M 3.1. i. Report of feasibility study on testing needs of regional companies

AFRICA CENTRE OF EXCELLENCE FOR SUSTAINABLE POWER

AND ENERGY DEVELOPMENT (ACESPED)

UNIVERSITY OF NIGERIA, NSUKKA

REPORT ON FEASIBILITY STUDY ON REGIONAL COMPANIES' TESTING NEEDS

Administrative Responsibility office:	ACE-SPED regional testing facility
Date which was feasibility study report developed:	March, 2021
Report feasibility study developed by:	ACE-SPED testing facility **Committee**
Authorized by:	ACE-SPED BOARD
Version:	01
Web link to document	

1.0 Background

To foster research innovation, we conducted a feasibility tour or visit to ascertain the testing needs and capabilities of our regional partners or companies. We used a questionnaire/interview to identify the testing needs and capabilities of these companies.

2.0 Objective of the feasibility study

i. By identifying the elements that may make the testing laboratory successful, feasibility studies assist ACE-SPED managers in determining the viability of a project or enterprise.

ii. A feasibility study includes a thorough examination of the requirements necessary to carry out the testing.

iii. The report may include a description of the new project or product, a market study, the technological and labor requirements, and the sources of funding and capital.

iv. The report concludes with a definitive decision, accompanied by financial forecasts, a success probability, and additional information.

3.0 Some of the companies and industrial partners visited are:

1) Enugu Electricity Distribution Company (EEDC) Enugu (National Partners, Support Letter Received)
2) National Center for Energy Research and Development (NCERD) Nsukka (National Partners, Support Letter Received)
3) National Power Training Institute of Nigeria (NAPTIN) (National Partners, Support Letter Received)
4) Mirai Denchi Inc Japan (International Partners, Support Letter Received)
5) Jacobs Engineering Inc London Uk (International Partners, Support Letter Received)
6) Cleanergy Global Solutions Ltd (National Partners, Support Letter Received)
7) EU-ACP Chamber for Multilateral Cooporation, Vienna Austria (International Partners, Support Letter Received)
8) National Stove Eligibility Laboratory (National Partners, Support Letter Received)

9) Nigeria Bulk Electricity Trading Company Abuja
10) Nigerian Chambers of Commerce and Industry, Japan (NCCIJ) (International Partners, Support Letter Received)
11) Project Development Agency (PRODA) Enugu (National Partners, Support Letter Received)
12) Lions Science Park (LSP) University of Nigeria, Nsukka
13) SCC IMPS Institute for Material Applications and 3D Printing Solutions, Stuttgart Germany (International Partners, Support Letter Received)
14) National Integrated Power Project (NIPP) Abuja
15) National Center for Equipment Maintenance and Development(NCEMD), University of Nigeria, Nsukka
16) Transmission Company of Nigeria (TCN) Abuja
17) Energy Commission of Nigeria (ECN) Abuja
18) Nigerian Electricity Regulatory Commission (NERC)
19) Electronic Development Institute (ELDI)
20) Science Equipment Development Institute (SEDI) Enugu(National Partners, Support Letter Received)
21) Anambra Motor Manufacturing Company (ANAMMCO) Enugu
22) Cutix Cables Plc Nnewi
23) Nigerian Breweries Limited (NBL) Lagos
24) Nigerian Bottling Company (NBC) Lagos
25) UNESCO BIOTEC Center University of Nigeria, Nsukka (National Partners, Support Letter Received)
26) Shell Petroleum Development Company (SPDC) Port Harcourt
27) Nigerian National Petroleum Corporation (NNPC) Abuja
28) Solive Oil Ltd Nsukka

4.0 Outcomes of the **feasibility study**

The **feasibility** study concentrated on identifying technical exchanges or other beneficial enhancements from the issue areas indicated by the survey results. We conduct interviews and collect survey responses from our regional partners. The table below illustrates the lack of adequate advanced materials testing equipment in many parts of Nigeria and West Africa.

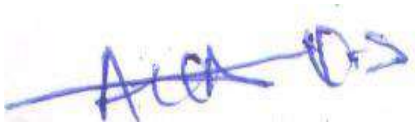
A. Control and Instrumentation Equipment

CE110 Servo Trainer	A compact self-contained bench mounting d.c. servo apparatus designed to allow students at all academic levels to investigate basic and advanced principles of control. In particular the CE110 deals with control issues relating to position and speed control in servo systems
Microgrid	The microgrid combines the outputs of Wind Turbine emulator, PV Emulator and Fuel Cell at a common DC link via different DC-DC converters which is further connected to a three-legged programmable inverter to deliver the combined power to an Actual Grid. Microgrid system enables user to do research in the field of Microgrid management, load side management, priority allocation to renewable sources etc.
Solar PV Grid Tied Training System	Enables user to study wiring and interconnections of different components involved in the system to develop basic understanding of working and operation of a Grid connected system
5kW Wind Emulator	Wind turbine emulator mimics the behaviour of wind turbine for hardware level simulations. This system has a DC motor coupled with the Induction generator/Permanent Magnet Synchronous Generator, speed of which is controlled as per the speed reference calculated by solving the mathematical model of wind turbine. An induction generator is coupled to the DC motor and bidirectional inverter is connected to the terminals of the generator.
B. Advanced Materials Characterization	
AA6000 mini Desktop Scanning Electron Microscope	Scanning electron microscope (SEM) is one of the most widely used instrumental methods for the examination and analysis of micro- and nanoparticle imaging characterization of solid objects. One of the reasons that SEM is preferred for particle size analysis is due to its resolution of 10 nm, that is, 100 Å.
7600 FTIR spectrometer	It is a valuable tool for various analytical applications in fields such as chemistry, medicine, food and beverage, wine industry, material , energy, and power, engineering and quality process control and for examining the functional group
STA 449 F5 Jupiter® Simultaneous Thermal Analyzer (TG-DSC/DTA Apparatus)	The Nano DSC and the Multi-Cell DSC represent ultrasensitive differential scanning calorimeters with unmatched flexibility for characterizing molecular structure and stability. The Nano DSC, with fixed-in-place cells, is specifically designed to analyze in-solution samples. The Multi-Cell DSC offers three removable cells and one reference cell for maximum sample flexibility.
c. RENEWABLE AND NEW ENERGY SYSTEMS	

Elemental Analyser with complete accessories Brand/Model: Perkin Elmer CHNS(O) Specification: Perkin Elmer 2400 Series II	The 2400 Series II offers multiple analysis modes and fast analysis times. Modes Time (Minutes) CHN 6 CHNS 8 Oxygen 4 Productivity and precision are your partners with the 2400 Series II. User-selected calibration procedures of single-standard calibration (multiple linear regression) offer the user increased precision throughout the broad analysis range of the 2400 Series II. Uses: For determination of elemental composition of Organic Liquids
Oxygen Bomb Calorimeter Brand/model: CAL3K-F CALORIMETER WITH MANUAL OXYGENCAL3K-AP Specification: 3K-F - CAL3K-F BOMB CALORIMETER SYSTEM.	**Uses:** For determination of Heating value of fuels. The CAL3K-A Oxygen Bomb Calorimeter System can be used with most applications including such as Coal Analysis, Fuel Analysis, Alternative Energy, Waste Analysis, Animal Feed Research, University Research, Food/Nutrition Analysis, Explosives Analysis, Coal Analysis, Oil Analysis, and other traditional and non-traditional applications.

5.0 Conclusions

The feasibility study identified specific test procedures that required changes in the survey and partner interviews. The study also identified areas for improvement in these processes. The interviews provided valuable insights and were quite helpful in pinpointing challenges they had encountered in advanced testing in the region. The committees recommended that if the ACE-SPED BOARD purchases the aforementioned equipment for the ACE-SPED testing laboratories, it will not only establish ACE-SPED as a leader in the region but also solve the issue of transporting the samples overseas for testing.



16/03/2021

Engr. Prof. V.S.AIGBODION
Chairman ACE-SPED testing facility **Committee**

M 3.1. ii Developed documents for expanding of testing facility

AFRICA CENTRE OF EXCELLENCE FOR SUSTAINABLE POWER AND ENERGY DEVELOPMENT (ACESPED)

UNIVERSITY OF NIGERIA, NSUKKA

Developed documents for expanding of testing facility

OCTOBER, 2022

Administrative Responsibility office:	ACE-SPED regional testing facility
Date which was documents for expanding of testing facility report developed:	October, 2022
Report documents for expanding of testing facility developed by:	ACE-SPED expanding of testing facility Committee
Authorized by:	ACE-SPED BOARD
Version:	01
Web link to document	

1.0 BACKGROUND

The ACE-SPED, after receiving the report of the feasibility study for testing facilities needed in the region from the committees in March 2021, set up committees to develop a document on expanding testing facilities in the University of Nigeria, Nsukka Enugu State, Nigeria. The Applied Research Officer (ARC) of the center headed the committee, with other members including Industrial Liaison Officers (ILO) and various program heads from the center.

2.0 The committee's terms of reference

i. The goal is to develop an expanding testing facility that will be beneficial to the regional partners.

ii. Search for specialists or suppliers the suggested equipment and set up advisory services that will benefit the region.

3.0 Outcomes of the committee work

The University of Nigeria, Nsukka, being a foremost centre of excellence in teaching and research within the region, is at the forefront of fostering regional and international integration through teaching and research. The ACE-SPED expansion of the testing facilities is to further strengthen the regional impact of the university through impactful testing and cutting-edge research in the area of sustainable power and energy development. This document established ACE-SPED as a laboratory hub for sub-regional testing facilities.

ii) University of Nigeria, Nsukka have standard Nano-laboratory, NLNG advanced materials characterization laboratory, high voltage laboratory, energy research centre, equipment research and maintenance centre, centre of entrepreneurship and development and innovation science

park. These laboratory and centre are equipped with modern testing equipment such as solar and PV analyzer, high voltage materials, battery, electrochemical,

iii.) The following testing facilities were proposed to enhance the testing needs of the region:

A. Control and Instrumentation Equipment

CE110 Servo Trainer	A compact self-contained bench mounting d.c. servo apparatus designed to allow students at all academic levels to investigate basic and advanced principles of control. In particular the CE110 deals with control issues relating to position and speed control in servo systems
Microgrid	The microgrid combines the outputs of Wind Turbine emulator, PV Emulator and Fuel Cell at a common DC link via different DC-DC converters which is further connected to a three-legged programmable inverter to deliver the combined power to an Actual Grid. Microgrid system enables user to do research in the field of Microgrid management, load side management, priority allocation to renewable sources etc.
Solar PV Grid Tied Training System	Enables user to study wiring and interconnections of different components involved in the system to develop basic understanding of working and operation of a Grid connected system
5kW Wind Emulator	Wind turbine emulator mimics the behaviour of wind turbine for hardware level simulations. This system has a DC motor coupled with the Induction generator/Permanent Magnet Synchronous Generator, speed of which is controlled as per the speed reference calculated by solving the mathematical model of wind turbine. An induction generator is coupled to the DC motor and bidirectional inverter is connected to the terminals of the generator.
B. Advanced Materials Characterization	
AA6000 mini Desktop Scanning Electron Microscope	Scanning electron microscope (SEM) is one of the most widely used instrumental methods for the examination and analysis of micro- and nanoparticle imaging characterization of solid objects. One of the reasons that SEM is preferred for particle size analysis is due to its resolution of 10 nm, that is, 100 Å.
7600 FTIR spectrometer	It is a valuable tool for various analytical applications in fields such as chemistry, medicine, food and beverage, wine industry, material , energy, and power, engineering and quality process control and for examining the functional group

STA 449 F5 Jupiter® Simultaneous Thermal Analyzer (TG-DSC/DTA Apparatus)	The Nano DSC and the Multi-Cell DSC represent ultrasensitive differential scanning calorimeters with unmatched flexibility for characterizing molecular structure and stability. The Nano DSC, with fixed-in-place cells, is specifically designed to analyze in-solution samples. The Multi-Cell DSC offers three removable cells and one reference cell for maximum sample flexibility.
c. RENEWABLE AND NEW ENERGY SYSTEMS	
Elemental Analyser with complete accessories Brand/Model: Perkin Elmer CHNS(O) Specification: Perkin Elmer 2400 Series II	The 2400 Series II offers multiple analysis modes and fast analysis times. Modes Time (Minutes) CHN 6 CHNS 8 Oxygen 4 Productivity and precision are your partners with the 2400 Series II. User-selected calibration procedures of single-standard calibration (multiple linear regression) offer the user increased precision throughout the broad analysis range of the 2400 Series II. Uses: For determination of elemental composition of Organic Liquids
Oxygen Bomb Calorimeter Brand/model: CAL3K-F CALORIMETER WITH MANUAL OXYGENCAL3K-AP Specification: 3K-F - CAL3K-F BOMB CALORIMETER SYSTEM.	**Uses:** For determination of Heating value of fuels. The CAL3K-A Oxygen Bomb Calorimeter System can be used with most applications including such as Coal Analysis, Fuel Analysis, Alternative Energy, Waste Analysis, Animal Feed Research, University Research, Food/Nutrition Analysis, Explosives Analysis, Coal Analysis, Oil Analysis, and other traditional and non-traditional applications.

4.0 Conclusions

The committee concluded that the center should prioritize the characterization of advanced materials, given the scarcity of this facility in the region and the difficulties faced by partners to send their jobs overseas for testing. They recommended the following equipment to the center and requested experts or vendors to submit proposals.

LIST OF EQUIPMENT WITH INVIOCES

EQUPIMENT	COST	COMPANY
AA6000 mini Desktop Scanning Electron Microscope	**$109,780.00**	www.angstrom-advanced.com
EDS	$60,500.00	www.angstrom-advanced.com
BSD, Back Scattered Electron Detector	$19,800.00	www.angstrom-advanced.com
Stage Motorization (X/Y/R/T/Z)	$4,950.00	www.angstrom-advanced.com
Ion Coater (pump included)	$7,700.00	www.angstrom-advanced.com
Configuration Upgrade• 10x-200,000x• Feature of Compressed Gas AntiVibration• Tilted Holder 0°~60° (Max 90°)	$10,450.00	www.angstrom-advanced.com
ADX8000 X-ray Diffraction Instrument	**$86,190.00**	www.angstrom-advanced.com
ADCX Sample Changer	$16,740.00	www.angstrom-advanced.com
Output Power Upgrade (1200W)	$9,612.00	www.angstrom-advanced.com
ADX-9800 XRF Spectrometer Angstrom Advanced	**$68,500.00**	www.angstrom-advanced.com
Vacuum System (Optional)• For the ability to test light elements of(Na) Sodium to (S) Sulfur.	$2,500.00	www.angstrom-advanced.com
Automatic Sample Changer (Optional)• Interchangeable between	$9,800.00	www.angstrom-

10 samples simultaneously.		advanced.com
7600 FTIR spectrometer	**$35,175.00**	www.angstrom-advanced.com
ATR Attachment	$9,100.00	www.angstrom-advanced.com
		www.angstrom-advanced.com
AAS machine		www.angstrom-advanced.com

TO: TheDirector General.March 16th 2023
ACE-SPED,
UNN (University of Nigeria, Nsukka)
Nigeria.

QUOTATION No: LCN-Q-004-16-03-23FOR LABORATORY INSTRUMENTS

SN	DESCRIPTION	UNIT COST(USD)	QTY	AMOUNT(USD)
1.0	***Analytical Technologies XRD Model: 3010 with X-ray tube*** ***Specification:*** o Tube Type: Ceramic or glass tube are optional o Target: Cu, Fe, Co, Cr, Mo, Ti, W o Default : Cu o Focus size: 1×10mm o Power : 2KW X-ray Generator: o Tube voltage: 10-30KV or 10-40KV o Tube current : 5-20mA or 5-30mA o Filament current : DC 0-3A o Stability: ±0.001%, Voltage deviation 10% o Max power: 600W or 1200W Vertical Goniometer: o Radius: 150mm o Scan Type: θ/2θ linkage o 2θ Scan range: -3°- 150° o 2θ Detecting range: +2°- 150° o Position Speed: 1000°/min (2θ) o Scan Speed : 0.01 - 100°/min o 2θ Min stepping : 0.0002° o Accuracy: 0.001° o 2θ Repeatability accuracy : 0.0005 Slit: o Divergent slit (DS) : θ shaft changeable slit (Max 4.2°) o Scatter slit (SS) : 0.5°/1°/2° o Receiving slit (RS) : 0.1mm/0.2mm/0.3mm/0.4mm o Soller slit : ±2.5° o X-ray extraction angle: 6° o Proportional Detector (PC): o Max counting 1×106cps/s;	91,000.00	1 set	91,000.00

	○ Spectrum resolution ≤20%; ○ Counter voltage 0-2100V; High-voltage stability above 0.005% Cooling Water System: ○ Supply Power: 220V/50HZ ○ Flow:3L/min ○ Pressure: 0.1Mpa-0.30.1Mpa ○ System temperature:18-30°, control accuracy ： ±1° ○ Control panel light : Power, Cooling, Flow indicator Data Analysis Software Instruction: The system includes data ○ Collecting and application package, one is for data collecting while the other is for analysis. ○ Software ○ Data Collecting Software ○ Data Analysis			
2.0	***Analytical Technologies Handheld Portable XRF 3005:*** ***Specification:*** ○ Model: The 4th generation EDX analyzer-Genius XRF series. ○ Analysis method: Energy dispersive X-ray fluorescence analysis method. ○ Measuring range of elements: Mg to U. ○ Simultaneously detect elements: Simultaneouslydetect tens of elements. ○ Processor and RAM: CUP: 667MHz, RAM: 256M, Maximum expanded storage: 32G, Standard configuration: 2G, can store large amounts of data. ○ Content range: ppm～99.99%. ○ Testing time: 3-30 seconds. ○ GPS 、 WIFI: Built-in system. ○ Battery time: Lithium battery, which can be charged, with maximum capacity of 7800mAH, can continuously work for 8 hours; Equipped with wide voltage (110V-220V) general adapter, can work under alternating current. ○ Testing object: Solid, liquid, powder. ○ Detector: 25mm 2 0.3mil， SDD detector. ○ Detector resolution: Lowest resolution can be 139eV. ○ Excitation source: 40KV/100uA-Ag anode window miniature X light tube and high voltage source. ○ Collimator and filter: Collimator of 4.0 or 2.0 diameter, automatic switch of 6 types filter groups. 12 kinds of groups, world's most compound mode, can satisfy various kinds of samples testing. ○ Screen: TFT-LCD touch screen, resolution 640*480. ○ Detection limit: Lowest detection limit accounts to ppm level. ○ Testing window: 12mm.20.Safety:Self-contained password manager mode. ○ Gas charging system: Helium charging at ordinary pressure system.	32,600.00	1 set	32,600.00

	○ Data transmission: Digital multi-channel technology, SPI data transmission, quick analysis, high counting rate, waterproof miniature USB,which can be connected to desktop computer ○ PC Control software ○ PC/21 Inch Monitor/Printer ○ Humidity: ≤90%.			
3.0	***Analytical Technologies Scanning Electron Microscope (Model: 3000)*** ***Resolution :*** ○ 5.0nm (30KV, SE Image) ○ W (Tungsten), Pre-Align Cartridge Filament Magnification: ○ x15 ~ x150,000 (Free scale Magnification) ○ Effective Magnification : x80,000 Detector: ○ Secondary Electron Detector ○ Accelerating Voltage : 1 to 30kV Lens System ○ 2 Step Condenser lens ○ 1 Step Objective lens Objective Aperture: ○ 4 Levels Variable Aperture ○ 30um, 50um, 50um, 100um Image Shift: 1. +/- 25um ○ Stage : 1. X (35mm), Y (35mm), T (0 ~ 45°) ○ Auto Step Motor Stage ○ Beam Rotation (360°), Z (5 ~ 50mm) ○ Manual Stage ***Specimen :*** ○ Standard Stub Φ30-9mm / MC30-1218-A ○ Tilted Sutb Φ : 0(90°&45°) / MC30-1313-A Scanning Mode: ○ Focus Mode (160 x 120 pixels) ○ Reduced Mode (320 x 240 pixels) ○ TV Mode (640 x 480 pixels) ○ Slow Screen Scan Mode (800 x 600 pixels) ○ Photo Screen Capture Mode I (1280 x 960 pixels) ○ Photo Screen Capture Mode II (2560 x 1920 pixels) ○ Photo Screen Capture Mode III (5120 x 3840 pixels) Navigation CAM : ○ Take the sample image for reference of location Image Format ○ JPG, TIFF, BMP, PNG Image Display ○ 27" FHD Monitor x 1set (For the case EM-30 is selected.) Convenient Function : ○ Auto Filament Saturation ○ Auto Focus ○ Auto Contrast/Brightness ○ Line Profile measure ○ SE+BSE Image Merge	2,030,000.00	1 set	2,030,000.00

	○ SE/BSE Image Split Working Distance: ○ Max height : 5 ~ 50mm ○ General height : 7~25mm ○ Use by special holder Vacuum System : ○ Fully Automation ○ Roughing : Rotary Pump ○ High Vacuum : Turbo Molecular Pump Control System : ○ PC Controlled by USB ○ i5 Processor, 8gb RAM ○ S/W Measuring Functions : ○ Length, Angle, Area, Panorama(Ver 1.0) ○ s. Power : ○ AC220V or AC110V +/-10%, 50/60Hz, 1.5kVA ○ 3kVA with EDS Equipment Configuration : ○ Gun Unit ○ Column Unit ○ Condenser and Object Lens Module ○ Chamber Unit ○ Detector and Stage Module ○ Vacuum Unit ○ Rotary Pump(100L/min) and TMP(80L/sec) ○ Control Unit ○ Board Unit ○ Image part and Vacuum Part ○ High Voltage Power Supply ○ Detail Description Ext. Price Spare Parts : ○ Tungsten Filament & Cartridge ○ EM Holder set ○ Carbon Tape and Silver Paste ○ Wrench ○ Blower ○ Driver ○ User Manual ○ Carrier Box accessories & tools included ***EDS (Electronic Data Systems):*** ○ Tru-Q Analysis Engine: Accurate Result By Multi Algorithm. ○ Multilingual Operation. ○ Fast & Easy Analysis With Functions: Point & ID, Line Scan ○ Mapping, Line Overlap & Background Correction. ○ Quantitative Mapping (Quant-lineScan, QuantMap). ○ Highest Performance SDD. ○ Sensor Size: 300mm2. ○ High quility Light Element Analysis: Be(4)~Am(95). ○ Diverse Element Analysis Functions: Point&ID Line Scan, ○ Mapping.			

	○ PC Control software ○ PC with dual monitor ○ UPS 6KVA			
4.0	***Analytical Technologies FTIR Spectrophotometer model FTIR 3000A*** Analysis range 7800-375 wavenumber. Supplied complete with the following accessories; ○ Standard spectral Library ○ Solid sampling analysis accessories ○ Demountable cell with KBR window cell ○ Demountable cell with NACL window cell ○ ATR analysis accessory ○ PC with 21 inch monitor/1.5 KVA UPS and printer ○ PC control software	37,800.00	1 set	37,800.00
5.0	***Analytical Technologies Atomic Absorption Spectrophotometer model AD 2800*** Flame only configuration with fully Automatic sample introduction Supplied complete with the following; ○ 20 sets of Hollow Cathode Lamp with 1,000 ppm calibration standard solution ○ Air acetylene burner head ○ Nitrous Oxide Acetylene Burner head ○ HP Printer/ Blue gate 4.0 KVA UPS Acetylene cylinder, gas and regulator ○ Nitrous-Oxide cylinder, gas and regulator Fume extractor	29,645.00	1 set	29,645.00
6.0	Biodiesel simulator			No offer
	Analytical Technologies Bomb Calorimeter (BCal3015 Series) ***Specification:*** ○ Analysis Time (min) : 11 min ○ Precision : <0.1%RSD ○ Jacket Type : Isoperibol ○ Gas Requirement : Oxygen (99.5% purity) ○ Water Requirement : Distilled water ○ Bomb Identification : Automatic ○ Heat capacity Stability : ≤0.20% within three month ○ Max Power : 1.5kw ○ Bucket Fill : Automatic	30,800.00	1 set	30,800.00
4.0	***Analytical Technologies Muffle Furnace GMP Model (Model: 3000series)*** ***Features:*** ○ Sturdy construction for long term use : Compact in design and space saving ○ Available with 800°C to 1800°C temperature : Safe and trouble free performance ○ Microprocessor PID controller : Over temperature and short circuit breaker ○ High ceramic fiber blanket and board insulation : Ventilation or chimney at the back ○ Only branded heating elements are used : Uniform heating inside chamber ○ CE and ISO marked : Comply to DIN and ASTM	8,400.00	1 set	8,400.00

	standards o Volume 13 litres			
5.0	***Analytical Technologies Atmospheric Control furnace, model BOX-1400Q*** o Heating element SiC heating element o Max. heating rate 15°C/min o Temperature departure ≤ 2°C o Thermocouple S type o Voltage AC 110V/220V/380V, 50/60Hz, o Temperature control 50 programmable and PID automatic control o With ports for connection of Nitrogen, argon and inert gases o Volume 13 Litres	8,400.00	1 set	8,400.00
6.0	***Analytical Technologies Sieve Shaker*** o Operating voltage: 230 V, 50 Hz order 110 V 60Hz o Time switch: 0-99 minutes - digital o Revolution/ min: 278 10 o Taps per min: 150 5 o Sound emission: 86 dB8 o Supplied complete with 6 sieves, receiving pan and collector.	7,700.00	1 set	7,700.00
7.0	***Analytical Technologies Dual Combustion Furnace Infrared Carbon, Nitrogen, Hydrogen & Sulphur Analyzer (Model: 3300)*** with four chamber infra-red detection. o Supplied complete with the following; o Carrier Gas: Oxygen 99.5%, 3L/min(Cylinder, Regulator and installation piping) o Power Gas: Nitrogen gas (Cylinder, Regulator and installation piping) o Chemical Reagent: Magnesium perchlorate,CO_2 absorbent o Standard Reference material o PC Control software o PC/Printer/21 Inch monitor/6KVA Blue gate UPS	55,600.00	1 set	55,600.00
8.0	***Analytical Technologies drying oven model FD-110*** with digital control. Volume 110L, Temperature range Ambient to 300°C	6,220.00	1 set	6,220.00
8.1	***Analytical Technologies Multiple Gas Analyzer (Model: MGA 3200)*** ***Specification:*** o Type : Rack / panel mount o Detectable gases / parameters : Toxic, Combustible, O_2, CO, CO_2, SO_2, HF, HCL, CL_2, NO, CNG, CH_4, H_2, o H_2S, NH_3, HCN, 03. o Electronics / processor : Micro-controller o Technology : 1. Sensor Specific (Electrochemical/TCD/PID) o 2. UV Photometry Technology o 3. Infra-red Technology o Resolution : 1 mg/m3, 1 PPM, 1% V/V, application defined o Accuracy : ± 0.5 % FS o Response time : less than 30 sec, sensor dependent	13,720.00	1 set	13,720.00

	○ Operating temperature : 0 - 55 °C ○ Sampling / input: Direct plug-in through sampling system / 4 -20 mA			
	SUB-TOTAL			***2,351,885.00***
	Freight, clearing and custom duties charges			20,000.00
	Installation, Commissioning and Operational charges			35,400.00
	SUB-TOTAL			***2,387,285.00***
	VAT@ 7.5%			179,046.00
	GRAND TOTAL			***2,566,331.00***

ACCOUNT DETAILS

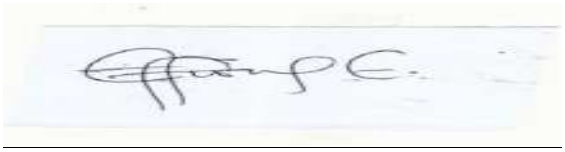
Leedex and company Nigeria Ltd

Acc/No: USD 0052828367

Union Bank Plc

OFFER/DELIVERY AND PAYMENT DETAILS

1. Within 8-10 weeks after receipt of LPO
2. Order will attract 80% advance payment with order and balance minimum of 14 days after successful delivery and Installation completion.
3. Offer valid for acceptance up till 30th of March 2023 and subject to review thereafter



Manager (Sales)

M 3.1. iii center Consulting Business Development Office established

FEDERAL REPUBLIC OF NIGERIA

CERTIFICATE OF INCORPORATION

OF A

PRIVATE COMPANY LIMITED BY SHARES

COMPANY REGISTRATION NO. 8083757

The Registrar - General of Corporate Affairs Commission

hereby certifies that

IVET-HUB LTD

is this day incorporated under the

COMPANIES AND ALLIED MATTERS ACT 2020

as a private company limited by shares

Given under my hand at Abuja this 20th day of November, 2024

Hussaini Ishaq Magaji SAN
Registrar - General

TAX IDENTIFICATION NUMBER: 32480831-0001

M 3.1. iv. Approved management policy document

AFRICA CENTRE OF EXCELLENCE FOR SUSTAINABLE POWER AND ENERGY DEVELOPMENT (ACESPED)

UNIVERSITY OF NIGERIA, NSUKKA MANAGEMENT LABORATORY POLICY'S

JUNE, 2022

LABORATORY GUIDELINES & POLICY

Administrative Responsibility office:	ACE-SPED testing facility
Date which Policy was developed:	June, 2022
Effective Date of Policy:	October, 2022
Policy developed by:	ACE-SPED testing facility Committee
Authorized by:	ACE-SPED BOARD
Version:	001
Web link to document	

1. Introduction

The Africa Centre of Excellence for Sustainable Power and Energy Development (ACE-SPED), University of Nigeria, Nsukka, is the owner of the ACE-SPED testing facility. The ACE-SPED Centre Leader serves as the team's chairman, and the other members of the management team take up their respective positions on the board. A technical coordinator oversaw the center's day-to-day operations, while resource personnel for particular tasks were selected from a pool of resources from relevant University departments. The Laboratory Quality Management System criteria in accordance with ISO 15189 are met by the ACE-SPED management laboratory policy, which is in accordance with the ACE-SPED's guiding principles and objectives.

2.0 The ACE-SPED management laboratory policy's goal

i. Verify the accuracy of the data produced by the laboratory.
ii. Quality management encompasses all aspects of laboratory operations that impact the outcomes, from method selection to instrument monitoring to staff education to specimen handling to result reporting. It is not limited to the creation and maintenance of quality control charts.
iii. Determining the accuracy of laboratory findings and enabling laboratory managers to assess whether the lab is performing its duties to a satisfactory standard are the real goals of quality management initiatives.
iv. Reagents, consumables, equipment, and services obtained from outside sources are referred to as external services and supplies.
v. The management strategy guarantees that prospective users are aware of and comprehend the range of the activities conducted in the laboratory. It also has an obligation to comprehend consumer wants and provide supplementary services.
vi. Customer contacts are warranted by good laboratory practices.
vii. There is a great deal of room for growth in these kinds of encounters. Feedback is also recommended as a potent tool for development.
viii. Create guidelines for the administration and operation of the labs.
ix. Promoting adherence to safety guidelines, policies, and procedures
x. Define expectations for the roles of all parties involved

2.1 Statements of Policy

The ACE-SPED testing laboratory is responsible for making sure that its laboratory are appropriate for fostering testing and learning in the relevant partners

3.0 Responsibilities

3.1 University Board

i. The University board will, to the greatest extent feasible, provide a setting where laboratory activities may promote testing and research.
ii. Make sure that every attempt is made to resolve any circumstances that could provide a risk in the laboratory.

3.2 **The Board of ACE-SPED**

The Laboratory Policy will be approved by the ACE-SPED Board, which will also receive reports on the monitoring of its implementation and upkeep.

3.3 The Committee for Laboratory

The Committee for Laboratories will:

i. Oversee the policy to guarantee compliance with it and that all parties involved have access to the required information.
ii. Encourage everyone involved—staff, students, and other stakeholders—to utilise the facilities safely and appropriately.
iii. Keep an eye on the materials available to help partner/students testing and provide suggestions.
iv. Constantly assess the laboratory procedures and provide recommendations for improvement as needed.
v. Create a laboratory schedule before the school year begins.
vi. Report on the Committee's work to the ACE-SPED Testing laboratory Board.
vii. Request feedback on courses, programs, and services from outside stakeholders.
viii. Take part in external evaluations and accreditation processes.

3.4 The Head of the testing Laboratory

The Head of the testing Laboratory will:

i) Authorise the Laboratory timetable and oversee personnel assignments
ii) Ensuring that students/partner understand how to operate the equipment in the lab correctly to get accurate findings and reduce dangers.
iii) Give the required safety instruction and/or information, particularly in the event that a new danger is discovered.
iv) Before partner begin using the Laboratory, make sure they are informed about safety precautions and emergency protocols.

3.5 The Laboratory assistant

The duties of the Laboratory assistant are as follows:

i. Help with everyday tasks related to the Laboratory operations.
ii. Communicates with the head to make sure the Laboratory is stocked with the necessary tools and materials to fulfil the testing and learning objectives and to keep track of consumables.
iii. Make sure the Laboratory is ready for use by organising supplies and equipment for partner usage and providing unambiguous demonstrations
iv. Provides staff support as required with basic laboratory facility management, organisation, and maintenance concerns pertaining to equipment use, safety, etc.

3.6 Students/partners

The students/Partner will:

i. Acquire familiarity with the laboratory apparatus and learn how to operate it properly to guarantee meaningful results and reduce hazards.
ii. Before the first laboratory session, familiarise yourself with information on safety and emergency protocols in laboratories. It is critical that students/partner understand that they bear the primary responsibility for their own personal safety in the laboratory. Additionally, students/partner should understand that while every attempt will be taken to handle potentially hazardous conditions in the lab, the directions and information supplied cannot be regarded as comprehensive.
iii. Follow verbal and written safety instructions at all times throughout the academic semester. It is crucial that all students attend at each laboratory session on time since there may be extra instructions provided at the start of the session.
iv. Avoid working alone or unattended, particularly when handling hazardous chemicals. Laboratories, shops, and other similar settings are full of potential dangers that might result in catastrophic injuries or equipment damage. There is very little chance of an accident happening if the safety procedures are followed. At least two individuals should be present, with permission, so that one person may turn off the device and seek for assistance in case of an emergency. The likelihood of an accident in this course is quite low with sound decision.

4.0 Overall Laboratory Policies & Expectations

4.1 Broad Principles

i. Laboratories must be open Monday through Friday from 9:00 a.m. to 5:00 p.m., and on weekends as needed.
ii. Laboratories must have a supervisor, who can be a lecturer, lab technician, or lab assistant.
iii. Laboratories must meet the requirements for a testing because they are considered specialised spaces.
iv. Safety rules and regulations must be followed at all times in laboratories. As a result, the following cannot be done in any laboratory : Smoking; Eating or drinking (except from Human Ecology and Hospitality); Noise (sound levels should be minimised).

v. It is expected of everyone use the laboratory to behave in a professional way.
vi. Reporting any mishap, no matter how little, to the supervisor right away is required.
vii. Clear paths must be maintained to all areas, including fire extinguishers, electrical panels, emergency showers, and eye wash stations. Smoke alarms need a clean space around them.
viii. Nothing heavy may be kept higher than the height of a table. Thus, only light-weight objects should be stored above in cabinets or other overhead storage areas.

4.2 Emergency Response

Everyone who uses a laboratory must:

i. Read the safety instructions and get acquainted with the fire alarms;
ii. Follow the directions in the event of an emergency.
iii. Be aware of where the eye wash, safety shower, and fire extinguisher are located and how to use them in any laboratory they use.
iv. Avoid using any unusual materials or equipment.
v. As soon as there is an accident, fire, explosion, or spill, let the instructor know.
vi. Understand how to evacuate a building.

5.0 Safety in general laboratories

i. Wash your hands both before entering the laboratory and afterward, and refrain from eating, drinking, or smoking while working in the laboratory.
ii. Carefully read labels.
iii. Before using any equipment, make sure you have received the necessary training and your supervisor's approval.
iv. Put on safety goggles or face shields while handling potentially dangerous objects or machinery, and put on gloves when handling any poisonous or hazardous substance.
v. Appearance: Wear safety glasses or a safety shield, gloves, and laboratory coats while working with hazardous materials.
vi. Verify that long hair or loose clothing is secured or fastened.
vii. Equipment Failure: Notify your instructor or laboratory assistant right once if any equipment breaks down while you're using it. Never attempt to solve the issue on your own since you might endanger both yourself and other people.
viii. Before using any glassware, inspect it for chips and cracks. Glassware cracks might be the result.
ix. Never leave an experiment running unsupervised. But, be sure that the doors are closed and that all ignition sources are off before leaving a lab alone.

5.1 Safety of electricity

i. Before using any high-voltage equipment, get authorisation.
ii. Keep all electrical panels free of obstructions.
iii. Any electrical alterations, including wiring, need to be reported to an authorised individual.
iv. Steer clear of extension cables whenever you can. If you must use one, make sure it's a heavy-duty, electrically grounded device with a separate fuse, and mount it securely.

Extension cables are not meant to be suspended from the ceiling, placed under doors, run across aisles, or connected into other extension cords.

v. Never, ever alter, affix, or substitute any high-voltage apparatus in any way.

vi. Even after an item has been switched off, ensure sure all capacitors are drained (by using a grounded wire with an insulating handle) before contacting high voltage leads or the "inside" of any device. Many hours may pass after an equipment has been switched off before capacitors lose their charge.

vii. USE ONLY ONE HAND to adjust high-voltage equipment or a laser that is driven by a high-voltage source. It's preferable to put your other hand behind your back or in a pocket. By following this technique, the risk of an accident where a high-voltage current runs up one arm, into your chest, and down the other arm is eliminated.

5.2 Mechanical safety

i. When using compressed air, always use authorised nozzles and never aim the air directly at a person.

ii. Verify that guards are installed on equipment while it is in use.
iii. Use caution while working near or on hydraulic or pneumatically powered machinery.

iii. Unexpected or sudden movements might cause catastrophic injuries.

5.3 Chemical safety

i. Consider all chemicals to be potentially dangerous.

ii. Verify that all chemicals have up-to-date, legible labels that provide the name of the substance, its concentration, the date, and the name of the person in charge.

iii. Reagent bottles should never contain chemicals again. (Aim for the exact quantity and distribute any extra.)

iv. Adhere to fire codes pertaining to the number of storage spaces allowed, the kinds of cabinets and containers that are permitted, labelling requirements, etc. If you have any questions concerning the rules, speak with the building coordinator.

v. Only use fume hoods when handling flammable and volatile substances. It is best to carry out aerosol-producing procedures under a hood to avoid breathing in potentially dangerous materials.

vi. Avoid getting solvents on your skin at all times. Wear gloves at all times.

6.0 The Committee for Laboratory

The ACE-SPED testing laboratory activities are to be managed and overseen by the Laboratory Committee.

Establishment of the Laboratory Committee

i. The institution will form a Laboratory Committee, whose chairman will be the Head of Laboratory, who will also have general oversight over the Committee.

ii. The Committee's membership cannot consist of more than 9 people, including the, laboratory assistants/technicians, a students/partners representative, and any more members the Committee decides to add to the group.
iii. The Committee will convene on a regular basis; the Committee will decide how often to meet. The Committee is required to keep minutes of its meetings in addition to communications and activity logs.
iv. The Committee will set up a method for receiving direct reports and recommendations from partners and students on how the labs are run. When required, the Committee will see to it that those using the labs are suitably trained.

6.1 Committee Workings

i. Timetable: The Committee will decide how often it meets, but it will convene on a regular basis. The Committee is required to keep minutes of its meetings in addition to communications and activity logs.
ii. The schedule: At a Committee meeting, any member may add topics to the agenda for consideration. Papers that are pertinent will be sent ahead of time to give members enough time to be ready.
iii. Minutes must be sent to every member of the committee and posted for ACE-SPED staff members as well, Minutes are kept for a maximum of three years.
iv. Meeting Procedures: The chairperson will preside over meetings. The members present will elect a member to serve as Acting Chair in the event that the Chairperson is unable to lead the meeting.
v. Quorum: Half of the members who have been appointed shall constitute a quorum at regular meetings. A committee meeting may proceed in the absence of a quorum, but no formal votes may be taken.

7.0 Conclusion

In line with ISO 15189, management review is an important part of quality management systems.

i. Fulfilling client needs in accordance with ISO-accredited standards
ii. Adherence to both domestic and global norms.
iii. Timely submission of test results.
iv. Creating a conductive and safe work environment.
v. The security of lab workers.
vi. Ensuring that all staff members involved in the laboratory's testing activities are aware of the rules and procedures and follow them in their work.
vii. Adherence to ISO/IEC 17025:2017 standards and ongoing enhancement of the management system's efficacy.
viii. Professionally discuss test results and conclusions with customers, making sure that every problem is swiftly rectified and properly recorded.

M 3.1. v Training modules

AFRICA CENTRE OF EXCELLENCE FOR SUSTAINABLE POWER

AND ENERGY DEVELOPMENT (ACESPED)

UNIVERSITY OF NIGERIA, NSUKKA

Developed modules for training Laboratory personnel

April, 2023

Administrative Responsibility office:	ACE-SPED testing facility
Date which manual was developed:	October, 2022
Effective Date of manual:	April, 2023
Policy developed by:	ACE-SPED testing facility Committee
Authorized by:	ACE-SPED BOARD
Version:	001
Web link to document	

1.0 Background

In order to accomplish the purpose of the innovation-oriented collaboration of research infrastructures with the commercial sector via advisory services, the ACE-SPED will guarantee training and re-training of the staff, providing them exceptional competency. Information on internal rules and processes to be followed for consumer product testing, staff training, report writing, safety, research, evaluating data from private labs, and other laboratory activities is supplied.

2.0 Objective

i. In addition to formulae and other technical data, laboratory manuals contain standard laboratory procedures, current methodologies, and safety measures.
ii. Laboratory staff members need to know how to operate systems, environmental controls, laboratory chemical hoods, and other related exhaust devices, as well as their capabilities and limits.
iii. The experimental activity should be considered in the context of the whole laboratory and its facilities to guarantee efficiency and safety.

3.0 Modules of Safety Training manual

According to the ACE-SPED laboratory policy, even the finest precautions to protect laboratory workers might be compromised by mistakes made by people or by bad protocol. Thus, the key to preventing occurrences and accidents related to laboratory acquired injuries is having a staff that is concerned about safety as well as a student/partners that is knowledgeable about identifying and managing laboratory dangers. It is crucial that ACE-SPED provide ongoing in-service training on safety measures because of this. The foundation of any successful safety program is a

laboratory manager, who should see to it that all staff members and students get basic training that includes integration of safe laboratory practices and procedures.

3.1 **Training in Instructional Laboratories**

The safety officer or ACE-SPED course teacher is required to provide laboratory safety training in instructional labs. Lab teachers need to have had pre-documented training. A discussion of the risks related to the substances used and the procedures to be followed, appropriate methods for handling and discarding hazardous materials, safety measures to be taken to prevent exposure or release into the environment, and emergency and spill procedures are all included in the training, which will be made sure of by ACE-SPED. In addition to offering extra laboratory safety training in instructional courses upon request, the ACE-SPED Safety Officer is ready to assist course instructors in creating this training. In close collaboration with the University Laboratory Safety Committee, the handbook will support the creation and distribution of instructional materials and records. The following highly hazardous procedures—which are frequently performed by all laboratory personnel and involve the risk of inhalation—will be covered in staff and student training:

i. Inhalation risks (i.e., aerosol production) when using loops, streaking agar plates, pipetting, making smears, opening cultures, taking blood/serum samples, centrifuging, etc.

ii. Dangers of ingestion while working with cultures, smears, and specimens

3.2 Information and training manual provided the following:

i. The location and availability of the written Laboratory Safety Manual

ii. The health hazards, signs, and symptoms associated with exposure(s) and infection(s) with the biohazardous agent(s) used in the work area

iii. The measures employees can take to protect themselves from these hazards include specific procedures the university or department has implemented, such as appropriate work practices, emergency procedures, and personal protective equipment.

iv. The location and availability of reference material on the hazards, safe handling, storage, and disposal of biohazardous agents

3.3 **Module on Laboratory instrumentation manual**

The use of instruments in a laboratory is for observation, measurement, or control. It entails using or working with equipment, particularly using one or more while doing laboratory procedures. The creation or use of measuring instruments for observation, monitoring, or control is referred to as instrumentation. A group of test equipment is referred to as laboratory instrumentation. A set of these tools might be used to automate testing procedures. The design, manufacture, and supply of instruments for measurement, control, etc.; the condition of having such instruments all at once or being controlled by them

3.4 Laboratory Instrument

Any device, tool, or utensil used in a laboratory is referred to as a laboratory instrument. A tool that measures a physical property, such as flow, concentration, temperature, level, distance, angle, or pressure, is known as an instrument. Instruments may range in complexity from multi-variable process analyzers to simple direct-reading hand-held thermometers. A medical instrument is a tool used to identify and treat illnesses. A tool or device used for a certain task;

particularly, a tool or piece of equipment designed to do meticulous and precise work. a tool for measuring anything.

3.5 Laboratory equipment

The measuring instruments used in a scientific laboratory are often electronic in design. The many instruments and tools that scientists use when working in a laboratory are referred to as laboratory equipment. Typically, laboratory equipment is used to conduct an experiment, take measurements, and collect data. A scientific instrument is often a larger or more advanced piece of equipment. More and more, open hardware ideas are being used in the design and sharing of scientific instruments and lab equipment. In addition to specialised tools like operant conditioning chambers, spectrophotometers, and calorimeters, the traditional equipment comprises instruments like Bunsen burners, microscopes, and spectrophotometers.

3.6 Laboratory techniques

Laboratory techniques are the procedures used in both pure and applied sciences to conduct experiments, all of which adhere to the scientific method. Some of these procedures call for the use of sophisticated laboratory apparatus, such as electrical devices and laboratory glassware, while other procedures call for specialised or expensive supplies.

3.8 Laboratory apparatus

A collection of instruments, tools, or a machine used in a laboratory is known as a laboratory apparatus. The equipment used in laboratories, whether it be a single instrument, a whole set, or both, is used to undertake projects and experiments. the most typical tools and equipment

required for hands-on activity in laboratories. The sort of laboratory you are in and the experiment you will do will determine what equipment you need.

Laboratory tool

Any physical object that may be utilised in a laboratory as long as it is not consumed while being used is considered a laboratory tool. Different names for tools used in certain areas or occupations include "instrument," "utensil," "implement," "machine," "device," and "apparatus." Equipment" is the collection of tools required to do a task. Technology is the understanding of creating, getting, and employing tools.

4.0 Module on Calibration of Equipment

The ACE-SPED laboratory policy believes that human error and poor procedure can affect the best results from the testing laboratory. As a result, the ACE-SPED laboratory policy makes training on the calibration of equipment necessary.

4.1 What is calibration of an instrument?

Calibration is the act of determining whether or not a piece of measuring equipment is performing safely and effectively by comparing it to an established standard in order to test or restore its accuracy. After calibration is complete, the equipment's values at each point of reference are calibrated, and the standard calibration equipment must match the results or fall within the tolerance/accuracy range permitted before the equipment may be certified as safe. However, if there is a deviation, the instrumentation engineer makes the necessary adjustments, corrections, resets, or repairs to the equipment to return it to the anticipated or usual standard.

Instrument calibration basically makes sure that businesses (food processing, environmental, oil and gas, etc.) are able to stop incorrect readings in their operations, making sure that the instruments continue to match their makers' requirements and designated purpose.

4.2 What makes calibration necessary?

As a result of the aforementioned explanation, we now know the importance of trustworthy calibration services for quality. In light of this, we thought it would be excellent to provide some justifications for why calibration is crucial to the calibre of your output. A new instrument has to be calibrated to make sure it is operating correctly and in accordance with the appropriate standard. When the instrument has been subjected to unfavourable circumstances, turbulent processes, etc., calibration is necessary. Additionally, when an instrument has been fixed or altered, calibration is necessary.

4.3 How are measurements Done

It is essential to remember that each kind of equipment has a unique calibration procedure and approach when thinking about how calibration is done. However, there are certain essential fundamental procedures that must be considered before calibration may begin. Here are the actions to take:

i. Decide what kind of instrument you are calibrating, such as if it measures temperature or pressure.
ii. Select a calibration tool that can accurately assess the calibration range of the target device.
iii. Organise the calibration environment.

iv. Make sure the calibrator is correctly attached to each instrument you are calibrating. This will assist in avoiding errors in your readings and save you from making incorrect observations.

v. You now carry out the calibration. However, it is suggested that you calibrate your device two or three times. This process of "iteration" is carried out to guarantee the accuracy of your results. Even if you always obtain the desired outcome the first time, always do this.

vi. Make a note of your readings and see if any variances exist. If there are, make sure it falls within the equipment's allowable deviation. That device did not pass the calibration if the variation was outside of its allowed range. Recommendations may be made in light of the findings.

4.4 List of calibration equipment

Here's a list of some of the calibration instruments that are popularly used:

- Dead weight tester
- Loop calibrator
- Comparison pump
- Multimeter
- Temperature bath
- Test flange
- Test bench

4.5 **What equipment has to be calibrated?**

Every measuring device eventually has to have its calibration checked. Scales, speedometers, thermometers, flow metres, temperature probes, and other devices need to be calibrated. The reality is that practically every instrument will eventually start to lose accuracy as a result of difficult working circumstances, exposure to severe environments, mechanical shocks, etc. Additionally, as it is usual for instruments to depart from pre-set parameters, such deviations must be fixed beforehand to avoid having an impact on the final product's quality.

4.6 How often an instrument should be calibrated

i. The frequency of instrument calibration is yet another inquiry we often get. And although a straightforward response would be wonderful, the reality is that it's not so straightforward since it mostly relies on use.

ii. A shorter interval between calibrations, such as monthly, quarterly, or semi-annually, can provide you better results if your business makes essential measurements.

iii. Annual calibration will be your best choice if your firm performs both crucial and less essential measurements.

iv. Regardless of the procedure and environmental factors, it is a legal necessity that all process equipment be calibrated yearly or twice a year.

M 3.1. vi INNOVATION ORIENTED COOPERATION OF RESEARCH INFRASTRUCTURES

The World Bank

AFRICA CENTRE OF EXCELLENCE FOR SUSTAINABLE POWER AND ENERGY DEVELOPMENT
UNIVERSITY OF NIGERIA, NSUKKA
OFFICE DIRECTOR

: (+234) 8028433576

Ref: UNN/ACE-SPED/001

Date: 25TH APRIL, 2022

Engr. Prof. V.S.Aigbodion
Industrials Liaison Officer
ACE-SPED

Dear Engr. Prof. Aigbodion

Chairmanship of Innovation-Oriented Cooperation of Research Infrastructures and Collaboration with a Private Sector through Advisory Services.

On behalf of the Board of ACE-SPED, I appoint you the Chairman of the **Innovation-Oriented Cooperation of Research Infrastructures and Collaboration with A Private Sector through Advisory Services**

The appointment is with immediate effect.

Other members of your Committee are:

Engr. Prof. Cosmas Anyanwu
Engr. Dr. P. U. Akpan
Engr. Dr. Mkpamdi.Eke
Engr. Dr. P.o.Offor
Engr. Dr. Onyekwere Ojike

It is hoped that you and your Committee will be willing and able to serve the Centre diligently in this capacity.

Terms of Reference

1. Draft specimen memorandum of understanding for collaborations with external Institutions and agencies.
2. Seek out and identify potential facility users
3. Pursue the collaborations with industries.

Engr. Prof. Emenike Ejiogu

Centre Leader
ACESPED), University of Nigeria Nsukka

AFRICA CENTRE OF EXCELLENCE FOR SUSTAINABLE POWER AND ENERGY DEVELOPMENT
UNIVERSITY OF NIGERIA
MINUTES OF THE INNOVATION-ORIENTED COOPERATION OF RESEARCH INFRASTRUCTURES AND COLLABORATION WITH A PRIVATE SECTOR THROUGH ADVISORY SERVICES HELD ON 15th May, 2022

ICRICPDS/2022/05/01. ATTENDANCE

1. Prof Victor Aigbodion — Chairman
2. Engr. Prof. Cosmas Anyanwu — Member
3. Engr. Dr. P. U. Akpan — Member
4. Engr. Dr. Mkpamdi.Eke — Member
5. Engr. Dr. P.O.Offor — Member
6. Engr. Dr. Onyekwere Ojike — Secretary

* Absent with permission.

ICRICPDS /2022/05/02 OPENING PRAYER

The meeting commenced at about 9.30am with an opening prayer said by Dr. P.O. Offor. The Chairman, in his opening remarks, welcomed members to the first meeting; he informed members that this was the inaugural meeting of the Committee. He congratulated the members for their nomination to serve in their various capacities as members of the **Innovation-Oriented Cooperation of Research Infrastructures and Collaboration with a Private Sector through Advisory Services**. He also urged members to remember that their appointment to the **Innovation-Oriented Cooperation of Research Infrastructures and Collaboration with a Private Sector through Advisory Services** is a call to divine service and to follow the Committee's terms of reference.

ICRICPDS /2021/3/03 Reading and Adoption of the Agenda

The agenda for the meeting was read and Engr. Dr. Onyekwere Ojike moved for the adoption, while Engr. Dr. Mkpamdi.Eke seconded the motion.

ICRICPDS /2022/3/04 Reading Terms of Reference

The Chairman read the terms of reference to the Committee members as directed by the Director/Centre Leader. He further explained that the terms of reference form the basis for the **Innovation-Oriented Cooperation of Research Infrastructures and Collaboration with a Private Sector through Advisory Services** duties, rules, and regulations.

ICRICPDS /2022/3/05 DELIBERATION ON THE TERMS OF REFERENCE

After deliberation on the terms of reference, the following was agreed upon:

1. The meeting should be held every quarterly.
2. The meeting should be hybrid
3. Members were given tasks to complete as well as relevant sources cutting-edge material

ICRICPDS /2022/3/06 AOB

There was no any other business for discussion

ICRICPDS /2022//3/07 ADJOURNMENT/CLOSING

Adjournment for the meeting was moved by Dr. P.O.Offor, Engr. Dr. Onyekwere Ojike seconded the motion and also closed the meeting with a word of prayer.

Engr. Prof Victor Aigbodion
(Chairman)

Engr. Dr. Onyekwere Ojike
(Secretary)

AFRICA CENTRE OF EXCELLENCE FOR SUSTAINABLE POWER AND ENERGY DEVELOPMENT
UNIVERSITY OF NIGERIA
MINUTES OF THE INNOVATION-ORIENTED COOPERATION OF RESEARCH INFRASTRUCTURES AND COLLABORATION WITH A PRIVATE SECTOR THROUGH ADVISORY SERVICES HELD ON 10th NOV, 2022

ICRICPDS /2022/11/01. ATTENDANCE

1.	Prof Victor Aigbodion	Chairman
2.	Engr. Prof. Cosmas Anyanwu	Member
3.	Engr. Dr. P. U. Akpan	Member
4.	*Engr. Dr. Mkpamdi.Eke	Member
5.	Engr. Dr. P.O.Offor	Member
6.	Engr. Dr. Onyekwere Ojike	Secretary

* Absent with permission.

ICRICPDS /2022/11/02 OPENING PRAYER

The meeting started by 11:35am with an opening prayer led by Engr. Dr. Onyekwere Ojike . The Chairman thanked the members for their steadfastness in the work.

SEM/2021/3/03 Reading and Adoption of the Agenda

The agenda for the meeting was read and Dr. P.O. Offor moved for the adoption, while Engr. Dr. P. U. Akpan seconded the motion.

ICRICPDS /2022/11/04 Reading and Adoption of the Minute

The minutes of the last meeting held on May 15th, 2022, were read by the Secretary. The motion for adoption was moved by Engr. Prof. Cosmas Anyanwu and seconded by Dr. P.O. Offor.

ICRICPDS /2022/11/05 ARISING MATTERS

A list of possible **private sector** with detailed were shared among the members.

ICRICPDS /2022/11/06 AOB

A member noted that there is a need to contact with the private sector for collaboration and after deliberation it was accepted that the secretary should write the private sector.

ICRICPDS /2022/11/07 ADJOURNMENT/CLOSURE

Adjournment for the meeting was moved by Dr. P.O. Offor. Engr. Prof. Cosmas Anyanwu seconded the motion and also closed the meeting with a word of prayer.

Engr. Prof Victor Aigbodion
(Chairman)

Engr. Dr. Onyekwere Ojike
(Secretary)

AFRICA CENTRE OF EXCELLENCE FOR SUSTAINABLE POWER AND ENERGY DEVELOPMENT
UNIVERSITY OF NIGERIA
MINUTES OF THE INNOVATION-ORIENTED COOPERATION OF RESEARCH INFRASTRUCTURES AND COLLABORATION WITH A PRIVATE SECTOR THROUGH ADVISORY SERVICES HELD ON 5th FEB, 2023

ICRICPDS /2023/02/01. ATTENDANCE

1. Prof Victor Aigbodion — Chairman
2. Engr. Prof. Cosmas Anyanwu — Member
3. Engr. Dr. P. U. Akpan — Member
4. Engr. Dr. Mkpamdi.Eke — Member
5. Engr. Dr. P.O.Offor — Member
6. Engr. Dr. Onyekwere Ojike — Secretary

* Absent with permission.

ICRICPDS /2023/02/02 OPENING PRAYER

The meeting started by 11:35am with an opening prayer led by Engr. Dr. Mkpamdi.Eke, the Chairman, who welcomed members to the meeting.

ICRICPDS /2023/02/03 Reading and Adoption of the Agenda

The agenda for the meeting was read and Dr. P.O. Offor moved for the adoption, while Engr. Dr. Onyekwere Ojike seconded the motion.

ICRICPDS /2023/02/04 Reading and Adoption of the Minute

The minutes of the last meeting held on NOV 10th, 2022, were read by the Secretary. The motion for adoption was moved by Dr. P.O. Offor and seconded by Engr. Prof. Cosmas Anyanwu

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ICRICPDS /2023/02/05 ARISING MATTERS

The chairman advised the members to prioritize the purchase of modern equipment to supplement the existing laboratory equipment. The chairman agreed to discuss the purchase of SEM/EDS, FTIR, and XRF for the centre with the centre director, following a member's suggestion.

ICRICPDS /2023/02/06 AOB

No AOB

ICRICPDS /2023/02/07 ADJOURNMENT/CLOSURE

Adjournment for the meeting was moved by Engr. Dr. P. U. Akpan. Engr. Dr. Onyekwere Ojike seconded the motion and also closed the meeting with a word of prayer.

Engr. Prof Victor Aigbodion
(Chairman)

Engr. Dr. Onyekwere Ojike
(Secretary)

AFRICA CENTRE OF EXCELLENCE FOR SUSTAINABLE POWER AND ENERGY DEVELOPMENT
UNIVERSITY OF NIGERIA
MINUTES OF THE INNOVATION-ORIENTED COOPERATION OF RESEARCH INFRASTRUCTURES AND COLLABORATION WITH A PRIVATE SECTOR THROUGH ADVISORY SERVICES HELD ON 15th JUNE, 2023

ICRICPDS /2023/05/01. ATTENDANCE

1. Prof Victor Aigbodion — Chairman
2. Engr. Prof. Cosmas Anyanwu — Member
3. Engr. Dr. P. U. Akpan — Member
4. Engr. Dr. Mkpamdi.Eke — Member
5. Engr. Dr. P.O.Offor — Member
6. Engr. Dr. Onyekwere Ojike — Secretary

* Absent with permission.

ICRICPDS /2023/05/02 OPENING PRAYER

The meeting started by 10:35am with an opening prayer led by Engr. Dr. P. U. Akpan. The Chairman welcomed members to the meeting.

ICRICPDS /2023/05/03 Reading and Adoption of the Agenda

The agenda for the meeting was read and Engr. Dr. P.O.Offor moved for the adoption while Engr. Dr. Onyekwere Ojike seconded the motion.

ICRICPDS /2023/05/04 Reading and Adoption of the Minute

The minutes of the last meeting held on 5th Feb, 2023 were read by the Secretary. The motion for adoption was moved by Engr. Prof. Cosmas Anyanwu and seconded by Dr. P.O. Offor.

ICRICPDS /2023/05/05 ARISING MATTERS

After a discussion, the chairman informed the members that the director had approved the purchase of the SEM, XRF, and FTIR machines. **The next meeting will discuss the quotations from three vendors.**

ICRICPDS /2023/05/06 AOB

The Chairman agreed to discuss with the Centre leader the need to purchase resource materials for the lab.

ICRICPDS /2023/05/07 ADJOURNMENT/CLOSURE

Adjournment of the meeting was moved by Dr. P.O. Offor. Engr. Prof. Cosmas Anyanwu seconded the motion and also closed the meeting with a word of prayer.

Engr. Prof Victor Aigbodion
(Chairman)

Engr. Dr. Onyekwere Ojike
(Secretary)

AFRICA CENTRE OF EXCELLENCE FOR SUSTAINABLE POWER AND ENERGY DEVELOPMENT
UNIVERSITY OF NIGERIA
MINUTES OF THE INNOVATION-ORIENTED COOPERATION OF RESEARCH INFRASTRUCTURES AND COLLABORATION WITH A PRIVATE SECTOR THROUGH ADVISORY SERVICES HELD ON 10th October, 2023

ICRICPDS /2023/10/01. ATTENDANCE

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1. Prof Victor Aigbodion — Chairman
2. Engr. Prof. Cosmas Anyanwu — Member
3. Engr. Dr. P. U. Akpan — Member
4. Engr. Dr. Mkpamdi.Eke — Member
5. Engr. Dr. P.O.Offor — Member
6. Engr. Dr. Onyekwere Ojike — Secretary

* Absent with permission

ICRICPDS /2023/10/02 OPENING PRAYER

The meeting started by 10:35am with an opening prayer led by Engr. Prof. Cosmas Anyanwu

. The Chairman welcomed members to the meeting.

ICRICPDS /2023/10/03 Reading and Adoption of the Agenda

The agenda for the meeting was read and Engr. Dr. P.O.Offor moved for the adoption, while Engr. Dr. Mkpamdi.Eke seconded the motion.

ICRICPDS /2023/10/04 Reading and Adoption of the Minute

The minutes of the last meeting held on 15th June, 2023 were read by the Secretary. The motion for adoption was moved by Dr. Mkpamdi Eke and seconded by Dr. P.O. Offor.

ICRICPDS /2023/10/05 ARISING MATTERS

We deliberated and reached a consensus on the subsequent matters: We awarded the contract to Katchey Company Limited Lagos to supply the equipment in three months.

ICRICPDS /2023/10/06 AOB

Members, thank the centre for the refreshment.

ICRICPDS /2023/10/07 ADJOURNMENT/CLOSURE

Adjournment for the meeting was moved by Dr. Mkpamdi.Eke. Dr. P.O. Offor seconded the motion and also closed the meeting with a word of prayer.

Engr. Prof Victor Aigbodion
(Chairman)

Engr. Dr. Onyekwere Ojike
(Secretary)

AFRICA CENTRE OF EXCELLENCE FOR SUSTAINABLE POWER AND ENERGY DEVELOPMENT
UNIVERSITY OF NIGERIA
MINUTES OF THE INNOVATION-ORIENTED COOPERATION OF RESEARCH INFRASTRUCTURES AND COLLABORATION WITH A PRIVATE SECTOR THROUGH ADVISORY SERVICES HELD ON 10th Jan, 2024

ICRICPDS /2024/01/01. ATTENDANCE

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1. Prof Victor Aigbodion — Chairman
2. Engr. Prof. Cosmas Anyanwu — Member
3. Engr. Dr. P. U. Akpan — Member
4. Engr. Dr. Mkpamdi.Eke — Member
5. Engr. Dr. P.O.Offor — Member
6. Engr. Dr. Onyekwere Ojike — Secretary

* Absent with permission.

ICRICPDS /2024/01/02 OPENING PRAYER

The meeting started by 10:35am with an opening prayer led by Engr. Dr. Mkpamdi.Eke. The Chairman welcomed members to the meeting.

ICRICPDS /2024/01/04 Reading and Adoption of the Agenda

The agenda for the meeting was read and Engr. Dr. P.O.Offor moved for the adoption while Engr. Dr. P. U. Akpan seconded the motion.

ICRICPDS /2024/01/05 Reading and Adoption of the Minute

The minutes of the last meeting held on Oct 10th, 2023 were read by the Secretary. The motion for adoption was moved by Engr. Dr. Mkpamdi Eke and seconded by Dr. P.O. Offor.

ICRICPDS /2024/01/06 ARISING MATTERS

We deliberated and reached a consensus on the subsequent matters: We intend to refurbish our laboratory equipment while waiting for Katchey Company Limited Lagos to supply .

ICRICPDS /2024/01/07 AOB

No AOB

ICRICPDS /2024/01/07 ADJOURNMENT/CLOSURE

Adjournment for the meeting was moved by Engr. Dr. Mkpamdi.Eke and seconded by Dr. P.O. Offor seconded the motion and also closed the meeting with a word of prayer.

Engr. Prof Victor Aigbodion
(Chairman)

Engr. Dr. Onyekwere Ojike
(Secretary)

AFRICA CENTRE OF EXCELLENCE FOR SUSTAINABLE POWER AND ENERGY DEVELOPMENT
UNIVERSITY OF NIGERIA
MINUTES OF THE INNOVATION-ORIENTED COOPERATION OF RESEARCH INFRASTRUCTURES AND COLLABORATION WITH A PRIVATE SECTOR THROUGH ADVISORY SERVICES HELD ON 15th May, 2024

ICRICPDS /2024/05/01. ATTENDANCE

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1. Prof Victor Aigbodion — Chairman
2. Engr. Prof. Cosmas Anyanwu — Member
3. Engr. Dr. P. U. Akpan — Member
4. Engr. Dr. Mkpamdi.Eke — Member
5. Engr. Dr. P.O.Offor — Member
6. Engr. Dr. Onyekwere Ojike — Secretary

* Absent with permission.

ICRICPDS /2024/05/02 OPENING PRAYER

The meeting started by 10:35am with an opening prayer led by Engr. Prof. Cosmas Anyanwu . The Chairman welcomed members to the meeting.

ICRICPDS /2024/05/03 Reading and Adoption of the Agenda

The agenda for the meeting was read and Engr. Dr. P.O.Offor moved for the adoption while Engr. Dr. Onyekwere Ojike seconded the motion.

ICRICPDS /2024/05/04 Reading and Adoption of the Minute

The minutes of the last meeting held on the 10th of Jan 2024 were read by the Secretary. The motion for adoption was moved by Engr. Dr. P. U. Akpan and seconded by Dr. P.O. Offor.

ICRICPDS /2024/05/05 ARISING MATTERS

We deliberated and reached a consensus on the subsequent matters: the Chairman informed members that Katchey Company Limited Lagos will supply the equipment in the month of June 2024

ICRICPDS /2024/05/06 AOB

The Chairman informed members that the development of manual for the new equipment will commence next meeting.

ICRICPDS /2024/05/07 ADJOURNMENT/CLOSURE

Adjournment for the meeting was moved by Engr. Dr. P. U. Akpan, Dr. P.O. Offor seconded the motion and also closed the meeting with a word of prayer.

Engr. Prof Victor Aigbodion
(Chairman)

Engr. Dr. Onyekwere Ojike
(Secretary)

MODULE 3. INNOVATION-ORIENTED COOPERATION OF RESEARCH INFRASTRUCTURES AND COLLABORATION WITH A PRIVATE SECTOR THROUGH ADVISORY SERVICES

Verification criteria (provide evidence for each)

i. Developed documents for expanding of testing facility

The University of Nigeria, Nsukka, being a foremost centre of excellence in teaching and research within the region, is at the forefront of fostering regional and international integration through teaching and research. The ACE-SPED expansion of the testing facilities is to further strengthen the regional impact of the university through impactful testing and cutting-edge research in the area of sustainable power and energy development. This document established ACE-SPED as a laboratory hub for sub-regional testing facilities.

ii) University of Nigeria, Nsukka have standard Nano-laboratory, NLNG advanced materials characterization laboratory, high voltage laboratory, energy research centre, equipment research and maintenance centre, centre of entrepreneurship and development and innovation science park. These laboratory and centre are equipped with modern testing equipment such as solar and PV analyzer, high voltage materials, battery, electrochemical,

iii.) The following testing facilities are proposed to enhance the testing needs of the region:

A. Control and Instrumentation Equipment

CE110 Servo Trainer	A compact self-contained bench mounting d.c. servo apparatus designed to allow students at all academic levels to investigate basic and advanced principles of control. In particular the CE110 deals with control issues relating to position and speed control in servo systems
Microgrid	The microgrid combines the outputs of Wind Turbine emulator, PV Emulator and Fuel Cell at a common DC link via different DC-DC converters which is further connected to a three-legged programmable inverter to deliver the combined power to an Actual Grid. Microgrid system enables user to do research in the field of Microgrid management, load side management, priority allocation to renewable sources etc.
Solar PV Grid Tied Training System	Enables user to study wiring and interconnections of different components involved in the system to develop basic understanding of working and operation of a Grid connected system
5kW Wind Emulator	Wind turbine emulator mimics the behaviour of wind turbine for hardware level simulations. This system has a DC motor coupled with the Induction generator/Permanent Magnet Synchronous Generator, speed of which is controlled as per the speed reference calculated by solving the mathematical model of wind turbine. An induction generator is coupled to the DC motor and bidirectional inverter is connected to the terminals of the generator.
B. Advanced Materials Characterization	
AA6000 mini Desktop Scanning Electron Microscope	Scanning electron microscope (SEM) is one of the most widely used instrumental methods for the examination and analysis of micro- and nanoparticle imaging characterization of solid objects. One of the reasons that SEM is preferred for particle size analysis is due to its resolution of 10 nm, that is, 100 Å.
7600 FTIR spectrometer	It is a valuable tool for various analytical applications in fields such as chemistry, medicine, food and beverage, wine industry, material , energy, and power, engineering and quality process control and for examining the functional group
STA 449 F5 Jupiter® Simultaneous Thermal Analyzer (TG-DSC/DTA Apparatus)	The Nano DSC and the Multi-Cell DSC represent ultrasensitive differential scanning calorimeters with unmatched flexibility for characterizing molecular structure and stability. The Nano DSC, with fixed-in-place cells, is specifically designed to analyze in-solution samples. The Multi-Cell DSC offers three removable cells and one reference cell for maximum sample flexibility.
c. RENEWABLE AND NEW ENERGY SYSTEMS	

Elemental Analyser with complete accessories Brand/Model: Perkin Elmer CHNS(O) Specification: Perkin Elmer 2400 Series II	The 2400 Series II offers multiple analysis modes and fast analysis times. Modes Time (Minutes) CHN 6 CHNS 8 Oxygen 4 Productivity and precision are your partners with the 2400 Series II. User-selected calibration procedures of single-standard calibration (multiple linear regression) offer the user increased precision throughout the broad analysis range of the 2400 Series II. Uses: For determination of elemental composition of Organic Liquids
Oxygen Bomb Calorimeter Brand/model: CAL3K-F CALORIMETER WITH MANUAL OXYGENCAL3K-AP Specification: 3K-F - CAL3K-F BOMB CALORIMETER SYSTEM.	**Uses:** For determination of Heating value of fuels. The CAL3K-A Oxygen Bomb Calorimeter System can be used with most applications including such as Coal Analysis, Fuel Analysis, Alternative Energy, Waste Analysis, Animal Feed Research, University Research, Food/Nutrition Analysis, Explosives Analysis, Coal Analysis, Oil Analysis, and other traditional and non-traditional applications.

ii. Approved management policy document

The ACE-SPED testing laboratory is owned by the Africa Centre of Excellence for Sustainable Power and Energy Development (ACE-SPED), University of Nigeria, Nsukka. The Centre Leader of ACE-SPED is Chairman of the Management Team, while the rest of the ACE-SPED Management Team assumes their respective roles on the board. The daily operation of the centre was overseen by a technical coordinator, while resource persons for specific assignments were drawn from a resource pool from relevant units of the university.

The ACE-SPED management laboratory policy is in line with the principles and set goals of the ACE-SPED in order to meet the requirements of the Laboratory Quality Management System in conformance with ISO 15189.

i) Objective of ACE-SPED management laboratory policy

- Ensure that the information generated by the laboratory is correct.
- Quality management is not restricted to the development and retention of quality control charts but rather includes all aspects of laboratory activities that affect the results produced, from the choices of methods to the monitoring of instruments to the education of personnel to the handling of specimens to the reporting of results.
- The true purpose of quality management activities is to determine how correct or incorrect the results emanating from the laboratory are and to allow those managing the laboratory to determine whether or not the lab is fulfilling its function satisfactorily.
- External services and supplies refer to reagents, consumables, equipment, and services sourced from outside.
- The management policy ensures that potential users know and understand the scope of the laboratory's activities. It is also its responsibility to understand the needs of the users and make additional services available.
- Good laboratory practice warrants customer interactions. In such interactions, there is tremendous scope for improvement. Additionally, feedback is suggested as a powerful tool for improvement.

- Management review is a valuable component of quality management systems in accordance with ISO 15189.

- **Meeting customer requirements as per ISO-accredited standard**
- **Compliance with national and international standards.**
- **Prompt delivery of test reports.**
- **Provision of a safe and conductive work environment.**
- **Safety of laboratory personnel.**

- **Ensuring that all personnel concerned with the testing activity within the laboratory are familiar with the documentation and implement the policies and procedures in their work.**
- **Compliance with ISO/IEC 17025:2017 requirements and continual improvement in the effectiveness of the management system.**
- Consult with clients regarding test results and findings in a professional manner, and ensure each issue is resolved promptly and documented appropriately.

iii. Centre Consulting Business Development Office established

ACE-SPED Business Development Consult Ltd, abbreviated as ACE-SPEDBDC has been established, is the business consulting unit of the Africa Centre of Excellence for Sustainable Power and Energy Development (ACE-SPED), University of Nigeria, Nsukka. ACE-SPEDBDC and provide provides consulting services to a wide range of businesses including startup businesses. The services include business consultations, business plans, lender meeting consultations, financial analysis, and marketing consultations tailored to meet the needs of clients. The unit will be registered with the Cooperate Affairs Commission, Nigeria as a limited liability company.

SERVICES

The services offered by ACE-SPEDBDC includes but not limited to:

i. Business Plans

ii. Financial Analysis & Projections
iii. Marketing Strategies
iv. Operations Plan
v. Business Policies & Procedures Implementation

MANAGEMENT TEAM

ACE-SPEDBDC is owned by the Africa Centre of Excellence for Sustainable Power and Energy Development (ACE-SPED), University of Nigeria, Nsukka. The Centre Leader of ACE-SPED is Chairman of the Management Team while the rest of the ACE-SPED Management Team assume their respective roles in the board. The daily operation of the Centre overseen by a Business Coordinator while resource persons for specific assignments and drawn from a resource pool from relevant units of the university.

ACE-SPEDBDC partners with the following units in the University of Nigeria for human resources sharing:

i. The university of Nigeria, Consultancy Services Ltd
ii. Centre for Entrepreneurship and Development Research (CEDR)
iii. Center for Technical Vocational Education Training and Research (CETVETER)
iv. Faculty of Business Administration
v. Faculty of Engineering
vi. Faculty of Environmental Sciences
vii. Faculty of Vocational and Technical Education
viii. Department of Economics
ix. Intellectual Properties and Technology Transfer Office (IPTTO)

i. Develop management policy for the Labs
ii.

v. Develop modules for training Laboratory personnel

i) Background

In order to meet the objective of the innovation-oriented cooperation of research infrastructures with the private sector through advisory services, the ACE-SPED ensure training and re-

training of the personnel, giving them great proficiency. Information on internal rules and procedures to be followed for consumer product testing, staff training, report writing, safety, research, reviewing data from private laboratories, and other laboratory operations is provided.

ii) Objective

In addition to formulas and other technical material, laboratory manuals provide common laboratory practices, modern methods, and safety precautions.

1. **Trained** laboratory personnel must understand how laboratory facilities operate. Given the chance, they should provide input to the laboratory designers to ensure that the facilities meet the needs of the laboratory's functions.
2. **Laboratory** personnel must understand the capabilities and limitations of the ventilation systems, environmental controls, laboratory chemical hoods, and other exhaust devices associated with such equipment and how to use them properly.
3. **To** ensure safety and efficiency, the experimental work should be viewed in the context of the entire laboratory and its facilities.

iii) The training manual is divided into two categories:

A) the general Laboratory guide and B) the specific manual for the equipment

A) the general Laboratory guide

i) Safety Training

The ACE-SPED laboratory policy believes that human error and poor procedure can affect the best safeguards to protect the laboratory worker. Thus, a safety-conscious staff as well as a

student body well-versed in the recognition and control of laboratory hazards is key to the prevention of laboratory-acquired incidents and accidents. For this reason, ACE-SPED ensure continuous in-service training in safety measures, which is essential. An effective safety programme begins with the laboratory managers, who should ensure that safe laboratory practices and procedures are integrated into the basic training of employees and students at all levels.

- **Training in Instructional Laboratories**

Laboratory safety training in instructional laboratories provided by the ACE-SPED course instructor or safety officer, lab instructors should have documented training in advance. ACE-SPED ensure the training includes a discussion of the risks associated with the substances used and procedures to be performed, proper techniques for handling and disposing of hazardous substances, safety precautions to be used to prevent exposure or release into the environment, and emergency and spill procedures.

The ACE-SPED Safety Officer is available to assist course instructors in developing this training and provide additional laboratory safety training in instructional courses upon request.

The manual assist in strict cooperation with the University Laboratory Safety Committee in developing and circulating training aids and documentation, staff and student training include information on safe methods for highly hazardous procedures that are commonly encountered by all laboratory personnel and that involve:

1. Inhalation risks (*i.e*. aerosol production) when using loops, streaking agar plates pipetting, making smears, opening cultures, taking blood/serum samples, centrifuging, etc.
2. Ingestion risks when handling specimens, smears and cultures
3. Risks of per-coetaneous exposures when using syringes and needles
4. Bites and scratches when handling animals
5. Handling of blood and other potentially hazardous pathological materials
6. Decontamination and disposal of infectious material.

- **Information and training manual provided the following:**
    i. The location and availability of the written Laboratory Safety Manual
    ii. The health hazards, signs, and symptoms associated with exposure(s) and infection(s) with the biohazard us agent(s) used in the work area
    iii. The measures employees can take to protect themselves from these hazards include specific procedures the university or department has implemented, such as appropriate work practices, emergency procedures, and personal protective equipment.
    iv. The location and availability of reference material on the hazards, safe handling, storage, and disposal of biohazardous agents

A. Laboratory instrumentation

The use of instruments in a laboratory is for observation, measurement, or control. It entails using or working with equipment, particularly using one or more while doing laboratory procedures. The creation or use of measuring instruments for observation, monitoring, or control

is referred to as instrumentation. A group of test equipment is referred to as laboratory instrumentation. A set of these tools might be used to automate testing procedures. The design, manufacture, and supply of instruments for measurement, control, etc.; the condition of having such instruments all at once or being controlled by them

Laboratory Instrument

Any device, tool, or utensil used in a laboratory is referred to as a laboratory instrument. A tool that measures a physical property, such as flow, concentration, temperature, level, distance, angle, or pressure, is known as an instrument. Instruments may range in complexity from multi-variable process analyzers to simple direct-reading hand-held thermometers. A medical instrument is a tool used to identify and treat illnesses. A tool or device used for a certain task; particularly, a tool or piece of equipment designed to do meticulous and precise work. a tool for measuring anything.

Laboratory equipment

The measuring instruments used in a scientific laboratory are often electronic in design. The many instruments and tools that scientists use when working in a laboratory are referred to as laboratory equipment. Typically, laboratory equipment is used to conduct an experiment, take measurements, and collect data. A scientific instrument is often a larger or more advanced piece of equipment. More and more, open hardware ideas are being used in the design and sharing of scientific instruments and lab equipment. In addition to specialised tools like operant

conditioning chambers, spectrophotometers, and calorimeters, the traditional equipment comprises instruments like Bunsen burners, microscopes, and spectrophotometers.

Laboratory techniques

Laboratory techniques are the procedures used in both pure and applied sciences to conduct experiments, all of which adhere to the scientific method. Some of these procedures call for the use of sophisticated laboratory apparatus, such as electrical devices and laboratory glassware, while other procedures call for specialized or expensive supplies.

Laboratory apparatus

A collection of instruments, tools, or a machine used in a laboratory is known as a laboratory apparatus. The equipment used in laboratories, whether it be a single instrument, a whole set, or both, is used to undertake projects and experiments. the most typical tools and equipment required for hands-on activity in laboratories. The sort of laboratory you are in and the experiment you will do will determine what equipment you need.

Laboratory tool

Any physical object that may be utilised in a laboratory as long as it is not consumed while being used is considered a laboratory tool. Different names for tools used in certain areas or occupations include "instrument," "utensil," "implement," "machine," "device," and "apparatus." Equipment" is the collection of tools required to do a task. Technology is the understanding of creating, getting, and employing tools.

B. **Calibration of Equipment**

The ACE-SPED laboratory policy believes that human error and poor procedure can affect the best results from the testing laboratory. As a result, the ACE-SPED laboratory policy makes training on the calibration of equipment necessary.

What is calibration of an instrument?

Calibration is the act of determining whether or not a piece of measuring equipment is performing safely and effectively by comparing it to an established standard in order to test or restore its accuracy. After calibration is complete, the equipment's values at each point of reference are calibrated, and the standard calibration equipment must match the results or fall within the tolerance/accuracy range permitted before the equipment may be certified as safe.

However, if there is a deviation, the instrumentation engineer makes the necessary adjustments, corrections, resets, or repairs to the equipment to return it to the anticipated or usual standard. Instrument calibration basically makes sure that businesses (food processing, environmental, oil and gas, etc.) are able to stop incorrect readings in their operations, making sure that the instruments continue to match their makers' requirements and designated purpose.

What makes calibration necessary?

As a result of the aforementioned explanation, we now know the importance of trustworthy calibration services for quality. In light of this, we thought it would be excellent to provide some justifications for why calibration is crucial to the calibre of your output. A new instrument has to be calibrated to make sure it is operating correctly and in accordance with the appropriate standard. When the instrument has been subjected to unfavourable circumstances, turbulent

processes, etc., calibration is necessary. Additionally, when an instrument has been fixed or altered, calibration is necessary.

How are measurements Done

It is essential to remember that each kind of equipment has a unique calibration procedure and approach when thinking about how calibration is done. However, there are certain essential fundamental procedures that must be considered before calibration may begin. Here are the actions to take:

- Decide what kind of instrument you are calibrating, such as if it measures temperature or pressure.
- Select a calibration tool that can accurately assess the calibration range of the target device.
- Organise the calibration environment.
- Make sure the calibrator is correctly attached to each instrument you are calibrating. This will assist in avoiding errors in your readings and save you from making incorrect observations.
- You now carry out the calibration. However, it is suggested that you calibrate your device two or three times. This process of "iteration" is carried out to guarantee the accuracy of your results. Even if you always obtain the desired outcome the first time, always do this.
- Make a note of your readings and see if any variances exist. If there are, make sure it falls within the equipment's allowable deviation. That device did not pass the calibration if the variation was outside of its allowed range. Recommendations may be made in light of the findings.

List of calibration equipment

Here’s a list of some of the calibration instruments that are popularly used:

- Dead weight tester
- Loop calibrator
- Comparison pump
- Multimeter
- Temperature bath
- Test flange
- Test bench

What equipment has to be calibrated

Every measuring device eventually has to have its calibration checked. Scales, speedometers, thermometers, flow metres, temperature probes, and other devices need to be calibrated. The reality is that practically every instrument will eventually start to lose accuracy as a result of difficult working circumstances, exposure to severe environments, mechanical shocks, etc. Additionally, as it is usual for instruments to depart from pre-set parameters, such deviations must be fixed beforehand to avoid having an impact on the final product's quality.

How often an instrument should be calibrated

- The frequency of instrument calibration is yet another inquiry we often get. And although a straightforward response would be wonderful, the reality is that it's not so straightforward since it mostly relies on use.
- A shorter interval between calibrations, such as monthly, quarterly, or semi-annually, can provide you better results if your business makes essential measurements.

- Annual calibration will be your best choice if your firm performs both crucial and less essential measurements.
- Regardless of the procedure and environmental factors, it is a legal necessity that all process equipment be calibrated yearly or twice a year.

What role does ACE-SPED team play in calibration?

It is impossible to overstate how crucial instrument calibration is. Any business that employs instruments and equipment must always do this essential maintenance task. **ACE-SPED Engineer**s has a team of qualified staff on hand to address the calibration requirements of the testing laboratory.

iv. Certification documents from relevant agencies

In order to maintain standards, the ACE-SPED has initiated certification with some international and national agencies. Some of our testing equipment is currently undergoing evaluation for certification, while our National Stove Eligibility Laboratory (NSEL) has been certified by the Standards Organisation of Nigeria (SON) and others by the National Equipment Maintenance under the University of Nigeria, Nsukka.

v. Documents on equipment usage

Some of our existing Laboratory/Workshops are

listed below:

1. Materials Characterization – NEW NLNG laboratory
2. Foundry shop- Metallurgical and Materials Engineering/Mechanical Engineering
3. Metallographic – Metallurgical and Materials Engineering/Mechanical Engineering
4. Mechanical Testing- Metallurgical and Materials Engineering/Mechanical Engineering
5. Mechatronics Laboratory- Mechanical Engineering
6. Corrosion Laboratory - Metallurgical and Materials Engineering
7. Strength of Materials Laboratory – Civil Engineering
8. Electrical Engineering Laboratory
9. Electronic Engineering Laboratory
10. Central Laboratory

Some list of our equipment usage and their pictures

S/N	Name of Equipment	Picture of the Equipment	Location of Equipment
1	Universal Testing Machine		NLNG Lab

2	Inverted Metallurgical Microscope		NLNG Lab
3	Drying Oven		NLNG Lab
4	Creep Testing Machine (Low temp)		NLNG Lab

5	Electrochemical Analyzer		NLNG Lab
6	Weighing balance		NLNG Lab
7	Weighing balance		NLNG Lab

8	Water bath		NLNG Lab
9	Plasma cutter and welding machine		NLNG Lab
10	Heat treatment furnace		Foundry lab

11	Heat treatment furnace		Foundry lab
12	Rotary furnace		Foundry lab

13	Welding machine		Foundry lab
14	Charcoal fired furnace		Foundry lab

15	Gas fired furnace		Foundry lab
16	Crucible Furnace		Foundry lab

17	Ball milling machine		Foundry lab
18	Rockwell hardness testing machine		Materials Science Lab
19	Polishing machine		Materials Science Lab

20	Polishing machine		Materials Science Lab
21	Polishing machine		Materials Science Lab
22	Polishing machine		Materials Science Lab

23	Mounting press		Materials Science Lab
24	Impact testing machine		Materials Science Lab

25	Optical Emission Spectrometer		

NATIONAL STOVE ELIGIBILITY LABORATORY

The National Stove Eligibility Laboratory (NSEL) National Centre for Energy Research and Development, University of Nigeria, Nsukka was founded in 2015 with grant funding from United Nations Foundation. The laboratory is affiliated with Standards Organisation of Nigeria (SON) and specializes in testing and certification of biomass cookstoves.

The equipment in the testing facility includes (i) the Laboratory Emissions Measuring System (LEMS), which is a computer-based system for carrying out Water Boiling Test. It is equipped with sensors for Carbon Monoxide, Carbon dioxide, and Particulate Matter; (ii) Testing Hood; (iii) High Precision Analytical Balance, (iv) Thermocouples and thermocouple read-out meters.

Laboratory Emissions Measuring System

vi. Web link to documents

https://www.unn.edu.ng/central-science-research-laboratory-conference-new-generation-technologies-for-sustainable-development/

https://nanotechunn.com/

vi. Appointment letters and minutes of meeting

The appointment letters and minutes of meetings of the various committees under the Innovation-Oriented Cooperation of Research Infrastructures and Collaboration with the Private Sector through Advisory Services have been attached

viii. List of potential facility users and record of their engagement

The laboratories in the ACE-SPED have made a great impact in the sub-region as a result of sample testing for partners and institutions in the region. The following is a list of our potential users as of 2022.

- Scientific Equipment Development Institute (SEDI) Enugu
- **Standards organization of Nigeria(SON)**
- Project Development Institute (PRODA) Enugu
- Enugu Electricity Distribution Company (EEDC)
- UNESCO International Centre for Biotechnology
- National Power Training Institute of Nigeria (NAPTIN)
- National Centre for Equipment Maintenance and Development(NCEMD), University of Nigeria, Nsukka
- Jibs Engineering Ltd Trans Amadi Port Harcourt Rivers State

- GREENAGE TECHNOLOGIES,10, ENUGU ONISHA EXPRESS WAY TRANSEKULU ENUGU STATE, NIGERIA
- A1 Tronix R&D Electrical and Electronics Engineering, Igbo-Etche, Port Harcourt, Rivers State
- CLEANERGY NIG LTD ASABA, DELTA STATEEngr. John Bipialaka,
- Poda Green Consult. 27b OlumorotiJaiyesimi Street, Gbagada Phase 2, Lagos.
- Foundation for Innovative Electronics and New Energy Systems (FIENES) Suite Abuja, Nigeria
- EL-FAD Concept, D 248, Ikota Shopping Complex, VGC, LekkiAjah Express way, Lagos.
- VACC LIMITED, 9, MacGregor Road, Ikoyi, Lagos.
- Edugen Technologies Nigeria Limited, Mekason Plaza Odenigbo Road Nsukka
- IGUWORLD SOLAR, Abuja;
- Green and and Smart Technologies Ltd. Maitama, Abuja.
- CYMAS TECHNOLOGY LIMITED, 44 Eket-Oron Road, Eket, AKWA IBOM State
- Decrown West Africa Company Limited. No. 44 Lord Lugard Street, Asokoro, Abuja – FCT
- FONGU Electrical Installation | Bamenda
- Vynet Invent Network Solutions Festac Town, Lagos State.
- Oracle Business Limited (Plastic Industry), Makurdi, Benue State.
- CF OLYC NIG LTD Enugu
- J&G Engineering, Lekki, Lagos.
- Edo State Mining and Investment Company (ESMIC), Benin City
- Engineering Company Limited, 36, Orominike Lane
- Gezeora Commercial Enterprise. Worgu road, off east west road Adjacent Wazobia radio office Complex, GRA Phase V Ozuoba.
- Liberia Electricity Corporation (LEC) Waterside, Monrovia Liberia.
- Transmission company of Nigeria (TCN), Apo transmission substation Abuja.
- BEDC Electricity Plc Agbarho Service Unit (92 Ughelli Patani Road By Orido Junction, Agbarho Ughelli North Lga Delta State),
- Regional Centre for Training and Development Office Address: 1st Floor Goldcrest Plaza, by Mega Chicken Restaurant, Ikota First Gate Bus Stop
- Universities in the Sub-regions

M 3.1. vii INNOVATION VOCATION AND ENTREPRENEURSHIP TRAINING IVET HUB Pictures

AFRICA CENTRE OF EXCELLENCE FOR SUSTAINABLE POWER AND ENERGY DEVELOPMENT

(ACE-SPED)

UNIVERSITY OF NIGERIA, NSUKKA

INNOVATION, VOCATION AND ENTREPRENEURSHIP TRAINING (IVET) HUB

Coordinator: Dr. Nnenna Joy Eneh

Phone: +234(0)806 481 1235

Email: nnenna.eneh@unn.edu.ng

Web link: https://www.acespedunn.edu.ng/news/innovation,-vocation-and-entrepreneurship-training-(ivet)-hub-unec

WORLD BANK AFRICA CENTRE OF EXCELLENCE FOR SUSTAINABLE POWER AND ENERGY DEVELOPMENT

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- Desktop/Laptop computer repairs/maintenance
- Plasma/LED TV & other electronics devices repairs/maintenance
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- Advance ICT equipment repair/installation
- Solar/inverter/power solution etc.
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(Based on programme choice)

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acesped@unn.edu.ng

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Application Closes:

July 14th, 2023

Training Starts:

August 1st, 2023

The Innovation, Vocational and Entrepreneurial Training(IVET) Hub of the Africa Centre of Excellence for Sustainable Power and Energy Development(ACE-SPED), University of Nigeria, Nsukka




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FREE ONE DAY PRACTICAL SEMINAR WORKSHOP IN ICT AND BASIC ELECTRONIC MAINTENANCE SKILLS

WRITE PROGRAMMING LANGUAGE IN MINUTES,
DESIGN A WEB PAGE,
FIX YOUR LAPTOP IN 15MINS,
FAULT & TROUBLE SHOOT SOME BASIC ELECTRONIC DEVICES ETC

3rd June 2023 Enugu Campus.
CBN Building , Opposite University Secondary School UNEC

10th June 2023 Nsukka Campus
Faculty of Engineering Drawing Hall, University of Nigeria Nsukka Campus.

10AM

IN PARTNERSHIP WITH
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WORLD BANK AFRICA CENTRE OF EXCELLENCE
FOR SUSTAINABLE POWER AND ENERGY DEVELOPMENT
INNOVATION, VOCATIONAL AND ENTREPRENEURSHIP TRAINING HUB.
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07089215959
07057242198

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- DIGITAL MARKETING
- GRAPHICS DESIGN
- 3D ANIMATION
- PRINTING TECHNOLOGY
- PRODUCT DESIGN (UI/UX)
- ROOFING TECHNOLOGY
- SOLAR & INVERTER INSTALLATION
- MACHINE LEARNING
- DATA ANALYSIS & ANALYTICS
- DESKTOP REPAIRS & MAINTENANCE
- LAPTOP REPAIRS & MAINTENANCE
- PHONE REPAIR AND MANINTENANCE
- ELECTRONIC DEVICE REPAIR & MAINTENANCE

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The Innovation, Vocational and Entrepreneurial Training (IVET) Hub of the Africa Centre of Excellence for Sustainable Power and Energy Development (ACE-SPED), University of Nigeria, Nsukka
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3rd June 2023 Enugu Campus
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Our Facilitator's PROFILE:

NWODO KOSISOCHUKWU F.

Higher Diploma in Computer Science.

Certified Graphics Designer & Publisher.

Our Facilitator's PROFILE:

CHUKWUKA REDEEM

Computer Network Engineer,
Computer Repair and
Maintenance Engineer.
Basic Computer Tutor.

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Our Facilitator's PROFILE:

DR. KENJEZE (DPT)

Data Science.

Our Facilitator's PROFILE:

ENGR. UCHE OBIEFUNA

Bachelor of Engineering

Main Stack Web Developer

Our Facilitator's PROFILE:

TOCHUKWU NWAGU

Backend Engineer.

BL Hons, Diploma in Backend Engineering.

Our Facilitator's PROFILE:

ENGR. JOHN PAUL OBIORA

National Diploma Mech. Engr.
B.sc, M.sc, CompTia (E-council)
Software Engineer, Full-stack web Developer, Server Security specialist.

Our Facilitator's PROFILE:

ENGR. CHIAMAH GEOFFREY

Bachelor of Engineering.

A facilitator in roofing Technology.

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M 3.1. viii Certification documents from relevant agencies

AFRICA CENTRE OF EXCELLENCE FOR SUSTAINABLE POWER AND ENERGY DEVELOPMENT
UNIVERSITY OF NIGERIA, NSUKKA
OFFICE OF THE ACE-SPED TESTING FACILITY
☎: (+234) 8028433576

Ref: UNN/ACE-SPED/ILO

Date: 25th JULY, 2024

Certification documents from relevant agencies

In order to maintain standards, ACE-SPED has partnered with Katchey Company Limited, situated at 26 Odanye Close, Harmony Enclave, Adeniyi Jones, Ikeja, Lagos, to certify their equipment for SON importation and ISO. Additionally, the University of Nigeria's Nsukka's National Equipment Maintenance has certified other equipment. The following list showcases some of the certifications that Katchey Company Limited has carried out:

Declaration of Conformity

We, Thermo Fisher Scientific Brno s.r.o., part of Thermo Fisher Scientific
Vlastimila Pecha 1282/12, Černovice, 627 00 Brno
Czech Republic

CE

an ISO9001 certified company

declare under our sole responsibility that the electron microscope

Product Name:	**Axia ChemiSEM LoVac**
Serial Number:	9961704

Meets the provisions of the directives:

2006/42/EC	Machinery directive
2014/30/EU	EMC directive
2011/65/EU	RoHS directive
2013/59/EURATOM	Ionizing radiation directive

using to the following standards and normative documents:

EN 61326-1	Electrical equipment for measurement, control and laboratory use – EMC requirements
EN 61010-1	Safety measurements for electrical equipment for measurement, control and laboratory use – Part 1: General requirements

and that the X-ray emission is below 1 µSv/h at 10 cm distance from the surface

Peter Walk
Sr. Regulatory Compliance Manager

Brno, 5.2.2024

Declaration of Conformity

We,

Thermo Fisher Scientific
Molecular and Microanalysis Products
5225 Verona Rd.
Madison, WI 53711
Ph: +1 608 276 6100

declare under our sole responsibility that the product

Nicolet™ iS™20 FT-IR spectrometer
Nicolet™ iZ10 module

To which this declaration relates is in conformity with the following standard(s) or other normative document(s)

EN 61010-1:2010 (Safety requirements for electrical equipment for measurement, control, and laboratory use)
EN 60825-1:2014 (Safety of laser products)
EN 61326-1:2013 (Electrical equipment for measurement, control, and laboratory use. EMC requirements)
EN 50581:2012 (Assessment of electrical and electronic products with respect to the RoHS)

following the provisions of Directive(s) 2014/30/EU (Electromagnetic Compatibility), 2014/35/EU (Low Voltage), and 2011/65/EU (RoHS).

The Technical Construction file is maintained at:

Thermo Fisher Scientific
Molecular and Microanalysis Products
5225 Verona Rd.
Madison, WI 53711
Ph: +1 608 276 6100

The authorized representative located within the Community is:

Thermo Fisher Scientific
Dieselstr. 4
76227 Karlsruhe, Germany
Ph: +49 (0) 721 4094 389

Date of issue: 04 (DD) DEC (MMM) 2018 (YYYY)

Place of issue: Madison, Wisconsin, USA

Signed:

Carlo Nardini
Director of Operations

CE

ThermoFisher SCIENTIFIC

ThermoFisher
SCIENTIFIC

Shipment Authorization/ Certification of Conformance

Customer Name: **AT - Vienna**

Job Number: **4501007902** **System Serial Number:** **2080-2037**

☑ The undersigned certifies this tested instrument meets or exceeds applicable Product Acceptance Criteria.

Ken Compton
Ken Compton
Validating Technician

26/Apr/2021
Date

Year of Manufacturing: 2021

Country of Origin: USA:

☑ All components of your order are present unless otherwise noted on the Notification of Partial Shipment form included in this envelope.

I authorize shipment of this order:

Ken Compton
System Configuration Specialist

26/Apr/2021
Date

If you have any problems conserning this order, please contact your nearest Sales/Service Office or Representative.

Thermo Fisher Scientific 5225 Verona Road Madison, WI 53711 (608) 276-6100
www.thermofisher.com

Multiskan SkyHigh Performance Test Results

Date:	26/11/2021
Instrument serial number:	1550-801287C
Instrument internal software version:	2.00.35
Instrument UI software version:	1.0.70.0
SkanIt software version:	6.1
Factory performance calculations file version:	1.0
Spectrophotometric verification plate serial number:	1911-04
Cuvette standard set	34152
Testing technician:	Eddie Ho

Linearity

96-well plate, 0 - 2.5 Abs, < 2 % @ 450 nm	PASSED

Precision

Fast mode, SD < 0.003 Abs or CV % < 1 % @ 450 nm	PASSED
Precision mode, SD < 0.003 Abs or CV % < 0.5 % @ 450 nm	PASSED

Accuracy

Plate, 0 - 2 Abs, < (1 % + 0.003 Abs), 2 - 2.5 Abs, <2%	PASSED
Cuvette, 0 - 2 Abs, < (1 % + 0.003 Abs), 2 - 2.5 Abs, <2%	PASSED

Spectral stray light

Spectral stray light, < 0.05 % @ 230 nm	PASSED

Wavelength accuracy

Plate, < 2 nm	PASSED
Cuvette, < 2 nm	PASSED

Incubator

Plate accuracy, ± 1.0°C @ 37°C	PASSED
Cuvette accuracy, ± 1.0°C @ 37°C	PASSED

Shaker

Operational test	PASSED

Name: EDDIE HO **Date:** 26 NOV 2021

Thanks

Engr. Prof. V.S. Aigbodion **FNMS, SA/NRF-C3**
Industrial Liaison Officer
Head-ACE-SPED TESTING FACILITY
+2348028433576
victor.aigbodion@unn.edu.ng