

HIRODC Postgraduate Training Institute



A Postgraduate - Only Institution



#245

**Advanced Legal – Dynamic Metrology:
NIST, NCWM, EURAMET, WELMEC, and
NPL Compliant**

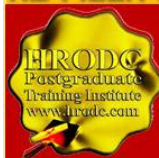
Programme

Leading To:

POSTGRADUATE DIPLOMA IN

Advanced Legal – Dynamic Metrology

HIRODC Postgraduate Training Institute
HQ : 122A Bhylls Lane, Castlecroft, Wolverhampton, West Midlands WV3 8DZ, UK



Prof. Dr. Ronald B. Crawford - Director

PhD (Uni London); M. Ed. M (Bristol); PGCIS (UWL); Adv. Dip. Sc. Ed (Bristol); Dip. Doc.
Res. (Uni Wlv); F.I.M.S.; HR. S. (I.M.S.); Exec. M. AOM; M. AAM; M.I.S.G.S.; M.S.C.O.S.;
M. RG. C.



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Websites:
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HRODC Postgraduate Training Institute, A Postgraduate-Only Institution

Our UK Government's Verification and Registration

Our Institute is Verified by, and Registered with, the United Kingdom (UK) Register of Learning Providers (UKRLP), of the Department for Education (DfE). Its UK Provider Reference Number (UKPRN) is: 10019585 and might be located at: <https://www.ukrlp.co.uk/>.

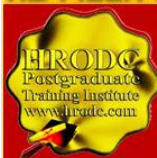
Programme Coordinator:

Prof. Dr. R. B. Crawford is the Director of HRODC Postgraduate Training Institute, A Postgraduate-Only Institution. He has the following Qualifications and Affiliations:

- Doctor of Philosophy {(PhD) {University College London (UCL) - University of London}};
- MEd Management (University of Bath);
- Postgraduate (Advanced) Diploma Science Teacher Ed. (University of Bristol);
- Postgraduate Certificate in Information Systems (University of West London, formerly Thames Valley University);
- Diploma in Doctoral Research Supervision, (University of Wolverhampton);
- Teaching Certificate;
- Fellow of the Institute of Management Specialists;

Advanced Legal-Dynamic Metrology: NIST, NCWM, EURAMET, WELMEC, and NPL Compliant Course - Page 2 of 51

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- Human Resources Specialist, of the Institute of Management Specialists;
- Member of the Asian Academy of Management (MAAM);
- Member of the International Society of Gesture Studies (MISGS);
- Member of the Standing Council for Organisational Symbolism (MSCOS);
- Member of ResearchGate;
- Executive Member of Academy of Management (AOM). There, his contribution incorporates the judging of competitions, review of journal articles, and guiding the development of conference papers. He also contributes to the Disciplines of:
 - Human Resources;
 - Organization and Management Theory;
 - Organization Development and Change;
 - Research Methods;
 - Conflict Management;
 - Organizational Behavior;
 - Management Consulting;
 - Gender & Diversity in Organizations; and
 - Critical Management Studies.

Professor Dr. Crawford has been an Academic in the following UK Universities:

- University of London (Royal Holloway), as Research Tutor;
- University of Greenwich (Business School), as Senior Lecturer (Associate Professor), in Organisational Behaviour and Human Resource Management;
- University of Wolverhampton, (Wolverhampton Business School), as Senior Lecturer (Associate Professor), in Organisational Behaviour and Human Resource Management;
- London Southbank University (Business School), as Lecturer and Unit Leader.


His responsibilities in these roles included:

- Doctoral Research Supervisor;
- Admissions Tutor;
- Postgraduate and Undergraduate Dissertation Supervisor;
- Programme Leader;
- Personal Tutor

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For Whom This Course is Designed

This Programme is Designed For:

- Aviation Maintenance Engineers;
- Department of Trade Technical Team Members;
- Design Engineers;
- Dynamic Metrology.
- Engineering Managers;
- Instrumentation and Control Engineers;
- International Laboratory Standard Setters;
- Legal Petrologists;
- Legal Metrology Enforcement Officers;
- Machine Operators;
- Machinists;
- Manufacturing Engineers;
- Measurement Specialists;
- Mechanical Engineers;
- Metrologists, Generally;
- Metrology Technicians;
- National Air Force Technical Training Managers;
- National Metrology Laboratory Co-ordinators;
- National Physics Laboratory Employees;
- Officials of Department of Commerce;
- Physics Laboratory Metrologists;
- Precision Engineers;
- Process Engineers;
- Quality Control Inspectors;
- Quality Specialists;
- Trading Standards Enforcers;
- Quality Inspectors;
- Weights and Measures Inspectors;
- Quality Engineers and Technicians;

- Quality Managers;
- Regional Metrology Laboratory Directors;
- Scientific Laboratory Assistants;
- Scientific Laboratory Directors;
- Technology Educators;
- Testers;
- Weights and Measures Specialists;
- All others desirous of enhancing their knowledge, skills and expertise in Legal-Metrology.

Classroom-Based Duration and Cost:	
Classroom-Based Duration:	12 Weeks (5 Days per Week)
Classroom-Based Cost:	£45,000.00 Per Student
Online (Video-Enhanced) Duration and Cost	
Online Duration:	20 Weeks – 3 Hours Per Day, 6 Days Per Week
Online Cost:	£30,150.00 Per Student

Classroom-Based Programme Cost includes:

- Free Continuous snacks throughout the Event Days;
- Free Hot Lunch on Event Days;
- Free City Tour;
- Free Stationery;
- Free On-site Internet Access;
- Postgraduate Diploma/ Diploma – Postgraduate –or
- Certificate of Attendance and Participation – if unsuccessful on resit.

Students and Delegates will be given a Selection of our Complimentary Products, which include:

- **Our Branded Leather Conference Folder;**
- **Our Branded Leather Conference Ring Binder/ Writing Pad;**

- **Our Branded Key Ring/ Chain;**
- **Our Branded Leather Conference (Computer – Phone) Bag – Black or Brown;**
- **Our Branded 8-16 GB USB Flash Memory Drive, with Course Material;**
- **Our Branded Metal Pen;**
- **Our Branded Polo Shirt.;**
- **Our Branded Carrier Bag.**

Daily Schedule: 9:30 to 4:30 pm.


Delivery Locations:

- 1. Central London, UK;**
- 2. Dubai, UAE;**
- 3. Kuala Lumpur, Malaysia;**
- 4. Amsterdam, The Netherlands;**
- 5. Brussels, Belgium;**
- 6. Paris, France; and**
- 7. Durban, South Africa;**
- 8. Other International Locations, on request.**

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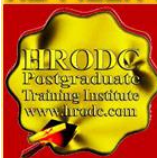
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Advanced Legal-Dynamic Metrology: NIST, NCWM, EURAMET, WELMEC, and NPL Compliant Programme				
Leading to Postgraduate Diploma in Advanced Legal-Dynamic Metrology				
Module Number	Pre-existing Course #	Module Title	Page #	Credit Value
1	89	Legal, Dynamic and Deterministic Metrology: Metrology with ISO 9000 Conformity	7	2
2		Accelerometers: Their Design, Function and Calibration	10	1
3		Advanced Specifications and Tolerances of Standards, and Weights and Measures Program Requirements and Assessment	11	1
4		The Role of the Metrology Laboratory in Maintaining Standard	11	2
5		Specifications and Tolerances for Reference Standards and Field Standard Weights and Measures: National Institute of Standards and Metrology (NIST) and National Conference on Weights and Measures (NCWM) Compliant	15	1
6		European Association of National Metrology Institutes' (EURAMET) Guides: International Metrology Standards Integration or Disintegration	18	2
7		Calibrating Temperature Measuring Instruments and Calibrators, in Legal Dynamic and Determinist Metrology		3

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Advanced Legal-Dynamic Metrology: NIST, NCWM, EURAMET, WELMEC, and NPL Compliant Programme, Programme

Leading to Postgraduate a Postgraduate Diploma in xxxxxxxxx

Programme Contents, Concepts and Issues

Module 1 (Double Credit)

Legal, Dynamic and Deterministic Metrology: Metrology with ISO 9000 Conformity, Leading to Diploma – Postgraduate in Legal, Dynamic and Deterministic Metrology: Metrology with ISO 9000 Conformity (Double Credit)

M1 - Part 1 – Requirements of ISO 9000 Standards for Test and Measuring Equipment

Introduction to, and Relevance of, Metrology

- Three Subfields of Metrology;
- 5 Factors Affecting the Accuracy of the Measuring System;
- Importance of Metrology in International Trade;
- Quality Control – Metrology to Achieve;
- Objectives of Metrology.

Exploring Fundamental Concepts of Metrology

- Measure and Influence Quantity;
- True Value of Quantity;
- Nominal Value and Conventional True Value;
- Process of Measurement;
- Methods of Measurement;
- Measuring System;
- Errors in Measurement;
- Accuracy and Precision.

ISO 9000

- Evolution of ISO 9000 Standards;
- Requirements of ISO 9001: 2000;
- Main Phases Involved in Obtaining ISO 9000 Certification.

M1 - Part 2 – Exploring Fundamental Concept of Metrology

- Calibration of Measurement and Test Equipment;
- Recalibration or Calibration Intervals;
- Recalibration or Calibration Intervals Requirement;
- Sealing Adjusting Mechanisms;
- Handling and Storage of Test Measuring Equipment;
- Managing Calibration Data;
- Documenting Calibration Result;
- Uncovering Out-of-Calibration State.

M1 - Part 3 – Linear and Angular Measurements

Length Measurement

- SI and Other Units;
- Primary Standard;
- Secondary and Working Standards;
 - Measuring Machines;
 - Gauge Blocks.
- Length Measuring Instruments;
- Surface Plate;
- Outside Micrometre;
- Inside Micrometre;
- External and Internal Vernier Calipers;
- Dial Gauge;
- Bore Gauge;
- Depth Gauge;
- Height Gauge;

- Tapes;
- Laser Measuring Systems;
- Coordinate Measuring Machines (CMM).

Calibration of Dimensional Standards and Measuring Instruments

- Effect of Temperature;
- Deformation;
- Force Exerted by the Measuring Instrument;
- The Method of Support of the Test Item;
- Reference Conditions;
- Reference Standard;
- Calibration of Gauge Blocks;
- Calibration of Micrometres;
- Calibration of Vernier Callipers;
- Calibration of Dial Gauge;
- Calibration of Ring Gauges;

Angular Measurement

- SI and other Units;
- Angle Standards;
 - Plane Angle;
 - Side Bar;
 - Indexing Table;
 - Precision Polygon;
 - Angle Gauge;
 - Autocollimator.

M1 - Part 4 – Mass Measurements (1)

Mass Measurements

- Primary Standards and SI Units;
- Secondary and Working Standards;
- Mass and Weight;
- True Mass;
- Air Buoyancy Effects and Apparent Mass;
 - Reference Materials;
 - Conventional Mass Value;
 - Relationship between True Mass and Conventional Mass;
 - Buoyancy Correction.

Types and Classes of Mass Measurements

- Types of Masses;
- Classes of Mass Standards;
- OIML RI-47 Classification;
- ASTM Classification;
- Types and Classes of Balances;
- Two-Pan, Three Knife Edge Balances;
- Single-Pan, Two Knife Edge Balances;
- Electromagnetic Force Compensation Balances;
 - Taring Control;
 - Dual Capacity and Precision;
 - Variable Sampling Period;
 - Filters;
 - Computer Compatibility;
 - Computation;
 - Elimination of Poor Data;
 - Weighing Ferromagnetic Material;
 - Electromagnetic Radiation;

- Dust Susceptibility.
- Mass Comparators.

M1 - Part 5 – Mass Measurements (2)

Industrial Weighing Systems

- Mechanical Systems;
- Electrical Systems;
- Pneumatic Systems;
- Hydraulic Systems;
- Accuracy Classes of Balances.

Calibration of Balances

- Precision Balances;
- Calibration of Direct Reading Electronic Precision Balances;
- Setting Scale Value;
- Repeatability;
- Linearity;
- Off-Centre Loading Effect;
- Hysteresis.

M1 - Part 6 – Pressure Measurements

Introduction to Pressure Measurements

- SI and Other Units;
- Absolute, Gauge and Differential Pressure Modes;
- Primary Standards;
- Spinning Ball Gauge Standard;
- Secondary Standards;
- Working Standards;
- Dead Weight Pressure Tester;
- The Pressure Balance;

- Simple Theory of the Pressure Balance;
- Corrections;
- Temperature Correction;
- Air Buoyancy Correction;
- Fluid Buoyancy Correction;
- Fluid Head Correction;
- Surface Tension Effects;
- Portable Pressure Standard;

Pressure Measuring Instruments

- Mercury Barometers;
- Fortin Barometer;
- Kew Pattern Barometer;
- Precautions for Handling of Mercury Barometers;
- U Tube Manometer;
- Mechanical Deformation Instruments;
- Bourdon Tube Gauge;
- Diaphragm Gauge;
- Piezo Electric Devices.
- Indirect Instruments;
- Thermal Conductivity Gauges;
- Ionization Gauge;
- Bayard Alpert Gauge;
- Penning Gauge;

Calibration of Pressure Standards and Instruments

- Reference Standard;
- Test Uncertainty Ratio;
- Reference Conditions;
- Local Gravity;
- Range of Calibration;
- Recalibration Interval;

- Pipework and Tubing;
- Pressure Medium;
- Instrument Adjustment;
- Calibration of Working Standard Dead Weight Pressure Testers;
- Cross Floating;
- Estimation of Uncertainty;
- Calibration of Vacuum Gauges.

M1 - Part 7 – Measurement of Force

Introduction to Measurement of Force

- SI and Other Units of Measurement;
- PRIMARY Standard;
- Secondary Standards;
- Lever or Hydraulic Force Standard Machines;
- Proving Ring;
- Load Cell;
- Universal Calibrator.

Force Measuring Instruments

- Characteristics of Force Measuring Devices;
- Strain Gauge Load Cell;
- Principle of Operation;
- Elastic Element;
- Resistance Strain Gauge;
- Foil Strain Gauge;
- Semiconductor Strain Gauge;
- Thin Film Strain Gauge;
- Wire Strain Gauge;
- Instrumentation;
- Hydraulic Load Cell;
- Pneumatic Load Cell;
- Elastic Devices;

- Capacitive Load Cell;
- Optical Strain Gauge;
- Magnetic Transducer;
- Vibrating Strings Transducer;
- Piezoelectric Transducer;
- Linear Variable Differential Transducer.

Calibration of Force Standards and Test Instruments

- General Considerations;
- Reference Standard;
- Test Uncertainty Ratio;
- Reference Conditions;
- Range and Scope of Calibration;
- In Situ or Laboratory Calibration;
- Recalibration Interval;
- Verification of Tensile and Compressive Testing Machines;
- Documentary Standards;
- Reference Standard;
- Temperature Equalization;
- Conditioning of the Testing Machine;
- Application of Test Forces;
- Data Analysis;
- Classes of Testing Machine Range.

M1 - Part 8 – Measurement of Temperature

Introduction to Measurement of Temperature

- SI and Units;
- Primary Standards;
- Secondary Standards;
- Working Standards;
- Multifunction Calibrator;
- Output Drift;
- Burden Current;
- Compliance Voltage;
- Protection;
- Output Noise;
- Process Calibrator;

Calibration of a Multifunction Calibrator

- Verification of Calibrator;
- Adjustment of Calibrator;
- Calibration of Multimeters and Other Instruments;
- Analogue Multimeters;
- Types of Digital Multimeters;
- Handheld Type;
- Bench Type;
- Laboratory Type;
- General Calibration Techniques;
- DC Voltage Range;
- AC-DC Converter;
- Resistance Converter Calibration;
- Calibration of Current Converters.

M1 - Part 9 – Electrical Measurement Standards

- SI Units;
- Primary Standards;
- Quantized Hall Resistance Standard;
- Calculable Capacitor;
- Secondary Standards;
- Capacitance and Inductance;
- Working Standards;
- Calibration of a Multifunction Calibrator;
- Calibration of Multimeters and other Instruments;
- Types of Digital Multimeters.

M1 - Part 10 – Uncertainty of Measurements

- Recommendations of the ISO Guide;
- Types of Evaluation;
- Expanded Uncertainty;
- Examples of Uncertainty Calculations;
- Estimation of Combined Standard Uncertainty;
- Effective Degrees of Freedom;
- Calculation of Uncertainty.

Module 2
**Accelerometers: Their Design, Function and Calibration Course,
Leading to Diploma – Postgraduate – in Design, Function and
Calibration of Accelerometers**

M2 – Part 1: Accelerometers: Their Design Principles and Application (1)

- The Concept of Force;
- Distinguishing Between Inertia of Rest and Inertia of Motion;
- The Concept of Speed;
- Speed and Velocity;
- Acceleration and Speed;
- Exploring Accelerometers;
- Accelerometers as a Motion Detectors;
- Accelerometers and Acceleration;
- The Principle of Acceleration Measurements;
- Accelerometers and Velocity Measurements;
- Importance of Accelerometers in Legal Metrology;
- Design Criteria of Accelerometers.

M2 – Part 2: Accelerometers: Their Design Principles and Application (2)

- Use of Accelerometers in Gun-Launched Projectile Guidance;
- Use of Accelerometers in Missile Guidance and Flight Control;
- Use of Accelerometers in Missile Safe-and-Arm;
- Use of Accelerometers in Aircraft Flight Test
- Use of Accelerometers in Launch Vehicle Load
- The Function of Accelerometers in Digital Phones;
- The Use of Accelerometers in Fibre Optics;
- The Use of Accelerometers in Navigational Equipment and Guidance Systems;
- Accelerators as Shock Detectors;
- Accelerometers and Signal Processing;
- The Function of Accelerometers in Smartphones.

M2 – Part 2: Development and Types of Accelerometers

- B&K Hand Held Accelerometers;
- Capacitive accelerometers;
- Pendulous Accelerometers;
- Piezoelectric (PE) Accelerometers;
- Piezoresistive (PR) Accelerometers;
- Resonant Accelerometers;
- Servo Accelerometers
- Thermal Accelerometers
- Tunnelling Accelerometers;
- Unbonded Strain Gage Accelerometers;
- Variable Capacitance Accelerometers;
- Variable Capacitance (VC) Accelerometers.

M2 – Part 3: Calibrating Accelerometers

- Calibration by Minimum-Point Method Laser Interferometry;
- Calibration by Sine-Approximation Method Using Quadrature Laser;
- Interferometry;
- Summary of Uncertainties;
- Performance;
- Super Shaker Characterization.
- Using a Reference Accelerometer to Calibrate Accelerometers;
- Use of Laser as a Calibrating Reference for the Calibration of Accelerometers;
- Using a Handheld Calibrator to Calibrate Accelerometers;
- Back-To-Back Calibration;
- Portable Vibration Calibrator;
- Using the National Institute of Standards and Technology (NIST) Traceable Double-Ended Calibration Standard Accelerometer;
- Using Electrodynamic Shakers to Calibrate Accelerometers;
- Mass Loading Compensation during the Calibration of Accelerometers;

- Calibrating Low Frequency Accelerometers

M2 – Part 4: The Use of Shakers in the Calibration of Accelerometers

- Description of the Shaker Assembly;
- Moveable Magnet Assemblies;
- Moving Element and Carriage Description;
- Shaker Operation;
- Shaker Performance Tests;
- Calibration by Reciprocity;
- Calibration by Laser Fringe-Counting Interferometry;
- Use of Sinusoidal "Shaking Table" to Calibrate Accelerometers;
- Using Portable Pulse-Type Calibrators for the Calibration of Accelerometers;
- Commercial Accelerometer Calibration Workstations;
- Calibration of Accelerometers

M2 – Part 5: Errors and Error-Minimization in Accelerometers

- Errors Caused by Variation in the Output Frequency;
- Errors generated by Recording Circuits;
- Errors resulting from Nonlinearity of Output, resulting from
- Variation of Applied Acceleration at a Fixed
- Frequency;
- Error Resulting from Response to Accelerations
- Applied in A Direction Transverse to The Axis of The Accelerometer

Module 3

Advanced Specifications and Tolerances of Standards, and Weights and Measures Program Requirements and Assessment

M3 – Part 1: Advanced Specifications and Tolerances of Standards (1)

- Specifications and Tolerances for Field Standard Weights (NIST Class F) – 1990;
- Specifications and Tolerances for Field Standard Measuring Flasks – 1996;
- Specifications and Tolerances for Graduated Neck Type Volumetric Field Standards – 2010;
- Specifications and Tolerances for Liquefied Petroleum Gas and Anhydrous Ammonia Liquid Volumetric Provers – 2010;
- Specifications and Tolerances for Field Standard Stopwatches – 1997;
- Specifications and Tolerances for Thermometers – 1997;
- Specifications and Tolerances for Dynamic Small Volume Provers – 1997;
- Specifications and Tolerances for Field Standard Weight Carts – 2003;
- Specifications and Tolerances for Field Standard Weights (NIST Class F) – 1990.

M3 – Part 2: Advanced Specifications and Tolerances of Standards (2)

- Specifications and Tolerances for Field Standard Measuring Flasks – 1996;
- Specifications and Tolerances for Graduated Neck Type Volumetric Field Standards – 2010;
- Specifications and Tolerances for Liquefied Petroleum Gas and Anhydrous Ammonia Liquid Volumetric Provers – 2010;
- Specifications and Tolerances for Field Standard Stopwatches – 1997;
- Specifications and Tolerances for Thermometers – 1997.
- Specifications and Tolerances for Dynamic Small Volume Provers - 1997
- Specifications and Tolerances for Field Standard Weight Carts - 2003

M3 – Part 3: Weights and Measures Program Requirements and Assessment (1)

- The Commercial Measurement System;
- Weights and Measures Laws and Regulations;
- The Regulatory Function of Weights and Measures;
- The Complexity of Weights and Measures Regulation;
- Standards and Units;
- Uniform Laws and Regulations;
- Measuring Instruments (Device) Regulation.

M3 – Part 4: Weights and Measures Program Requirements and Assessment (2)

- Type Evaluation Program;
- Weighmaster Law;
- Method of Sale Regulation;
- Packaging and Labelling Regulation;
- Voluntary Unit Pricing Regulation;
- Registration of Service Companies;
- Price Verification Program;
- Open Dating Regulation;
- Fuel Quality Laws.

Module 4 The Role of the Metrology Laboratory in Maintaining Standard

M4 – Part 1 –Standards and Roles

- Physical Standards;
- Calibration;
- Traceability;
- Recognition and Accreditation of Laboratories;
- Roles of Organizations and Officials;
- The Role of the Fuel Quality Laboratory;
- The Role of Manufacturers of Measuring Instruments;
- The Role of Consumer Product Manufacturers;
- The Role of Service Companies;
- The Role of Weights and Measures Officials.

M4 – Part 2 –General Laboratory Operation and Management

- Location of Weights and Measures withinan Organization;
- Program Scope;
- Program Management;
- Administrative Functions;
- Budget;
- Data Management;
- Uniform Test Procedures;
- Communication Programs;
- Strategic Planning;
- Management Responsibilities;
- Program Funding and Fees;
- Issues in Obtaining Funding.

M4 – Part 3 –Managing the Regulatory Environment

- Scheduling Work Assignments;
- Knowledge and Training;
- Evaluation of Inspector Performance;
- Alternative Approaches to Regulatory Control;
- 100 % Device Inspection;
- Variable Frequency Inspections;
- Risk-Based Device Inspections and Statistical Sampling;
- Integrating Government and Private Sector Inspections;
- Delegating Inspection Responsibilities to Private Companies;
- Witnessed Testing;
- Record System;
- Analysis of Data;
- Examples of Analysis for Retail Motor-Fuel Dispensers;
- Industry Relations;
- Benchmarking.

M4 – Part 4 –Reviewing Exemplars of Instruments and Evidence (1)

- Components of Weights and Measurements Laws;
- Measurement Activities and Instruments;
- Retail Motor Fuel Dispenser Rejection Codes;
- NCWM Device Category Codes;
- Measurement Traceability;
- Inspector Performance Evaluation – Scales;
- Inspector Performance Evaluation - Liquid Meters;
- Comparison of Inspectors' Annual Time;
- Retail Motor Fuel Dispenser Flow Deliver Error Rate;
- Retail Motor Fuel Dispenser Compliance Rate by Manufacturer;
- Noncompliance by Rejection Code, 2006;
- Retail Motor Fuel Fast Flow Error Rates, 2006:
 - Training;
 - Facilities;

- Equipment;
- Standards.
- Advanced LAP Problems;
 - LAP Problem;
 - LAP Problem 2;
 - LAP Problem 3.

M4 – Part 5 – Reviewing Exemplars of Instruments and Evidence (2)

- Establishing Measurement Controls:
 - Process Evaluation;
 - Data Input;
 - Handling the Output.
- Reviewing Mass Code Report;
- Graphs and Control Charts:
 - Critical Graphs;
 - Optional Graphs.
- Proficiency Tests;
- Evaluation Criteria for Proficiency Tests;
 - Verification of Laboratory Values;
 - Verification of the Laboratory Precision.
- File Management;
- Software Management:
 - Distribution;
 - Licensing and Software Quality Assurance;
 - Updating;
 - Approved Weighing Designs.
- Documentation of Standard Operating Procedures;
- Traceability and Calibration Intervals;
- Formulae and Calculations.

M4 – Part 6: Some International and National Metrology Laboratories and Their Contribution to Legal Metrology Standards

- Centre for Metrology and Accreditation (MIKES), Finland;
- European Association of National Metrology Institutes (EURAMET);
- European Legal Metrology (WELMEC);
- Federal Institute of Metrology (METAS), Switzerland;
- International Bureau of Weights and Measures, international body, headquartered in France, one of the bodies that governs SI;
- International Organization of Legal Metrology;
- Joint Committee for Guides in Metrology;
- Korea Research Institute of Standards and Science (KRISS), Republic of Korea;
- National Institute of Standards and Technology (NIST), USA, formerly the National Bureau of Standards;
- National Measurement Institute, Australia;
- National Physical Laboratory (United Kingdom);
- National Physical Laboratory of India;
- Physikalisch-Technische Bundesanstalt;
- Physikalisch-Technische Bundesanstalt, Germany.

Module 5

Specifications and Tolerances for Reference Standards and Field Standard Weights and Measures: National Institute of Standards and Metrology (NIST) and National Conference on Weights and Measures (NCWM) Compliant

M6 – Part 1: Preliminary Issues

- 'Field Standard' Classification;
- Retroactivity;
- Safety Considerations;
- Relevant Units;
- Reference Documents;
- National Institute of Standards and Metrology (NIST): Its History and Function;
- The Remit of the National Conference on Weights and Measures (NCWM).

M6 – Part 2: Terminology and General Specifications (1)

- Pertinent and Definitive Terminologies;
- Weight;
- Materials;
- Workmanship, Finish, and Appearance;
- Design;
- Identification Plate;
- Power;
- Fuel Tank;
- Hydraulic Fluid System;
- Engine Lubricating Oil System;
- Engine Exhaust;
- Tires;
- Wheel Bearings.

M6 – Part 3: Terminology and General Specifications (2)

- Minimum Wheelbase and Track Dimensions;
- Drainage;
- Weight Restraint;
- Weight Cart Transport;
- Lifting Attach Points;
- Adjustment Cavities;
- Brakes;
- Directional Controls;
- Battery;
- Battery Charging Circuit;
- Routine Lubrication;
- Electrical Power Connections;
- Remote Operation.

M6 – Part 4: Understanding and Using Tolerances

- Interpreting and Working with Table of Tolerances;
- Verification Requirements;
- Legal Requirements;
- Initial Verification;
- Periodic Calibration;
- Traceability;
- Calibration Reports;
- Test Methods: Documented Test Procedure.

M6. Part 5: Uncertainties and User Requirements

- Use in Combination with Test;
- Weight Cart Maintenance;
- Weight Cart Maintenance Log;
- Inspection Checklist Verification;
- Weight Cart Cleanliness;
- User Modifications;
- Licensing of Weight Cart Operators;
- Liquid Fuel Powered Weight Cart Configurations;
- Electrically Powered Weight Cart Configurations;
- Example Fuel Tank Drawing;
- Daily Weight Cart Inspection Checklist.

Module 6

European Association of National Metrology Institutes' (EURAMET) Guides: International Metrology Standards Integration or Disintegration?

M6 Part 1: Legal Metrology and The European Directive (1)

- 2004/22/EC vs. OIML R 99-1 & 2 - 2008;
- An Application of Directives 75/106/EEC and 76/211/EEC concerning the marking and quantity control of e-marked prepackages: Translation of terms;
- Application of Directives 75/106/EEC and 76/211/EEC concerning the marking and quantity control of e-marked prepackages: Definition of terms;
- Directive 90/384/EEC - Explanation and Interpretation;
- Directive 90/384/EEC: Common Application;
- Elements for deciding the appropriate level of confidence in regulated measurements.

M6 Part 2: Legal Metrology and The European Directive (2)

- European Directory of Legal Metrology;
- General and Administrative Aspects of the Voluntary System of Modular Evaluation of Measuring Instruments;
- Guidance for Market Control on Prepackages for Competent Departments;
- Guidance for Prepackages whose Quantity Changes after Packing;
- Guidance for the Harmonized Implementation of Council Directive 76/211/EEC;
- Guidance for the Verification of Drained Weight, Drained Washed Weight and Deglazed Weight and Extent of Filling of Rigid Food Containers;
- Guidance on Controls by Competent Department's on "e" marked Prepackages;
- Guidance to the application of Measuring Instruments Directive 2004/22/EC (MID) on measuring instruments;
- Guide for Common Application of Marking of Fuel Dispensers;
- Guide for common application of MID MI-005 and OIML R117-1, (R81, R80, R139).

M6 Part 3: Measuring Instruments Guide (1)

- Guide for Conversion of NAWI (Indicators) Test Results for AWI Purposes;
- Guide for Examining Software;
- Guide for Load Cells;
- Guide for Measuring Instruments Directive 2004/22/EC Application of Module H1;
- Guide for Measuring Instruments Directive 2004/22/EC Area Measuring Instruments Corresponding Tables OIML R 136-1 2004– MID-009 III;
- Guide for Measuring Instruments Directive 2004/22/EC Automatic Gravimetric Filling Instruments Corresponding Tables OIML R 61-1 2004 – MID-006 III;
- Guide for Measuring Instruments Directive 2004/22/EC Automatic Rail Weighbridges Corresponding Tables OIML R 106-1 1997– MID-006 VI;
- Guide for Measuring Instruments Directive 2004/22/EC Capacity Serving Measures Corresponding Tables OIML R 138 2007 – MID-008 II;

- Guide for Measuring Instruments Directive 2004/22/EC Continuous Totalizers
Corresponding Tables OIML R 50-1 1997– MID-006 V;
- Guide for Measuring Instruments Directive 2004/22/EC Discontinuous Totalizers
Corresponding Tables OIML R 107-1 1997– MID-006 IV;
- Guide for Measuring Instruments Directive 2004/22/EC Gas Meters.

M6 Part 4: Measuring Instruments Guide (2)

- Corresponding Tables OIML R 137-1 2006– MID-002;
- Guide for Measuring Instruments Directive 2004/22/EC Heat Meters
Corresponding Tables OIML R 75-1 and R 75-2 2002 – MID-04;
- Guide for Measuring Instruments Directive 2004/22/EC Length Measuring Instruments Corresponding Tables OIML R 66 1985– MID-009 II;
- Guide for Measuring Instruments Directive 2004/22/EC Multidimensional Measuring Instruments Corresponding Tables OIML R 129 2000 - MID-009 IV;
- Guide for Measuring Instruments Directive 2004/22/EC Taximeters Corresponding Tables OIML R 21 2007 – MID-007 II;
- Guide for Measuring Instruments Directive 2004/22/EC,
Common Application for utility meters;
Guideline on time depending consumption measurements for billing purposes (interval metering);
- Guide for Modular Approach and Testing of PCc and other Digital Peripheral Devices;
- Guide for Notified Bodies performing Conformity Assessment of Measuring Instruments;
- Guide for Pattern Examination;
- Guide for recognition of procedures;
- Guide for Sealing of Fuel Dispensers (Measuring Systems for Liquids other than Water);
- Guide for sealing of Utility meters;
- Guide for Testing Indicators.

M6 Part 3: Guide to Testing Electronic Calculators and Automatic Catch weighing Instruments

- Guide for Testing of Electronic Calculators with Conversion Function and Conversion Devices;
- Guide for Testing Point of Sale Devices;
- Guide for the testing of automatic catch weighing instruments;
- Guide for the use of an alibi recording device (printer or memory) in Measuring Systems for Liquids other than Water;
- Guide for Exhaust Gas Analyzer Cross Reference Table;
- Guide on Directive 75/107/EEC Measuring Container Bottles;
- Guide on evaluating purely digital self-service devices for direct sales to the public;
- Guide to Metrological Devices for Transferring Measured Quantities (DTMQ) associated to bottom loading measuring systems;
- Market Surveillance Guide (NAWI and MID);
- Measuring Instruments Directive (2004/22/EC): Common Application – Capacity Serving Measures (CSM);
- Measuring Instruments Directive (2004/22/EC): Guide for generating sampling plans for statistical verification according to Annex F and F1 of MID 2004/22/EC; Guide for Measuring Instruments Directive 2004/22/EC Water Meters Corresponding Tables OIML R 49 2006 and R 49-2 2004 – MID-001;
- Measuring Instruments Directive 2004/22/EC - Assessment of Notified Bodies Designated for Module F based on EN ISO/IEC 17020.

M6 Part 3: Automatic Catchweighers, Quality System, Software, Uncertainties and Risk Assessment Guides

- Measuring Instruments Directive 2004/22/EC Automatic Catchweighers; Corresponding Tables OIML R 51-1 2006 – MID-006 II;
- Measuring Instruments Directive 2004/22/EC, Application of Module B;
- Measuring Instruments Directive 2004/22/EC, Application of Module D;
- Measuring Instruments Directive 2004/22/EC, Assessment of Notified Bodies in Charge of Type Examination Presumption of Conformity based on EN 45011;

Advanced Legal-Dynamic Metrology: NIST, NCWM, EURAMET, WELMEC, and NPL Compliant Course - Page 32 of 51

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- Measuring Instruments Directive 2004/22/EC, Generalities on the Assessment and Operation of Notified Bodies performing Conformity Assessment;
- Measuring Instruments Directive 2004/22/EC, Presumption of Conformity of the Quality System of Manufacturers with Module D or H 1 when EN ISO 9001:2000 is applied;
- Measuring system for the continuous and dynamic measurement of quantities of liquids other than water - Cross Reference Table 2004/22/EC vs. OIML R 117-1 – 2007;
- Prepackages - Uncertainty of Measurement;
- Risk Assessment Guide for Market Surveillance: Weigh and Measuring Instruments;
- Software Guide (Measuring Instruments Directive 2004/22/EC);
- Software Requirements based on the Measuring Instruments Directive (MID);
- Terms and definitions in MID and their relation to terms defined in other international metrologically relevant documents;
- Volume conversion devices Cross Reference Table 2004/22/EC vs. OIML R 140 – 2007.

Module 7

Calibrating Temperature Measuring Instruments and Calibrators, in Legal, Dynamic and Determinist Metrology Course, Leading to Diploma – Postgraduate – in Calibrating Temperature Measuring Instruments and Calibrators, in Legal, Dynamic and Determinist Metrology (Triple Credit)

M7. Part 1 – Temperature Measurement Principles

- Thermistors and their Function;
- The Principles of Thermistors as Temperature Sensors;
- Practical Applications of Thermistors;
- Temperature Measurement as an Issue for Metrologists;
- SI and Units;
- Primary Standards;
- Secondary Standards;
- Working Standards;

- The International Temperature Scale - 1990 (ITS-90);
- Thermometers and Thermocouples as Temperature Measuring Devices;
- Differences between Thermometers and Thermocouples;
- Temperature-Sensitive Resistance Vs Voltage Generation;
- How are Readings from Thermometers Made?

M7. Part 2: Thermometer Types and the International Temperature Scale of 1990 (ITS-90) (1)

Types of Thermometers

- Contact Thermometers
- Non-Contact Thermometers

Contact Thermometers

- Contact Liquid-in-glass Thermometers;
- Contact Electrical Thermometers:
 - Contact Electrical Resistance Thermometers;
 - Contact Electrical Thermocouples

Features of Contact Thermometers

- Advantages of Contact - Liquid-In-Glass Thermometer
 - Simplicity and Stability;
 - Portability;
 - Low Cost.
- Disadvantages of Contact - Liquid-In-Glass Thermometer
 - Limited accuracy and temperature range covered
 - Requires visual reading and is not easy to automate
- Main Features of Thermocouples:
 - Simple;
 - Rugged in Protective Metal Cables;
 - Small;
 - Inexpensive;

- Wide Temperature Range.

M7. Part 3: Thermometer Types and the International Temperature Scale of 1990 (ITS-90) (2)

Non-Contact Thermometers

- Infra-Red Radiation Thermometers
- Use of Standard Platinum Resistance Thermometers Between Fixed Points, and Varied Range Points on ITS-90;
- Exploring Temperature Range, from the Triple Point of Hydrogen, at 13.8033 K, to the Freezing Point of Silver, at 961.78 °C;
- Exploring Standard Platinum Resistance Thermometers (SPRTs);

M7. Part 4: Resistance Temperature Detectors (RTDs) Compared with Thermocouples and Thermistors.

- Thermocouples: Their Properties, Use and Limitations;
- Thermistor Types;
- Thermistor Output Circuits;
- Thermistors' Value
- Thermistors' Suitability for Use;
- Limitations of Thermistors' Use in Thermometry;
- Analysis of the Use of Copper as a Resistance Temperature Detector;
- Nickel-Iron as a Resistance Temperature Detector;
- Nickel as a Resistance Temperature Detector;
- DIN Nickel as a Resistance Temperature Detector;
- The Place of Platinum as a Resistance Temperature Detector.

M7. Part 5: Calibration of Temperature Measuring Instruments

- Exploring Temperature Calibration;
- Multifunction Calibrator;
- Output Drift;

- Burden Current;
- Compliance Voltage;
- Protection;
- Output Noise;
- Process Calibrator;
- What is a Reference Thermometer or Standard Thermometer?
- Deconstructing Temperature Calibration;
- What is involved in Temperature Calibration
- Temperature Sensors and their Calibration;
- Uncertainties Associated with Temperature Calibration;
- Using Temperature Reference Thermometers for Temperature Measuring Instrument Calibration;
- Using Temperature Reference Baths for Temperature Measuring Instrument Calibration.

M7. Part 6: High-Precision Temperature Measuring Instrument Calibration: Field, Laboratory and Fixed-Point Temperature Calibration (1)

Field Temperature Calibration

- Industrial or Portable Temperature Calibration;
- Thermometers Being Tested Outside of a Laboratory Environment,
- Aiming at Temperature Accuracies of 5 °C to 0.5 °C;
- Calibrating Using Dry-Wells;
- Calibrating with Metrology Wells;
- Using Micro-Baths;
- Using Ir Targets;
- Using Other Portable Heat Sources for Temperature Calibration;
- Using Portable Thermometer Readouts as Reference Temperatures;
- Using Thermometer Standards as Reference Temperatures;
- Comparing the Accuracy of Heat Sources with Portable Thermometer Readouts and Temperature Standards

M7. Part 7: High-Precision Temperature Measuring Instrument Calibration: Field, Laboratory and Fixed-Point Temperature Calibration (2)

Laboratory or Secondary Temperature Calibration:

- Calibration of Reference-Grade PRT or PT-100,
- Precision Thermistors,
- Noble-Metal Thermocouples.
- Ultra-stable Temperature Baths;
- Uniform Temperature
- Horizontal Furnaces (for the High Temperatures needed by Thermocouples);
- SPRT Reference Thermometers;
- high-accuracy thermometer readouts.
- Towards Temperature Calibration Accuracies of 0.5 °C to 0.02 °C.

M7. Part 8: High-Precision Temperature Measuring Instrument Calibration: Field, Laboratory and Fixed-Point Temperature Calibration (3)

Fixed-Point or Primary Temperature Calibration;

- Using Fixed-Point Cells for Temperature Calibration,
- Using Triple Point of Water,
- National Institute of Standards and Technology (NIST) temperature Range Selection;
- Using Noble-Metal Thermocouples to 0.001 °C Calibration Accuracy
- Industrial Temperature Calibration
- Automatic Temperature Calibration;
- Industrial Temperature Calibration: Traceable Calibration
- Temperature Calibration Software.

M7. Part 9: Temperature Calibration Uncertainty (1)

- Deconstructing Measurement Uncertainty;
- Distinguishing Measurement Error from Uncertainty of Measurement;
- Methods for Determining Measurement Uncertainty;
- Expressing Uncertainty of Measurements;
- The Monte Carlo Method That Is Used to Assess Uncertainty;
- The Effect of the Environment on Temperature Measurement Uncertainty,
- The Effect of Air Pressure on the Temperature Measurement Uncertainty;
- The Effect of Humidity on Temperature Measurement Uncertainty;
- The Uncertainty of Radiation Thermometers;
- Example of Temperature Uncertainty Calculation;
- Uncertainties Components Linked to Reference Standard;
- Uncertainties Linked to Instrument Under Calibration;
- Uncertainties Linked to Data Acquisition for Temperature Calibration;
- Uncertainties Components Linked to Temperature Bath;
- Combined Standard Uncertainty in Temperature Calibration;
- Using Dry Block to Calculate the Total Uncertainty of Temperature Calibration.

M7. Part 10: Temperature Calibration Uncertainty (2)

- Using an External Reference Sensor for the Calculation of the Uncertainty of Temperature Calibration;
- Deconstructing Metrology Wells;
- Uncertainty of Metrological Wells;
- Uncertainty of the Reference Thermometer Inputs of Metrological Wells;
- Axial Uniformity of Metrological Wells and its Implications for Temperature Calibration;
- Continuing Stability of Metrological Wells;
- Stem conduction Error in Metrological Wells;
- Uncertainty of Air Temperature Measurements;
- New Generation Temperature Sensors for Reduced Temperature Uncertainty Levels;

- Equipment Developments: Improving Temperature Measurement Accuracies;
- Improving Short-term Stability During Calibrations;
- Improving Chamber Uniformity During Calibrations;
- Using of A Sub-Chamber to Reduce Fluctuations Associated with Climatic Chamber Control Cycles.

M7. Part 11: Platinum and Platinum Resistant Thermometers (PRTs) 1

Platinum (Pt)



- Platinum and its Physical Characteristics:
 - Color;
 - Luster;
 - Transparency;
 - Cleavage;
 - Fracture;
 - Hardness;
 - Specific Gravity;
 - Streak;
 - Tenacity.

- The Chemical Properties of Platinum:
 - Atomic number;
 - Atomic mass;
 - Electronegativity according to Pauling;
 - Density;
 - Melting point;
 - Boiling point;

- Vander Waals Radius;
 - Ionic Radius;
 - Isotopes;
 - Electronic Shell;
 - Energy of first Ionization;
 - Energy of Second Ionization.
- Platinum and its General Uses:
- In Electronics and Scientific Apparatus.
 - As Jewelry.
 - In Dentistry.
 - As Catalyst in Petroleum Refining.
 - In Car Exhaust Anti-Pollution Devices.
 - In Platinum Resistance Thermometers.
- Platinum Properties Lending to its use in Thermometers.

M7. Part 12: Platinum and Platinum Resistant Thermometers (PRTs) 2

- Platinum Resistant Thermometers (PRTs);
- Temperature Measurement Range of Platinum Resistant Thermometers (PRTs)
- Using Standard Platinum Resistance Thermometer (SPRT) Calibrations
- Resistance Values of Platinum Resistant Thermometers (PRTs) and their Temperature Measuring Capabilities:
 - Thermometers with Pt100 Temperature Probes;
 - Thermometers with Pt500 Temperature Probes;
 - Thermometers with Pt1000 Temperature Probes.
- Wire Core of Platinum Resistance Thermometers and its Significance for Error Creation or Elimination;
- The Dual Core (2-wire) Platinum Resistance Thermometers (PRTs);
- The Triple Core (3-wire) Platinum Resistance Thermometers (PRTs);
- The Quad Core (4-wire) Platinum Resistance Thermometers (PRTs);
- BS EN 60751 Color Coding for the Wiring PRTs.

M7. Part 13 - Types of Standard Platinum Resistance Thermometers (SPRTs): Their Configuration and Use:

- The Helium-Filled Capsule-Type (cSPRT) Thermometers;
- The Long-Stem SPRT;
- Special High-Temperature SPRTs.
- Industrial Platinum Resistance Thermometer Sensors;
- The Place of Negative Temperature Coefficient (NTC) Thermistors in Resistance Thermometers.

M7. Part 14: Pyrometers and Their Role in Temperature Measurements

- Guiding Principles of Pyrometry;
- Advantages of Pyrometers in Temperature Measurements;
- Types of Pyrometers:
 - Optical pyrometers;
 - Infrared / Radiation Pyrometers.

M7. Part 15 - Radiation Thermometry (Infrared Thermometry/ Radiation Pyrometry): Its Use, Problems and Solutions

- Advantages of Infrared (IR) Thermometers;
- Determining Emissivity in IR Temperature Measurements;
- Measuring Metals with IR Thermometers;
- Measuring Plastics with IR Thermometers;
- Measuring Glass with IR Thermometers;
- Measuring Ambient Conditions with IR Thermometers
- Measuring Optics with IR Thermometers;
- Measuring Windows with IR Thermometers
- Detectors
- Displays and Interfaces of IR Thermometers;
- Disadvantages of Radiation Pyrometers:

- Simultaneous dependence on Surface Temperature and its Emissivity;
- Emissivity Dependent on The Material Type and Its Surface Condition;
- Error Caused by Radiation Emission by heated Objects and Lighting on Object Surface;
- Imperfections in The Optics Used to Focus the Radiation on the Detector Might Obscure the Field of View, resulting in Calibration Error.

Use of Special Pyrometers

- The Principles and Use of Fiber-optic Pyrometer Thermometers;
- Understanding and Using Ratio Pyrometer Thermometers.
- Errors Inherent in Resistance Thermometers.

M7. Part 16 – Non-Contact Thermal Imaging and Thermography: Analysis of Its Thermal Imaging Application

- Use in Surveillance;
- Night Vision Aid;
- Search and Rescue
- Building and Land Surveying
- Aircraft and Missile Tracking
- Ideal for Detecting Hot Spots Due to Failure in Electrical Equipment;
- Immensely Important in Electronic Circuits;
- Use in Non-Contact Medical Infrared Thermography.

M7. Part 17: Positive and Negative Features of 2-Dimensional Radiation Thermometers

- Fixed Installations,
- Portable Devices;
- Hand-Held devices;
- Attributes for Long Focal Distance;
- Focal Orientation Towards Close Objects;
- Improved Affordability;
- Thermal Measurement Accuracy;

- Highly Accurate Temperature Measurement;
- Prone to The Emissivity Error;
- Subject to Reflected Radiation Error;
- Source-Size Error.

Postgraduate Diploma, Postgraduate Certificate, and Diploma – Postgraduate - Short Course Regulation

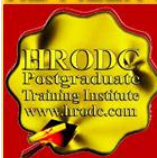
Postgraduate Certificate, Postgraduate Diploma, and Diploma – Postgraduate: Their Distinction, Credit Value and Award Title

Postgraduate Short Courses of a minimum of five days' duration, are referred to as Diploma – Postgraduate. This means that they are postgraduate credits, towards a Postgraduate Certificate and Postgraduate Diploma. Postgraduate Certificate and Postgraduate Diploma represent Programmes of Study, leading to Awards bearing their title prefixes. While we refer to our short studies, of 5 days to five weeks, as 'Courses', those with duration of 6 weeks and more are labelled 'Programmes'. Nevertheless, in line with popular usage, we often refer to all study durations as 'Courses'. Another mark of distinction, in this regard, is that participants in a short course are referred to as 'Delegates', as opposed to the term 'Students', which is confined to those studying a Postgraduate Programme.

Courses are of varying Credit-Values; some being Single-Credit, Double-Credit, Triple-Credit, Quad-Credit, 5-Credit, etc. These short courses accumulate to Postgraduate Certificate, with a total of 180 Credit-Hours (= 6 X 5-Day Courses or 3 X 10-Day Courses), or Postgraduate Diploma, with a total of 360 Credit-Hours (= 12 X 5-Day Courses or 6 X 10-Day Courses).

Delegates studying courses of 5-7 days' duration, equivalent to 30-42 Credit-Hours (Direct Lecturer Contact), will, on successful assessment, receive the Diploma – Postgraduate Award. This represents a single credit at Postgraduate Level. While 6-day and 7-day courses also lead to a Diploma – Postgraduate, they accumulate 36 and 42 Credit Hours, respectively.

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Postgraduate Certificate, Postgraduate Diploma, and Diploma – Postgraduate Assessment Requirement

Because of the intensive nature of our courses and programmes, assessment will largely be in-course, adopting differing formats. These assessment formats include, but not limited to, in-class tests, assignments, end of course examinations. Based on these assessments, successful candidates will receive the Diploma – Postgraduate, Postgraduate Certificate, or Postgraduate Diploma, as appropriate.

In the case of Diploma – Postgraduate, a minimum of 70% overall pass is expected. In order to receive the Awards of Postgraduate Certificate and Postgraduate Diploma, candidates must have accumulated at least the required minimum 'Credit-Hours', with a pass (of 70% and above) in at least 70% of the courses taken.

Delegates and students who fail to achieve the requirement for Postgraduate Certificate, Postgraduate Diploma, or Diploma - Postgraduate - will be given support for 2 re-submissions for each course. Those delegates who fail to achieve the assessment requirement for the Postgraduate Diploma or Diploma - Postgraduate - on 2 resubmissions, or those who elect not to receive them, will be awarded the Certificate of Attendance and Participation.

Diploma – Postgraduate, Postgraduate Certificate, and Postgraduate Diploma Application Requirements

Applicants for Diploma – Postgraduate – Postgraduate Certificate, and Postgraduate Diploma are required to submit the following documents:

- Completed Postgraduate Application Form, including a passport sized picture affixed to the form;
- A copy of Issue and Photo (bio data) page of the applicant's current valid passport or copy of his or her Photo-embedded National Identity Card;
- Copies of credentials mentioned in the application form.

Admission and Enrolment Procedure

- On receipt of all the above documents we will assess applicants' suitability for the Course or Programme for which they have applied;
- If they are accepted on their chosen Course or Programme, they will be notified accordingly and sent Admission Letters and Invoices;
- One week after the receipt of an applicant's payment or official payment notification, the relevant Course or Programme Tutor will contact him or her, by e-mail or telephone, welcoming him or her to HRODC Postgraduate Training Institute;
- Those intending to study in a foreign country, and require a Visa, will be sent the necessary immigration documentation, to support their application;
- Applicants will be notified of the dates, location and venue of enrolment and orientation, where appropriate.

Modes of Study and Duration of Postgraduate Certificate and Postgraduate Diploma Programmes

There are two delivery formats for Postgraduate Certificate and Postgraduate Diploma Programmes, as follows:

1. Intensive Full-time (Classroom-Based) Mode, lasting 3 months for Postgraduate Diploma, and 6 weeks for Postgraduate Certificate. These durations are based on six hours' lecturer-contact per day, five days (30 hours) per week, for Postgraduate Diploma.
2. Video-Enhanced On-Line Mode. This interactive online mode lasts twenty (20) weeks, for Postgraduate Diploma, and ten (10) weeks for Postgraduate Certificate. Our calculation is based on three hours per day, six days per week.

Whichever study mode is selected, the aggregate of 360 Credit Hours must be achieved.

Introducing Our Video-Enhanced Online Study Mode

In a move away from the traditional online courses and embracing recent developments in technology-mediated distance education, HRODC Postgraduate Training Institute has introduced a Video-Enhanced Online delivery. This Online mode of delivery is revolutionary and, at the time of writing, unique to HRODC Postgraduate Training Institute.

You are taught as individuals, on a one-to-one or one-to-small-group basis. You see the tutor face to-face, for the duration of your course. You will interact with the tutor, ask and address questions; sit examinations in the presence of the tutor. It is as real as any face-to-face lecture and seminar can be. Choose from a wide range of Diploma – Postgraduate Courses and an increasing number of Specialist Postgraduate Certificate and Postgraduate Diploma Programmes. You might also accumulate Postgraduate Short Courses, via this mode of study, over a 6-year period, towards a Postgraduate Certificate or Postgraduate Diploma.

Key Features of Our Online Study: Video-Enhanced Online Mode

- The tutor meets the group and presents the course, via Video, in a similar way to its classroom-based counterpart.
- All participants are able to see, and interact with, each other, and with the tutor;
- They watch and discuss the various video cases and demonstrations that form an integral part of our delivery methodology.
- Their assessment is structured in the same way as it is done in a classroom setting;
- The Video-Enhanced Online mode of training usually starts on the 1st of each month, with the cut-off date being the 20th of each month, for inclusion the following month;
- Its duration is twice as long as its classroom-based counterpart. For example, a 5-day (30 Credit Hours) classroom-based course will last 10 days, in Video-Enhanced Online mode. This calculation is based on 3 hours tuition per day, adhering to the Institute's required 30 Credit-Hours;
- The cost of the Video-Enhanced Online mode is 67% of similar classroom-based courses;

- For example, a 5-day classroom-based course, which costs Five Thousand Pounds, is only Three Thousand Three Hundred and Fifty Pounds (£3,350.00) in Video-Enhanced Online Mode.

10-Week Video-Enhanced Online Postgraduate Certificate and 20-Week Video-Enhanced Online Postgraduate Diploma

You might study an Online Postgraduate Certificate or Online Postgraduate Diploma, in 10 and 20 weeks, respectively, in the comfort of your office or homes, through HRODC Postgraduate Training Institute's Video-Enhanced Online Delivery. We will deliver the 180 Credit-Hours and 360 Credit-Hours, in line with our regulation, through 'Direct-Lecturer-Contact', within the stipulated timeframe. We aim to fit the tuition around your work, family commitment and leisure, thereby enhancing your maintenance of an effective 'work-study-life-style balance', at times convenient to you and your appointed tutor.

Cumulative Postgraduate Certificate and Postgraduate Diploma Courses

All short courses can accumulate to the required number of Credit-Hours, for the Postgraduate Certificate and Postgraduate Diploma, over a six-year period from first registration and applies to both general and specialist groupings. In this regard, it is important to note that short courses vary in length, the minimum being 5 days (Diploma – Postgraduate) – equivalent to 30 Credit Hours, representing one credit, as is tabulated below.

On this basis, the definitive calculation on the Award requirement is based on the number of hours studied (aggregate credit-value), rather than merely the number of credits achieved. This approach is particularly useful when a student or delegate studies a mixture of courses of different credit-values.

For those delegates choosing the accumulative route, it is advisable that at least one or two credits be attempted each year. This will ensure that the required 180 Credit-Hours and 360 Credit-Hours, for the Postgraduate Certificate and Postgraduate Diploma, respectively, are

Advanced Legal-Dynamic Metrology: NIST, NCWM, EURAMET, WELMEC, and NPL Compliant Programme, Leading to Postgraduate Diploma in Advanced Legal-Dynamic Metrology achieved, within the designated period. These Credit-Values, awards and their accumulation are exemplified below.

Examples of Postgraduate Course Credits: Their Value, Award Prefix & Suffix – Based on 5-Day Multiples		
Credit Value	Credit Hours	Award Title Prefix (& Suffix)
Single-Credit	30-54	Diploma - Postgraduate
Double-Credit	60-84	Diploma – Postgraduate (Double-Credit)
Triple-Credit	90-114	Diploma – Postgraduate (Triple-Credit)
Quad-Credit	120-144	Diploma – Postgraduate (Quad-Credit)
5-Credit	150-174	Diploma – Postgraduate (5-Credit)
6-Credit	180-204	Postgraduate Certificate
7-Credit	210-234	Postgraduate Certificate (+ 1 Credit)
8-Credit	240-264	Postgraduate Certificate (+2 Credits)
9-Credit	270-294	Postgraduate Certificate (+3 Credits)
10-Credit	300-324	Postgraduate Certificate (+ 4 Credits)
11-Credit	330-354	Postgraduate Certificate (+5 Credits)
12-Credit	360	Postgraduate Diploma
360 Credit-Hours = Postgraduate Diploma		
12 X 5-Day Courses = 360 Credit-Hours = Postgraduate Diploma		
10 X 6-Day Courses = 360 Credit-Hours = Postgraduate Diploma		


Exemplification of Accumulated Postgraduate Certificate and Postgraduate Diploma Award Titles

All Specialist Postgraduate Certificate and Postgraduate Diploma Programmes have their predetermined Award Titles. Where delegates do not follow a Specialism, for accumulation to a Postgraduate Diploma, they will normally be Awarded a General Award, without any Specialist Award Title. However, a Specialist Award will be given, where a delegate studies

HRODC Postgraduate Training Institute
 HQ : 122A Bhylls Lane, Castlecroft, Wolverhampton, West Midlands WV3 8DZ, UK

Prof. Dr. Ronald B. Crawford - Director

PhD (Uni London); M. Ed. M (Bristol); PGCIS (UWL); Adv. Dip. Sc. Ed (Bristol); Dip. Doc. Res. (Uni Wlv); F.I.M.S.; HR. S. (I.M.S.); Exec. M. AOM; M. AAM; M.I.S.G.S.; M.S.C.O.S.; M. RG. C.

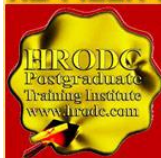


Advanced Legal-Dynamic Metrology: NIST, NCWM, EURAMET, WELMEC, and NPL Compliant Programme, Leading to Postgraduate Diploma in Advanced Legal-Dynamic Metrology at least seventy percent (70%) of his or her courses in a specialist grouping. These are exemplified below:

1. **Postgraduate Diploma in Accounting and Finance;**
2. **Postgraduate Certificate in Accounting and Finance;**
3. **Postgraduate Certificate in Aviation Management;**
4. **Postgraduate Diploma in Aviation Management;**
5. **Postgraduate Certificate in Industrial Health and Safety Management, Incorporating Oil and Gas Safety;**
6. **Postgraduate Diploma in Industrial Health and Safety Management, Incorporating Oil and Gas Safety;**
7. **Postgraduate Certificate in Business Communication;**
8. **Postgraduate Diploma in Business Communication;**
9. **Postgraduate Certificate in Corporate Governance;**
10. **Postgraduate Diploma in Corporate Governance;**
11. **Postgraduate Certificate in Costing and Budgeting;**
12. **Postgraduate Diploma in Costing and Budgeting;**
13. **Postgraduate Certificate in Client or Customer Relations;**
14. **Postgraduate Diploma in Client or Customer Relations;**
15. **Postgraduate Certificate in Engineering and Technical Skills;**
16. **Postgraduate Diploma in Engineering and Technical Skills;**
17. **Postgraduate Certificate in Events Management;**
18. **Postgraduate Diploma in Events Management;**
19. **Postgraduate Certificate in Health and Safety Management;**
20. **Postgraduate Diploma in Health and Safety Management;**
21. **Postgraduate Certificate in Health Care Management;**
22. **Postgraduate Diploma in Health Care Management;**
23. **Postgraduate Certificate in Human Resource Development;**
24. **Postgraduate Diploma in Human Resource Development;**
25. **Postgraduate Certificate in Human Resource Management;**
26. **Postgraduate Diploma in Human Resource Management;**

- 27. Postgraduate Certificate in Information and Communications Technology (ICT);**
- 28. Postgraduate Diploma in Information and Communications Technology (ICT);**
- 29. Postgraduate Certificate in Leadership Skills;**
- 30. Postgraduate Diploma in Leadership Skills;**
- 31. Postgraduate Certificate in Law – International and National;**
- 32. Postgraduate Diploma in Law – International and National;**
- 33. Postgraduate Certificate in Logistics and Supply Chain Management;**
- 34. Postgraduate Diploma in Logistics and Supply Chain Management;**
- 35. Postgraduate Certificate in Management Skills;**
- 36. Postgraduate Diploma in Management Skills;**
- 37. Postgraduate Certificate in Maritime Studies;**
- 38. Postgraduate Diploma in Maritime Studies;**
- 39. Postgraduate Certificate in Oil and Gas Operation;**
- 40. Postgraduate Diploma in Oil and Gas Operation;**
- 41. Postgraduate Certificate in Oil and Gas Accounting;**
- 42. Postgraduate Diploma in Oil and Gas Accounting;**
- 43. Postgraduate Certificate in Politics and Economic Development;**
- 44. Postgraduate Diploma in Politics and Economic Development;**
- 45. Postgraduate Certificate in Procurement Management;**
- 46. Postgraduate Diploma in Procurement Management;**
- 47. Postgraduate Certificate in Project Management;**
- 48. Postgraduate Diploma in Project Management;**
- 49. Postgraduate Certificate in Public Administration;**
- 50. Postgraduate Diploma in Public Administration;**
- 51. Postgraduate Certificate in Quality Management;**
- 52. Postgraduate Diploma in Quality Management;**
- 53. Postgraduate Certificate in Real Estate Management;**
- 54. Postgraduate Diploma in Real Estate Management;**
- 55. Postgraduate Certificate in Research Methods;**

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M. RG. C.

56. Postgraduate Diploma in Research Methods;

57. Postgraduate Certificate in Risk Management;

58. Postgraduate Diploma in Risk Management;

59. Postgraduate Certificate in Sales and Marketing;

60. Postgraduate Diploma in Sales and Marketing;

61. Postgraduate Certificate in Travel, Tourism and International Relations;

62. Postgraduate Diploma in Travel, Tourism and International Relations.

The actual courses studied will be detailed in a student or delegate's Transcript.

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Director
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