(6.0005 to 12) in<br>(150.001 to 300) mm<br><br>(12.0005 to 18) in<br>(300.001 to 450) mm<br><br>(18.0005 to 24) in<br>(450.001 to 600) mm<br><br>(24.0005 to 36) in<br>(600.001 to 900) mm<br><br>(36.0005 to 48) in<br>(900.001 to 1200) mm<br><br>(48.0005 to 60) in<br>(1200.001 to 1500) mm<br><br>(60.005 to 72) in<br>1500.001 to 1830) mm | (3.7 + 3.6L) $\mu$ in<br>(94 + 3.6L) nm<br><br>(3 + 4L) $\mu$ in<br>(76 + 4L) nm<br><br>(5 + 4.5L) $\mu$ in<br>(4.5L nm) + 0.13 $\mu$ m<br><br>(20 + 5L) $\mu$ in<br>(5.0L nm) + 0.51 $\mu$ m<br><br>(15 + 4.6L) $\mu$ in<br>(4.6L nm) + 0.38 $\mu$ m<br><br>(11 + 4.2L) $\mu$ in<br>(4.2L nm) + 0.28 $\mu$ m<br><br>(70 + 2.5L) $\mu$ in<br>(2.5 nm) + 1.8 $\mu$ m<br><br>(270 + 7.5L) $\mu$ in<br>(7.5L nm) + 6.9 $\mu$ m | Gage blocks                                |

| Parameter/Equipment                                                              | Range                                                                                                                                                           | CMC <sup>2, 8</sup> (±)                                                                                                                                                                                                                                                                   | Comments                                                           |
|----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|
| Chamfer & Countersink Gages                                                      | Up to 3 in<br>Up to 76.2 mm                                                                                                                                     | $(170 + 110D) \mu\text{in}$<br>$4.3 \mu\text{m} + 110D \text{ nm}$                                                                                                                                                                                                                        | Chamfer rings                                                      |
| Coating Thickness                                                                | Up to 0.060 in thick                                                                                                                                            | $0.022 + 0.0035L$ mils                                                                                                                                                                                                                                                                    | Comparison to master films                                         |
| Concentricity Gage                                                               | Up to 0.050 in                                                                                                                                                  | $8 \mu\text{in}$                                                                                                                                                                                                                                                                          | LVDT with amplifier master cylinder                                |
| Crimpers                                                                         | Up to 12 in<br>Up to 304.8 mm<br><br>(0.011 to 0.060) in<br>(0.061 to 0.250) in<br>(0.251 to 0.500) in                                                          | $(80 + 3.2L) \mu\text{in}$<br>$(2.03 + 3.25L) \mu\text{m}$<br><br>$(140 + 200L) \mu\text{in}$<br>$(140 + 160L) \mu\text{in}$<br>$(130 + 80L) \mu\text{in}$                                                                                                                                | Video measuring system<br><br>Pin gages                            |
| Depth Measuring Instruments, Gages & Micrometers <sup>3</sup>                    | Up to 6 in<br>Up to 150.0 mm<br>(6.000 to 12) in<br>(150.001 to 300) mm<br>(12.000 to 18) in<br>(300.001 to 450) mm<br>(18.000 to 24) in<br>(450.001 to 600) mm | $(12 + 1.3L) \mu\text{in}$<br>$(1.30L \text{ nm}) + 0.30 \mu\text{m}$<br>$(20 + 2.5L) \mu\text{in}$<br>$(2.5L \text{ nm}) + 0.51 \mu\text{m}$<br>$(14 + 5L) \mu\text{in}$<br>$(5L \text{ nm}) + 0.36 \mu\text{m}$<br>$(15 + 4.8L) \mu\text{in}$<br>$(4.8L \text{ nm}) + 0.38 \mu\text{m}$ | Gage blocks, surface plate                                         |
| Flatness <sup>3</sup> –<br><br>Anvils, Spindles,<br>Gage Stands & Gage<br>Blocks | Up to 3 in diameter<br>Up to 76.2 mm<br>diameter                                                                                                                | $2.8 \mu\text{in}$<br>$0.071 \mu\text{m}$                                                                                                                                                                                                                                                 | Comparison to master optical flat under monochromatic light source |
| Gage Block –<br>Length                                                           | (0.01 to 0.21) in<br>(0.031 25 to 4) in<br>2 in<br>3 in<br>4 in<br>(5 to 20) in<br>(125 to 500) mm                                                              | $4.7 \mu\text{in}$<br>$(2.5 + 1.7L) \mu\text{in}$<br>$5.7 \mu\text{in}$<br>$7.2 \mu\text{in}$<br>$8.9 \mu\text{in}$<br>$(8.8 + 1.2L) \mu\text{in}$<br>$(1.2L \text{ nm}) + 0.22 \mu\text{m}$                                                                                              | Gage blocks,<br>gage block comparator<br><br>Lab Master 175        |



| Parameter/Equipment                                                                       | Range                                                                                                                                                                                                                                                                          | CMC <sup>2, 8</sup> ( $\pm$ )                                                                                                                                                                                                                                                                                                    | Comments                                       |
|-------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|
| Gage Block – Parallelism                                                                  | Up to 4 in<br>Up to 100 mm<br><br>(5 to 20) in<br>(125 to 500) mm                                                                                                                                                                                                              | 2.7 $\mu$ in<br>0.069 $\mu$ m<br><br>1.6 $\mu$ in<br>0.04 $\mu$ m                                                                                                                                                                                                                                                                | Gage block<br><br>Comparator<br>Lab Master 175 |
| Glass Scale / Stage<br>Micrometer                                                         | Up to 12 in<br>Up to 304.8 mm                                                                                                                                                                                                                                                  | (80 + 3.2L) $\mu$ in<br>(2.0 + 3.2L) nm                                                                                                                                                                                                                                                                                          | Video measuring<br>system                      |
| Height Gages <sup>3</sup> –<br><br>Dial, Digital & Vernier                                | Up to 12 in<br>Up to 300 mm<br><br>(12.000 to 18) in<br>(300.001 to 450) mm<br><br>(18.000 to 24) in<br>(450.001 to 600) mm<br><br>(24.000 to 36) in<br>(600.001 to 900) mm<br><br>(36.000 to 48) in<br>(900.001 to 1200) mm<br><br>(48.000 to 60) in<br>(1200.001 to 1500) mm | (17 + 3L) $\mu$ in<br>(3L nm) + 0.43 $\mu$ m<br><br>(35 + 3.5L) $\mu$ in<br>(3.5L nm) + 0.86 $\mu$ m<br><br>(21 + 6.3L) $\mu$ in<br>(6.3L nm) + 0.53 $\mu$ m<br><br>(41 + 3.3L) $\mu$ in<br>(3.3L nm) + 1.0 $\mu$ m<br><br>(30 + 5L) $\mu$ in<br>(5.0L nm) + 0.76 $\mu$ m<br><br>(60 + 2.5L) $\mu$ in<br>(2.5L nm) + 1.5 $\mu$ m | Gage blocks<br>surface plate                   |
| High Accuracy Height<br>Gages                                                             | Up to 12 in<br>Up to 300 mm<br><br>(12.000 1 to 18) in<br>(300.001 to 450) mm<br><br>(18.000 1 to 24) in<br>450.000 1 to 609.6) mm                                                                                                                                             | (23 + 1.7L) $\mu$ in<br>(0.17L nm) + 0.58 $\mu$ m<br><br>(8 + 2L) $\mu$ in<br>(2.0L nm) + 0.20 $\mu$ m<br><br>(14 + 1.8L) $\mu$ in<br>(1.8L nm) + 0.36 $\mu$ m                                                                                                                                                                   | Gage blocks<br>Surface plate                   |
| Indicators <sup>3</sup> –<br><br>Digital, Dial, Bore<br>gages with Removable<br>Indicator | Up to 4 in<br>Up to 101.6 mm                                                                                                                                                                                                                                                   | (6.8 + 2.6L) $\mu$ in<br>(170 + 2.6L) nm                                                                                                                                                                                                                                                                                         | Gage blocks                                    |

| Parameter/Equipment                                     | Range                                                | CMC <sup>2, 8</sup> (±) | Comments                        |
|---------------------------------------------------------|------------------------------------------------------|-------------------------|---------------------------------|
| Indicators Test <sup>3</sup> –                          | Up to 0.05 in<br>Up to 1.25 mm                       | 15 µin<br>0.38 µm       | Calibration tester, gage blocks |
| Cylindrical Gages,<br>Protusion Gages &<br>Washer Rings |                                                      |                         | LMU-175, gage blocks            |
| Inside measurements                                     | (0.040 to 0.125) in<br>(1.015 to 3.175) mm           | 4.4 µin<br>0.11 µm      |                                 |
|                                                         | (0.125 to 0.250) in<br>(3.175 to 6.350) mm           | 4.5 µin<br>0.14 µm      |                                 |
|                                                         | (0.250 to 1.000) in<br>(6.350 to 25.400) mm          | 5.2 µin<br>0.13 µm      |                                 |
|                                                         | (1.000 to 2.000) in<br>(50.8025 to 76.2000) mm       | 5.5 µin<br>0.14 µm      |                                 |
|                                                         | (2.0001 to 3.0000) in<br>(50.8025 to 76.2000) mm     | 5.5 µin<br>0.14 µm      |                                 |
|                                                         | (3.0001 to 4.0000) in<br>(76.2025 to 101.6000) mm    | 5.5 µin<br>0.14 µm      |                                 |
|                                                         | (4.0001 to 5.0000) in<br>(101.6025 to 127.0000) mm   | 6.2 µin<br>0.16 µm      |                                 |
|                                                         | (5.0001 to 6.0000) in<br>(127.0025 to 152.4000) mm   | 6.6 µin<br>0.17 µm      |                                 |
|                                                         | (6.0001 to 7.0000) in<br>(152.4025 to 177.8000) mm   | 8.8 µin<br>0.22 µm      |                                 |
|                                                         | (7.0001 to 8.0000) in<br>(1 778 025 to 2 032 000) mm | 9.2 µin<br>0.23 µm      |                                 |
|                                                         | (8.0001 to 9.0000) in<br>(203.2025 to 228.6000) mm   | 9.2 µin<br>0.23 µm      |                                 |
|                                                         | (9.0001 to 10.0000) in<br>(228.6025 to 254.0000) mm  | 9.2 µin<br>0.23 µm      |                                 |
|                                                         | (10.0001 to 11.0000) in<br>(254.0025 to 279.4000) mm | 10 µin<br>0.25 µm       |                                 |
|                                                         | (11.0001 to 12.0000) in<br>(279.4025 to 304.8000) mm | 13 µin<br>0.33 µm       |                                 |

| Parameter/Equipment                                                                                     | Range                                                                                                                                                            | CMC <sup>2, 8</sup> ( $\pm$ )                                                                                                                                                                                                                                                   | Comments                                                                                                                                  |
|---------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| Inside / Outside Measurement<br><br>Non-Contact                                                         | Up to 12 in<br>Up to 304.8 mm                                                                                                                                    | $(80 + 3.2L) \mu\text{in}$<br>$(2.03 + 3.2L) \mu\text{m}$                                                                                                                                                                                                                       | Video measuring system                                                                                                                    |
| Inspection Fixtures<br><br>Parallelism<br><br>Perpendicularity / Squareness<br><br>V-Groove Parallelism | Up to 72 in<br>Up to 1825 mm<br><br>Up to 24 in<br>Up to 455 mm<br><br>Up to 12 in<br>Up to 305 mm                                                               | $(37 + 0.4L) \mu\text{in}$<br>$(0.94 + 0.4L) \text{nm}$<br><br>$(37 + 66L) \mu\text{in}$<br>$(0.94 + 5.5L) \text{nm}$<br><br>$(37 + 7L) \mu\text{in}$<br>$(0.94 + 7L) \text{nm}$                                                                                                | Surface plate, LVDT with amplifier<br><br>Surface plate, granite square, LVDT with amplifier<br><br>Surface plate, master cylinders, LVDT |
| Laser Micrometer <sup>3</sup>                                                                           | (0.05 to 1.00) in<br>(1.27 to 25.4) mm                                                                                                                           | $(4.1 + 31L) \mu\text{in}$<br>$(100 + 31L) \text{nm}$                                                                                                                                                                                                                           | Master cylinders                                                                                                                          |
| Step Height Parallelism                                                                                 | Up to 5000 $\mu\text{in}$                                                                                                                                        | 8.5 $\mu\text{in}$                                                                                                                                                                                                                                                              | LVDT w/ amplifier                                                                                                                         |
| Levels                                                                                                  | Up to 18 in<br>Up to 455 mm                                                                                                                                      | $(6.4 + 5.6L) \mu\text{in}$<br>$(160 + 5.6L) \text{nm}$                                                                                                                                                                                                                         | Gage blocks & surface plate                                                                                                               |
| Micrometers <sup>3</sup><br><br>Inside                                                                  | Up to 6 in<br>Up to 150 mm<br>(6.0001 to 12) in<br>(150.001 to 300) mm<br>(12.0001 to 32) in<br>(300.001 to 800) mm<br>(32.001 to 60) in<br>(800.001 to 1525) mm | $(7.4 + 2.6L) \mu\text{in}$<br>$(190 + 2.6L) \text{nm}$<br>$(13 + 3.2L) \mu\text{in}$<br>$(3.2L \text{ nm}) + 0.33 \mu\text{m}$<br>$(21 + 2.8L) \mu\text{in}$<br>$(2.8L \text{ nm}) + 0.53 \mu\text{m}$<br>$(27 + 2.9L) \mu\text{in}$<br>$(2.9L \text{ nm}) + 0.69 \mu\text{m}$ | Gage blocks                                                                                                                               |

| Parameter/Equipment                                                                                                                                                                                 | Range                                                                                                                                                                                                                                                                                                                                                                                                                                                 | CMC <sup>2, 8</sup> (±)                                                                                                                                                                                                                                                                                                                                                                                            | Comments                                         |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------|
| Micrometers <sup>3</sup> (cont)                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                    | Gage blocks                                      |
| Outside                                                                                                                                                                                             | Up to 6 in<br>Up to 150 mm<br>(6.0001 to 12) in<br>(150.001 to 300) mm<br>(12.0001 to 18) in<br>(300.001 to 450) mm<br>(18.0001 to 24) in<br>(450.001 to 600) mm<br>(24.0001 to 30) in<br>(600.001 to 750) mm<br>(30.0001 to 36) in<br>(750.001 to 900) mm<br>(36.0001 to 42) in<br>(900.001 to 1050) mm<br>(42.0001 to 48) in<br>(1050.001 to 1200) mm<br>(48.0001 to 54) in<br>(1200.001 to 1375) mm<br>(54.0001 to 60) in<br>(1375.001 to 1525) mm | (18 + 0.26L) µin<br>(460 + 0.26L) nm<br>(19 + 1L) µin<br>(480 + 1.0L) nm<br>(28 + 0.67L) µin<br>(710 + 0.67L) nm<br>(20 + 3.3L) µin<br>(3.3L nm) + 0.51 µm<br>(52 + 0.17L) µin<br>(0.17L nm) + 1.3 µm<br>(49 + 2.5L) µin<br>2.5L nm + 1.2 µm<br>(97 + 3.5L) µin<br>(3.5L nm) + 2.5 µm<br>(89 + 2.8L) µin<br>(2.8L nm) + 2.3 µm<br>(76 + 2.2L) µin<br>(2.2L nm) + 1.8 µm<br>(110 + 2.7L) µin<br>(2.70L nm) + 2.8 µm |                                                  |
| Length/Height – Ranged<br><br>- Caliper Checkers<br>- Check Master<br>- Depth Mic Master<br>- Height Master<br>- Mic Master<br>- Micrometer Standards<br>- Rise Blocks<br>- Standard Reference Bars | Up to 6 in<br>Up to 155 mm<br>(6.0001 to 12) in<br>(150.001 to 300) mm<br>(12.0001 to 18) in<br>(300.001 to 450) mm<br>(18.0001 to 24) in<br>(450.001 to 600) mm<br>(24.0001 to 36) in<br>(600.001 to 900) mm<br>(36.0001 to 48) in<br>(900.001 to 1200) mm<br><br>(48.0001 to 60) in<br>(1200.001 to 1500) mm                                                                                                                                        | (12 + 0.2L) µin<br>(0.20L nm) + 0.30 µm<br>(12 + 0.33L) µin<br>(0.33L nm) + 0.30 µm<br>(17 + 0.33L) µin<br>(0.33L nm) + 0.43 µm<br>(14 + 0.67L) µin<br>(0.67L nm) + 0.36 µm<br>(19 + 0.58L) µin<br>(0.58L nm) + 0.48 µm<br>(21 + 0.17L) µin<br>(0.17L nm) + 0.53 µm<br><br>(22 + 0.17L) µin<br>(0.17L nm) + 0.56 µm                                                                                                | Surface plate, gage blocks & LVDT with amplifier |
| Mu-Checker/Gage Amplifier & Probe <sup>3</sup>                                                                                                                                                      | Up to 0.05 in<br>Up to 1.25 mm                                                                                                                                                                                                                                                                                                                                                                                                                        | 5 µin<br>120 nm                                                                                                                                                                                                                                                                                                                                                                                                    | Gage blocks                                      |

| Parameter/Equipment                                 | Range                                                                                       | CMC <sup>2, 8</sup> (±)                                             | Comments                             |
|-----------------------------------------------------|---------------------------------------------------------------------------------------------|---------------------------------------------------------------------|--------------------------------------|
| Microscope <sup>3</sup>                             |                                                                                             |                                                                     |                                      |
| Linearity<br>X<br>Y                                 | Up to 4 in<br>Up to 101.6 mm                                                                | $(8.8 + 1.5L) \mu\text{in}$<br>$(220 + 1.5L) \text{nm}$             | Gage blocks                          |
| Angle                                               | (0 to 90) °                                                                                 | 0.012°                                                              | Angle blocks                         |
| Optical Comparator <sup>3</sup> –<br>Stage Movement |                                                                                             |                                                                     |                                      |
| Angularity<br>X<br>Y                                | (0.5 to 12) in<br>(12.7 mm to 304.8 mm)                                                     | $(37 + 12L) \mu\text{in}$<br>$(940 + 12L) \text{nm}$                | Gage blocks                          |
| Squareness<br>X<br>Y                                | 0° to 360° (12 in of X<br>axis travel maximum, Y<br>axis travel maximum less<br>than 12 in) | 0.0013°                                                             | True square                          |
| Magnification<br>X<br>Y                             | 10X, 20X, 31.25X, 50X,<br>62.5X, 100X                                                       | 0.08 %                                                              | Gage blocks, glass<br>scales         |
| Optical Flats                                       | Up to 3 in diameter<br>Up to 76.2 mm diameter                                               | 2.8 $\mu\text{in}$<br>0.071 $\mu\text{m}$                           | Comparison to<br>master optical flat |
| Optical Parallels                                   |                                                                                             |                                                                     |                                      |
| Flatness                                            | Up to 3 in diameter<br>Up to 76.2 mm dia                                                    | 2.8 $\mu\text{in}$<br>0.071 $\mu\text{m}$                           | Comparison to<br>master optical flat |
| Parallelism                                         | Up to 3 in diameter<br>Up to 76.2 mm dia                                                    | 0.75 $\mu\text{in}$<br>0.019 $\mu\text{m}$                          |                                      |
| Protractors <sup>3</sup>                            | Up to 90°                                                                                   | 0.023°                                                              | Master angle blocks                  |
| Radius Length                                       | Up to 6 in<br>Up to 152.4 mm                                                                | $(80 + 3.2L) \mu\text{in}$<br>$(3.2L \text{ nm}) + 2.0 \mu\text{m}$ | Video measuring<br>system            |

| Parameter/Equipment                                                                                                              | Range                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | CMC <sup>2, 8</sup> (±)                                                                                                                                                                                                                                      | Comments                                     |
|----------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|
| Outside Measurements<br><br>Cylindrical Plug Gages,<br>Deltronic Pin Gages,<br>Discs, Master<br>Cylinders, Spheres<br>(Diameter) | Up to 1.0000 in<br>Up to 25.4000 mm<br><br>(1.0001 to 2.0000) in<br>(25.4025 to 50.8000) mm<br><br>(2.0001 to 3.0000) in<br>(50.8025 to 76.2000) mm<br><br>(3.0001 to 4.0000) in<br>(76.2025 to 101.6000) mm<br><br>(4.0001 to 5.0000) in<br>(101.6025 to 127.0000) mm<br><br>(5.0001 to 6.0000) in<br>(127.0025 to 152.4000) mm<br><br>(6.0001 to 7.0000) in<br>(152.4025 to 177.8000) mm<br><br>(7.0001 to 8.0000) in<br>(177.8025 to 203.2000) mm<br><br>(8.0001 to 9.0000) in<br>(203.2025 to 228.6000) mm<br><br>(9.0001 to 10.0000) in<br>(228.6025 to 254.0000) mm | 6.0 µin<br>0.15 µm<br><br>6.3 µin<br>0.16 µm<br><br>6.3 µin<br>0.16 µm<br><br>6.3 µin<br>0.16 µm<br><br>6.9 µin<br>0.18 µm<br><br>7.2 µin<br>0.18 µm<br><br>9.5 µin<br>0.24 µm<br><br>9.5 µin<br>0.24 µm<br><br>9.5 µin<br>0.24 µm<br><br>9.5 µin<br>0.24 µm | LMU-175, gage<br>blocks                      |
| Rulers & Tape                                                                                                                    | Up to 12 in<br>Up to 304.8 mm<br><br>(12 to 300) in<br>(304.0 to 365.7) mm                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | (80 + 3.2L) µin<br>(3.2L nm) + 2.0 µm<br><br>(1100 + 8.3L) µin<br>(8.3L nm) + 28 µm                                                                                                                                                                          | Video measuring<br>system<br><br>Gage blocks |

| Parameter/Equipment                              | Range                                                                                                                                                                                                               | CMC <sup>2, 8</sup> (±)                                                                                                                                                                | Comments                                                   |
|--------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------|
| Sine Bars/Plates                                 | Up to 5 in<br>Up to 127 mm                                                                                                                                                                                          | $(23 + 20L) \mu\text{in}$<br>$(20L \text{ nm}) + 0.58 \mu\text{m}$                                                                                                                     | Squares, angle blocks<br>LVDT w/ amplifier,<br>gage blocks |
| Surface Plates <sup>3</sup>                      |                                                                                                                                                                                                                     |                                                                                                                                                                                        |                                                            |
| Flatness                                         | Up to 12 in<br>Up to 300 mm                                                                                                                                                                                         | 20 $\mu\text{in}$<br>0.51 $\mu\text{m}$                                                                                                                                                | LVDT with amplifier                                        |
|                                                  | (12 to 120) in<br>(300 to 3050) mm                                                                                                                                                                                  | 21 $\mu\text{in}$<br>0.54 $\mu\text{m}$                                                                                                                                                | Auto collimator                                            |
| Repeatability                                    | 0.002 in<br>0.05 mm                                                                                                                                                                                                 | 25 $\mu\text{in}$<br>0.64 $\mu\text{m}$                                                                                                                                                | Repeat O Meter                                             |
| Surface Roughness -<br>Profilometer              | 118.6 $\mu\text{in Ra}$<br>2.96 $\mu\text{m Ra}$<br><br>40 $\mu\text{in Ra}$<br>1.02 $\mu\text{m Ra}$<br><br>20 $\mu\text{in Ra}$<br>0.508 $\mu\text{m Ra}$<br><br>15.9 $\mu\text{in Ra}$<br>0.378 $\mu\text{m Ra}$ | 1 $\mu\text{in}$<br>0.03 $\mu\text{m}$<br><br>2.5 $\mu\text{in}$<br>0.064 $\mu\text{m}$<br><br>1.2 $\mu\text{in}$<br>0.031 $\mu\text{m}$<br><br>1 $\mu\text{in}$<br>0.03 $\mu\text{m}$ | Roughness specimen                                         |
| Surface Roughness<br>Patch / Specimens           | (2 to 500) $\mu\text{in Ra}$<br>(0.0508 to 127) $\mu\text{m Ra}$                                                                                                                                                    | 9.2 $\text{nin}/\mu\text{in} + 0.92 \mu\text{in}$<br>0.23 $\text{nm}/\mu\text{m} + 0.023 \mu\text{m}$                                                                                  | Profilometer<br>w/ specimens                               |
| Tapered Thread Plug                              |                                                                                                                                                                                                                     |                                                                                                                                                                                        |                                                            |
| Major Diameter                                   | Up to 6 in<br>Up to 150 mm                                                                                                                                                                                          | $(100 + 1.3D) \mu\text{in}$<br>$(1.3D \text{ nm}) + 2.6 \mu\text{m}$                                                                                                                   | Lab Master 175, thread<br>wires                            |
| Pitch Diameter                                   | Up to 6 in<br>Up to 150 mm                                                                                                                                                                                          | $(110 + 1.3D) \mu\text{in}$<br>$(1.3D \text{ nm}) + 2.8 \mu\text{m}$                                                                                                                   |                                                            |
| Tapered Thread Ring -<br>Thickness / Step Height | Up to 6 in<br>Up to 150 mm                                                                                                                                                                                          | $(3.1 + 1.3D) \mu\text{in}$<br>$(1.3D \text{ nm}) + 0.13 \mu\text{m}$                                                                                                                  | Gage blocks, master<br>taper plugs, Lab<br>Master          |

| Parameter/Equipment                                                                    | Range                                                             | CMC <sup>2, 8</sup> (±)                                                                                                                       | Comments                                                              |
|----------------------------------------------------------------------------------------|-------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|
| Thread Plug<br>Major Diameter<br>Pitch Diameter<br>(127 to 4) TPI<br>(0.35 to 2.50) mm | Up to 10 in<br>Up to 254 mm<br>Up to 10 in<br>Up to 254 mm        | $(5.6 + 1.2D) \mu\text{in}$<br>$(1.2D \text{ nm}) + 0.14 \mu\text{m}$<br>$(29 + 1.2D) \mu\text{in}$<br>$(1.2D \text{ nm}) + 0.74 \mu\text{m}$ | Lab Master 175, gage blocks, thread wires                             |
| Thread Rings<br>Pitch Diameter<br>Taper                                                | Up to 4.5000 in<br>Up to 115.000 mm<br>Up to 6 in<br>Up to 150 mm | $(29 + 1.3D) \mu\text{in}$<br>$(1.3D \text{ nm}) + 0.74 \mu\text{m}$<br>$(110 + 1.3D) \mu\text{in}$<br>$(1.3D \text{ nm}) + 2.8 \mu\text{m}$  | Setting plug gages<br>Gage blocks, master taper plugs, Lab Master 175 |
| Thread & Gear Wires                                                                    | Up to 1.0000 in Dia<br>Up to 25.400 mm Dia                        | 7.9 $\mu\text{in}$<br>0.22 $\mu\text{m}$                                                                                                      | Lab Master 175, gage blocks, master cylinders                         |
| Video Measuring System Keyence <sup>3</sup>                                            | Up to 12 in                                                       | $(6.6 + 16L) \mu\text{in}$                                                                                                                    | Master cylinders                                                      |



#### IV. Electrical – DC/Low Frequency

| Parameter/Equipment                | Frequency                                                                                           | CMC <sup>2, 4</sup> ( $\pm$ )                                                                                                                                               | Comments                 |
|------------------------------------|-----------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| AC Current – Generate <sup>3</sup> |                                                                                                     |                                                                                                                                                                             |                          |
| Up to 220 $\mu$ A                  | (10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz                   | 700 $\mu$ A/A + 25 nA<br>350 $\mu$ A/A + 20 nA<br>140 $\mu$ A/A + 16 nA<br>600 $\mu$ A/A + 40 nA<br>1.6 mA/A + 80 nA                                                        | Fluke 5700A, Fluke 5725A |
| 220 $\mu$ A to 2.02 mA             | (10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz                   | 700 $\mu$ A/A + 40 nA<br>350 $\mu$ A/A + 35 nA<br>140 $\mu$ A/A + 35 nA<br>600 $\mu$ A/A + 400 nA<br>1.6 mA/A + 800 nA                                                      |                          |
| (2.2 to 22) mA                     | (10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz                   | 700 $\mu$ A/A + 400 nA<br>350 $\mu$ A/A + 350 nA<br>140 $\mu$ A/A + 350 nA<br>600 $\mu$ A/A + 4 $\mu$ A<br>1.6 mA/A + 8 $\mu$ A                                             |                          |
| (22 to 220) mA                     | (10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz                   | 700 $\mu$ A/A + 4 $\mu$ A<br>350 $\mu$ A/A + 3.5 $\mu$ A<br>140 $\mu$ A/A + 3.5 $\mu$ A<br>600 $\mu$ A/A + 40 $\mu$ A<br>1.6 mA/A + 80 $\mu$ A                              |                          |
| 220 mA to 2.2 A                    | 20 Hz to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz                                                     | 650 $\mu$ A/A + 35 $\mu$ A<br>750 $\mu$ A/A + 80 $\mu$ A<br>8.5 mA/A + 160 $\mu$ A                                                                                          |                          |
| (2.2 to 11) A                      | 40 Hz to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz                                                     | 460 $\mu$ A/A + 170 $\mu$ A<br>950 $\mu$ A/A + 380 $\mu$ A<br>3.6 mA/A + 760 $\mu$ A                                                                                        |                          |
| (29 to 330) $\mu$ A                | (10 to 20) Hz<br>(20 to 45) Hz<br>45 Hz to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz<br>(10 to 30) kHz | 0.44 nA/A + 160 nA<br>0.22 nA/A + 98 nA<br>0.16 nA/A + 49 nA<br>1.1 nA/A + 18 nA<br>0.99 nA/A + 43 nA<br>9.5 nA/A + 220 nA                                                  | Fluke 5522A              |
| 330 $\mu$ A to 3.3 mA              | 10 to 20) Hz<br>(20 to 45) Hz<br>45 Hz to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz<br>(10 to 30) kHz  | 3.4 $\mu$ A/A + 0.31 $\mu$ A<br>2.5 $\mu$ A/A + 0.27 $\mu$ A<br>0.14 $\mu$ A/A + 54 nA<br>0.14 $\mu$ A/A + 46 nA<br>0.77 $\mu$ A/A + 140 nA<br>0.44 $\mu$ A/A + 1.1 $\mu$ A |                          |



| Parameter/Equipment                              | Frequency                                                                                          | CMC <sup>2,4</sup> (□)                                                                                                                                           | Comments                        |
|--------------------------------------------------|----------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| AC Current – Generate <sup>3</sup><br>(cont)     |                                                                                                    |                                                                                                                                                                  | Fluke 5522A                     |
| (3.3 to 33) mA                                   | 10 to 20) Hz<br>(20 to 45) Hz<br>45 Hz to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz<br>(10 to 30) kHz | 0.81 $\mu$ A/A + 2.3 $\mu$ A<br>0.3 $\mu$ A/A + 4 $\mu$ A<br>90 nA/A + 330 nA<br>90 nA/A + 330 nA<br>210 nA/A + 1 $\mu$ A<br>74 nA/A + 9.8 $\mu$ A               |                                 |
| (33 to 330) mA                                   | 10 to 20) Hz<br>(20 to 45) Hz<br>45 Hz to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz<br>(10 to 30) kHz | 0.71 $\mu$ A/A + 27 $\mu$ A<br>47 nA/A + 48 $\mu$ A<br>98 nA/A + 2.8 $\mu$ A<br>160 nA/A + 0.82 $\mu$ A<br>190 nA/A + 9.7 $\mu$ A<br>0.44 $\mu$ A/A + 66 $\mu$ A |                                 |
| (330 mA to 1.1 A                                 | (10 to 45) Hz<br>45 Hz to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz                                   | 0.79 mA/A + 0.45 mA<br>61 $\mu$ A/A + 54 $\mu$ A<br>1.6 mA/A + 0.45 mA<br>5.1 mA/A + 0.017 mA                                                                    |                                 |
| (1.1 to 3) A                                     | (10 to 45) Hz<br>45 Hz to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz                                   | 37 $\mu$ A/A + 0.65 mA<br>270 $\mu$ A/A + 180 $\mu$ A<br>0.57 mA/A + 0.51 mA<br>6.2 mA/A + 5.5 mA                                                                |                                 |
| (3 to 11) A                                      | (45 to 100) Hz<br>100 Hz to 1 kHz<br>(1 to 5) kHz                                                  | 0.17 mA/A + 3.5 mA<br>0.29 mA/A + 0.16 mA<br>22 mA/A + 72 mA                                                                                                     |                                 |
| (11 to 20.5) A                                   | (45 to 100) Hz<br>100 to 1 kHz<br>(1 to 5) kHz                                                     | 0.64 mA/A + 4.2 mA<br>0.82 mA/A + 6.4 mA<br>29 mA/A + 310 mA                                                                                                     |                                 |
| Clamp Meters<br>(20 to 150) A<br>(150 to 1050) A | (50 to 400) Hz<br>(50 to 400) Hz                                                                   | 0.057 % + 0.14 A<br>0.026 % + 0.45 A                                                                                                                             | Fluke 5522A/ with<br>5500A COIL |
| AC Current – Measure <sup>3</sup>                |                                                                                                    |                                                                                                                                                                  |                                 |
| Up to 100 $\mu$ A                                | (10 to 20) Hz<br>(20 to 45) Hz<br>(45 to 100) Hz<br>100 Hz to 5 kHz                                | 4 mA/A + 30 nA<br>1.5 mA/A + 30 nA<br>600 $\mu$ A/A + 30 nA<br>600 $\mu$ A/A + 30 nA                                                                             | Keysight 3458A,<br>option 002   |

| Parameter/Equipment               | Frequency                                                                                                                 | CMC <sup>2,4</sup> (□)                                                                                                                                                                  | Comments                         |
|-----------------------------------|---------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|
| AC Current – Measure <sup>3</sup> |                                                                                                                           |                                                                                                                                                                                         | Keysight 3458A,<br>option 002    |
| 100 $\mu$ A to 1 mA               | (10 to 20) Hz<br>(20 to 45) Hz<br>(45 to 100) Hz<br>100 Hz to 5 kHz<br>(5 to 20) kHz<br>(20 to 50) kHz<br>(50 to 100) kHz | 4 mA/A + 200 nA<br>1.5 mA/A + 200 nA<br>600 $\mu$ A/A + 200 nA<br>300 $\mu$ A/A + 200 nA<br>600 $\mu$ A/A + 200 nA<br>4 mA/A + 400 nA<br>5.5 mA/A + 1.5 $\mu$ A                         |                                  |
| (1 to 10) mA                      | (10 to 20) Hz<br>(20 to 45) Hz<br>(45 to 100) Hz<br>100 Hz to 5 kHz<br>(5 to 20) kHz<br>(20 to 50) kHz<br>(50 to 100) kHz | 4 mA/A + 2 $\mu$ A<br>1.5 mA/A + 2 $\mu$ A<br>600 $\mu$ A/A + 2 $\mu$ A<br>300 $\mu$ A/A + 2 $\mu$ A<br>600 $\mu$ A/A + 2 $\mu$ A<br>4 mA/A + 4 $\mu$ A<br>5.5 mA/A + 15 $\mu$ A        |                                  |
| (10 to 100) mA                    | (10 to 20) Hz<br>(20 to 45) Hz<br>(45 to 100) Hz<br>100 Hz to 5 kHz<br>(5 to 20) kHz<br>(20 to 50) kHz<br>(50 to 100) kHz | 4 mA/A + 20 $\mu$ A<br>1.5 mA/A + 20 $\mu$ A<br>600 $\mu$ A/A + 20 $\mu$ A<br>300 $\mu$ A/A + 20 $\mu$ A<br>600 $\mu$ A/A + 20 $\mu$ A<br>4 mA/A + 40 $\mu$ A<br>5.5 mA/A + 150 $\mu$ A |                                  |
| 100 mA to 1 A                     | (10 to 20) Hz<br>(20 to 45) Hz<br>(45 to 100) Hz<br>100 Hz to 5 kHz<br>(5 to 20) kHz<br>(20 to 50) kHz                    | 4 mA/A + 200 $\mu$ A<br>1.6 mA/A + 200 $\mu$ A<br>800 $\mu$ A/A + 200 $\mu$ A<br>1 mA/A + 200 $\mu$ A<br>3 mA/A + 200 $\mu$ A<br>10 mA/A + 400 $\mu$ A                                  |                                  |
| (1 to 3) A                        | 3 Hz to 5 kHz<br>(5 to 10) kHz                                                                                            | 20 $\mu$ A/A + 0.1 mA<br>0.9 mA/A + 0.2 mA                                                                                                                                              | Keysight 34465A                  |
| (3 to 10) A                       | 33 Hz to 5 kHz<br>(5 to 10) kHz                                                                                           | 0.43 mA/A + 0.72 mA<br>0.2 mA/A + 1.6 mA                                                                                                                                                |                                  |
| (1 to 50) A                       | 10 Hz to 1 kHz                                                                                                            | 0.59 mA/A + 2 mA                                                                                                                                                                        | Keysight 34465A<br>current shunt |
| (1 to 100) A                      | 10 Hz to 1 kHz                                                                                                            | 0.42 mA/A + 0.27 mA                                                                                                                                                                     |                                  |

| Parameter/Equipment                | Frequency                                                                                                                                           | CMC <sup>2,4</sup> (□)                                                                                                                                                                                                                                                                                                                                             | Comments               |
|------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| AC Voltage – Generate <sup>3</sup> |                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                    | Fluke 5700A with 5725A |
| Up to 2.2 mV                       | (10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 300) kHz<br>(300 to 500) kHz<br>(500 to 1000) kHz | 550 $\mu\text{V}/\text{V}$ + 4.5 $\mu\text{V}$<br>210 $\mu\text{V}/\text{V}$ + 4.5 $\mu\text{V}$<br>105 $\mu\text{V}/\text{V}$ + 4.5 $\mu\text{V}$<br>370 $\mu\text{V}/\text{V}$ + 4.5 $\mu\text{V}$<br>850 $\mu\text{V}/\text{V}$ + 7 $\mu\text{V}$<br>1.1 mV/V + 13 $\mu\text{V}$<br>1.7 mV/V + 25 $\mu\text{V}$<br>3.4 mV/V + 25 $\mu\text{V}$                  |                        |
| (2.2 to 22) mV                     | 10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 300) kHz<br>(300 to 500) kHz<br>(500 to 1000) kHz  | 550 $\mu\text{V}/\text{V}$ + 5 $\mu\text{V}$<br>210 $\mu\text{V}/\text{V}$ + 5 $\mu\text{V}$<br>105 $\mu\text{V}/\text{V}$ + 5 $\mu\text{V}$<br>370 $\mu\text{V}/\text{V}$ + 5 $\mu\text{V}$<br>850 $\mu\text{V}/\text{V}$ + 7 $\mu\text{V}$<br>1.1 mV/V + 12 $\mu\text{V}$<br>1.7 mV/V + 25 $\mu\text{V}$<br>3.4 mV/V + 25 $\mu\text{V}$                          |                        |
| (22 to 220) mV                     | (10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 300) kHz<br>(300 to 500) kHz<br>(500 to 1000) kHz | 550 $\mu\text{V}/\text{V}$ + 13 $\mu\text{V}$<br>210 $\mu\text{V}/\text{V}$ + 8 $\mu\text{V}$<br>105 $\mu\text{V}/\text{V}$ + 8 $\mu\text{V}$<br>370 $\mu\text{V}/\text{V}$ + 8 $\mu\text{V}$<br>850 $\mu\text{V}/\text{V}$ + 25 $\mu\text{V}$<br>1.1 mV/V + 25 $\mu\text{V}$<br>1.7 mV/V + 35 $\mu\text{V}$<br>3.4 mV/V + 80 $\mu\text{V}$                        |                        |
| 220 mV to 2.2 V                    | (10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 300) kHz<br>(300 to 500) kHz<br>(500 to 1000) kHz | 500 $\mu\text{V}/\text{V}$ + 80 $\mu\text{V}$<br>160 $\mu\text{V}/\text{V}$ + 25 $\mu\text{V}$<br>75 $\mu\text{V}/\text{V}$ + 6 $\mu\text{V}$<br>120 $\mu\text{V}/\text{V}$ + 16 $\mu\text{V}$<br>250 $\mu\text{V}/\text{V}$ + 70 $\mu\text{V}$<br>430 $\mu\text{V}/\text{V}$ + 130 $\mu\text{V}$<br>1.05 mV/V + 350 $\mu\text{V}$<br>2.2 mV/V + 850 $\mu\text{V}$ |                        |
| (2.2 to 22) V                      | (10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 300) kHz<br>(300 to 500) kHz<br>(500 to 1000) kHz | 500 $\mu\text{V}/\text{V}$ + 800 $\mu\text{V}$<br>160 $\mu\text{V}/\text{V}$ + 250 $\mu\text{V}$<br>75 $\mu\text{V}/\text{V}$ + 60 $\mu\text{V}$<br>120 $\mu\text{V}/\text{V}$ + 160 $\mu\text{V}$<br>250 $\mu\text{V}/\text{V}$ + 350 $\mu\text{V}$<br>500 $\mu\text{V}/\text{V}$ + 1.5 mV<br>1.25 mV/V + 4.3 mV<br>2.7 mV/V + 85 mV                              |                        |

| Parameter/Equipment                          | Frequency                                                                                                                                           | CMC <sup>2, 4</sup>                                                                                                                                                                                                                                                                                                                                                      | Comments                     |
|----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| AC Voltage – Generate <sup>3</sup><br>(cont) |                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                          |                              |
| (22 to 220) V                                | (10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 300) kHz<br>(300 to 500) kHz<br>(500 to 1000) kHz | 500 $\mu\text{V}/\text{V} + 8 \text{ mV}$<br>160 $\mu\text{V}/\text{V} + 2.5 \text{ mV}$<br>80 $\mu\text{V}/\text{V} + 0.8 \text{ mV}$<br>220 $\mu\text{V}/\text{V} + 3.5 \text{ mV}$<br>500 $\mu\text{V}/\text{V} + 8 \text{ mV}$<br>1.5 $\text{mV}/\text{V} + 90 \text{ mV}$<br>4.7 $\text{mV}/\text{V} + 90 \text{ mV}$<br>11.5 $\text{mV}/\text{V} + 190 \text{ mV}$ | Fluke 5700A with<br>5725A    |
| (220 to 750) V                               | 30 to 50) kHz<br>(50 to 100) kHz                                                                                                                    | 600 $\mu\text{V}/\text{V} + 11 \text{ mV}$<br>2.3 $\text{mV}/\text{V} + 45 \text{ mV}$                                                                                                                                                                                                                                                                                   |                              |
| (220 to 1100) V                              | (15 to 50) Hz<br>40 Hz to 1 kHz<br>(1 to 20) kHz<br>(20 to 30) kHz                                                                                  | 400 $\mu\text{V}/\text{V} + 16 \text{ mV}$<br>90 $\mu\text{V}/\text{V} + 4 \text{ mV}$<br>165 $\mu\text{V}/\text{V} + 6 \text{ mV}$<br>600 $\mu\text{V}/\text{V} + 11 \text{ mV}$                                                                                                                                                                                        |                              |
| (33 to 330) V                                | 45 Hz to 1 kHz<br>(1 to 10) kHz<br>(10 to 20) kHz<br>(20 to 50) kHz<br>(50 to 100) kHz                                                              | 160 $\mu\text{V}/\text{V} + 0.82 \text{ mV}$<br>140 $\mu\text{V}/\text{V} + 3.9 \text{ mV}$<br>230 $\mu\text{V}/\text{V} + 0.91 \text{ mV}$<br>350 $\mu\text{V}/\text{V} + 27 \text{ mV}$<br>1.1 $\text{mV}/\text{V} + 30 \text{ mV}$                                                                                                                                    | Fluke 5522A                  |
| (330 to 1020) V                              | 45 Hz to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz                                                                                                     | 66 $\mu\text{V}/\text{V} + 11 \text{ mV}$<br>67 $\mu\text{V}/\text{V} + 3.1 \text{ mV}$<br>91 $\mu\text{V}/\text{V} + 6 \text{ mV}$                                                                                                                                                                                                                                      |                              |
| AC Voltage – Measure <sup>3</sup>            |                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                          | Keysight 3458A               |
| Up to 10 mV                                  | (1 to 40) Hz<br>40 Hz to 1 kHz<br>(1 to 20) kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 300) kHz<br>100 kHz to 1 MHz                        | 300 $\mu\text{V}/\text{V} + 3 \mu\text{V}$<br>200 $\mu\text{V}/\text{V} + 1.1 \mu\text{V}$<br>300 $\mu\text{V}/\text{V} + 1.1 \mu\text{V}$<br>1 $\text{mV}/\text{V} + 1.1 \mu\text{V}$<br>5 $\text{mV}/\text{V} + 1.1 \mu\text{V}$<br>40 $\text{mV}/\text{V} + 2 \mu\text{V}$<br>12 $\text{mV}/\text{V} + 5 \mu\text{V}$                                                 | AC Band $\leq 2 \text{ MHz}$ |
| Up to 10 mV                                  | (1 to 4) MHz<br>(4 to 8) MHz                                                                                                                        | 70 $\text{mV}/\text{V} + 7 \mu\text{V}$<br>200 $\text{mV}/\text{V} + 8 \mu\text{V}$                                                                                                                                                                                                                                                                                      | AC Band $> 2 \text{ MHz}$    |

| Parameter/Equipment                      | Frequency                                                                                                                                                                                                         | CMC <sup>2, 4</sup>                                                                                                                                                                                                                                                                                                                                                                                              | Comments                                                                                                          |
|------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|
| AC Voltage – Measure <sup>3</sup> (cont) |                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                   |
| (10 to 100) mV                           | (1 to 40) Hz<br>40 Hz to 1 kHz<br>(1 to 20) kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 300) kHz<br>300 kHz to 1 MHz<br>(1 to 2) MHz<br>100 kHz to 1 MHz<br>(1 to 4) MHz<br>(4 to 8) MHz<br>(8 to 10) MHz | 70 $\mu\text{V/V} + 4 \mu\text{V}$<br>70 $\mu\text{V/V} + 2 \mu\text{V}$<br>140 $\mu\text{V/V} + 2 \mu\text{V}$<br>300 $\mu\text{V/V} + 2 \mu\text{V}$<br>800 $\mu\text{V/V} + 2 \mu\text{V}$<br>3 mV/V + 10 $\mu\text{V}$<br>10 mV/V + 10 $\mu\text{V}$<br>15 mV/V + 10 $\mu\text{V}$<br>20 mV/V + 50 $\mu\text{V}$<br>40 mV/V + 70 $\mu\text{V}$<br>40 mV/V + 80 $\mu\text{V}$<br>150 mV/V + 100 $\mu\text{V}$ | Keysight 3458A<br>AC Band $\leq 2$ MHz<br><br><br><br><br><br><br><br><br><br>Keysight 3458A<br>AC Band $> 2$ MHz |
| 100 mV to 1 V                            | (1 to 40) Hz<br>40 Hz to 1 kHz<br>(1 to 20) kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 300) kHz<br>300 kHz to 1 MHz<br>(1 to 2) MHz<br>100 kHz to 1 MHz<br>(1 to 4) MHz<br>(4 to 8) MHz<br>(8 to 10) MHz | 70 $\mu\text{V/V} + 40 \mu\text{V}$<br>70 $\mu\text{V/V} + 20 \mu\text{V}$<br>140 $\mu\text{V/V} + 20 \mu\text{V}$<br>300 $\mu\text{V/V} + 20 \mu\text{V}$<br>800 $\mu\text{V/V} + 20 \mu\text{V}$<br>3 mV/V + 100 $\mu\text{V}$<br>10 mV/V + 100 $\mu\text{V}$<br>15 mV/V + 100 $\mu\text{V}$<br>20 mV/V + 500 $\mu\text{V}$<br>40 mV/V + 700 $\mu\text{V}$<br>40 mV/V + 800 $\mu\text{V}$<br>150 mV/V + 1mV    | Keysight 3458A<br>AC Band $\leq 2$ MHz<br><br><br><br><br><br><br><br><br><br>Keysight 3458A<br>AC Band $> 2$ MHz |
| (1 to 10) V                              | (1 to 40) Hz<br>40 Hz to 1 kHz<br>(1 to 20) kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 300) kHz<br>300 kHz to 1 MHz<br>(1 to 2) MHz<br>300 kHz to 1 MHz<br>(2 to 4) MHz<br>(4 to 8) MHz<br>(8 to 10) MHz | 70 $\mu\text{V/V} + 400 \mu\text{V}$<br>70 $\mu\text{V/V} + 200 \mu\text{V}$<br>140 $\mu\text{V/V} + 200 \mu\text{V}$<br>300 $\mu\text{V/V} + 200 \mu\text{V}$<br>800 $\mu\text{V/V} + 200 \mu\text{V}$<br>3 mV/V + 1 mV<br>10 mV/V + 1 mV<br>15 mV/V + 1 mV<br>20 mV/V + 5 mV<br>40 mV/V + 7 mV<br>40 mV/V + 8 mV<br>150 mV/V + 10 mV                                                                           | Keysight 3458A<br>AC Band $\leq 2$ MHz<br><br><br><br><br><br><br><br><br><br>Keysight 3458A<br>AC Band $> 2$ MHz |
| (10 to 100) V                            | (1 to 40) Hz<br>40 Hz to 1 kHz<br>(1 to 20) kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 300) kHz<br>300 kHz to 1 MHz                                                                                      | 200 $\mu\text{V/V} + 4 \text{ mV}$<br>200 $\mu\text{V/V} + 2 \text{ mV}$<br>200 $\mu\text{V/V} + 2 \text{ mV}$<br>350 $\mu\text{V/V} + 2 \text{ mV}$<br>1.2 mV/V + 2 mV<br>4 mV/V + 10 mV<br>15 mV/V + 10 mV                                                                                                                                                                                                     | Keysight 3458A<br>AC Band $\leq 2$ MHz                                                                            |
| (100 to 1000) V                          | (1 to 40) Hz<br>40 Hz to 1 kHz<br>(1 to 20) kHz<br>(20 to 50) kHz<br>(50 to 100) kHz                                                                                                                              | 400 $\mu\text{V/V} + 40 \text{ mV}$<br>400 $\mu\text{V/V} + 20 \text{ mV}$<br>600 $\mu\text{V/V} + 20 \text{ mV}$<br>1.2 mV/V + 20 mV<br>3 mV/V + 20 mV                                                                                                                                                                                                                                                          |                                                                                                                   |

| Parameter/Equipment                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Frequency                                                                                                                                                                                                                                                                                                             | CMC <sup>2, 4</sup>                                                                                                                                                                                                                                                                                                                                                                                                               | Comments                     |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| AC Voltage – Measure <sup>3</sup> (cont)<br><br>(100 to 1000) V<br>(1000 to 50 000) V                                                                                                                                                                                                                                                                                                                                                                                                     | 50 Hz to 400 Hz<br>50 Hz to 400 Hz                                                                                                                                                                                                                                                                                    | 820 $\mu$ V/V + 480 mV<br>0.72 mV/V + 170 mV                                                                                                                                                                                                                                                                                                                                                                                      | Vitrek 4700<br>Vitrek HVL-70 |
| Capacitance – Generate <sup>3</sup><br><br>(220 to 399.9) pF<br>(0.4 to 1.0999) nF<br>(1.1 to 3.2999) nF<br>(3.3 to 10.9999) nF<br>(11 to 32.9999) nF<br>(33 to 109.999) nF<br>(110 to 329.999) nF<br>(0.33 to 1.099 99) $\mu$ F<br>(1.1 to 3.299 99) $\mu$ F<br>(3.3 to 10.9999) $\mu$ F<br>(11 to 32.9999) $\mu$ F<br>(33 to 109.999) $\mu$ F<br>(110 to 329.999) $\mu$ F<br>(0.33 to 1.0999) mF<br>(1.1 to 3.299 99) mF<br>(3.3 to 10.9999) mF<br>(11 to 32.9999) mF<br>(33 to 110) mF | 10 Hz to 10 kHz<br>10 Hz to 10 kHz<br>10 Hz to 3 kHz<br>10 Hz to 1 kHz<br>10 Hz to 1 kHz<br>10 Hz to 1 kHz<br>10 Hz to 1 kHz<br>(10 to 600) Hz<br>(10 to 300) Hz<br>(10 to 150) Hz<br>(10 to 120) Hz<br>(10 to 80) Hz<br>(0 to 50) Hz<br>(0 to 20) Hz<br>(0 to 6) Hz<br>(0 to 2) Hz<br>(0 to 0.6) Hz<br>(0 to 0.2) Hz | 0.12 % + 1.6 pF<br>0.19 pF/F + 2.2 pF<br>2.8 pF/F + 7.6 pF<br>1.3 pF/F + 11 pF<br>1.3 pF/F + 7.6 pF<br>1.8 pF/F + 6 pF<br>1.3 pF/F + 50 pF<br>1.8 nF/F + 0.04 nF<br>1.4 nF/F + 0.6 nF<br>2.1 nF/F + 4.7 nF<br>3 nF/F + 26 nF<br>2.8 nF/F + 86 nF<br>1.7 nF/F + 10 nF<br>1.7 $\mu$ F/F + 0.38 $\mu$ F<br>1.8 $\mu$ F/F + 0.52 $\mu$ F<br>2.1 $\mu$ F/F + 0.87 $\mu$ F<br>5.3 $\mu$ F/F + 49 $\mu$ F<br>1.9 $\mu$ F/F + 130 $\mu$ F | Fluke 5522A                  |
| Capacitance – Measure <sup>3</sup><br><br>1 pF to 1 mF                                                                                                                                                                                                                                                                                                                                                                                                                                    | 20 Hz to 300 kHz                                                                                                                                                                                                                                                                                                      | 0.11 % Rdg + 3.6 fF                                                                                                                                                                                                                                                                                                                                                                                                               | Keysight E4980AL             |

| Parameter/Equipment                | Range                                                                                                              | CMC <sup>2, 4</sup>                                                                                                                                          | Comments                |
|------------------------------------|--------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| DC Current – Generate <sup>3</sup> | Up to 220 $\mu$ A<br>220 $\mu$ A to 2.2 mA<br>(2.2 to 22) mA<br>(22 to 220) mA<br>220 mA to 2.2 A<br>(2.2 to 11) A | 50 $\mu$ A/A + 8 nA<br>50 $\mu$ A/A + 8 nA<br>50 $\mu$ A/A + 80 nA<br>60 $\mu$ A/A + 0.8 $\mu$ A<br>80 $\mu$ A/A + 25 $\mu$ A<br>360 $\mu$ A/A + 480 $\mu$ A | Fluke 5700A w/<br>5725A |

| Parameter/Equipment                          | Range                                                                                                                                                                                                                                                                                            | CMC <sup>2, 4</sup>                                                                                                                                                                                                                                                                                                                                                                                     | Comments                                                                                                                           |
|----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|
| DC Current – Generate <sup>3</sup><br>(cont) | Up to 330 $\mu$ A<br>330 $\mu$ A to 3.3 mA<br>(3.3 to 33) mA<br>(33 to 330) mA<br>330 mA to 1.1 A<br>(1.1 to 3) A<br>(3 to 11) A<br>(11 to 20.5) A                                                                                                                                               | 32 pA/A + 2.4 nA<br>47 nA/A + 24 nA<br>40 nA/A + 190 nA<br>35 nA/A + 1.4 $\mu$ A<br>20 $\mu$ A/A + 22 $\mu$ A<br>66 $\mu$ A/A + 34 $\mu$ A<br>90 $\mu$ A/A + 220 $\mu$ A<br>270 $\mu$ A/A + 1.2 mA                                                                                                                                                                                                      | Fluke 5522A                                                                                                                        |
| Clamp Meters                                 | (20 to 150) A<br>(150 to 1050) A                                                                                                                                                                                                                                                                 | 0.26 % + 40 mA<br>0.25 % + 100 mA                                                                                                                                                                                                                                                                                                                                                                       | Fluke 5522A/ with<br>5500A COIL                                                                                                    |
| DC Current – Measure <sup>3</sup>            | Up to 100 nA<br>100 nA to 1 $\mu$ A<br>(1 to 10) $\mu$ A<br>(10 to 100) $\mu$ A<br>100 $\mu$ A to 1 mA<br>(1 to 10) mA<br>(10 to 100) mA<br>100 mA to 1 A<br><br>(1 to 50) A<br>(1 to 100) A<br>(1 to 500) A<br><br>(1 to 3) A<br>(3 to 10) A<br><br>(1 to 50) A<br>(1 to 100) A<br>(1 to 500) A | 30 $\mu$ A/A + 40 pA<br>20 $\mu$ A/A + 40 pA<br>20 $\mu$ A/A + 100 pA<br>20 $\mu$ A/A + 800 pA<br>20 $\mu$ A/A + 5 nA<br>20 $\mu$ A/A + 50 nA<br>35 $\mu$ A/A + 500 nA<br>110 $\mu$ A/A + 10 $\mu$ A<br><br>0.59 mA/A + 60 mA<br>0.42 mA/A + 42 mA<br>0.28 mA/A + 28 mA<br><br>390 $\mu$ A/A + 190 $\mu$ A<br>240 $\mu$ A/A + 1.4 mA<br><br>0.59 mA/A + 62 mA<br>0.42 mA/A + 45 mA<br>0.28 mA/A + 31 mA | Keysight 3458A option<br>2<br><br>Keysight 3458A<br>current shunts<br><br>Keysight 34465A<br><br>Keysight 34465A<br>current Shunts |
| DC Voltage – Generate <sup>3</sup>           | Up to 220 mV<br>220 mV to 2.2 V<br>(2.2 to 11) V<br>(11 to 22) V<br>(22 to 220) V<br>(220 to 1100) V<br><br>Up to 330 mV<br>330 mV to 3.3 V<br>(3.3 to 33) V<br>(33 to 330) V<br>(330 V to 1020) V                                                                                               | 8 $\mu$ V/V + 0.6 $\mu$ V<br>7 $\mu$ V/V + 1 $\mu$ V<br>7 $\mu$ V/V + 3.5 $\mu$ V<br>7 $\mu$ V/V + 6.5 $\mu$ V<br>8 $\mu$ V/V + 80 $\mu$ V<br>9 $\mu$ V/V + 500 $\mu$ V<br><br>5.8 $\mu$ V/V + 1.2 $\mu$ V<br>4.5 $\mu$ V/V + 5.3 $\mu$ V<br>4.5 $\mu$ V/V + 61 $\mu$ V<br>3.3 $\mu$ V/V + 720 $\mu$ V<br>2.8 $\mu$ V/V + 4.4 mV                                                                        | Fluke 5700A<br><br>Fluke 5522A                                                                                                     |



| Parameter/Equipment                                            | Range                                                                                                                     | CMC <sup>2, 4</sup>                                                                                                                                                         | Comments                                                             |
|----------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|
| DC Voltage – Measure <sup>3</sup>                              | Up to 100 mV<br>100 mV to 1 V<br>(1 to 10) V<br>(10 to 100) V<br>(100 to 1000) V<br>(100 to 10 000) V<br>(1000 to 70 000) | 5 $\mu$ V/V + 300 nV<br>4 $\mu$ V/V + 300 nV<br>4 $\mu$ V/V + 500 nV<br>6 $\mu$ V/V + 30 $\mu$ V<br>6 $\mu$ V/V + 100 $\mu$ V<br>160 $\mu$ V/V + 55 mV<br>0.22 mV/V + 5.7 V | Keysight 3458A,<br>option 002<br><br>Vitretek 4700, Vitrek<br>HVL-70 |
| Inductance – Generate <sup>3</sup>                             | 100 mH                                                                                                                    | 0.13 mH                                                                                                                                                                     | Standard Inductor                                                    |
| Oscilloscopes <sup>3</sup>                                     |                                                                                                                           |                                                                                                                                                                             | Fluke<br>5522A/SC1100                                                |
| AC Square Wave Signal<br>Into 1 M $\Omega$<br>Into 50 $\Omega$ | 1.0 mVpp to 130 Vpp<br>1.0 mVpp to 6.6 Vpp                                                                                | 0.1 % of output + 40 $\mu$ V<br>0.25 % of output + 40 $\mu$ V                                                                                                               |                                                                      |
| AC Square Wave<br>Frequency                                    | 10 Hz to 10 kHz                                                                                                           | 2.5 $\mu$ Hz/Hz                                                                                                                                                             |                                                                      |
| DC Signal<br>Into 1 M $\Omega$<br>Into 50 $\Omega$             | Up to $\pm$ 130 V<br>Up to $\pm$ 6.6 V                                                                                    | 0.05 % of output + 40 $\mu$ V<br>0.25 % of output + 40 $\mu$ V                                                                                                              |                                                                      |
| Edge – Aberrations                                             | Within 2 ns from 50<br>% of Rising Edge<br>(2 to 5) ns<br>(5 to 15) ns<br>After 15 ns                                     | <(3 % of output + 2 mV)<br><(2 % of output + 2 mV)<br><(1 % of output + 2 mV)<br><(0.5 % of output + 2 mV)                                                                  |                                                                      |
| Edge - Amplitude Range                                         | 5 mVpp to 2.5 Vpp                                                                                                         | 2 % of Output + 200 $\mu$ V                                                                                                                                                 |                                                                      |
| Edge - Frequency Range                                         | 1 kHz to 10 MHz                                                                                                           | 2.5 $\mu$ Hz/Hz                                                                                                                                                             |                                                                      |
| Edge - Rise Time                                               | 24 ps to 350 ps                                                                                                           | 23 ps                                                                                                                                                                       |                                                                      |
| Level Sine Wave –<br>Amplitude<br><br>(5 mV to 5.5 V)          | 50 kHz Reference<br>50 kHz to 100 MHz<br>(100 to 300) MHz<br>(300 to 600) MHz                                             | 2.0 % of output + 0.3 mV<br>3.5 % of output + 0.3 mV<br>4.0 % of output + 0.3 mV<br>6.0 % of output + 0.3 mV                                                                |                                                                      |
| (5 mV to 3.5 V)                                                | (600 to 1100) MHz                                                                                                         | 7.0 % of output + 0.3 mV                                                                                                                                                    |                                                                      |

| Parameter/Equipment                                       | Range                                                                                                                                                                                                                                                                                                | CMC <sup>2, 4</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                      | Comments                                              |
|-----------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|
| Oscilloscopes <sup>3</sup> (cont)                         |                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Fluke 5522A/SC1100                                    |
| Level Sine Wave – Flatness                                |                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                       |
| (5 mV to 5.5 V)                                           | 50 kHz to 100 MHz<br>(100 to 300) MHz<br>(300 to 600) MHz                                                                                                                                                                                                                                            | 1.5 % + 100 $\mu$ V<br>2 % + 100 $\mu$ V<br>4 % + 100 $\mu$ V                                                                                                                                                                                                                                                                                                                                                                                            |                                                       |
| (5 mV to 3.5 V)                                           | 600 to 1100) MHz                                                                                                                                                                                                                                                                                     | 5 % + 100 $\mu$ V                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                       |
| Frequency Range                                           | 50 kHz to 1100 MHz                                                                                                                                                                                                                                                                                   | 2.5 $\mu$ Hz/Hz                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                       |
| Time Marker                                               | (1 to 5) ns<br>10 ns<br>(20 to 50) ns<br>100 ns to 20 ms<br>50 ms to 5 s                                                                                                                                                                                                                             | 1.2 ps<br>12 ps<br>12 ps<br>460 ps/s + 46 ps<br>42 $\mu$ s/s + 108 ns                                                                                                                                                                                                                                                                                                                                                                                    |                                                       |
| Resistance – Generate <sup>3</sup><br>Fixed Points 4-Wire | 0.001 $\Omega$<br>0.01 $\Omega$<br>0.1 $\Omega$<br>1 $\Omega$<br>10 $\Omega$<br>100 $\Omega$<br>1 k $\Omega$<br>10 k $\Omega$<br>100 k $\Omega$<br>1 M $\Omega$<br>10 M $\Omega$                                                                                                                     | 30 $\mu\Omega$<br>33 $\mu\Omega$<br>36 $\mu\Omega$<br>75 $\mu\Omega$<br>87 $\mu\Omega$<br>550 $\mu\Omega$<br>3.7 m $\Omega$<br>90 m $\Omega$<br>620 m $\Omega$<br>9.9 $\Omega$<br>310 $\Omega$                                                                                                                                                                                                                                                           | Standard resistors &<br>Keysight 3458A,<br>option 002 |
| Fixed Points                                              | 0 $\Omega$<br>1 $\Omega$<br>1.9 $\Omega$<br>10 $\Omega$<br>19 $\Omega$<br>100 $\Omega$<br>190 $\Omega$<br>1 k $\Omega$<br>1.9 k $\Omega$<br>10 k $\Omega$<br>19 k $\Omega$<br>100 k $\Omega$<br>190 k $\Omega$<br>1 M $\Omega$<br>1.9 M $\Omega$<br>10 M $\Omega$<br>19 M $\Omega$<br>100 M $\Omega$ | 50 $\mu\Omega$<br>95 $\mu\Omega/\Omega$<br>95 $\mu\Omega/\Omega$<br>28 $\mu\Omega/\Omega$<br>27 $\mu\Omega/\Omega$<br>17 $\mu\Omega/\Omega$<br>17 $\mu\Omega/\Omega$<br>13 $\mu\Omega/\Omega$<br>13 $\mu\Omega/\Omega$<br>12 $\mu\Omega/\Omega$<br>12 $\mu\Omega/\Omega$<br>14 $\mu\Omega/\Omega$<br>14 $\mu\Omega/\Omega$<br>20 $\mu\Omega/\Omega$<br>21 $\mu\Omega/\Omega$<br>40 $\mu\Omega/\Omega$<br>47 $\mu\Omega/\Omega$<br>110 $\mu\Omega/\Omega$ | Fluke 5700A                                           |



| Parameter/Equipment                       | Range           | CMC <sup>2, 4</sup> | Comments                                      |
|-------------------------------------------|-----------------|---------------------|-----------------------------------------------|
| Resistance – Generate <sup>3</sup> (cont) |                 |                     |                                               |
| (1 to 10) k $\Omega$ Decade               | 1 k $\Omega$    | 150 m $\Omega$      | IET HRRS-F-9-1k-5kV-WT high voltage resistors |
|                                           | 2 k $\Omega$    | 270 m $\Omega$      |                                               |
|                                           | 3 k $\Omega$    | 400 m $\Omega$      |                                               |
|                                           | 4 k $\Omega$    | 510 m $\Omega$      |                                               |
|                                           | 5 k $\Omega$    | 660 m $\Omega$      |                                               |
|                                           | 6 k $\Omega$    | 800 m $\Omega$      |                                               |
|                                           | 7 k $\Omega$    | 930 m $\Omega$      |                                               |
|                                           | 8 k $\Omega$    | 1 $\Omega$          |                                               |
|                                           | 9 k $\Omega$    | 1 $\Omega$          |                                               |
|                                           | 10 k $\Omega$   | 1 $\Omega$          |                                               |
| (10 to 100) k $\Omega$ Decade             | 10 k $\Omega$   | 46 m $\Omega$       |                                               |
|                                           | 20 k $\Omega$   | 1.5 $\Omega$        |                                               |
|                                           | 30 k $\Omega$   | 2.9 $\Omega$        |                                               |
|                                           | 40 k $\Omega$   | 3.9 $\Omega$        |                                               |
|                                           | 50 k $\Omega$   | 3.1 $\Omega$        |                                               |
|                                           | 60 k $\Omega$   | 4.4 $\Omega$        |                                               |
|                                           | 70 k $\Omega$   | 5.4 $\Omega$        |                                               |
|                                           | 80 k $\Omega$   | 6.4 $\Omega$        |                                               |
|                                           | 90 k $\Omega$   | 7.5 $\Omega$        |                                               |
|                                           | 100 k $\Omega$  | 7.2 $\Omega$        |                                               |
| (100 to 1000) k $\Omega$ Decade           | 100 k $\Omega$  | 1.9 $\Omega$        |                                               |
|                                           | 200 k $\Omega$  | 91 $\Omega$         |                                               |
|                                           | 300 k $\Omega$  | 90 $\Omega$         |                                               |
|                                           | 400 k $\Omega$  | 91 $\Omega$         |                                               |
|                                           | 500 k $\Omega$  | 85 $\Omega$         |                                               |
|                                           | 600 k $\Omega$  | 86 $\Omega$         |                                               |
|                                           | 700 k $\Omega$  | 75 $\Omega$         |                                               |
|                                           | 800 k $\Omega$  | 79 $\Omega$         |                                               |
|                                           | 900 k $\Omega$  | 78 $\Omega$         |                                               |
|                                           | 1000 k $\Omega$ | 74 $\Omega$         |                                               |
| (1 to 10) M $\Omega$ Decade               | 1 M $\Omega$    | 190 $\Omega$        |                                               |
|                                           | 2 M $\Omega$    | 140 $\Omega$        |                                               |
|                                           | 3 M $\Omega$    | 180 $\Omega$        |                                               |
|                                           | 4 M $\Omega$    | 230 $\Omega$        |                                               |
|                                           | 5 M $\Omega$    | 310 $\Omega$        |                                               |
|                                           | 6 M $\Omega$    | 340 $\Omega$        |                                               |
|                                           | 7 M $\Omega$    | 420 $\Omega$        |                                               |
|                                           | 8 M $\Omega$    | 500 $\Omega$        |                                               |
|                                           | 9 M $\Omega$    | 530 $\Omega$        |                                               |
|                                           | 10 M $\Omega$   | 590 $\Omega$        |                                               |

| Parameter/Equipment                       | Range                                                                                             | CMC <sup>2, 4</sup>                                                                             | Comments                                      |
|-------------------------------------------|---------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|-----------------------------------------------|
| Resistance – Generate <sup>3</sup> (cont) |                                                                                                   |                                                                                                 | IET HRRS-F-9-1k-5kV-WT high voltage resistors |
| (10 to 100) MΩ Decade                     | 10 MΩ<br>20 MΩ<br>30 MΩ<br>40 MΩ<br>50 MΩ<br>60 MΩ<br>70 MΩ<br>80 MΩ<br>90 MΩ<br>100 MΩ           | 2.4 kΩ<br>17 kΩ<br>34 kΩ<br>57 kΩ<br>80 kΩ<br>100 kΩ<br>130 kΩ<br>120 kΩ<br>130 kΩ<br>78 kΩ     |                                               |
| (100 to 1000) MΩ Decade                   | 100 MΩ<br>200 MΩ<br>300 MΩ<br>400 MΩ<br>500 MΩ<br>600 MΩ<br>700 MΩ<br>800 MΩ<br>900 MΩ<br>1000 MΩ | 37 kΩ<br>80 kΩ<br>290 kΩ<br>480 kΩ<br>600 kΩ<br>910 kΩ<br>1.1 MΩ<br>1.3 MΩ<br>1.6 MΩ<br>1.8 MΩ  |                                               |
| (1 to 10) GΩ Decade                       | 1 GΩ<br>2 GΩ<br>3 GΩ<br>4 GΩ<br>5 GΩ<br>6 GΩ<br>7 GΩ<br>8 GΩ<br>9 GΩ<br>10 GΩ                     | 0.72 MΩ<br>1 MΩ<br>1.7 MΩ<br>4 MΩ<br>6.4 MΩ<br>8.7 MΩ<br>21 MΩ<br>22 MΩ<br>28 MΩ<br>35 MΩ       |                                               |
| (10 to 100) GΩ Decade                     | 10 GΩ<br>20 GΩ<br>30 GΩ<br>40 GΩ<br>50 GΩ<br>60 GΩ<br>70 GΩ<br>80 GΩ<br>90 GΩ<br>100 GΩ           | 60 MΩ<br>140 MΩ<br>290 MΩ<br>510 MΩ<br>750 MΩ<br>990 MΩ<br>1.4 GΩ<br>1.9 GΩ<br>2.1 GΩ<br>1.3 GΩ |                                               |

| Parameter/Equipment                       | Range                                                                                                                                                                                                                                                                                                       | CMC <sup>2, 4</sup>                                                                                                                                                                                                                                                                                                                            | Comments                                      |
|-------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|
| Resistance – Generate <sup>3</sup> (cont) |                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                |                                               |
| (100 to 1000 GΩ) Decade                   | 100 GΩ<br>200 GΩ<br>300 GΩ<br>400 GΩ<br>500 GΩ<br>600 GΩ<br>700 GΩ<br>800 GΩ<br>900 GΩ<br>1000 GΩ                                                                                                                                                                                                           | 1.2 GΩ<br>2.4 GΩ<br>3.5 GΩ<br>7.2 GΩ<br>8.2 GΩ<br>9.7 GΩ<br>12 GΩ<br>16 GΩ<br>18 GΩ<br>20 GΩ                                                                                                                                                                                                                                                   | IET HRRS-F-9-1k-5kV-WT high voltage resistors |
| Variable Points                           | Up to 11 Ω<br>(10 to 33) Ω<br>(33 to 110) Ω<br>(110 to 330) Ω<br>330 to 1.1 kΩ<br>(1.1 to 3.3) kΩ<br>(3.3 to 11) kΩ<br>(11 to 33) kΩ<br>(33 to 110) kΩ<br>(110 to 330) kΩ<br>330 kΩ to 1.1 MΩ<br>(1.1 to 3.3) MΩ<br>(3.3 to 11) MΩ<br>(1 to 33) MΩ<br>(33 to 110) MΩ<br>(110 to 330) MΩ<br>(330 to 1100) MΩ | 18 μΩ/Ω + 270 μΩ<br>32 μΩ/Ω + 340 μΩ<br>9.2 μΩ/Ω + 1.1 mΩ<br>11 μΩ/Ω + 110 μΩ<br>15 μΩ/Ω + 0.45 mΩ<br>29 μΩ/Ω + 17 mΩ<br>5.3 μΩ/Ω + 120 mΩ<br>10 μΩ/Ω + 31 mΩ<br>9.3 μΩ/Ω + 180 mΩ<br>30 μΩ/Ω + 12 Ω<br>1.3 μΩ/Ω + 14 Ω<br>23 μΩ/Ω + 51 Ω<br>100 μΩ/Ω + 150 Ω<br>100 μΩ/Ω + 10 Ω<br>150 μΩ/Ω + 4.7 kΩ<br>860 μΩ/Ω + 79 kΩ<br>8.2 mΩ/Ω + 2.6 MΩ | Fluke 5522A                                   |
| Resistance – Measure <sup>3</sup>         | Up to 10 Ω<br>(10 to 100) Ω<br>100 Ω to 1 kΩ<br>(1 to 10) kΩ<br>(10 to 100) kΩ<br>(100 to 1) MΩ<br>(1 to 10) MΩ<br>(10 to 100) MΩ<br>100 MΩ to 1 GΩ                                                                                                                                                         | 15 μΩ/Ω + 50 μΩ<br>12 μΩ/Ω + 500 μΩ<br>10 μΩ/Ω + 500 μΩ<br>10 μΩ/Ω + 5 mΩ<br>10 μΩ/Ω + 50 mΩ<br>10 μΩ/Ω + 2 Ω<br>50 μΩ/Ω + 100 Ω<br>500 μΩ/Ω + 1 kΩ<br>0.5 % + 10 kΩ                                                                                                                                                                           | Keysight 3458A option 002                     |

| Parameter/Equipment                                | Range                                  | CMC <sup>2, 4</sup>  | Comments                                     |
|----------------------------------------------------|----------------------------------------|----------------------|----------------------------------------------|
| Electrical Calibration of Thermocouples – Generate |                                        |                      | Ectron 1140A<br>SPRT with readout & ice bath |
| Type E                                             | (-175 to 950) °C<br>(-283 to 1742) °F  | 0.077 °C<br>0.138 °F |                                              |
| Type K                                             | (-200 to 1200) °C<br>(-328 to 2192) °F | 0.096 °C<br>0.172 °F |                                              |
| Type J                                             | (-105 to 1100) °C<br>(-157 to 2012) °F | 0.101 °C<br>0.181 °F |                                              |
| Type N                                             | (-175 to 1000) °C<br>(-283 to 1832) °F | 0.133 °C<br>0.239 °F |                                              |
| Type T                                             | (-135 to 300) °C<br>(-211 to 572) °F   | 0.188 °C<br>0.338 °F |                                              |
| Electrical Calibration of Thermocouples – Measure  |                                        |                      | Ectron 1140A<br>SPRT with readout & ice bath |
| Type E                                             | (-175 to 950) °C<br>(-283 to 1742) °F  | 0.052 °C<br>0.093 °F |                                              |
| Type K                                             | (-200 to 1200) °C<br>(-328 to 2192) °F | 0.099 °C<br>0.178 °F |                                              |
| Type J                                             | (-105 to 1100) °C<br>(-157 to 2012) °F | 0.068 °C<br>0.122 °F |                                              |
| Type N                                             | (-175 to 1000) °C<br>(-283 to 1832) °F | 0.129 °C<br>0.233 °F |                                              |
| Type T                                             | (-135 to 300) °C<br>(-211 to 572) °F   | 0.115 °C<br>0.207 °F |                                              |

| Parameter/Equipment                                                         | Range                                                                                                                                      | CMC <sup>2, 4</sup>                                                       | Comments     |
|-----------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|--------------|
| Temperature Calibrations<br>Electrical Indication &<br>Control <sup>3</sup> |                                                                                                                                            |                                                                           | Ectron 1140A |
| Type B                                                                      | (250 to 350) °C<br>(350 to 445) °C<br>(450 to 580) °C<br>(580 to 750) °C<br>(750 to 1000) °C<br>(1000 to 1820) °C                          | 0.95 °C<br>0.74 °C<br>0.58 °C<br>0.45 °C<br>0.37 °C<br>0.29 °C            |              |
| Type C                                                                      | (0 to 250) °C<br>(250 to 1000) °C<br>(1000 to 1500) °C<br>(1500 to 1800) °C<br>(1800 to 2000) °C<br>(2000 to 2250) °C<br>(2250 to 2315) °C | 0.20 °C<br>0.16 °C<br>0.18 °C<br>0.21 °C<br>0.23 °C<br>0.29 °C<br>0.32 °C |              |
| Type E                                                                      | (-270 to -245) °C<br>(-245 to -195) °C<br>(-195 to -155) °C<br>(-155 to -90) °C<br>(-90 to 15) °C<br>(15 to 890) °C<br>(890 to 1000) °C    | 1.20 °C<br>0.18 °C<br>0.10 °C<br>0.08 °C<br>0.07 °C<br>0.06 °C<br>0.07 °C |              |
| Type J                                                                      | (-210 to -180) °C<br>(-180 to -120) °C<br>(-120 to -50) °C<br>(-50 to 990) °C<br>(990 to 1200) °C                                          | 0.12 °C<br>0.10 °C<br>0.08 °C<br>0.07 °C<br>0.07 °C                       |              |
| Type K                                                                      | (-270 to -255) °C<br>(-255 to -195) °C<br>(-195 to -115) °C<br>(-115 to -55) °C<br>(-55 to 1000) °C<br>(1000 to 1372) °C                   | 2.20 °C<br>0.70 °C<br>0.12 °C<br>0.09 °C<br>0.07 °C<br>0.08 °C            |              |
| Type N                                                                      | (-270 to -260) °C<br>(-260 to -200) °C<br>(-200 to -140) °C<br>(-140 to -70) °C<br>(-70 to 25) °C<br>(25 to 160) °C<br>(160 to 1300) °C    | 5 °C<br>1 °C<br>0.23 °C<br>0.15 °C<br>0.12 °C<br>0.10 °C<br>0.09 °C       |              |

| Parameter/Equipment                                                                | Range                                                                                                                                      | CMC <sup>2, 4</sup>                                                       | Comments     |
|------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|--------------|
| Temperature Calibrations<br>Electrical Indication &<br>Control <sup>3</sup> (cont) |                                                                                                                                            |                                                                           | Ectron 1140A |
| Type R                                                                             | (-50 to -30) °C<br>(-30 to 45) °C<br>(45 to 160) °C<br>(160 to 380) °C<br>(380 to 775) °C<br>(775 to 1768) °C                              | 0.65 °C<br>0.55 °C<br>0.40 °C<br>0.30 °C<br>0.26 °C<br>0.22 °C            |              |
| Type S                                                                             | (-50 to -30) °C<br>(-30 to 45) °C<br>(45 to 105) °C<br>(105 to 310) °C<br>(310 to 615) °C<br>(615 to 1768) °C                              | 0.62 °C<br>0.56 °C<br>0.40 °C<br>0.33 °C<br>0.29 °C<br>0.26 °C            |              |
| Type T                                                                             | (-270 to -255) °C<br>(-255 to -240) °C<br>(-240 to -210) °C<br>(-210 to -150) °C<br>(-150 to -40) °C<br>(-40 to 100) °C<br>(100 to 400) °C | 1.80 °C<br>0.49 °C<br>0.30 °C<br>0.18 °C<br>0.12 °C<br>0.08 °C<br>0.07 °C |              |
| Type L                                                                             | (-200 to -100) °C<br>(-100 to 800) °C<br>(800 to 900) °C                                                                                   | 0.37 °C<br>0.26 °C<br>0.17 °C                                             |              |
| Type U                                                                             | (-200 to 0) °C<br>(0 to 600) °C                                                                                                            | 0.56 °C<br>0.27 °C                                                        |              |
| Electrical Calibration of RTD                                                      |                                                                                                                                            |                                                                           | Fluke 5522A  |
| Pt 385, 100 Ω                                                                      | (-200 to -80) °C<br>(-80 to 0) °C<br>(0 to 100) °C<br>(100 to 300) °C<br>(300 to 400) °C<br>(400 to 630) °C<br>(630 to 800) °C             | 0.05 °C<br>0.05 °C<br>0.07 °C<br>0.09 °C<br>0.10 °C<br>0.12 °C<br>0.23 °C |              |



| Parameter/Equipment                     | Range                                                                                                                                                                  | CMC <sup>2, 4</sup>                                                                             | Comments    |
|-----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|-------------|
| Electrical Calibration of RTD<br>(cont) |                                                                                                                                                                        |                                                                                                 | Fluke 5522A |
| Pt 3916, 100 $\Omega$                   | (-200 to -190) °C<br>(-190 to -80) °C<br>(-80 to 0) °C<br>(0 to 100) °C<br>(100 to 260) °C<br>(260 to 300) °C<br>(300 to 400) °C<br>(400 to 600) °C<br>(600 to 630) °C | 0.25 °C<br>0.04 °C<br>0.05 °C<br>0.06 °C<br>0.07 °C<br>0.08 °C<br>0.09 °C<br>0.10 °C<br>0.23 °C |             |
| Pt 3926, 100 $\Omega$                   | (-200 to -80) °C<br>(-80 to 0) °C<br>(0 to 100) °C<br>(100 to 300) °C<br>(300 to 400) °C<br>(400 to 630) °C                                                            | 0.05 °C<br>0.05 °C<br>0.07 °C<br>0.09 °C<br>0.10 °C<br>0.12 °C                                  |             |
| Pt 385, 200 $\Omega$                    | (-200 to -80) °C<br>(-80 to 0) °C<br>(0 to 100) °C<br>(100 to 260) °C<br>(260 to 300) °C<br>(300 to 400) °C<br>(400 to 600) °C<br>(600 to 630) °C                      | 0.04 °C<br>0.04 °C<br>0.04 °C<br>0.05 °C<br>0.12 °C<br>0.13 °C<br>0.14 °C<br>0.16 °C            |             |
| Pt 385, 500 $\Omega$                    | (-200 to -80) °C<br>(-80 to 0) °C<br>(0 to 100) °C<br>(100 to 260) °C<br>(260 to 300) °C<br>(300 to 400) °C<br>(400 to 600) °C<br>(600 to 630) °C                      | 0.04 °C<br>0.05 °C<br>0.05 °C<br>0.06 °C<br>0.08 °C<br>0.08 °C<br>0.09 °C<br>0.11 °C            |             |
| Pt 385, 1000 $\Omega$                   | (-200 to -80) °C<br>(-80 to 0) °C<br>(0 to 100) °C<br>(100 to 260) °C<br>(260 to 300) °C<br>(300 to 400) °C<br>(400 to 600) °C<br>(600 TO 630) °C                      | 0.03 °C<br>0.03 °C<br>0.04 °C<br>0.05 °C<br>0.06 °C<br>0.07 °C<br>0.07 °C<br>0.23 °C            |             |
| PtNi, 120 $\Omega$                      | (-80 to 0) °C<br>(0 to 100) °C<br>(100 to 260) °C                                                                                                                      | 0.08 °C<br>0.08 °C<br>0.14 °C                                                                   |             |
| Cu 42 710 $\Omega$                      | (-120 to 260) °C                                                                                                                                                       | 0.30 °C                                                                                         |             |

| Parameter/Equipment                                                                                                              | Range                                                                                                                                      | CMC <sup>2, 4</sup>                                                                                                                                          | Comments                                                |
|----------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|
| Welders <sup>3</sup> –<br><br>AC Voltage<br>10 Hz to 20 kHz<br><br>AC Current<br>10 Hz to 20 kHz<br><br>DC Voltage<br>DC Current | Up to 750 V<br><br><br>Up to 100 A<br><br><br>Up to 1000 V<br>Up to 500 A                                                                  | 0.43 mV/V + 330 mV<br><br><br>0.42 mA/A + 24 mA<br><br><br>6.7 $\mu$ V/V + 14 mV<br>0.28 mA/A + 31 mA                                                        | Keysight 34465A<br>Current Shunt                        |
| Wrist Strap/Footwear &<br>Workstation Monitors <sup>3</sup>                                                                      | 675 k $\Omega$<br>825 k $\Omega$<br>8.5 M $\Omega$<br>11.5 M $\Omega$<br>35 M $\Omega$<br>40 M $\Omega$<br>80 M $\Omega$<br>120 M $\Omega$ | 5.6 k $\Omega$<br>2.2 k $\Omega$<br>2.2 k $\Omega$<br>22 k $\Omega$<br>140 k $\Omega$<br><u>140 k<math>\Omega</math></u><br>610 k $\Omega$<br>1.9 M $\Omega$ | Calibration Unit<br>Desco 07010 &<br>Charleswater 99090 |

## V. Mechanical

| Parameter/Equipment                                                                                                 | Range                                                                                                                                                                | CMC <sup>2, 5, 8</sup>                                                                                                                                                                                              | Comments                                                                                           |
|---------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|
| Durometers –<br><br>Types: A, B, O<br>Types: C, D<br>Types: CF<br>Types: OO, OOO<br>Types: M<br><br>Indenter Length | Up to 750 gf<br>Up to 4100 gf<br>Up to 10 000 gf<br>Up to 2610 gf<br>Up to 2610 gf<br><br>Up to 1 in                                                                 | 0.016 % + 0.17 gf<br>0.003 % + 0.3 gf<br>0.023 % + 0.39 gf<br>0.01 % + 0.18 gf<br>0.01 % + 0.18 gf<br><br>(80 + 3.2L) $\mu$ in                                                                                      | Weight scale<br>ASTM D2240<br><br><br><br><br><br>Video Measuring<br>System ASTM D2240             |
| Force <sup>3</sup> – Measuring &<br>Sourcing Devices                                                                | Up to 10 gf<br>(10 to 100) gf<br>(100 to 500) gf<br><br>(1 to 10) lbf<br>(10 to 50) lbf<br><br>Up to 300 lbf<br>Up to 1000 lbf<br>Up to 5000 lbf<br>Up to 15 000 lbf | 0.29 mgf/gf + 2.7 mgf<br>0.027 mgf/gf + 5.3 mgf<br>0.018 mgf/gf + 10 mgf<br><br>0.038 % + 0.013 ozf<br>0.0058 % + 0.064 ozf<br><br>0.0015 % + 0.0018 lbf<br>0.0016 % + 0.0059 lbf<br>0.0014 % + 0.015 lbf<br>0.05 % | Class 3 standard<br>weights<br><br><br>NIST Class F weights<br><br><br>Load cell with<br>indicator |

| Parameter/Equipment                                             | Range                                                  | CMC <sup>2</sup>                       | Comments                               |
|-----------------------------------------------------------------|--------------------------------------------------------|----------------------------------------|----------------------------------------|
| Indirect Verification of Rockwell Hardness Testers <sup>3</sup> | (170 to 960) HLD                                       | 9.7 HLD                                | Leeb Hardness Test Blocks ASTM A956    |
|                                                                 | HRA<br>(20 to 70)<br>(70.01 to 79)<br>(79.01 to 84)    | 0.55 HRA<br>0.48 HRA<br>0.41 HRA       | Rockwell hardness Test blocks ASTM E18 |
|                                                                 | HRB<br>(940 to 60)<br>(960.01 to 88)<br>(88.01 to 100) | 1.58 HRB<br>1.05 HRB<br>1.05 HRB       |                                        |
|                                                                 | HRC<br>(20 to 35)<br>(35.01 to 60)<br>(60.01 to 71)    | 0.77 HRC<br>0.53 HRC<br>0.43 HRC       |                                        |
|                                                                 | HRE<br>(70 to 84)<br>(84.01 to 93)<br>(93.01 to 150)   | 1.01 HRE<br>1.02 HRE<br>1.00 HRE       |                                        |
|                                                                 | HR15N<br>(70 to 78)<br>(78.01 to 90)<br>(90.01 to 92)  | 0.63 HR15N<br>0.61 HR15N<br>0.61 HR15N |                                        |
|                                                                 | HRN30<br>(40 to 55)<br>(55.01 to 77)<br>(77.01 to 82)  | 1.01 HR30N<br>0.75 HR30N<br>0.62 HR30N |                                        |
|                                                                 | HRN45N<br>(20 to 37)<br>(37.01 to 66)<br>(66.01 to 72) | 1.04 HR45N<br>1.01 HR45N<br>0.65 HR45N |                                        |
|                                                                 | HR15T<br>(74 to 79)<br>(79.01 to 85)<br>(85.01 to 93)  | 1.02 HR15T<br>1.02 HR15T<br>1.07 HR15T |                                        |
|                                                                 | HR30T<br>(42 to 57)<br>(57.01 to 70)<br>(70.01 to 87)  | 1.03 HR30T<br>1.02 HR30T<br>1.05 HR30T |                                        |
|                                                                 | HR45T<br>(13 to 33)<br>(33.01 to 53)<br>(53.01 to 73)  | 1.02 HR45T<br>1.05 HR45T<br>1.01 HR45T |                                        |





| Parameter/Equipment                                | Range                                                                                | CMC <sup>2, 5, 8</sup>                                                                                               | Comments                                                       |
|----------------------------------------------------|--------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|
| Pressure Measuring & Sourcing Devices <sup>3</sup> | (- 60 to 60) inH <sub>2</sub> O<br>Up to 300 psi                                     | 0.0025 % + 0.000 48 inH <sub>2</sub> O)<br>0.0051 % + 0.0007 psi                                                     | Ruska 7252i                                                    |
|                                                    | (0.2 to 25) psi<br>Up to 1000 psi                                                    | 0.0011 % of rdg + 0.000 01 psi<br>0.0017 % of rdg + 0.000 06 psi                                                     | Ruska 2465                                                     |
|                                                    | (8 to 17) psia<br>(14.5 to 1014) psia<br>Up to 1000 psi<br>Up to 10 000 psi          | 0.003 % + 0.000 02 psia<br>0.011 % + 0.011 psia<br>0.0021 % + 0.018 psi<br>0.0029 % + 0.32 psi                       | Mensor CPG2500<br>with CPR2550                                 |
|                                                    | (100 to 3000) psi                                                                    | 0.0036 % of rdg + 0.000 02 psi                                                                                       | Ruska 2470                                                     |
|                                                    | (90 to 40 000) psi                                                                   | 0.0055 % of Rdg                                                                                                      | DH-Budenberg<br>CPB3800HP                                      |
|                                                    | (-10 to 10) inH <sub>2</sub> O                                                       | 0.0053 % + 0.017 in.H <sub>2</sub> O                                                                                 | Fluke 700G01                                                   |
|                                                    | (-15 to 30) psi<br>(-30 to 60) inHg                                                  | 0.001 % + 0.0057 psi<br>0.001 % + 0.012 inHg                                                                         | Additel ADT681                                                 |
|                                                    | Up to 100 psi                                                                        | 0.0012 % + 0.027 psi                                                                                                 | Additel ADT681                                                 |
|                                                    | (-12 to 300) psi<br>(-24.4 to 610 inHg                                               | 0.0031 % + 0.044 psi<br>0.0031 % + 0.09 inHg                                                                         | Fluke 2700G                                                    |
|                                                    | (-15 to 500) psi<br>(-30 to 1018) inHg                                               | 0.027 % + 0.043 psi<br>0.027 % + 0.088 inHg                                                                          | Omega DPG4000                                                  |
|                                                    | Up to 1000 psi<br>Up to 3000 psi<br>Up to 5000 psi<br>Up to 10 000 psi               | 0.0024 % + 0.15 psi<br>0.009 % + 0.23 psi<br>0.002 % + 0.91 psi<br>0.017 % + 0.36 psi                                | Additel ADT681<br>Fluke 2700G<br>Additel ADT681<br>Fluke 2700G |
|                                                    | Up to 30 000 psi                                                                     | 0.0035 % + 2.8 psi                                                                                                   | Additel ADT681                                                 |
| Transducers, Tester & Analyzer                     | Up to 10 lbf·in<br>(5 to 100) lbf·in<br>(100 to 3000) lbf·in<br>(200 to 2000) lbf·ft | 0.016 % Rdg + 0.0018 lbf·in<br>0.01 % Rdg + 0.0049 lbf·in<br>0.01 % Rdg + 0.011 lbf·in<br>0.031 % Rdg + 0.039 lbf·ft | Torque wheel<br>arm 2.5, 5, 10 &<br>40 in with<br>weights      |

| Parameter/Equipment                                 | Range                                                                                                                                                                                                           | CMC <sup>2,5, 8</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Comments                                             |
|-----------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|
| Scales <sup>3</sup> –<br><br>Analytical & Precision | 1 mg<br>10 mg<br>20 mg<br>50 mg<br>100 mg<br>200 mg<br>500 mg<br>1 g<br>2 g<br>3 g<br>5 g<br>10 g<br>20 g<br>30 g<br>50 g<br>100 g<br>200 g<br>300 g<br>500 g<br>1 kg<br>2 kg<br>4 kg<br>5 kg<br>10 kg<br>20 kg | 2.9 µg<br>17 µg<br>4.4 µg<br>8.3 µg<br>3.4 µg<br>3.9 µg<br>4.3 µg<br>7 µg<br>6.1 µg<br>7.1 µg<br>8.1 µg<br>14 µg<br>18 µg<br>46 µg<br>27 µg<br>63 µg<br>0.19 mg<br>0.16 mg<br>0.3 mg<br>0.57 mg<br>1 mg<br>2.2 mg<br>2.7 mg<br>5.3 mg<br>10 mg                                                                                                                                                                                                                                                                                                                                                                                                              | Ultra & Class 1<br>standard weight                   |
| Floor & Bench Scales                                | (0.001 to 1) lb<br>(1 to 10) lb<br>(10 to 50) lb<br>(50 to 100) lb<br>(100 to 200) lb<br>(200 to 500) lb<br>(500 to 1000) lb<br>(1000 to 1500) lb<br>(1500 to 2000) lb                                          | $(1.90 \times 10^{-6} + 1.50 \times 10^{-4} \text{ Wt}) \text{ lb}$<br>$(1.40 \times 10^{-4} + 8.90 \times 10^{-6} \text{ Wt}) \text{ lb}$<br>$(8.50 \times 10^{-4} + 1.50 \times 10^{-5} \text{ Wt}) \text{ lb}$<br>$(2.00 \times 10^{-4} + 1.80 \times 10^{-5} \text{ Wt}) \text{ lb}$<br>$(6.00 \times 10^{-4} + 2.50 \times 10^{-5} \text{ Wt}) \text{ lb}$<br>$(1.00 \times 10^{-2} + 1.30 \times 10^{-4} \text{ Wt}) \text{ lb}$<br>$(1.10 \times 10^{-2} + 3.60 \times 10^{-5} \text{ Wt}) \text{ lb}$<br>$(3.30 \times 10^{-2} + 1.40 \times 10^{-5} \text{ Wt}) \text{ lb}$<br>$(1.00 \times 10^{-2} + 2.00 \times 10^{-5} \text{ Wt}) \text{ lb}$ | NIST Class F<br>weights                              |
| Torque Tools <sup>3</sup> –                         | (2 to 20) ozf·in<br>(10 to 100) ozf·in<br>(2 to 20) lbf·in<br>(24 to 240) lbf·in<br>(20 to 200) lbf·ft<br>(100 to 1000) lbf·ft<br>(200 to 2000) lbf·ft                                                          | 00.022 % Rdg + 0.0056 ozf·in<br>0.026 % Rdg + 0.022 ozf·in<br>0.022 % Rdg + 0.0039 lbf·in<br>0.013 % Rdg + 0.029 lbf·in<br>0.013 % Rdg + 0.029 lbf·ft<br>0.15 % Rdg + 0.1 lbf·ft<br>0.35 % Rdg + 0.02 lbf·ft                                                                                                                                                                                                                                                                                                                                                                                                                                                | AKO TSD6500<br>with transducers<br><br>AWS QCMF-2000 |

# VI. Thermodynamics

| Parameter/Equipment                                                                                                                                                                                                        | Range                                                                                                                                                                                                                                                                                                                                                                | CMC <sup>2,5,8</sup>                                                                                                                                                                                                                                                         | Comments                                                                                            |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|
| Humidity Generate –<br><br>at 0 °C<br><br><br><br><br><br><br><br><br><br>at 25 °C<br><br><br><br><br><br><br><br><br><br>at 50 °C<br><br><br><br><br><br><br><br><br><br>at 70 °C<br><br><br><br><br><br><br><br><br><br> | 10 % RH<br>(10 to 30) % RH<br>(30 to 50) % RH<br>(50 to 70) % RH<br>(70 to 95) % RH<br><br>10 % RH<br>(10 to 30) % RH<br>(30 to 50) % RH<br>(50 to 70) % RH<br>(70 to 95) % RH<br><br>10 % RH<br>(10 to 30) % RH<br>(30 to 50) % RH<br>(50 to 70) % RH<br>(70 to 95) % RH<br><br>10 % RH<br>(10 to 30) % RH<br>(30 to 50) % RH<br>(50 to 70) % RH<br>(70 to 95) % RH | 0.03 % RH<br>0.08 % RH<br>0.13 % RH<br>0.19 % RH<br>0.25 % RH<br><br>0.02 % RH<br>0.06 % RH<br>0.10 % RH<br>0.14 % RH<br>0.19 % RH<br><br>0.02 % RH<br>0.05 % RH<br>0.08 % RH<br>0.12 % RH<br>0.16 % RH<br><br>0.02 % RH<br>0.05 % RH<br>0.07 % RH<br>0.10 % RH<br>0.14 % RH | RH Systems CGS-240 ,<br>humidity generator<br><br>By primary realization<br>in accordance to RISP-5 |
| Temperature Generate                                                                                                                                                                                                       | (0 to 70) °C<br>(32 to 158) °F                                                                                                                                                                                                                                                                                                                                       | 0.018 °C<br>0.032 °F                                                                                                                                                                                                                                                         | RH Systems CGS-240<br>humidity generator                                                            |
| Infrared Temperature<br>Measuring Instruments                                                                                                                                                                              | (-15 to 120) °C<br>(35 to 500) °C<br>(50 to 749) °C<br>(601 to 1100) °C<br>(1101 to 1200) °C                                                                                                                                                                                                                                                                         | 0.13 % Rdg + 0.85 °C<br>0.25 % Rdg + 0.33 °C<br>2.8 °C<br>4.9 °C<br>0.7 °C                                                                                                                                                                                                   | Fluke 4180 $\varepsilon = 0.95$<br>Fluke 4181 $\varepsilon = 0.95$<br>IR-564<br>IR-300              |
| Ovens, Autoclaves,<br>Freezers, Refrigerators,<br>Environmental<br>Chambers, Liquid Baths <sup>3</sup><br><br>Type K<br>Type N<br>Type K<br>Type N                                                                         | (-87.2 to 1204.4) °C<br>TUS<br>TUS<br>SAT<br>SAT                                                                                                                                                                                                                                                                                                                     | 1.2 °C<br>1.3 °C<br>1.4 °C<br>1.2 °C                                                                                                                                                                                                                                         | Thermocouples<br>AMS 2750<br>customer<br>specific<br>specifications                                 |

| Parameter/Equipment                                                                    | Range                                                                                               | CMC <sup>2, 5, 8</sup>                                            | Comments                                                                           |
|----------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|------------------------------------------------------------------------------------|
| Oven/Chamber Temperature Uniformity Measure <sup>3</sup>                               | (32 to 1800) °F                                                                                     | 0.073 % Rdg + 0.59 °F                                             | Fluke 1586A Type K thermocouple, AMS2750                                           |
|                                                                                        | (32 to 1400) °F                                                                                     | 0.11 % Rdg + 0.26 °F                                              | Fluke 1586A Type J thermocouple                                                    |
| Temperature – Measuring Equipment, Resistance Thermometers<br>Fixed Point Calibrations |                                                                                                     |                                                                   |                                                                                    |
| Liquid Nitrogen                                                                        | -196 °C                                                                                             | 6.2 mK                                                            | Triple, melting, & freezing point cells with MicroK thermometry bridge             |
| Mercury                                                                                | -38.8344 °C                                                                                         | 1.4 mK                                                            |                                                                                    |
| Triple Point Water                                                                     | 0.010 °C                                                                                            | 0.5 mK                                                            |                                                                                    |
| Gallium                                                                                | 29.7646 °C                                                                                          | 0.9 mK                                                            |                                                                                    |
| Indium                                                                                 | 156.5985 °C                                                                                         | 2.1 mK                                                            |                                                                                    |
| Tin                                                                                    | 231.928 °C                                                                                          | 2.3 mK                                                            |                                                                                    |
| Zinc                                                                                   | 419.527 °C                                                                                          | 2.3 mK                                                            |                                                                                    |
| Aluminum                                                                               | 660.323 °C                                                                                          | 6.0 mK                                                            |                                                                                    |
| Comparison                                                                             | -196 °C<br>(-80 to 0) °C<br>(0 to 150) °C<br>(150 to 300) °C<br>(300 to 550) °C<br>(550 to 1100) °C | 0.012 °C<br>0.009 °C<br>0.017 °C<br>0.032 °C<br>0.06 °C<br>0.9 °C | Calibration baths and furnaces, SPRT, Super thermometer<br><br>Type S Thermocouple |
| Thermocouple Probes & Wire Types E, J, K, N, T                                         | (-80 to 0) °C<br>(0 to 150) °C<br>(25 to 250) °C<br>(50 to 660) °C                                  | 0.16 °C<br>0.12 °C<br>0.11 °C<br>0.015 % + 0.13 °C                | Temperature Baths, Ectron 1140A Fluke 1594A w/SPRT & field metrology well          |

## VII. Time & Frequency

| Parameter/Equipment                          | Range             | CMC <sup>2, 5, 8</sup> | Comments        |
|----------------------------------------------|-------------------|------------------------|-----------------|
| Frequency – Measuring Equipment <sup>3</sup> | 1 µHz to 30 MHz   | 56 nHz/Hz + 0.055 µHz  | Keysight 33519B |
|                                              | 0.1 Hz to 225 MHz | 50 pHz/Hz + 1.2 mHz    | Agilent 53181A  |
|                                              | 100 MHz to 3 GHz  | 340 pHz/Hz + 19 mHz    | Counter         |



| Parameter/Equipment              | Range                                           | CMC <sup>2, 5, 8</sup>                           | Comments                                                     |
|----------------------------------|-------------------------------------------------|--------------------------------------------------|--------------------------------------------------------------|
| Stop Watches/ Timer <sup>3</sup> | Up to 24 hr<br>Up to 86 400 s<br>Up to 86 400 s | 0.063 s / 24 hr<br>0.08 s<br>0.001 s/hr + 0.47 s | Timometer 4500<br>Photo totalize method<br>Direct comparison |
| Tachometer –                     |                                                 |                                                  |                                                              |
| Contact                          | (10 to 50 000) RPM                              | 0.000 12 % + 0.021 RPM                           | Ideal Aerosmith                                              |
| Non - Contact                    | Up to 99 999 RPM                                | 0.001 % + 0.003 RPM                              | Generator with LED                                           |

<sup>i</sup> This laboratory offers commercial calibration service and field calibration service, where noted.

<sup>2</sup> Calibration and Measurement Capability Uncertainty (CMC) is the smallest uncertainty of measurement that a laboratory can achieve within its scope of accreditation when performing more or less routine calibrations of nearly ideal measurement standards or nearly ideal measuring equipment. CMCs represent expanded uncertainties expressed at approximately the 95 % level of confidence, usually using a coverage factor of  $k = 2$ . The actual measurement uncertainty of a specific calibration performed by the laboratory may be greater than the CMC due to the behavior of the customer's device and to influences from the circumstances of the specific calibration.

<sup>3</sup> Field calibration service is available for these calibrations. Please note the actual measurement uncertainties achievable on a customer's site can normally be expected to be larger than the CMC found on the A2LA Scope. Allowance must be made for aspects such as the environment at the place of calibration and for other possible adverse effects such as those caused by transportation of the calibration equipment. The usual allowance for the actual uncertainty introduced by the item being calibrated, (e.g., resolution) must also be considered and this, on its own, could result in the actual measurement uncertainty achievable on a customer's site being larger than the CMC.

<sup>4</sup> The stated measured values are determined using the indicated instrument (see Comments). This capability is suitable for the calibration of the devices intended to measure or generate the measured value in the ranges indicated. CMCs are expressed as either a specific value that covers the full range or as a percent or fraction of the reading plus a fixed floor specification.

<sup>5</sup> In the statement of CMC, percentages are to be read as percent of reading, unless noted otherwise.

<sup>6</sup> In the statement of CMC,  $L$  is the numerical value of the nominal length of the device measured in inches,  $R$  is the numerical value of the resolution of the device under test in microinches,  $D$  is the numerical value of the nominal diameter of the device measured in inches.

<sup>7</sup> This scope meets A2LA's *P112 Flexible Scope Policy*.

<sup>8</sup> The type of instrument or material being calibrated is defined by the parameter. This indicates the laboratory is capable of calibrating instruments that measure or generate the values in the ranges indicated for the listed measurement parameter.

<sup>9</sup> This laboratory meets *R205 – Specific Requirements: Calibration Laboratory Accreditation Program* for the types of dimensional tests listed above and is considered equivalent to that of a calibration.



# Accredited Laboratory

A2LA has accredited

## TECHNICAL MAINTENANCE, INC.

for technical competence in the field of

### Calibration

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 *General requirements for the competence of testing and calibration laboratories*. This laboratory also meets the requirements of ANSI/NCSL Z540-1-1994 and the requirements of ANSI/NCSL Z540.3-2006 and R205 – Specific Requirements: Calibration Laboratory Accreditation Program. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).



Presented this 5<sup>th</sup> of September, 2025.

A blue ink signature of Mr. Trace McInturff.

Mr. Trace McInturff, Vice President, Accreditation Services  
For the Accreditation Council  
Certificate Number 2348.01  
Valid to see scope of accreditation

*For the calibrations to which this accreditation applies, please refer to the laboratory's Calibration Scope of Accreditation.*



## Accredited Laboratory

A2LA has accredited

**MICRO QUALITY CALIBRATION, INC.**

*Chatsworth, CA*

for technical competence in the field of

**Calibration**

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 *General requirements for the competence of testing and calibration laboratories*. This laboratory also meets the requirements of ANSI/NCSL Z540-1-1994 and the requirements of ANSI/NCSL Z540.3-2006 and R205 – Specific Requirements: Calibration Laboratory Accreditation Program. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).



Presented this 30<sup>th</sup> day of January 2023.

A blue ink signature of Mr. Trace McInturff.

Mr. Trace McInturff, Vice President, Accreditation Services  
For the Accreditation Council  
Certificate Number 2348.01  
Valid to November 30, 2026  
Revised January 6, 2026

*For the calibrations to which this accreditation applies, please refer to the laboratory's Calibration Scope of Accreditation.*