

# SCOPE OF ACCREDITATION

## PCSIR Labs Complex, Peshawar (PLC)

### Chemical Testing Laboratory

Annex-I

| <i>Materials</i>    | <i>Types of test/ properties measured</i> | <i>Range of Measurement</i> | <i>Minimum Detection Limit</i> | <i>Uncertainty of measurement (where applicable ) (±)</i> | <i>Standard Specification/ Techniques/ Equipment Used</i>  |
|---------------------|---|-----------------------------|--------------------------------|---|--|
| Water               | i. pH                                     | 0-14                        | 0.01                           | 0.0185  | Standard Methods for the Examination of water and wastewater,<br>APHA/ AWWA/ WEF 21 <sup>st</sup> Edition, 2005<br>Method No. Section 4-90-94<br>Method No. 3500-Na B<br>Method No. 3500 – K B<br>Method No. 2340 – C<br>Method No. 3500 – Ca B<br>Method No. 2320 - B |
|                     | ii. Sodium (Na)                           | 0-40 ppm                    | 0.1 ppm                        | 0.1555 ppm  |  |
|                     | iii. Potassium (K)                        | 0-20 ppm                    | 0.1 ppm                        | 0.120975 ppm  |  |
|                     | iv. Total Hardness as CaCO <sub>3</sub>   | 0-1000 ppm                  | 4 ppm                          | 0.000302 ppm  |  |
|                     | v. Calcium Hardness as CaCO <sub>3</sub>  | 0-1000 ppm                  | 4 ppm                          | 0.000302 ppm  |  |
|                     | vi. Total Alkalinity as CaCO <sub>3</sub> | 0-1000 ppm                  | 4 ppm                          | 0.000248 ppm  |  |
| Fruits & Vegetables | i. Organochlorine Pesticide Residues      | 0.5 ppb – 40 ppm            | ≤ 10 ng/g.                     | ---   | Official Method of Analysis of AOAC International,<br>19 <sup>TH</sup> Edition; Vol. 1, 2012<br>Chapter 10, Page 17,<br>Method No. 2007.01.  |

**Microbiological Testing Laboratory**
**Annex-II**

| <b>Materials</b> | <b>Types of test/ properties measured</b>      | <b>Range of Measurement</b> | <b>Minimum Detection Limit</b> | <b>Uncertainty of measurement (where applicable ) (±)</b> | <b>Standard Specification/ Techniques/ Equipment Used</b>  |
|------------------|--|-----------------------------|--------------------------------|---|--|
| Water            | <i>i. Total plate Count (TPC)</i>              | <i>25 – 250 CFU/plate</i>   | <i>N.A.</i>                    | <i>---</i>  | <i>Standard Methods for the Examination of water and Wastewater, APHA/ AWWA/WEF 21<sup>st</sup> Edition, 2005<br/>Method No. 9215 A – B<br/>Method No.</i>                                     |
|                  | <i>ii. Total Coliforms and Fecal Coliforms</i> | <i>---</i>                  | <i>&lt; 1.1</i>                | <i>---</i>  |  |
| Juices           | <i>i. Total Plate Count (TPC)</i>              | <i>25-250 CFU/plate</i>     | <i>N.A.</i>                    | <i>---</i>  | <i>Compendium of method for Microbiological examination of food 4<sup>th</sup> edition,2001 Edited by Frances Pouch Downes Keith TTO American Public Health Association Washington DC, USA</i> |
|                  | <i>ii. Total Coliforms and Fecal Coliforms</i> | <i>---</i>                  | <i>&lt; 1.1</i>                | <i>---</i>  |  |
| Milk             | <i>i. Total Plate Count (TPC)</i>              | <i>25-250 CFU/plate</i>     | <i>N.A.</i>                    | <i>---</i>  | <i>---do---</i>  |
|                  | <i>ii. Total Coliforms and Fecal Coliforms</i> | <i>---</i>                  | <i>&lt; 1.1</i>                | <i>---</i>  |  |

**Calibration Laboratory**
**Annex-II**

| <b>Materials</b> | <b>Types of test/ properties measured</b>                  | <b>Range of Measurement</b>                  | <b>Minimum Detection Limit</b> | <b>Uncertainty of measurement (where applicable ) (±)</b> | <b>Standard Specification/ Techniques/ Equipment Used</b> |
|------------------|--|--|--------------------------------|---|---|
| Mass             | <i>i. Calibration of weights</i>                           | <i>Class F<sub>2</sub> and lower classes</i> | <i>0.01 mg</i>                 | <i>0.01 mg</i>  | <i>OTML RIII-I, 2004 (E)</i>                              |
|                  | <i>ii. Calibration of Balances</i>                         | <i>1 mg to 5 kg</i>                          | <i>0.01 mg</i>                 | <i>0.01 mg</i>  | <i>OTML R76-I, 2006 (E)</i>                               |
|                  | <i>iii. Calibration of Laboratory Volumetric Apparatus</i> | <i>Upo 2 ltrs</i>                            | <i>0.01 ml</i>                 | <i>0.01 ml</i>  | <i>E 542-01, ASTM 2002, Vol:14.01.</i>                    |
| Temperature      | <i>i. Calibration of liquid in glass thermometers</i>      | <i>-20°C – 250°C</i>                         | <i>0.1°C</i>                   | <i>0.1oC</i>  | <i>E 77-07, ASTM 2002, Vol:14.03.</i>                     |

**PCSIR Leather Research Centre, Karachi (LRC)****Annex-III**

| <b>Materials</b> | <b>Types of test/ properties measured</b> | <b>Range of Measurement</b> | <b>Minimum Detection Limit</b> | <b>Uncertainty of measurement (where applicable ) (±)</b> | <b>Standard Specification/ Techniques/ Equipment Used</b>                                  |
|------------------|---|-----------------------------|--------------------------------|---|--|
| Leather          | <i>i. Volatile Matter</i>                 | <i>2.5% - 50%</i>           | <i>2.5%</i>                    | <i>0.40%</i>  | <i>SLC-3<br/>Oven<br/>Analytical Balance</i>   |
|                  | <i>ii. Fat Content</i>                    | <i>0.5% - 25%</i>           | <i>0.5%</i>                    | <i>0.05%</i>  | <i>SLC-4<br/>Oven<br/>Analytical Balance<br/>Soxhlet Apparatus</i>                         |
|                  | <i>iii. Chromium Oxide</i>                | <i>0.5% - 5.5%</i>          | <i>0.5%</i>                    | <i>0.02%</i>  | <i>SLC-8<br/>Analytical Balance</i>  |
|                  | <i>iv. pH Value</i>                       | <i>1 -13</i>                | <i>0.1</i>                     | <i>0.07</i>   | <i>SLC-13<br/>EN ISO-4045<br/>Shaker pH Meter<br/>Analytical Balance</i>                   |
|                  | <i>v. Formaldehyde Content</i>            | <i>20mg/kg – 150 mg/ kg</i> | <i>1 mg/ kg</i>                | <i>0.75 mg/kg</i>   | <i>IUC 19 (SLC-23)<br/>Analytical Balance<br/>Spectrophotometer<br/>Shaking Water Bath</i> |

|                         |   |   |                   |        |   |
|-------------------------|---|---|-------------------|--------|---|
|                         | vi. <i>Tensile Strength</i>               | 0.1 N – 5000 N  | 0.1 N             | 0.22 N | ASTM D 2209-95/<br>IUP-6/ Universal Testing Machine                       |
|                         | vii. <i>Elongation at Break</i>           | 0.01% - 100%  | 0.01%             | 0.24%  | ASTM D 2211-94/<br>IUP-9/ Universal Testing Machine                       |
|                         | viii. <i>Bursting Strength</i>            | 0.01kg – 500kg  | 0.01kg            | 0.82kg | IUP-6/ Universal Testing Machine  |
|                         | ix. <i>Colour Fatness (Wet &amp; Dry)</i> | 1 to 99999 rev grading 5-1 (change in colour) grading 5-1 (Stain on Felt) | 1 rev<br>Grade 1  | 1.0    | BS 1006 UK-LC<br>SLF 5/ Colour Fatness Test                               |
| Leather Gloves          | i. <i>Sizing &amp; Dexterity of Glove</i> | 150mm – 280mm<br>155mm – 220mm<br>5mm – 11mm                              | 1mm<br>1mm<br>5mm | NA     | EN-420/ Measuring Tape, Dexterity Bars                                    |
| Leather/ Leather Gloves | i. <i>Tear Strength (Single Edge)</i>     | 0.01kg – 500kg  | 0.01kg            | 0.5kg  | EN-388/ Universal Testing Machine   |
| Water & Waste Water     | i. <i>Total Hardness</i>                  | 5ppm – 1000ppm  | 5ppm              | 2ppm   | APHA 2340 C 20 <sup>th</sup> Editions/<br>Electronic Balance              |
|                         | ii. <i>Sulphide</i>                       | 5ppm – 1000ppm  | 5ppm              | 4ppm   | APHA 4500 S <sup>2</sup> 20 <sup>th</sup> Editions/<br>Electronic balance |
|                         | iii. <i>pH Value</i>                      | 1 - 13  | 0.1               | 0.02   | ASTM D-1293-99<br>Analytical Balance<br>pH Meter                          |

**PCSIR Labs Complex, Lahore (LLC)**

Applied Chemistry Research Centre

Annex-IV

| <i>Materials/ Products tested</i> | <i>Types of test/ Properties measured</i>  | <i>Range of measurement</i> | <i>Minimum Detection limit</i> | <i>Uncertainty of Measurement (where applicable)</i><br><i>MU (±)</i> | <i>Standard specification/ Techniques/ Equipment Used</i> |
|-----------------------------------|--|-----------------------------|--------------------------------|---|---|
| <b>Textile Testing Laboratory</b> |  |                             |                                |   |   |
| Textiles                          | Colour Fastness to Light: Xenon Arc Fading Lamp Test   | 1-5 Grey Scale Rating       | 1/2                            | 0.5   | ISO 105 B02: 1999 Instrumental Technique                  |
|                                   | Colour Fastness to Domestic & Commercial Laundering  | 1-5 Grey Scale Rating       | 1/2                            | 0.5   | ISO 105 C06 / C2S: 1994 Instrumental Technique            |
|                                   | Colour Fastness to Dry Cleaning  | 1-5 Grey Scale Rating       | 1/2                            | 0.5   | ISO 105 D01: 1993 Instrumental Technique                  |
|                                   | Colour Fastness to Water   | 1-5 Grey Scale Rating       | 1/2                            | 0.5   | ISO 105 E01: 1994 Instrumental Technique                  |
|                                   | Colour Fastness to Sea-water   | 1-5 Grey Scale Rating       | 1/2                            | 0.5   | ISO 105 E02: 1994 Instrumental Technique                  |
|                                   | Colour Fastness to Perspiration  | 1-5 Grey Scale Rating       | 1/2                            | 0.5   | ISO 105 E04: 1994 Instrumental Technique                  |
|                                   | Colour Fastness to Rubbing   | 1-5 Grey Scale Rating       | 1/2                            | 0.5   | ISO 105 X12: 2002 Instrumental Technique                  |
|                                   | Determination of the Pilling Resistance & other related Surface Changes of Textile Fabrics (Martindale Tester) | 1 – 5 Grade                 | 1/2                            | 0.5   | ISO 12945 2:2000 Instrumental Technique                   |
|                                   | Determination of Abrasion Resistance of Fabrics (Martindale Tester)  | 1 - 99,999 Rubs             | 1                              | 4.036   | ISO 12947:1998  |
| Water Repellency: Spray Test      | 0-100 Spray Rating   | 0                           | Not applicable                 | AATCC 22:2005 Instrumental Technique                                  |   |

|  |                                     |                                 |                |                                       |
|--|-------------------------------------|---------------------------------|----------------|---------------------------------------|
| Wrinkle Recovery of Fabrics: Appearance Method                                 | WR-1 – WR-5 Wrinkle Recovery Rating | 1                               | 0.5            | AATCC 128:2004 Instrumental Technique |
| Gray Scale for Assessing change in Color                                       | 1-5 Grey Scale Rating               | 1/2                             | 1/2            | ISO 105 A02 :1994 Visual Assessment   |
| Gray Scale for Assessing Staining  | 1-5 Grey Scale Rating               | 1/2                             | 1/2            | ISO 105 A03: 1994 Visual Assessment   |
| Textiles-Standard Atmosphere for Conditioning and Testing                      | 18-22 <sup>0</sup> C<br>61-69%RH    | 0.1 <sup>0</sup> C,<br>0.1 % RH | 0.2<br>1.6     | ISO 139: 2005 Instrumental Technique  |
| Dimensional Changes of Garments after Home Laundering                          | 0-100%                              | 0.5%                            | 0.5            | AATCC150-2003 Instrumental Technique  |
| Dimensional Changes of Fabrics after Home Laundering                           | 0-100%                              | 0.5%                            | 0.5            | AATCC135-2003 Instrumental Technique  |
| Determination of Linear Density of Yarn (Yarn Number) by the Skein Method      | 1-2500 Wraps                        | 1 Wrap                          | 0.002          | ASTM D 1907-01 Instrumental Technique |
| Standard Test Method for Warp End Count and Filling Pick Count of Woven Fabric | Not applicable                      | >1                              | Not applicable | ASTM D 3775-03a Physical Counting     |

| Leather Testing Laboratory |  |                                  |                  |   |  |
|----------------------------|--|----------------------------------|------------------|---|--|
| Leather                    | Cr-VI Content                              | 1mg/kg-50 mg/kg                  | 1.25 mg/kg       | 0.4mg/kg  | SLC 22,<br>(IUC 18)<br>Spectrophotometric Technique                    |
|                            | Pentachlorophenol                          | 0.005-10.000 ppm                 | 0.005ppm         | 0.1mg/kg  | CLRI & Freiburg<br>Method<br>Gas Chromatography                        |
|                            | Formaldehyde Content in Leather            | 9mg/kg-74 (mg/kg)                | 9.0 mg/kg        | 0.2mg/kg  | IUC 19<br>(SLC 23)<br>Spectrophotometric                               |
|                            | Tensile strength and percentage elongation | 0.1N -2.5 KN                     | 0.1N             | Tensile= $\pm 1$ N/mm <sup>2</sup><br>Elongation= $\pm 1.4$ % | IUP 6 (SLP 6)<br>Tensile Strength                                      |
|                            | Circular Rubbing                           | 1-5 Gray Scale Rating            | 1 Grade 1        | 1/2   | SLF 5<br>(BS 1006: UK-LC)<br>Rubbing                                   |
|                            | Tearing Load (Double Edge)                 | 0.1N -2.5 KN                     | 0.1N             | 2.16N   | IUP 8 (SLP 7)/<br>BS EN ISO 3377-<br>2:2002 Tear                       |
|                            | Tearing Load (Single Edge)                 | 0.1N -2.5 KN                     | 0.1N             | 0.1N  | EN 388:2003<br>6.3. Tear   |
|                            | pH Value of an Aqueous Extract             | 0.01-14                          | 0.01s            | 0.82  | SLC 13<br>(IUC 11; BS 1309:9)/<br>BS EN ISO<br>4045:1998 Electrometric |
|                            | Determination of Water Vapour Permeability | 1.0 Sec-99Hrs                    | 1.0 Sec          | 0.13mg/cm <sup>2</sup> .h                                     | BS EN 420:2003<br>6.3. Transmission                                    |
|                            | Measurement of Abrasion Resistance         | 1.0 - 99,999 Rubs<br>(1-4 Level) | 1.0<br>(1 Level) | Not applicable  | BS EN 388:2003<br>6.1 Abrasion<br>Resistance                           |



| <b>Drug Residue Testing Laboratory</b>      |                 |              |           |        |                         |
|---|-----------------|--------------|-----------|--------|-------------------------|
| Meat  | Chloramphenicol | 0.05-50mg/Kg | 0.02mg/Kg | ±0.037 | USP: 2012 /<br>HPLC-UVD |
| <b>Pesticide Residue Testing Laboratory</b> |                 |              |           |        |                         |
| Orange                                      | Cypermethrin    | 0.1-2.0mg/Kg | 0.1mg/Kg  | ±0.102 | AOAC: 2012<br>/GC-ECD   |
|   | Deltamethrin    |              |           |        |                         |
|   | Permethrin      |              |           |        |                         |
|   | Bifenthrin      |              |           |        |                         |

| <b>Field of Measurement:</b>                         |                     |                                      |  |
|--|---------------------|--------------------------------------|--|
| <i>Measured Quantity</i>                             | <i>Range</i>        | <i>Best Measurement Capability *</i> | <i>Brief Description of measurement and equipment used</i>   |
| <b>Calibration &amp; Physical Testing Laboratory</b> |                     |                                      | <b>Annex-VIII</b>  |
| <b>Length:</b>                                       |                     |                                      |  |
| Line Length Standard                                 | <i>Upto 100 cm</i>  | $\pm 0.1 \text{ cm}$                 | Technique: Direct Comparison<br>Line Length Standard<br># 251100 PTB, Germany  |
| Measuring Tape                                       | <i>Up to 500 cm</i> | $\pm 0.1 \text{ cm}$                 | Technique: Direct Comparison<br><i>Measuring tape</i><br># 34-336, Stanley USA   |
| Vernier Caliper                                      | <i>Up to 300 mm</i> | $\pm 0.01 \text{ mm}$                | Technique: Direct Comparison Gauge Block Set #<br>0403970,<br>Mitutoyo, Japan  |
| Micrometer   | <i>Up to 25 mm</i>  | $\pm 0.001 \text{ mm}$               | Technique: Direct Comparison Gauge Block Set #<br>0403970,<br>Mitutoyo, Japan  |
| Gauge Blocks   | 0.5 mm to 100 mm    | $\pm 0.2 \mu\text{m}$                | Technique: Direct Comparison<br>Micrometer, Vernier Caliper CD-12 <sup>II</sup> C, Gauge Block Set<br># 0408006 Mitutoyo, Japan, Tesa Tronic Amplifier Type:<br>04430008, Swiss-Made |

**Masses and Weighing Balances:**

|        |   |   |  |
|--------|---|---|--|
| Masses | 1 mg to 200mg<br>1g to 200g<br>1kg to 10 Kg | $\pm 0.1 \text{ mg}$<br>$\pm 0.1 \text{ mg}$<br>$\pm 0.1 \text{ g}$ | <i>Technique: Direct Loading</i><br><i>Set of Standard Masses</i><br><i>Weighing Balance SARTORIUS ME235S</i><br><i>Weighing Balance OHAUS, USA</i><br><i>Weighing Balance GP-30K, AND, Japan,</i><br><i>Weighing Balance, DIGI D-I 30N, Japan</i> |
|--------|---|---|--|

| <b>Field of Measurement:</b>               |   |  |  |
|--|---|--|--|
| <b>Measured Quantity</b>                   | <b>Range</b>  | <b>Best Measurement Capability *</b>                 | <b>Brief Description of measurement and equipment used</b>   |
| Weighing Balance                           | 1 mg to 200mg<br>1g to 200g<br>5 g to 10 kg                           | $\pm 0.1$ mg<br>$\pm 0.1$ mg<br>$\pm 0.1$ g          | Technique: Direct Loading<br>Set of Standard Masses, <i>Cal Lab. M25, M26 China</i>  |
| <b>Temperature:</b>                        |   |  |  |
| Liquid in Glass Thermometer                | $-10^{\circ}\text{C}$ to $375^{\circ}\text{C}$                        | $\pm 1^{\circ}\text{C}$                              | Technique: Direct comparison<br><i>Dry Well Calibrator 9100S, Precision Thermometer, WA57497</i>   |
| Temperature Probe / Temperature Controller | $-10^{\circ}\text{C}$<br>$0^{\circ}\text{C}$ to $800^{\circ}\text{C}$ | $\pm 0.1^{\circ}\text{C}$<br>$\pm 1^{\circ}\text{C}$ | -do-   |
| <b>Pressure:</b>                           |   |  |  |
| Pressure Gauge                             | $-10$ to $100$ psi<br>$100$ to $3000$ psi<br>$1000$ to $10000$ psi    | $\pm 0.1$ psi<br>$\pm 1$ psi<br>$\pm 5$ psi          | Technique: Direct Comparison<br><ul style="list-style-type: none"> <li>● <i>Pressure Calibrator PPC-3300</i></li> <li>● <i>Hydraulic Pressure Calibrator, H540/193,</i></li> </ul> |

| Frequency:   |  |  |   |
|--------------|--|--|---|
| Frequency    | 1 Hz<br>10 Hz<br>100 Hz<br>1 kHz<br>10 kHz<br>100 kHz<br>1 MHz<br>10 MHz<br>50 rpm to 500rpm<br>1000 rpm to<br>30000 rpm | $\pm 0.001$ Hz<br>$\pm 0.01$ Hz<br>$\pm 0.1$ Hz<br>$\pm 0.001$ kHz<br>$\pm 0.01$ kHz<br>$\pm 0.1$ kHz<br>$\pm 0.001$ MHz<br>$\pm 0.01$ MHz<br>$\pm 0.2$ rpm<br>$\pm 1$ rpm | Technique: Direct Comparison <ul style="list-style-type: none"> <li>● Universal Frequency Counter<br/>(Agilent, Malaysia)<br/>MY40004247, Cal.Lab-f6</li> <li>● Frequency Counter<br/>Tektronix-Malaysia<br/>CMC-251TW54148, Cal.Lab-f2</li> <li>● Digital tachometer 5600, Kyoritsu Japan,<br/>Cal.Lab-f7</li> </ul> |
| <b>Time:</b> |  |  |   |
| Time         | 1s to 3600 s   | $\pm 0.038$ s  | <ul style="list-style-type: none"> <li>● Universal Frequency Counter<br/>(Agilent, Malaysia)<br/>MY40004247, Cal.Lab-f6</li> <li>● Frequency Counter<br/>Tektronix-Malaysia<br/>CMC-251TW54148, Cal.Lab-f2</li> <li>● Technique: Direct comparison<br/>Digital Timer # 57120 USA.</li> </ul>                          |

| <b>Electrical Parameters:</b> |   |   |  |
|-------------------------------|---|---|--|
| a.c Voltage,                  | 0.1 V to 1 V<br>10 V to 100 V<br>200 V<br>600 V                     | $\pm 0.008 V$<br>$\pm 0.06 V$<br>$\pm 0.1 V$<br>$\pm 1 V$                       | Technique: Direct comparison<br><i>Digital Multimeter 3155A</i><br><i>Escort, Taiwan</i>   |
| d.c. Voltage                  | 1 mV to 100mV<br>1 V<br>10V<br><br>100 V to 200 V<br>200 V to 800 V | $\pm 0.01 mV$<br>$\pm 0.0002 V$<br>$\pm 0.001 V$<br>$\pm 0.01 V$<br>$\pm 0.1 V$ | <ul style="list-style-type: none"> <li>• <i>Digital Multimeter 3155A</i><br/><i>Escort, Taiwan</i></li> <li>• <i>D.C. High Voltage Probe</i></li> <li>• <i>Portable Calibrator 2422</i><br/><i>Yokogawa, Japan</i></li> </ul>              |
| a.c Current                   | 1mA<br>10 to 100mA<br>1A to 10A<br>10A to 100A<br>100A to 1000A     | $\pm 0.001 mA$<br>$\pm 0.1 mA$<br>$\pm 0.001 A$<br>$\pm 1 A$<br>$\pm 1 A$       | <ul style="list-style-type: none"> <li>• <i>Digital Multimeter 3155A</i><br/><i>Escort, Taiwan</i></li> <li>• <i>Digital Multimeter 45 Fluke</i></li> <li>• <i>AC/DC Clamp-on Meter, Kyortisu, Japan</i><br/><i>Cal.Lab-E60</i></li> </ul> |

| <b>Field of Measurement:</b> |   |   |  |
|------------------------------|---|---|--|
| d.c. Current                 | <i>1mA</i><br><i>10 to 100mA</i><br><i>1A to 10A</i><br><i>10A to 100A</i><br><i>100A to 1000A</i>      | $\pm 0.01 \text{ mA}$<br>$\pm 0.1 \text{ mA}$<br>$\pm 0.001 \text{ A}$<br>$\pm 1 \text{ A}$<br>$\pm 1 \text{ A}$  | -do-   |
| Resistance                   | <i>1Ω to 100Ω</i><br><i>1kΩ, 10kΩ</i><br><i>100kΩ</i><br><i>1MΩ, 10MΩ, 100MΩ</i><br><i>100MΩ to 1GΩ</i> | $\pm 0.1\Omega$<br>$\pm 0.001k\Omega, \pm 0.01k\Omega$<br>$\pm 0.1K\Omega$<br>$\pm 0.001M\Omega, \pm 0.01M\Omega$<br>$\pm 0.1M\Omega$<br>$\pm 1M\Omega$ | <ul style="list-style-type: none"> <li>Standards Resistances</li> <li>Digital Insulation Tester, MIS-4D Japan</li> <li>LCR Meter PM6304, Fluke, USA</li> </ul> |
| <b>Spectrophotometer:</b>    |   |   |  |
| Spectrophotometer            | <i>0%T to 100%T</i><br><i>0 to .999 ABS</i><br><i>520 to 535nm</i>                                      | $\pm 0.1 \%T$<br>$\pm 0.001 \text{ ABS}$<br>$\pm 1.2 \text{ nm}$  | Spectronic Standards<br>Model # 333150<br>Thermospectronics, USA   |

- Best Measurement Capability expressed as Uncertainty, with k=2, providing a
- Level of Confidence of approximately 95%

| <i>Materials/ Products tested</i>       | <i>Types of test/ Properties measured</i> | <i>Range of measurement</i> | <i>Minimum detection limit</i> | <i>Uncertainty of Measurement (where applicable)</i><br><i>MU (±)</i> | <i>Standard specification/ Techniques/ equipment Used</i> |
|---|---|-----------------------------|--------------------------------|---|---|
| <b>Environmental Testing Laboratory</b> |   |                             |                                |   |   |
| Water & Wastewater                      | BOD 5 at 25 °C                            | 2.0 mg/l -1000mg/l          | 2.0 mg/l                       | 0.2 mg/l  | 5210 B<br>AWWA/APHA,<br>2005 Titrimetric<br>Method        |
|   | COD                                       | 2.0 mg/l -2000<br>mg/l      | 2.0 mg/                        | 0.1 mg  | 5220 B<br>AWWA/APHA,<br>2005 Open<br>reflex Method        |
|   | PH Value at 25 °C                         | 0.1-14                      | 0.1                            | .01   | 4500 – HB<br>AWWA/APHA,<br>2005 pH Meter                  |
|   | Chlorides                                 | 0.25 mg/l- 1000<br>mg/l     | 0.25 mg/l                      | 0.05 mg/l   | 4500 – CIB<br>AWWA/APHA,<br>2005 Titrimetric              |
|   | Total Dissolved<br>Solids                 | 2.5 mg/l - 200<br>mg/l      | 1.0 mg/l                       | 6.0 mg/l  | 2540 – C<br>AWWA/APHA,<br>2005Gravimetric<br>Method       |



|  |                                |                      |           |           |   |
|--|--------------------------------|----------------------|-----------|-----------|---|
|  | Total Suspended Solids         | 2.0 mg/l - 2000 mg/l | 1.0 mg/l  | 6.0 mg/l  | 2540 – D<br>AWWA/APHA,<br>2005<br>Gravimetric<br>Method                                     |
|  | Grease & Oil                   | 1.0 mg/l - 500 mg/l  | 1.4mg/l   | 0.1 mg/l  | 5520 – B<br>AWWA/APHA,<br>2005<br>Gravimetric<br>Method                                     |
|  | Temperature                    | Ambient-100°C        | 0.5°C     | 0.1°C     | 2550 B-1<br>AWWA/APHA,<br>2005<br>Equipment:<br>Thermometer<br>(Mercury filled,<br>Celsius) |
|  | Phenolic Compounds (as Phenol) | 0.05mg/l – 1 mg/l    | 0.05 mg/l | 0.005mg/l | 5530-D<br>AWWA/APHA,<br>2005<br>Equipment:<br>Spectrophotometer<br>pH Meter                 |

|                                       |                              |                |            |          |  |
|---------------------------------------|------------------------------|----------------|------------|----------|--|
|                                       | Ammonia (NH <sub>3</sub> -N) | > 5mg/l        | 5 mg/l     | 0.5 mg/l | 4500 B & 4500 C<br>AWWA/APHA, 2005<br>Equipment:<br>pH Meter   |
| Water & Wastewater                    | Sulfide                      | > 2 mg/l       | 2.0 mg/l   | 0.2 mg/l | 4500-S <sup>2</sup> -F<br>AWWA/APHA, 2005<br>Technique:<br>Titrimetric   |
|                                       | Sulfate                      | 1mg/l- 40 mg/l | 1.0 mg/L   | 0.1 mg/l | 4500-E<br>AWWA/APHA, 2005<br>Equipment:<br>Spectrophotometer<br>Nephelometer<br>Technique:<br>Turbidity method |
| <b>Heavy Metal Testing Laboratory</b> |                              |                |            |          |  |
| Rice                                  | Cadmium                      | 0.01-10 mg/Kg  | 0.01 mg/Kg | 0.004    | ICP-OES/<br>JAOAC:2005   |
|                                       | Lead                         | 0.02-20 mg/Kg  | 0.02 mg/Kg | 0.006    | ICP-OES/<br>JAOAC:2005   |

| Materials/ Products tested             | Types of test/ Properties measured   | Range of measurement          | Minimum detection limit | Uncertainty of Measurement (where applicable)<br>MU (+) | Standard specification/ Techniques/ equipment used  |
|--|--|-------------------------------|-------------------------|---|---|
| <b>Microbiology Testing Laboratory</b> |  |                               |                         |   |   |
| Water, drinks and food items           | Enumeration of total plate count in food                                   | 30 to $3.0 \times 10^7$ CFU/g | <1.0                    | 0.061   | Manual of Food Quality Control 4. Rev.1 Microbiological Analysis. FAO Food and Nutrition Paper 14/4 Rev. 1. Chapter 2. FAO of the United Nations. 1992. |
|  | Enumeration of Total Coliforms, Fecal coliforms and <i>E. coli</i> in Food | <3 to $1.1 \times 10^4$ MPN/g | <3                      | Not applicable  | Manual of Food Quality Control 4. Rev.1 Microbiological Analysis. FAO Food and Nutrition Paper 14/4 Rev.1. Chapter 3. FAO of the United Nations. 1992.  |
|  | Detection of <i>Salmonella</i> spp. in Food                                | Absence/ presence per 25gm    | Qualitative             | Not applicable  | Manual of Food Quality Control 4, Rev.1 Microbiological Analysis, FAO Food & Nutrition Paper 14/4 Rev. 1 Chapter 4. FAO of the United Nations. 1992     |
|  | Enumeration of <i>Staphylococcus aureus</i> in Food                        | 20 to $2.0 \times 10^7$ CFU/g | <1.0                    | 0.056   | Manual of Food Quality Control 4, Rev.1 Microbiological Analysis, FAO Food & Nutrition Paper 14/4 Rev. 1 Chapter 4. FAO of the United Nations. 1992     |

|  |  |  |       |                |   |
|--|--|--|-------|----------------|---|
|  | Enumeration of Yeast and Mould in Food                                     | 10 to 1.5 × 10 <sup>6</sup><br>CFU/g     | <1.0  | 0.014          | Manual of Food Quality Control 4, Rev.1<br>Microbiological Analysis, FAO Food & Nutrition Paper 14/4 Rev. 1 Chapter 4. FAO of the United Nations. 1992                                  |
|  | Enumeration of total plate count in water (LLC/M;/TM/003)                  | 30 to 3.0 × 10 <sup>7</sup><br>CFU/ml    | <1.0  | 0.48           | Standard methods for the examination of water and waste water. 21 <sup>st</sup> edition. (2005) Method no. 9215B. Published by American Public Health Association, Washington, DC       |
|  | Enumeration of Total Coliforms, Fecal Coliforms and <i>E.coli</i> in water | <1 TO 4.6 X 10 <sup>3</sup><br>MPN/100ml | < 1.0 | Not applicable | Standard methods for the examination of water and wastewater. 21 <sup>st</sup> edition. (2005) Method no.(9221B E & F). Published by American Public Health Association, Washington, DC |
|  | Enumeration of Pseudomonas spp   |  | < 1.0 | Not applicable | Standard methods for the examination of water and wastewater. 21 <sup>st</sup> edition. (2005) Method no.(9221B E & F). Published by American Public Health Association, Washington, DC |

| <b>Nutrition Testing Laboratory</b>  |                                      |             |      |                |                  |
|--|--------------------------------------|-------------|------|----------------|------------------|
| Milk products,<br>Cereals, Animal<br>Feeds, Dry<br>vegetable, Pulses,<br>Dry Fruits and Baby<br>Foods etc. | Determination of<br>Moisture (% Age) | 0.1%- 99.5% | 0.1% | 2.02 %         | AOAC: 2012       |
|  | Determination of<br>Ash (% Age)      | 0.1%- 99.5% | 0.1% | 3.12%          | AOAC: 2012       |
|  | Determination of<br>Total Fat (%age) | 0.1%- 99.5% | 0.1% | 2.06%          | AOAC: 2012       |
|  | Determination of<br>Protein (%age)   | 0.1%- 99.5% | 0.1% | 2.84%          | AOAC: 2012       |
| <b>Mycotoxin Testing Laboratory</b>  |                                      |             |      |                |                  |
| Food, Food<br>Products, Feed and<br>Feed Ingredients.  | Determination of<br>Aflatoxin B1     | 0.72-500    | 0.72 | Not applicable | AOAC 972.26:2012 |
|  | Determination of<br>Aflatoxin B2     | 0.20-500    | 0.20 | Not applicable | AOAC 972.26:2012 |
|  | Determination of<br>Aflatoxin G1     | 0.72-500    | 0.72 | Not applicable | AOAC 972.26:2012 |
|  | Determination of<br>Aflatoxin G2     | 0.20-500    | 0.20 | Not applicable | AOAC 972.26:2012 |

| Materials/<br>Products<br>Tested               | Types of test/<br>Properties measured  | Range of<br>Measurement | Minimum<br>detection<br>limit | Uncertainty of<br>Measurement<br>(where applicable)<br>MU (+) | Standard<br>specification/<br>Techniques/<br>equipment used |
|--|--|-------------------------|-------------------------------|---|---|
| <b>Glass &amp; Ceramics Testing Laboratory</b> |  |                         |                               |   |   |
| Limestone                                      | Loss on ignition,<br>silica (SiO <sub>2</sub> ),<br>Alumina (Al <sub>2</sub> O <sub>3</sub> ),<br>Iron oxide (Fe <sub>2</sub> O <sub>3</sub> ),<br>Lime(CaO), Magnesia(MgO),<br>Soda (Na <sub>2</sub> O),<br>Potashs(K <sub>2</sub> O) | 0.01% - 56.00%          | 0.01%                         | 0.86%   | ASTM C-25-06 2007   |

| Materials/<br>Products<br>Tested        | Types of test/<br>Properties measured  | Range of<br>Measurement  | Minimum<br>detection<br>limit | Uncertainty of<br>Measurement<br>(where applicable)<br>MU (+) | Standard<br>specification/<br>Techniques/<br>equipment used |
|---|--|--|-------------------------------|---|---|
| <b>Metallography Testing Laboratory</b> |  |  |                               |   |   |
| Metallic Materials                      | Standard guide for preparation of metallographic Specimens                   | Metallic materials   | Not Applicable                | Not Applicable  | ASTM E 3-01   |
|   | Standard practice for Microetching of Metals & Alloys                        | Metallic materials   | Not Applicable                | Not Applicable  | ASTM E 407-07   |
|   | Standard practice for Macroetching of Metals & Alloys.                       | Metallic materials   | Not Applicable                | Not Applicable  | ASTM E 340-00   |
|   | Standard Test Method for Determining Average grain size                      | ASTM Grain size No. 0-10   | 0.5                           | Not Applicable  | ASTM E 112-96   |
|   | Standard Test Method for Measurement of metals & oxide coating thickness.    | 0.5 $\mu$ m – 1mm  | 0.5 $\mu$ m                   | Not Applicable  | ASTM B 487-85   |
|   | Standard Test Method for Evaluating the microstructure of graphite.          | All types of Graphite in iron  | 1                             | Not Applicable  | ASTM A 247-06   |
|   | Optical Emission Vacuum Spectrometric analysis of carbon and low alloy steel | C 0.0 – 1.1<br>Mn 0.0 – 2.0<br>Si 0.0 – 1.15<br>S 0.0 – 0.055<br>P 0.0 – 0.085 | 0.001%                        | 0.03%   | ASTM E 415-08   |

|   |  |        |                |                |
|---|--|--------|----------------|----------------|
| Test Method for Optical Emission Vacuum Spectrometric analysis of Stainless Steel by Point to Plane Excitation Technique  | C 0.005 – 0.25<br>Mn 0.01- 2.0<br>Si 0.01 – 0.9<br>S 0.003-0.065<br>P 0.003 – 0.15<br>Cr 17.0 – 23.0<br>Ni 7.5 – 13.00<br>Mo 0.01 – 3.0                      | 0.001% | 0.197%         | ASTM E1086-94  |
| Test Method for Analysis of Manganese Steel using Atomic Emission Spectrometer  | C 0.3 – 1.4<br>Mn 8.0 – 16.2<br>Si 0.25 – 1.5<br>P 0.025-0.06<br>Cr 0.25 – 2.0<br>Ni 0.05 – 4.0  | 0.001% | 0.412%         | ASTM E 2209-02 |
| Test Method for Optical Emission Spectrometric Analysis of Aluminum and Aluminum Alloys by the argon atmosphere Point to Plane, unipolar self- Initiating Capacitor Discharge | Si<br>0.001 -24.0<br>Cu 0.001- 20.0<br>Mg 0.001- 11.0<br>Zn 0.001- 10.0<br>Ni 0.001- 4.0<br>Sn 0.001- 7.5<br>Fe 0.001- 3.5<br>Mn 0.001- 2.0<br>Pb 0.002- 0.7 | 0.001% | 0.872%         | ASTM E 1251-07 |
| Practice for Sampling of steel & iron for determination of Chemical composition   | Diameter.<br>(12mm -100 mm)  | 12mm   | Not Applicable | ASTM E1806-09  |
| Test Method for Analysis of Cast Iron using Optical Emission Spectrometer   | C 1.9 – 3.8<br>Mn 0.0 – 1.8<br>Si 0.0 – 2.5<br>S 0.0 – 0.08<br>P 0.0 – 0.04  | 0.001% | 0.872%         | ASTM E1999-99  |



| <b>Mechanical Testing Laboratory</b>                                   |   |   |                                  |                              |   |
|--|---|---|----------------------------------|------------------------------|---|
| Metallic Materials<br>(Deformed Steel Bars)                            | Standard Test Method for Tension Testing Of Deformed Steel Bars (Tensile Strength, Yield Strength, Elongation )   | 4-1000 KN   | 4 KN &<br>Least Count<br>0.01 KN | ---                          | Instrumental<br>ASTM E 8M-04,A 370-03a,615/A 615 BS EN 10002-1:2001, BS4449 UTM, Jinan TE China |
| Metallic Materials<br>(Hardened &Tempered Alloy Steel, Brass & Bronze) | Hardness<br>HRB<br>HRC  | (0.1-129.9)<br>HRB<br>(0.1-99.9)<br>HRC   | 0.1                              | 2.085<br>HRB<br>2.011<br>HRC | Instrumental<br>ASTM E -18 Rockwell Hardness Tester, INDENTEC, UK                               |
| <b>Optical Emission spectrometer Laboratory</b>                        |   |   |                                  |                              |   |
| Metallic Materials   | Test Method for Optical Emission Spectrometric Analysis of Aluminum and Aluminum Alloys by the argon atmosphere Point to Plane, unipolar self- Initiating Capacitor Discharge | Si 0.001 -24.0<br>Cu 0.001- 20.0<br>Mg 0.001- 11.0<br>Zn 0.001- 10.0<br>Ni 0.001- 4.0<br>Sn 0.001- 7.5<br>Fe 0.001- 3.5<br>Mn 0.001- 2.0<br>Pb 0.002- 0.7 | 0.001%                           | 0.872%                       | ASTM E 1251-07  |
|  | Practice for Sampling of steel & iron for determination of Chemical composition   | Diameter.<br>(12mm -100 mm)   | 12mm                             | Not Applicable               | ASTM E1806-09   |
|  | Test Method for Analysis of Cast Iron using Optical Emission Spectrometer   | C 1.9 – 3.8<br>Mn 0.0 – 1.8<br>Si 0.0 – 2.5<br>S 0.0 – 0.08<br>P 0.0 – 0.04   | 0.001%                           | 0.872%                       | ASTM E1999-99   |

| Materials/Products tested | Types of test/ Properties measured                    | Range of measurement                          | Minimum detection limit | Uncertainty of Measurement (where applicable) MU ( $\pm$ ) | Standard specification/ Techniques/ equipment used              |
|---------------------------|---|---|-------------------------|--|---|
| EMTL/SOA/01               | Resistance of conductors                              | 100 n $\Omega$ – 30 k $\Omega$                | 100 n $\Omega$          | $\pm$ 0.002 m $\Omega$                                     | IEC 60227-3, IEC 60227-4, IEC 60227-5, IEC 60227-2 Clause 2.1   |
| EMTL/SOA/02               | Voltage test on cores at 1500 V                       | 0.01 – 15 KV                                  | 0.01 KV                 | $\pm$ 0.02 KV  | IEC 60227-5, IEC 60227-2 Clause 2.3                             |
| EMTL/SOA/03               | Voltage test on cores at 2000 V                       | 0.01 – 15 KV                                  | 0.01 KV                 | $\pm$ 0.02 KV  | IEC 60227-4, IEC 60227-2 Clause 2.3                             |
| EMTL/SOA/04               | Voltage test on completed cable at 2000 V             | 0.01 – 15 KV                                  | 0.01 KV                 | $\pm$ 0.02 KV  | IEC 60227-5, IEC 60227-4, IEC 60227-2 Clause 2.2                |
| EMTL/SOA/05               | Voltage test at 2500 V                                | 0.01 – 15 KV                                  | 0.01 KV                 | $\pm$ 0.02 KV  | IEC 60227-3, IEC 60227-2 Clause 2.2                             |
| EMTL/SOA/06               | Insulation resistance at 70°C                         | 1 – 5000 VDC<br>1 k $\Omega$ – 5.0 T $\Omega$ | 1 VDC<br>1 k $\Omega$   | $\pm$ 0.002 M $\Omega$                                     | IEC 60227-3, IEC 60227-4, IEC 60227-5, IEC 60227-2 Clause 2.4   |
| EMTL/SOA/07               | Checking of compliance with constructional provisions | Visual Inspection                             | Visual Inspection       | N.A  | IEC 60227-3, IEC 60227-4, IEC 60227-5, IEC 60227-1              |
| EMTL/SOA/08               | Measurement of insulation thickness                   | 0.001 – 100 mm                                | 0.001 mm                | $\pm$ 0.002 mm   | IEC 60227-3, IEC 60227-4, IEC 60227-5, IEC 60227-2 Clause 1.9   |
| EMTL/SOA/09               | Measurement of sheath thickness                       | 0.001 – 100 mm                                | 0.001 mm                | $\pm$ 0.002 mm   | IEC 60227-4, IEC 60227-5, IEC 60227-2 Clause 1.10               |
| EMTL/SOA/10               | Measurement of overall diameter                       | 0.001 – 100 mm                                | 0.001 mm                | $\pm$ 0.002 mm   | IEC 60227-3, IEC 60227-4, IEC 60227-5, IEC 60227-2 Clause 1.11  |
| EMTL/SOA/11               | Ovality   | 0.001 – 100 mm                                | 0.001 mm                | $\pm$ 0.002 mm   | IEC 60227-4, IEC 60227-5, IEC 60227-2 Clause 1.11               |
| EMTL/SOA/12               | Tensile test of insulation before ageing              | 0.01 N – 5 KN                                 | 0.01 N/mm <sup>2</sup>  | $\pm$ 0.03 N/mm <sup>2</sup>                               | IEC 60227-3, IEC 60227-4, IEC 60227-5, IEC 60811-1-1 Clause 9.1 |

|             |  |                   |                        |                          |  |
|-------------|--|-------------------|------------------------|--------------------------|--|
| EMTL/SOA/13 | Tensile test of insulation after ageing          | 0.01 N – 5 KN     | 0.01 N/mm <sup>2</sup> | ± 0.03 N/mm <sup>2</sup> | IEC 60227-3, IEC 60227-4, IEC 60227-5, IEC 60811-1-2 Clause 8.1, 8.1.3 & 8.1.3.1 |
| EMTL/SOA/14 | Loss of mass test                                | 0.1 mg – 30 Kg    | 0.1 mg                 | ± 0.2 mg                 | IEC 60227-3, IEC 60227-4, IEC 60227-5, IEC 60811-3-2 Clause 8.1                  |
| EMTL/SOA/15 | Tensile test of sheath before ageing             | 0.01 N – 5 KN     | 0.01 N/mm <sup>2</sup> | ± 0.03 N/mm <sup>2</sup> | IEC 60227-4, IEC 60227-5, IEC 60811-1-1 Clause 9.2                               |
| EMTL/SOA/16 | Tensile test of sheath after ageing              | 0.01 N – 5 KN     | 0.01 N/mm <sup>2</sup> | ± 0.03 N/mm <sup>2</sup> | IEC 60227-4, IEC 60227-5, IEC 60811-1-2 Clause 8.1 & 8.1.3                       |
| EMTL/SOA/17 | Loss of mass test                                | 0.1 mg – 30 Kg    | 0.1 mg                 | ± 0.2 mg                 | IEC 60227-4, IEC 60227-5, IEC 60811-3-2 Clause 8.2                               |
| EMTL/SOA/18 | Pressure test of insulation at high temperature  | 0.001 – 100 mm    | 0.001 mm               | ± 0.002 mm               | IEC 60227-3, IEC 60227-4, IEC 60227-5, IEC 60811-3-1 Clause 8.1                  |
| EMTL/SOA/19 | Pressure test of sheath at high temperature      | 0.001 – 100 mm    | 0.001 mm               | ± 0.002 mm               | IEC 60227-4, IEC 60227-5, IEC 60811-3-1 Clause 8.2                               |
| EMTL/SOA/20 | Bending test of insulation at low temperature    | Visual Inspection | Visual Inspection      | N.A                      | IEC 60227-3, IEC 60227-4, IEC 60227-5, IEC 60811-1-4 Clause 8.1                  |
| EMTL/SOA/21 | Bending test of sheath at low temperature        | Visual Inspection | Visual Inspection      | N.A                      | IEC 60227-4, IEC 60227-5, IEC 60811-1-4 Clause 8.2                               |
| EMTL/SOA/22 | Elongation test of insulation at low temperature | 0.01 – 100 %      | 0.01 %                 | ± 0.05 %                 | IEC 60227-3, IEC 60811-1-4 Clause 8.3  |
| EMTL/SOA/23 | Elongation test of sheath at low temperature     | 0.01 – 100 %      | 0.01 %                 | ± 0.05 %                 | IEC 60227-4, IEC 60811-1-4 Clause 8.4  |
| EMTL/SOA/24 | Impact test of insulation                        | Visual Inspection | Visual Inspection      | N.A                      | IEC 60227-3, IEC 60811-1-4 Clause 8.5  |
| EMTL/SOA/25 | Impact test on completed cable                   | Visual Inspection | Visual Inspection      | N.A                      | IEC 60227-4, IEC 60227-5, IEC 60811-1-4 Clause 8.5                               |

|             |  |                                |                     |                         |   |
|-------------|--|--------------------------------|---------------------|-------------------------|---|
| EMTL/SOA/26 | Heat shock test of insulation                                  | Visual Inspection              | Visual Inspection   | N.A                     | IEC 60227-3, IEC 60227-4, IEC 60227-5, IEC 60811-3-1 Clause 9.1 |
| EMTL/SOA/27 | Heat shock test of sheath                                      | Visual Inspection              | Visual Inspection   | N.A                     | IEC 60227-4, IEC 60227-5, IEC 60811-3-1 Clause 9.2              |
| EMTL/SOA/28 | Flexing test of completed cable                                | 1 – 15000 cycle                | 1 cycle             | N.A                     | IEC 60227-5, IEC 60227-2 Clause 3.1                             |
| EMTL/SOA/29 | Test of flame retardance of completed cable                    | 1 – 100 cm                     | 1 mm                | ± 0.1 cm                | IEC 60332-1-1, IEC 60332-1-2                                    |
| EMTL/SOA/30 | General Conditions for the Tests                               | N.A                            | N.A                 | N.A                     | IEC 60335-2-80 Clause 5   |
| EMTL/SOA/31 | Classification   | N.A                            | N.A                 | N.A                     | IEC 60335-2-80 Clause 6   |
| EMTL/SOA/32 | Marking and instructions                                       | N.A                            | N.A                 | N.A                     | IEC 60335-2-80 Clause 7   |
| EMTL/SOA/33 | Protection against access to live parts                        | N.A                            | N.A                 | N.A                     | IEC 60335-2-80 Clause 8   |
| EMTL/SOA/34 | Starting of motor-operated appliances                          | N.A                            | N.A                 | N.A                     | IEC 60335-2-80 Clause 9   |
| EMTL/SOA/35 | Power input and current  | 0.1 – 100 kW<br>0.1 – 100A     | 0.1 W<br>0.1 mA     | ± 0.15 W<br>± 0.003 mA  | IEC 60335-2-80 Clause 10  |
| EMTL/SOA/36 | Heating  | 0.1 – 350 °C                   | 0.1 °C              | ± 0.3 °C                | IEC 60335-2-80 Clause 11  |
| EMTL/SOA/37 | Leakage current and electric strength at operating temperature | 0.01µA –20 mA<br>0.01 – 15 KV  | 0.01 µA<br>0.01 KV  | ± 0.003 mA<br>0.02 KV ± | IEC 60335-2-80 Clause 13  |
| EMTL/SOA/38 | Transient over voltages  | 0.01 – 15 KV                   | 0.01 KV             | ± 0.02 KV               | IEC 60335-2-80 Clause 14  |
| EMTL/SOA/39 | Moisture resistance  | 0.01 – 100 °C<br>20 – 100 % rh | 0.01 °C<br>0.1 % rh | ± 1.2 °C<br>± 2 % rh    | IEC 60335-2-80 Clause 15  |
| EMTL/SOA/40 | Leakage current and electric strength                          | 0.01µ A–20 mA<br>0.01 – 15 KV  | 0.01 µA<br>0.01 KV  | ± 0.003 mA<br>0.15 KV ± | IEC 60335-2-80 Clause 16  |

|             |   |                                   |                        |                            |                                |
|-------------|---|-----------------------------------|------------------------|----------------------------|--------------------------------|
| EMTL/SOA/41 | Overload protection of transformers and associated circuits | N.A                               | N.A                    | N.A                        | IEC 60335-2-80 Clause 17       |
| EMTL/SOA/42 | Endurance   | N.A                               | N.A                    | N.A                        | IEC 60335-2-80 Clause 18       |
| EMTL/SOA/43 | Abnormal operation  | 0.1 – 350 °C                      | 0.1 °C                 | ± 0.3 °C                   | IEC 60335-2-80 Clause 19       |
| EMTL/SOA/44 | Stability and mechanical hazards                            | 1° – 180°                         | 1°                     | ± 1°                       | IEC 60335-2-80 Clause 20       |
| EMTL/SOA/45 | Mechanical strength   | 0.20 – 1.0 J                      | 0.2 J                  | ± 0.01 J                   | IEC 60335-2-80 Clause 21       |
| EMTL/SOA/46 | Construction  | 1 – 100 N                         | 1 N                    | ± 1N                       | IEC 60335-2-80 Clause 22       |
| EMTL/SOA/47 | Internal wiring   | 0.01 – 15 KV                      | 0.01 KV                | ± 0.02 KV                  | IEC 60335-2-80 Clause 23       |
| EMTL/SOA/48 | Components  | N.A                               | N.A                    | N.A                        | IEC 60335-2-80 Clause 24       |
| EMTL/SOA/49 | Supply connection and external flexible cords               | 0.001 – 100 mm<br>0.1 – 50 cN - m | 0.001 mm<br>0.1 cN - m | ± 0.003 mm<br>± 0.9 cN - m | IEC 60335-2-80 Clause 25       |
| EMTL/SOA/50 | Terminals for external conductor                            | 0.001 – 100 mm                    | 0.001 mm               | ± 0.002 mm                 | IEC 60335-2-80 Clause 26       |
| EMTL/SOA/51 | Provision of earthing                                       | 0.001 – 1.8 Ω                     | 0.001 Ω                | ± 0.002 Ω                  | IEC 60335-2-80 Clause 27       |
| EMTL/SOA/52 | Screws and connections                                      | 20–500 cN - m                     | 20 cN - m              | ± 1.0 cN - m               | IEC 60335-2-80 Clause 28       |
| EMTL/SOA/53 | Clearances, creepage distance and solid insulation          | 1.0mm–8.0mm                       | 1.0 mm                 | ± 0.001 mm                 | IEC 60335-2-80 Clause 29       |
| EMTL/SOA/54 | Resistance to heat and fire                                 | 0.001 – 100mm<br>1 – 1000 °C      | 0.001 mm<br>1 °C       | ± 0.002 mm<br>± 1.0 °C     | IEC 60335-2-80 Clause 30       |
| EMTL/SOA/55 | Resistance to rusting                                       | N.A                               | N.A                    | N.A                        | IEC 60335-2-80 Clause 31       |
| EMTL/SOA/56 | Radiation, toxicity and similar hazards                     | N.A                               | N.A                    | N.A                        | IEC 60335-2-80 Clause 32       |
| EMTL/SOA/57 | Marking   | -                                 | -                      | -                          | IEC 60968 Clause 4.1, 4.2, 4.3 |
| EMTL/SOA/58 | Interchangeability  | -                                 | -                      | -                          | IEC 60968 Clause 5.1, 5.2, 5.3 |
| EMTL/SOA/59 | Protection against Electric Shock                           | -                                 | -                      | -                          | IEC 60968 Clause 6             |

|             |  |   |                        |                                       |                           |
|-------------|--|---|------------------------|---------------------------------------|---------------------------|
| EMTL/SOA/60 | Insulation Resistance and Electric Strength after Humidity Treatment | 1K $\Omega$ – 5.00T $\Omega$<br>0.01 – 5 kV | 1K $\Omega$<br>0.01 kV | $\pm$ 0.15M $\Omega$<br>$\pm$ 0.05 kV | IEC 60968 Clause 7.1, 7.2 |
| EMTL/SOA/61 | Mechanical Strength  | 0.001 – 6 Nm                                | 0.001 Nm               | $\pm$ 1.0 %                           | IEC 60968 Clause 8        |
| EMTL/SOA/62 | Cap Temperature Rise   | 0.1 – 200°C                                 | 0.1°C                  | $\pm$ 2.0°C                           | IEC 60968 Clause 9        |
| EMTL/SOA/63 | Resistance to Heat   | 0.1 – 220 °C                                | 0.1 °C                 | $\pm$ 1.5 °C                          | IEC 60968 Clause 10       |
| EMTL/SOA/64 | Resistance to Flame and Ignition                                     | 0.1 – 960°C                                 | 0.1°C                  | $\pm$ 2.0 °C                          | IEC 60968 Clause 11       |
| EMTL/SOA/65 | Fault Conditions   | -   | -                      | -                                     | IEC 60968 Clause 12       |
| EMTL/SOA/66 | Dimensions   | 0.01 – 150 mm                               | 0.01mm                 | $\pm$ 0.05 mm                         | IEC 60969 Clause 3        |
| EMTL/SOA/67 | Test Conditions  | -   | -                      | -                                     | IEC 60969 Clause 4        |
| EMTL/SOA/68 | Starting and Run-up  | -   | -                      | -                                     | IEC 60969 Clause 5        |
| EMTL/SOA/69 | Lamp wattage   | 0.1 – 5 kW                                  | 0.1 W                  | $\pm$ 1.0 W                           | IEC 60969 Clause 6        |
| EMTL/SOA/70 | Luminous flux  | -   | 0.1 lm                 | $\pm$ 2.0 %                           | IEC 60969 Clause 7        |
| EMTL/SOA/71 | Colour   | 2700 – 6500 K                               | -                      | $\pm$ 12.0 K                          | IEC 60969 Clause 8        |
| EMTL/SOA/72 | Lumen maintenance  | -   | -                      | -                                     | IEC 60969 Clause 9        |
| EMTL/SOA/73 | Life   | -   | -                      | -                                     | IEC 60969 Clause 10       |
| EMTL/SOA/74 | Caps   | 0.01 – 150 mm                               | 0.01 mm                | $\pm$ 0.05 mm                         | IEC 60081 Clause 1.5.2    |
| EMTL/SOA/75 | Dimensions   | 0.1 – 100 cm                                | 0.1 cm                 | $\pm$ 0.2 cm                          | IEC 60081 Clause 1.5.3    |
| EMTL/SOA/76 | Starting Characteristics   | 0.01 – 5 min                                | 0.01 sec.              | $\pm$ 1.0 sec.                        | IEC 60081 Clause 1.5.4    |
| EMTL/SOA/77 | Electrical & Cathode Characteristics                                 | 0.1 – 5 kW                                  | 0.1W                   | $\pm$ 1.0 W                           | IEC 60081 Clause 1.5.5    |
| EMTL/SOA/78 | Photometric Characteristics  | -   | 0.1 lm                 | $\pm$ 2.0 %                           | IEC 60081 Clause 1.5.6    |
| EMTL/SOA/79 | Lumen Maintenance  | -   | -                      | -                                     | IEC 60081 Clause 1.5.7    |
| EMTL/SOA/80 | Marking  | -   | -                      | -                                     | IEC 60081 Clause 1.5.8    |
| EMTL/SOA/81 | Marking  | -   | -                      | -                                     | IEC 60921 Clause 5        |
| EMTL/SOA/82 | Voltage at Terminations of Lamp or Starter (If any)                  | 0.1 – 500 V                                 | 0.1 V                  | $\pm$ 1.0 V                           | IEC 60921 Clause 6        |

|             |   |                                 |                   |                        |                             |
|-------------|---|---------------------------------|-------------------|------------------------|-----------------------------|
| EMTL/SOA/83 | Pre-Heating Conditions                      | 0.001 – 15 A                    | 0.001 mA          | ±1.0 %                 | IEC 60921 Clause 7          |
| EMTL/SOA/84 | Lamps Power and Current                     | 0.1 – 5 kW<br>0.001 – 40 A      | 0.1 W<br>0.001 A  | ± 1.0 W<br>± 0.01 A    | IEC 60921 Clause 8          |
| EMTL/SOA/85 | Circuit Power Factor                        | 0.001 – 1.0                     | 0.001             | ± 0.03                 | IEC 60921 Clause 9          |
| EMTL/SOA/86 | Supply Current                              | 0.001 – 40 A                    | 0.001 A           | ± 0.01 A               | IEC 60921 Clause 10         |
| EMTL/SOA/87 | Maximum Current in any Lead to a Cathode    | 0.001 – 15 A                    | 0.001 mA          | ± 1.0 %                | IEC 60921 Clause 11         |
| EMTL/SOA/88 | Magnetic Screening                          | 0.001 – 40 A                    | 0.001 A           | ± 0.01 A               | IEC 60921 Clause 13         |
| EMTL/SOA/89 | Marking                                     | -                               | -                 | -                      | IEC 60879 / PS-1 Clause 8   |
| EMTL/SOA/90 | Test of Air Performance (Air Delivery Test) | 0.01 – 20 m/s                   | 0.01 m/s          | ± 0.05 m/s             | IEC 60879 / PS-1 Clause 9.4 |
| EMTL/SOA/91 | Measurement of Speed of the Fan             | 0.1-10000 RPM                   | 0.1 RPM           | ± 1.0 RPM              | IEC 60879 / PS-1 Clause 9.5 |
| EMTL/SOA/92 | Measurement of Power Factor and Power Input | 0.1 – 100 kW<br>0.001 – 1.00 Pf | 0.1 W<br>0.001 Pf | ± 0.15 W<br>± 0.002 Pf | IEC 60879 / PS-1 Clause 9.6 |
| EMTL/SOA/93 | Service Value                               | -                               | -                 | -                      | -                           |

**National Physical & Standard Laboratory (NPSL), Islamabad**

Testing Laboratory

Annex-XI

| <i>Materials/ Products tested</i>          | <i>Types of test/ Properties measured</i> | <i>Range of measurement</i>                 | <i>Minimum Detection limit</i>    | <i>Uncertainty of Measurement (where applicable) MU (±)</i> | <i>Standard specification/ Techniques/ Equipment Used</i>              |
|--|---|---|-----------------------------------|---|--|
| Liquids Fluids                             | 1) Kinematics Viscosity                   | 0.2 – 30000 mm <sup>2</sup> s <sup>-1</sup> | 1 mm <sup>2</sup> s <sup>-1</sup> | 0.3 – 1.8 %   | ASTM D 445-97 Calibrated Ubbelohde viscometers                         |
| pH of Water                                | 2) Measurement of pH                      | 0 to 14                                     | 0.001 pH                          | 0.01 to 0.03 pH   | ASTM D1293 (99-2005)<br>Two point calibration (glass electrode method) |
| Water/ Wastewater and Industrial Effluents | 3) Measurement of Conductivity            | 4 to 5000 µmhos/cm                          | 4 µmhos/cm                        | 20 µmhos/cm   | AWWA/APHA 2510 –B Conductometry /Conductivity meter                    |
|  | 4) Total Dissolved Solid (TDS)            | 2.5 to 200 mg/L                             | 2.5 mg/L                          | 3.0 mg/L  | Gravimetric method, 2540 B, AWWA/APHA                                  |
|  | 5) Total Suspended Solid (TSS)            | 2.5 to 200 mg/L                             | 2.5 mg/L                          | 3.0 mg/L  | Filtration & Drying of residues,2540D, AWWA/APHA                       |
|  | 6) Total Hardness                         | 5 to 1000 mg/L                              | 2.0 mg/L                          | 3.0 mg/L  | EDTA Titrimetric method, 2340 C AWWA/APHA                              |
|  | 7) Alkalinity                             | 20 to 500 mg/L                              | 2.0 mg/L                          | 2.0 mg/L  | Titration method 2320 B AWWA/APHA                                      |
|  | 8) Chloride                               | 1.5 to 100 mg/L                             | 1.0 mg/L                          | 1.0 mg/L  | Argentometric Method, 4500 CIB, AWWA/APHA                              |
|  | 9) Calcium                                | 0 to 100 mg/L                               | 0.8 mg/L                          | 2.0 mg/L  | EDTA Titric method, 3500-CaB AWWA/APHA                                 |
|  | 10) Chemical Demand (COD) Oxygen          | 0.5 to 900 mg/L                             | 5.0 mg/L                          | 8.0 mg/L  | Open reflux method, 5220 B   |



|  |   |                            |                        |  |
|--|---|----------------------------|------------------------|--|
| 11) Copper in water<br>ASTM(D1688-02)<br>wavelength: 324.8nm             | 0.05 to 5 mg/L                            | 0.05<br>mg/L               | 0.5 mg/L               | ASTM Standards/<br>Atomic Absorption Spectrometer,<br>model A Analyst -100, Perkin<br>Elmer-USA/<br>Direct method<br>(Flame - AAS) |
| 12) Iron in water<br>ASTM(D1068-05)<br>wavelength: 248.3nm               | 0.1 to 5<br>mg/L                          | 0.06<br>mg/L               | 0.1mg/L                |  |
| 13) Potassium in water<br>ASTM(D4192-03)<br>wavelength:766.5nm           | 0.2 to 4<br>mg/L                          | 0.02<br>mg/L               | 0.8 mg/L               |  |
| 14) Sodium in water<br>ASTM(D4191-03)<br>wavelength: 589.0nm             | 0.2 to 3<br>mg/L                          | 0.02<br>mg/L               | 0.1 mg/L               |  |
| 15) Nickel in water<br>ASTM(D1886-03)<br>wavelength: 232.0nm             | 0.1 to 10 mg/L                            | 0.06<br>mg/L               | 0.6 mg/L               |  |
| 16) Calcium & Magnesium in<br>water ASTM(D511-03)<br>wavelength: 285.2nm | Ca= 1.0 to 15 mg/L<br>Mg=0.25 to 3.5 mg/L | 0.09Ca<br>Mg 0.008<br>mg/L | 0.05 mg/L<br>0.15 mg/L |  |
| 17)Chromium in water ASTM<br>(D1687-02)<br>wavelength:357.9nm            | 0.1 to 10 mg/L                            | 0.06<br>mg/L               | 0.24 mg/L              |  |
| 18) Lead in water<br>ASTM(D3559-03)<br>wavelength:283.3nm                | 1 to 10<br>mg/L                           | 0.28<br>mg/L               | 0.5 mg/L               |  |
| 19) Cadmium in water ASTM<br>(D3557-02)<br>wavelength:228.8nm            | 0.05 to 2 mg/L                            | 0.08<br>mg/L               | 0.12 mg/L              |  |
| 20) Zinc in water<br>ASTM(D1691-02)<br>wavelength:213.9nm                | 0.05 to 2 mg/L                            | 0.02<br>mg/L               | 0.2 mg/L               |  |

| <b><u>Field of measurement: (i) MASS MEASUREMENTS</u></b> |  |   |   |
|---|--|---|---|
| <b>Measured quantity</b>                                  | <b>Range</b>   | <b>Calibration &amp; Measurement Capability (CMC) expressed as an uncertainty (+)</b> | <b>Brief description of measurement and equipment used</b>  |
| Mass  | i) 1mg to 1000 g<br>ii) 2000 g to 5000 g<br>iii) 10,000 mg to 20,000 g | i) (0.001 to 0.22) mg<br>ii) (0.37 to 0.98) mg<br>iii) (1.8 to 5) mg                  | i) E <sub>2</sub> , F <sub>1</sub> and F <sub>2</sub> class standard masses from 1mg to 20kg<br>ii) Mass Comparator CCE6 having readability 0.1µg and capacity of 6.1g<br>iii) Mass Comparator CC111 having readability 1µg and capacity of 111g<br>iv) Mass Comparator AX1006 having readability 1µg and capacity of 1000g<br>v) Mass Comparator CC10000U-L having readability 10µg and capacity of 10kg<br>vi) Mass Comparator CC50001S-L having readability 1mg and capacity of 50kg |
| Balance/ Weighing machine (On-Site Calibration)           | 5g to 5000g  | (0.01 to 1) mg  | E <sub>2</sub> class standard masses from 1mg to 5000g  |

| <b><i>Field of measurement: (ii) VOLUME MEASUREMENTS</i></b>        |  |   |  |
|---|--|---|--|
| <b>Measured quantity</b>  | <b>Range</b>                                     | <b>Calibration &amp; Measurement Capability (CMC) expressed as an uncertainty (+)</b> | <b>Brief description of measurement and equipment used</b>   |
| Micropipette  | 10 µL to 1000 µL                                 | 0.2 µL to 5µL   | Gravimetric Method is used for the calibration of volume measures ranging from 10µL to 20 L. Three precision electronic balances are used for the calibration measures i-e. M-27, M-28 and M-39.                               |
| Glassware   | 1 mL to 1000 mL                                  | 0.1mL to 3.5 mL   |  |
| Glassware   | 1 L to 10 L                                      | 0.004 L to 0.03 L   |  |
| Metallic  | 20 mL to 2000 m L                                | 0.12 mL to 5.78 mL  |  |
| Metallic  | 2 L to 5 L                                       | 0.006 L to 0.017 L  |  |
| Metallic  | 5 L to 10 L                                      | 0.017 L to 0.029 L  |  |
| Metallic  | 10 L to 20 L                                     | 0.029 L to 0.050 L  |  |
| <b><i>Field of measurement: (iii-a) ELECTRICAL MEASUREMENTS</i></b> |  |   |  |
| DC Voltage  | i)1.0180 V<br>ii)10 V                            | i) 0.2 µV<br>ii) 0.4 µV   | Model 732B is a dc voltage laboratory standard that produces reference voltages of 10V and 1.018V  |
|   | 0 mV to 1100 V                                   | 0.00205 mV to 0.0069 V  | Multifunction Calibrator (Fluke 5720A/ Wavetek 9100) is used to calibrate various instruments and devices; digital and analogue multimeters, frequency meters, ohm meters, AC/DC mill voltmeters, clamp meters, and much more. |
| AC Voltage  | 1 mV (10 Hz – 1 MHz) to 750 V(10 Hz – 100 kHz)   | 0.00424 mV to 0.431 V   | - do -   |
| DC Current  | i) 220 µA to 20 A<br>ii)1000 A(via current coil) | 0.0148 µA to 0.00408 A  | - do -   |

|  |  |                                   |   |
|--|--|-----------------------------------|---|
| AC Current   | 220 $\mu$ A(10 Hz – 10 kHz)<br>to 20 A (40 Hz – 40 kHz)<br>1000 A (via current coil) | 0.071 $\mu$ A to 15.5 mA          | - do -  |
| Resistance   | 0 $\Omega$ to 100 M $\Omega$   | 40 $\mu\Omega$ to 0.0001 $\Omega$ | - do -  |
|  | 0.0001 $\Omega$ to 10 k $\Omega$   | 60 $\mu\Omega$ to 0.008 $\Omega$  | High accuracy working Resistance standards.   |
| Capacitance  | 0.1 $\mu$ F to 1 $\mu$ F   | 0.0005 $\mu$ F                    | Standard Capacitors   |
|  | 500 pF to 400 mF   | 0.115 pF to 1.15 $\mu$ F          | Multifunction Calibrator (Wavetek 9100) is used to calibrate various instruments and devices; digital and analogue multimeters, frequency meters, ohm meters, AC/DC millivoltmeters, clamp meters, and much more.                                     |
| AC Power   | 1 mW/mVAR to 20 kW/kVAR (up to 1MW/MVAR ( via current coil )                         | 4.2806 $\mu$ W to 155.5 W         | - do -  |
| DC Power   | 1 mW to 20 Kw (up to 1MW via current coil )  | 4.2806 $\mu$ W to 155.5 W         | - do -  |
| <b>Field of measurement: (iii-b) ELECTRICAL MEASUREMENTS</b> |  |                                   |   |
| DC Voltage   | 1 mV to 1000 V   | 0.0021 mV to 0.0055 V             | The Reference Multimeters (3458A Agilent DMM, 8½ Digit/34401A Agilent DMM, 6½ Digit) are high performance DMMs, offer very high accuracy and high-speed digitizing for calibration laboratory precision measurements and fast test system throughput. |
| AC Voltage   | 0.01V<br>(1 kHz – 300 kHz) to<br>750 V (1 kHz)                                       | 2.7 $\mu$ V to 0.035 V            | - do -  |
| DC Current   | 100 $\mu$ A to 20 A  | 0.0018 $\mu$ A to 0.0012 A        | - do -  |

|   |                                       |  |   |
|---|---------------------------------------|--|---|
| AC Current  | 10 $\mu$ A to 20 A<br>(1 kHz - 50 Hz) | 0.0053 $\mu$ A – 0.0052 A  | - do -  |
| Resistance  | 0.1 m $\Omega$ to 100 M $\Omega$      | 0.0578 m $\Omega$ to 0.1366 M $\Omega$                               | - do -  |
| Capacitance   | 900 pF to 9 $\mu$ F<br>(1 kHz )       | 5.6x10 <sup>-6</sup> $\mu$ F   | The PM 6303A is a quality assurance tool used for calibration of Capacitors, Resistors and Inductors  |
| Inductance  | 100 $\mu$ H to 1 H                    | 0.00577 $\mu$ H to 0.006 $\mu$ H                                     | - do –  |
| <b>Field of measurement: (iv) TEMPERATURE MEASUREMENTS</b>          |                                       |  |   |
| Calibration of Liquid in Glass Thermometer                          | -38 °C to 200 °C                      | 0.1 °C to 0.15 °C  | Digital Readout, Ultra Low Bath/ Stirrer Oil Bath, Zero point Dry Well, Reference Thermometer   |
| Calibration of Thermocouples  | -40°C to 900°C                        | 1.0 ° C to 1.5 °C  | Dry block Temperature Calibrator, Muffle Furnace, Digital Readout, Low Temperature Bath, Reference Thermometer  |
| <b>Field of measurement: (vi) LENGTH AND DIMENSION MEASUREMENTS</b> |                                       |  |   |
| Length  | (i) 1Meter                            | 0.1 mm (point to point comparison) & 0.01 mm (end to end comparison) | Meter Scales, Measuring Tapes, steel rulers, One meter Gauge Blocks, Length Bars using Length Comparator & Double Image Comparator                                    |
|   | (ii) Up to 300 mm                     | (0.08 to 0.2) $\mu$ m  | Gauge Blocks sets up to 100 mm range normally End Standards, Feeler Gauges, Snap Gauges, Dial Gauges Using Mechanical Measuring Machine & Universal Measuring Machine |
|   | (iii) Up to 300mm                     | 1.0 $\mu$ m  | Vernier caliper, Dial calipers, External Micrometers, Thickness gauges and Mandrel Using Standard Gauge Blocks set.   |
| Diameter External   | Up to 300 mm                          | 0.6 $\mu$ m  | Master Plug Gauges, Pin Gauges and Cylinders using Mechanical Measuring Machine & Universal Measuring Machine   |
| Diameter Internal   | 10 mm to 205 mm                       | 0.6 $\mu$ m  | Master Ring Gauges Using Mechanical Measuring Machine & Universal Measuring Machine   |

**Field of measurement: vii) TIME AND FREQUENCY MEASUREMENTS**

| Measured quantity              | Range            | Calibration & Measurement Capability (CMC) expressed as an uncertainty (+) | Brief description of measurement and equipment used   |
|--------------------------------|------------------|--|---|
| <b>Frequency (Source)</b>      | (0.1,1,5,10) MHz | ( $2.3 \times 10^{-5}$ to $1.6 \times 10^{-3}$ ) Hz                        | Direct frequency measurement using calibrated frequency counters along with primary standard, GPS 10RBN.<br>All kinds of Rubidium Frequency Standards and frequency converters are calibrated through this scheme of practice for all available outputs and time basis within T&FMD's range of calibration.   |
| <b>Frequency (Measure)</b>     | 10 Hz to 18GHz   | ( $8.0 \times 10^{-3}$ to $1.4 \times 10^{-1}$ ) Hz                        | Direct frequency measurement using calibrated frequency source / Generator along with primary standard, GPS 10RBN is used.<br>All kinds of General Frequency counter: Universal Counter, Microwave Counter etc. are calibrated through this scheme of practice within T&FMD's range of calibration and time bases (5MHz, 10 MHz etc.) if available. |
| <b>Time Interval (Measure)</b> | 5 s to 28800 s   | ( $9.0 \times 10^{-3}$ to $1.0 \times 10^{-2}$ ) Hz                        | Using second ticks of Master clock of PST drawn from calibrated Rubidium Frequency standard.<br>All kinds of stopwatches, timers, up / down counters etc. are calibrated through this scheme of practice within T&FMD's range of calibration  |

| <b><i>Field of measurement: vii) TIME AND FREQUENCY MEASUREMENTS</i></b> |   |  |   |
|--|---|--|---|
| <b>Measured quantity</b>   | <b>Range</b>                                  | <b>Calibration &amp; Measurement Capability (CMC) expressed as an uncertainty (<math>\pm</math>)</b> | <b>Brief description of measurement and equipment used</b>  |
| Pressure   | i) (0.1 to 1100) bar                          | 0.017 bar  | <p><b>a.</b> Pressure Gauge and dead weight testers are calibrated.</p> <p><b>b.</b> Instruments used: Dead weight pressure tester and references gauges.</p> <p><b>c.</b> Pressure gauge and dead weight pressure testers are calibrated.</p> <p><b>d.</b> Instruments used: HDWT and references gauges,</p> <ul style="list-style-type: none"> <li>• Pneumatic calibrator, pressure switches, pressure module and pneumatic pressure gauges.</li> <li>• Vacuums gauges, pressure gauges and pneumatic calibrators are calibrated.</li> </ul> <p>Instruments used: Digital Calibrator.</p> |
|  | ii) (10 to 18000) psi                         | 0.02 psi   |   |
|  | iii) ( -1 to 20) bar                          | 0.01 bar   |   |
|  | iv) 0 to 20 bar                               | 0.005 bar  |   |
|  | v) (10 to 10000) psi                          | (0.005-0.01) psi   |   |
| <b><i>Field of measurement: (viii) VISCOSITY MEASUREMENTS</i></b>        |   |  |   |
| UBBELOHDE<br>Viscometer Calibration                                      | (0.03 to 500) mm <sup>2</sup> s <sup>-2</sup> | (0.3 – 1.8) %  | ASTM D 445-97 Viscosity Standard oils   |

| <b>Field of measurement: (ix) CONDUCTIVITY MEASUREMENTS</b> |                              |  |  |
|---|------------------------------|--|--|
| <b>Measured quantity</b>                                    | <b>Range</b>                 | <b>Calibration &amp; Measurement Capability (CMC) expressed as an uncertainty (<math>\pm</math>)</b> | <b>Brief description of measurement and equipment used</b>         |
| Conductivity Meter Calibration                              | 4-10 <sup>6</sup> $\mu$ s/cm | (1410-12800) $\mu$ s/cm  | Calibration of conductivity meters by using KCl standard solution. |
| <b>Field of measurement: (x) pH MEASUREMENTS</b>            |                              |  |  |
| <b>Measured quantity</b>                                    | <b>Range</b>                 | <b>Calibration &amp; Measurement Capability (CMC) expressed as an uncertainty (<math>\pm</math>)</b> | <b>Brief description of measurement and equipment used</b>         |
| pH  | 0-14 pH                      | 0.01 to 0.03   | Standard Buffer solutions / Two point calibration method           |



**PCSIR Labs Complex, Karachi (KLC)**

Testing Laboratory

Annex-XIII

| <i>Materials/<br/>Products tested</i> | <i>Types of test/ Properties<br/>measured</i> | <i>Range of measurement</i> | <i>Minimum<br/>Detection limit</i> | <i>Uncertainty of<br/>Measurement (where<br/>applicable) MU (±)</i> | <i>Standard specification/<br/>Techniques/ Equipment<br/>Used</i>  |
|---------------------------------------|---|-----------------------------|------------------------------------|---|--|
| <b>Food Chemistry</b>                 |   |                             |                                    |   |  |
| Cereal Foods                          | Mosture                                       | 1 % - 99 %                  | 0.5 %                              | 0.28 %  | Air Oven Method<br>AOAC 18 <sup>th</sup> Edition (2005)<br>AOAC Official Methods<br>32.1.03, 925.10  |
|                                       | Protein                                       | 1 % - 99 %                  | 0.2 %                              | 0.28 %  | Kjeldahl Method<br>AOAC 18 <sup>th</sup> Edition (2005)<br>AOAC Official Methods<br>32.1.22, 920.87<br>Total Protein in flour  |
|                                       | Fat   | 1 % - 99 %                  | 0.5 %                              | 0.71 %  | Soxhlet Method<br>AOAC 18 <sup>th</sup> Edition (2005)<br>Crude fat or Ether extract<br>32.2.01, F (4.5.01) 920.39C  |
|                                       | Ash   | 1 % - 99 %                  | 0.1 %                              | 0.35 %  | Direct Method<br>AOAC 18 <sup>th</sup> Edition (2005)<br>Official Methods AOAC<br>32.1.05, 923.03  |
|                                       | Crude Fiber                                   | 0.5 % - 99 %                | 0.1 %                              | 0.52 %  | Weende Method<br>AOAC 18 <sup>th</sup> Edition 2005, Fiber<br>Tech M6 (1020/1021) FOSS<br>AOAC Official Method<br>920.86, (32.1.15)<br>AOAC Official Method<br>950.37, (32.3.16)<br>AOAC Official Method<br>930.24, (32.4.02)<br>AOAC Official Method<br>935.39, (32.5.06) |

|                      |   |                        |            |               |  |
|----------------------|---|------------------------|------------|---------------|--|
|                      | Carbohydrate (by difference)/ Nitrogen free Extract | 1 % - 99 %             | 0.2 %      | 0.5 %         | By Calculation<br>Modern Food Analysis by Hart & Fisher 1971<br>by difference/ Nitrogen Free Extract   |
|                      | Calorific Value/ Energy Value                       | 1 % - 99 %             | 0.2 %      | 0.5 %         | (By Calculation)<br>MacCance & Widdowson's.<br>The composition of Food by Paul & Southgate 4 <sup>th</sup> Ed. 1988                                    |
|                      | Fat   | 1 % - 99 %             | 0.2 %      | 0.11 %        | Acid Hydrolysis Method<br>AOAC Official Method 922.06,<br>Chapter 32.1.14 official method of Analysis AOAC International 18 <sup>th</sup> Edition 2005 |
| Raw/ Processed Foods | Vitamin C   | 3 mg/100g – 10 mg/100g | 1 mg/ 100g | 2 mg/ 100g    | Titrimetric Method<br>Association of Official Analytical Chemists (AOAC) 18 <sup>th</sup> Edition (2005) 45.1.14, Method: 967.21                       |
|                      | Vitamin A   | 90 IU/g – 150 IU/g     | 80 IU/g    | 50.7 µg/100 g | UV-Spectrophotometer<br>Pearson's Composition & Analysis of Food 9 <sup>th</sup> Edition Page 641  |
|                      | Vitamin –C  | 2 mg/100g – 10 mg/100g | 1 mg/ 100g | 2 mg/ 100g    | Titrimetric method<br>AOAC Official Method 985.33,<br>Chapter 50.1.09, Official Methods of Analysis of AOAC Int., 18 <sup>th</sup> Ed. 2005            |

|   |  |                |   |   |  |
|---|--|----------------|---|---|--|
| Red Chili,<br>Rice, Food,<br>Feed &<br>Agriculture<br>Commodities | Aflatoxins B1, B2, G1, G2 &<br>Total Aflatoxin in Food &<br>Feed | Not applicable | LOD 1 µg/kg   | 1.368 ppb<br>1.055 ppb<br>0.487 ppb<br>0.445 ppb<br>0.838 ppb | 1. Thin-layer chromatographic<br>method<br>2. Liquid-Liquid Partiti on<br>chromatography<br>18 <sup>th</sup> Edition (2005)<br>Chapter 49<br>AOAC Official Method<br>(Adapted) 975.36<br>(49.2.08), 968.22 (49.2.08),<br>970.43 (49.1.01), 971.22<br>(49.2.03), 970.44 (49.2.07),<br>968.22 (49.2.02)            |
| Milk & Milk<br>Products   | Aflatoxin M1 in Milk & Milk<br>Products                          | Not Applicable | Aflatoxin<br>M1/conc. in<br>µg/kg (ppb)/<br>1. LOD in fluid<br>milk = 0.05 µg/L,<br>2. LOD Dried<br>milk=0.1<br>µg/kg,<br>3. LOD in<br>cheese =0.1<br>µg/kg | 0.988 ppb   | 1. Thin-layer chromatographic<br>method<br>2. Column Chromatography<br>18 <sup>th</sup> Edition (2005) chapter 49<br>AOAC Official Method<br>(Adapted) 980.21<br>(49.3.02), 974.17 (49.3.01),<br>970.43 (49.1.01), 978.15<br>(49.2.21), 970.44 (49.2.07),<br>968,22 (49.2.08) Aflatoxin M1<br>in Milk and cheese |
| Red Resin,<br>Wheat & Feed  | Ochratoxin 'A'   | Not Applicable | LOD 1 µg/kg   | 0.852 ppb   | 1. Thin-layer chromatographic<br>method<br>2. Column Chromatography<br>Adapted Method of IARC<br>(1982)<br>AOAC 18 <sup>th</sup> Edition (2005)<br>Chapter 49 AOAC Official<br>Method (Adapted)  |

**Microbiology**

|      |                                   |                                  |                |                |   |
|------|-----------------------------------|----------------------------------|----------------|----------------|---|
| Food | Aerobic Plate Count               | 250- 10 <sup>8</sup> cfu/g       | 10 cfu/g       | 0.64 cfu/g     | Bacteriological Analytical Manual, Online USFDA, Chapter # 03 (Jan. 2001), (By Pour Plate Method)             |
|      | Total Coliforms                   | 3 cfu/g – 1100 cfu/g             | 3 cfu/g        | Not applicable | Bacteriological Analytical Manual, Online USFDA, Chapter # 04 (Sept. 2002), (By MPN Multiple Tube Method)     |
|      | Fecal Coliforms                   | 3 cfu/g – 1100 cfu/g             | 3 cfu/g        | Not applicable | Bacteriological Analytical Manual, Online USFDA, Chapter # 04 (Sept. 2002), (By MPN Multiple Tube Method)     |
|      | Mould & Yeast Count               | 10 cfu/g – 10 <sup>5</sup> cfu/g | 10cfu/g        | 0.34 cfu/g     | Bacteriological Analytical Manual, Online USFDA, Chapter # 18 (April 2003), (Spread plate/ pour plate method) |
|      | Salmonella Detection              | Absent/ present                  | Not applicable | Not applicable | Bacteriological Analytical Manual, Online USFDA, Chapter # 05 (Jan. 2001), (Selective enrichment method)      |
|      | Staphylococcus aureus Enumeration | 35 cfu/g - 10 <sup>5</sup> cfu/g | 35 cfu/g       | Not applicable | Bacteriological Analytical Manual, Online USFDA, Chapter # 12 (Jan.2001), (Spread plate method)               |
|      | E.coli in Food                    | 3 cfu/g – 1100 cfu/g             | 3 cfu/g        | Not applicable | Bacteriological Analytical Manual, Online USFDA, Chapter # 04 (Sept. 2002), (MPN Multiple Tube Method)        |

|       |                           |                                    |            |              |   |
|-------|---------------------------|------------------------------------|------------|--------------|---|
| Water | Heterotrophic Plate Count | 30 cfu/ml - 10 <sup>5</sup> cfu/ml | 01 cfu/ dL | 0.37 cfu/ml  | Standard Method for the examination of water & wastewater, 20 <sup>th</sup> Edition 1998, (Pour plate method)   |
|       | Total Coliforms Count     | 1 cru/ml - 10 <sup>4</sup> cfu/ml  | 01 cfu/dL  | 0.14 cfu/ml  | ISO-9308 – 1 Part 1 Membrane filtration Method 2 <sup>nd</sup> Edition, 2000, (Membrane filtration/ MPN Multiple tube method) ISO- 9308 – 2 Part 2 Multiple tube Method 1 <sup>st</sup> Edition, 1990, Membrane filtration Method/ (MPN Multiple tube Method) |
|       | Fecal Coliforms Count     | 1 cfu/dL – 10 <sup>4</sup> cfu/dL  | 01 cfu/dL  | 0.005 cfu/ml | ISO – 9308 – 1 Part 1 Membrane filtration Method 2 <sup>nd</sup> Edition, 2000, (Membrane filtration Method/ MPN Multiple tube method) ISO – 9308 – 2 Part 2 Multiple Tube Method 1 <sup>st</sup> Edition, 1990, (MPN Multiple tube method)                   |
|       | E. Coli in Water          | 1 cfu/dL – 10 <sup>4</sup> cfu/dL  | 01 cfu/dL  | 0.005 cfu/ml | ISO – 9308 – 1 Part 1 Membrane filtration Method 2 <sup>nd</sup> Edition, 2000, (Membrane filtration method / MPN Multiple tube Method) ISO – 938.10– 2 Part 2 Multiple Tube Method 1 <sup>st</sup> Edition, 1990, (MPN Multiple Tube Method)                 |

| Chemical Pharmaceutical                       |                                  |                   |             |   |   |
|---|----------------------------------|-------------------|-------------|---|---|
| Edible Oil and Products Containing Edible Oil | Erucic Acid                      | 0.5% - 5.0%       | 5.0%        | 0.02%   | Validated self developed method<br>KL/PRC/Erucic Acid/ 03 Gas Chromatograph |
| Food/ Pharmaceutical                          | Vitamin E                        | 5 µg – 20mg       | 5 µg – 100g | 0.013 µg/ 100g  | HPLC  |
| Pharmaceutical                                | Vitamin C                        | >2 mg             | 2mg         | 0.0081 mg   | BP 2008 page # 186 – 187<br>Techniques used: Titrimetric Method             |
| Spices & Food containing Spices               | (Sudan I – IV) Absorbance        | 20 ppm – 100 ppm  | 10ppm       | Not applicable  | AOAC, 920.208B (2005) UV Visible Spectrophotometer<br>TLC                   |
| Pickles                                       | Water Activity Equilibrium Water | 0.1 – 1           | 0.08        | 0.0016  | AOAC 978.18 (2005)  |
| Margarine/ Milk Powder, Pharmaceutical        | Vitamin A                        | 7 µg – 0.5mg      | 5 µg        | 0.011 µg  | HPLC  |
| Food/ Pharmaceutical                          | Vitamin D                        | 0.5 µg/g -12 µg/g | 0.5 µg      | 0.06 µg   | AOAC, 2002.2.05 HPLC  |
| Chilli  | Para red                         | 2 ppm – 100 ppm   | 1 ppm       | ± 0.18 ppm  | Validated self developed method<br>KL/PRC/Para red/08                       |
| Spices & Food Containing Spices               | Sudan I,II, III, IV Absorbance   | >0.2ppm           | 0.1ppm      | Sudan:<br>I ± 0.025 ppm<br>II ± 0.08 ppm<br>III ± 0.01 ppm<br>IV ± 0.01 ppm | LC – MS/ MS   |

| Environment            |            |                     |           |           |   |
|------------------------|------------|---------------------|-----------|-----------|---|
| Food (All Commodities) | Lead       | ≥ 0.100 ppm         | 3.000 ppb | 0.155 ppb | AOAC 18 <sup>th</sup> Edition (2005)<br>AOAC Official Method<br>999.10 (9.1.08) |
|                        | Cadmium    | ≥ 0.010 ppm         | 0.200 ppb | 0.034 ppb | AOAC 18 <sup>th</sup> Ed (2005)<br>AOAC Official Method<br>999.10 (9.1.08)      |
|                        | Zinc       | ≥ 0.5 ppm           | 0.010 ppm | 0.039 ppm | AOAC 18 <sup>th</sup> Ed (2005)<br>AOAC Official Method<br>999.10 (9.1.08)      |
|                        | Copper     | ≥ 0.500 ppm         | 0.010 ppm | 0.016 ppm | AOAC 18 <sup>th</sup> Ed (2005)<br>AOAC Official Method<br>999.10 (9.1.08)      |
|                        | Iron       | ≥ 0.2 ppm           | 0.04 ppm  | 5.000 ppm | AOAC 18 <sup>th</sup> Ed (2005)<br>AOAC Official Method<br>999.10 (9.1.08)      |
|                        | Arsenic    | ≥ 0.100 ppm         | 1.000 ppb | 0.025 ppm | AOAC 18 <sup>th</sup> Ed (2005)<br>AOAC Official Method<br>986.15(Sec 9.1.01)   |
|                        | Selenium   | ≥ 0.20 ppm          | 3.0 ppb   | 0.021 ppm | AOAC 18 <sup>th</sup> Ed (2005)<br>AOAC Official Method<br>986.15(Sec 9.1.01)   |
|                        | Mercury    | ≥ 0.100 ppm         | 0.2 ppb   | 6.23 ppm  | AOAC 18 <sup>th</sup> Ed (2005)<br>AOAC Official Method<br>971.21 (Sec 9.2.22)  |
|                        | Pesticides | 0.010 ppm – 005 ppm | 0.001 ppm | 0.002 ppm | AOAC 2005 GC  |
| Water                  | Pesticides | 0.010 ppm – 005 ppm | 0.001 ppm | 0.002 ppm | AOAC 2005 GC  |

| Textile |  |                    |                       |   |   |
|---------|--|--------------------|-----------------------|---|---|
| Fabric  | Colour Fastness to Rubbing                   | Grey Scale (1 – 5) | 1 (Grey Scale Rating) | Change in colour 1/2  | AATCC – 08 (2005)<br>(Change in Colour & Staining)    |
|         | Colour Fastness to Perspiration              | Grey Scale (1 – 5) | 1(Grey Scale Rating)  | Change in colour<br>Acid: 1/2<br>Alkaline: 1/2  | ISO – 105 EO4 (1994)<br>(Change in Colour & Staining) |
|         | Colour Fastness to Water                     | Grey Scale (1-5)   | 1 (Grey Scale Rating) | Change in colour 1/2  | ISO – 105 EO1 (1994)<br>(Change in Colour & Staining) |
|         | Colour Fastness to Sea Water                 | Grey Scale (1 – 5) | 1 (Grey Scale Rating) | Change in colour 1/2  | ISO – 105 EO2 (1994)<br>(Change in Colour & Staining) |
|         | Colour Fastness to Rubbing (Organic Solvent) | Grey Scale (1 – 5) | 1 (Grey Scale Rating) | Change in Colour<br>Warp: 1/2<br>Weft: 1/2<br>Staining<br>Warp:1/2<br>Weft: 1/2               | ISO – 105 DO2 (1993)<br>(Change in Colour & Staining) |
|         | Wrinkle Recovery of Woven Fabrics            | 20° – 180°         | 20° (Angle)           | 2°  | AATCC – 66 (2003)<br>Angle of Recovery                |
|         | Tensile Strength of Fabric (Strip Method)    | 1N – 5 KN          | 1N (Force)            | Warp: 9.0 % of the observed value<br>Weft: 14.9 % of the observed value                       | ISO – 13934 – 1 (1999)<br>Force at Break              |
|         | Tear Strength                                | 1N – 5KN           | 1N (Force)            | Across Warp:<br>15.7 % of the observed value<br>Across Weft:<br>13.40 % of the observed value | ISO – 13937 – 2 (2000)<br>Force at Tear               |



|      |                                   |                               |                     |   |   |
|------|-----------------------------------|-------------------------------|---------------------|---|---|
|      | Fibre Composition/<br>Blend Ratio | % of Cotton % of<br>Polyester | 0.1 %               | % of Cotton: 0.09 %<br>% of Polyester: 0.09 % | ISO 1833, Section 10.<br>(Mixture of Cellulose &<br>Polyester) (1977) Fiber<br>Solubility |
|      | Ends and Picks                    | Numeric Values                | 1 Thread            | Warp: 5.4 thread<br>Warp: 3.9 thread          | ISO – 7211 – 2<br>No. of threads/ Area  |
|      | Pilling (Martindale)              | Numeric Value (1 – 5)         | 1 (Rating)          | 15 % of observed<br>reading                   | ASTM D – 4970 (2002)<br>Fabric Deformation  |
|      | Abrasion (Martindale)             | Numeric Value (1 – 5)         | 1 (Rating)          | 33 % of observed<br>reading                   | ISO – 12947 (1998)<br>Fabric Deformation  |
|      | Spray Rating Tester               | 0 – 100                       | 0 (AATCC<br>Rating) | 1.0   | AATCC - 22 (2005)<br>Water Penetration  |
|      | pH of water Extract               | 4 – 10                        | 2                   | ± 0.084                                       | AATCC – 81 (2001)<br>pH of fabric   |
| Yarn | Count of Yarn                     | English (Ne)/ Denier/<br>Tex  | Not Applicable      | 15 % of observed<br>reading                   | ISO – 7211 – 5 (1984)   |

| Measured quantity | Range            | Calibration & Measurement Capability (CMC) expressed as an uncertainty ( $\pm$ ) | Brief description of measurement and equipment used   |
|-------------------|------------------|--|---|
| Weighing          | 2.0 mg to 1.0 Kg | 0.2 mg to 2.0 mg   | R – 76 – 1 & 2 (OIML)<br>Masses: ASTM Class – 1<br>(1 mg to 10 Kg)<br>Working Class (10 mg to 10 Kg)  |
| Mass/ Weights     | 10 mg to 20 Kg   | 0.01 mg to 0.5 g   | Technique:<br>Direct Comparison<br>1. Set of masses<br>2. Analytical Balance Mettler Toledo AX 205<br>3. Mass comparator Mettler Toledo XP 5003S<br>4. Mass Comparator Mettler Toledo KA 30 – 3/P<br>5. Top Loading Balance, AND GP – 40K |
| Volume            | 1 ml to 2 L      | 0.03 ml to 0.5 ml  | ASTM E – 542 -01<br>Top Loading Balance<br>(i) Ohaus Model AR 3130 and<br>(ii) AND Model GX 6100<br>(iii) Analytical Balance ME 414 Capacity 410 g  |
| Length            | 1 mm to 1000 mm  | 0.01 mm to 1 mm  | Direct Comparison Use<br>Use of gauge blocks Grade 0,<br>Length comparator  |

|             |                   |                       |   |
|-------------|-------------------|-----------------------|---|
| Temperature | -20 °C to 1000 °C | 0.03 °C to 0.8 °C     | <p>ASTM E – 77/84<br/> Low Temperature Hydra Liquid Bath, 7380 Fluke<br/> Dry Block Calibrator Jupiter Make<br/> ISO Tech Model 650B<br/> Dry Block Calibrator Tecal, 650S<br/> Dry Block Calibrator Pegas, ISO Tech<br/> Three Zone Furnace ISO Tech 465<br/> Saturn Thermocouple Calibrator 27152 – 6<br/> Huminator Germany<br/> Multi Function Process<br/> Calibrator Model 725<br/> Make Fluke<br/> Thermocouples S, R T and K type</p> |
| DC Voltage  | 1 mV to 1000V     | 0.001 mV to 1.0 V     | <p>Direct comparison<br/> Universal<br/> Calibration System,<br/> Keithley Model 2002 DMM<br/> Agilent 344401</p>   |
| AC Voltage  | 1 mV to 700 V     | 0.0004 mV to 1.0 V    |   |
| Resistance  | 1 Ω to 300 MΩ     | 0.2 m Ω to 0.0003 M Ω |   |