

QUALIFICATIONS PACK - OCCUPATIONAL STANDARDS FOR INSTRUMENTATION AUTOMATION SURVEILLANCE AND COMMUNICATION INDUSTRY

What are Occupational Standards(OS)?

- OS describe what individuals need to do, know and understand in order to carry out a particular job role or function
- OS are performance standards that individuals must achieve when carrying out functions in the workplace, together with specifications of the underpinning knowledge and understanding

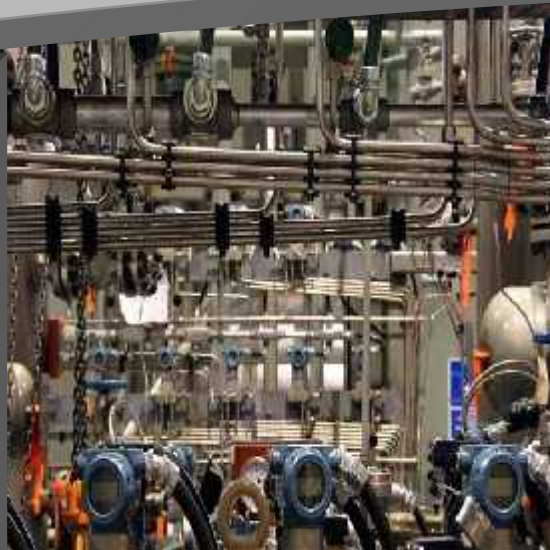
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Introduction

Qualifications Pack- Calibration Technician-Mechanical (Mass, Balance, Volume, Density, Viscosity)

SECTOR: INSTRUMENTATION AUTOMATION SURVEILLANCE & COMMUNICATION

SUB-SECTOR: Instrumentation

OCCUPATION: Testing & Calibration

REFERENCE ID: IAS/Q5011

ALIGNED TO: NCO-2015/ NIL

Brief Job Description: Calibration Technician - Mechanical (Mass, Balance, Volume, Density, Viscosity) is responsible for performing calibration of mechanical instruments used for Mass, Balance, Volume, Density and Viscosity measurements using authorized calibration setup and procedure in accordance with ISO/IEC 17025:2005 or equivalent standards

Personal Attributes: This job requires the individual to be disciplined, assertive, team player, possess analytical skills and problem solving ability, effective communicator and have the ability to work under pressure.

Qualifications Pack For Calibration Technician -Mechanical (Mass, Balance, Volume, Density, Viscosity)

Job Details	Qualifications Pack Code	IAS/Q5011		
	Job Role	Calibration Technician -Mechanical (Mass, Balance, Volume, Density, Viscosity)		
	Credits(NSQF)	TBD	Version number	1.0
	Sector	Instrumentation, Automation Surveillance and Communication	Drafted on	31/08/2017
	Sub-sector	Instrumentation	Last reviewed on	31/08/2017
	Occupation	Testing & Calibration	Next review date	31/08/2019

Job Role	Calibration Technician -Mechanical (Mass, Balance, Volume, Density, Viscosity)
Role Description	Calibration Technician - Mechanical (Mass, Balance, Volume, Density, Viscosity) is responsible for performing calibration of mechanical instruments used for Mass, Balance, Volume, Density and Viscosity measurements using authorized calibration setup and procedure in accordance with ISO/IEC 17025:2005 or equivalent standards
NSQF level	4
Minimum Educational Qualifications	B.Sc.(with Physics as a subject), Diploma in Mechanical, Instrumentation/ Electrical/Electronics. Final year students eligible for On Job Training and Certification Assessment.
Maximum Educational Qualifications	NA
Training (Suggested but not mandatory)	Practical hands-on training in Basics of Mass Metrology, Balance Calibration, Volume & Density Calibration and Viscosity Calibration in a calibration laboratory.
Minimum Job Entry (Age)	19 Years
Experience	No prior experience required
Applicable National Occupational Standards (NOS)	<p>Mandatory:</p> <ol style="list-style-type: none"> 1. IAS/N0515 Wo222rk Place Readiness - Mass, Balance, Density, Viscosity Calibration 2. IAS/N0516 Calibration of Weights 3. IAS/N0517 Calibration of Weighing Balance and Mass Comparator

Qualifications Pack For Calibration Technician -Mechanical (Mass, Balance, Volume, Density, Viscosity)

	<ol style="list-style-type: none"> 4. IAS/N0518 Calibration of Volumetric Apparatus 5. IAS/N0519 Calibration of Density of Solids 6. IAS/N0530 Determination of Density of Liquids and Calibration of Density Hydrometers 7. IAS/N0531 Calibration of Viscometers 8. IAS/N0204 Reporting of Task Performed-Calibration 9. IAS/N0532 Preventive Maintenance of Mass, Balance, Density, Viscosity Calibration Setup 10. IAS/N2105 Work Effectively with Teams
Performance Criteria	As described in relevant OS units

Qualifications Pack For Calibration Technician -Mechanical (Mass, Balance, Volume, Density, Viscosity)

Definitions

Keywords /Terms	Description
Calibration	Calibration is the process of determining and verification of the physical characteristics of a system with reference to an established primary or secondary standard for that physical quantity, as prescribed by a national or international standard. Calibration assures the integrity and accuracy of a measurement device or system. Calibrations are performed according to accepted international standards so that there is global uniformity in dealing with physical quantities and their technical, trade and economic consequences.
Core skills/generic skills	Core skills or generic skills are a group of skills that are key to learning and working in today’s world. These skills are typically needed in any work environment. In the context of the OS these include communication related skills that are applicable to most job roles.
Description	Description gives a short summary of the unit content. This would be helpful to anyone searching on a data base to verify that this is the appropriate OS they are looking for.
Function	Function is an activity necessary for achieving the key purpose of the sector, occupation, or area of work, which can be carried out by a person or group of persons.
Instrumentation	Instrumentation is the variety of measuring instruments to monitor and control a process. It is the art and science of measurement and control of process variables within a production, laboratory, or manufacturing area.
Job Role	Job role defines a unique set of functions that together form a unique employment opportunity in an organization.
Knowledge and understanding	Knowledge and understanding statements which together specify the technical, generic, professional and organizational specific knowledge that an individual needs in order to perform to the required standards.
National occupational standards	NOS are occupational standards which apply uniquely in the Indian context.
Occupation	Occupation is a set of job roles under which role holders perform similar/related set of functions in an industry.
Organizational context	Organizational context includes the way the organization is structured and how it operates, including the operative knowledge managers have of their relevant areas of responsibility.
OS (Occupational Standards)	OS specify the standards of performance an individual must achieve when carrying out a function in the work place together with the knowledge and understanding they need to meet that standard consistently. Occupational standards are applicable both in Indian and global contexts.

Qualifications Pack For Calibration Technician -Mechanical (Mass, Balance, Volume, Density, Viscosity)

Performance Criteria	Performance criteria are statements that together specify the standards of performance required when carrying out a task.
Qualification pack code	Qualification pack code is a unique reference code that identifies a qualification pack.
Scope	Scope is a set of statements specifying the range of variables that an individual may have to deal with, carrying out the function which has a critical impact on the quality of performance required.
Sector	Sector is a conglomeration of different business operation having similar businesses and interests. It may also be defined as a distinct subset of the economy whose components share similar characteristics and interests.
Sub Sector	Sub sector is derived from a further breakdown based on the characteristics and interests of its components.
Technical Knowledge	Technical knowledge is the specific knowledge needed to accomplish specific designated responsibilities.
Traceability	Ability to correlate calibration of equipment to national and international standards - ultimately to secondary and primary standards.
Unit Code	Unit code is a unique identifier for an 'OS' unit which can be denoted with either 'O' or 'N'.
Unit title	Unit title gives clear overall statement about what the incumbent should be able to do.

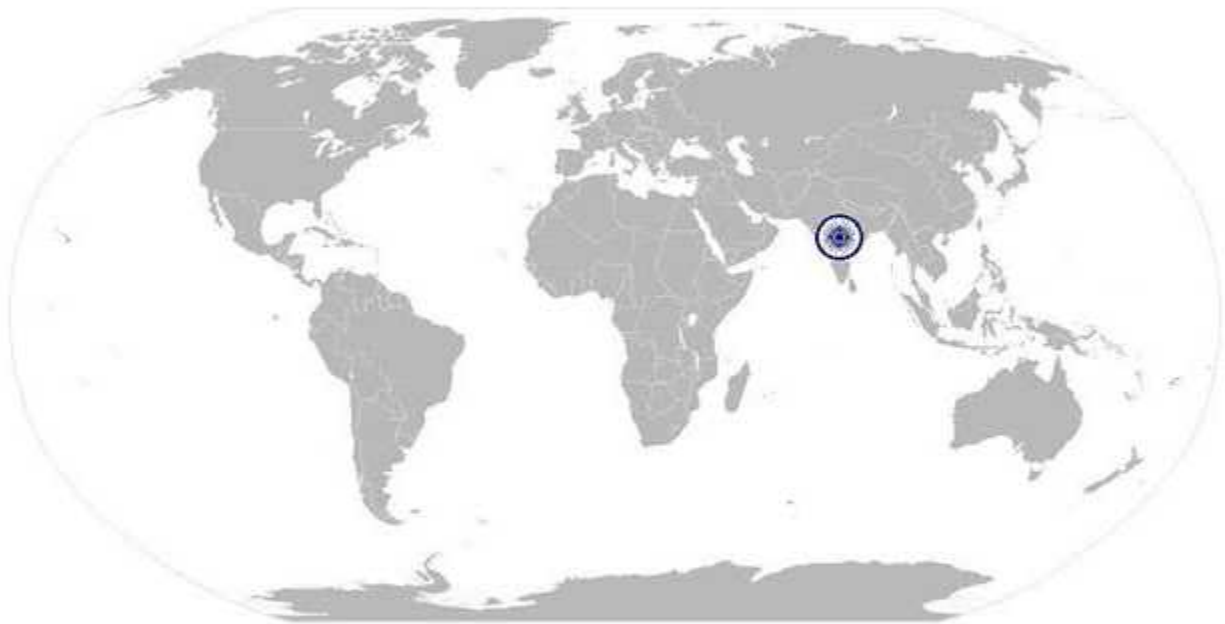
Acronyms	Keywords /Terms	Description
	PM	Preventive Maintenance
	SOP	Standard Operating Procedures
	UUC	Unit Under Calibration
	Metrology	
	Reference Instrument	
	Environmental Accommodation	

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IAS/N0515

**Work Place Readiness - Mechanical
(Mass, Balance, Volume, Density, Viscosity) Calibration**

National Occupational Standard



Overview

The OS unit is about ensuring calibration environment and the Readiness and Usability of calibration system and Safety at the workplace.

IAS/N0515

**Work Place Readiness - Mechanical
(Mass, Balance, Volume, Density, Viscosity) Calibration**

National Occupational Standard	Unit Code	IAS/N0515
	Unit title (Task)	Work Place Readiness - Mechanical (Mass, Balance, Volume, Density, Viscosity) Calibration
	Description	This OS unit is about ensuring calibration environment and the Readiness and Usability of calibration system and Safety at the workplace. The individual follows organization specified handling methods and keeps the calibration equipment and setup in good order.
	Scope	<p>Clean and Uncluttered Workplace</p> <ul style="list-style-type: none"> • Vibration • Acoustic Noise • Illumination • Environmental Conditions • Availability and Quality of Power Supply • Dust and external air pressure • Safety Precautions • Availability and Usability of calibration instruments and system • Workplace Operational Guidelines
	Performance Criteria (PC) with respect to the scope	
	Element	Performance Criteria
	Maintain Workplace Cleanliness	<p>To be competent, the individual must be able to:</p> <p>PC1. Perform Workplace Checks using prescribed checklists and organizational norms and report any deviations.</p> <p>PC2. Check for cleanliness of work area and equipment</p> <p>PC3. Ensure an uncluttered workplace</p>

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**Work Place Readiness - Mechanical
(Mass, Balance, Volume, Density, Viscosity) Calibration**

<p>Ensure Vibration norms</p>	<p>To be competent, the individual must be able to:</p> <p>PC4. Check / Feel for any abnormal vibrations generated by central air-conditioning plants, vehicular traffic and other sources.</p> <p>PC5. If any vibration is felt which is unusual, then try to locate the source of vibration. Check if special/ protective devices like vibration free tables and pillars etc., isolating the equipment from the floor, are affected in any way.</p> <p>PC6. Report any deviations and findings to the Supervisor and the concerned department.</p> <p>PC7. If the vibration level is above specified limits, Calibration operation may be suspended. Refer to organization SOP for the quantitative</p>
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IAS/N0515

**Work Place Readiness - Mechanical
(Mass, Balance, Volume, Density, Viscosity) Calibration**

	measurement of vibration and relation guidelines.
Ensure Acoustic Noise norms	<p>To be competent, the individual must be able to:</p> <p>PC8. Check / Listen for any abnormal noise in the calibration area. Refer to SOP for acceptable noise level - usually less than 60dBA.</p> <p>PC9. If any noise is felt which is unusual, then try to locate the source of noise.</p> <p>PC10. Report any deviations and findings to the Supervisor and the concerned department.</p> <p>PC11. If the noise level affects the Calibration process, then the operation may be suspended. Refer to organization SOP for the quantitative measurement of noise and related guidelines.</p>
Ensure Lighting Environment norms	<p>To be competent, the individual must be able to:</p> <p>PC12. Check for lighting / associated electricals at Mass, Weight, Volume, Density, Viscosity Calibration Installation. Report any deviations to electrical department.</p> <p>PC13. Check for adequate lighting and working of associated electrical fittings in the Calibration area. The recommended level of illumination is 250-500 Lux on the working table, or as specified in the SOP.</p> <p>PC14. Check for temporary/unsafe electrical wiring</p>
Ensure Environment norms	<p>To be competent, the individual must be able to:</p> <p>PC15. Check for ambient temperature and humidity in the Calibration area. Refer to organization SOP for the quantitative measurement of temperature and humidity and the related guidelines.</p> <p>PC16. Ensure that the reference standards are maintained at temperatures specified in order to ensure their conformance to the required level of operation.</p> <p>PC17. Report any deviations to the concerned department.</p> <p>PC18. If the environment parameters are likely to adversely affect the required accuracy of measurement, then report to the Supervisor and seek guidance about performing calibration.</p>
Ensure Quality of Power Supply	<p>To be competent, the individual must be able to:</p> <p>PC19. Ensure that the power supply of right quality (voltage, frequency, transients, regulation etc.) as specified in SOP is available - usually from a UPS. Check that any isolation transformers and filters etc. installed are not tampered with and the hum interference is within limits.</p> <p>The recommended voltage regulation level is $\pm 2\%$ or better, and</p>

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**Work Place Readiness - Mechanical
(Mass, Balance, Volume, Density, Viscosity) Calibration**

	<p>Frequency variation ± 2.5 Hz or better on the calibration bench. The THD and transient noise must be within specified limits.</p> <p>PC20. Ensure that operation of heavy loads in the premises or nearby locations does not cause any dip in voltage or transient currents.</p> <p>PC21. Report any deviations to the concerned department.</p>
<p>Ensure Dust and External Air Pressure norms</p>	<p>To be competent, the individual must be able to:</p> <p>PC22. Ensure that the laboratory is free from dust and external air pressure. Positive air pressure is normally maintained inside the laboratory to avoid ingress of dust.</p> <p>PC23. Report any deviations to the concerned department.</p>
<p>Ensure Safety Precautions</p>	<p>To be competent, the individual must be able to:</p> <p>PC24. Ensure availability of suitable fire extinguishing equipment for possible fire hazards in the laboratory, per SOP.</p> <p>PC25. Ensure familiarity with method of giving the treatment in case of electric shock. Wall chart showing the procedure should be placed near the power supply switchgear and at other prominent places as prescribed under Indian Electricity Rules 1956.</p>
<p>Ensure Availability and Usability of calibration instruments and system</p>	<p>To be competent, the individual must be able to:</p> <p>PC26. Check for availability of instruments in the Mass, Weight, Volume, Density, Viscosity Metrology calibration setup.</p> <p>PC27. Check availability of electrical power and the quality (whether UPS backed, voltage and frequency) as specified in the SOP</p>
<p>Maintain Workplace Operational Guidelines</p>	<p>To be competent, the individual must be able to:</p> <p>PC28. Handle equipment in recommended and safe manner.</p> <p>PC29. Uses hand gloves of specified material for handling the UUC and Reference so that these are not soiled and to avoid heat transfer to Reference equipment or UUC during Calibration which may otherwise drastically affect the results.</p>

Knowledge and Understanding (K)

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**Work Place Readiness - Mechanical
(Mass, Balance, Volume, Density, Viscosity) Calibration**

<p>A. Organizational context (Knowledge of the company / organization and its process relevant to areas of responsibilities)</p>	<p>The individual on the job needs to know and understand:</p> <p>KA1. The requirements of maintaining environment and cleanliness of the workplace for Calibration operation and how it impacts the organization process and business.</p> <p>KA2. The role of calibration in the organization (whether part of the end user Production and Quality Assurance process or of a calibration service provider)</p> <p>KA3. The impact of calibration quality on the company business</p>
<p>B. Technical Knowledge</p>	<p>The individual on the job needs to know and understand:</p> <p>KB1. The Calibration Technician knows and understands Mass, Weight, Volume, Density, Viscosity Metrology process and its impact on calibration accuracy.</p>
<p>Skill(S) [Optional]</p>	
<p>A. Core Skills / Generic Skills</p>	<p>Writing skills</p>
	<p>The individual on the job needs to know and understand</p> <p>SA1. Use Formats and check list for workplace readiness</p> <p>SA2. Write emails and messages about site related issues</p>
	<p>Reading Skills</p>
	<p>The user/individual on the job needs to know and understand</p> <p>SA3. Read product literature and manuals relevant for</p> <p>SA4. Read the company information about working practices at the site</p> <p>SA5. Read the information displayed at the workplace</p>
	<p>Oral Communication (Listening and Speaking skills)</p>
<p>The user/individual on the job needs to know and understand</p> <p>SA6. Describe site conditions and issues to co-workers and supervisor</p> <p>SA7. Communicate to the management in meetings about site issues to get their support</p> <p>SA8. Interact with coworkers and gather information related to process and site conditions</p>	
<p>B. Professional Skills</p>	<p>Decision Making</p>
	<p>The user individual on the job needs to know and understand:</p> <p>SB1. Make decisions pertaining to the concerned area of work</p>
	<p>Plan and Organize</p>

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**Work Place Readiness - Mechanical
(Mass, Balance, Volume, Density, Viscosity) Calibration**

	<p>The individual on the job needs to know and understand: SB2. Prioritize daily activities for the upkeep of calibration operation through ensuring availability of the calibration setup and its components.</p>
	Customer Centricity
	<p>The user/individual on the job needs to know and understand: SB3. Real needs of the customer and suggest most appropriate solution SB4. Support customer when they need help</p>
	Problem Solving
	<p>The user/individual on the job needs to know and understand: SB5. Think through the problem, evaluate the possible solution(s) and suggest an optimum /best possible solution(s) SB6. Identify immediate or temporary solutions to resolve delays</p>
	Analytical Thinking
	<p>The user/individual on the job needs to know and understand: SB7. Use the existing information to arrive at actionable decision points SB8. Use the existing information for improving the customer satisfaction</p>
	Critical Thinking
<p>The user/individual on the job needs to know and understand: SB9. Apply, analyze, and evaluate the information gathered from observation, experience, reasoning, or communication, as a guide to thought and action SB10. Anticipate problems, risks and opportunities and utilize these for mitigation and business optimization</p>	

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**Work Place Readiness - Mechanical
(Mass, Balance, Volume, Density, Viscosity) Calibration**

NOS Version Control

NOS Code	IAS/N0515		
Credits(NSQF)	TBD	Version number	1.0
Sector	Instrumentation, Automation Surveillance and Communication	Drafted on	31/08/2017
Sub-sector	Instrumentation	Last reviewed on	31/08/2017
Occupation	Testing & Calibration	Next review date	31/08/2019

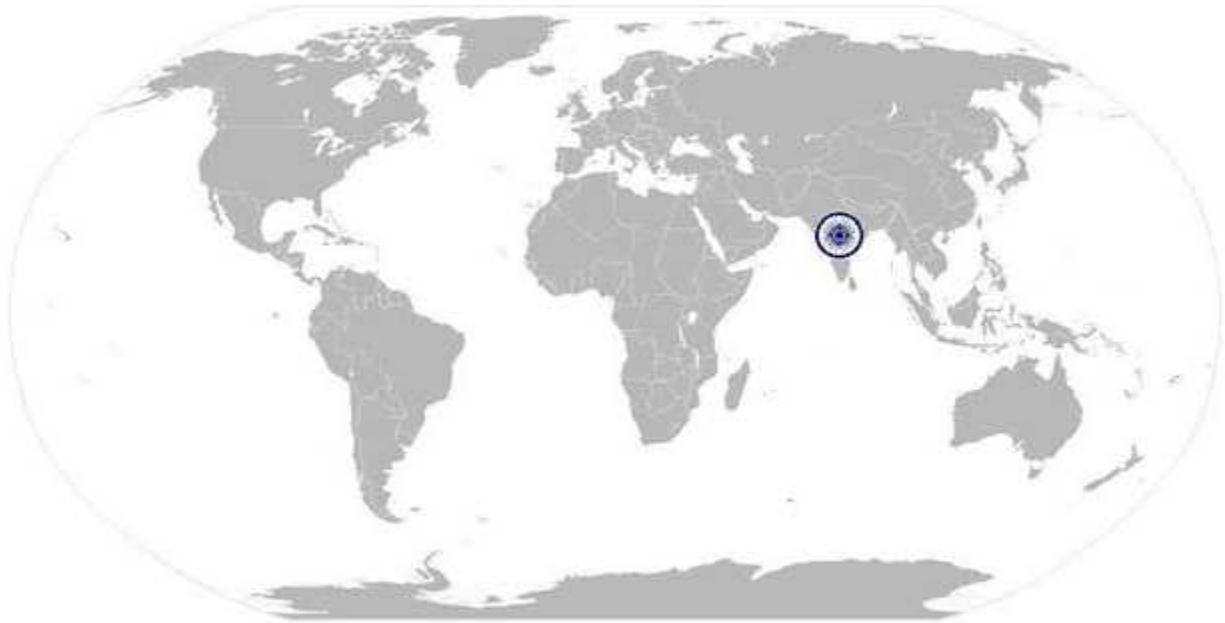


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IAS/N0516

Calibration of Weights

National Occupational Standard

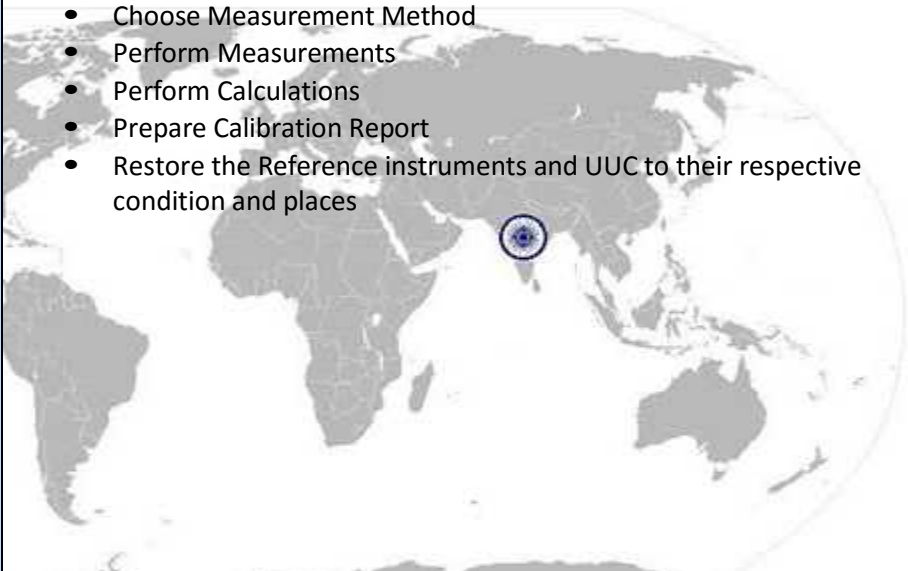


Overview

This unit is about Calibration of Weights according to the Standard Operating Procedures (SOP) of the organization.

IAS/N0516

Calibration of Weights

National Occupational Standard	Unit Code	IAS/N0516
	Unit title (Task)	Calibration of Weights
	Description	To perform calibration of a range of weights according to OIML-R 111-1 standards and organization SOP.
	Scope	<p>The Unit/Task cover the following:</p> <ul style="list-style-type: none"> • Plan and prepare for calibration • Select Reference Weights and Comparator/Balance • Ensure Metrological Requirements • Choose Measurement Method • Perform Measurements • Perform Calculations • Prepare Calibration Report • Restore the Reference instruments and UUC to their respective condition and places 
Performance Criteria (PC) with respect to the scope		
Element	Performance Criteria	
Plan and prepare for calibration	<p>To be competent, the individual must be able to:</p> <p>PC1. Prepare Observation Sheet (use a standard form/format as specified in the SOP)</p> <p>PC2. Note in the Observation Sheet the details of the UUC (requesting company, lab reference number, type, make, model, serial number, date, time, technician's name etc.)</p> <p>PC3. Verify that the UUC is in good shape (i.e. no physical damage, readable markings, clean, no loose parts etc.)</p> <p>PC4. Note all parameters to measure for the requested calibration</p> <p>PC5. Note the number of readings to be taken for each parameter</p> <p>PC6. Note the Reference Instruments to use for the parameters</p> <p>PC7. Wear gloves while handling instruments</p>	

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Calibration of Weights

	<p>PC8. Verify that the Reference Instruments are available and are in good shape (i.e. usable for calibration, have valid certificates)</p> <p>PC9. Verify that the measurement environment is appropriate for the reference instruments and for the requested calibration</p> <p>PC10. Record readings of ambient temperature, relative humidity and atmospheric pressure, with required precision using recommended devices</p> <p>PC11. Ensure Thermal Stabilization time are met for Test Weights, per SOP. This will need to be reported. As a practical guideline, a waiting time of 24 hours is recommended.</p>
<p>Select Reference Weights and Comparator/Balance</p>	<p>To be competent, the individual must be able to:</p> <p>PC12. Follow the SOP guidelines and consult the Supervisor for selection of Reference Weights and Comparator/Balance. The following general considerations apply:</p> <p>PC13. The reference weight shall be of a higher class of accuracy than the weight to be calibrated.</p> <p>PC14. In the calibration of weights of class E1, the reference weight shall have similar or better metrological characteristics (magnetic properties, surface roughness) than the weights to be calibrated.</p> <p>PC15. On the basis of the accuracy class, a mass comparator is to be selected in such a way that its uncertainty component is balanced in proportion to the overall uncertainty of the weighing result.</p> <p>PC16. The most important uncertainty component of a mass comparator is calculated from its standard deviation.</p> <p>PC17. The specification of the manufacturer can be selected as a first approximation for the value of a standard deviation. It must be taken into account for the smallest nominal value. It should not exceed an amount of 30% of the combined standard uncertainty u_1 ($k=2$).</p>
<p>Ensure Metrological Requirements are met</p>	<p>To be competent, the individual must be able to:</p> <p>PC18. Follow SOP guidelines regarding Metrological requirements.</p> <p>PC19. At higher altitudes, the buoyancy correction shall be used, which requires the density of the weight to be known. If class E weights are to be used above 330 m, the density of the weights shall be provided along with their associated uncertainty. For Class F1 the same is true above 800 m.</p>
<p>Choose Measurement Method</p>	<p>To be competent, the individual must be able to:</p> <p>PC20. Method used for calibration is required to be mentioned in the calibration certificate issued to the customer. There are two methods for determination of conventional mass of weights in a weight set.</p> <p>PC21. For Direct Comparison Method, choose the Minimum Number of Weighing Cycles per SOP (based on standard OIML R-111-1).</p> <p>PC22. For Sub -Division/Sub-Multiplication Method (Ref. C.3.2 of OIML) choose the appropriate Reference Weights per SOP guidelines.</p>

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Calibration of Weights

<p>Perform Measurements</p>	<p>To be competent, the individual must be able to:</p> <p>PC23. Follow the measurement procedure for the method chosen per SOP.</p> <p>PC24. Make measurements using the Reference Weights, the Comparator instrument and the UUC, following the prescribed measurement sequence.</p> <p>PC25. Record the number of readings, as prescribed in the SOP.</p> <p>PC26. Record readings of ambient temperature and relative humidity and the air pressure at the beginning and end of measurements using recommended devices.</p>
<p>Calibration of Newton Weights, Pressure Balance Weights and Non-metric Weights</p>	<p>To be competent, the individual must be able to:</p> <p>PC27. Weights used for realization of Pressure in Dead weight pressure balance or weights used for realization of force in Newton are to be calibrated on true mass basis.</p> <p>PC28. If, weights are calibrated on conventional mass basis, equation for conversion from conventional mass to true mass are to be mentioned to enable the user to apply appropriate buoyancy correction.</p> <p>PC29. Newton or Force weights are typically of a slotted design or with a centre hole and are typically marked with a nominal Force in Newton. Force is calculated with respect to Local gravity 'gL' during calibration using the formula: $F = m (1 - \rho_a / \rho_m) * g_L$</p> <p>PC30. When the customer requires the force weight with respect to his local 'g' value he has to provide the same with uncertainty. Then the force value shall be calculated using the local 'g' value and declare in the certificate in terms mass value along with the calculated value in Newton. The 'g' value of the calibration laboratory shall also be known to sufficient accuracy.</p> <p>PC31. The Laboratory may calibrate weights of non-metric units (e.g. Pound or Ounce etc.) However, the results shall be reported in SI units like kg, g, mg, etc. along with the calculated equivalent value in the non-metric unit or mention the conversion factor to be used.</p>

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Calibration of Weights

Perform Calculations	<p>To be competent, the individual must be able to:</p> <p>PC32. Refer to SOP for the equations to use for the type of calibration being performed</p> <p>PC33. Use form/format specified in the SOP for performing calculations</p> <p>PC34. Perform the required calculations using calculator or software as specified, using the equations and procedures specified in the SOP.</p> <p>PC35. Determine Air Density and its Uncertainty, per SOP guidelines</p> <p>PC36. Use Equations for Determination of Conventional Mass, True mass and their uncertainties</p> <p>PC37. Calculate contribution of Uncertainty in Calibration of Weights. The estimation of the uncertainty measurement for the weight calibrated by a laboratory shall consider at least the following contributions.</p> <ul style="list-style-type: none"> (a) repeatability-standard deviation of weighing result (b) The contribution of the reference standard weight. (c) The air buoyancy correction (d) The uncorrected drift of the reference standard weight (e) The resolution of the balance <p>PC38. Calculate Uncertainty for Calibration Results for Type A Standard uncertainty and Type B Standard uncertainty.</p>
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Calibration of Weights

<p>Prepare Calibration Report</p>	<p>To be competent, the individual must be able to:</p> <p>PC39. Record the results, including uncertainty, as calculated above, in the specified format</p> <p>PC40. Prepare Report in the format specified in the SOP. The calibration certificates issued to the customer shall be in accordance with clause 5.10 of ISO/IEC/17025:2005. It also includes the following:</p> <ol style="list-style-type: none"> Thermal stabilization hours taken before calibration. Specific calibration method followed Density of Reference weight (whether assumed or measured). Density of Test weight (whether assumed or measured). Declaration that, the calibration certificate issued for weights/Mass used for scientific or industrial purposes only. <p>PC41. Store and share report with the designated persons</p>
<p>Restore the Reference instruments and UUC to their respective condition and places</p>	<p>To be competent, the individual must be able to:</p> <p>PC42. Return the Reference instruments to their recommended storage position and put in their box/cover</p> <p>PC43. Return the UUC to its recommended storage position and put in its accompanying box/cover</p> <p>PC44. Fix/Attach any recommended tag/markings on the UUC to signify that its calibration has been done</p>
<p>Knowledge and Understanding (K)</p>	
<p>A. Organizational context (Knowledge of the company / organization and its process relevant to areas of responsibilities)</p>	<p>KA1. The requirements of performing Weight Calibration and how it impacts organization process and business.</p> <p>KA2. The role of calibration in the organization (whether part of the end user Production and Quality Assurance process or of a Calibration Service Provider)</p> <p>KA3. The Certification of the organization and their capability to perform calibration tests according to accepted level of standards.</p> <p>KA4. The impact of calibration quality on the company business</p> <p>KA5. Knows about the Standard Operating Procedures and its importance</p> <p>KA6. Follows the SOPs rigorously and takes guidance from the Calibration Supervisor when in doubt.</p> <p>KA7. Records any non-compliance to SOP and reports it to the Calibration Supervisor and takes guidance.</p>

IAS/N0516

Calibration of Weights

B. Technical Knowledge	<p>KB1. Knows about and understands how Weight Calibration is performed.</p> <p>KB2. Knows about the sources of errors in the Weight calibration process, how these are avoided and its impact on calibration accuracy.</p> <p>KB3. Familiar with:</p> <ul style="list-style-type: none"> • What is Weight Calibration • Why is Weight calibration needed • Traceability of the calibration of instruments performing the tests • Types of Weight, ranges and applications • Sources of inaccuracies in Weight measurements and how to avoid / minimize these • Equipment needed for Weight Calibration • Deriving calibration results - data processing and interpretation
Skill(S)	
A. Core Skills / Generic Skills	<p>Writing skills</p> <p>The individual on the job needs to know and understand how to:</p> <p>SA1. Use Formats and check list for Weight calibration and reports</p> <p>SA2. Write emails and messages about calibration related issues</p>
	<p>Reading Skills</p> <p>The user/ individual on the job needs to read and understand how to:</p> <p>SA3. Company policy related to Weight calibration</p> <p>SA4. Terminology, symbols, codes, standards, methods and common practices related to Weight Calibration</p> <p>SA5. Data processing steps, Uncertainty Calculations and reporting of results related to Weight calibration.</p> <p>SA6. Formats and check list for Weight Calibration</p>
	<p>Oral Communication (Listening and Speaking skills)</p> <p>The individual on the job needs to know and understand how to:</p> <p>SA7. Communicate with the Calibration Supervisor for task scheduling, task reporting and exception reporting</p> <p>SA8. Communicate to the management in meetings about process or equipment issues which need management attention</p>
B. Professional Skills	<p>Decision Making</p> <p>The individual on the job needs to know and understand how to:</p> <p>SB1. Make decisions about what calibration to perform and consult Supervisor if needed</p>
	<p>Plan and Organize</p>

IAS/N0516

Calibration of Weights

	<p>The individual on the job needs to know and understand how to:</p> <p>SB2. Prioritize daily tasks and batches of calibration efficiently and effectively to meet client and company needs</p>
	<p>Customer Centricity</p>
	<p>The user/individual on the job needs to know and understand how to:</p> <p>SB3. Real needs of the customer and suggest most appropriate solution</p> <p>SB4. Support customer when they need help</p>
	<p>Problem Solving</p>
	<p>The individual on the job needs to know and understand how to:</p> <p>SB5. Diagnose reasons for any down time in the calibration setup</p> <p>SB6. Identify immediate or temporary solutions to resolve delays and discuss with the Supervisor</p>
	<p>Analytical Thinking</p>
	<p>The user/individual on the job needs to know and understand how to:</p> <p>SB7. Use the existing information to arrive at actionable decision points</p> <p>SB8. Use the existing information for improving the customer satisfaction</p>
	<p>Critical Thinking</p>
	<p>The user/individual on the job needs to know and understand how to:</p> <p>SB9. Apply, analyze, and evaluate the information gathered from observation, experience, reasoning, or communication, as a guide to thought and action</p>

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Calibration of Weights

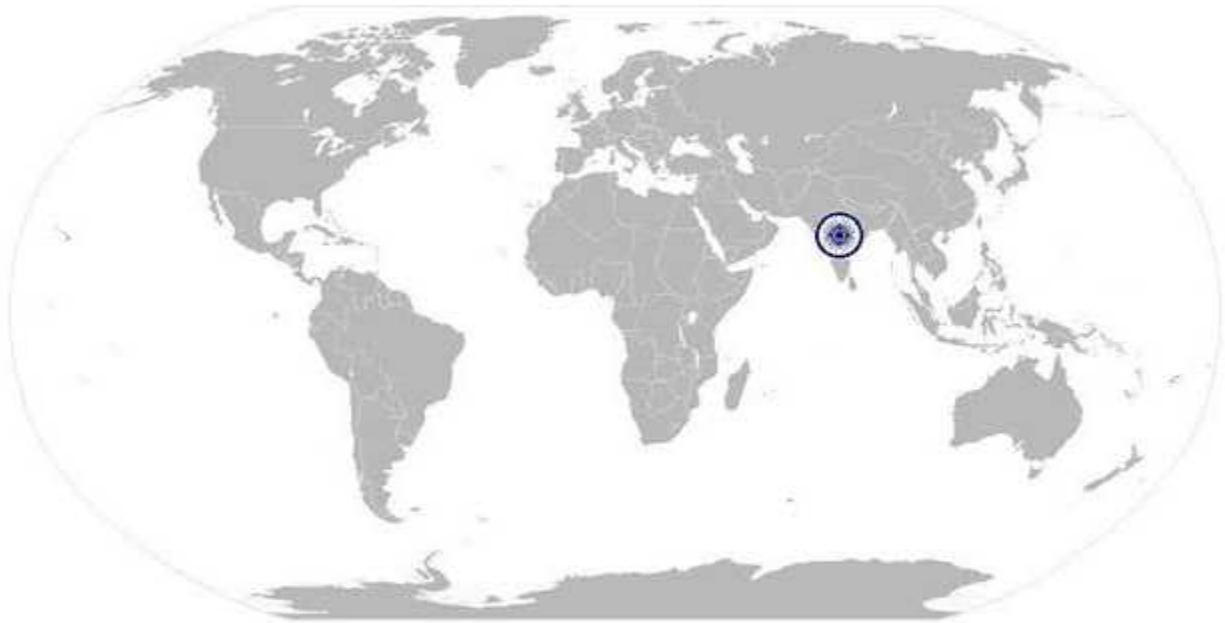
NOS Version Control

NOS Code	IAS/N0516		
Credits (NSQF)	TBD	Version number	1.0
Sector	Instrumentation, Automation Surveillance and Communication	Drafted on	31/08/2017
Sub-sector	Instrumentation	Last reviewed on	31/08/2017
Occupation	Testing & Calibration	Next review date	31/08/2019



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National Occupational Standard

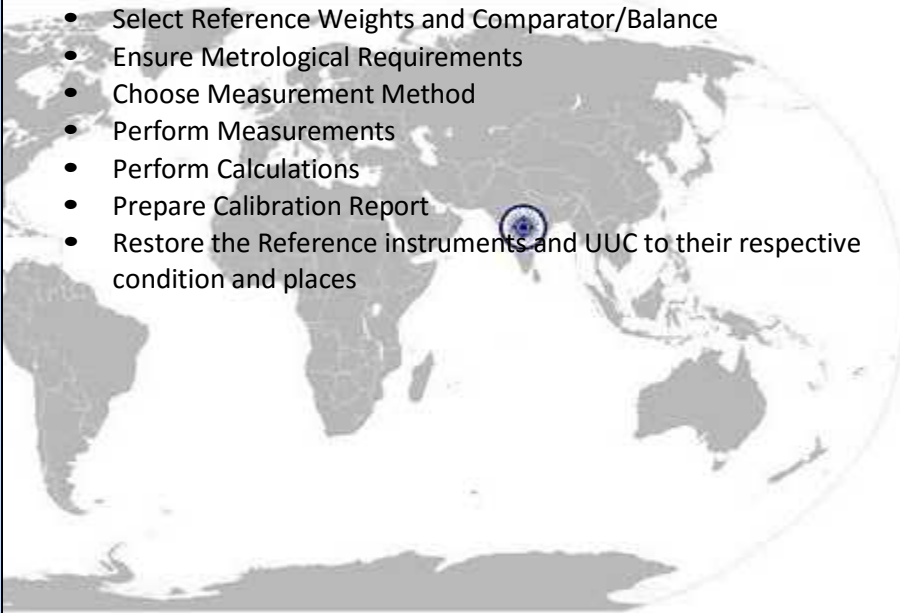


Overview

The OS unit is about calibration of a range of Weighing Balance and Mass Comparator according to organization SOP

IAS/N0517

Calibration of Weighing Balance and Mass Comparator

National Occupational Standard	Unit Code	IAS/N0517
	Unit title (Task)	Calibration of Weighing Balance and Mass Comparator
	Description	The OS unit is about calibration of a range of Weighing Balance and Mass Comparator according to organization SOP and relevant standards, such as EURAMET cg -18/v.3 or OIML-R-76-1 and OIML-R76-2; and OIML R 47 for high capacity machines.
	Scope	<p>The unit/task covers the following</p> <ul style="list-style-type: none"> Plan and prepare for calibration Select Reference Weights and Comparator/Balance Ensure Metrological Requirements Choose Measurement Method Perform Measurements Perform Calculations Prepare Calibration Report Restore the Reference instruments and UUC to their respective condition and places 
	Performance Criteria (PC) with respect to the scope	
Element	Performance Criteria	

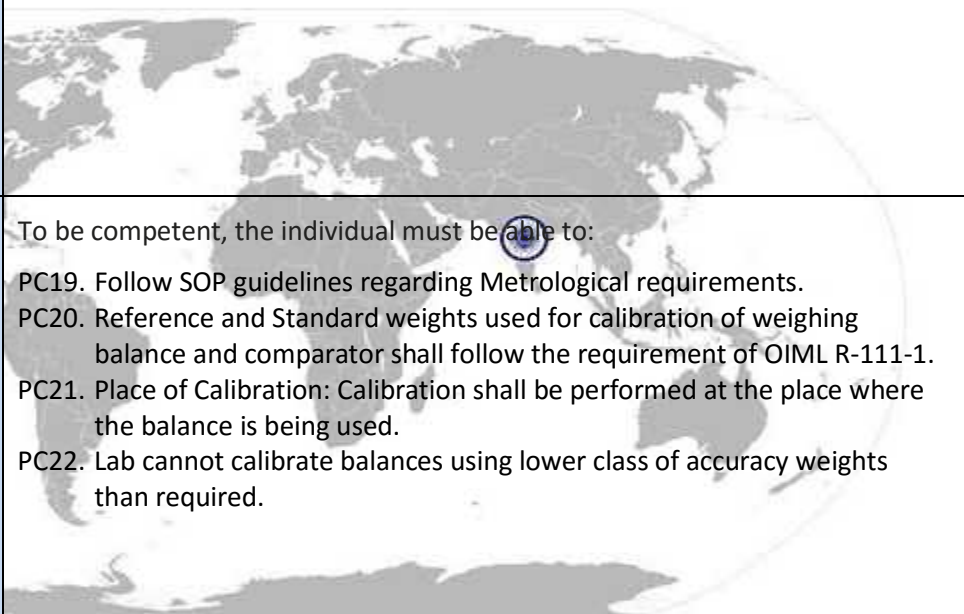
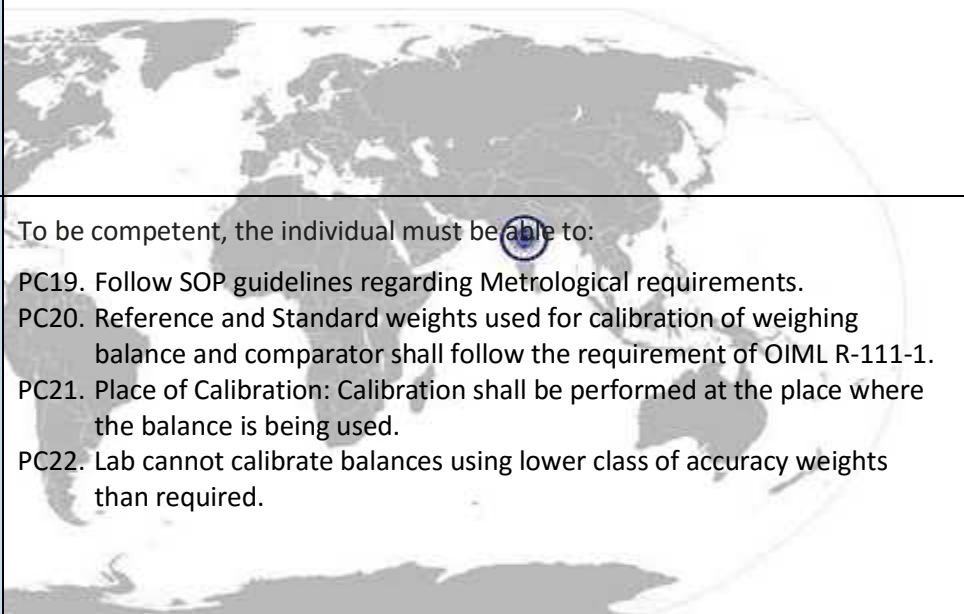
IAS/N0517

Calibration of Weighing Balance and Mass Comparator

<p>Plan and prepare for calibration</p>	<p>To be competent, the individual must be able to:</p> <p>PC1. Prepare Observation Sheet (use a standard form/format as specified in the SOP)</p> <p>PC2. Note in the Observation Sheet the details of the UUC (requesting company, lab reference number, type, make, model, serial number, date, time, technician's name etc.)</p> <p>PC3. Verify that the UUC is in good shape (i.e. no physical damage, readable markings, clean, no loose parts etc.)</p> <p>PC4. Note all parameters to measure for the requested calibration</p> <p>PC5. Note the number of readings to be taken for each parameter</p> <p>PC6. Note the Reference Instruments to use for the parameters</p> <p>PC7. Wear gloves while handling instruments</p> <p>PC8. Verify that the Reference Instruments are available and are in good shape (i.e. usable for calibration, have valid certificates)</p> <p>PC9. Verify that the measurement environment is appropriate for the reference instruments</p> <p>PC10. Record readings of ambient temperature, relative humidity and atmospheric pressure, with required precision using recommended devices</p> <p>PC11. The effect of Convection: When the reference weights used are transported for calibration site, they may not have the same temperature as that of the balance and its environment, then there will be heat exchange between the weights and their environment. Due to this there will be apparent change in mass in relation to the temperature difference. An initial temperature may be reduced to a smaller value by acclimatization (habituation to a new climate) over time. This occurs faster for smaller weights than for larger weights.</p> <p>PC12. When a weight is put on the load receptor of a balance, the actual difference in temperature will produce an air flow about the weight leading to parasitic forces which results in conventional mass of the weight. This value will be greater for large weights than for small ones.</p> <p>PC13. Ensure Thermal Stabilization time is met for Test Weights, per SOP. This will need to be reported. As a practical guideline, a waiting time of 24 hours is recommended.</p> <p>PC14. Incorporate effect of Gravity 'g' on Calibration of Balance. Follow SOP guidelines.</p>
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Calibration of Weighing Balance and Mass Comparator

<p>Select Reference Weights and Comparator/Balance</p>	<p>To be competent, the individual must be able to:</p> <p>PC15. Follow the SOP guidelines and consult the Supervisor for selection of Reference Weights and Comparator/Balance.</p> <p>PC16. Ensure that the design and accuracy of weights are appropriate to the weighing machine being calibrated, and where possible should have a 95% confidence level uncertainty of calibration less than half the smallest digit size or recorded scale interval of the weighing machine to be calibrated.</p> <p>PC17. Ensure that the weighing machines can be calibrated using calibrated weights in the pattern of the designated OIML class.</p> <p>PC18. Lab cannot calibrate balances using lower class of accuracy weights than required.</p> 
<p>Ensure Metrological Requirements are met</p>	<p>To be competent, the individual must be able to:</p> <p>PC19. Follow SOP guidelines regarding Metrological requirements.</p> <p>PC20. Reference and Standard weights used for calibration of weighing balance and comparator shall follow the requirement of OIML R-111-1.</p> <p>PC21. Place of Calibration: Calibration shall be performed at the place where the balance is being used.</p> <p>PC22. Lab cannot calibrate balances using lower class of accuracy weights than required.</p> 

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Calibration of Weighing Balance and Mass Comparator

<p>Choose Measurement Method</p>	<p>To be competent, the individual must be able to:</p> <p>PC23. Follow SOP guidelines. Recommended to refer to the standard OIML R 76-1 or Euramet guidelines cg -18 V.03 on the calibration of non-automatic weighing instruments.</p> <p>PC24. Perform steps of calibration</p> <ul style="list-style-type: none"> • Applying test loads to the instrument under specified conditions, • Determining the error or variation of the indication, and • Evaluating the uncertainty of measurement to be attributed to the results <p>PC25. Follow calibration Procedure for Performance Check of balances to include:</p> <p>i) Repeatability Test</p> <p>This test is carried out at max load capacity and half load capacity of the balance under calibration. At least 10 readings for balance upto 10 kg and 5 readings for balance above 10 kg shall be taken and the standard deviation gives the repeatability values. Maximum of the two should be considered for uncertainty calculation.</p> <p>ii) Linearity Test or Departure of Indication from the Nominal Value The departure of indication from nominal value or the linearity of the scale is measured at sufficiently equally spaced points over the ranges of the balance to ensure safe interpolation, if needed between these points. Usually minimum 10 such readings are taken including no load and the maximum capacity load.</p> <p>iii) Eccentricity Test This test is carried out at a load recommended by the manufacturer of the balance or if it is not known a load between one-third (1/3) and half (1/2) of the maximum capacity of the balance may be used. A single weight should be used for this test.</p> <p>iv) Hysteresis Test (if the Balance is calibrated first time or after a major repair) This test is required to be carried out only if the balance is calibrated for the first time or after a major repair.</p>
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Calibration of Weighing Balance and Mass Comparator

<p>Perform Measurements</p>	<p>To be competent, the individual must be able to:</p> <p>PC26. Follow the measurement procedure for the method chosen per SOP.</p> <p>PC27. Make measurements using the Reference Weights, the Comparator instrument and the UUC, following the prescribed measurement sequence.</p> <p>PC28. Do Performance Check for the Balance Calibration, as specified in SOP</p> <ol style="list-style-type: none"> a. Repeatability b. Linearity or departure of indication c. Eccentricity d. Hysteresis (if the Balance is calibrated first time or after a major repair) <p>PC29. Record the number of readings, as prescribed in the SOP.</p> <p>PC30. Record readings of ambient temperature and relative humidity and the air pressure at the beginning and end of measurements using recommended devices.</p>
<p>Perform Calculations</p>	<p>To be competent, the individual must be able to:</p> <p>PC31. Refer to SOP for the equations to use for the type of calibration being performed</p> <p>PC32. Use form/format specified in the SOP for performing calculations</p> <p>PC33. Perform the required calculations using calculator or software as specified, using the equations and procedures specified in the SOP.</p> <p>PC34. Determine Air Density and its Uncertainty, per SOP guidelines</p> <p>PC35. Use Equations for Determination of Conventional Mass, True mass and their uncertainties</p> <p>PC36. Determine Uncertainty Components in Balance Calibration (u_{ba}) The components of measurement uncertainty to be considered, but are not limited to the following:</p> <ul style="list-style-type: none"> • Repeatability • Linearity or departure of indication • Resolution • Reference standard weights • Drift in mass or instability of the mass of weights used • Eccentricity (whenever the test is carried out) <p>PC37. Calculate Combined Standard Uncertainty of the Weighing Balance.</p> <p>PC38. Calculate Expanded uncertainty, $U = k \times u$</p>

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Calibration of Weighing Balance and Mass Comparator

	<p>PC39. Calculate the overall uncertainty of the balance. It is the limit of the performance (F) of the balance given by:</p> $F = k * SD(\max) + C_{\max} + U(C_{\max})$ <p>Where, SD(max) = the maximum standard deviation of repeatability at half load and full load Cmax = magnitude of the maximum correction for the balance reading U(Cmax) = the expanded uncertainty associated with Cmax the correction of the balance</p>
<p>Prepare Calibration Report</p>	<p>To be competent, the individual must be able to:</p> <p>PC40. Record the results, including uncertainty, as calculated above, in the specified format</p> <p>PC41. Prepare Report in the format specified in the SOP. The calibration certificates issued to the customer shall be in accordance with clause of ISO/IEC/17025:2005. It also includes the following:</p> <ol style="list-style-type: none"> Thermal stabilization hours taken before calibration. Class of weight used for calibration depending on the class of accuracy of balance Environmental conditions during calibration Exact location of the balance during calibration Declaration that, the calibration certificate issued for weighing balance used for scientific or industrial purposes only. <p>PC42. Perform Verification of Comparator, if required in SOP</p> <p>PC43. To verify the performance of the comparator same procedure shall be followed to ascertain its performance as per manufacturer specification. Only uncertainty due to standard deviation (from repeatability) is considered during calibration of weights. No other components like eccentricity, error of indication etc. are taken into account for a comparator.</p> <p>PC44. Store and share report with the designated persons</p>
<p>Calibration of Volumetric Apparatus</p>	<p>To be competent, the individual must be able to:</p> <p>PC45. Return the Reference instruments to their recommended storage position and put in their box/cover</p> <p>PC46. Return the UUC to its recommended storage position and put in its accompanying box/cover</p> <p>PC47. Fix/Attach any recommended tag/markings on the UUC to signify that its calibration has been done</p>

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Calibration of Weighing Balance and Mass Comparator

Knowledge and Understanding (K)	
<p>A. Organizational context (Knowledge of the company / organization and its process relevant to areas of responsibilities)</p>	<p>KA1. The requirements of performing Weight Balance Calibration and how it impacts organization process and business.</p> <p>KA2. The role of calibration in the organization (whether part of the end user Production and Quality Assurance process or of a Calibration Service Provider)</p> <p>KA3. The Certification of the organization and their capability to perform calibration tests according to accepted level of standards.</p> <p>KA4. The impact of calibration quality on the company business</p> <p>KA5. Knows about the Standard Operating Procedures and its importance</p> <p>KA6. Follows the SOPs rigorously and takes guidance from the Calibration Supervisor when in doubt.</p> <p>KA7. Records any non-compliance to SOP and reports it to the Calibration Supervisor and takes guidance.</p>
<p>B. Technical Knowledge</p>	<p>KB1. Knows about and understands how Weight Balance Calibration is performed.</p> <p>KB2. Knows about the sources of errors in the calibration process, how these are avoided and its impact on calibration accuracy.</p> <p>KB3. Familiar with:</p> <ul style="list-style-type: none"> • What is Weight Balance Calibration • Why is Weight Balance calibration needed • Traceability of the calibration of instruments performing the tests • What are Weight Balance Equipment • Types of Weight Balance Devices, ranges and applications • Types of Weight Balance Calibration • Sources of inaccuracies in Weight Balance measurements and how to avoid / minimize these • Equipment needed for Weight Balance Calibration • Deriving calibration results - data processing and interpretation
Skill(S)	
<p>A. Core Skills / Generic Skills</p>	<p>Writing skills</p> <p>The individual on the job needs to know and understand how to:</p> <p>SA1. Use Formats and check list for Weight Balance calibration and reports</p> <p>SA2. Write emails and messages about calibration related issues</p>
	<p>Reading Skills</p>

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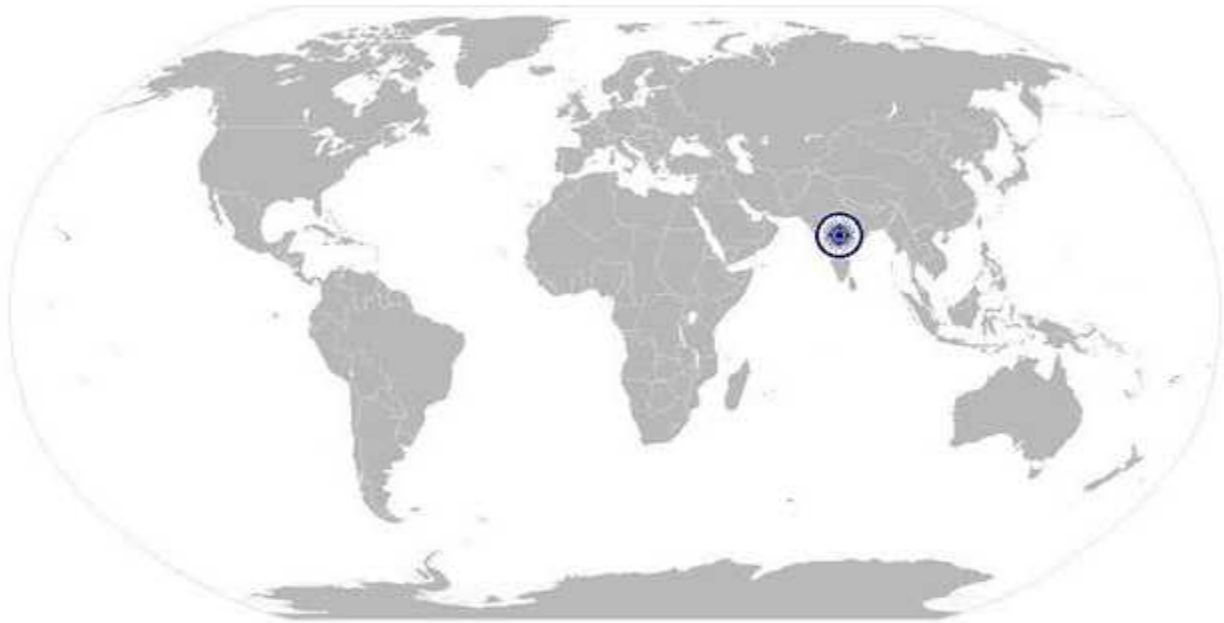
Calibration of Weighing Balance and Mass Comparator

	<p>The individual on the job needs to read and understand how to:</p> <p>SA3. Company policy related to Weight Balance calibration SA4. Terminology, symbols, codes, standards, methods and common practices related Weight Balance Calibration SA5. Data processing steps, Uncertainty Calculations and reporting of results related to Weight Balance calibration. SA6. Formats and check list for Weight Balance Calibration</p>
	<p>Oral Communication (Listening and Speaking skills)</p>
	<p>The individual on the job needs to know and understand how to:</p> <p>SA7. Communicate with the Calibration Supervisor for task scheduling, task reporting and exception reporting SA8. Communicate to the management in meetings about process or equipment issues which need management attention</p>
	<p>Decision Making</p>
B. Professional Skills	<p>The individual on the job needs to know and understand how to:</p> <p>SB1. Make decisions about what calibration to perform and consult Supervisor if needed</p>
	<p>Plan and Organize</p>
	<p>The individual on the job needs to know and understand how to:</p> <p>SB2 . Prioritize daily tasks and batches of calibration efficiently and effectively to meet client and company needs</p>
	<p>Customer Centricity</p>
	<p>The user/individual on the job needs to know and understand how to:</p> <p>SB3. Real needs of the customer and suggest most appropriate solution SB4. Support customer when they need help</p>
	<p>Problem Solving</p>
	<p>The individual on the job needs to know and understand how to:</p> <p>SB5. Diagnose reasons for any down time in the calibration setup SB6. Identify immediate or temporary solutions to resolve delays and discuss with the Supervisor</p>
	<p>Analytical Thinking</p>

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Calibration of Weighing Balance and Mass Comparator

	<p>The user/individual on the job needs to know and understand how to:</p> <p>SB7. Use the existing information to arrive at actionable decision points</p> <p>SB8. Use the existing information for improving the customer satisfaction</p>
	<p>Critical Thinking</p>
	<p>The user/individual on the job needs to know and understand how to:</p> <p>SB9. Apply, analyze, and evaluate the information gathered from observation, experience, reasoning, or communication, as a guide to thought and action</p>



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Calibration of Weighing Balance and Mass Comparator

NOS Version Control

NOS Code	IAS/N0517		
Credits (NSQF)	TBD	Version number	1.0
Sector	Instrumentation, Automation Surveillance and Communication	Drafted on	31/08/2017
Sub-sector	Instrumentation	Last reviewed on	31/08/2017
Occupation	Testing & Calibration	Next review date	31/08/2019

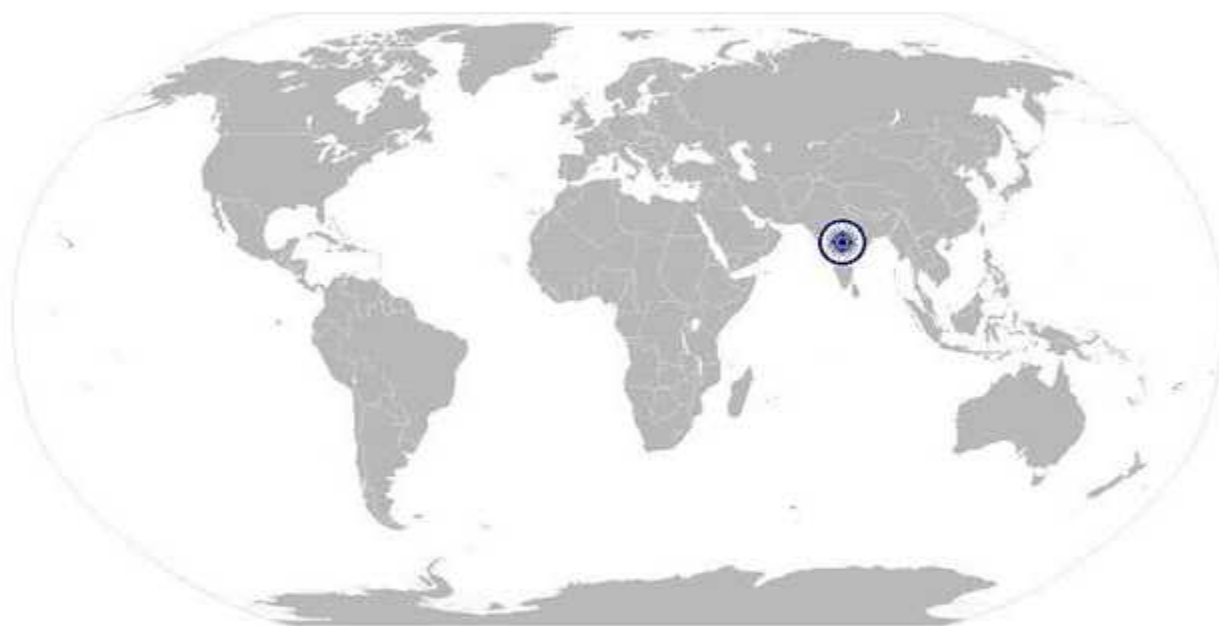


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IAS/N0518

Calibration of Volumetric Apparatus

National Occupational Standard



Overview

This unit is about Calibration of a range of Volumetric Apparatus according to the SOP of the organization

IAS/N0518

Calibration of Volumetric Apparatus

National Occupational Standard

Unit Code	IAS/N0518
Unit title (Task)	Calibration of Volumetric Apparatus
Description	The OS unit is about Calibration of a range of Volumetric Apparatus according to the SOP of the organization
Scope	<p>The unit task covers the following:</p> <ul style="list-style-type: none"> • Plan and prepare for calibration • Select Reference Weights and Comparator/Balance • Ensure Metrological Requirements • Choose Measurement Method • Perform Measurements • Perform Calculations • Prepare Calibration Report • Restore the Reference instruments and UUC to their respective condition and places 

IAS/N0518

Calibration of Volumetric Apparatus

Performance Criteria (PC) with respect to the scope	
Element	Performance Criteria
Plan and prepare for calibration	<p>To be competent, the individual must be able to:</p> <p>PC1. Prepare Observation Sheet (use a standard form/format as specified in the SOP)</p> <p>PC2. Note in the Observation Sheet the details of the UUC (requesting company, lab reference number, type, make, model, serial number, date, time, technician's name etc.)</p> <p>PC3. Verify that the UUC is in good shape (i.e. no physical damage, readable markings, clean, no loose parts etc.)</p> <p>PC4. Note all parameters to measure for the requested calibration</p> <p>PC5. Note the number of readings to be taken for each parameter</p> <p>PC6. Note the Reference Instruments to use for the parameters</p> <p>PC7. Wear gloves while handling instruments</p> <p>PC8. Verify that the Reference Instruments are available and are in good shape (i.e. usable for calibration, have valid certificates)</p> <p>PC9. Verify that the measurement environment is appropriate for the reference instruments</p> <p>PC10. Record readings of ambient temperature, relative humidity and atmospheric pressure, with required precision using recommended devices</p>
Select Reference Apparatus and Reference Liquid for Volumetric Calibration	<p>To be competent, the individual must be able to:</p> <p>PC11. Follow the SOP guidelines and consult the Supervisor for selection of Reference Liquid.</p> <p>PC12. Ensure that the balance used as reference for calibration has traceability certificate and meets the requirements mentioned below.</p> <p>PC13. Ensure that the balance used for calibration of volumetric apparatus has a readability / resolution of the order of 1/3rd of accuracy specified for volumetric apparatus.</p> <p>PC14. Ensure that weighing balances for calibration of volumetric apparatus are as per IS/ISO 4787:2010.</p> <p>PC15. Ensure that requirements of balances for micro pipette calibration are as per ISO 8655-6.</p> <p>PC16. Ensure availability of other devices needed:</p> <ul style="list-style-type: none"> • Timing Device • Thermometer for measuring temperature of calibration liquid (water) • Hydrometer • Barometer

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Calibration of Volumetric Apparatus

<p>Ensure Metrological Requirements are met</p>	<p>To be competent, the individual must be able to:</p> <p>PC17. Follow SOP guidelines regarding Metrological requirements.</p> <p>PC18. Prefer Volume Measurement by Gravimetric Method</p> <ul style="list-style-type: none"> • Mass volume of the distilled water dispensed from a volumetric instrument is measured with a balance and then corrected to a dispensed quantity (volumetric value). No method can measure directly the physical quantity of a minute volume. Therefore the most common and precise method is to measure the mass value of distilled water, whose physical properties are known using a balance and then convert the mass to a volumetric value. <p>PC19. Use balance and the thermometer only for volume calibration.</p> <ul style="list-style-type: none"> • The variation in measured results due to barometric fluctuation is negligible and in practice it will be sufficient to set and use a representative value (fixed value) of the location of measurement. <p>PC20. Correct for Density variation of distilled water due to temperature change and correction for buoyancy.</p> <p>PC21. Take extreme care in dispensing volume of volumetric apparatus, as it is known to be influenced by operator skill.</p>
<p>Choose Measurement Method</p>	<p>To be competent, the individual must be able to:</p> <p>PC22. Follow SOP guidelines for selecting calibration method.</p> <p>PC23. Calibration of volumetric apparatus can be done either of the following two methods:</p> <ul style="list-style-type: none"> • Gravimetric Method (preferred) • Volumetric Method <p>Recommended method for Volume Measurement is Gravimetric Method.</p> <p>PC24. For Calibration Procedure (Based on Gravimetric Method):</p> <ul style="list-style-type: none"> • Use method based on IS/ISO 4787:2010 for Laboratory glass ware - volumetric instruments. This is applicable for calibration of volumetric instruments made from glass for the range above 0.1ml to 10000 ml, in order to obtain the best accuracy in use. • Use method based on ISO 8655-6, 2002 for piston operated volumetric apparatus. This is applicable for $\leq 1\mu\text{l}$ to 200 ml volumetric apparatus: <ol style="list-style-type: none"> a. Single –channel piston pipettes with air interface (as per ISO 8655-2) follow clause 7.2 of the above standard. b. Multi-channel piston pipettes (as per ISO 8655-2) follow clause 7.3 of the above standard. c. Positive –displacement pipettes (as per ISO 8655-2) follow clause 7.4 of the above standard. d. Piston burettes (as per ISO 8655-3) follow clause 7.5 of the above standard. e. Diluters (as per ISO 8655-4) follow clause 7.6 of the above standard. f. Dispensers (as per ISO8655-5) follow clause 7.6 of the above standard. • The standard reference temperature is the temperature at which the volumetric instrument is intended to contain or deliver its


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Calibration of Volumetric Apparatus

	<p>volume (capacity). It shall be 27°C (for tropical countries like India).</p> <p>PC25. Perform Mass Measurement using Balance</p> <p>PC26. Mass to Volume Conversion uses the density of the distilled water (approximately 1g/ ml). Variation of volume with change in temperature of water is to be taken into account.</p>
<p>Perform Measurements</p>	<p>To be competent, the individual must be able to:</p> <p>PC27. Follow the measurement procedure for the method chosen per SOP.</p> <p>PC28. Make measurements using the Reference Weights, the Comparator instrument and the UUC, following the prescribed measurement sequence.</p> <p>PC29. Do Performance Check for the Balance Calibration, as specified in SOP</p> <ul style="list-style-type: none"> • Repeatability • Linearity or departure of indication • Eccentricity • Hysteresis (if the Balance is calibrated first time or after a major repair) <p>PC30. Record the number of readings, as prescribed in the SOP.</p> <p>PC31. Record readings of ambient temperature and relative humidity and the air pressure at the beginning and end of measurements using recommended devices.</p>
<p>Perform Calculations</p>	<p>To be competent, the individual must be able to:</p> <p>PC32. Refer to SOP for the equations to use for the type of calibration being performed</p> <p>PC33. Use form/format specified in the SOP for performing calculations</p> <p>PC34. Perform the required calculations using calculator or software as specified, using the equations and procedures specified in the SOP.</p> <p>PC35. Use appropriate Equation for Calculation of Volume, per SOP.</p> <p>PC36. Calculate the effect of Evaporation</p> <p>PC37. Especially for small volumes below 50 µl, errors due to evaporation of the test liquid during weighing shall be taken in to consideration. Apart from the design of the weighing vessel, the test cycle time is important.</p> <p>PC38. In order to keep the error due to evaporation as small as possible, the following additional items can be considered, if volumes below 50 µl are tested:</p> <ul style="list-style-type: none"> • a balance with appropriate accessories such as an evaporation trap could be used ; • Or, the test liquid to be weighed could be delivered in to a capillary tube, although this method does not replicate the normal method of use and the user should verify for himself that correlation exists. <p>Regardless of these items, the error due to evaporation during the measuring series can be determined experimentally (see 7.2.8 of the standard ISO 8655-6) and compensated mathematically (see 8.1 of the standard ISO 8655-6). The uncertainty of this compensation should be added to the uncertainty of measurement.</p> <p>PC39. Determine Measurement Uncertainty, per SOP guidelines. The</p>

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Calibration of Volumetric Apparatus

	<p>following components of uncertainty are considered:</p> <ol style="list-style-type: none"> a. Uncertainty in Measurement repeatability (type A) b. Uncertainty of the balance including linearity* c. Uncertainty in water temperature measurement d. Uncertainty Water Density e. Uncertainty Air density f. Uncertainty Coefficient of expansion of the material of the volumetric apparatus g. Uncertainty due to reference mass and its drift* h. Uncertainty of density of the reference mass* i. Uncertainty due to meniscus j. Uncertainty due to evaporation (below 50 μl) <p>PC40. Calculate Combined Uncertainty per SOP guidelines</p> 
<p>Prepare Calibration Report</p>	<p>To be competent, the individual must be able to:</p> <p>PC41. Record the results, including uncertainty, as calculated above, in the specified format</p> <p>PC42. Prepare Report in the format specified in the SOP.</p> <p>PC43. Store and share report with the designated persons</p>
<p>Restore the Reference instruments and UUC to their respective condition and places</p>	<p>To be competent, the individual must be able to:</p> <p>PC44. Return the Reference instruments to their recommended storage position and put in their box/cover</p> <p>PC45. Return the UUC to its recommended storage position and put in its accompanying box/cover</p> <p>PC46. Fix/Attach any recommended tag/markings on the UUC to signify that its calibration has been done</p>
<p>Knowledge and Understanding (K)</p>	

IAS/N0518

Calibration of Volumetric Apparatus

<p>A. Organizational context (Knowledge of the company / organization and its process relevant to areas of responsibilities)</p>	<p>KA1. The requirements of performing Volumetric Apparatus Calibration and how it impacts organization process and business.</p> <p>KA2. The role of calibration in the organization (whether part of the end user Production and Quality Assurance process or of a Calibration Service Provider)</p> <p>KA3. The Certification of the organization and their capability to perform calibration tests according to accepted level of standards.</p> <p>KA4. The impact of calibration quality on the company business</p> <p>KA5. Knows about the Standard Operating Procedures and its importance</p> <p>KA6. Follows the SOPs rigorously and takes guidance from the Calibration Supervisor when in doubt.</p> <p>KA7. Records any non-compliance to SOP and reports it to the Calibration Supervisor and takes guidance.</p>
<p>B. Technical Knowledge</p>	<p>KB1. Knows about and understands how Volumetric Apparatus Calibration is performed.</p> <p>KB2. Knows about the sources of errors in the calibration process, how these are avoided and its impact on calibration accuracy.</p> <p>KB3. Familiar with:</p> <ul style="list-style-type: none"> • What is Volumetric Calibration • Why is Volumetric calibration needed • Traceability of the calibration of instruments performing the tests • What are Volumetric devices • Types of Volumetric, ranges and applications • Types of Volumetric Calibration • Sources of inaccuracies in Volumetric Apparatus measurements and how to avoid / minimize these • Equipment needed for Volumetric Apparatus Calibration • Deriving calibration results - data processing and interpretation
<p>Skill(S)</p>	
<p>A. Core Skills / Generic Skills</p>	<p>Writing skills</p> <p>The individual on the job needs to know and understand how to:</p> <p>SA1. Use Formats and check list for Volumetric Apparatus calibration and reports</p> <p>SA2. Write emails and messages about calibration related issues</p> <p>Reading Skills</p>

IAS/N0518

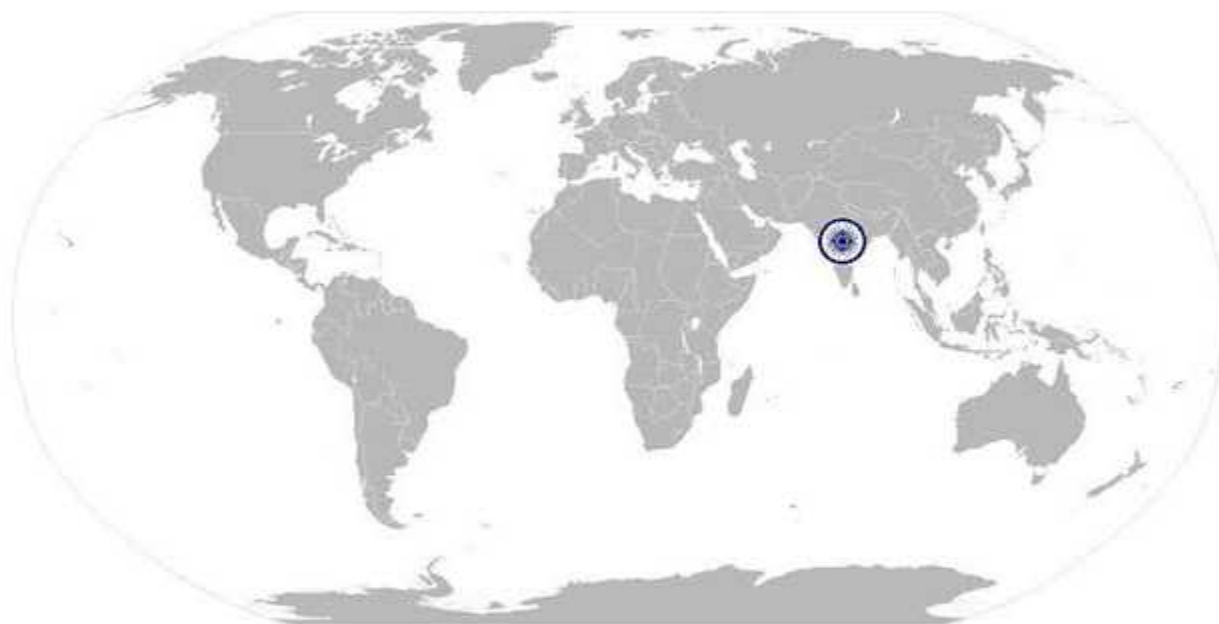
Calibration of Volumetric Apparatus

	<p>The user/ individual on the job needs to know and understand how to:</p> <p>SA3. Company policy related to Volumetric Apparatus calibration SA4. Terminology, symbols, codes, standards, methods and common practices related to Volumetric Apparatus Calibration SA5. Data processing steps, Uncertainty Calculations and reporting of results related to Volumetric Apparatus calibration. SA6. Formats and check list for Volumetric Calibration</p> <p>Oral Communication (Listening and Speaking skills)</p> <p>The individual on the job needs to know and understand how to:</p> <p>SA7. Communicate with the Calibration Supervisor for task scheduling, task reporting and exception reporting SA8. Communicate to the management in meetings about process or equipment issues which need management attention</p>
<p>B. Professional Skills</p>	<p>Decision Making</p>
	<p>The individual on the job needs to know and understand how to:</p> <p>SB1 . Make decisions about what calibration to perform and consult Supervisor if needed</p>
	<p>Plan and Organize</p>
	<p>The individual on the job needs to know and understand how to:</p> <p>SB2. Prioritize daily tasks and batches of calibration efficiently and effectively to meet client and company needs</p>
	<p>Customer Centricity</p>
	<p>The user/individual on the job needs to know and understand how to:</p> <p>SB3. Real needs of the customer and suggest most appropriate solution SB4. Support customer when they need help</p>
	<p>Problem Solving</p>
	<p>The individual on the job needs to know and understand how to:</p> <p>SB5. Diagnose reasons for any down time in the calibration setup SB6. Identify immediate or temporary solutions to resolve delays and discuss with the Supervisor</p>
<p>Analytical Thinking</p>	
<p>The user/individual on the job needs to know and understand how to:</p> <p>SB7. Use the existing information to arrive at actionable decision points SB8. Use the existing information for improving the customer satisfaction</p>	

IAS/N0518

Calibration of Volumetric Apparatus

	Critical Thinking
	<p>The user/individual on the job needs to know and understand how to:</p> <p>SB9. Apply, analyze, and evaluate the information gathered from observation, experience, reasoning, or communication, as a guide to thought and action</p>



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Calibration of Volumetric Apparatus

NOS Version Control

NOS Code	IAS/N0518		
Credits (NSQF)	TBD	Version number	1.0
Sector	Instrumentation, Automation Surveillance and Communication	Drafted on	31/08/2017
Sub-sector	Instrumentation	Last reviewed on	31/08/2017
Occupation	Testing & Calibration	Next review date	31/08/2019



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IAS/N0519

Calibration of Density of Solids

National Occupational Standard



Overview

This unit is about Calibration of Density of Solids per standard OIML G14 and Density of standard weights according to the Standard Operating Procedures (SOP) of the organization.

IAS/N0519

Calibration of Density of Solids

National Occupational Standard

Unit Code	IAS/N0519
Unit title (Task)	Calibration of Density of Solids
Description	The OS unit is about calibration of Density of Solids per standard OIML G14 and Density of standard weights per standard OIML R111-1, following the organization SOP.
Scope	<p>The unit/task covers the following :</p> <ul style="list-style-type: none"> • Plan and prepare for measurement • Select Reference Weights and Comparator/Balance • Ensure Metrological Requirements • Choose Measurement Method • Perform Measurements • Perform Calculations • Prepare Calibration Report • Restore the Reference instruments and UUC to their respective condition and places
Performance Criteria (PC) with respect to the scope	
Element	Performance Criteria
Plan and prepare for calibration	<p>To be competent, the individual must be able to:</p> <p>PC1. Prepare Observation Sheet (use a standard form/format as specified in the SOP)</p> <p>PC2. Note in the Observation Sheet the details of the UUC (requesting company, lab reference number, type, make, model, serial number, date, time, technician's name etc.)</p> <p>PC3. Verify that the UUC is in good shape (i.e. no physical damage, readable markings, clean, no loose parts etc.)</p> <p>PC4. Note all parameters to measure for the requested calibration</p> <p>PC5. Note the number of readings to be taken for each parameter</p> <p>PC6. Note the Reference Instruments to use for the parameters</p> <p>PC7. Wear gloves while handling instruments</p> <p>PC8. Verify that the Reference Instruments are available and are in good shape (i.e. usable for calibration, have valid certificates)</p> <p>PC9. Verify that the measurement environment is appropriate for the reference instruments</p> <p>PC10. Record readings of ambient temperature, relative humidity and atmospheric pressure, with required precision using recommended devices</p>

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Calibration of Density of Solids

<p>Select Reference Weights and Comparator/Balance</p>	<p>To be competent, the individual must be able to:</p> <p>PC11. Follow the SOP guidelines and consult the Supervisor for selection of Reference Weights and Comparator/Balance.</p> <p>PC12. The design and accuracy of weights shall be appropriate to the weighing machine being calibrated, and where possible should have a 95% confidence level uncertainty of calibration less than half the smallest digit size or recorded scale interval of the weighing machine to be calibrated. Where groups of weights are to be used to make up a single load, this criterion shall be applied to the arithmetic sum of the weight's individual calibration uncertainties.</p> <p>PC13. Weighing machines can usually be calibrated using calibrated weights in the pattern of the designated OIML class. The uncertainty of calibration of the weights used will be 1/3 of its specified maximum permissible error. When selecting suitable weights, attention shall also be given to properties of the weights other than accuracy, such as magnetism, corrosion and wear resistance.</p> <p>PC14. Lab cannot calibrate balances using lower class of accuracy weights than required.</p>
<p>Ensure Metrological Requirements are met</p>	<p>To be competent, the individual must be able to:</p> <p>PC15. Follow SOP guidelines regarding Metrological requirements.</p> <p>PC16. For Density measurement of Standard weights follow the requirements of OIML R-111-1 and density of solids.</p>
<p>Choose Measurement Method</p>	<p>To be competent, the individual must be able to:</p> <p>PC17. Follow the guidelines for method selection per SOP.</p> <p>PC18. Choose one of the two methods for determination of density solids:</p> <p>PC19. Hydrostatic weighing method: Usually the sample of solid is weighed in Air and weighed in water or known reference density liquid and the difference in weighing is converted in to volume and the Refer the standard OIML G14 for further details. For determination of Standard weights OIML R-111-1 shall be followed.</p> <p>PC20. Determination of Density of Solid matter using Pycnometer. Pycnometer can be used to determine the density of homogeneous solid object that do not dissolve in working liquid (distilled water). Pycnometer is a glass measure having a fixed volume V.</p>

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Calibration of Density of Solids

<p>Perform Measurements</p>	<p>To be competent, the individual must be able to:</p> <p>PC21. Follow the measurement procedure for the method chosen per SOP.</p> <p>PC22. For Hydrostatic weighing method,</p> <ol style="list-style-type: none"> a. The density of a solid is determined with the aid of a liquid whose density is known (water or ethanol are usually used as auxiliary liquids). The solid is weighed in air (A) and then in auxiliary liquid (B), the density of the solid is then calculated using appropriate equation. b. The volume of the solid is calculated using appropriate equation. <p>PC23. For Determination of Density of Solid matter using Pycnometer, follow the steps specified in the SOP.</p> <p>PC24. Do Performance Check for the Balance Calibration, as specified in SOP</p> <ol style="list-style-type: none"> a. Repeatability b. Linearity or departure of indication c. Eccentricity d. Hysteresis (if the Balance is calibrated first time or after a major repair) <p>PC25. Record the number of readings, as prescribed in the SOP.</p> <p>PC26. Record readings of ambient temperature and relative humidity and the air pressure at the beginning and end of measurements using recommended devices.</p>
<p>Perform Calculations</p>	<p>To be competent, the individual must be able to:</p> <p>PC27. Refer to SOP for the equations to use for the type of calibration being performed</p> <p>PC28. Use form/format specified in the SOP for performing calculations</p> <p>PC29. Perform the required calculations using calculator or software as specified, using the equations and procedures specified in the SOP.</p> <p>PC30. Determine Uncertainty contributions for weighing process, per SOP guidelines. The components of uncertainty include:</p> <ol style="list-style-type: none"> a. Balance – Repeatability, resolution, linearity b. Reference standard weight c. Density of reference liquid- density, surface tension and temperature d. Air density <p>PC31. Calculate Combined Uncertainty per SOP guideline.</p> <p>PC32. Calculate Expanded Uncertainty</p>
<p>Prepare Calibration Report</p>	<p>To be competent, the individual must be able to:</p> <p>PC33. Record the results, including uncertainty, as calculated above, in the specified format</p> <p>PC34. Prepare Report in the format specified in the SOP.</p> <p>PC35. Store and share report with the designated persons</p>

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Calibration of Density of Solids

<p>Restore the Reference instruments and UUC to their respective condition and places</p>	<p>To be competent, the individual must be able to:</p> <p>PC36. Return the Reference instruments to their recommended storage position and put in their box/cover</p> <p>PC37. Return the UUC to its recommended storage position and put in its accompanying box/cover</p> <p>PC38. Fix/Attach any recommended tag/markings on the UUC to signify that its calibration has been done</p>
<p>Knowledge and Understanding (K)</p>	
<p>A. Organizational context (Knowledge of the company / organization and its process relevant to areas of responsibilities)</p>	<p>KA1. The requirements of performing Density Calibration and how it impacts organization process and business.</p> <p>KA2. The role of calibration in the organization (whether part of the end user Production and Quality Assurance process or of a Calibration Service Provider)</p> <p>KA3. The Certification of the organization and their capability to perform calibration tests according to accepted level of standards.</p> <p>KA4. The impact of calibration quality on the company business</p> <p>KA5. Knows about the Standard Operating Procedures and its importance</p> <p>KA6. Follows the SOPs rigorously and takes guidance from the Calibration Supervisor when in doubt.</p> <p>KA7. Records any non-compliance to SOP and reports it to the Calibration Supervisor and takes guidance.</p>
<p>B. Technical Knowledge</p>	<p>KB1. Knows about and understands how Density Calibration is performed.</p> <p>KB2. Knows about the sources of errors in the calibration process, how these are avoided and its impact on calibration accuracy.</p> <p>KB3. Familiar with:</p> <ul style="list-style-type: none"> • What is Density Calibration • Why is Density calibration needed • Traceability of the calibration of instruments performing the tests • What are Density Calibration • Types of Density Calibration Equipment, ranges and applications • Types of Calibration • Sources of inaccuracies in Density measurements and how to avoid / minimize these • Equipment needed for Density Calibration • Deriving calibration results - data processing and interpretation
<p>Skill(S)</p>	
<p>A. Core Skills /</p>	<p>Writing skills</p>

IAS/N0519

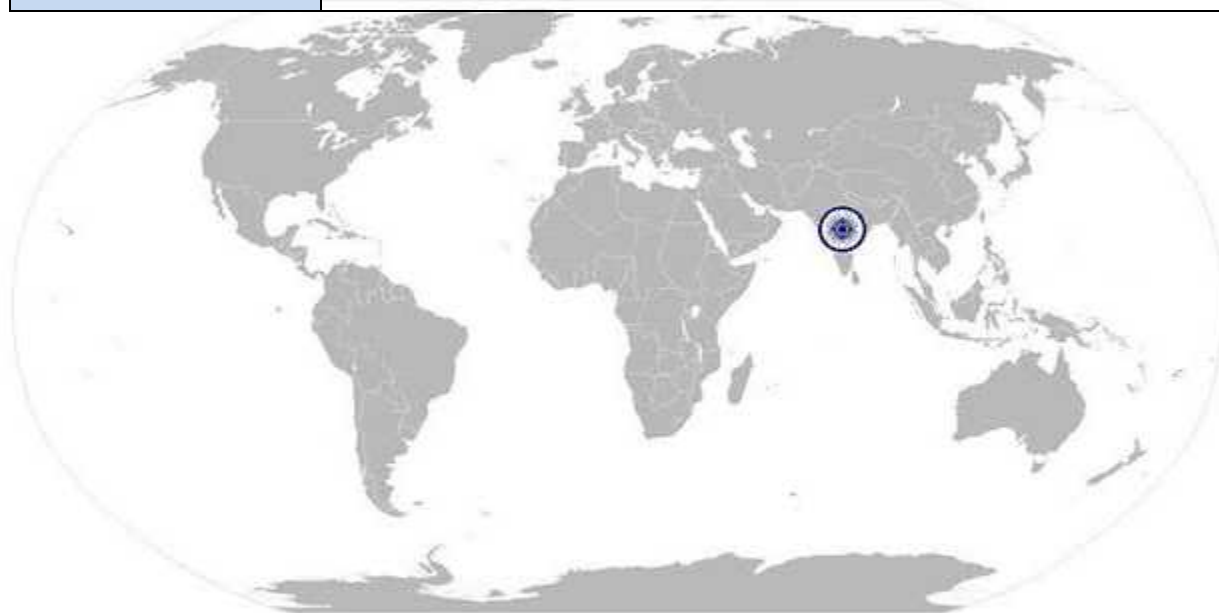
Calibration of Density of Solids

Generic Skills	<p>The individual on the job needs to know and understand how to:</p> <p>SA1. Use Formats and check list for Density calibration and reports SA2. Write emails and messages about calibration related issues</p>
	Reading Skills
	<p>The individual on the job needs to read and understand how to:</p> <p>SA3. Company policy related to Density calibration SA4. Terminology, symbols, codes, standards, methods and common practices related to Density Calibration SA5. Data processing steps, Uncertainty Calculations and reporting of results related to Density calibration. SA6. Formats and check list Density Calibration</p>
	Oral Communication (Listening and Speaking skills)
	<p>The individual on the job needs to know and understand how to:</p> <p>SA7. Communicate with the Calibration Supervisor for task scheduling, task reporting and exception reporting SA8. Communicate to the management in meetings about process or equipment issues which need management attention</p>
B. Professional Skills	Decision Making
	<p>The individual on the job needs to know and understand how to:</p> <p>SB1. Make decisions about what calibration to perform and consult Supervisor if needed</p>
	Plan and Organize
	<p>The individual on the job needs to know and understand how to:</p> <p>SB2. Prioritize daily tasks and batches of calibration efficiently and effectively to meet client and company needs</p>
	Customer Centricity
	<p>The user/individual on the job needs to know and understand how to:</p> <p>SB3. Understand real needs of the customer and suggest most appropriate solution SB4. Support customer when they need help</p>
	Problem Solving
	<p>The individual on the job needs to know and understand how to:</p> <p>SB5. Diagnose reasons for any down time in the calibration setup SB6. Identify immediate or temporary solutions to resolve delays and discuss with the Supervisor</p>

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Calibration of Density of Solids

	Analytical Thinking
	The user/individual on the job needs to know and understand how to: SB7. Use the existing information to arrive at actionable decision points SB8. Use the existing information for improving the customer satisfaction
	Critical Thinking
	The user/individual on the job needs to know and understand how to: SB9. Apply, analyze, and evaluate the information gathered from observation, experience, reasoning, or communication, as a guide to thought and action



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Calibration of Density of Solids

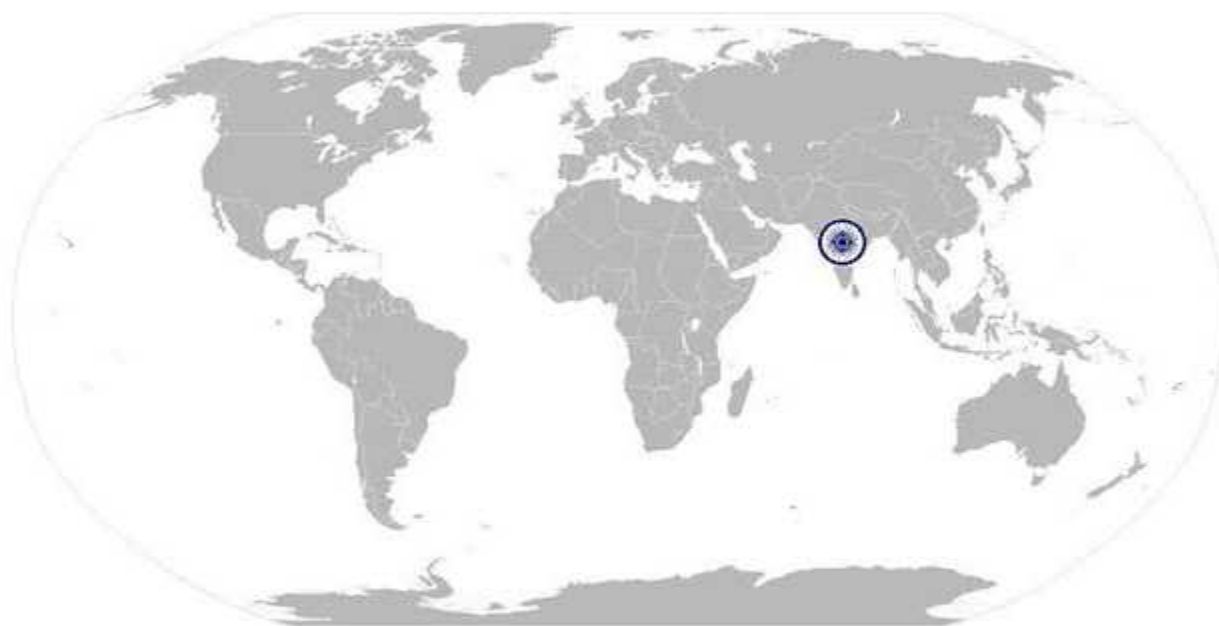
NOS Version Control

NOS Code	IAS/N0519		
Credits (NSQF)	TBD	Version number	1.0
Sector	Instrumentation, Automation Surveillance and Communication	Drafted on	31/08/2017
Sub-sector	Instrumentation	Last reviewed on	31/08/2017
Occupation	Testing & Calibration	Next review date	31/08/2019



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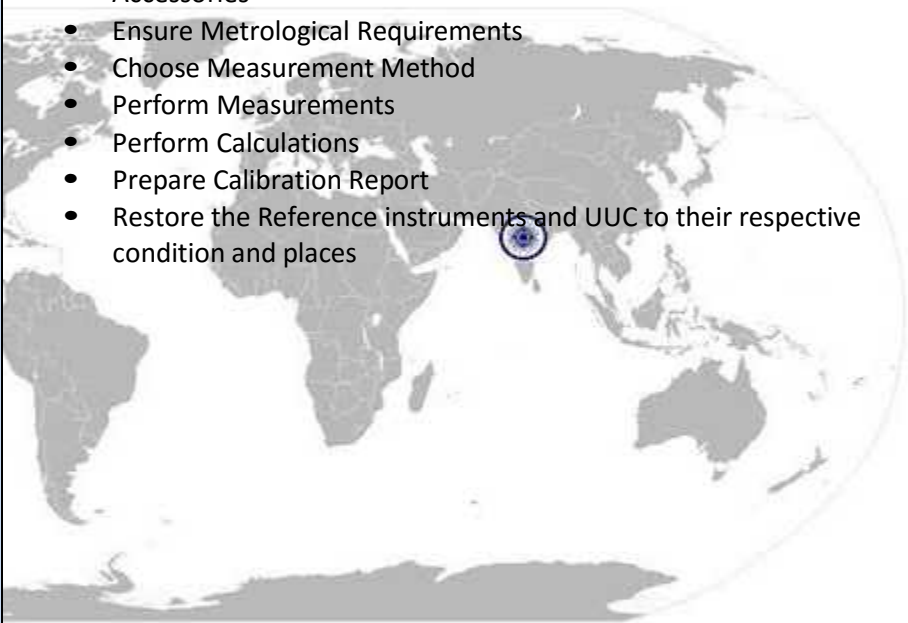
National Occupational Standard



Overview

The OS unit is about calibration of density of a range liquids and of Hydrometers according to standards and following organization SOP

IAS/N0530 Determination of Density of Liquids and Calibration of Density Hydrometers

National Occupational Standard	Unit Code	IAS/N0530
	Unit title (Task)	Determination of Density of Liquids and Calibration of Density Hydrometers
	Description	The OS unit is about calibration of density of a range liquids and of Hydrometers according to standards and following organization SOP.
	Scope	<p>The unit/task covers the following :</p> <ul style="list-style-type: none"> Plan and prepare for measurement Select Reference Weights and Comparator/Balance and Other Accessories Ensure Metrological Requirements Choose Measurement Method Perform Measurements Perform Calculations Prepare Calibration Report Restore the Reference instruments and UUC to their respective condition and places 
	Performance Criteria (PC) with respect to the scope	
Element	Performance Criteria	
Plan and prepare for calibration	<p>To be competent, the individual must be able to:</p> <p>PC1. Prepare Observation Sheet (use a standard form/format as specified in the SOP)</p> <p>PC2. Note in the Observation Sheet the details of the UUC (requesting company, lab reference number, type, make, model, serial number, date, time, technician's name etc.)</p> <p>PC3. Verify that the UUC is in good shape (i.e. no physical damage, readable markings, clean, no loose parts etc.)</p> <p>PC4. Note all parameters to measure for the requested calibration</p>	

IAS/N0530 Determination of Density of Liquids and Calibration of Density Hydrometers

	<p>PC5. Note the number of readings to be taken for each parameter</p> <p>PC6. Note the Reference Instruments to use for the parameters</p> <p>PC7. Wear gloves while handling instruments</p> <p>PC8. Verify that the Reference Instruments are available and are in good shape (i.e. usable for calibration, have valid certificates)</p> <p>PC9. Verify that the measurement environment is appropriate for the reference instruments</p> <p>PC10. Record readings of ambient temperature, relative humidity and atmospheric pressure, with required precision using recommended devices</p>
<p>Select Reference Weights and Comparator/Balance and Other Accessories</p>	<p>To be competent, the individual must be able to:</p> <p>PC11. Follow the SOP guidelines and consult the Supervisor for selection of Reference Weights and Comparator/Balance and other accessories.</p> <p>PC12. For Hydrostatic Weighing (Cuckow’s) Method, select:</p> <ul style="list-style-type: none"> • Weighing Balance, Standard weights, Temperature Sensor with indicator, Tridecane, Water bath, Laser light etc. <p>PC13. For Comparison Method based on Archimedes Principle, the calibration set up consists of: Standard Hydrometers, Standard liquid of known density and other support equipment.</p> <p>PC14. Support Equipment include:</p> <ol style="list-style-type: none"> a. Hydrometer Vessel b. Stirrer c. Thermometer: Long total immersion type thermometer covering a range of -0.5°C to 40.5°C, with a resolution of 0.1°C along with a certificate of scale correction is preferable. d. Chamber: a closed chamber with exhaust system to suck out the fumes of the liquid used. e. Exhaust f. Wooden rectangular board: painted to assist in proper reading of scales.
<p>Ensure Metrological Requirements are met</p>	<p>To be competent, the individual must be able to:</p> <p>PC15. Follow the guidelines for method selection per SOP.</p> <p>PC16. The general classifications of Density Hydrometer are as follows:</p> <ul style="list-style-type: none"> • L20: long scale length, range 20 kg/m³, the density interval 0.2 kg/ m³ with 100 graduations • L50: long scale length, range 50 kg/m³, the density interval 0.5 kg/ m³ with 100 graduations • M50: Medium scale length, range 50 kg/m³, the density interval 1 kg/ m³ with 50 graduations • M100: Medium scale length, range 100 kg/m³, the density interval 2 kg/ m³ with 50 graduations • S50: Short scale length, range 50 kg/m³, the density interval 2 kg/ m³ with 25 graduations • S50SP: Short scale length, range 50 kg/m³, the density interval 1 kg/

IAS/N0530 Determination of Density of Liquids and Calibration of Density Hydrometers

Choose Measurement Method	<p>To be competent, the individual must be able to:</p> <p>PC17. Follow the guidelines for method selection per SOP.</p> <p>PC18. Select one of the two methods for determination of density liquids:</p> <ol style="list-style-type: none"> a. Using Pycnometer (specific gravity bottle) b. Using a hydrometer by comparison <p>PC19. Select one of the two methods for calibration of hydrometers:</p> <ol style="list-style-type: none"> a. Hydrostatic weighing (Cuckow's) method b. Comparison method based on Archimedes principle <p>Hydrometer is calibrated using the method of comparison, in which it is compared with a standard hydrometer whose scale is precisely known.</p>
Perform Measurements	<p>To be competent, the individual must be able to:</p> <p>PC20. Follow the measurement procedures for the methods chosen per SOP.</p> <p>PC21. Determine Density of Liquids using Sinker of known volume. The sinker is weighed in air and then in the liquid whose density is to be determined. The density ρ can be determined from the two weighing using specified equations.</p> <p>PC22. Determine Density of Liquids using Pycnometer following specified procedures and equations.</p> <p>PC23. Perform measurements for Calibration of Hydrometers by Cuckow's Method, based on the three equilibrium equations obtained in different conditions and situations, as specified in SOP.</p> <p>PC24. Perform measurements for Calibration of Hydrometer by Comparison Method, in which the UUC is compared with reference to a standard hydrometer whose scale is precisely known, as specified in SOP.</p> <p>PC25. Record the number of readings, as prescribed in the SOP.</p> <p>PC26. Record readings of ambient temperature and relative humidity and the air pressure at the beginning and end of measurements using recommended devices.</p>

IAS/N0530 Determination of Density of Liquids and Calibration of Density Hydrometers

Perform Calculations	<p>To be competent, the individual must be able to:</p> <p>PC27. Refer to SOP for the equations to use for the type of calibration being performed</p> <p>PC28. Use form/format specified in the SOP for performing calculations</p> <p>PC29. Perform the required calculations using calculator or software as specified, using the equations and procedures specified in the SOP.</p> <p>PC30. For Cuckow`s method, calculate contributions of uncertainty using the following parameters:</p> <ol style="list-style-type: none"> a. Process and procedure contributions(Type A) b. Balance – Repeatability, resolution, linearity c. Reference standard weight d. Density of reference liquid- density, surface tension and temperature e. Hydrometer – reference temperature, reference surface tension, width of scale interval, Thermal expansion coefficient, Diameter of the stem f. Environment -Air density, Local gravity <p>PC31. Calculate Combined Uncertainty per SOP guideline.</p> <p>PC32. Calculate Expanded Uncertainty</p>
Prepare Calibration Report	<p>To be competent, the individual must be able to:</p> <p>PC33. Record the results, including uncertainty, as calculated above, in the specified format</p> <p>PC34. Prepare Report in the format specified in the SOP.</p> <p>PC35. Store and share report with the designated persons</p>
Restore the Reference instruments and UUC to their respective condition and places	<p>To be competent, the individual must be able to:</p> <p>PC36. Return the Reference instruments to their recommended storage position and put in their box/cover</p> <p>PC37. Return the UUC to its recommended storage position and put in its accompanying box/cover</p> <p>PC38. Fix/Attach any recommended tag/markings on the UUC to signify that its calibration has been done</p>
Knowledge and Understanding (K)	

IAS/N0530 Determination of Density of Liquids and Calibration of Density Hydrometers

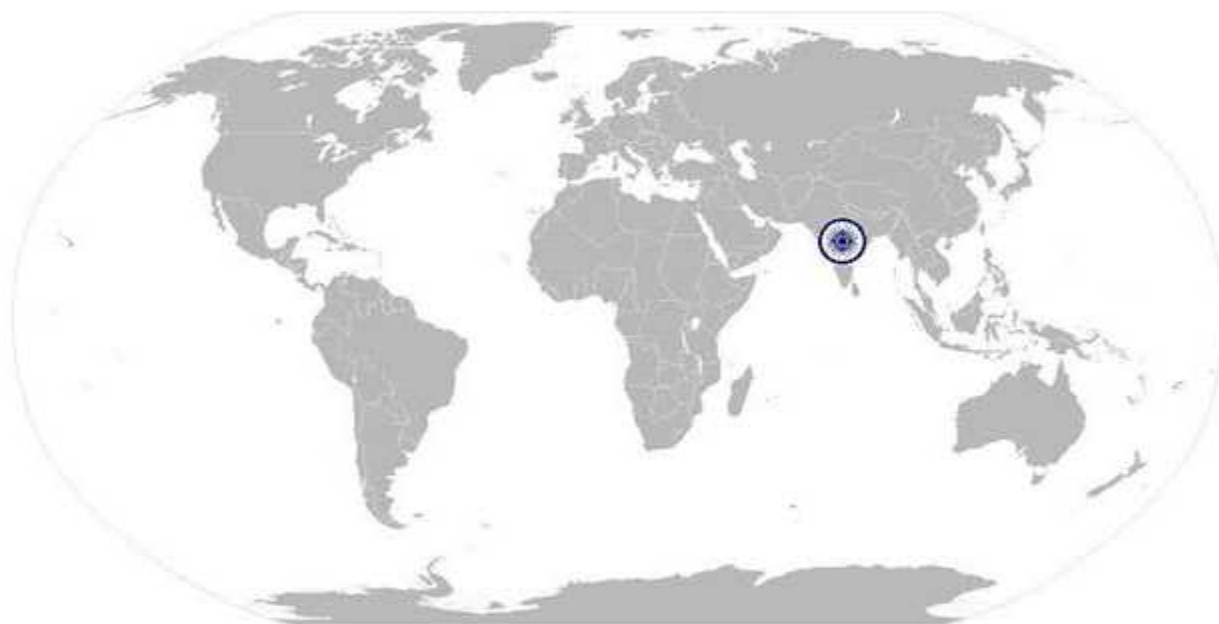
<p>A. Organizational context (Knowledge of the company / organization and its process relevant to areas of responsibilities)</p>	<p>KA1. The requirements of performing Hydrometer Calibration and how it impacts organization process and business.</p> <p>KA2. The role of calibration in the organization (whether part of the end user Production and Quality Assurance process or of a Calibration Service Provider)</p> <p>KA3. The Certification of the organization and their capability to perform calibration tests according to accepted level of standards.</p> <p>KA4. The impact of calibration quality on the company business</p> <p>KA5. Knows about the Standard Operating Procedures and its importance</p> <p>KA6. Follows the SOPs rigorously and takes guidance from the Calibration Supervisor when in doubt.</p> <p>KA7. Records any non-compliance to SOP and reports it to the Calibration Supervisor and takes guidance.</p>
<p>B. Technical Knowledge</p>	<p>KB1. Knows about and understands how Hydrometer Calibration is performed.</p> <p>KB2. Knows about the sources of errors in the calibration process, how these are avoided and its impact on calibration accuracy.</p> <p>KB3. Familiar with:</p> <ul style="list-style-type: none"> • What is Hydrometer Calibration • Why is Hydrometer calibration needed • Traceability of the calibration of instruments performing the tests • What are Liquid density Measuring Devices • Types of Hydrometers, ranges and applications • Types of Hydrometer Calibration • Sources of inaccuracies in Hydrometer measurements and how to avoid / minimize these • Equipment needed for Hydrometer Calibration • Deriving calibration results - data processing and interpretation
<p>Skill(S)</p>	
<p>A. Core Skills / Generic Skills</p>	<p>Writing skills</p> <p>The individual on the job needs to know and understand how to:</p> <p>SA1. Use Formats and check list for Hydrometer calibration and reports</p> <p>SA2. Write emails and messages about calibration related issues</p> <p>Reading Skills</p>

IAS/N0530 Determination of Density of Liquids and Calibration of Density Hydrometers

	<p>The individual on the job needs to read and understand:</p> <p>SA3. Company policy related to Hydrometer calibration SA4. Terminology, symbols, codes, standards, methods and common practices related to Hydrometer Calibration SA5. Data processing steps, Uncertainty Calculations and reporting of results related to Hydrometer calibration. SA6. Formats and check list for Hydrometer Calibration</p>
	<p>Oral Communication (Listening and Speaking skills)</p>
	<p>The individual on the job needs to know and understand how to:</p> <p>SA7. Communicate with the Calibration Supervisor for task scheduling, task reporting and exception reporting SA8. Communicate to the management in meetings about process or equipment issues which need management attention</p>
	<p>Decision Making</p>
B. Professional Skills	<p>The individual on the job needs to know and understand how to:</p> <p>SB1. Make decisions about what calibration to perform and consult Supervisor if needed</p>
	<p>Plan and Organize</p>
	<p>The individual on the job needs to know and understand how to:</p> <p>SB2. Prioritize daily tasks and batches of calibration efficiently and effectively to meet client and company needs</p>
	<p>Customer Centricity</p>
	<p>The user/individual on the job needs to know and understand how to:</p> <p>SB3. Understand real needs of the customer and suggest most appropriate solution SB4. Support customer when they need help</p>
	<p>Problem Solving</p>
	<p>The individual on the job needs to know and understand how to:</p> <p>SB5. Diagnose reasons for any down time in the calibration setup SB6. Identify immediate or temporary solutions to resolve delays and discuss with the Supervisor</p>
	<p>Analytical Thinking</p>
	<p>The user/individual on the job needs to know and understand how to:</p> <p>SB7. Use the existing information to arrive at actionable decision points SB8. Use the existing information for improving the customer satisfaction</p>

IAS/N0530 Determination of Density of Liquids and Calibration of Density Hydrometers

	Critical Thinking
	<p>The user/individual on the job needs to know and understand how to:</p> <p>SB9. Apply, analyze, and evaluate the information gathered from observation, experience, reasoning, or communication, as a guide to thought and action</p>



IAS/N0530 Determination of Density of Liquids and Calibration of Density Hydrometers

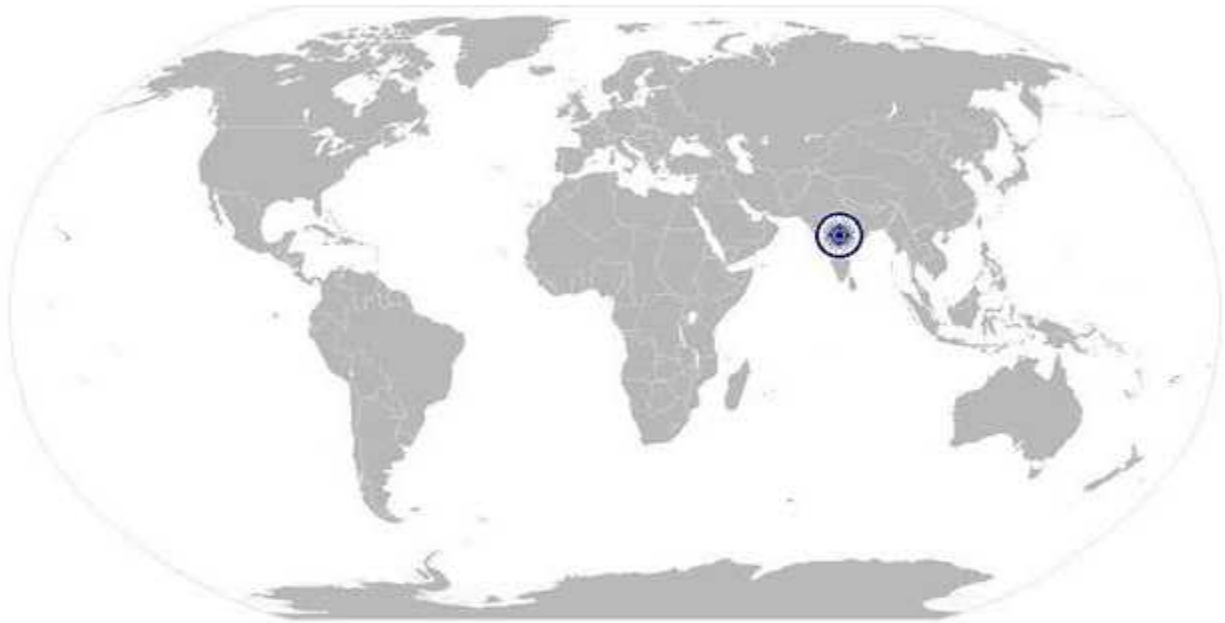
NOS Version Control

NOS Code	IAS/N0530		
Credits (NSQF)	TBD	Version number	1.0
Sector	Instrumentation, Automation Surveillance and Communication	Drafted on	31/08/2017
Sub-sector	Instrumentation	Last reviewed on	31/08/2017
Occupation	Testing & Calibration	Next review date	31/08/2019



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National Occupational Standard




Overview

This unit is about Calibration of a range of Viscometers and Flow Cups according to standards and following organization SOP.

IAS/N0531

Calibration of Viscometers

National Occupational Standard	Unit Code	IAS/N0531
	Unit title (Task)	Calibration of Viscometers
	Description	The OS unit is about Calibration of a range of Viscometers and Flow Cups according to standards and following organization SOP.
	Scope	<p>The unit task covers the following :</p> <ul style="list-style-type: none"> Plan and prepare for measurement Selection of Reference viscometer and reference standard viscosity for calibration Ensure Metrological Requirements Choose Measurement Method Perform Measurements Perform Calculations Prepare Calibration Report Restore the Reference instruments and UUC to their respective condition and places 
Performance Criteria (PC) with respect to the scope		
Element	Performance Criteria	
Plan and prepare for calibration	<p>To be competent, the individual must be able to:</p> <p>PC1. Prepare Observation Sheet (use a standard form/format as specified in the SOP)</p> <p>PC2. Note in the Observation Sheet the details of the UUC (requesting company, lab reference number, type, make, model, serial number, date, time, technician's name etc.)</p> <p>PC3. Verify that the UUC is in good shape (i.e. no physical damage, readable</p>	

IAS/N0531

Calibration of Viscometers

	<p>markings, clean, no loose parts etc.)</p> <p>PC4. Note all parameters to measure for the requested calibration</p> <p>PC5. Note the number of readings to be taken for each parameter</p> <p>PC6. Note the Reference Instruments to use for the parameters</p> <p>PC7. Wear gloves while handling instruments</p> <p>PC8. Verify that the Reference Instruments are available and are in good shape (i.e. usable for calibration, have valid certificates)</p> <p>PC9. Verify that the measurement environment is appropriate for the reference instruments</p> <p>PC10. Record readings of ambient temperature, relative humidity and atmospheric pressure, with required precision using recommended devices</p>
<p>Selection of Reference viscometer and reference standard viscosity for calibration</p>	<p>To be competent, the individual must be able to:</p> <p>PC11. Follow the SOP guidelines and consult the Supervisor for selection of Reference equipment, reference oil and other accessories.</p> <p>PC12. For Calibration of Glass Capillary Viscometers, select from the following:</p> <ul style="list-style-type: none"> • Standard or reference viscometers of the, Cannon (NPL), U-tube(NRLM) etc., types, the constants of which is known with the error not exceeding $\pm 0.01\%$ • Reference materials of viscosity: transparent Newtonian liquids, of stable viscosity (silicone liquids are not recommended). • Thermostatic baths, with temperature control devices ensuring a constant temperature during measurement, the variations not exceeding $\pm 0.01^{\circ}\text{C}$. • Devices for measurement of flow time of the liquid in a standard or reference viscometer with an error not exceeding $\pm 0.01\text{s}$ and in a viscometer to be verified with an error not exceeding $\pm 0.2\text{ s}$. • Thermometers for the measurement of the temperature in the thermostatic bath with an error not exceeding $\pm 0.01^{\circ}\text{C}$. • Water jet pump, or other type of suction pump. • Laboratory Glassware (beakers, flasks, funnels, stirrers, etc.). • Liquids for washing the viscometers: distilled water, chromic acid, white spirit, rectified ethyl alcohol, acetone and other solvents. • Small diameter rubber or plastic tubes. • Lighting fixtures with negligible thermal radiation. <p>PC13. Select Reference viscometer and Reference standard viscosity for calibration following SOP guidelines: (For more details refer annexes of the standards ASTM D446 or ISO 3104: 1994 or ISO3105:1994)</p>

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Calibration of Viscometers

<p>Ensure Metrological Requirements are met</p>	<p>To be competent, the individual must be able to:</p> <p>PC14. Follow SOP guidelines regarding Metrological requirements.</p> <p>PC15. For Density measurement of Standard weights follow the requirements of OIML R-111-1 and density of solids.</p> <p>PC16. The most important factor affecting the quality of a viscosity measurement is temperature, so ensure it is measured accurately.</p> <p>PC17. Ensure temperature control is as specified in SOP. A slight variation in temperature can have a large effect on the viscosity of fluid.</p> <p>PC18. Viscometers are calibrated under normal stable room temperature conditions. Ensure a room temperature within 20°C to and 30°C with variation of $\pm 40^\circ\text{C}$, or as specified in the SOP.</p> <p>PC19. Recommended resolution of Environmental Temperature Monitoring System is 0.1°C.</p> <p>PC20. Ensure that the 'g' value is known with sufficient accuracy either by Geological Survey of India or any other relevant source for reporting the g value along with viscosity constant in the calibration certificate. This helps the end user to apply required correction due to change in g for viscosity constant.</p> <p>PC21. Laboratory may also calculate 'g' value knowing latitude and height as per standard formula recommended in SOP.</p>
<p>Choose Measurement Method</p>	<p>To be competent, the individual must be able to:</p> <p>PC22. Follow the SOP guidelines for selection of calibration method and procedure for the type of UUC.</p> <p>PC23. The general guidelines for calibration procedures for different types of Viscometers are as follows. For more details, construction, operation and calibration set up for these type of viscometers refer Annexure A-1 of ASTM D446-12 or Annexure A of ISO 3105:1994:</p> <p>PC24. The general guidelines for calibration procedures for other types of Viscometers are as follows</p> <p style="text-align: center;">Suspended Level Viscometer (follow the Annexure –A2 of standard ASTM D446-12 or Annexure B of ISO 3105:1994).</p> <ul style="list-style-type: none"> • For transparent and Newtonian liquids upto 100000 mm²/s. <p style="text-align: center;">C.1 Reverse Flow Viscometer (refer to Annexure A-3 of ASTM</p>

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Calibration of Viscometers

	<p>12 Or Annexure C of ISO 3105:1994 Or ISO 3104:1994).</p> <ul style="list-style-type: none"> • For opaque & transparent liquids 300000 mm²/s. Flow cups- as per IS 3944 -1982, RA 2005 Or ASTM D 1200 • For calibration follow IS 3944 -1982, RA 2005 “Method for Determination of Flow Time for Flow Cups” Or ASTM D1200. Rotational Viscometers –as per ISO 2555 1989 & ISO 1652 2011 • For calibration follow the standard ISO 2555 1989 “Plastics – Resins in the Liquid State or as Emulsions or Dispersions- Determination of Apparent Viscosity by the Brookfield Test Method”. • For calibration follow the standard ISO 1652 2011 “Rubber Latex-Determination of Apparent Viscosity by Brookfield Test Method”
Perform Measurements	<p>To be competent, the individual must be able to:</p> <p>PC25. Follow the measurement procedures for the methods chosen per SOP.</p> <p>PC26. Record the number of readings of the reference viscometer and UUC, as prescribed in the SOP.</p> <p>PC27. Record readings of ambient temperature and relative humidity and the air pressure at the beginning and end of measurements using recommended devices.</p>
Perform Calculations	<p>To be competent, the individual must be able to:</p> <p>PC28. Refer to SOP for the equations to use for the type of calibration being performed</p> <p>PC29. Use form/format specified in the SOP for performing calculations</p> <p>PC30. Perform the required calculations using calculator or software as specified, using the equations and procedures specified in the SOP.</p> <p>PC31. Calculate the relative overall uncertainty in the measurement of kinematic viscosity (Uv)</p> <p>PC32. Calculate Combined / Expanded Uncertainty per SOP guideline.</p>

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Calibration of Viscometers

<p>Prepare Calibration Report</p>	<p>To be competent, the individual must be able to:</p> <p>PC33. Record the results, including uncertainty, as calculated above, in the specified format</p> <p>PC34. Prepare Report in the format specified in the SOP.</p> <p>PC35. Store and share report with the designated persons</p>
<p>Restore the Reference instruments and UUC to their respective condition and places</p>	<p>To be competent, the individual must be able to:</p> <p>PC36. Return the Reference instruments to their recommended storage position and put in their box/cover</p> <p>PC37. Return the UUC to its recommended storage position and put in its accompanying box/cover</p> <p>PC38. Fix/Attach any recommended tag/markings on the UUC to signify that its calibration has been done</p>
<p>Knowledge and Understanding (K)</p>	
<p>A. Organizational context (Knowledge of the company / organization and its process relevant to areas of responsibilities)</p>	<p>KA1. The requirements of performing Viscosity Calibration and how it impacts organization process and business.</p> <p>KA2. The role of calibration in the organization (whether part of the end user Production and Quality Assurance process or of a Calibration Service Provider)</p> <p>KA3. The Certification of the organization and their capability to perform calibration tests according to accepted level of standards.</p> <p>KA4. The impact of calibration quality on the company business</p> <p>KA5. Knows about the Standard Operating Procedures and its importance</p> <p>KA6. Follows the SOPs rigorously and takes guidance from the Calibration Supervisor when in doubt.</p> <p>KA7. Records any non-compliance to SOP and reports it to the Calibration Supervisor and takes guidance.</p>
<p>B. Technical Knowledge</p>	<p>KB1. Knows about and understands Viscosity Calibration is performed.</p> <p>KB2. Knows about the sources of errors in the calibration process, how these are avoided and its impact on calibration accuracy.</p> <p>KB3. Familiar with:</p> <ul style="list-style-type: none"> • What is Viscosity Calibration • Why is Viscosity calibration needed • Traceability of the calibration of instruments performing the tests • What are Viscosity Measuring Devices • Types of Viscosity Measuring Devices, ranges and applications • Types of Viscosity Calibration • Sources of inaccuracies in Viscosity measurements and how to avoid / minimize these • Equipment needed for Viscosity Calibration • Deriving calibration results - data processing and interpretation

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Calibration of Viscometers

Skill(S)	
A. Core Skills / Generic Skills	Writing skills
	The individual on the job needs to know and understand how to: SA1. Use Formats and check list for Viscosity calibration and reports SA2. Write emails and messages about calibration related issues
	Reading Skills
	The individual on the job needs to read and understand: SA3. Company policy related to Viscosity calibration SA4. Terminology, symbols, codes, standards, methods and common practices related to Viscosity Calibration SA5. Data processing steps, Uncertainty Calculations and reporting of results related to Viscosity calibration. SA6. Formats and check list for Viscosity Calibration
B. Professional Skills	Oral Communication (Listening and Speaking skills)
	The individual on the job needs to know and understand how to: SA7. Communicate with the Calibration Supervisor for task scheduling, task reporting and exception reporting SA8. Communicate to the management in meetings about process or equipment issues which need management attention
	Decision Making
	The individual on the job needs to know and understand how to: SB1. Make decisions about what calibration to perform and consult Supervisor if needed
B. Professional Skills	Plan and Organize
	The individual on the job needs to know and understand how to: SB2. Prioritize daily tasks and batches of calibration efficiently and effectively to meet client and company needs
	Customer Centricity
	The user/individual on the job needs to know and understand how to: SB3. Understand real needs of the customer and suggest most appropriate solution SB4. Support customer when they need help
B. Professional Skills	Problem Solving

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Calibration of Viscometers

	<p>The individual on the job needs to know and understand how to:</p> <p>SB5. Diagnose reasons for any down time in the calibration setup</p> <p>SB6. Identify immediate or temporary solutions to resolve delays and discuss with the Supervisor</p>
	<p>Analytical Thinking</p>
	<p>The user/individual on the job needs to know and understand how to:</p> <p>SB7. Use the existing information to arrive at actionable decision points</p> <p>SB8. Use the existing information for improving the customer satisfaction</p>
	<p>Critical Thinking</p>
	<p>The user/individual on the job needs to know and understand how to:</p> <p>SB9. Apply, analyze, and evaluate the information gathered from observation, experience, reasoning, or communication, as a guide to thought and action</p>



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Calibration of Viscometers

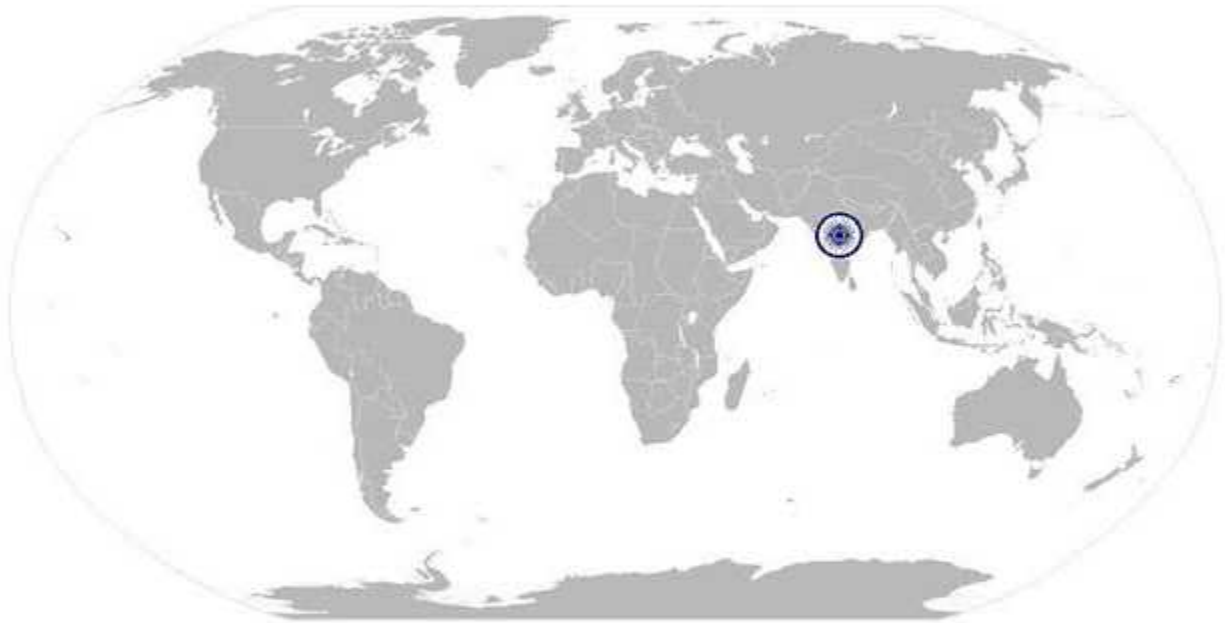
NOS Version Control

NOS Code	IAS/N0506		
Credits (NSQF)	TBD	Version number	1.0
Sector	Instrumentation, Automation Surveillance and Communication	Drafted on	31/08/2017
Sub-sector	Instrumentation	Last reviewed on	31/08/2017
Occupation	Testing & Calibration	Next review date	31/08/2019



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National Occupational Standard



Overview

This unit is about reporting and record keeping of calibration processes as per company processes.

IAS/N0204

Reporting of task performed -Calibration

National Occupational Standard	Unit Code	IAS/N0204
	Unit title task	Task Reporting-Calibration
	Description	The OS unit is about reporting and record keeping as per company processes and job description for Calibration Technician.
	Scope	<p>This Unit /Task covers the following:</p> <ul style="list-style-type: none"> • Task Reporting - Normal • Task reporting - faults • Task reporting - PM • Task reporting – unusual occurrence • Task reporting - theft • Task reporting – security breach
	Performance Criteria (PC) with respect to the scope:	
	Element	Performance Criteria
	Perform Task reporting- normal	<p>PC1. Report completed task per organization process.</p> <ul style="list-style-type: none"> • Record the completed task in log book or other document as defined by the SOP
	Perform Task reporting- faults	PC2. Report faults/issues to immediate supervisor
	Perform Task reporting - PM	PC3. Perform entry of preventive maintenance check lists/reports
	Perform Task reporting-unusual occurrence	PC4. Report on noticing any visible changes in of Mass, Weight, Volume, Density, Viscosity Calibration setup or its accessories. Report for immediate attention of supervisor
Perform Task reporting- theft	PC5. Report any theft in Mass, Weight, Volume, Density, Viscosity Calibration setup to supervisor	
Perform Task reporting-security breach	PC6. Report suspicious movement of new persons near of Mass, Weight, Volume, Density, Viscosity Calibration setup to security and supervisor	
Knowledge and Understanding (K)		
(A) Organizational context (Knowledge of the company organization and its process relevant to area of	KA1. how Mass, Weight, Volume, Density, Viscosity Calibration is performed in the organization and the impact of it on the business.	

IAS/N0204

Reporting of task performed -Calibration

responsibilities)	
(B) Technical Knowledge	<p>The individual has the knowledge and understanding to be:</p> <p>KB1. Able to write daily log and failure reports</p> <p>KB2. Able to furnish basic data to supervisor related to specifications of Mass, Weight, Volume, Density, Viscosity Calibration setup</p> <p>KB3. Able to send internal mails related to supervisor or co-workers</p> <p>KB4. Familiar with basic computer work to type simple reports and use of e-mail. Records Maintenance history</p>
Skill(s)	
A. Core Skills / Generic Skills	Writing skills
	<p>The individual on the job needs to know and understand how to:</p> <p>SA1. Use Formats and check list for calibration and reports</p> <p>SA2. Write emails and messages about calibration related issues</p>
	Reading Skills
	<p>The individual on the job needs to read and understand:</p> <p>SA3. Company policy related to calibration and reporting</p> <p>SA4. Formats and check list for Calibration</p> <p>SA5. Terminology, symbols, codes, standards and common practices related to sensors that are calibrated</p> <p>SA6. Terminology, data processing steps and reporting process</p>
	Oral Communication (Listening and Speaking skills)
	<p>The individual on the job needs to know and understand how to:</p> <p>SA7. Communicate issue / fault with complete details to the supervisor</p> <p>SA8. Communicate with the Calibration Supervisor for task scheduling, task reporting and exception reporting</p> <p>SA9. Communicate to the management in meetings about process or equipment issues which need management attention</p>
B. Professional Skills	Decision Making
	<p>The individual on the job needs to know and understand:</p> <p>SB1. What data is to be recorded</p> <p>SB2. What reports are to be made</p>
	Plan and Organize
<p>The individual on the job needs to know and understand how to:</p> <p>SB3. Prioritize and schedule reporting tasks</p> <p>SB4. Cooperates with his/her team and offers assistance on a regular basis</p>	

IAS/N0204

Reporting of task performed -Calibration

	<p>SB5. Communicate with the Calibration Supervisor for task scheduling, task reporting and exception reporting</p>
	<p>Customer Centricity</p>
	<p>The user/individual on the job needs to know and understand how to: SB6. Understand real needs of the customer and suggest most appropriate solution</p>
	<p>Problem Solving</p>
	<p>The individual on the job needs to know and understand how to: SB7. Investigate reasons for any anomalous report and correct it</p>
	<p>Analytical Thinking</p>
	<p>The user/individual on the job needs to know and understand how to: SB8. Use the existing information to arrive at actionable decision points SB9. Use the existing information for improving the customer satisfaction</p>
	<p>Critical Thinking</p>
<p>The user/individual on the job needs to know and understand how to: SB10. Apply, analyze, and evaluate the information gathered from observation, experience, reasoning, or communication, as a guide to thought and action SB11. Anticipate problems, risks and opportunities and utilize these for mitigation and business optimization</p>	

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Reporting of task performed -Calibration

NOS Version Control

NOS Code	IAS/N0204		
Credits(NSQF)	TBD	Version number	1.0
Sector	Instrumentation, Automation Surveillance and Communication	Drafted on	31/08/2017
Sub-sector	Instrumentation	Last reviewed on	31/08/2017
Occupation	Testing & Calibration	Next review date	31/08/2019

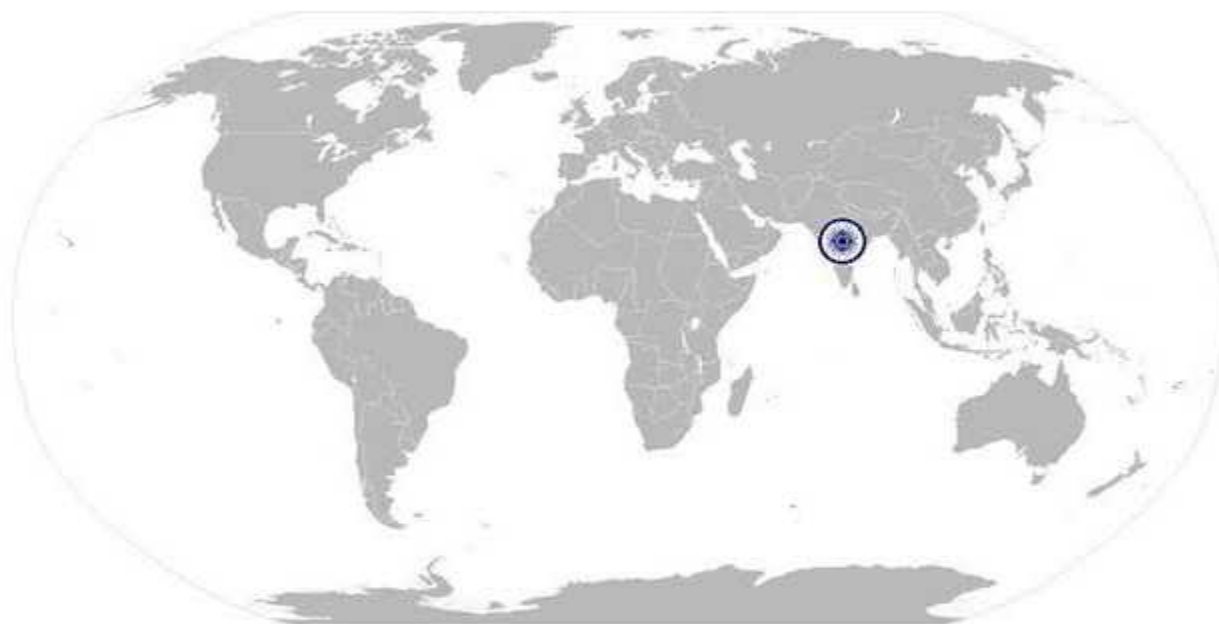


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IAS/N0532

Preventive Maintenance - Mechanical
(Mass, Balance, Volume, Density, Viscosity)

National Occupational Standard



Overview

The unit is about conducting regular Preventive Maintenance activities of Mass, Weight, Volume, Density, Viscosity Calibration setup.

IAS/N0532

**Preventive Maintenance - Mechanical
(Mass, Balance, Volume, Density, Viscosity)**

National Occupational Standard	Unit Code	IAS/N0532
	Unit title task	Preventive Maintenance – Mass, Weight, Volume, Density, Viscosity Calibration
	Description	The OS unit is about performing Preventive maintenance for Mass, Weight, Volume, Density, Viscosity Calibration setup.
	Scope	This Unit/ Task covers the following : <ul style="list-style-type: none"> • PM- Visual checks and action • PM – completion of preventive maintenance schedule
	Performance Criteria (PC) with respect to the scope:	
	Element	Performance Criteria
	Perform PM-Visual Checks and action	The individual on the job needs to be able to: <ul style="list-style-type: none"> PC1. Prepare PM list of devices and instruments. PC2. Carry out Visual Checks, using SOP of the organization for system health check and list observations and actions needed if any. PC3. Check calibration gauges, instruments and accessories for any rusting, burrs, stains, foreign objects, missing or loose screws and any other visible deficiency. Note the actions to be performed in the list. PC4. Check calibration gauges, instruments, meters and accessories for proper operation over their range. PC5. Check all devices in the list for validity of calibration, or validity expiring soon. Record and report to the designated person for action per SOP.
	Perform PM-completion of preventive maintenance schedule.	The individual on the job needs to be able to: <ul style="list-style-type: none"> PC6. For the listed items, perform corrective action such as cleaning, greasing, tightening of screws etc. following recommended procedure in the SOP. PC7. Use authorized cleaning solvents and greases in the right amount. Use approved cleaning tissues or cloth. PC8. If the recommended maintenance does not restore the device to the required condition, add this to the Corrective Maintenance list and report. PC9. Complete preventive maintenance schedule list of Mass, Weight, Volume, Density, Viscosity Calibration setup and accessories. Close any

IAS/N0532

**Preventive Maintenance - Mechanical
(Mass, Balance, Volume, Density, Viscosity)**

	issues in the list.
Knowledge and Understanding	
<p>A. Organizational context (Knowledge of the company organization and its process relevant to area of responsibilities)</p>	<p>Needs to know and understand :</p> <p>KA1. PM norms as defined by the company</p> <p>KA2. Production targets and production loss figures for the month and contribution of Mass, Weight, Volume, Density, Viscosity Calibration towards it.</p> <p>KA3. Maintenance Policy of the company with respect to Mass, Weight, Volume, Density, Viscosity Calibration strategy</p>
<p>B. Technical Knowledge</p>	<p>Needs to Know and understand:</p> <p>KB1. Trouble Shooting of:</p> <p>KB2. Use of Calibration Manuals when required</p>
Skill(s)	
<p>A. Core Skills / Generic Skills</p>	<p>Writing skills</p>
	<p>The individual on the job needs to know how to:</p> <p>SA1. Use Formats and check list for Preventive Maintenance planning and reports</p> <p>SA2. Write emails and messages about maintenance related issues</p>
	<p>Reading Skills</p>
	<p>The individual on the job needs to know read and understand:</p> <p>SA3. Company policy related to Preventive Maintenance</p> <p>SA4. Down time in terms of production loss</p> <p>SA5. Formats for Preventive Maintenance check sheets</p>
	<p>Oral Communication (Listening and Speaking skills)</p>
	<p>The individual on the job needs to know and understand how to:</p> <p>SA6. Describe condition of control valves and accessories and issues to co-workers and supervisor</p> <p>SA7. Communicate to the management in meetings about maintenance issues which need management attention</p> <p>SA8. Interact with coworkers and gather information related to process and</p>

IAS/N0532

**Preventive Maintenance - Mechanical
(Mass, Balance, Volume, Density, Viscosity)**

	control valve conditions
B. Professional Skills	Decision Making
	The individual on the job needs to know and understand how to: SB1. Make decisions about timing and extent of preventive maintenance, in consultation with the Supervisor
	Plan and Organize
	The individual on the job needs to know and understand how to: SB2. Prioritize daily tasks to conduct Preventive Maintenance effectively
	Customer Centricity
	The user/individual on the job needs to know and understand how to: SB3. Understand real needs of the customer and suggest most appropriate solution
	Problem Solving
	The individual on the job needs to know and understand how to: SB4. Diagnoses reasons for down time due to calibration setup failure SB5. Identify immediate or temporary solutions to resolve delays and discuss with the Supervisor
	Analytical Thinking
	The user/individual on the job needs to know and understand how to: SB6. Use the existing information to arrive at actionable decision points SB7. Use the existing information for improving the customer satisfaction
Critical Thinking	
The user/individual on the job needs to know and understand how to: SB8. Apply, analyze, and evaluate the information gathered from observation, experience, reasoning, or communication, as a guide to thought and action SB9. Anticipate problems, risks and opportunities and utilize these for mitigation and business optimization	

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**Preventive Maintenance - Mechanical
(Mass, Balance, Volume, Density, Viscosity)**

NOS Version Control

NOS Code	IAS/N0532		
Credits(NSQF)	TBD	Version number	1.0
Sector	Instrumentation, Automation Surveillance and Communication	Drafted on	31/08/2017
Sub-sector	Instrumentation	Last reviewed on	31/08/2017
Occupation	Testing & Calibration	Next review date	31/08/2019

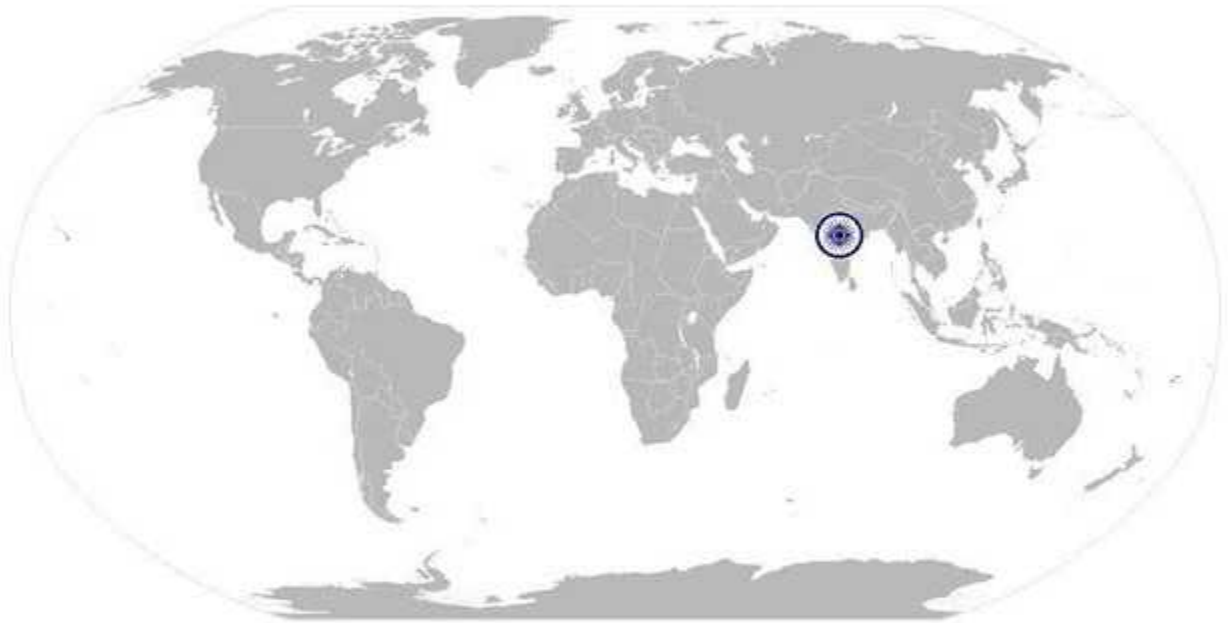


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IAS/N2105

Work Effectively With Teams

National Occupational Standard



Overview

This unit is about working effectively with colleagues, in own work group and in other work groups within the organization.

IAS/N2105

Work Effectively With Teams

National Occupational Standard

Unit Code	IAS/N2105
Unit Title (Task)	Work Effectively With Teams
Description	This NOS unit is about building relationships and working with people and groups inside and outside the organization, using skills and habits, to achieve the team goals and objectives.
Scope	This unit/task covers the following: <ul style="list-style-type: none"> • Creating team environment • Communicating - giving and receiving • Working cooperatively • Participating in team decision making • Demonstrating Sense of Responsibility • Showing respect for opinions, customs and preferences
Performance Criteria(PC) w.r.t. the Scope	
Element	Performance Criteria
Create Team Environment	To be competent, the individual on the job must be able to: PC1. Know and understand the team objectives and goals PC2. Know team members by name. Greet them appropriately and respond to their greetings. PC3. Know the roles and responsibilities of team members. Ensure others know about you and your role in the team PC4. Learn about the culture and preferences of team members – especially if they belong to other organizations or nationalities PC5. Follow organization’s policies and procedures for working with team members within and outside the organization – especially relating to privacy, confidentiality and security. PC6. Create an environment of trust and mutual respect
Communicate – Give and Receive	To be competent, the individual on the job must be able to: PC7. Use appropriate mode of communication – verbal, written, mail, phone or text and clearly articulate your message to ensure that the recipient understands the message. PC8. Listen to team members and try to understand what they are wanting to say. Seek or provide clarifications if you see any gap in understanding PC9. Communicate professionally and follow organization protocols. Do not overload the team members with unnecessary and unsolicited information PC10. Share important information with the team timely. PC11. Respond to communications promptly.

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Work Effectively With Teams

<p>Work Cooperatively</p>	<p>To be competent, the individual on the job must be able to:</p> <p>PC12. Perform own role and produce output in time for other team members to consume</p> <p>PC13. Receive inputs from others and work upon it per role requirement</p> <p>PC14. Make adjustments within the permissible rules so that work flows smoothly.</p> <p>PC15. Help team members to perform their role effectively and provide any clarifications and support they need</p> <p>PC16. Share tools and common resources fairly, taking cognizance of others' needs and schedules</p> <p>PC17. Resolve any contentious issues amicably, involving the team lead or the supervisor if needed</p> <p>PC18. Let team members know in good time if you cannot carry out your commitments, explaining the reasons and alternate solutions, if any. Let the team lead know about this.</p>
<p>Participate in Team Decision making</p>	<p>To be competent, the individual on the job must be able to:</p> <p>PC19. Think positively and make constructive suggestions to meet the goals</p> <p>PC20. Accept and give suggestions with open mind</p> <p>PC21. Take initiatives and volunteer to contribute</p> <p>PC22. Help team members with facts and figures to arrive at workable decisions</p> <p>PC23. Accept decisions professionally and support these, even if these do not match your suggestions and personal views</p>
<p>Demonstrate Sense of Responsibility</p>	<p>To be competent, the individual on the job must be able to:</p> <p>PC24. Act in the interest of the team and the organization to ensure that things do not 'fall through the gap' and team goals are achieved.</p> <p>PC25. Take initiative to correct the situation if something seems to be going wrong.</p> <p>PC26. Seek help or escalate if the situation demands</p>
<p>Show Respect for Opinions, Customs and Preferences</p>	<p>To be competent, the individual on the job must be able to:</p> <p>PC27. Follow organization's and statutory guidelines about making references or comments to social customs or preferences</p> <p>PC28. Refrain from making any comments to hurt sentiments</p> <p>PC29. Accommodate team members' preferences to the extent feasible. If these come in the way of fulfilling team goals, discuss with the supervisor/ team leader.</p> <p>PC30. Seek information and clarifications from others if you do not understand any customs.</p>
<p>Knowledge and Understanding (K)</p>	

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Work Effectively With Teams

<p>A. Organizational Context (Knowledge of the company / organization and its processes)</p>	<p>The user/individual on the job needs to know and understand:</p> <p>KA1. The organization’s policies and procedures for working with colleagues, roles and responsibilities in relation to this</p> <p>KA2. The importance of effective communication and establishing good working relationships with colleagues</p> <p>KA3. Different methods of communication and the circumstances in which it is appropriate to use these</p> <p>KA4. The importance of creating an environment of trust and mutual respect</p> <p>KA5. The implications of own work on the work and schedule of others</p>
<p>B. Technical Knowledge</p>	<p>The user/individual on the job needs to know and understand:</p> <p>KB1. Different types of information that colleagues might need and the importance of providing this information when it is required</p> <p>KB2. The importance of helping colleagues with problems, in order to meet quality and time standards as a team</p>
<p>Skills (S) [Optional]</p>	
<p>A. Core Skills/ Generic Skills</p>	<p>Writing Skills</p>
	<p>The user/ individual on the job need to know and understand how to:</p> <p>SA1. Complete written work with attention to detail</p>
	<p>Reading Skills</p>
	<p>The user/individual on the job needs to know and understand how to:</p> <p>SA2. Read instructions, guidelines/procedures</p>
	<p>Oral Communication (Listening and Speaking skills)</p> <p>The user/individual on the job needs to know and understand how to:</p> <p>SA3. Listen effectively and orally communicate information</p> <p>SA4. Ask for clarification and advice from the concerned person</p>
<p>B. Professional Skills</p>	<p>Decision Making</p>
	<p>The user/individual on the job needs to know and understand how to:</p> <p>SB1. Make decisions on a suitable course of action or response keeping in view resource utilization while meeting commitments</p>
	<p>Plan and Organize</p> <p>The user/individual on the job needs to know and understand:</p> <p>SB2. Plan and organize work to achieve targets and deadlines</p>

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Work Effectively With Teams

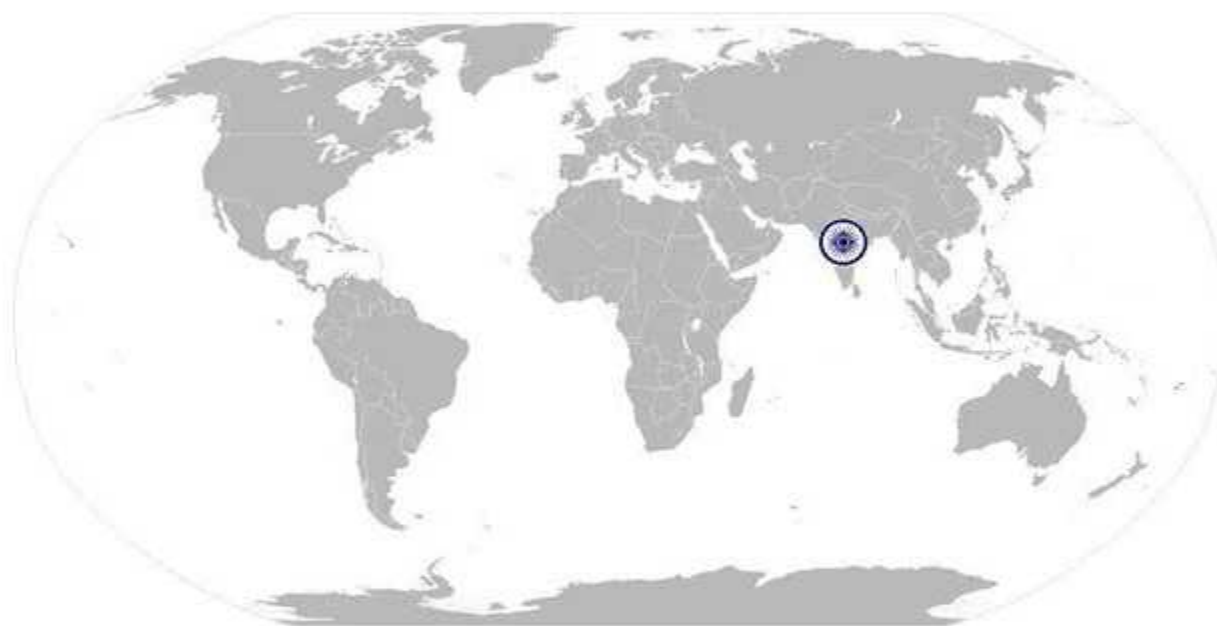
	Customer Centricity
	<p>The user/individual on the job needs to know and understand how to:</p> <ul style="list-style-type: none"> SB3. Understand real needs of the customer and suggest most appropriate solution SB4. Support customer when they need help
	Problem Solving
	<p>The user/individual on the job needs to know and understand how to:</p> <ul style="list-style-type: none"> SB5. Apply problem solving approaches in different situations
	Analytical Thinking
	<p>The user/individual on the job needs to know and understand how to:</p> <ul style="list-style-type: none"> SB6. Use the existing information to arrive at actionable decision points SB7. Use the existing information for improving the customer satisfaction SB8. Use the existing information to optimize solution and company business SB9. Analyze problems and identify causes and possible solutions
Critical Thinking	
<p>The user/individual on the job needs to know and understand how to:</p> <ul style="list-style-type: none"> SB10. Apply balanced judgments to different situations 	

IAS/N2105

Work Effectively With Teams

NOS Version Control

NOS Code	IAS/N2105		
Credits(NSQF)	TBD	Version number	1.0
Industry	Instrumentation Automation Surveillance & Communication	Drafted on	31/08/2017
Industry Sub-sector	Instrumentation	Last reviewed on	31/08/2017
Occupation	Testing and Calibration	Next review date	31/08/2019



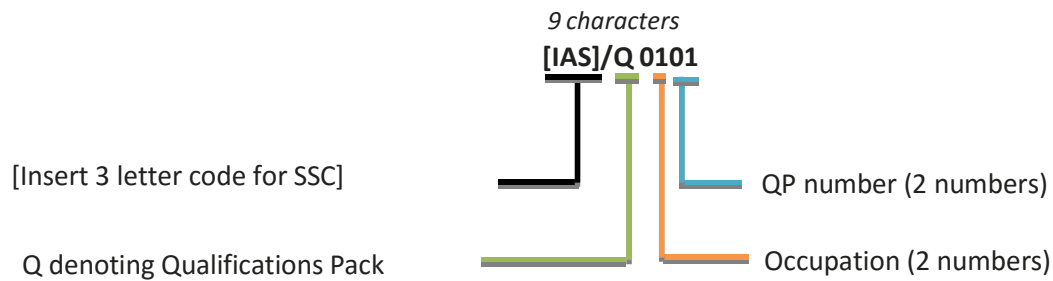
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Qualifications Pack For Calibration Technician -Mechanical (Mass, Balance, Volume, Density, Viscosity)

Annexure

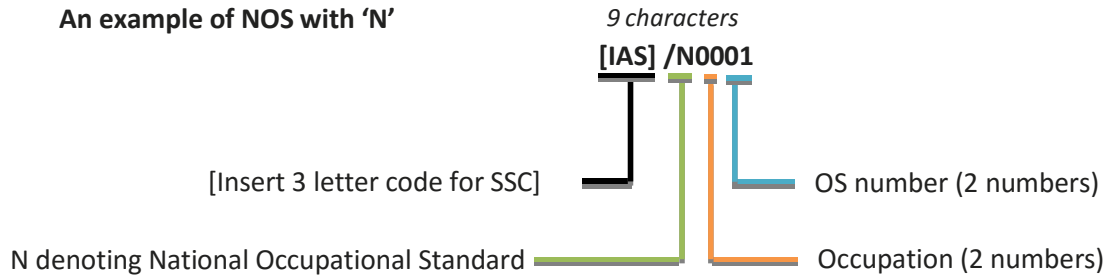
Nomenclature for QP and NOS

Qualifications Pack



Occupational Standard

An example of NOS with 'N'



Qualifications Pack For Calibration Technician -Mechanical (Mass, Balance, Volume, Density, Viscosity)

The following acronyms/codes have been used in the nomenclature above:

Sub-sector	Range of Occupation numbers
Installation and Commissioning	01-29
Operation and Maintenance	30-49
Calibration	50-55
Design, Fabrication / Manufacturing	56-79
Design, Fabrication, Installation & Commissioning	80-89
General	90-99

Sequence	Description	Example
Three letters	Industry name	IAS
Slash	/	/
Next letter	Whether QP or NOS	Q
Next two numbers	Occupation code	01
Next two numbers	OS number	01

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Qualifications Pack For Calibration Technician -Mechanical (Mass, Balance, Volume, Density, Viscosity)

CRITERIA FOR ASSESSMENT OF TRAINEES

Job Role Qualifications Pack- Calibration Technician -Mechanical (Mass, Balance, Volume, Density, Viscosity)

Qualification Pack IAS/Q5011

Sector Skill Council Instrumentation Automation Surveillance & Communication

Guidelines for Assessment

1. Criteria for assessment for each Qualification Pack will be created by the Sector Skill Council. Each Performance Criteria (PC) will be assigned marks proportional to its importance in NOS. SSC will also lay down proportion of marks for Theory and Skills Practical for each PC.
2. The assessment for the theory part will be based on knowledge bank of questions created by the SSC.
3. Assessment will be conducted for all compulsory NOS, and where applicable, on the selected elective/option NOS/set of NOS.
4. Individual assessment agencies will create unique question papers for theory part for each candidate at each examination/training center (as per assessment criteria below).
5. Individual assessment agencies will create unique evaluations for skill practical for every student at each examination/training center based on this criterion.
6. To pass the Qualification Pack , every trainee should score a minimum of 70% of aggregate marks to successfully clear the assessment.
7. In case of unsuccessful completion, the trainee may seek reassessment on the Qualification Pack.

Relative Weight of NOSs in the Assessment

Sr No	NOS nos.	NOS Name	% Weightage
1	IAS/N0515	Work Place Readiness - Mass, Balance, Density, Viscosity Calibration	10
2	IAS/N0516	Calibration of Weights	10
3	IAS/N0517	Calibration of Weighing Balance and Mass Comparator	10
4	IAS/N0518	Calibration of Density of Solids	10
5	IAS/N0519	Calibration of Density of Liquids	10
6	IAS/N0530	Determination of Density of Liquids and Calibration of Density Hydrometers	10
7	IAS/N0531	Calibration of Viscometers	10
8	IAS/N0204	Reporting of Task Perform -Calibration	10
9	IAS/N0532	Preventive Maintenance of Mass, Balance, Density, Viscosity Calibration Setup	10
10	IAS/N2105	Work Effectively with Teams	10
			100%

Qualifications Pack For Calibration Technician -Mechanical (Mass, Balance, Volume, Density, Viscosity)

Assessment outcomes	Assessment Criteria for outcomes	Total Marks (110+170 +190+180 +150+155 +145+100 +60+75)	Out of	Marks Allocation	
				Theory	Skills Practical
1. IAS/N0515 Work Place Readiness - Mass, Balance, Density, Viscosity Calibration	PC1. Perform Workplace Checks using prescribed checklists and organizational norms and report any deviations.	110	3	1	2
	PC2. Check for cleanliness of work area and equipment		3	1	2
	PC3. Ensure an uncluttered workplace		3	1	2
	PC4. Check / Feel for any abnormal vibrations generated by central air-conditioning plants, vehicular traffic and other sources.		5	2	3
	PC5. If any vibration is felt which is unusual, then try to locate the source of vibration. Check if special/ protective devices like vibration free tables and pillars etc., isolating the equipment from the floor, are affected in any way.		3	1	2
	PC6. If the vibration level is above specified limits, Calibration operation may be suspended. Refer to organization SOP for the quantitative measurement of vibration and relation guidelines.		3	1	2
	PC7. Check / Listen for any abnormal noise in the calibration area. Refer to SOP for acceptable noise level - usually less than 60dBA.		3	1	2
	PC8. Check / Listen for any abnormal noise in the calibration area. Refer to SOP for acceptable noise level - usually less than 60dBA.		5	2	3
	PC9. If any noise is felt which is unusual, then try to locate the source of noise.		3	1	2
	PC10. Report any deviations and findings to the Supervisor and the concerned department.		3	1	2
	PC11. If the noise level affects the Calibration process, then the operation may be suspended. Refer to organization SOP for the quantitative measurement of noise and related guidelines.		3	1	2
	PC12. Check for lighting / associated electricals at Mass, Weight, Volume, Density, Viscosity Calibration Installation. Report any deviations to electrical department.		3	1	2
	PC13. Check for adequate lighting and working of associated electrical fittings in the Calibration area.		3	1	2

Qualifications Pack For Calibration Technician -Mechanical (Mass, Balance, Volume, Density, Viscosity)

	The recommended level of illumination is 250-500 Lux on the working table, or as specified in the SOP.				
PC14.	Check for temporary/unsafe electrical wiring		5	2	3
PC15.	Check for ambient temperature and humidity in the Calibration area. Refer to organization SOP for the quantitative measurement of temperature and the related guidelines.		5	2	3
PC16.	Ensure that the reference standards are maintained at temperatures specified in order to ensure their conformance to the required level of operation.		5	2	3
PC17.	Report any deviations to the concerned department.		3	1	2
PC18.	If the environment parameters are likely to adversely affect the required accuracy of measurement, then report to the Supervisor and seek guidance about performing calibration.		3	1	2
PC19.	Ensure that the power supply of right quality (voltage, frequency, transients, regulation etc.) as specified in SOP is available - usually from a UPS. Check that any isolation transformers and filters etc. installed are not tampered with and the hum interference is within limits.		5	2	3
PC20.	Ensure that operation of heavy loads in the premises or nearby locations does not cause any dip in voltage or transient currents.		5	2	3
PC21.	Report any deviations to the concerned department.		3	1	2
PC22.	Ensure that the laboratory is free from dust and external air pressure. Positive air pressure is normally maintained inside the laboratory to avoid ingress of dust.		5	2	3
PC23.	Report any deviations to the concerned department.		3	1	2
PC24.	Ensure availability of suitable fire extinguishing equipment for possible fire hazards in the laboratory, per SOP.		4	1	3
PC25.	Ensure familiarity with method of giving the treatment in case of electric shock. Wall chart showing the procedure should be placed near the power supply switchgear and at other prominent places as prescribed under Indian Electricity Rules 1956.		5	2	3
PC26.	Check for availability of instruments in the Mass, Weight, Volume, Density, Viscosity Metrology calibration setup.		5	2	3
PC27.	Check availability of electrical power and the quality (whether UPS backed, voltage and frequency) as specified in the SOP		3	1	2

Qualifications Pack For Calibration Technician -Mechanical (Mass, Balance, Volume, Density, Viscosity)

	PC28. Handle equipment in recommended and safe manner.		5	2	3
	PC29. Uses hand gloves of specified material for handling the UUC and Reference so that these are not soiled and to avoid heat transfer to Reference equipment or UUC during Calibration which may otherwise drastically affect the results.		3	1	2
		Total	110	40	70
2. IAS/N0516 Calibration of Weights	PC1. Prepare Observation Sheet (use a standard form/format as specified in the SOP)		3	1	2
	PC2. Note in the Observation Sheet the details of the UUC (requesting company, lab reference number, type, make, model, serial number, date, time, technician's name etc.)		3	1	2
	PC3. Verify that the UUC is in good shape (i.e. no physical damage, readable markings, clean, no loose parts etc.)		3	1	2
	PC4. Note all parameters to measure for the requested calibration		3	1	2
	PC5. Note the number of readings to be taken for each parameter		3	1	2
	PC6. Note the Reference Instruments to use for the parameters		3	1	2
	PC7. Wear gloves while handling instruments		3	1	2
	PC8. Verify that the Reference Instruments are available and are in good shape (i.e. usable for calibration, have valid certificates)		5	2	3
	PC9. Verify that the measurement environment is appropriate for the reference instruments and for the requested calibration		5	2	3
	PC10. Record readings of ambient temperature, relative humidity and atmospheric pressure, with required precision using recommended devices		3	1	2
	PC11. Ensure Thermal Stabilization time are met for Test Weights, per SOP. This will need to be reported. As a practical guideline, a waiting time of 24 hours is recommended.		3	1	2
	PC12. Follow the SOP guidelines and consult the Supervisor for selection of Reference Weights and Comparator/Balance. The following general considerations apply		3	1	2
	PC13. The reference weight shall be of a higher class of accuracy than the weight to be calibrated.		3	1	2
	PC14. In the calibration of weights of class E1, the reference weight shall have similar or better metrological characteristics (magnetic properties, surface roughness) than the weights to be calibrated.		3	1	2

Qualifications Pack For Calibration Technician -Mechanical (Mass, Balance, Volume, Density, Viscosity)

PC15.	On the basis of the accuracy class, a mass comparator is to be selected in such a way that its uncertainty component is balanced in proportion to the overall uncertainty of the weighing result.	5	2	3
PC16.	The most important uncertainty component of a mass comparator is calculated from its standard deviation.	3	1	2
PC17.	The specification of the manufacturer can be selected as a first approximation for the value of a standard deviation. It must be taken into account for the smallest nominal value. It should not exceed an amount of 30% of the combined standard uncertainty u_1 ($k=2$).	3	1	2
PC18.	Follow SOP guidelines regarding Metrological requirements.	5	2	3
PC19.	At higher altitudes, the buoyancy correction shall be used, which requires the density of the weight to be known. If class E weights are to be used above 330 m, the density of the weights shall be provided along with their associated uncertainty. For Class F1 the same is true above 800 m.	5	2	3
PC20.	Method used for calibration is required to be mentioned in the calibration certificate issued to the customer. There are two methods for determination of conventional mass of weights in a weight set.	3	1	2
PC21.	For Direct Comparison Method, choose the Minimum Number of Weighing Cycles per SOP (based on standard OIML R-111-1).	5	2	3
PC22.	For Sub -Division/Sub-Multiplication Method (Ref. C.3.2 of OIML) choose the appropriate Reference Weights per SOP guidelines.	5	2	3
PC23.	Follow the measurement procedure for the method chosen per SOP.	5	2	3
PC24.	Make measurements using the Reference Weights, the Comparator instrument and the UUC, following the prescribed measurement sequence.	5	2	3
PC25.	Record the number of readings, as prescribed in the SOP.	3	1	2
PC26.	Record readings of ambient temperature and relative humidity and the air pressure at the beginning and end of measurements using recommended devices.	3	1	2
PC27.	Weights used for realization of Pressure in Dead weight pressure balance or weights used for realization of force in Newton are to be calibrated on true mass basis.	5	2	3
PC28.	If, weights are calibrated on conventional mass basis, equation for conversion from conventional mass to true mass are to be mentioned to enable the user to	3	1	2

Qualifications Pack For Calibration Technician -Mechanical (Mass, Balance, Volume, Density, Viscosity)

	apply appropriate buoyancy correction.			
PC29.	Newton or Force weights are typically of a slotted design or with a centre hole and are typically marked with a nominal Force in Newton. Force is calculated with respect to Local gravity 'gL' during calibration using the formula: $F = m(1 - \rho_a / \rho_m) * gL$	5	2	3
PC30.	When the customer requires the force weight with respect to his local 'g' value he has to provide the same with uncertainty. Then the force value shall be calculated using the local 'g' value and declare in the certificate in terms mass value along with the calculated value in Newton. 'g' value of the calibration laboratory shall also be known to sufficient accuracy.	5	2	3
PC31.	The Laboratory may calibrate weights of non-metric units (e.g. Pound or Ounce etc.) However, the results shall be reported in SI units like kg, g, mg, etc. along with the calculated equivalent value in the non-metric unit or mention the conversion factor to be used.	5	2	3
PC32.	Refer to SOP for the equations to use for the type of calibration being performed	5	2	3
PC33.	Use form/format specified in the SOP for performing calculations	3	1	2
PC34.	Perform the required calculations using calculator or software as specified, using the equations and procedures specified in the SOP.	5	2	3
PC35.	Determine Air Density and its Uncertainty, per SOP guidelines	5	2	3
PC36.	Use Equations for Determination of Conventional Mass, True mass and their uncertainties	5	2	3
PC37.	Calculate contribution of Uncertainty in Calibration of Weights. The estimation of the uncertainty measurement for the weight calibrated by a laboratory shall consider at least the following contributions.	5	2	3
PC38.	Calculate Uncertainty for Calibration Results for Type A Standard uncertainty and Type B Standard uncertainty.	5	2	3
PC39.	Record the results, including uncertainty, as calculated above, in the specified format	3	1	2
PC40.	Prepare Report in the format specified in the SOP. The calibration certificates issued to the customer shall be in accordance with clause 5.10 of ISO/IEC/17025:2005. It also includes the following:	3	1	2
PC41.	Store and share report with the designated persons	3	1	2
PC42.	Return the Reference instruments to their recommended	3	1	2

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	storage position and put in their box/cover				
	PC43. Return the UUC to its recommended storage position and put in its accompanying box/cover		3	1	2
	PC44. Fix/Attach any recommended tag/markings on the UUC to signify that its calibration has been done		3	1	2
		Total	170	63	107
3. IAS/N0517 Calibration of Weighing Balance and Mass Comparator	PC1. Prepare Observation Sheet (use a standard form/format as specified in the SOP)	180	3	1	2
	PC2. Note in the Observation Sheet the details of the UUC (requesting company, lab reference number, type, make, model, serial number, date, time, technician's name etc.)		3	1	2
	PC3. Verify that the UUC is in good shape (i.e. no physical damage, readable markings, clean, no loose parts etc.)		3	1	2
	PC4. Note all parameters to measure for the requested calibration		3	1	2
	PC5. Note the number of readings to be taken for each parameter		3	1	2
	PC6. Note the Reference Instruments to use for the parameters		3	1	2
	PC7. Wear gloves while handling instruments		3	1	2
	PC8. Verify that the Reference Instruments are available and are in good shape (i.e. usable for calibration, have valid certificates)		5	2	3
	PC9. Verify that the measurement environment is appropriate for the reference instruments		5	2	3
	PC10. Record readings of ambient temperature, relative humidity and atmospheric pressure, with required precision using recommended devices		3	1	2
	PC11. The effect of Convection: When the reference weights used are transported for calibration site, they may not have the same temperature as that of the balance and its environment, then there will be heat exchange between the weights and their environment. Due to this there will be apparent change in mass in relation to the temperature difference. An initial temperature may be reduced to a smaller value by acclimatization (habituation to a new climate) over time. This occurs faster for smaller weights than for larger weights.		5	2	3
	PC12. When a weight is put on the load receptor of a balance, the actual difference in temperature will produce an air flow about the weight leading to parasitic forces which results in conventional mass		5	2	3

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	of the weight. This value will be greater for large weights than for small ones.			
PC13.	Ensure Thermal Stabilization time are met for Test Weights, per SOP. This will need to be reported. As a practical guideline, a waiting time of 24 hours is recommended.	5	2	3
PC14.	Incorporate effect of Gravity 'g' on Calibration of Balance. Follow SOP guidelines.	5	2	3
PC15.	Follow the SOP guidelines and consult the Supervisor for selection of Reference Weights and Comparator/Balance.	5	2	3
PC16.	Ensure that the design and accuracy of weights are appropriate to the weighing machine being calibrated, and where possible should have a 95% confidence level uncertainty of calibration less than half the smallest digit size or recorded scale interval of the weighing machine to be calibrated. Where groups of weights are to be used to make up a single load, this criterion shall be applied to the arithmetic sum of the weight's individual calibration uncertainties.	5	2	3
PC17.	Ensure that the weighing machines can be calibrated using calibrated weights in the pattern of the designated OIML class. The uncertainty of calibration of the weights used will be 1/3 of its specified maximum permissible error. When selecting suitable weights, attention shall also be given to properties of the weights other than accuracy, such as magnetism, corrosion and wear resistance.	5	2	3
PC18.	Lab cannot calibrate balances using lower class of accuracy weights than required.	3	1	2
PC19.	Follow SOP guidelines regarding Metrological requirements.	5	2	3
PC20.	Reference and Standard weights used for calibration of weighing balance and comparator shall follow the requirement of OIML R-111-1.	3	1	2
PC21.	Calibration shall be performed at the place where the balance is being used. If the balance is moved to another location after calibration, many factor may invalidate the calibration.	5	2	3
PC22.	Lab cannot calibrate balances using lower class of accuracy weights than required.	3	1	2
PC23.	Follow SOP guidelines. Recommended to refer to the standard OIML R 76-1 or Euramet guidelines cg -18 V.03 on the calibration of non-automatic weighing instruments.	3	1	2
PC24.	Perform steps of calibration per SOP.	5	2	3

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PC25.	Follow calibration Procedure for Performance Check of balances to including Repeatability, Linearity, Eccentricity, and Hysteresis Test (if the Balance is calibrated first time or after a major repair)	5	2	3
PC26.	Follow the measurement procedure for the method chosen per SOP.	5	2	3
PC27.	Make measurements using the Reference Weights, the Comparator instrument and the UUC, following the prescribed measurement sequence.	5	2	3
PC28.	Do Performance Check for the Balance Calibration, as specified in SOP, including Repeatability, Linearity, Eccentricity and Hysteresis (if the Balance is calibrated first time or after a major repair)	6	2	4
PC29.	Record the number of readings, as prescribed in the SOP.	3	1	2
PC30.	Record readings of ambient temperature and relative humidity and the air pressure at the beginning and end of measurements using recommended devices.	3	1	2
PC31.	Refer to SOP for the equations to use for the type of calibration being performed	3	1	2
PC32.	Use form/format specified in the SOP for performing calculations	3	1	2
PC33.	Perform the required calculations using calculator or software as specified, using the equations and procedures specified in the SOP.	5	2	3
PC34.	Determine Air Density and its Uncertainty, per SOP guidelines	5	2	3
PC35.	Use Equations for Determination of Conventional Mass, True mass and their uncertainties	3	1	2
PC36.	Determine Uncertainty Components in Balance Calibration, including Repeatability, Linearity, Resolution, Reference standard weights, Drift in mass or instability of the mass of weights used, Eccentricity (whenever the test is carried out)	5	2	3
PC37.	Calculate Combined Standard Uncertainty of the Weighing Balance	5	2	3
PC38.	Calculate Expanded uncertainty	3	1	2
PC39.	Calculate Overall Uncertainty of the Balance	3	1	2
PC40.	Record the results, including uncertainty, as calculated above, in the specified format	5	2	3
PC41.	Prepare Report in the format specified in the SOP. The calibration certificates issued to the customer shall be in accordance with clause 5.10 of ISO/IEC/17025:2005.	5	2	3
PC42.	Perform Verification of Comparator, if required in SOP	5	2	3
PC43.	To verify the performance of the comparator same procedure shall be followed to ascertain its			

Qualifications Pack For Calibration Technician -Mechanical (Mass, Balance, Volume, Density, Viscosity)

	performance as per manufacturer specification. Only uncertainty due to standard deviation (from repeatability) is considered during calibration of weights. No other components like eccentricity, error of indication etc. are taken into account for a comparator.		5	2	3
	PC44. Store and share report with the designated persons		3	1	2
	PC45. Return the Reference instruments to their recommended storage position and put in their box/cover		3	1	2
	PC46. Return the UUC to its recommended storage position and put in its accompanying box/cover		3	1	2
	PC47. Fix/Attach any recommended tag/markings on the UUC to signify that its calibration has been done		3	1	2
		Total	190	71	119
4. IAS/N0518 Calibration of Volumetric Apparatus	PC1. Prepare Observation Sheet (use a standard form/format as specified in the SOP)	180	3	1	2
	PC2. Note in the Observation Sheet the details of the UUC (requesting company, lab reference number, type, make, model, serial number, date, time, technician's name etc.)		3	1	2
	PC3. Verify that the UUC is in good shape (i.e. no physical damage, readable markings, clean, no loose parts etc.)		3	1	2
	PC4. Note all parameters to measure for the requested calibration		3	1	2
	PC5. Note the number of readings to be taken for each parameter		3	1	2
	PC6. Note the Reference Instruments to use for the parameters		3	1	2
	PC7. Wear gloves while handling instruments		3	1	2
	PC8. Verify that the Reference Instruments are available and are in good shape (i.e. usable for calibration, have valid certificates)		5	2	3
	PC9. Verify that the measurement environment is appropriate for the reference instruments		5	2	3
	PC10. Record readings of ambient temperature, relative humidity and atmospheric pressure, with required precision using recommended devices		3	1	2
	PC11. Follow the SOP guidelines and consult the Supervisor for selection of Reference Liquid.		5	2	3
	PC12. Ensure that the balance used as reference for calibration has traceability certificate and meets the requirements mentioned below.		3	1	2
	PC13. Ensure that the balance used for calibration of volumetric apparatus has a readability / resolution of the order of 1/3rd of accuracy specified for		3	1	2

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	volumetric apparatus.			
PC14.	Ensure that weighing balances for calibration of volumetric apparatus are as per IS/ISO 4787:2010.	3	1	2
PC15.	Ensure that requirements of balances for micro pipette calibration are as per ISO 8655-6.	3	1	2
PC16.	Ensure availability of other devices needed: Timing Device, Thermometer for measuring temperature of calibration liquid (water), Hydrometer, Barometer	5	2	3
PC17.	Follow SOP guidelines regarding Metrological requirements.	5	2	3
PC18.	Prefer Volume Measurement by Gravimetric Method No method can measure directly the physical quantity of a minute volume. Therefore the most common and precise method is to measure the mass value of distilled water, whose physical properties are known using a balance and then convert the mass to a volumetric value.	3	1	2
PC19.	Use balance and the thermometer only for volume calibration.	3	1	2
PC20.	Correct for Density variation of distilled water due to temperature change and correction for buoyancy.	5	2	3
PC21.	Take extreme care in dispensing volume of volumetric apparatus, as it is known to be influenced by operator skill.	5	2	3
PC22.	Follow SOP guidelines for selecting calibration method.	5	2	3
PC23.	Calibration of volumetric apparatus can be done either of the following two methods: (a) Gravimetric Method (preferred) (b) Volumetric Method	5	2	3
PC24.	For Calibration Procedure (Based on Gravimetric Method), follow SOP guidelines.	5	2	3
PC25.	Perform Mass Measurement using Balance	5	2	3
PC26.	Mass to Volume Conversion uses the density of the distilled water (approximately 1g/ ml). Variation of volume with change in temperature of water is to be taken into account.	5	2	3
PC27.	Follow the measurement procedure for the method chosen per SOP.	5	2	3
PC28.	Make measurements using the Reference Weights, the Comparator instrument and the UUC, following the prescribed measurement sequence.	3	1	2
PC29.	Do Performance Check for the Balance Calibration, as specified in SOP, including Repeatability, Linearity, eccentricity, Hysteresis (if the Balance is calibrated first time or after a major repair)	5	2	3
PC30.	Record the number of readings, as prescribed in the SOP.	3	1	2

Qualifications Pack For Calibration Technician -Mechanical (Mass, Balance, Volume, Density, Viscosity)

PC31.	Record readings of ambient temperature and relative humidity and the air pressure at the beginning and end of measurements using recommended devices.	3	1	2
PC32.	Refer to SOP for the equations to use for the type of calibration being performed	5	2	3
PC33.	Use form/format specified in the SOP for performing calculations	3	1	2
PC34.	Perform the required calculations using calculator or software as specified, using the equations and procedures specified in the SOP.	5	2	3
PC35.	Use appropriate Equation for Calculation of Volume, per SOP.	5	2	3
PC36.	Calculate the effect of Evaporation	5	2	3
PC37.	Especially for small volumes below 50 μ l, errors due to evaporation of the test liquid during weighing shall be taken in to consideration. Apart from the design of the weighing vessel, the test cycle time is important.	5	2	3
PC38.	In order to keep the error due to evaporation as small as possible, the following additional items can be considered, if volumes below 50 μ l are tested: <ul style="list-style-type: none"> • a balance with appropriate accessories such as an evaporation trap could be used ; • or, the test liquid to be weighed could be delivered in to a capillary tube, although this method does not replicate the normal method of use and the user should verify for himself that correlation exists. <p>Regardless of these items, the error due to evaporation during the measuring series can be determined experimentally (see 7.2.8 of the standard ISO 8655-6) and compensated mathematically (see 8.1 of the standard ISO 8655-6). The uncertainty of this compensation should be added to the uncertainty of measurement.</p>	5	2	3
PC39.	Determine Measurement Uncertainty, per SOP guidelines. The following components of uncertainty are considered:	5	2	3
PC40.	Calculate Combined Uncertainty per SOP guidelines	3	1	2
PC41.	Record the results, including uncertainty, as calculated above, in the specified format	3	1	2
PC42.	Prepare Report in the format specified in the SOP.	3	1	2
PC43.	Store and share report with the designated persons	3	1	2

Qualifications Pack For Calibration Technician -Mechanical (Mass, Balance, Volume, Density, Viscosity)

	PC44. Return the Reference instruments to their recommended storage position and put in their box/cover		3	1	2
	PC45. Return the UUC to its recommended storage position and put in its accompanying box/cover		3	1	2
	PC46. Fix/Attach any recommended tag/markings on the UUC to signify that its calibration has been done		3	1	2
		Total	180	67	113
5. IAS/N0519 Calibration of Density of Solids	PC1. Prepare Observation Sheet (use a standard form/format as specified in the SOP)	150	3	1	2
	PC2. Note in the Observation Sheet the details of the UUC (requesting company, lab reference number, type, make, model, serial number, date, time, technician's name etc.)		3	1	2
	PC3. Verify that the UUC is in good shape (i.e. no physical damage, readable markings, clean, no		3	1	2
	PC4. Note all parameters to measure for the requested calibration		3	1	2
	PC5. Note the number of readings to be taken for each parameter		3	1	2
	PC6. Note the Reference Instruments to use for the parameters		3	1	2
	PC7. Wear gloves while handling instruments		3	1	2
	PC8. Verify that the Reference Instruments are available and are in good shape (i.e. usable for calibration, have valid certificates)		5	2	3
	PC9. that the measurement environment is appropriate for the reference instruments		5	2	3
	PC10. Record readings of ambient temperature, relative humidity and atmospheric pressure, with required precision using recommended devices		3	1	2
	PC11. Follow the SOP guidelines and consult the Supervisor for selection of Reference Weights and Comparator/Balance.		5	2	3
	PC12. The design and accuracy of weights shall be appropriate to the weighing machine being calibrated, and where possible should have a 95% confidence level uncertainty of calibration less than half the smallest digit size or recorded scale interval of the weighing machine to be calibrated. Where groups of weights are to be used to make up a single load, this criterion shall be applied to the arithmetic sum of the weight's individual calibration uncertainties.		5	2	3
	PC13. Weighing machines can usually be calibrated using calibrated weights in the pattern of the				

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	designated OIML class. The uncertainty of calibration of the weights used will be 1/3 of its specified maximum permissible error. When selecting suitable weights, attention shall also be given to properties of the weights other than accuracy, such as magnetism, corrosion and wear resistance.		3	1	2
PC14.	Lab cannot calibrate balances using lower class of accuracy weights than required.		3	1	2
PC15.	Follow SOP guidelines regarding Metrological requirements.		5	2	3
PC16.	For Density measurement of Standard weights follow the requirements of OIML R-111-1 and density of solids.		5	2	3
PC17.	Follow the guidelines for method selection per SOP.		5	2	3
PC18.	Choose one of the two methods for determination of density solids:		5	2	3
PC19.	Hydrostatic weighing method: Usually the sample of solid is weighed in Air and weighed in water or known reference density liquid and the difference in weighing is converted in to volume and the Refer the standard OIML G14 for further details. For determination of Standard weights OIML R-111-1 shall be followed.		5	2	3
PC20.	Determination of Density of Solid matter using Pycnometer. Pycnometer can be used to determine the density of homogeneous solid object that do not dissolve in working liquid (distilled water). Pycnometer is a glass measure having a fixed volume V.		5	2	3
PC21.	Follow the measurement procedure for the method chosen per SOP.		5	2	3
PC22.	For Hydrostatic weighing method, the density of a solid is determined with the aid of a liquid whose density is known (water or ethanol are usually used as auxiliary liquids). The solid is weighed in air (A) and then in auxiliary liquid (B), the density of the solid is then calculated using appropriate equation. The volume of the solid is calculated using appropriate equation.		5	2	3
PC23.	For Determination of Density of Solid matter using Pycnometer, follow the steps specified in the SOP.		5	2	3
PC24.	Do Performance Check for the Balance Calibration, as specified in SOP for Repeatability, Linearity, Eccentricity, Hysteresis (if the Balance is calibrated first time or after a major repair)		5	2	3
PC25.	Record the number of readings, as prescribed in the SOP.		3	1	2
PC26.	Record readings of ambient temperature and relative humidity and the air pressure at the		3	1	2

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	beginning and end of measurements using recommended devices.				
	PC27. Refer to SOP for the equations to use for the type of calibration being performed		5	2	3
	PC28. Use form/format specified in the SOP for performing calculations		3	1	2
	PC29. Perform the required calculations using calculator or software as specified, using the equations and procedures specified in the SOP.		5	2	3
	PC30. Determine Uncertainty contributions for weighing process, per SOP guidelines. The components of uncertainty include: Balance - Repeatability, resolution, linearity; Reference standard weight; Density of reference liquid-density, surface tension and temperature; Air density		5	2	3
	PC31. Calculate Combined Uncertainty per SOP guideline.		5	2	3
	PC32. Calculate Expanded Uncertainty		3	1	2
	PC33. Record the results, including uncertainty, as calculated above, in the specified format		3	1	2
	PC34. Prepare Report in the format specified in the SOP.		3	1	2
	PC35. Store and share report with the designated persons		3	1	2
	PC36. Return the Reference instruments to their recommended storage position and put in their box/cover		3	1	2
	PC37. Return the UUC to its recommended storage position and put in its accompanying box/cover		3	1	2
	PC38. Fix/Attach any recommended tag/markings on the UUC to signify that its calibration has been done		3	1	2
		Total	150	56	94
6. IAS/N0530 Determination of Density of Liquids and Calibration of Density Hydrometers	PC1. Prepare Observation Sheet (use a standard form/format as specified in the SOP)		3	1	2
	PC2. Note in the Observation Sheet the details of the UUC (requesting company, lab reference number, type, make, model, serial number, date, time, technician's name etc.)		3	1	2
	PC3. Verify that the UUC is in good shape (i.e. no physical damage, readable markings, clean, no loose parts etc.)		3	1	2
	PC4. Note all parameters to measure for the requested calibration		3	1	2
	PC5. Note the number of readings to be taken for each parameter		3	1	2
	PC6. Note the Reference Instruments to use for the parameters		3	1	2

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PC7.	Wear gloves while handling instruments	155	3	1	2
PC8.	Verify that the Reference Instruments are available and are in good shape (i.e. usable for calibration, have valid certificates)		5	2	3
PC9.	Verify that the measurement environment is appropriate for the reference instruments		5	2	3
PC10.	Record readings of ambient temperature, relative humidity and atmospheric pressure, with required precision using recommended devices		3	1	2
PC11.	Follow the SOP guidelines and consult the Supervisor for selection of Reference Weights and Comparator/Balance and other accessories.		5	2	3
PC12.	For Hydrostatic Weighing (Cuckow’s) Method, select: Weighing Balance, Standard weights, Temperature Sensor with indicator, Tridecane, Water bath, Laser light etc.		5	2	3
PC13.	For Comparison Method based on Archimedes Principle,choose the calibration set up consisting of: Standard Hydrometers, Standard liquid of known density and other support equipment.		5	2	3
PC14.	Choose appropriate Support Equipment per SOP.		5	2	3
PC15.	Follow the guidelines for method selection per SOP.		5	2	3
PC16.	Use the general classifications of Density Hydrometer.		3	1	2
PC17.	Follow the guidelines for method selection per SOP.		5	2	3
PC18.	Select one of the two methods for determination of density of liquids, per SOP guidelines: Using Pycnometer (specific gravity bottle); OR Using a hydrometer by comparison.		5	2	3
PC19.	Select one of the two methods for calibration of hydrometers: Hydrostatic weighing (Cuckow’s) method; OR Comparison method based on Archimedes principle		5	2	3
PC20.	Follow the measurement procedures for the methods chosen per SOP.		5	2	3
PC21.	Determine Density of Liquids using Sinker of known volume. The sinker is weighed in air and then in the liquid whose density is to be determined. The density ρ can be determined from the two weighing using specified equations.		5	2	3
PC22.	Determine Density of Liquids using Pycnometer following specified procedures and equations.		5	2	3
PC23.	Perform measurements for Calibration of Hydrometers by Cuckow’s Method, based on the three equilibrium equations obtained in different conditions and situations, as specified in SOP.		5	2	3
PC24.	Perform measurements for Calibration of				

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		Hydrometer by Comparison Method, in which the UUC is compared with reference to a standard hydrometer whose scale is precisely known, as specified in SOP.	5	2	3
	PC25.	Record the number of readings, as prescribed in the SOP.	3	1	2
	PC26.	Record readings of ambient temperature and relative humidity and the air pressure at the beginning and end of measurements using recommended devices.	3	1	2
	PC27.	Refer to SOP for the equations to use for the type of calibration being performed	5	2	3
	PC28.	Use form/format specified in the SOP for performing calculations	3	1	2
	PC29.	Perform the required calculations using calculator or software as specified, using the equations and procedures specified in the SOP.	3	1	2
	PC30.	For Cuckow`s method, calculate contributions of uncertainty using the following parameters:	5	2	3
	PC31.	Calculate Combined Uncertainty per SOP guideline.	5	2	3
	PC32.	Calculate Expanded Uncertainty	5	2	3
	PC33.	Record the results, including uncertainty, as calculated above, in the specified format	3	1	2
	PC34.	Prepare Report in the format specified in the SOP.	6	2	4
	PC35.	Store and share report with the designated persons	3	1	2
	PC36.	Return the Reference instruments to their recommended storage position and put in their box/cover	3	1	2
	PC37.	Return the UUC to its recommended storage position and put in its accompanying box/cover	3	1	2
	PC38.	Fix/Attach any recommended tag/markings on the UUC to signify that its calibration has been done	3	1	2
		Total	155	58	97
7. IAS/N0531 Calibration of Viscometers	PC1.	Prepare Observation Sheet (use a standard form/format as specified in the SOP)	3	1	2
	PC2.	Note in the Observation Sheet the details of the UUC (requesting company, lab reference number, type, make, model, serial number, date, time, technician's name etc.)	3	1	2
	PC3.	Verify that the UUC is in good shape (i.e. no physical damage, readable markings, clean, no loose parts etc.)	3	1	2
	PC4.	Note all parameters to measure for the requested calibration	3	1	2

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PC5.	Note the number of readings to be taken for each parameter	145	3	1	2
PC6.	Note the Reference Instruments to use for the parameters		3	1	2
PC7.	Wear gloves while handling instruments		3	1	2
PC8.	Verify that the Reference Instruments are available and are in good shape (i.e. usable for calibration, have valid certificates)		5	2	3
PC9.	Verify that the measurement environment is appropriate for the reference instruments		5	2	3
PC10.	Record readings of ambient temperature, relative humidity and atmospheric pressure, with required precision using recommended devices		3	1	2
PC11.	Follow the SOP guidelines and consult the Supervisor for selection of Reference equipment, reference oil and other accessories.		5	2	3
PC12.	For Calibration of Glass Capillary Viscometers, select appropriate reference and other devices per SOP.		5	2	3
PC13.	Select Reference viscometer and Reference standard viscosity for calibration following SOP guidelines: (For more details refer annexes of the standards ASTM D446 or ISO 3104: 1994 or ISO3105:1994)		5	2	3
PC14.	Follow SOP guidelines regarding Metrological requirements.		5	2	3
PC15.	For Density measurement of Standard weights follow the requirements of OIML R-111-1 and density of solids.		5	2	3
PC16.	The most important factor affecting the quality of a viscosity measurement is temperature, so ensure it is measured accurately.		3	1	2
PC17.	Ensure temperature control is as specified in SOP. A slight variation in temperature can have a large effect on the viscosity of fluid.		3	1	2
PC18.	Viscometers are calibrated under normal stable room temperature conditions. Ensure a room temperature within 20C to and 30C with variation of $\pm 4C$, or as specified in the SOP.		3	1	2
PC19.	Ensure resolution of Environmental Temperature Monitoring System is 0.1C.		3	1	2
PC20.	Ensure that the 'g' value is known with sufficient accuracy either by Geological Survey of India or any other relevant source for reporting the g value along with viscosity constant in the calibration certificate. This helps the end user to apply required correction due to change in g for viscosity constant.		3	1	2

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PC21.	Laboratory may also calculate 'g' value knowing latitude and height as per standard formula recommended in SOP.		3	1	2
PC22.	Follow the SOP guidelines for selection of calibration		5	2	3
PC23.	Follow the general guidelines for calibration procedures for different types of iscometers per SOP.		5	2	3
PC24.	Follow the general guidelines for calibration procedures for other types of Viscometers such as Suspended Level Viscometer, Reverse Flow Viscometer, Flow cups and Rotational Viscometers		5	2	3
PC25.	Follow the measurement procedures for the methods chosen per SOP.		5	2	3
PC26.	Record the number of readings of the reference viscometer and UUC, as prescribed in the SOP.		3	1	2
PC27.	Record readings of ambient temperature and relative humidity and the air pressure at the beginning and end of measurements using recommended devices.		3	1	2
PC28.	Refer to SOP for the equations to use for the type of calibration being performed		5	2	3
PC29.	Use form/format specified in the SOP for performing calculations		3	1	2
PC30.	Perform the required calculations using calculator or software as specified, using the equations and procedures specified in the SOP.		5	2	3
PC31.	Calculate the relative overall uncertainty in the measurement of kinematic viscosity (Uv).		5	2	3
PC32.	Calculate Combined / Expanded Uncertainty per SOP guidelines.		3	1	2
PC33.	Record the results, including uncertainty, as calculated above, in the specified format		4	1	3
PC34.	Prepare Report in the format specified in the SOP.		5	2	3
PC35.	Store and share report with the designated persons		3	1	2
PC36.	Return the Reference instruments to their recommended storage position and put in their box/cover		3	1	2
PC37.	Return the UUC to its recommended storage position and put in its accompanying box/cover		3	1	2
PC38.	Fix/Attach any recommended tag/markings on the UUC to signify that its calibration has been done		3	1	2
		Total	145	53	92

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8. IAS/N 0204 Reporting of Task Performed- Calibration	PC1.	Report completed task per organization process.		20	10	1
	PC2.	Report faults/issues to immediate supervisor		20	5	1 5
	PC3.	Perform entry of preventive maintenance check lists/reports		20	10	1 0
	PC4.	Report on noticing any visible changes in of Mass, Weight, Volume, Density, Viscosity Calibration setup or its accessories. Report for immediate attention of supervisor		20	5	1 5
	PC5.	Report any theft in Mass, Weight, Volume, Density, Viscosity Calibration setup to supervisor		10	5	5
	PC6.	Report suspicious movement of new persons near of Mass, Weight, Volume, Density, Viscosity Calibration setup to security and supervisor		10	5	5
			Total	100	40	60
9. IAS/N0532 Preventive Maintenance of Mass, Balance, Density, Viscosity Calibration Setup	PC1.	Prepare PM list of devices and instruments.		5	2	3
	PC2.	Carry out Visual Checks, using SOP of the organization for system health check and list		8	3	5
	PC3.	Check calibration gauges, instruments and accessories for any rusting, burrs, stains, foreign objects, missing or loose screws and any other visible deficiency. Note the actions to be performed in the list.		10	5	5
	PC4.	Check calibration gauges, instruments, meters and accessories for proper operation over their range.		10	5	5
	PC5.	Check all devices in the list for validity of calibration, or validity expiring soon. Record and report to the designated person for action per SOP.		5	2	3
	PC6.	For the listed items, perform corrective action such as cleaning, greasing, and tightening of screws etc. following recommended procedure in the SOP.		8	3	5
	PC7.	Use authorized cleaning solvents and greases in the right amount. Use approved cleaning tissues or cloth.		5	2	3
	PC8.	If the recommended maintenance does not restore the device to the required condition, add this to the Corrective Maintenance list and report.		5	2	3
	PC9.	Complete preventive maintenance schedule list of Mass, Weight, Volume, Density, Viscosity Calibration setup and accessories. Close any issues in the list.		4	1	3
			Total	60	25	35

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10. IAS/N2105 Work Effectively With Teams	PC1.	Know and understand the team objectives and goals	75	3	1	2
	PC2.	Know team members by name. Greet them appropriately and respond to their greetings.		2	1	1
	PC3.	Know the roles and responsibilities of team members. Ensure others know about you and your role in the team		2	1	1
	PC4.	Learn about the culture and preferences of team members – especially if they belong to other organizations or nationalities		5	1	4
	PC5.	Follow organization’s policies and procedures for working with team members within and outside the organization – especially relating to privacy, confidentiality and security.		2	1	1
	PC6.	Create an environment of trust and mutual respect		3	1	2
	PC7.	Use appropriate mode of communication – verbal, written, mail, phone or text and clearly articulate your message to ensure that the recipient understands the message.		2	1	1
	PC8.	Listen to team members and try to understand what they are wanting to say. Seek or provide clarifications if you see any gap in understanding		3	1	2
	PC9.	Communicate professionally and follow organization protocols. Do not overload the team members with unnecessary and unsolicited information		4	1	3
	PC10.	Share important information with the team timely.		3	1	2
	PC11.	Respond to communications promptly.		3	1	2
	PC12.	Perform own role and produce output in time for other team members to consume		3	1	2
	PC13.	Receive inputs from others and work upon it per role requirement		2	1	1
	PC14.	Make adjustments within the permissible rules so that work flows smoothly.		2	1	1
	PC15.	Help team members to perform their role effectively and provide any clarifications and support they need		2	1	1
	PC16.	Share tools and common resources fairly, taking cognizance of others’ needs and schedules		2	1	1
	PC17.	Resolve any contentious issues amicably, involving the team lead or the supervisor if needed		2	1	1
	PC18.	Let team members know in good time if you cannot carry out your commitments, explaining the reasons and alternate solutions, if any. Let the team lead know about this.		2	1	1
	PC19.	Think positively and make constructive suggestions to meet the goals		2	1	1

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PC20.	Accept and give suggestions with open mind		2	1	1
PC21.	Take initiatives and volunteer to contribute		2	1	1
PC22.	Help team members with facts and figures to arrive at workable decisions		2	1	1
PC23.	Accept decisions professionally and support these, even if these do not match your suggestions and personal views		4	1	3
PC24.	Act in the interest of the team and the organization to ensure that things do not ‘fall through the gap’ and team goals are achieved.		4	1	3
PC25.	Take initiative to correct the situation if something seems to be going wrong.		2	1	1
PC26.	Seek help or escalate if the situation demands		2	1	1
PC27.	Follow organization’s and statutory guidelines about making references or comments to social customs or preferences		2	1	1
PC28.	Refrain from making any comments to hurt sentiments		2	1	1
PC29.	Accommodate team members’ preferences to the extent feasible. If these come in the way of fulfilling team goals, discuss with the supervisor/ team leader.		2	1	1
PC30.	Seek information and clarifications from others if you do not understand any customs.		2	1	1
		Total	75	30	45

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