

MASS AND WEIGHING TRAINING

Learning objectives

- Familiarity with mass scale
- Understand traceability in the mass area
- Understand the different weight classes
- Familiarity with good practice in weight inspection, handling and calibration
- Carry out ABA and ABABA calibrations
- Use of automatic mass comparators and robot balances
- Understand buoyancy corrections and how to apply them
- Carry out balance assessments
- Direct comparison and sub-division weighing techniques
- Understand and produce uncertainty budgets for mass calibrations

Potential Course Contents

INTRODUCTION TO THE INTERNATIONAL MASS SCALE

- International Metrology
 - Role of the BIPM
 - Mutual Recognition Agreement (MRA)
 - Calibration and Measurement Capability (CMC)
 - International Comparison (role, methods, results)
- The SI unit of Mass
- Maintenance of the Mass scale
 - Worldwide
 - Nationally
- Relevant International Standards
 - ISO
 - ASTM
- Relevant International recommendations
 - OIML R76, R106, R111, R134
- Other standards and recommendations
 - EA, UKAS, BS
- National accreditation of laboratories
- Legal metrology infrastructure
- Quality system
 - ISO requirements
 - Implementation
 - Specific mass area requirements

TRACEABILITY, WEIGHT INSPECTION AND WEIGHT HANDLING

- Traceability
- Weights
- Weight Inspection
 - Surface Condition
 - Magnetism
- Weight handling
 - Gloves
 - Tweezers
 - Clean surfaces
- Weight Storage
- Calibration Interval

WEIGHING TECHNIQUES

- Introduction
- ABABA and ABBA Calibration
- Use of automatic comparators and robot balances
- Cyclic Weighing
- Weighing by Sub-Division
- Make-weights
- Buoyancy Corrections
- Gravitational Corrections

BALANCE ASSESSMENT

- Introduction
- Preparation
 - Balance Location
 - Measurement Equipment
- Balance Types
 - Two-pan balances
 - Single-pan balances
 - Automatic comparators
 - Robot balances
- Assessment
 - Hysteresis
 - Effect of off-centre loading
 - Scale error and linearity
 - Repeatability
 - Frequency of assessment

AIR DENSITY MEASUREMENT AND BUOYANCY CORRECTION

- Introduction
 - True and conventional mass
 - Buoyancy correction
- The application of buoyancy corrections
- Measurement of air density
 - Determination of air density from parametric measurements
 - Other methods for the measurement of air density

UNCERTAINTY CALCULATION

- General principles
- Typical mass area uncertainty budgets
 - Weights
 - Balances
- The role of the ISO Guide to the Expression of Uncertainty in Measurement (GUM)

Bengt Gutfelt
Research institutes of Sweden
Brinellgatan 4 | Borås | Sweden
Tel: +46 10 516 54 76
Email: bengt.gutfelt@ri.se | Web: www.ri.se

Stuart Davidson
National Physical Laboratory
Hampton Rd | Teddington | Middlesex | UK | TW11 0LW
Tel: +44 20 8943 6846
Email: stuart.davidson@npl.co.uk | Web: www.npl.co.uk