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Guidance for countries on the specifications for managing TB laboratory equipments and supplies

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Acronyms

A	ampere
AC	alternating current
AFB	acid-fast bacilli
AIDS	acquired immunodeficiency syndrome
bp	base pair
BSC	biological safety cabinet
°C	degrees Celsius
C_A	average monthly consumption
CFC	chlorofluorocarbon
CI	colour index
dbA	decibel (A-scale weighted)
DC	direct current
DNA	deoxyribonucleic acid
DNase	deoxyribonuclease
DOTS	directly observed treatment, short-course
DST	drug-susceptibility testing
EDTA	ethylenediaminetetraacetic acid
EN	European norms (standards)
ETFE	ethylene tetrafluorethylene
FEFO	first expired, first out
FIFO	first in, first out
FL-DST	first-line drug susceptibility testing
FM	fluorescence microscope
GLP	good laboratory practice
HDPE	high-density polyethylene
HEPA	high-efficiency particulate air
HFC	hydrofluorocarbon
HIV	human immunodeficiency virus
Hz	hertz (*frequency)*
IEC	International Electrotechnical Commission
ISO	International Organization for Standardization
kW	kilowatt
LCD	liquid crystal display
LDPE	low density polyethylene
LED	light-emitting diode
LJ	Loewenstein–Jensen
µS	microsiemens
MGIT	mycobacteria growth indicator tube
MW	molecular weight [g/mol]
NA	numerical aperture
NALC	N-acetyl-L-cysteine
NGO	nongovernmental organization
NRL	national reference laboratory
NSF	National Sanitation Foundation (standards, United States)

NTP	national tuberculosis control programme
p.a.	per analysis
Pa·s	pascal second (SI derived unit of dynamic viscosity)
PCR	polymerase chain reaction
PE	polyethylene
PNB	paranitrobenzoic acid
PP	polypropylene
PTFE	polytetrafluorethylene
PVC	polyvinyl chloride
rcf	relative centrifugal force
RNase	ribonuclease
rpm	revolutions per minute
S	siemens (unit of conductivity)
SL-DST	second-line drug susceptibility testing
SOP	standard operating procedure
TB	tuberculosis
TBCAP	Tuberculosis Control Assistance Program (funded by USAID)
TPX	polymethylpentene
TWB/TWW	digitally adjustable electronic temperature controller
UPS	uninterrupted power supply
USAID	United States Agency for International Development
USD	United States dollar
UV	ultraviolet
UVGI	ultraviolet germicidal intensity
V	volt
W	watt
WHO	World Health Organization
ZN	Ziehl-Neelsen

Overview

Over the past decade, tuberculosis (TB) has become a major public health problem globally, but particularly in Africa and Asia. This situation has been further complicated by the need to expand laboratory services to address the challenges posed by the epidemic of human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/AIDS), and the emergence of multidrug-resistant and extensively drug-resistant TB.

Many national TB control programmes (NTPs) have been in existence for nearly 30 years and directly observed treatment, short-course (DOTS) has been generally available during that time. DOTS is the basic five-point package that is the first component of the World Health Organization's Stop TB Strategy. The five points of the package are:

- political commitment with adequate and sustained financing
- early case detection and diagnosis through quality-assured bacteriology
- standardized treatment with supervision and patient support
- effective drug supply and management
- monitoring and evaluation of performance and impact.

Tuberculosis laboratory services were often neglected by NTPs, meaning that the DOTS strategy was less effective than it could have been. In the past few years, this situation has changed. Investment in laboratories has increased, due to increasing recognition of the role of the laboratory in TB control and in managing drug-resistant TB, and the launch of the Global Laboratory Initiative in 2007 by the Stop TB Partnership.

Scope and content

If TB laboratory services are to support NTPs effectively through TB diagnosis and monitoring, they need to provide reliable, valid and timely results. High-quality equipment and reliable supplies are essential for quality-assured laboratory services. However, governments, NTPs and donors responsible for the procurement and management of TB laboratory equipment and other commodities lack up-to-date, standard, international guidance. Consequently, there are many examples of wastage of resources; for example, the purchase of large quantities of materials that are:

- inadequate (e.g. centrifuges not adapted for the recovery of TB bacilli, monocular instead of binocular microscopes)
- of poor quality (e.g. cheap microscopes that break within months)
- inappropriate (e.g. some types of biological safety cabinets).

These guidelines and specifications have been developed to fill this gap by providing current, standard guidance on procuring TB laboratory equipment, consumables and supplies.

The content is based on current international practice in commodity management.

Purpose and objectives

The purpose of this document is to provide guidance to governments, NTPs, donors and others responsible for the procurement, logistics and management of laboratory equipment and other commodities used in TB laboratory services. Such services include reliable TB microscopy and culture, and drug susceptibility testing. The document will be useful in developing systems for the efficient and timely procurement of quality laboratory equipment and supplies, and the ongoing management of all TB-related laboratory commodities.

The objectives of the guidelines are to:

- strengthen and build capacity of TB diagnostic services in TB laboratory commodity management systems
- ensure that high-quality TB diagnostic commodities are provided and available at all times.

Each country's ministry of health should ensure that these guidelines are followed in setting standards, quality assurance mechanisms, reporting mechanisms, and monitoring and evaluation systems.

Structure of document

The document is divided into two parts:

- *Part A* provides guidelines for effective management of TB laboratory commodities – it covers procurement mechanisms, logistics, quantification and management systems.
- *Part B* details the technical specifications for equipment, consumables and reagents needed to perform all techniques for the diagnosis of TB – it covers microscopy, culture, identification and drug susceptibility testing of *Mycobacterium tuberculosis* using conventional methods and molecular biology. Part B also provides additional details on the specifications and requirements for sensitive equipment, such as biological safety cabinets; this information will help to improve biosafety and guarantee infection control in TB laboratories.

Part A

Guidance for countries on the specifications for managing TB laboratory equipments and supplies

Chapter A1:

Introduction

Effective care and treatment of tuberculosis (TB) requires an effective national TB control programme (NTP). In turn, NTPs require support from fully functioning laboratory services that provide reliable, valid and timely results. Services need to include the diagnosis of TB infections and the monitoring of treatment at every level of care. To be fully functional, a laboratory service requires that laboratory commodities are available as needed. These commodities include equipment and supplies, such as laboratory reagents, diagnostic kits and other consumables.

In contrast to the management of pharmaceutical commodities, little attention has been given to the management of commodities in laboratories. A lack of overall laboratory management often leads to problems at the facility level. Thus, NTPs need to concentrate on those aspects of equipment and supply-chain management that are required for a fully functional TB diagnostic and monitoring service. This approach requires effective collaboration between laboratory staff and those making decisions about the TB commodity management system.

In terms of TB commodity management, the role of the national TB laboratory is to set standards; provide quality assurance and reporting mechanisms; and evaluate the quality, accuracy and performance of the equipment and supplies. More specifically, the national TB laboratory, in collaboration with the NTP, should be responsible for:

- selecting equipment and supplies, and setting specifications and quantities;
- participating in the budgeting and planning process – this includes being involved in verification of tender bids and awards of contracts for TB laboratory equipment and supplies;
- working with local and national procurement committees for purchasing equipment and supplies;
- arranging for laboratory managers and staff to be trained in equipment and commodity management.

This part of the document covers systems for the management of laboratory commodities (Chapter A2), management of equipment (Chapter A3) and monitoring and evaluation (Chapter A4). It also provides annexes that contain the two workbooks for commodity management (Annexes A1 and A2), examples of inventory control forms (Annex A3) and a list of resources for further reading (Annex A4).

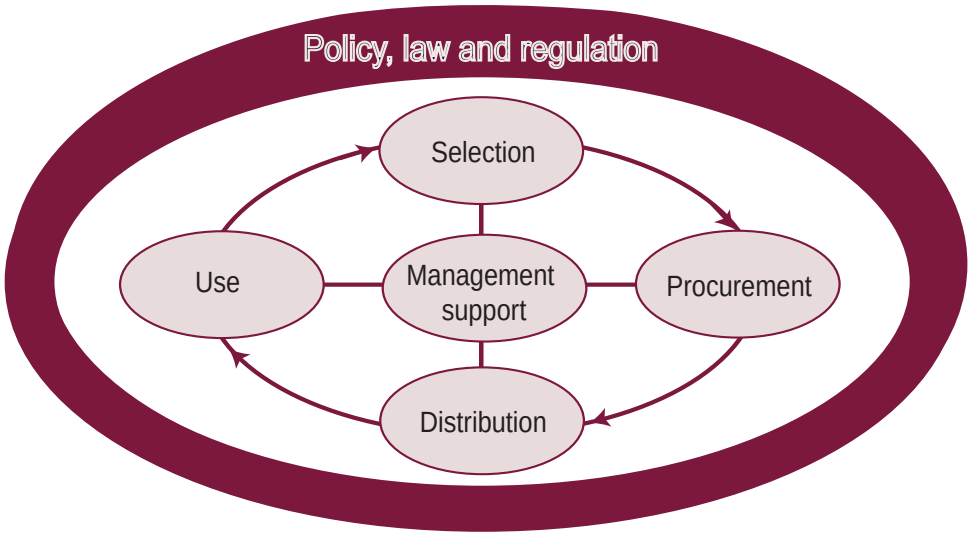
Chapter A2:

Laboratory commodity management systems

A2.1 What is commodity management?

Laboratory commodity management involves many different activities that must be carefully planned and coordinated. The aim is to ensure that the right commodities, of acceptable quality, get to the right place at the right time to perform laboratory tests for patient diagnosis, care and management.

Managing laboratory commodities, in any setting (public or private sector) and at any level (local, regional, provincial or national), follows a well-recognized cycle of selection, procurement, distribution and use, as shown in Figure A2.1. These activities are carried out in health systems that provide the necessary infrastructure and organization, financial and human resources, and information systems. Effective and efficient performance of these systems requires a framework of policy, law and regulation that upholds a commitment to the availability of commodities and their appropriate use.



Adapted from: Management Sciences for Health in collaboration with the World Health Organization. *Managing drug supply*, 2nd ed. West Hartford, Kumarian Press, 1997.

Figure A2.1 Commodity management cycle

A2.1.1 Components of the commodity management cycle

The components of the commodity management cycle shown in Figure A2.1 are defined below.

- *Selection* – the process of establishing a list of laboratory equipment and commodities; usually decided at national policy-making level. The agreed list is then used to plan and decide which types of laboratory equipment and commodities to purchase.
- *Procurement* – the process of acquiring (quantifying, ordering and purchasing) laboratory equipment and supplies from private or public suppliers through purchases from manufacturers, distributors or agencies, or through donations. Procurement includes:
  - *quantification* – the process of estimating quantities of a specific item needed for procurement for a specific period of time, and the financial requirements needed to purchase those items;
  - *forecasting* – the process of projecting future needs over a longer period of time.
- *Distribution* – the process of transporting, delivering and receiving laboratory supplies; appropriate storage; inventory control; and information systems for receipt and disbursement.
- *Use* – the safe and effective use of TB laboratory diagnostic services and commodities; includes performing tests effectively and efficiently, and technical aspects of testing.
- *Management support and preparedness* – essential to all the functions listed above. Management of the procurement and distribution parts of the cycle is particularly important; for example, proper quantification is vital to ensuring that adequate stock levels of TB laboratory commodities are always available. The laboratory diagnostic system depends on:
  - *organization of the system* – infrastructure and equipment;
  - *financial management* – effective integration of planning, finances and budgeting;
  - *information management systems* – maintenance of accurate, useful, and up-to-date information systems, proper documentation and record keeping;
  - *human resource management* – identification and motivation of adequately trained and capable staff;
  - *monitoring and evaluation* – includes quality assurance and supervision.
- *Policy, law and regulation* – defines the goals and parameters for effective management of the laboratory services. Each of the above components must be carried out within the policies and legal framework of the country.

All of the above components operate within the local political, social, cultural and economic context. This influences the nature of the activities, but not the nature of the relationships.

The following section deals with the practical aspects of the cycle of selection, procurement, distribution and use of all laboratory commodities.

A2.2 Selection

Careful planning for and selection of essential TB laboratory commodities are critical. For example, it is important to be selective in the range and type of TB diagnostic commodities – limiting the list can lead to better supply, more knowledge and experience (through buying reagents that staff are familiar with), more rational use and lower costs. Selection is one of the most cost-effective areas of intervention, because it has both clinical and economic implications.

In terms of diagnosis, the selection of commodities has implications for procurement, local production, training and ordering of tests. Policy makers need to understand the reasoning behind the selection, and this reasoning should be enshrined in the national TB policy and in the procedures followed by the selecting committee. The recommendations of the World Health Organization (WHO) Prequalification of Diagnostics Programme should be followed; this will help to ensure that laboratories purchase affordable diagnostic commodities of assured quality that are appropriate for use in resource-limited settings.

To ensure adequate availability of essential laboratory commodities, health managers and policy makers must seek input from users (clinicians and laboratory staff) and review current information on:

- TB in the country
- disease episodes
- national health policies and plans
- budgetary constraints
- product availability (inventory and consumption) – this information is gathered from the procurement, distribution and use processes.

A2.2.1 Selection of reagents and supplies

Laboratory staff should be involved in decisions on selecting reagents and supplies. The selection process involves:

- reviewing the health problems or conditions to be prevented, tested for and treated at health facilities;
- developing a list of reagents and supplies by level of health care, using agreed criteria;
- choosing appropriate packaging or unit sizes;
- basing the selection process on relevance, proven efficacy and safety, performance in a variety of settings, quality, cost–benefit ratio, previous experience, location of manufacturer and capacity of laboratory staff.

A2.2.2 Selection of equipment

Laboratory staff should be involved in decisions on selecting capital equipment. Selections should be made on the basis of performance, local needs, cost, value for money and the availability of servicing, spare parts, reagents and consumables needed to run the equipment. In addition, equipment should be selected based on:

- policy guidelines;
- broad consultation with both users and maintenance staff (equipment must be user friendly);
- bidders having sufficient knowledge of maintenance, rather than being mere traders;
- training for maintenance and training of users being a condition of the contract or purchasing agreement.

A2.3 Procurement

The effectiveness of the procurement system determines the availability and cost of essential laboratory commodities. Good procurement practices depend on reliable and accurate quantification of needs, transparency in the selection of suppliers and in management of bids or contracting, and quality assurance of the commodities.

The procurement cycle for TB laboratory commodities – shown in Figure A2.2 – is identical to that used for procurement of drugs and pharmaceuticals. It includes most of the decisions and actions that determine the quantities of commodities obtained, the prices paid, and the quality of the commodities received.

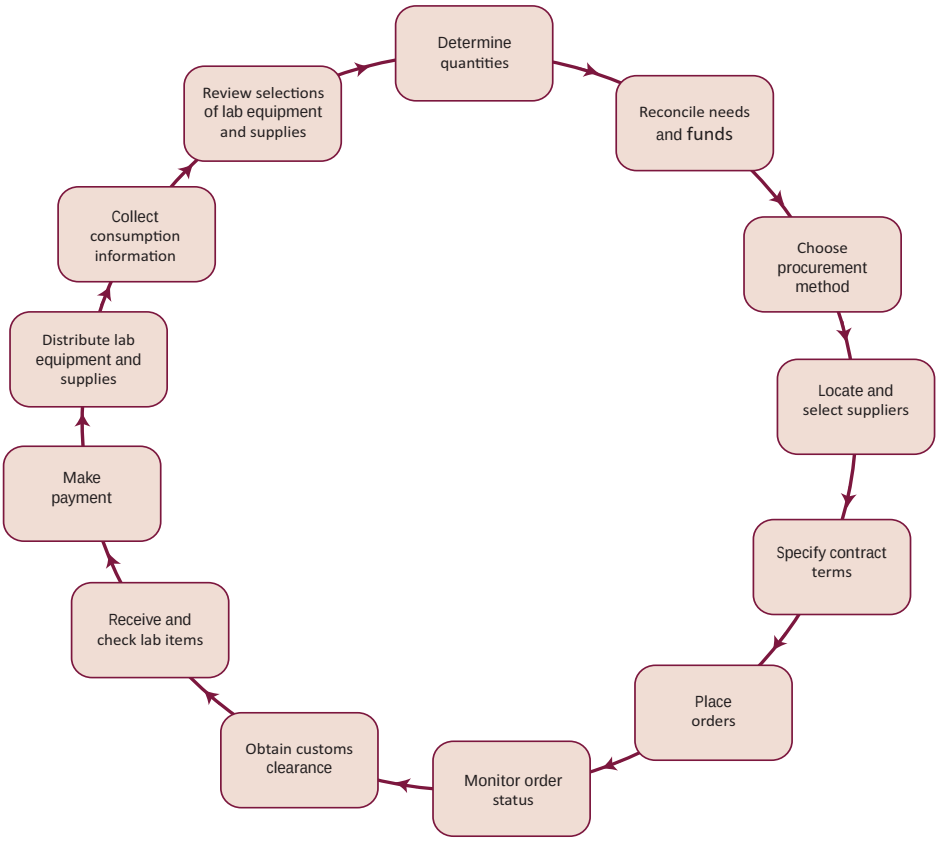


Figure A2.2 The procurement cycle for TB laboratory commodities

An effective procurement process for commodities for TB laboratories should efficiently:

- procure the right commodities in the right quantities;
- obtain the lowest possible purchase prices;
- ensure that all commodities procured meet recognized standards of quality;
- arrange timely delivery;
- set the purchase-schedule formulas for order quantities and safety stock in such a way as to achieve the lowest total cost at each level of the health-care system;
- train staff to have expertise in laboratory, managerial, economic and even political skills;
- have procurement procedures that are fair, transparent and sound, and that accord with generally accepted international standards;
- use effective transport and communications facilities;
- have access to reliable information about inventories and consumption;
- have good storage facilities;
- facilitate timely customs clearance.

A2.3.1 Quantification

Quantification helps:

- to avoid stock-outs and ensure continuous availability of essential supplies;
- to avoid wastage due to over-stocking;
- to make the best use of scarce resources and to budget within a laboratory's means;
- to facilitate central bulk purchasing by providing sufficient details from health facilities to allow central orders to be placed well in advance;
- to increase the effectiveness of an existing laboratory supply programme budget;
- in the preparation of, and justification for, a budget;
- in planning for new or expanding programmes and policies;
- in calculating emergency needs;
- in resupplying an existing supply network that has become depleted of laboratory supplies;
- in estimating how much refrigerated space might be needed in the future.

Table A2.1 lists symptoms of good and poor quantification.

Table A2.1 Symptoms of good and poor quantification

Symptoms of good quantification	Symptoms of poor quantification
▪ Consistent availability of supplies ▪ Low wastage ▪ No over or under-stocking ▪ Service providers have adequate TB diagnostic reagents and supplies ▪ Cost effectiveness ▪ Rational adjustment to budgetary constraints ▪ Rational use of reagents and supplies ▪ Easy management of stock ▪ Fulfilment of demand ▪ Satisfied clients	▪ Shortages and stock-outs ▪ Surpluses and expired stock ▪ Breaks or delays in services, or both ▪ Loss of coverage – clients or patients who come for TB testing are turned away ▪ Lack of treatment – clients or patients who are sick and need TB treatment are not diagnosed or do not start treatment ▪ Inappropriate treatment ▪ Inaccurate budget estimates ▪ Suppression or distortion of demand ▪ Dissatisfied clients and loss of business

A2.3.2 Methods used in quantification

In relation to TB laboratory consumables, there are several primary methods of quantifying how much to order: consumption, adjusted consumption and morbidity. Each method is discussed below.

Consumption method

The consumption method – so called because it is based on how much of a product is used (or consumed) by the system – employs historical data on past use of commodities to calculate the quantities that will be used in the future. The data required should be readily available in both the central store and individual laboratories. If this is not the case, then a laboratory information management system needs to be put in place to collect the required data.

The consumption method assumes that current usage patterns will continue. To be of value, the consumption data on which projections are based must be accurate and reliable. The data must come from good inventory records, and from a system with a relatively uninterrupted supply and a full supply pipeline. If the supply is not continuous, the person doing the quantification may have difficulty interpreting actual past use; this will result in less reliable calculations and estimations. The consumption method can only be applied to products that have been used in the past, or to the direct replacement of a product that has been used in the past (e.g. one test kit being replaced by an equivalent). It is not useful for new services, where data on previous use will not be available.

Adjusted consumption method

The adjusted consumption method can be employed in situations where historical data on which to base orders are not available. In this method, data from a similar laboratory service, with a similar workload and numbers of clients or patients, are used as the basis of the quantification.

Morbidity method

The morbidity method is related to disease patterns. It is useful when reliable laboratory data on workload and consumption are not available. A modification of the morbidity method is useful for calculating the quantity of laboratory supplies required for TB microscopy. This helps national TB control programmes (NTPs) to accurately forecast requirements for laboratory consumables, based on simple TB case data already being collected by the programme.

Annexes A1 and A2 contain tools to assist countries in the quantification of TB laboratory consumables and supplies. Detailed instructions on the use of these tools are provided.

Selecting the best method for the quantification of TB laboratory supplies in a country

Option A

If the country is already using a well-established supply-chain management system for laboratory supplies, and all TB laboratory requirements are procured satisfactorily, the country should continue to use this system. There is no need to set up a new, separate system solely for TB laboratory requirements.

Option B

If the country does not yet have an established, satisfactory supply-chain system, if there are problems with stock-outs and expired supplies, or if there is a lack of understanding of how to calculate appropriate quantities of items for techniques such as TB microscopy or TB culture and drug-susceptibility testing (DST), then the tools in Annexes A1 and A2 should be used.

- Annex A1 contains the *AFB-SuppliesProcurement* workbook. This workbook is intended for use in quantifying and managing the consumables needed in laboratories doing acid-fast bacilli (AFB) microscopy at the intermediate or national level. It is not intended for use in calculating supplies for individual laboratories.
- Annex A2 contains the *CU&DST-Supplies* workbook. This workbook is intended for use in quantifying and managing the consumables used in laboratories undertaking TB single-culture and DST, and eventually in laboratories undertaking molecular tests.

A2.4 Distribution

Distribution is the process of transferring products from the source of supply to the place of consumption. It needs to be done economically and efficiently, and can be thought of as the "art" of getting the right amounts of commodities to the right places at the right times. In terms of TB commodities, distribution involves:

- moving commodities from the supplier through clearing ports
- receipt
- inspection
- inventory control
- storage (i.e. national or central medical stores)
- requisitioning of supplies
- delivery to hospitals or districts
- dispensing to end users
- reporting on use.

Distribution systems are important. If they function well and are supported by good procurement practices, it is more likely that laboratory diagnostic services and point-of-care testing of assured quality will be available where and when they are needed.

A distribution system ensures continuous flow of supplies from a central point to end-user facilities. It comprises the following elements:

- *the system's design* – for example, the degree of centralization, "push" versus "pull" ordering, geographic or population coverage and number of different levels;
- *an information system* – for example, inventory control, records and forms, consumption reports and information flow;
- *appropriate storage* – for example, locations, building design, materials-handling systems and order-picking systems (e.g. first expired, first out [FEFO]);
- *delivery* – for example, collection versus delivery, choice of transport, vehicle procurement, vehicle maintenance, routing and scheduling of deliveries.

Figure A2.3 illustrates theTB laboratory commodity distribution cycle.

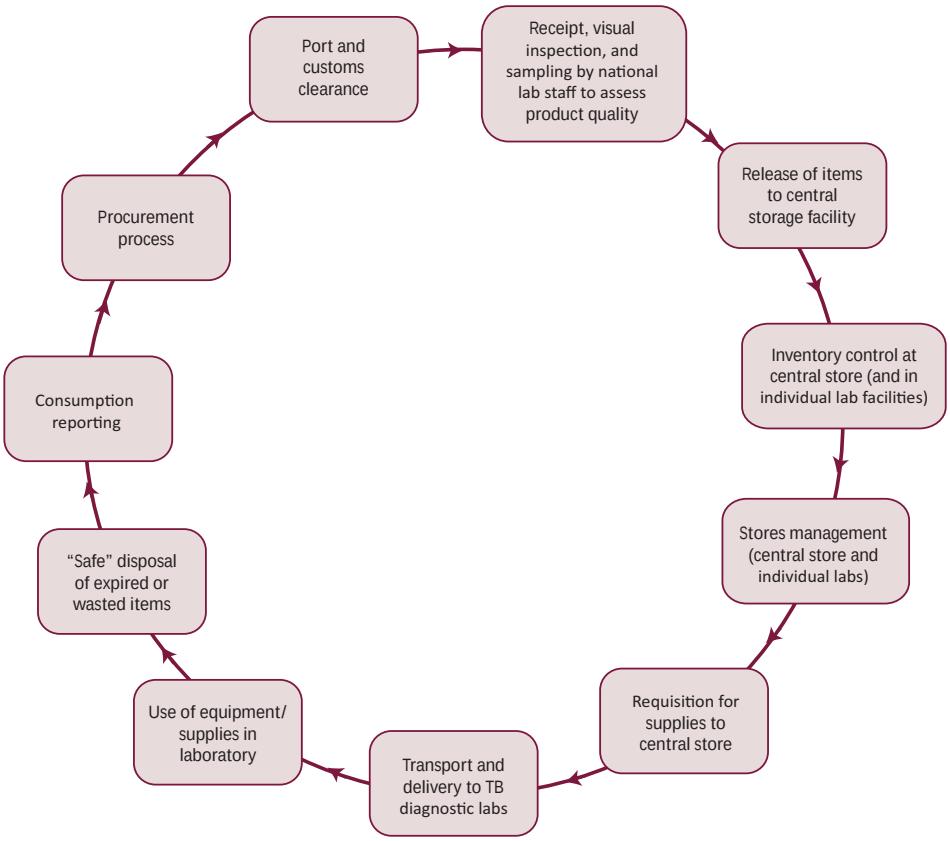


Figure A2.3 TB laboratory commodity distribution cycle

An effective distribution system relies on good system design and management. Such a system should:

- maintain a constant supply of TB diagnostic commodities;
- keep TB diagnostic commodities in good condition throughout the distribution process;
- include visual inspection of reagents and supplies, and testing of quality by laboratory staff;
- minimize losses of TB diagnostic commodities due to spoilage and expiry;
- maintain accurate inventory records to prevent stock-outs or over-stocking, while at the same time maintaining enough inventory to sustain good service levels at all of the system's distribution points;
- maintain a register of TB diagnostic commodity needs, to prevent future stock-outs and to analyse consumption data;
- locate storage warehouses in a way that optimizes the infrastructure available for storing stock when needed, and facilitates distribution to peripheral health facilities;
- use available transportation resources as efficiently as possible;
- reduce theft and fraud;
- provide information for planning TB diagnostic commodity needs.

Procurement, port clearing, receipt and inspection can be done by the national laboratory or the central stores, depending on the country's policy and the availability of staff.

A2.5 Store management

Good management of storage and inventory involves monitoring expiration dates, inventory levels, unexplained losses (leakage) and storage conditions, such as light, temperature and sanitation, which are particularly critical for diagnostic reagents.

The role of the central store is to receive, hold and distribute all TB laboratory products for the public sector. The process should be controlled by an inventory control system, supported by an information system for performance monitoring; described below.

Definitions

- The *inventory* is the total of all products kept on hand at any storage point.
- *Inventory control* is the function of supply management, which focuses on providing sufficient stocks of laboratory commodities while minimizing handling costs. Inventory control includes requisitioning and issuing products, financial accounting, and preparing the consumption and stock balance reports that are necessary for procurement.

A2.5.1 Inventory control systems

The purpose of an inventory control system is to manage procurement and stock movements.

Which commodities should be stocked?

Based on the selection criteria discussed above, the commodities stocked (for the public sector) should be:

- listed in each country's essential list of laboratory supplies and equipment;
- of value to the public health system;
- consumed on a regular basis;
- of known frequency and lead time for ordering and purchasing.

Part B of this document provides a comprehensive list of TB commodities.

How much should be stocked?

In TB control, stock-outs of diagnostic laboratory commodities are unacceptable. All TB diagnostic laboratory commodities are essential for diagnosis and follow-up tests of TB patients; therefore, they must be available at all times.

A2.5.2 Information and records

What is required for proper inventory control?

Several computerized or manual (i.e. paper) records are required for effective inventory control. This document provides examples of the following basic records (Annex A3):

- stock card (also known as a bin card);
- monthly consumption record;
- inventory control form;
- list of expired laboratory supplies form.

However, where local, national, regional, or facility record forms or cards are already in existence, these should be used instead.

A2.6 Storage and safe disposal

Definition

- *Shelf-life* is the length of time a product may be stored under ideal conditions without affecting the usability, safety, purity or potency of the item.

A2.6.1 Storage conditions

The following conditions need to be considered when storing laboratory supplies:

- restricting access to the laboratory and storage area to authorized personnel;
- cleanliness of benches and shelves, and appropriate methods for disposal of waste;
- humidity;
- temperature – general and special requirements, and temperature monitoring;
- air-conditioning;
- adequate refrigerated space, maintained at optimal temperatures (+2 to +6 °C);
- adequate freezer space (at –20 °C and –70 °C);
- an emergency power supply;
- lighting (note: supplies stored in direct sunlight may deteriorate);
- shelving and cupboards – these need to be adequate, accessible and stable.

A2.6.2 Organization of stock

The following issues need to be considered when organizing stock:

- stock rotation by FEFO, first in, first out (FIFO) and expiry dates
- use of stock or bin cards
- security for dangerous or expensive items.

A2.6.3 Special precautions

Special precautions need to be considered for:

- flammables, irritants and corrosives
- fire risks (fire extinguisher)
- pest control.

A2.6.4 Safe disposal

The safe disposal of laboratory waste and contaminated materials is of prime importance. These items represent hazards to both laboratory staff and the community. Also, the uncontrolled dumping of solid, liquid, chemical and biological laboratory waste can threaten the environment.

A2.6.5 Types of waste

Laboratory-generated waste includes:

- sharps
- chemical waste – expired reagents and consumables
- human anatomical waste
- blood and body fluids
- solid waste, such as cotton wool, tissue paper, culture plates with used media, used blood-giving sets, empty blood packs, used test-tubes and used glass slides
- laboratory specimens
- equipment effluent.

A2.6.6 Methods of safe disposal

Waste can be disposed of by incineration or burial, both of which are discussed below. The method used will depend on the nature of the waste.

Incineration

Incineration provides high temperatures and destroys microorganisms; thus, it is the best method for disposal of contaminated wastes. Incineration also reduces the bulk size of wastes to be buried.

Simple incinerators can be built from locally available materials, such as bricks, concrete blocks, and used fuel or oil drums.

Burial

If incineration is not possible, all contaminated wastes must be buried in a rubbish pit and covered with soil to prevent the waste materials from being scattered.

Rubbish pits should be at least 4–5 m deep and 1–2 m wide, and protected with a cover or fence to prevent scavenging. The rubbish should also be covered with soil regularly to prevent scavenging or incidental contamination of the environment.

A2.6.7 Transport of waste material for incineration

All materials for incineration must be documented in a logbook, which must include at least the following information:

- name of the porter and signature
- supervisor's name and signature
- date of collection
- source of the waste
- weight of the waste
- signature of receiving officer at the incinerator.

The porter's supervisor must make sure that the material for incineration is properly packaged, that it is labelled as BIOHAZARDOUS material, and that the package is leak proof.

The porter must wear personal protective equipment as necessary, and must transport the material as quickly as possible, using a route that avoids close encounters with members of the public, to protect them from exposure.

A2.7 Rational use of TB laboratory commodities

Current TB laboratory diagnostic services and commodities, as well as new diagnostics, should be used safely and effectively. This requires health workers (clinicians and diagnostic service providers), patients and the community to understand the role and function of the laboratory in the control of TB.

Health workers must know:

- when and who to test for TB
- how to use test results in decision-making
- what findings should be reported and whom they should be reported to.

Laboratory managers and staff must know:

- which tests to use
- how to perform the tests
- how to safely dispose of testing commodities and specimens after use
- what findings should be reported and to whom
- how to maintain essential equipment and commodities.

The community needs to know:

- the benefits of testing
- where the services can be obtained.

Ensuring safe and effective use of diagnostic services and commodities will entail a range of interventions, including incorporation of laboratory testing into diagnostic and treatment guidelines, development and implementation of standard operating procedures, and use of job aids and other appropriate behaviour-change interventions targeted at clinicians, diagnostic service providers and care seekers in the community.

The Tuberculosis Control Assistance Program (TBCAP) toolbox contains several tools that should be used in conjunction with this document to promote rational use of laboratory commodities. These include:

- TB laboratory standard operating procedures (SOPs);
- a management information system that includes a set of recording and reporting formats;
- microscopy external quality assessment – a training package aimed at strengthening quality assurance of AFB microscopy;
- culture and DST – a training package on biosafety for laboratories
- a country roadmap – a generic document for strengthening laboratories.

A2.7.1 Training of laboratory managers and staff

To make proper use of this document and the TBCAP toolbox, laboratory staff at all levels of care will need adequate training. The training should focus on implementation of laboratory commodity management systems.

Chapter A3:

Equipment management

Chapter A2 provided information on overall commodity management. This chapter covers some additional considerations required for managing tuberculosis (TB) laboratory equipment.

A3.1 National equipment policy

Countries should develop a laboratory equipment policy that includes all relevant activities. The policy should include an equipment maintenance plan, a budget for equipment maintenance (i.e. for repairs and spare parts) and guidance on equipment donations.

A3.2 Criteria for selecting equipment

When selecting equipment for purchase, laboratories need to take into account:

- the proposed use of the equipment
- how well the equipment accords with the service provided
- performance characteristics
- facility and infrastructural requirements
- cost
- availability of reagents and consumables, and arrangements for supply of these materials
- ease of operation
- warranty
- availability of technical support from the manufacturer
- service contracts
- location in the laboratory
- available space and accessibility
- safety.

Part B of this document provides detailed equipment specifications that will be useful when selecting equipment.

A3.3 Acquisition

Equipment may be acquired through direct purchase, lease or rental. It is often best to procure items of equipment centrally. If many of the same items are required, then bulk procurement may be the most cost-effective and practical approach. Similar considerations apply when acquiring equipment from donors.

Regardless of how the equipment is acquired, laboratories must take into consideration:

- responsibilities of the manufacturer or distributor
- conditions of the commercial sales contract
- customer-support plan and maintenance contracts.

Each of these aspects is discussed below.

A3.3.1 Responsibilities of the manufacturer or distributor

The manufacturer or distributor must guarantee:

- provision of all reagents, consumables and culture materials at an affordable and sustainable price (note: distributors usually offer reduced prices for high consumption, so bulk or central ordering may be a distinct advantage);
- a reasonably lengthy expiration date on all reagents and consumables;
- acceptable shipment conditions and assistance with customs logistics, to avoid damage to equipment or deterioration of reagents;
- installation of the equipment, staff training and ongoing technical support;
- provision of a parts manual and an operator's manual;
- a trial period for the equipment, after which it can be returned if it is not deemed suitable;
- ongoing maintenance and repairs, including emergency services.

A3.3.2 Conditions of the commercial sales contract

The sales contract must be reviewed carefully before completing the purchase. The contract should clearly stipulate all of the above responsibilities of the manufacturer or distributor.

A3.3.3 Customer-support plan and maintenance contracts

A customer-support plan and maintenance contracts should be available for all items of capital equipment. Maintenance contracts are essential for all automated equipment (e.g. *Mycobacterium* growth indicator tubes) and biosafety equipment. Laboratories should pay particular attention to contracts for biological safety cabinets – these should provide for regular maintenance.

A3.4 Installation

Before installation:

- verify that physical requirements have been met; these include electrical, space, ventilation, water supply and ambient-temperature requirements, and safety checks;
- confirm who is responsible for installation.

Upon receipt:

- verify the package contents;
- do not attempt to use the equipment before it has been properly installed;
- generally, in the case of capital equipment, ensure that the equipment is installed by the manufacturer.

After installation:

- establish an inventory record for the equipment
- define the conditions for use
- develop and implement protocols for calibration, performance verification and operating procedures
- establish a maintenance programme
- provide training for all operators.

A3.5 Validation and calibration

Validate the performance of new equipment and calibrate it before use by:

- testing known samples and analysing the data
- establishing stability or uniformity in temperature-controlled equipment
- checking the accuracy or precision of pipettes
- checking the speed (in revolutions per minute [rpm]) of a centrifuge.

A3.6 Maintenance and troubleshooting

Maintenance involves systematic and routine cleaning, and adjustment or replacement of instrument and equipment parts. It should be performed regularly – either daily, weekly or monthly, depending on the equipment. Examples of maintenance include cleaning optical lenses, adjusting thermostats and changing motor brushes.

If a piece of equipment malfunctions, users should:

- check the manufacturer's instructions;
- determine the source of the problem – for example, the sample, the reagent, the equipment, the electrical supply or the water supply;
- make one change at a time, to attempt to diagnose the source of the problem.

A3.7 Professional service and repair

In terms of professional service and repair, laboratory managers should schedule regular servicing, by the manufacturer or representative, for all key items of equipment. To ensure cost effectiveness, it is preferable that all items of the same model (e.g. microscopes) are serviced at the same time. Basic items of equipment such as water-baths may be maintained by local biomedical service technicians.

A3.8 Retiring equipment

Questions to ask in terms of retiring equipment include the following.

- *When* should an item be retired? This might occur when experts indicate that the item cannot be repaired, or is outmoded and should be replaced with a new model.
- *Why* should an item be retired? Reasons might be to avoid issuing inaccurate test results, to free up valuable space and to reduce hazards.
- *How* should an item be retired? A useful approach is to salvage any usable parts, taking into account any biohazards, and then follow safety disposal procedures for any parts that cannot be reused.

A3.9 Equipment maintenance programmes

The benefits of maintenance programmes are:

- safety of equipment
- fewer interruptions of work
- lower repair costs
- equipment lasting longer, rather than needing to be replaced prematurely
- less need for standby equipment
- identification of high maintenance costs
- reduction of variation in test results
- greater confidence in the reliability of results.

A good equipment maintenance programme:

- helps the laboratory to achieve a high level of performance
- lengthens instrument life
- reduces interruption of services due to breakdowns and failures
- improves customer satisfaction
- improves the confidence and knowledge of laboratory technologists.

A3.10 Equipment management oversight

In terms of oversight of equipment management, laboratories should:

- assign responsibilities for all activities;
- train all personnel on equipment management requirements and responsibilities;
- monitor equipment management activities by:
  - routinely reviewing all records;
  - ensuring that all procedures are followed;
  - updating procedures, if necessary.

A3.11 Donations of laboratory equipment and other commodities

Countries and laboratories need to ensure that donations of commodities to TB laboratories are handled properly. This means making sure that:

- donations are based on need expressed by the recipient country, ministry of health or a national TB control programme;
- all donated capital equipment and TB diagnostic commodities comply with the quality standards of both the donor and the recipient country;
- on arrival, all donated TB diagnostic commodities have a remaining shelf-life of at least one year;
- all TB laboratory equipment and diagnostic commodities are labelled and have instructions in English or in a country's national official language that is easily understood by health professionals;
- recipients are made aware of all donations of TB diagnostic equipment and commodities that are being considered or are under way;
- the declared value of the TB diagnostic equipment and commodity donation is based on the wholesale price of its equivalent in the donating country;
- wherever possible, costs of international and local transport, warehousing and port clearance are paid by the donor agency;
- wherever possible, a maintenance contract and adequate supplies of consumables accompany donations of capital equipment.

Chapter A4:

Monitoring and evaluation

The entire tuberculosis (TB) laboratory diagnostic system depends on effective integration and management of finances and budgets; maintenance of accurate, useful, and up-to-date information systems; identification and motivation of capable staff; and the institution of monitoring and evaluation systems. The expertise and organizational framework provided through management support are critical in each process of laboratory services and technology management.

A4.1 Monitoring

A commodity monitoring system provides information that the national TB control programme (NTP) and the national laboratory can use periodically to determine whether the commodity management system is performing as expected. For example, if all the TB laboratory commodities ordered are being delivered and recorded, the order quantities are correct and no stock-out or over-stock situation arises, then the monitoring will find that the book record and the physical count of the equipment and supplies correspond.

Other uses of a monitoring system include:

- determining whether commodities are stored at the right temperature and that expiry dates of supplies are known in advance – this allows supplies to be returned to the suppliers or redistributed to other centres before they become useless;
- assessing whether the samples collected are useful, equipment is calibrated routinely, the supply of reagents is adequate, and so on; and
- providing information that can be used to assess the workload of the laboratory staff.

A4.2 Evaluation

The purpose of evaluation is to assess the impact of intervention, usually in the long term. Short-term evaluation can also be undertaken, but will reflect only the outcome of an intervention, not the impact.

A4.3 Indicators for monitoring and evaluation

Examples of indicators for monitoring and evaluating laboratory commodity management include the average percentage of:

- stock-out time for a set of tracer commodities at a TB microscopy site;
- unexpired tracer commodities at a TB microscopy site;
- stock records that correspond with physical counts for TB laboratory tracer commodities.

Such information is helpful in making timely and informed management decisions. In turn, such decisions help to ensure the continuity and quality of services.

Annex A1:

AFB-SuppliesProcurement workbook

The Excel workbook *AFB-SuppliesProcurement* is intended for use in quantifying and managing the consumables needed in laboratories doing AFB microscopy at an intermediate or national level. It is not intended for use in calculating supplies for individual laboratories.

Instructions for use

Once essential information on stocks and performance has been entered and a few other parameters have been set in the appropriate sheets, the workbook will automatically show the quantities that are theoretically needed. The workbook can then be printed, to be used as the paper request. The supplying level can make further use of this tool by filling in quantities actually supplied (i.e. manually changing the quantities to what is feasible, taking into account stock limitations). The completed form can also be used as a delivery and receipt document.

Another sheet uses the information entered, plus the information from a country-specific database, to calculate costs of estimated needs. Adding specifications will produce a sheet for procurement – for example, at the national level.

There is also a hidden sheet that only performs calculations and shows the various intermediary steps. This sheet should remain hidden unless there is a need to make changes to the formulas or to check on the correctness of the calculations.

All values already entered are only examples. It is the responsibility of the user to adapt these values according to the actual:

- parameters (smears performed, laboratories functional and stock situation);
- guidelines (stains formulation, procurement period);
- other conditions or estimates (e.g. consumption) that are valid for the specific setting where the tool will be used.

The formulas and links built into this workbook are complicated and should not be disturbed. Although the formulas and links have been protected, it is the responsibility of the head of the laboratory services to complete this protection by giving the hidden sheet a password and keeping that password confidential.

Similarly, a blank master copy of the entire workbook should always be kept in reserve. This original should be copied to a "safe" directory, where it should be saved with an extension indicating the name of the laboratory; for example, *AFB-SuppliesProcurementTanzania*.

Sheets within the workbook

ItemsDatabase *sheet*

The *ItemsDatabase* sheet is the general database from which a country-specific database should be constituted at national level. It contains a variety of small materials and supplies (i.e. consumables), and lists their specifications, prices and so on.

CountryItems *sheet*

The *CountryItems* sheet is an example of a country-customised database of items needed for AFB-microscopy work. It can be further adapted by being copied and pasted from the general database – with correction of packing sizes, prices and so on, as needed. If there are unnecessary items (e.g. names, specifications and prices), it is best to replace these without deleting lines because the item names are automatically copied to other sheets (e.g. stock ledgers and projected needs), where they may be linked to factors for calculation.

Never attempt to sort the *CountryItems* sheet because this will corrupt the calculations in other sheets.

VariableData *sheet*

The *VariableData* sheet contains information needed for the calculations and must be updated by users. Information that must be entered includes:

- numbers of smears performed earlier over a specified number of months (Ziehl–Neelsen [ZN] smears versus auramine smears) – these should be placed in boxes at the top of the sheet;
- number of functional microscopy laboratories to supply – these should be placed in boxes at the top of the sheet;
- quantities left in stock (report only those remaining at the requesting [intermediary] level) – these should be placed in the second column;
- quantities ordered previously and expected to arrive – these should be placed in the third column.

Make sure the counting and calculation units specified are respected for each item when filling in these data. Please also note that the quantities left in stock to be reported are only those remaining at the requesting (intermediary) level.

Do not include stocks present at the laboratories at lower levels of the service.

Dealing with items that are not needed

Some of the sheets contain items that may not be needed. For example, it will generally be necessary to choose between sulfuric and hydrochloric acid. This can be dealt with:

- in the *VariableData* sheet – by hiding the lines that are not needed (i.e. select the line; right click on the mouse and select "Hide"; to unhide, select the line, right click on the mouse and select "Unhide");
- in the *FixedData* sheet – by setting these items to "zero" for the consumption factors.

Do not delete lines from the sheets because this may disturb some calculations. The entire workbook should remain protected to make it impossible to delete lines.

Adding items

It may also be necessary to add items to the database. Lines that can be used to add items for microscopy are :

- line 20 for fluorescence staining;
- line 21 for ZN staining reagent;
- lines 48 and 49 at the bottom of the *VariableData* sheet, for items calculated by functional laboratory rather than by smears done.

The details (name, unit, etc.) for these products need to be specified in the *CountryItems* sheet, from where they will be copied to this sheet.

Calculation of quantities

After the required information has been entered into the *VariableData* sheet, the quantities needed will appear automatically, provided that essential information has also been entered in the *FixedData* sheet. The quantities combine consumption (period specified for consumption plus lead-time period) and reserve stocks. They are expressed as units and also as packing units for clarity and versatility, appearing in the centre of the sheet. The columns to the right are intended to be used at the supplying (i.e. higher) level and when supplies are received, as explained above.

Stocks

The *VariableData* sheet contains a column titled "Quantities ordered and expected to arrive", which is next to a column titled "No. of months consumption in stock + coming". The latter column shows how many months the current stock of that item will allow the laboratory to continue to undertake AFB microscopy for the same values of the parameters (i.e. numbers of slides examined and numbers of functional laboratories), as entered. Low stocks will be flagged by a colour code that can be changed (colour and/or criteria) via the Format menu ("Conditional Formatting"). The default colour settings for number of months remaining are:

- orange, if the quantity left in stock is not sufficient to cover the period of consumption plus lead time specified; or
- red, indicating the need for an emergency supply, if the quantity left in stock has dropped below that required for the usual lead time, even without taking into account the consumption period.

FixedData *sheet*

The *FixedData* sheet needs to be updated only occasionally.

At the top of the sheet are boxes indicating the number of months for which the consumption and reserve stock should be calculated, and the lead time (in months) for procurement (i.e. the time that usually elapses between ordering and availability of supplies).

The left-hand side of the sheet has columns showing:

- the formulation of stains, expressed as grams or millilitres needed per litre of ready-for-use staining solution, following the national guidelines (central column);
- the quantities per packing unit as supplied by the manufacturer (if unknown, this can be left open, in which case only the counting units of this item will be calculated).

When the workbook is first used, these factors will need to be checked and adapted as appropriate; a similar approach will be needed to that given above for items not yet included or specified in the first sheet.

The *FixedData* sheet contains only one line for methylene blue, which may be used as counterstain for both ZN and fluorescence microscopy. Should the concentrations of these solutions differ, then only the highest concentration should be added to the sheet. This will lead to more of the solution being ordered than is absolutely necessary, if the quantities left in stock are subsequently entered when estimating needs.

The right-hand side of the sheet has two boxes for consumption factors that must be estimated.

- The upper box is used to record information on the consumption of ready-for-use staining solutions and other items expressed per smear.
- The lower box contains similar information to the upper box, but covers items for which the consumption is estimated based on number of functional laboratories rather than number of smears, expressing the consumption of these items per laboratory and per year.

The formulas in this sheet are protected, but the sheet is currently not password protected. Countries are encouraged to add a password after adapting this tool to their specific needs and before releasing it for wider use. Adding password protection should prevent formulas being accidentally erased, which is usually followed by attempts at repair that introduce further errors.

ToBeProcured *sheet*

The *ToBeProcured* sheet takes the final calculations from the *VariableData* sheet, and adds the specification, pack size and price from the *CountryItems* sheet. The names must be identical, which will be the case provided that the formulas have been left intact. The *ToBeProcured* sheet also shows the total cost of the order. The user can then enter the amounts to be procured – in the column titled "Number of packing units to order", which is surrounded by a heavy black line – as a rounded number of packing units, and can correct the figures based on past experience, as necessary. The total cost of this final order will appear at the top of this box, which makes it possible to adjust quantities to work within the budget available.

The "Number of packing units to order" column also allows the user to enter a zero amount for unused items or variations. Finally, any items that are not needed (zero, or no value entered) can be left out of the order by using the filter arrow in the "Number of packing units to order" column. Users should choose "Custom" and then specify "is greater than … zero"; this will leave only items to be included in the order. The sheet can then be modified further by hiding columns, to produce a table containing all the elements needed to start procurement. Returning to a view that includes all items simply requires all filters to be reset to "All".

A final document for printing or other manipulations can also be prepared from the *ToBeProcured* sheet, by copying the complete sheet to a new Excel file. To do this, select the whole sheet by placing the cursor in the left-hand upper corner of the sheet, where the line and column numbering meet, right click and select "Copy", then open a new book, move the cursor to the same corner, right click and select "Paste". This manipulation can be done without unprotecting the sheet.

It is also possible to use the sheet in a more flexible way by copying the entire sheet as described above, but then selecting "Paste Special" rather than "Paste", and then pasting only "Values". This will remove the formulas, allowing all usual manipulations, including sorting, without introducing errors.

AFBsuppliesProcurement V02.xls [include hotlink or address where file can be downloaded on obtained]

Annex A2:
CU&DST-Supplies workbook

The Excel workbook *CU&DST-Supplies* is intended for use in quantifying and managing the consumables used in laboratories undertaking tuberculosis (TB) culture and drug-susceptibility testing (DST), and eventually in laboratories undertaking molecular tests.

The *CU&DST-Supplies* workbook contains several sheets for input by users or for output, plus a laboratory-specific database of the items routinely used and a stock ledger for these items. There are also a number of hidden sheets that perform interim calculations and only need to be seen infrequently. Overall, the formulas and links built into this workbook are complicated and should not be disturbed. Although the formulas and links have been protected, it is the responsibility of the head of the laboratory services to complete this protection by giving the hidden sheet a password and keeping that password confidential.

Similarly, a blank master copy of the entire workbook should always be kept in reserve. This original should be copied to a "safe" directory, where it should be saved with an extension indicating the name of the laboratory; for example, *CU&DST-SuppliesDhakaNRL*. This version can be used to customize items and parameters; it should be saved with the same name, to act as a master file for the laboratory. In each new year, laboratories should start by saving a copy of the customized version of the workbook, adding an extension for the year; for example, *CU&DST-SuppliesDhakaNRL2009*. This copy will then be the working file for the particular year.

There are two ways in which estimates for procurement can be made using the workbook; these methods, which are explained below, can be used separately or in combination.

- *Consumption-based method*. This method, which is recommended, involves basing future needs on recorded past consumption. It is simple because it is done automatically by the workbook and requires the user to set only a few parameters. However, this method will only deliver meaningful and accurate estimates if the stock ledger has been maintained regularly and completely.
- *Projected needs-based method*. This method involves basing future needs on the number of tests to be done, the time frame and the number of technicians. It is more difficult than the consumption-based method because it requires the user to specify the consumption of most items per test. However, this method may regularly have to be used alongside the consumption-based estimate; for example, when an increase in numbers is expected because of an upcoming survey. This system of projected needs can also be used to estimate total requirements, and will be the only method available if stock ledgers have not been well kept.

The workbook uses both methods simultaneously where parameters have been specified.

To avoid a double order due to use of the two systems for procurement, the user must specify which method of estimate should be used:

- consumption-based only;
- projected needs-based only;
- both methods in combination, with extra projected needs on top of average past consumption.

Besides choosing which system to use for procurement, the user also needs to customize the *CU&DST-Supplies* workbook in several ways. Customization is required for items routinely consumed, their specifications and prices; consumption factors; stocks at a specific moment; months' consumption to be covered by the order; reserve allowed; and expected lead-time until arrival of the order. The workbook contains a database of items based mainly on the globally recommended lists; users will need to adapt this database extensively. The same is true for consumption factors, stocks left and past consumption in the ledger page.

All values already in the workbook are examples only. It is the responsibility of the user to adapt these values to the actual situation.

Sheets within the workbook

Menu *sheet*

The *Menu* sheet shows the different parts of the workbook, and contains hyperlinks to the sheets intended to be used regularly. Users can click on the boxes containing text in red to open the appropriate sheet. The other sheets in the workbook all contain the command "Return to menu" in the upper right-hand corner of the screen. Users can click on this link to return to the *Menu* sheet.

ItemsDatabase *sheet*

The *ItemsDatabase* sheet lists small materials and supplies considered to represent consumables; only those that need to be procured (i.e. that are not produced or bought locally) should be included. The list is divided into different parts, from top to bottom of the screen, by area of work or type of supply. The uppermost part, which is surrounded by a heavy red border, should not be changed because it contains complex links to calculations of chemicals required for various tests. The packing units and prices can be changed to reflect local variation, but no other items in this box should be changed unless the password protection is first disabled (an approach that is strongly discouraged).

Any lines that are not needed can be hidden, both in this sheet and in the sheets that depend on the *ItemsDatabase* sheet – hiding lines that are not required is much safer than deleting them. To hide a line, select it; right click on the mouse and select "Hide"; to unhide a line, select the line, right click on the mouse and select "Unhide". For some culture media, the sheet shows both the composite-medium base powder and the different chemical components. The various chemicals that may be needed for different decontamination and identification methods are also listed. Again, any options that are not used in a particular laboratory should be hidden in both this sheet and dependent sheets.

The part of the *ItemsDatabase* sheet directly below the section bordered in red contains all the remaining items; these can be changed as necessary to suit individual needs. However, the user should hide unnecessary items, or replace their names, specifications, prices and so on, rather than deleting lines. This approach is recommended because names are copied to other sheets (stock ledger, projected needs and so on), where they may be linked to factors for calculation that apply only to the particular item. It is best to add new items on the first empty line at the bottom of the sheet, because this line contains preset links to the other sheets. It is also possible to insert lines for new items by copying formulas downwards in all sheets; if this is done, the user must ensure that the inserted lines are placed identically (i.e. in-between the same lines) in all sheets, and that the formulas are copied downwards in the same way.

Never attempt to sort the *ItemsDatabase* sheet because this will corrupt the calculations in some other sheets.

The filter arrows that are given in the heading of many of the columns can be used to locate particular items quickly. Clicking on an arrow produces an alphabetically sorted list in a small window. Typing a character makes the cursor jump to the first item of the list starting with that character. Clicking to select an item causes only that item to be shown, with all others remaining hidden; the filter arrow is now displayed in blue to show that only a selection of the items in the column is being displayed. To revert to the complete database, the user clicks on the filter arrow and selects "All" at the top of the list (or types "A"). If more than one filter is preset for a particular sheet (i.e. more than one column has a filter arrow), it may be necessary to select "All" for other columns in order to see the complete database.

StockLedger *sheet*

In the *StockLedger* sheet, names of the items and units for counting (given in columns A and B) are filled automatically from the *ItemsDatabas*e sheet. The columns to the right should be updated quarterly.

- At the start of a new year, users enter the total consumption for the previous year and the stock in hand. For items that are consumed only infrequently (e.g. some glassware), it may be better to use an average consumption over several previous years.
- Each quarter, users enter the amounts added to the stock, losses (i.e. items not consumed but stolen or expired) and the stock situation at the end of the quarter, using the columns inside the red border. The units for counting preset in the sheet must be respected. Consumption is calculated from these data rather than from current stock. Thus, actual quantities in stock must be obtained by physically counting items in the store each quarter; in the long run, this is far more accurate than obtaining the numbers by addition and subtraction.

Once the data listed above have been entered, consumption during the quarter appears in the database. The months' consumption left in stock also appears; this shows how many months the current stock of a particular item will last, using an average consumption over the previous 12 months. Low stocks will be flagged by a colour code that can be changed (colour and/or criteria) via the Format menu ("Conditional Formatting"). The default colour settings for number of months left are:

- orange, if the quantity left in stock is not sufficient to cover the period of consumption plus lead time specified; or
- red, indicating the need for an emergency supply, if the quantity left in stock has dropped below that required for the usual lead time, even without taking into account the consumption period.

The consumption calculation in this sheet is based on averages of past consumption, always taking into account the previous 12 months, according to the state of completion of the ledger. The most recently filled stock positions are taken into account in the needs calculations.

As for the *ItemsDatabas*e sheet, the *StockLedger* sheet contains many items, many of which may not be needed and should therefore be hidden. If users wish to delete unused items, they should do so only in the *ItemsDatabas*e sheet, which is the master for all sheets.

For some chemicals that are rarely used and for the TB drugs needed for preparation of DST media, the system described above may not be practical. For example, it is not easy to determine the amounts left in stock if there is only one container or vial in use that will last for more than one year.

- For drug powders, it may be preferable to have a system whereby the items are replaced every two years, and supplies of those items are ordered for two years at a time, without updating their stock position in the way described above.
- For chemicals that are consumed at a rate of less than one packing unit per year, it may be preferable to count only complete, unopened packing units when determining the stock position, ensuring that at least one unit is always kept in stock. Alternatively, the weight of the container can be determined at receipt (i.e. weight of container plus contents, minus contents weight as indicated on the label), and noted on the stock card or ledger. When an inventory is taken, the containers in use would then be weighed with their contents, and the container weight subtracted, to determine the weight of the material remaining in the container; this weight would then be entered in the supplies workbook.

ParameterEntry *sheet*

The upper part of the *ParameterEntry* sheet should always be used to indicate whether the estimated needs should be based on:

- previous consumption (preferable, provided the ledger has been well maintained)
- projected needs
- both previous consumption and projected needs (in situations where additional needs, above usual consumption, are expected).

The selection is made by simply selecting the method of choice in the appropriate box in the upper part of the sheet. Selecting the method correctly avoids situations in which needs are erroneously estimated in duplicate.

The upper part of the *ParameterEntry* sheet should also be used to specify:

- the months' consumption targeted by the order
- the reserve allowed
- the expected lead-time for procurement (based on previous experience, but often more than 12 months).

The lower part of the *ParameterEntry* sheet may not need to be filled out if the estimation of needs is based on previous consumption. However, if the estimation is based on additional needs, the main details of techniques need to be specified:

- culture media used and their volumes, for culture, DST, identification and preservation of strains;
- decontaminant and neutralization buffer used and their volumes, for decontamination of specimens.

The expected numbers of these tests also need to be specified. In situations where this calculation complements consumption-based calculation, the numbers entered should only be quantities above or below those used in the previous year (note: to indicate quantities below those of the previous year, use a minus sign before the number).

NeedsProjected(Extra) *sheet*

The values in the *NeedsProjected(Extra)* sheet only need to be entered in cases where needs are estimated based on previous consumption. Values for culture media and other chemicals do not need to be specified because they are predefined in the *Chemicals_for_MediaDecontIdent* sheet. However, consumption of other items – tubes, pipettes, gloves – varies between laboratories, and needs to be set once, based on standard operating procedures. The list of items and their counting or calculation units, copied automatically from the *ItemsDatabase* sheet, appears in the first two columns. In the columns to the right, users enter values for consumption per test (various types of tests are specified on top), per month or per technician working with a test. Calculations are performed automatically in the hidden part of the sheet.

NeedsConsumptionBased *sheet*

The *NeedsConsumptionBased* sheet is a hidden sheet that contains calculations of expected needs based on past consumption, as shown in the stock ledger. The user is not required to give any input here, and the sheet should remain hidden.

Chemicals_for_MediaDecontIdent *sheet*

The *Chemicals_for_MediaDecontIdent* sheet is another hidden sheet that contains calculations of expected needs for chemicals used for preparation of media, decontamination, and the main biochemical identification tests – paranitrobenzoic acid , thiophene-2-carboxylic acid hydrazide, niacin, catalase and nitratase. The total volumes of media and reagents needed are taken from the parameters specified in the *ParameterEntry* sheet. Values for each chemical are summed automatically to yield a single quantity, even though a chemical may be used in more than one medium or technique.

For most media, two calculations will be made – one applicable to use of a composite-medium base powder and one providing the amounts of the different chemical components – and both options will appear. Also, the various products possibly needed for different decontamination and identification methods will appear. Where this sheet contains information on items that are not used, the best approach is to hide the lines for the unused options in the output sheets.

The user is not required to give any input here, and the sheet should remain hidden.

CombinedEstimates&Stock *sheet*

The *CombinedEstimates&Stock* sheet combines two methods of needs calculation and the most recent stock position entered in the *StockLedger* sheet. The two columns on the left “Item in consumption calculation sheet” and “Estimated needs based on consumption” are again copied from the *ItemsDatabase* sheet, but the estimated needs and stock are obtained automatically from other sheets in the workbook through a “lookup” function. The automated function works even if items are not on the same line or in the same sequence, but it requires the names to be written in exactly the same way in different sheets. This causes a problem only in situations where the sheets have been changed by the user. If the automated function cannot find an item, or if the name is written differently, the text “N/A” will appear instead of the expected number.

The *CombinedEstimates&Stock* sheet also contains columns bordered in red, which may need to be completed by the user; they are:

- a column for quantities left in stock – this should only be completed in situations where the *StockLedger* sheet is not up to date (or is not used);
- a column in which to enter quantities that have been ordered, are expected to come but have not yet arrived.

The amounts calculated as needing to be procured appear on the right (an automated function having subtracted the stock left and quantities ordered and expected to arrive). The amounts calculated based on previous consumption, or those based on projected work, or both, may be used automatically, depending on what was specified as the basis for calculation in the *ParameterEntry* sheet.

ToBeProcured *sheet*

The *ToBeProcured* sheet takes the final calculations from the *CombinedEstimates&Stock* sheet and adds the specification, pack size and price by looking these up in the database (again, the names have to be exactly the same in each place; this will not cause a problem provided that the formulas have been left intact). This sheet also shows the total cost of the order. The user can then enter the amounts to be procured in the column bordered in red (titled "Number of packing units to order"), giving the amounts as a rounded number of packing units, and perhaps adjusting the values based on past experience. The total cost of this final order will also appear at the top of the sheet; this allows users to work within the budget available by modifying quantities, as necessary.

The red-bordered column also makes it possible for users to set unused items or variations (e.g. media components versus complete-base powders) to zero. Finally, the items that are not needed (zero, or no value entered) can be omitted using the filter arrow in the red-bordered column. Choosing "Custom" and then specifying "is greater than … zero" will leave only items to be included in the order. Users can further modify the sheet by hiding columns, to produce a table containing all the elements needed to start procurement.

Returning to a view that includes all items simply requires all filters to be reset to "All".

A final document for printing or other manipulations can also be prepared from the *ToBeProcured* sheet, by copying the complete sheet to a new Excel file. To do this, select the whole sheet by placing the cursor in the left-hand upper corner of the sheet, where the line and column numbering meet, right click and select "Copy", then open a new book, move the cursor to the same corner, right click and select "Paste". This manipulation can be done without unprotecting the sheet.

It is also possible to use the sheet in a more flexible way by copying the entire sheet as described above, but then selecting "Paste Special" rather than "Paste", and then pasting only "Values". This will remove the formulas, allowing all usual manipulations, including sorting, without introducing errors.

CU&DSTsupplies.xls [include hotlink or address where file can be downloaded on obtained]

Annex A3:

Examples of inventory control forms

Stock or bin card

Stock (or bin) cards keep track of stock movements within a store or health facility. A stock card is the basic record needed to establish accurate quantities of individual items to reorder. A separate stock card is needed for each inventory item.

Basic components of a stock card

A stock card should contain the following components.

- *Full name and chemical formula*. Enter the full name (for all items) and the chemical formula (as appropriate) for the commodity; for example:
  - Unigold HIV rapid test kit
  - potassium iodide [KI]
  - sulfuric acid [H_2SO_4].
- *Unit*. Provide the distribution unit of measure. Determine in what unit the item will be distributed (e.g. by packs of 100 tests or by base units, such as grams or litres). When supplies arrive and are not in predetermined units of measure, employees in the storeroom can become confused when attempting to fill out stock cards.
- *Item code*. Record the unique identification code used by the health system. This code is normally found in the catalogue of the medical stores.
- *Expiry date*. Find the expiry date printed on the container. This date is determined by the manufacturing company. When the item passes this date, the manufacturer does not guarantee the potency, purity or safety of the product.
- *Minimum stock level*. Determine and record the minimum stock level. When stocks are depleted to the minimum stock level, the item must be reordered.
- *Maximum stock level*. The maximum stock level is the total quantity necessary to meet the needs of the health facility for a specific period.

How to use the stock card

1. Enter the opening balance and the date the stock is checked.
2. *Receiving stock*. Enter the date stock is received, the quantity received according to the issue unit, and the stock balance (in this case, the stock balance will equal the previous balance plus the quantity received).
3. *Issuing stock*. Enter the date stock is issued, the quantity issued according to the issue unit, and the stock balance (in this case, the stock balance will equal the previous balance minus the quantity issued).
4. *Tracking loans*. Enter the date stock is borrowed and the location the goods are loaned to or borrowed from. Enter the quantity issued or received according to the issue unit, and record the stock balance (in this case, the stock balance will equal the previous balance minus the quantity loaned or plus the quantity borrowed).

Figures AA3.1 and AA3.2 show the format of a typical stock card and an example of a stock card for a laboratory storeroom.

Figure AA3.1 Typical stock card

Name and strength		Unit		Item code		Expiration date			
Average monthly consumption				Minimum level			Maximum level		
RECEIPTS				DISBURSEMENTS			STOCK		
Date	Document number	Quantity	Location	Document number	Quantity	Destination	Quantity	Unit value	Total value

Figure AA3.2 Typical stock card - example for laboratory storeroom

Name and strength		Unit		Item code		Expiration date			
Glass slides		Box (100 slides)		P500		None			
Average monthly consumption				Minimum level			Maximum level		
				50			150		
RECEIPTS				DISBURSEMENTS			STOCK		
Date	Document number	Quantity	Location	Document number	Quantity	Destination	Quantity	Unit value	Total value
1 Jan	Inventory						50		
15 Jan				Req #1	5	Lab	45		
18 Feb				Req #3	20	Lab	25		
22 Mar				Req #10	5	Lab	20		
6 Apr				Req #43	8	Lab	12		
10 May	LI-3	100	Lab store				112		
15 May				Req #50	25	Lab	87		
20 Jun				Req #53	30	Lab	57		
30 Jun				Req #59	25	Lab	32		
1 Jul				Req #62	15	Lab	17		
3 Aug				Req #70	17	Lab	0		
Sep							0		
Oct							0		
4 Nov	SU-15	200	Lab store				200		
6 Nov				Req #72	30	Lab	170		
8 Nov				Req #78	40	Lab	130		
31 Dec	Inventory						130		

Using the stock card to calculate average monthly consumption

Average monthly consumption (C_A), adjusted for stock-outs (due to damage, expiry or problems with delivery), is a measure of how much stock is used in an average month over a specific period. This information is critical for those responsible for calculating quantities to be procured or to be supplied by stores to an individual laboratory.

Average monthly consumption can be calculated using the sum of quantities used or distributed over a period of time, normally 12 months.

Average monthly consumption, adjusted for stock-outs **(C_A), is defined as the average number of units used per month.**

The formula for calculating C_A is:

$$C_A = C_T \div [R_M - (D_{OS} \div 30.5)]$$

where:

C_T = total consumption during the review period

R_M = total consumption review period, in months

D_{OS} = number of days an item was out of stock during the review period

30.5 = average number of days in a month.

Example

Using the stock card for glass slides shown in Figure AA3.2, it is possible to obtain two pieces of information that will assist in calculating the average monthly consumption over 12 months.

- The total consumption over 12 months is obtained by summing all the disbursements made between 1 January and 31 December of the year covered by the stock card. The total consumption was 220 boxes of glass slides.
- The number of days out of stock can be obtained by looking at the STOCK column. This shows that, from 3 August to 4 November, there were no boxes of slides in stock. Therefore, the number of days the item was out of stock was 92 days.

These values can be entered into the above equation to calculate C_A, as follows:

$C_A = C_T \div [R_M - (D_{OS} \div 30.5)]$

$C_A = 220 \div [12 - (92 \div 30.5)]$

$C_A = 220 \div [12 - 3.02]$

$C_A = 220 \div 8.98$

$C_A = 24.5$ boxes.

Note: failing to take into account the number of days out of stock would give a lower (and inaccurate) result of 220 ÷ 12 = 18.3. This would subsequently affect all other calculations and result in inaccurate quantification of needs for the laboratory.

Minimum safety stock

Safety stock is necessary to protect the storeroom from stock-outs; it also provides a safety net for variation within the procurement system. There is no single formula for calculating the safety stock level; however, this number is usually calculated from C_A. For example, if stock is normally distributed every month and the laboratory wishes to have sufficient safety stock for two months to account for slower than normal delivery, safety stock would be calculated as follows:

Safety stock = $2 \times C_A$

= 2 months extra for distribution × the number of units per month.

In the case of the glass slides, the safety stock required is:

$2 \times 24.5 = 49$ boxes.

When stocks are depleted to this level, the item must be reordered.

To avoid stock-outs, the stock should not be allowed to go below the amount needed to cover two months. The approaches and strategies used to maintain adequate inventory levels should be reviewed. In the calculations presented above, the average inventory level can be lowered by reducing either the safety stock or the order quantity. However, if the order quantity is reduced, the item will need to be ordered more frequently to prevent stock-outs. This results in a reduced average inventory. More frequent ordering makes it easier to adapt to changes in demand and means that a lower level of safety stock is required. This reduction in the safety stock further reduces the average inventory. A shortened order interval increases some costs related to procurement, including:

- administrative costs – there will be a greater workload in the ordering process;
- shipping and transportation costs – more deliveries will be needed;
- unit costs – the cost per unit may be higher when purchasing smaller quantities.

In summary, shortening the order interval can reduce the average inventory level and thereby reduce the costs of holding inventory. However, procurement costs may increase.

Inventory control form

The inventory control form is a form that allows the store or the individual laboratory to summarize the quantities and value of stock on hand. It also makes it possible to record discrepancies between the amount of stock that is actually on hand and the amount that should be on hand. An example of such a form is shown in Figure AA3.3.

Stock may become unavailable due to stock-outs, deterioration, expiry, breakage or theft. Losses due to deterioration, expiry, breakage or theft often constitute a large part of the budget, so all means to reduce such losses should be taken. The quantification process can correct for, or at least minimize, stock-outs and losses due to over-stocking, but it cannot correct for the other factors.

Used in conjunction with the list of expired laboratory supplies, the inventory control form is a critical record because it identifies stock losses that may have occurred at the storeroom level.

Another method for checking for stock losses within the laboratory is to compare the amount of stock ordered for the laboratory against the test register. It can be difficult to check everything; therefore, it is best to select a few key high-value or problematic items, and monitor these regularly. Losses above those expected due to calibration of equipment or breakage may indicate some other cause of loss, which should be investigated.

Loss from any cause should be minimized to make the laboratory more efficient. Money saved by minimizing stock losses can be used for improving or expanding services at no extra cost to the facility.

Using the inventory control form

This exercise should be performed at least once per quarter.

- Using the information on the laboratory's stock cards, enter the details for each product and the current balance.
- Assign a member of staff to make a physical count of each of the items that have been listed on the inventory control form.
- Enter the physical count in the appropriate column and compare with the quantities on the stock card.
- Record the discrepancies in the appropriate column.

In the example of a completed inventory control form (Figure AA3.4), there are discrepancies between the balance on the stock card and the physical count for five items. Possible reasons for such discrepancies could be that:

- the stock cards have not been accurately maintained;
- the physical stock count was inaccurate; or
- stock has been stolen from the storeroom.

This should be further investigated and corrective action taken.

Figure AA3.3 Inventory control: quarterly stock-taking form

Page no: _____

Name of store or laboratory _____ Date completed: ____/____/____

Code no.	Product name	Stock unit	Quantity on stock card	Physical count	Unit price	Total price (physical count × unit price)	Discrepancy (stock card minus physical count)	Expiration date

Prepared by: _____

Function or category: _____

Confirmed by: _____

Function or category: _____

Figure AA3.4 Example of completed inventory control form

Name of store or laboratory _____ Date completed: ____/____/____

Code no.	Product name	Stock unit	Quantity on stock card	Physical count	Unit price (USD)	Total price (physical count × unit price)	Discrepancy (stock card minus physical count)	Expiration date
P500	Glass slides	Box (500 slides)	130	130	8.00	1040.00	-	
P511	Sputum collection containers	Carton (1000)	72	56	70.00	3920.00	16	
R26	Basic fuchsin powder	100 g	8	8	35.00	280.00	-	
R28	Auramine O powder	50 g	7	7	20.00	140.00	-	
R27	Methylene blue powder	100 g	11	10	60.00	600.00	1	
R43	Immersion oil	100 ml	14	14	20.00	280.00	-	
P482	Nichrome wire	Roll (10 metres)	5	5	8.00	40.00	-	
A28	Disposable gloves	Box (100)	32	25	10.00	250.00	7	
T22	Microscope bulb	1	12	8	25.00	200.00	4	
R18	Lysol disinfectant	Bottle (5 litres)	43	43	7.00	301.00	-	
T23	Spare eyepiece for microscope	1	6	2	200.00	400.00	4	
					TOTAL	7451.00		

Prepared by: _____

Function or category: _____

Confirmed by: _____

Function or category: _____

List of expired laboratory supplies

A typical form for listing expired laboratory supplies is shown in Figure AA3.5. The list can be used to reveal two common problems.

- The expired items may have been over-stocked.
- Goods may have been received that have a shelf-life that is shorter than the reorder period.

The first of these problems can be overcome by more accurate quantification. The second suggests either that orders should be placed more frequently, or that items with unduly short expiry dates should not be accepted, or both.

A second use for the list of expired laboratory supplies is to find evidence of theft. To do this, users should compare the list of expired laboratory supplies with the inventory control form, subtracting the amount of expired stock from any discrepancy and allowing for normal wastage. The result can point to the possibility of theft. This information can then be used as the basis for investigating and taking necessary action to prevent such theft from happening again.

A third use for the list of expired laboratory supplies can be to record expired, damaged or deteriorated stock that has been destroyed. In all cases, stock that has been returned or destroyed or is otherwise unusable should be deducted from the stock on hand in the stock records – it does not constitute part of the regular use of that item.

The data gathered in this list provide an indicator and can be used periodically to help manage the laboratory's work. The results can be sent to the procurement team with the consumption data.

An example of a completed list of expired laboratory supplies is given in Figure AA3.6.

Figure AA3.5 List of expired laboratory supplies

Stock number	Product description	Expiry date	Quantity	Unit price	Total price
			TOTAL:		

Date completed: _____

Figure AA3.6 Example of completed list of expired laboratory supplies

Stock number	Product description	Expiry date	Quantity	Unit price	Total price
R27	Methylene blue powder, 100 g	May 2005	1	60.00	60.00
R28	Auramine O powder, 50 g	June 2009	3	20.00	60.00
			TOTAL: USD 120.00		

Date completed: _____

Annex A4:

Additional resources

This section lists resources that provide further, more detailed information on laboratory commodity and equipment management.

- Management Sciences for Health and World Health Organization. *Managing drug supply*, 2nd ed. West Hartford, CT, Kumarian Press, 1997.
- Rational Pharmaceutical Management Plus Program. *Managing pharmaceuticals and commodities for tuberculosis: a guide for national tuberculosis programs* (submitted to the United States Agency for International Development by the Rational Pharmaceutical Plus Program). Arlington, VA, Management Sciences for Health, 2005.
- Zagorskiy A, Owunna C, Moore T. *Pharmaceutical management for tuberculosis assessment manual*: revised edition of *Drug management for tuberculosis assessment manual* (submitted to the United StatesAgency for International Development by the Rational Pharmaceutical Plus Program). Arlington, VA, Management Sciences for Health, 2004.
- Walkowiak H, Gabra M. *A commodity management planning guide for the scale-up of HIV counseling and testing services* (submitted to the United StatesAgency for International Development by the Rational Pharmaceutical Plus Program). Arlington, VA, Management Sciences for Health, 2008.
- WHO *Consultation on technical and operational recommendations for clinical laboratory testing harmonization and standardization*, 22–24 January 2008, Maputo, Mozambique.
- International Union Against Tuberculosis and Lung Disease (IUATLD). *Technical guide: sputum examination for tuberculosis by direct microscopy in low income countries*, 5th ed. France, IUATLD, 2000.
- *Report – Meeting on procurement of laboratory items*, WHO/HQ, Geneva, 27–28 October 2008. Geneva, World Health Organization, 2008 (http://www.who.int/diagnostics_laboratory/report_lab_procurement_oct08.pdf).
- WHO Prequalification of Diagnostics Programme (http://www.who.int/diagnostics_laboratory/evaluations/en/).
- Mundy C, Kahenya G, Vrakking H. *The design and in-country evaluation of TB diagnostic kits, 2004–2006* (submitted to the Global TB Drug Facility and the United States Agency for International Development by the Rational Pharmaceutical Management Plus Program). Arlington, VA, Management Sciences for Health, 2006 (http://www.stoptb.org/gdf/assets/documents/design_evalution_diagnostic_kits_GDF_2007.pdf).
- *Use of liquid TB culture and drug susceptibility testing (DST) in low and medium income settings*. Summary report of the Expert Group Meeting on the use of liquid culture media, WHO Stop TB Department, Geneva, 26 March 2007.

Part B
Specifications for TB laboratory equipment, supplies and other commodities

Chapter B1:

Introduction to specifications

The purpose of this part of the document is mainly to provide technical guidance for commodities used for diagnostic purposes in a tuberculosis (TB) laboratory. The document covers all commodities – that is, equipment and supplies such as laboratory reagents, diagnostic kits and other consumables – for all TB-laboratory activities, including microscopy, molecular tests, culture and drug susceptibility testing (DST). However, it does not cover commodities for research laboratories.

Part B of this document has further information relating to the selection of laboratory equipment and commodities for a country. It provides lists of equipment, consumables and chemicals needed for the different laboratory activities. It also has detailed specifications for selected items.

Countries can use the lists in Part B to:

- prepare a standard list of equipment and commodities that meets local needs
- select the items needed for the country at each level of health care
- select items for procurement or donations.

Chapter B2 provides lists of commodities needed for the different laboratory activities. Chapters B3–B5 cover the requirements for culture, DST and molecular biology in TB laboratories. Specifically, they provide the main specifications for equipment (Chapter B3), consumables (Chapter B4) and chemicals (Chapter B5). Chapter B6 provides detailed specifications for items used in molecular biology techniques.

B1.1 Layout of lists

The lists in Chapter B2 contain four columns, which provide the following information:

- the item number (column 1)
- the descriptions and specifications for the item; that is, the quality requirements (column 2)
- the number of items required (column 3)
- whether or not a detailed specification is available (column 4).

The item numbers in column 1 are sometimes followed by a letter – this denotes accessories for the item. For example, item 2 in the list in Section B2.1 is a Bunsen burner, and item 2a is gas safety tubing for use with the burner.

Alternatives to some items are also indicated in blue. Countries need to adjust and select alternative items as necessary, to fit local needs. Only certain items from the list will be required. The actual items needed and the quantities required will depend on the methods used, the workload and the design of the laboratory. Quantities indicated in this document are based on experience, and are suited for a national reference laboratory (NRL) performing about 12 000 cultures and about 1000 first-line DST (FL-DST) and 100 second-line DST (SL-DST); these quantities should serve as an estimate. For some consumables and chemicals, a fractionated delivery has to be included in the tender description, to take into account the shelf-life. Special delivery conditions (e.g. cool chain) must also be indicated in the tender documents.

B1.2 Layout of detailed specifications

For the detailed specifications (Chapter B6), a format is used that can be adjusted, as necessary, to fit the needs of the country. The first column provides the specifications to be met in the tender; the second column provides space for the bidder to enter the specifications of the item offered. If required, a narrow third column can be added to record whether the item offered by the bidder meets the specifications, exceeds the specifications, or fails to meet the specifications but is still acceptable.

The purchaser indicates the number or quantity of items required, while the bidder provides information about the manufacturer, type or model (or both), and country of origin.

The section "Description of function and use" will include information about the equipment's purpose and the laboratory area for which the equipment is intended. If necessary, this section will also contain comments on possible extension for additional use. Countries should adapt this paragraph to their specific use of the equipment.

The main specifications contain all relevant technical data, including material to be used for manufacturing, acceptable noise levels, safety features, indicators desired to control correct functions, programs and so on.

Electrical requirements should be adjusted to suit local needs for voltage, phase and so on, and the type of electrical plug system commonly used in the country.

B1.3 Manufacturer's certificate

In general, countries or laboratories procuring equipment should consider only manufacturers who produce their equipment under a strict quality management system (e.g. ISO 9001 or better) . The main norms applying to medical devices – especially for electrical engineering – must be listed in the specifications. Country-specific norms should also be included.

B1.4 Additional headings

The other headings in the form are self-explanatory and may be summarized in the tender documents. They cover accessories, the operation and maintenance manual, installation and maintenance, standard maintenance tools, spare parts, packing data and customer's tariff number, warranty and any other relevant remarks.

The form gathers information beyond the specific technical specifications of each item. Depending on its purpose, the form can be simplified. For example, if a tender document is prepared for purchase of several different devices, most of the more general requests (e.g. certificates to be provided, installation and maintenance, after-sales service, operation and maintenance manuals, standard maintenance tools, warranty) will be included as separate paragraphs in the general tender document. For some organizations or nongovernmental organizations (NGOs) who buy and ship the equipment themselves, it will be helpful and more efficient for the information on "Packing data and the customer's tariff number" to be available with each of the goods; these documents are needed for customs declaration and clearance.

B1.5 Adjustment to local needs

Specifications may vary according to the purpose of use. For example, where equipment will be

used in the laboratory for both TB services and other investigations (e.g. use of a microscope to check blood films for diagnosis of malaria or other parasites), the specifications will need to be adjusted accordingly.

In many countries, appropriate equipment will depend on the environment and infrastructure; factors that should be considered include:

- climate (e.g. temperature, humidity, rainy seasons, thunderstorms);
- likelihood of earthquakes;
- whether the laboratory is easy to access (e.g. road conditions);
- available infrastructure (e.g. clean water supply under sufficient pressure, electricity of constant voltage and gas supply).

Environment and infrastructure conditions should be described in detail in the technical specifications for the equipment to be purchased. Any additional equipment that will be required for the laboratory equipment to function (e.g. air conditioning, water pump or uninterrupted power supply [UPS]) must be included in the tender documents.

Annex B1 describes factors that should be considered when evaluating the quality of the laboratory's electrical supply. Annexes B2 and B3 describe requirements for selecting, installing and maintaining a biological safety cabinet (BSC); BSCs are critical for personnel safety in laboratories handling cultures of *Mycobacterium tuberculosis*.

Chapter B2:

Equipment, consumables and chemicals for microscopy laboratories

Table B2.1 lists standard equipment required for one peripheral or microscopy laboratory, serving a population of 100 000 people. Items 1–28 apply to all laboratories; items 29–54 are additional equipment for microscopy laboratories preparing or procuring staining solutions for microscopy. Detailed specifications, where available, are given in Section B6.

Quantities should be adjusted to suit specific situations, such as the size of the laboratory, the workload and the external quality assurance policy.

Table B2.1 Equipment for microscopy laboratories

Item	Description and specifications	No. items	Detailed specifications
1	**Binocular light microscope**	1-3	Yes
1a	**Binocular fluorescence microscope**	1	Yes
2	**Bunsen burner** Burner able to use natural gas, propane or butane gas, with a needle valve to regulate gas-air mix; adjustable to economizer (mini) flame; gas hose connection; safety tubing with 9.5 mm inner diameter; safe stand.	2	
2a	**Gas safety tubing** Tubing (length 0.5-1.5 m) appropriate for the type of gas to be used and for safe connection to the gas hose connection; two hose clips for each tube.	2	
2b	**Gas safety tubing** 5 m roll.	1	
2c	**Butane gas cylinder** Cylinder sizes selected according to the size of the available storage containers. Cylinders stored according to national rules; cylinders larger than 500 ml stored in a well-ventilated locked box, connected to the laboratory by a metal pipe. Inside the laboratory, flexible connections as short as possible.	2	
2d	**Pressure reducer** If gas cylinders are used, pressure reducers are needed with appropriate tube fittings and stopcock (one stopcock is required per laboratory with five spare stopcocks kept in stock).	2	
3	Alternative to item 2: **Spirit lamp (stainless steel)** Provide an alternative to Bunsen burners if gas is not available. Lamps made of stainless steel; volume approximately 85 ml; dimensions approximately 100 mm (diameter) and 65 mm (height); with a wick (cotton wool or metal wire), a method of wick adjustment and a cap.	2	
3a	Alternative to item 3: **Spirit lamp (soda-lime glass)** Provide an alternative if stainless steel spirit lamps are not available. Lamps made of soda-lime glass (composition 72-74% SiO_2, 1-1.9% Al_2O_3, 0.09-0.1% Fe_2O_3); volume approximately 100 ml; dimensions approximately 75 mm (diameter) and 100 mm (height); with a wick (cotton wool or metal wire) and a seat-grinded cap.	2	
4	**Loop holder** Loop holders with an upper part made of aluminium or stainless steel and handle made of plastic (240 mm long).	3	
5	**Rack for loop holders** Disinfectable racks able to hold 3-4 loop holders, with a proper stand.	1	

Table B2.1 *continued*

6	**Loop** Closed loops of 3–4 mm diameter, made of nickel-chromium alloy wire 0.8–1 mm in diameter and heat resistant to 1200 °C.	4
7	**Staining rack** Constructed in the laboratory from glass rods and rubber or silicon tubes, or from wire (preferably stainless steel) of appropriate size. Racks to have a bowl (made of glass or stainless steel) to collect staining solutions.	1–2
8	**Slide drying rack** Constructed in the laboratory from metal or granite (not wood); if bought, to be of metal or heat-stable plastic (stable at ≥120 °C). Racks to have 20–30 positions and a slight incline so that slides are easy to remove.	1
9	**Slide storage box** Boxes able to hold 100 slides (slides 76 mm × 26 mm), with a sturdy lock, a cork-lined base and a flap cover with an index-card holder.	4
10	**Scissors** Stainless steel (18/8), polished; one blade sharp, one blade blunt; 160 mm long; autoclavable.	1
11	**Anatomical forceps** Stainless steel (18/8); antimagnetic; rounded; 160 mm long.	1
12	**Pressure cooker** Staff to purchase the largest size available from local suppliers.	1
13	**Timer** Features to include spring-driven motor, 0–60-minute timer and a disinfectable plastic housing. Timers to have a sound (e.g. buzzer or bell) to signal time elapsed, a stand and a clip to attach them to laboratory gowns.	1
14	**Laboratory gown** Cotton, long sleeved and white; available in a selection of sizes appropriate for local staff.	1 per person
15	**Pen** Blue or black ballpoint pens.	2
16	**Pen** Red ballpoint pens.	1
17	**Marker pens** Fast-drying, black, thick-line (0.8–1 mm) marker pens that can write on most surfaces (even when the surface is cold and wet); ink resistant to water, alcohol and autoclaving.	2
18	Alternative to item 17: **Self-adhesive labels** Labels in rolls or sheets (e.g. 50 mm × 19 mm labels, 24 per sheet and 200 sheets per box = 4800 labels); strong adhesive.	1 box
19	**Reagent bottle** Bottles of 1 litre; made of amber borosilicate glass; GL45 thread and cap; compliant with ISO 4746 (*Oxygen-free copper – scale adhesion test*).	4
20	**Staining bottle** Polyethylene flasks with a narrow neck; with a screw cap, swan neck or jet dispenser; volume required (250 ml or 500 ml) will depend on the number of slides stained per day.	3
21	**Beaker** 1 litre plastic polypropylene (PP); with handles.	1
22	**Funnel** Made of soda-lime glass or PP; upper diameter of approximately 100 mm.	3
23	Alternative to item 22: **Stainless steel funnel** Upper diameter of approximately 100 mm; with a handgrip and an air drain.	3

Table B2.1 *continued*

24	**Sea sand** 1 kg, washed (for cleaning loops).	1	
25	**Container** Thick walled; made of glass; screw cap and wide neck (to hold sand and alcohol for cleaning loops).	1	
26	**Drop bottle** Made of soda-lime glass; complete with exchangeable norm-grinded pipette and rubber suction device; volume 100 ml.	1	
27	**Oil dropper bottle** 10 ml; made of low-density polyethylene (LDPE); with a sealed stopper fixed to a screw cap.	1	
28	**Metal rod** 30 cm long; used to heat slides on staining racks.	52	
Additional equipment for microscopy laboratories preparing or procuring staining solutions for microscopy			
29	**Water distiller**	1	Yes
30	**Balloon** 30 litres; made of high-density polyethylene (HDPE); with stopcock (to store distilled water).	1	
31	**Analytical balance, with set of weights**	1	Yes
32	**Magnetic stirrer with heating plate**	1	Yes
33	**Stirring rod** Magnetic; cylindrical; coated with polytetrafluorethylene; at least 10 mm wide and 60 mm long.	3	
34	**Jerry can for stain storage** 20–30 litres; made of HDPE; with spout and ventilation cap.	6	
35	**Jerry can for stain supply** 3–5 litres; made of HDPE; double leak-proof cap.	3	
36	**Stain stock bottle** 1 litre; made of HDPE (opaque or coloured); double leak-proof cap.	As needed	
37	**Plastic bottle**	3	
38	**Transport container** Used if specimens are to be sent to another laboratory; must meet P650 packaging requirements (*Guide to the Packaging & Transportation of Biological Specimens by Road*, available from http://www.izvg.co.uk/regulations.pdf).	As needed	
39	**3 litre conical flask (Erlenmeyer)** Made of borosilicate glass 3.3; thick walls and narrow mouth; graduated.	6	
40	**1 litre conical flask (Erlenmeyer)** Made of borosilicate glass 3.3; thick walls and narrow mouth; graduated.	3	
41	**1 litre measuring cylinder** Made of borosilicate glass 3.3 class A; autoclavable; 0.5 ml graduated.	10	
42	**500 ml measuring cylinder** Made of borosilicate glass 3.3 class A; autoclavable; 2.5 ml graduated.	10	
43	**250 ml measuring cylinder** Made of borosilicate glass 3.3 class A; autoclavable; 1.0 ml graduated.	10	
44	**100 ml measuring cylinder** Made of borosilicate glass 3.3 class A; autoclavable; 1.0 ml graduated.	10	
45	**50 ml measuring cylinder** Made of borosilicate glass 3.3 class A; autoclavable; 0.5 ml graduated.	10	

Table B2.1 *continued*

46	**25 ml measuring cylinder** Made of borosilicate glass 3.3 class A; autoclavable; 0.25 ml graduated.	10
47	**Laboratory glassware drying rack** Wall mounted; made of polystyrene; with at least 24 pegs for cylinders and conical flasks.	1
48	**Bottle brush** Brush at least 120 mm long; total length (brush and handle) approximately 480 mm.	10
49	**Chemicals spoon** Medium size (20–25 cm); made of polished stainless steel; spoon on one side and spatula on the other.	2
50	**Filtration funnel** Made of soda-lime glass or PP; diameter approximately 160 mm; total height approximately 195 mm.	2
51	**Filter paper** Qualitative, retaining particles ≥8 µm; diameter 240 mm; folded (prepleated).	100
52	**Household water filter** Stainless steel unit with a tap and a ceramic candle filter; each compartment should hold at least 5 litres of water.	1
53	**Beaker with handle** 1 litre; made of PP; graduated.	2

Table B2.2 lists consumables needed in the microscopy laboratory. The actual quantities required will depend on the number of smears performed. Quantities indicated are based on an estimate of 10 000 slides per year and need to be adjusted to the actual workload of the laboratory.

Table B2.2 Consumables for microscopy laboratories

Item	Description and specifications	No. items	Detailed specifications
1	Alternative to item 6, Table B2.1: **Wooden applicator stick** Can be used if loops are not available.	10 packs of 1000	
2	**Microscope slides** Made of soda-lime glass; 76 mm × 24 mm; 1.0–1.2 mm thick; compliant with ISO 8037-1 (*Optics and optical instruments – Microscopes –- Slides – Part 1: Dimensions, optical properties and marking*); cleaned and degreased; straight edges and corners; cellophane wrapped and tropical packing (i.e. sheets of paper between each slide).	200 packs of 50	
3	Alternative to item 2: **Microscope slides** As described in item 2, but with a 20 mm frosted end (so that slides can be marked with pencil).	200	
4	**Diamond pen** To mark glass sides; handle made of plastic or wood.	2	
5	**Sputum container** Break resistant, disposable and made of transparent plastic (polyethylene [PE] or PP) that can be burnt without releasing toxins; wide mouth (diameter ≥35 mm); volume 40–50 ml; tight, waterproof, screw cap; frosted writing panel (if possible).	10 000	
6	**Immersion oil** 500 ml glass bottle of nondrying, synthetic oil with a refractory index of 1.515–1.517; a viscosity at 20 °C of 100–120 mPa·s; nonfluorescent; light transparency at 400 nm of ≥75%.	1	
7	**Lens tissue (or lens paper)** Soft, lint-free tissue; approximately 80 mm × 100 mm (sold in blocks of 50 sheets with 10 blocks per pack).	5 packs	

Table B2.2 *continued*

8	**Handwashing soap** Preferred type is liquid soap distributed from a mechanical, wall-mounted dispenser.	At least one per sink
9	**Paper towel** Single use; approximately 230 mm × 300 mm; folded, to be dispensed individually from a wall-mounted box (sold in packs of 150 towels per pack, 30 packs per carton).	1 carton
10	Option: **Paper towel box** Wall-mounted, refillable box that can hold at least 150 paper towels.	2
11	**Gloves** Powder-free, latex-free disposable gloves made of vinyl (clear) or nitrile (blue); rated as CE category III (for complex risks) and with a textured surface for slip resistance; ≥0.3 mm thick and ≥240 mm long; stocked in sizes (small, medium and large) appropriate for the laboratory staff (sold in boxes, with 100 gloves per box).	24 boxes
12	Option: **Nitrile gloves** Recommended for use if staining with Auramine O is performed. Powder-free, latex-free disposable gloves; rated as CE category III (against chemical risks and resistant to ethidium bromide or auramine staining); ≥0.3 mm thick and ≥249 mm long; stocked in sizes (small, medium and large) appropriate for the laboratory staff (sold in boxes, with 100 gloves per box).	Depending on use of Auramine O
13	**Laboratory request form**	15 000
14	**Laboratory report form**	15 000
15	**Laboratory register**	1–3
16	**70 mm filter paper** Round cellulose filter paper, type 113A; weight 80 g/m²; medium-fast filtration; retaining particles ≥8 µm; 70 mm diameter (sold in packs, with 100 sheets per pack).	4 packs
17	**150 mm filter paper** Round cellulose filter paper, type 113A; weight 80 g/m²; medium-fast filtration; retaining particles ≥8 µm; 150 mm diameter (sold in packs, with 100 sheets per pack).	4 packs
18	**Disinfectant** 5 kg bottle of phenol technical-grade disinfectant.	3
19	**Stable chlorine disinfectant** Sodium dichloroisocyanurate; 6 g tablets with 1 g active chlorine per tablet; usually dissolved with one tablet per 5 litres of warm water (sold in packs with 100 tablets per pack).	2 packs
20	**Goggles** Meeting EN 166 and EN 170; adjustable frames (adjustable to at least three positions); nonslip strap; integrated side and top protection; total weight <35 g.	2
21	Option: **Centrifuge tube** The national tuberculosis control programme (NTP) may require sputa or specimens from selected patients to be sent to a central laboratory for culture. Transport may be in 50 ml graduated centrifuge tubes, made of PP, sterile, with screw cap (sold in packs, with 500 tubes per pack).	10 packs

Table B2.3 lists chemicals needed for a microscopy laboratory. Quantities indicated are based on an estimate of 10 000 slides per year. They need to be adjusted to the actual workload of the laboratory (i.e. the number of smears performed).

Table B2.3 Chemicals for microscopy laboratories

Item	Description and specifications	No. items
1	**Methylated ethanol** Low-grade, required for spirit lamps (sold in 2.5 litre bottles).	4
2	**Basic fuchsine** - $C_{20}H_{20}ClN_3$ Certified, with colour index (CI) 42510; molecular weight (MW) 337.85 g/mol; melting (decomposition) point 200 °C; main product component ≥80% (sold in 100 g bottles).	3
3	**Methylene blue** - $C_{16}H_{18}ClN_3S{\cdot}xH_2O$ (where x = 2-3) Certified, with CI 50015; MW ≤319.86 g/mol; melting (decomposition) point ~180 °C; dye component ≥82%% (sold in 100 g glass bottles, including counterstain for Auramine O).	1
4	**Colourless phenol crystals** - C_6H_6O Pure grade (≥99% pure); MW 94.11 g/mol; melting point 40.8 °C (sold in 5 kg bags). (Note: crystals may become light reddish over time.)	1
5	**Ethanol for stain solutions** - C_2H_6O Technical-grade ethanol (96% pure); MW 46.07 g/mol; boiling point 75-78 °C (sold in 2.5 litre bottles).	2
6	**Ethanol for decolourization** - C_2H_6O Technical-grade ethanol (96% pure); MW 46.07 g/mol; boiling point 75-78 °C (sold in 2.5 litre bottles).	20
7	**Hydrochloric acid** - HCl Of ≥35% HCl, density ≥1.17 g/cm^3; MW 36.5 g/mol (sold in 2.5 litre bottles).	1
8	Alternative to item 7: **Concentrated sulfuric acid** - H_2SO_4 Technical-grade sulfuric acid; density 1.84 g/cm^3; MW 98.08 (sold in 2.5 litre bottles).	1
Additional chemicals for fluorescence microscopy		
9	**Auramine O** - $C_{17}H_{22}ClN_3$ Certified, with CI 41000; MW 303.84 g/mol; melting point ~265 °C; dye component ≥85 (sold in 50 g bottles).	1
10	**Potassium permanganate** - $KMnO_4$ Analytical grade (99% $KMnO_4$); MW 158.04 g/mol; decomposition >240 °C (sold in 250 g bottles). (Note: potassium permanganate is a strong oxidant; it can be replaced by methylene blue or diluted blue ink.)	1

Chapter B3:

Main specifications for equipment for culture, DST and molecular biology

Table B3.1 lists equipment needed for culture, drug-susceptibility testing (DST) and molecular biology laboratories. Indicated quantities are based on experience and are suited for a national reference laboratory (NRL) performing approximately 12 000 cultures and about 1000 FL-DST (and 100 SL-DST). They should serve as an estimate – some laboratories may need additional or alternative equipment; also, the actual items and quantities needed will depend on the methods chosen, the workload and the design of the laboratory.

Table B3.1 Equipment for culture, DST and molecular biology laboratories

Item	Description and specifications	No. items	Detailed specifications
1	**Biological safety cabinet** Class I or class II BSC; minimum width 120 cm (4 ft); recommended width at least 150 cm (5 ft).	2	Yes
1a	**Base support** For BSC.	2	
1b	**Uninterrupted power supply (UPS)** For BSC; battery pack should last 20 minutes.	2	
2	Mini-shaker or vortex	3	Yes
3	Alternative to item 2: **Overhead stirrer** Able to fit at least 10 × 50 ml tubes.	2	
3a	**Universal adapter** For overhead stirrer.	2	
4	**Test-tube rack** Made of 18/8 stainless steel; to hold two rows of 12 test-tubes (test-tubes with diameter 16 mm or 18 mm).	5	
5	**Test-tube rack** Made of 18/8 stainless steel; to hold two rows of 4 test-tubes (test-tubes with diameter 35 mm).	5	
6	**Safety gas burner** With a glass chimney and a foot switch to operate the ignition and gas supply.	2	Yes
6a	**Safety gas tubing** With safety clamps on both ends; inner diameter 9 mm; length 750 mm.	2	
7	Alternative to item 6: **Electric micro-incinerator for loops**	2	Yes
8	**4 mm inoculation loop** Made of platinum-iridium wire with diameter 0.6–0.7 mm; total length 5 cm; closed loop with diameter 4 mm.	8	
8a	**3 mm inoculation loop** Made of platinum-iridium wire with diameter 0.6–0.7 mm; total length 5 cm; closed loop with diameter 3 mm, holding 10 µl for DST.	8	
8b	**Loop holder** Upper part made of aluminium or stainless steel and handle made of plastic (240 mm long).	12	
8c	**Rack for loop holder** Disinfectable; able to hold 3–4 loop holders; with a proper stand.	4	

Table B3.1 *continued*

9	Alternative to item 8: **Disposable loop** Sterile and approximately 220 mm long (sold in packs of 1000 loops).	15 packs	
10	**Stainless steel bucket** 10 litres with lid; height 250 mm; upper diameter 280 mm; lower diameter 185 mm.	5	
11	**Discard bottle** Made of stainless steel or thick-walled glass; screw cap.	6	
12	**Funnel** Made of 18/8 stainless steel, with an air drain; diameter of ramp approximately 15 mm; top diameter approximately 120 mm; total height approximately 165 mm.	6	
13	**Safety box** For sharps; made of PP; volume 3 litres; self-opening lid and safety lock.	5	
14	**Laboratory chair** Adjustable (vertical adjustment 480–540 mm); seat and back made of polyurethane foam; disinfectable; five wheels; no armrests.	2	
15	**Mobile container** Disinfectable; preferably made of PP and set on four roller castors (two lockable); approximate dimensions 600 mm wide × 550 mm deep × 750 mm high; high resistance to chemicals and temperature (to 90 °C); light-fast and colour-fast; worktop 30 mm thick, with edges rimmed with impact-resistant PP; four drawers that cannot be totally extracted.	2	
16	**Incubator** Capacity ≥700 litre; temperature range 30–70 °C; calibrated to 37 °C.	2	Yes
16a	**Shelf for incubator** Made of perforated stainless steel (if not included with the incubator).	4	
17	**Centrifuge** Refrigerated bench-top centrifuge with aerosol-free buckets; swing-out rotor with capacity for 1 litre of liquid to be centrifuged at >3200 G.	1	Yes
17a	**Swing-out rotor** For bench-top centrifuge; four place.	1	
17b	**Rotor bucket**	4	
17c	**Aerosol-tight lid for rotor bucket**	4	
17d	**Reducing adapter** For 50 ml Falcon tubes, or equivalent tubes.	4	
17e	**Reducing adapter** For 15 ml or 12 ml Falcon tubes, or equivalent tubes.	4	
18	**Autoclave** Basic vertical unit with capacity of approximately 75 litres (or larger).	2	Yes
18a	**Program control unit** A unit to enable fully automated process control, with temperature up to 134 °C.	2	
18b	**Exhaust air filtration system** Forced-air filter (1.0 μm pore size) for autoclave and vacuum pump.	1	
18c	**Liquid temperature-control unit** With temperature probe and pressure-sealed duct.	1	
18d	**Pressure device** For sterilization of liquid.	1	
18e	**Autoclave recooling system** To shorten the time taken to sterilize liquids.	1	
18f	**Wire basket or stainless steel bucket** For autoclave.	2	

Table B3.1 *continued*

18g	**Wire basket with drip tray** For autoclave.	2	
19	**Hot-air oven** Temperature range 30–250 °C, approximately 110 or 250 litres (size depends on the number of reusable items and amount of glassware).	1	Yes
19a	**Shelf for 254 litre hot-air oven** Perforated stainless steel (if not delivered with the incubator).	2	
20	**Ion-exchanger cartridge** Able to support a flow rate of approximately 950 l/hour; quick connection coupling; exhaust; excess pressure valve (2.5–10 bar).	2	
21	**Digital conductivity measuring device** To measure the quality of laboratory-grade water.	2	
22	**Ion-exchanger resin** For laboratory-grade water; pack of 5 × 10 litre resin; with filter bag to store used resin.	5	
23	**Water distiller** Fully automatic; capacity of 4–12 l/hour; producing distilled water with conductivity of approximately 3 µS.	1	Yes
24	**30 litre balloon** HDPE winding with discharge cock; 30 litres (additional storage tank for distilled water).	1	
25	**10 litre balloon** HDPE winding with discharge cock; 10 1itres (for distribution of distilled water).	4	
26	**Stopcock** PP HDPE winding for HDPE balloon.	10	
27	**Test-tube rack** To hold 60 × 16 mm diameter test-tubes; made of PP; temperature resistant (–15 °C to 130 °C); autoclavable; approximately 250 mm wide × 105 mm deep × 70 mm high.	12	
28	Alternative to item 27: **Test-tube rack** If 18 mm diameter test-tubes are purchased, test-tube rack must be adjusted to match.	150	
29	Alternative to items 27 and 28: Rack to hold 28 universal bottles	150	
30	**Alarm clock or digital countdown timer** With a memory function and a countdown (2 digit display), with an alarm at 0 minutes.	3	
31	**1 ml pipettes** Conformity certified; graduation of 0.01 ml (sold in packs of 10 pipettes).	3 packs	
32	**2 ml pipettes** Conformity certified; graduation of 0.02 ml (sold in packs of 10 pipettes).	3 packs	
33	**5 ml pipettes** Conformity certified; graduation of 0.05 ml (sold in packs of 10 pipettes).	3 packs	
34	**10 ml pipettes** Conformity certified; graduation of 0.1 ml (sold in packs of 10 pipettes).	3 packs	
35	**Short pipette** For work in BSC; approximately 25 cm long; 0.5 ml; graduation 0.01 (quantity adjusted according to dilution and inoculation schema for DST).	200	
36	**Pipette box** Square, made of aluminium, with lid; suitable for pipettes 20–25 cm long and for work in BSC; silicon insert; disinfectable; autoclavable up to 205 °C.	10	
37	**Pipette box** Square, made of aluminium, with lid; suitable for pipettes 35 cm long; silicon insert; disinfectable; autoclavable up to 205 °C.	10	

Table B3.1 *continued*

38	**Inlay** Teflon, for pipette box.	20
39	**Safety pipetting ball** Standard.	10
40	**Automatic pipette aid** For use with pipettes and pasteur pipettes (volumes between 0.1 ml and 1.0 ml); rechargeable, with an 8-hour battery capacity and a low-battery indicator; pipetting velocity adjustable (at least 3 speeds); weighing less than 200 g.	2
41	Alternative to item 40: **Set of mechanical pipetting aids** For standard pipettes (up to 0.2 ml, up to 2 ml and up to 10 ml); thumb wheel and quick-release mechanism.	2
42	**Pipette washer** With automatic siphon system; made up of one cylindrical washing container with siphon outlet, a connecting tube and two pipette baskets (as inserts); total height approximately 750 mm, diameter approximately 170 mm.	1
43	**Desiccator** Made of borosilicate glass; total height approximately 150 mm; inner diameter approximately 175 mm; lid with stopcock and screw cap (with a GL32 thread).	2
44	**Membrane vacuum pump** For desiccator; suction >15 l/hour and pressure endpoint <20 mbar.	1
45	**Woulff flask or bottle** 1 litre, made of borosilicate glass with a screw cap (thread GL45) and a silicone ring; height adjustable; two necks, each with an 8 mm outer diameter and a screw cap (thread GL14).	1
46	**Vacuum tube** 3 m long.	1
47	**Silica gel** For desiccator (sold in 0.5 kg bags).	1 bag
48	**Transport box** Boxes to transport specimens; boxes should meet P650 packaging requirements	10
49	Alternative to item 48: **Cool box for sputum transport** Boxes to transport sputum by car for long travel times in areas with extreme temperature variation over the year; able to cool to 20 °C below ambient temperature and heat to 40 °C above ambient temperature, using Peltier elements; with a 12 V plug to fit a car cigarette lighter and a car cable (length ≥2.5 m); able to hold approximately 27 litres; inner dimensions ≥335 mm (width), ≥230 mm (depth) and ≥380 mm (height); inside and outside surfaces made of a durable and disinfectable material (e.g. LDPE); insulated with polyurethane foam; meeting P650 packaging requirements.	3
50	Additional to items 48 and 49: **Sturdy container** Sturdy containers with tight-fitting lids and leak-proof covers, holding at least 1 litre; made of PP with a gasket-tightened screw cap, or from stainless steel with a tightly fixed cover; meeting P650 packaging requirements.	10
50a	**Sorbent material** Material to buffer specimen containers when packed into transport boxes (see item 48) (sold by the kilogram).	10 kg
51	**Electronic maxima-minima thermometer** Electronic, two-channel thermometer for measuring range of room temperature (-10 °C to 50 °C); with battery.	10
52	**Plastic-foil welder** 30 cm.	1
53	**Dispenser** Wall-mounted dispenser for 1 litre bottles (two per sink: one for liquid soap and one for disinfectant).	2 per sink

Table B3.1 *continued*

54	**Paper-towel box** Wall-mounted, refillable box that can hold at least 150 paper towels.	4	
55	**Goggles** Goggles meeting EN 166 and EN 170; frames adjustable to at least three positions; nonslip strap; integrated side and top protection; total weight <35 g.	5	
56	**Emergency spill kit**	1	Yes
57	**First-aid kit** Designed specifically for scientific laboratories, including an eye-rinse bottle; store in a wall-mounted, lockable cupboard that has a gasket-sealed door.	1	
58	**Thermic anemometer** With telescope probe.	1	Yes
Media kitchen (additional equipment)			
59	**Analytical balance**	1	Yes
60	**Precision balance**	1	Yes
61	**pH meter**	1	Yes
62	**Bunsen burner** With fine tubing.	2	
63	**Tripod stand**	1	
64	**Water-bath** 20 litres, with cover; temperature regulation controlled by a microprocessor.	1	
65	**Magnetic stirrer** With heating plate.	1	Yes
66	**Magnetic stirring bars** Set of 10: 1 × 15 mm, 2 × 20 mm, 2 × 25 mm, 1 × 30 mm, 2 × 40 mm, 2 × 50 mm; round and coated with polytetrafluoroethylene (PTFE).	1	
67	**Filling station for sterile culture media** 1 litre reservoir (Squibb sedimentation funnel or cylindrical dropping funnel) with graduation lines and tube for pressure exchange; outlet tube with 6 mm diameter; glass stopcock and PE stopper.	4	
68	**Filling station for sterile culture media** 250 ml reservoir (Squibb sedimentation funnel or cylindrical dropping funnel) with graduation lines and a tube for pressure exchange; outlet tube with 4 mm diameter; glass stopcock and PE stopper.	10	
69	Alternative to item 68: **Automatic filling station** Peristaltic pump (1–350 revolutions per minute [rpm]) for sterile dispensing of culture media, with a four-roller, easy-load pump head; pump to include a 15 m silicon tubing bore (1.6 mm in diameter) and run on 230 ± 10 V AC/50 Hz; pump to store at least five dispensing programs, dispensing a minimum dose of 3.5 ± 0.5 ml and a maximum dose of 15 ± 2 ml, with accuracy ±1%. Pump to be compliant with standards IEC 335-1 and EN 60529.	1	
70	**Stative set** Plate plus rod and clamp.	3	
71	**Inspissator** To coagulate egg-based culture media; capacity for ≥350 tubes; able to run on 230 ± 10 V AC/50 Hz.	1	Yes
72	**Refrigerator** 300 litres, suitable for environments with ambient temperatures up to 43 °C; including a 60 litre freezer (-22 °C); energy efficiency class A+; able to run on 230 ± 10 V AC/50 Hz.	2	Yes
73	**Floor-standing refrigerator** 150 litres with 20 litre freezer (-22 °C); energy efficiency class A+; able to run on 230 ± 10 V AC/50 Hz.	1	Yes

Table B3.1 *continued*

74	**Floor-standing refrigerator** 300 litres, cooling to 4 °C; energy efficiency class A+; able to run on 230 ± 10 V AC/50 Hz.	3	Yes
75	Option: **Chest freezer** For laboratories preserving strains for national or scientific purposes; 70 litres, with temperature range -50 °C to -85 °C; complete with cassettes and racks.	1	Yes
76	**Stainless steel funnel** Short, wide stem; upper diameter of approximately 150 mm; with an air drain.	5	
77	**Swan-neck bottle (flask)** PE bottle with narrow neck, screw cap and water dispenser (sold as a set comprising one 250 ml, one 500 ml and one 1 litre bottle).	5 sets	
78	**Bowl** Plastic, approximately 500 mm × 350 mm.	5	
79	**2 litre conical flask (Erlenmeyer)** Graduated; made of borosilicate glass 3.3; wide neck; autoclavable; compliant with ISO 3585.	2	
80	**1 litre conical flask (Erlenmeyer)** Graduated; made of borosilicate glass 3.3; wide neck; autoclavable; compliant with ISO 3585.	10	
81	**500 ml conical flask (Erlenmeyer)** Graduated; made of borosilicate glass 3.3; wide neck; autoclavable; compliant with ISO 3585.	10	
82	**250 ml conical flask (Erlenmeyer)** Graduated; made of borosilicate glass 3.3; wide neck; autoclavable; compliant with ISO 3585.	10	
83	**100 ml conical flask (Erlenmeyer)** Graduated; made of borosilicate glass 3.3; wide neck; autoclavable; compliant with ISO 3585.	20	
84	**50 ml conical flask (Erlenmeyer)** Graduated; made of borosilicate glass 3.3; wide neck; autoclavable; compliant with ISO 3585.	20	
85	**1 litre measuring cylinder** Class A; made of polymethylpentene (TPX); autoclavable; compliant with ISO 6706; 10.0 ml graduated.	5	
86	**500 ml measuring cylinder** Class A; made of TPX; autoclavable; compliant with ISO 6706; 5.0 ml graduated.	5	
87	**250 ml measuring cylinder** Class A; made of TPX; autoclavable; compliant with ISO 6706; 2.0 ml graduated.	5	
88	**100 ml measuring cylinder** Class A; made of TPX; autoclavable; compliant with ISO 6706; 1.0 ml graduated.	10	
89	**50 ml measuring cylinder** Class A; made of TPX; autoclavable; compliant with ISO 6706; 1.0 ml graduated.	5	
90	**Thick-walled glass flask** 2.5 litres; flanged rim; for preparation of culture medium.	6	
91	**2.0 litre bottle (transparent)** Graduated; made of transparent borosilicate glass 3; to include a ring and cap of PP (GL45 thread); autoclavable; compliant with ISO 3585 and ISO 4796.	3	
92	**1.0 litre bottle (transparent)** Graduated; made of transparent borosilicate glass 3.3; to include a ring and cap of PP (GL45 thread); autoclavable; compliant with ISO 3585 and ISO 4796.	10	

Table B3.1 *continued*

93	**500 ml bottle (transparent)** Graduated; made of transparent borosilicate glass 3.3; to include a ring and cap of PP (GL45 thread); autoclavable; compliant with ISO 3585 and ISO 4796.	5
94	**2.0 litre bottle (amber)** Graduated; made of amber borosilicate glass 3.3; to include a ring and cap of PP (GL45 thread); autoclavable; compliant with ISO 3585 and ISO 4796.	3
95	**1.0 litre bottle (amber)** Graduated; made of amber borosilicate glass 3.3; to include a ring and cap of PP (GL45 thread); autoclavable; compliant with ISO 3585 and ISO 4796.	2
96	**Screw cap** With welded-in PTFE membrane (0.2 µm pore size); autoclavable to 40 °C.	10
97	**100 ml laboratory beaker** Made of ethylene tetrafluoroethylene (ETFE); heat stable up to 150 °C; low form with graduation and spout.	10
98	**250 ml laboratory beaker** Made of ETFE; heat stable up to 150 °C; low form with graduation and spout.	10
99	**600 ml laboratory beaker** Made of ETFE; heat stable up to 150 °C; low form with graduation and spout.	10
100	**1 litre laboratory beaker** Made of ETFE; heat stable up to 150 °C; low form with graduation and spout.	3
101	**2 litre laboratory beaker** Made of ETFE; heat stable up to 150 °C; low form with graduation and spout.	3
102	**1 litre volumetric flask** Class A; made of borosilicate glass 3.3 with PE stopper; autoclavable; error margin ±0.5 ml.	5
103	**500 ml volumetric flask** Class A; made of borosilicate glass 3.3 with PE stopper; autoclavable; error margin ±0.25 ml.	10
104	**250 ml volumetric flask** Class A; made of borosilicate glass 3.3 with PE stopper; autoclavable; error margin ±0.15 ml.	10
105	**200 ml volumetric flask** Class A; made of borosilicate glass 3.3 with PE stopper; autoclavable; error margin ±0.15 ml.	15
106	**100 ml volumetric flask** Class A; made of borosilicate glass 3.3 with PE stopper; autoclavable; error margin ±0.1 ml.	10
107	**50 ml volumetric flask** Class A; made of borosilicate glass 3.3 with PE stopper; autoclavable; error margin ±0.08 ml.	15
108	**25 ml volumetric flask** Class A; made of borosilicate glass 3.3 with PE stopper; autoclavable; error margin ±0.06 ml and adjusted to “In”.	5
109	**20 ml volumetric flask** Class A; made of borosilicate glass 3.3 with PE stopper; autoclavable; error margin ±0.06 ml and adjusted to “In”.	25
110	**Drying rack for laboratory glassware** Wall-mounted polystyrene drying rack, with at least 24 pegs for cylinders and conical flasks.	1
111	**Funnel** Short stem; diameter 75 mm; made of PP.	5

Table B3.1 *continued*

112	**Funnel** Short-stem; diameter 125 mm; made of PP.	5	
113	**Powder funnel** Stem diameter 100 mm.	5	
114	**5 mm diameter glass bead** Made of massive glass.	2	
115	**3 mm diameter glass bead** Made of massive glass.	1	
116	**Pyrex tubes** Thick-walled; autoclavable; with ISO winding and screw cap with tight gasket; 16 mm × 100 mm (sold in packs of 100).	5 packs	
117	**Strainer** Stainless steel; diameter 20 cm; including one grip and two rests.	1	
118	**Set of spatulas** Each approximately 150 mm long (with blades approximately 40 mm long); widths ranging from 3 mm to 9 mm; made of electrolytically polished 18/8 stainless steel.	6	
119	**Forceps** Straight; pointed; made of polished 18/8 stainless steel.	5	
120	Optional: **Laboratory washer** For laboratory glass; with upper and lower baskets.	1	
120a	**Washer 1/2 insert** With 28 small spring hooks.	1	
120b	**Washer 1/2 insert** For baskets.	1	
120c	**Washer upper basket** For nozzles.	1	
120d	**Washer 1/4 insert** For test-tubes 160 × 16 mm.	2	
120e	**Phosphate cartridge** With first refill.	1	
120f	**Water supply** Separate supply for deionized water; including a conductivity meter with digital display; hoses for inflow and outflow.	1	
120g	**Aqua purificator cabinet** To hold two demineralizing cartridges.	1	
Molecular biology			
121	**Polymerase chain reaction (PCR) workstation** Working under ultraviolet (UV) light.	1	Yes
122	**Thermocycler** To hold 96 tubes.	1	Yes
123	**Centrifuge** For standard reaction tubes; at least 15 000 G.	1	Yes
124	**Ultrasonic bath**	1	Yes
125	**Thermo-shaker** For use in hybridisation; to hold at least 12 tubes (but preferably 48 or 96 tubes).	1	Yes
126	Optional: **Electrophoresis** Horizontal minigel system.	1	Yes

Table B3.1 *continued*

127	Optional: **Power supply** For electrophoresis.	1	Yes
128	Optional: **UV-light illuminator** With window at least 200 mm × 200 mm.	1	
129	**Test-tube rack** Autoclavable; able to hold at least 20 test-tubes (1.5–2 ml test-tubes, 10 mm diameter).	10	
130	**Floating rack** For ultrasonic baths; to hold 20 reaction containers (2 ml containers, 10 mm diameter).	2	
131	**Deep-freeze storage box** Autoclavable; made of PP; with lid; able to hold 0.2 ml PCR tubes (as single tubes, 8-tube strips or 12-tube strips) and 96-well PCR plates.	5	
132	**Rack with plastic lid** Autoclavable racks to hold cryovials (2 ml); suitable for temperatures –196 °C to 121 °C.	50	
133	**Deep-freeze storage box** Autoclavable; to hold cryovials; made of PP; with a lid, including a panel to record contents.	10	
134	**1-channel pipette** Variable from 0.5 µl to 10 µl.	3	Yes
135	**1-channel pipette** Variable from 10 µl to 100 µl.	4	Yes
136	**1-channel pipette** Variable from 100 µl to 1000 µl.	4	Yes
137	**Rack** To hold at least four 1-channel pipettes.	4	
138	Optional: **8-channel pipette** 5–50 µL (accuracy at least ±4–1.5% when the first value applies to smallest volume, last one to the largest volume in the stated range, precision at least ±3–0.6% when the first value applies to smallest volume, last one to the largest volume in the stated range).	1	
139	Optional: **8-channel pipette** 50–300 µL (accuracy at least ±1.5%–1%, precision at least ±0.8–0.5%).	1	
140	**Stand for multichannel pipettes**	1	
141	**Hand-dispenser pipette** Suitable for combi-tips, with five dispensing steps.	2	
142	**Tripod stand** For 2 litre waste bags.	5	
143	Optional: **Microwave oven or water-bath** Microwave oven of approximately 900 W; inner volume ≥20 litres.	1	
144	**Refrigerator** With freezing compartment.	1	
145	**Freezer**	1	
Use of liquid media			
146	**Mycobacteria growth indicator tube (MGIT) system** To detect mycobacterial growth in liquid media.	1	
147	**UPS** For the MGIT.	1	

Table B3.1 *continued*

Office		
148	**Computer**	1
149	**Combined printer/fax/photocopier**	1
150	**UPS** For the computer.	1
151	**Consumables** Except paper.	1
152	**Request and report form sheets**	As needed

Chapter B4:

Main specifications for consumables for culture, DST and molecular biology

Table B4.1 lists consumables needed for culture, drug-susceptibility testing (DST) and molecular biology laboratories. Indicated quantities are based on experience and are suited for a national reference laboratory (NRL) performing approximately 12 000 cultures and about 1000 FL-DST (and 100 SL-DST). They should serve as an estimate – quantities should be adjusted to the actual workload of the laboratory and the methods used.

Table B4.1 Consumables for culture, DST and molecular biology laboratories

Item	Description and specifications	No. items	Detailed specifications
1	**Culture tubes** 125 mm long; outer diameter 16 mm or 18 mm and inner diameter at least 13 mm; made of borosilicate glass; at least 1 mm thick; with an external thread; autoclavable screw cap made of polypropylene (PP) or Teflon, with a sealing gasket (sold in packs of 100).	260 packs	
1a	Alternative to item 1: **28 ml universal glass bottles** Straight neck (no shoulder) made of heavy-duty glass; either an aluminium screw cap with rubber lining or an autoclavable screw cap made of PP or Teflon, with a sealing gasket (sold in packs of 100).	260 packs	
2	**50 ml PP tubes for centrifuge** Tight screw cap; size 115 mm × 30 mm (sold in packs of 500).	60 packs	Yes
3	**15 ml PP tubes for centrifuge** Tight screw cap; size 120 mm ×17 mm (sold in packs of 500).	4 packs	
4	**Plastic pasteur pipettes** Graduated; holding 1.5 ml; disposable and sterile (sold in packs of 500).	30 packs	
5	Optional for strain bank: **Cryovials** Graduated 2 ml vials with screw cap; vials round with an external thread; made of PP with a frosted marking area; sterile and able to be sterilized with γ-rays; stable at -196 °C to 121 °C; free from ribonuclease (RNase), deoxyribonuclease (DNase), deoxyribonucleic acid (DNA) and endotoxins (sold in packs of 1000).	1 pack	
6	**Small gloves** Powder free; disposable; made of vinyl or nitrile; 0.16 mm thick and >240 mm long (sold in packs of 100).	60 packs	
7	**Medium gloves** Powder free; disposable; made of vinyl or nitrile; 0.16 mm thick and >240 mm long (sold in packs of 100).	90 packs	
8	**Large gloves** Powder free; disposable; made of vinyl or nitrile; 0.16 mm thick and >240 mm long (sold in packs of 100).	30 packs	
9	**Bags for waste bins** Capacity approximately 24 litres; made of transparent PP at least 40 µm thick; autoclavable up to 134 °C; meeting the country's standards for environmental and hygiene considerations (sold in packs of 1000).	1 pack	
10	**Stand** To hold small plastic bags with a 2 litre capacity.	5	
11	**Bags** For noninfectious material; made of transparent PP; size 200 mm × 300 mm (sold in packs of 100).	1 pack	

Table B4.1 *continued*

12	**Syringes** 20 ml; graduated; with Luer connection and a piston lock; made of colourfast PP; for single use only; sterile; individually wrapped; compliant with ISO 7886-1 (sold in packs of 100).	1 pack	
13	**Syringe filter** Hydrophilic and at least 25 mm in diameter; pore size ≤0.22 µm; with Luer connection; suitable for pressure up to 5 bar; for single use only; sterile and individually wrapped (sold in packs of 100).	1 pack	
14	**Filter paper** Round; weight approximately 75 g/m²; diameter 185 mm; able to retain particles >4 µm (sold in packs of 100).	3 packs	
15	**Filter paper** Round; weight approximately 75 g/m²; diameter 150 mm; able to retain particles >4 µm (sold in packs of 100).	6 packs	
16	**Marker pen** Fast drying, black, thick line (0.8–1 mm); able to write on most surfaces (even when the surface is cold and wet); ink resistant to water, alcohol and autoclaving.	3	
17	**Adhesive labels** (Sold in rolls of 5000 labels).	2 rolls	
18	**Cryotags** To fit cryovials and standard microtubes (sold in rolls of 1000).	5 rolls	
19	**Sterile indicator tape** Approximately 19 mm wide × 55 m long, for hot-air sterilization (green/brown).	5 rolls	
20	**Sterile indicator tape** Approximately 19 mm wide × 55 m long, for autoclave (beige/dark brown).	5 rolls	
21	**Aluminium foil** 30 µm thick × 600 mm wide (sold in 100 m rolls).	3 rolls	
22	**Parafilm** For use at -40 °C to 50 °C; 100 mm wide × 58 m long; with dispenser.	3 rolls	
23	**Plastic-foil rolls** 30 cm wide.	5 rolls	
24	**Tube brush** At least 280 mm long (brush 80 mm long) × 20 mm in diameter.	20	
25	**Glassware brush** Approximately 480 mm long (brush 120 mm long) × 60 mm in diameter.	10	
26	**Large laboratory coat** Long sleeved; white; made of cotton; with back opening.	10	
27	**Medium laboratory coat** Long sleeved; white; made of cotton; with back opening.	20	
28	**Small laboratory coat** Long sleeved; white; made of cotton; with back opening.	10	
29	**Face masks** Fit Factor for Inert Particle (FFP) — FFP2 or FFP3 face masks (depending on national policy); individually packaged (sold in boxes of 10).	1 box	Yes
30	**Disinfectant for floors** Either locally made or commercially available (sold in 10 litre containers).	6	
31	**Disinfectant for surfaces** Ethanol based, certified for TB bacilli (if not certified, use 70% ethanol) (sold in 5 litre containers).	8	

Table B4.1 *continued*

32	**Spray bottle** For disinfectant; 1 litre.	6	
33	**Liquid soap** pH neutral (sold in 1 litre bottles).	12	
34	**Disinfectant for hands** Ethanol-based disinfectant for hands, either locally made or commercially available (sold in 1 litre bottles).	15	
35	**Paper towel** Single use; 150 towels per pack (sold in cartons of 30 packs).	5 cartons	
36	**Cotton wool** White; absorbent (bought locally by the kilogram).	Purchase as required	
37	**Tissue pulp** Absorbent sheets; approximately 550 mm × 350 mm.	30	
38	If a laboratory dishwasher is available: **Detergent washing powder** Suitable for laboratory dishwashers (sold in 10 kg containers).	36	
39	**Salt** Suitable for laboratory dishwashers (sold in 10 kg packs).	10	
40	**Rinse aid** Suitable for laboratory dishwashers (sold in 1 litre containers).	10	
Molecular biology			
41	**1.5 ml standard reaction tubes** Conical; with screw top and O-ring (sold in packs of 1000).	10 packs	Yes
42	**2 ml standard reaction tubes** Conical; with screw top and O-ring (sold in packs of 1000).	10 packs	Yes
43	**Cryovials** Graduated; 2 ml; screw cap; vials round with an external thread; made of PP with a frosted marking area; vials sterile and able to be sterilized with γ-rays; stable at -196 °C to 121 °C; free from RNase, DNase, DNA and endotoxins (sold in packs of 1000).	3 packs	
44	**Cryotags** To fit cryovials and standard microtubes (sold in rolls of 1000).	3 rolls	
45	**Polymerase chain reaction (PCR) tubes** 0.2 ml; with attached caps and thin walls; free from DNase and RNase; tubes should be compatible with thermal cyclers with heated lids.	Pack of 1000	
46	**0.1-10 µl pipette tips** Sterile and free from DNase and RNase; made of PE; with compatible filters available; 96 tips per pack (sold in boxes of 10 packs).	10 boxes	
47	**1.0-20 µl tips** Sterile and free from DNase and RNase; made of PE; with compatible filters available; 96 tips per pack (sold in boxes of 10 packs).	40 boxes	
48	**10-100 µl tips** Sterile and free from DNase and RNase; made of PE; with compatible filters available; 96 tips per pack (sold in boxes of 10 packs).	20 boxes	
49	**20-200 µl tips** Sterile and free from DNase and RNase; made of PE; with compatible filters available; 96 tips per pack (sold in boxes of 10 packs).	10 boxes	
50	**100-1000 µl tips** Sterile and free from DNase and RNase; made of PE; with compatible filters available; 96 tips per pack (sold in boxes of 10 packs).	10 boxes	

Table B4.1 *continued*

51	**0.5–10 µl tips** Made of PE (sold in bulk containers of 1000 tips).	10 containers
52	**1–200 µl tips** Made of PE (sold in bulk containers of 1000 tips).	5 containers
53	**100–1000 µl tips** Made of PE (sold in bulk containers of 1000 tips).	5 containers
54	**Pasteur pipettes** Sterile; single use; made of plastic; volume 1.5 ml (sold in packs of 500).	30 packs
55	**Combi-tips** For 5 ml repeating pipette (sold in packs of 100).	3 packs
56	**Combi-tips** For 10 mL repeating pipette (sold in packs of 100).	3 packs
57	**Forceps** For handling strips; preferably made of plastic.	3
58	**Plastic bottle**	3
59	**Filter paper** Preferably as sheets.	As needed
60	**Special marker pen** For strips (alternatively, soft-grade pencils).	2
61	**Marker pen** Fast-drying, black, thick-line (0.8–1 mm) marker pens that can write on most surfaces (even when the surface is cold and wet); ink resistant to water, alcohol and autoclaving.	3
62	**Nitrile gloves (size 6-7)** Disposable; rated as CE category III (against chemical risks and resistant to ethidium bromide, sulfuric acid or auramine staining); ≥0.36 mm thick.	10 boxes
63	**Nitrile gloves (size 7-8)** Disposable; rated as CE category III (against chemical risks and resistant to ethidium bromide, sulfuric acid or auramine staining); ≥0.36 mm thick.	5 boxes
64	**Nitrile gloves (size 8-9)** Disposable; rated as CE category III (against chemical risks and resistant to ethidium bromide, sulfuric acid or auramine staining); ≥0.36 mm thick.	2 boxes
65	**Liquid culture tube** For mycobacteria growth indicator tube (MGIT).	15 000
66	**Reagent cocktail** For liquid enrichment.	150
67	**Reagent cocktail** For minimizing contamination in liquid medium.	20
68	**Antibiotic preparation** For DST in liquid medium.	20
69	**Medium base** For solid culture of nonmycobacterial organisms (sold in 1 kg containers).	1 container
70	**Petri dishes** Either disposable or made of glass (sold in boxes of 50 pieces).	24 boxes
71	**Plastic pasteur pipettes** Graduated; able to hold 1.5 ml; disposable; sterile (sold in packs of 500).	30 packs
72	**Bags** For noninfectious material; made of transparent PP; size 200 mm × 300 mm (sold in packs of 100).	5 packs

Chapter B5:

Main specifications for chemicals for culture, DST and molecular biology

Table B5.1 lists chemicals needed for culture, drug-susceptibility testing (DST) and molecular biology laboratories. Indicated quantities are based on experience and are suited for a national reference laboratory (NRL) performing approximately 12 000 cultures and about 1000 FL-DST (and 100 SL-DST). They should serve as an estimate – quantities should be adjusted to the actual workload of the laboratory and the methods used.

Table B5.1 Chemicals for culture, DST and molecular biology

Item	Description and specifications	No. items
Chemicals for culture of tubercle bacilli		
Loewenstein-Jensen medium		
1	**Ready-to-use medium mix** From a certified supplier of Loewenstein-Jensen (LJ) medium, with correct composition of ingredients (sold in 500 g containers).	7
2	**Fresh eggs** From hens fed without growth factors or antibiotics, sourced from a local producer; each 1600 ml of medium requires 25 eggs.	2000
3	**Glycerol** ($C_3H_8O_3$) ≥99% pure, molecular weight (MW) 92.1 g/mol (sold in 1 litre bottles).	2
4	Option: **Sodium pyruvate** 50 g (used as an alternative to glycerol for *M. bovis* growth).	2
IUTM base (called modified LJ-medium in the standard operating procedure); made of single components		
5	**Potassium dihydrogen phosphate** (KH_2PO_4) ≥99% per analysis (p.a.); anhydrous; MW 136.09 g/mol.	1 kg
6	**Magnesium sulfate heptahydrate** ($MgSO_4 \cdot 7H_2O$) ≥99% p.a.; MW 246.48 g/mol.	500 g
7	**L-asparagine monohydrate** ($C_4H_8N_2O_3 \cdot H_2O$) ≥99% p.a.; MW 150.13 g/mol.	2 × 250 g
8	**Trimagnesium dicitrate nonahydrate** ($Mg_3(C_6H_5O_7)_2 \cdot 9H_2O$) ≥95% p.a.; MW 613.25 g/mol (sold in 500 g plastic bottles).	1 bottle
9	**Malachite green oxalate** p.a. (sold by the 100 g).	100 g
10	**Glycerol** ($C_3H_8O_3$) ≥99% pure; MW 92.1 g/mol (sold in 1 litre bottles).	2 bottles
11	**Fresh eggs** Eggs from hens fed without growth factors or antibiotics, sourced from a local producer; each 1600 ml of medium requires 25 eggs.	2000
Ogawa medium		
12	**Sodium L-glutamate monohydrate** ($C_5H_8NNaO_4 \cdot H_2O$) ≥98% pure; MW 187.13 g/mol.	1 kg
13	**Potassium dihydrogen phosphate** (KH_2PO_4) ≥99% p.a.; anhydrous; MW 136.09 g/mol.	1 kg

Table B5.1 *continued*

14	**Malachite green oxalate** p.a.	100 g
15	**Glycerol** ($C_3H_8O_3$) ≥99% pure; MW 92.1 g/mol.	3 bottles
16	**Fresh eggs** Eggs from hens fed without growth factors or antibiotics, sourced from a local producer; each 1600 mL of medium requires 25 eggs.	2000
Modified Ogawa medium		
17	**Sodium L-glutamate monohydrate** ($C_5H_8NNaO_4 \cdot H_2O$) ≥98% pure; MW 187.13 g/mol.	1 kg
18	**Potassium dihydrogen phosphate** (KH_2PO_4) ≥99% p.a.; anhydrous; MW 136.09 g/mol.	1 kg
19	**Magnesium sulfate-heptahydrate** ($MgSO_4 \cdot 7H_2O$) ≥99% p.a.; MW 246.48 g/mol.	500 g
20	**Malachite green oxalate** p.a.	100 g
21	**Glycerol** ($C_3H_8O_3$) ≥99% pure; MW 92.1 g/mol (sold in 1 litre bottles).	2 bottles
22	**Fresh eggs** Eggs from hens fed without growth factors or antibiotics, sourced from a local producer; each 1600 ml of medium requires 25 eggs.	2000
Phosphate buffer according to Soerensen (1/15 M, pH 6.8 or adjustable between pH 5 and 8.2)		
23	**Disodium hydrogen phosphate** (Na_2HPO_4) For buffer; anhydrous; p.a.; MW 141.96 g/mol.	2 × 1 kg
24	Alternative: **Disodium hydrogen phosphate dodecahydrate** ($Na_2HPO_4 \cdot 12H_2O$) For buffer; p.a.; MW 358.14 g/mol.	2 × 1 kg
25	**Potassium dihydrogen phosphate** (KH_2PO_4) ≥99% p.a.; anhydrous; MW 136.09 g/mol.	2 × 2 kg
Decontamination procedures		
Petroff method		
26	**Sodium hydroxide** (NaOH) Purum ≥98%; MW 40 g/mol; 1 kg plastic bottle of pellets with tight screw cap.	2 bottles
Sodium phosphate method		
27	**Trisodium phosphate dodecahydrate** ($Na_3PO_4 \cdot 12H_2O$) MW 380.12 g/mol.	4 × 2.5 kg
N-acetyl-L-cysteine method		
28	NALC ($C_5H_9NO_3S$) Puriss ≥99%; MW 163.19 g/mol.	250 g
29	**Trisodium citrate dihydrate** ($C_6H_5Na_3O_7 \cdot 2H_2O$) MW 294.10 g/mol.	1 kg
30	**Sodium hydroxide** (NaOH) Purum ≥98%; MW 40 g/mol; 1 kg plastic bottle of pellets with tight screw cap.	1 bottle
Cetylpyridinium chloride for specimen transportation		
31	**Cetylpyridinium chloride monohydrate** ($C_{21}H_{38}ClN \cdot H_2O$) ≥98% pure for biochemistry; MW 358.01 g/mol; melting point 77 °C.	500 g

Table B5.1 *continued*

32	**Sodium chloride** ($NaCl$) p.a. ≥99%; MW 58.44 g/mol.	1 kg
Pretreatment of urine for enrichment before decontamination		
33	**5-sulfosalicylic acid dihydrate** ($C_6H_7NO_3S \cdot 2H_2O$) p.a. ≥99%; MW 254.22 g/mol.	100 g
Neutralization of gastric washings		
34	**Sodium bicarbonate** ($NaHCO_3$) >99% p.a.; MW 84 g/mol.	500 g
Reagents for biochemical identification of *M. tuberculosis*		
Paranitrobenzoic acid		
35	**Paranitrobenzoic acid (PNB, 4-nitrobenzoic acid)** ($C_7H_5O_4$) Purum ≥98%; MW 167.12 g/mol.	250 g
Niacin strips		
36	**Niacin strips** (50 per pack).	24 packs
Catalase test		
37	**Tween® 80** (polyoxyethylene-80-sorbitan monooleate)	1 kg
38	**Hydrogen peroxide** (H_2O_2) 30% p.a.; MW 34.01 g/mol; stabilised.	250 ml
Nitrate reduction test (nitratase test)		
39	**Potassium dihydrogen phosphate** (KH_2PO_4) ≥99% p.a.; anhydrous; MW 136.09 g/mol.	1 kg
40	**Disodium hydrogen phosphate** (Na_2HPO_4) Anhydrous; p.a.; for buffer; MW 141.96 g/mol.	1 kg
41	**Sodium nitrate** ($NaNO_3$) p.a. ≥99.5%; MW 84.99 g/mol.	500 g
42	**Sulfanilamide** ($C_6H_8N_2O_2S$) p.a. ≥98%; MW 172.21 g/mol; melting point >164 °C.	100 g
43	**N-(1-naphthyl)-ethylenediamine dihydrochloride** ($C_{12}H_{14}N_2 \cdot 2HCl$) p.a. ≥98%; MW 259.18 g/mol.	25 g
44	**Zinc dust** (Zn) p.a.	250 g
45	**Hydrochloric acid** (HCl) Purum ≥35%.	1 litre
Reagents for long-term storage of mycobacterial cultures		
46	**Skim-milk powder** (Sold in 500 g packs).	500 g
47	Alternative: **Glycerol** (Sold in 500 ml quantities).	4 × 500 ml
McFarland standard		
48	**Barium chloride dihydrate** ($BaCl_2 \cdot 2H_2O$) ≥99% p.a.; MW 244.26 g/mol.	250 g

Table B5.1 *continued*

49	**Sulfuric acid** (H_2SO_4) Purum.	100 ml
Solvent		
50	**Dimethyl sulfoxide** 99.8%, p.a.	500 ml
DST		
First-line drugs (of high quality with certified purity and/or potency)		
51	**Isoniazid** (5 g)	5 g
52	**Rifampicin** (1 g)	1 g
53	**Ethambutol** (25 g)	25 g
54	**Dihydrostreptomycin** (5 g)	5 g
Second-line drugs (with certified purity and/or potency)		
55	**Ofloxacin/Ciprofloxacin** (2 g)	2 g
56	**Protionamide/ethionamide** (2 g)	2 g
57	**Kanamycin/amikacin** (2 g)	2 g
58	**Capreomycin** (1 g)	1 g
Molecular biology		
Reagent for gene amplification		
59	**Taq polymerase** 250 units/vial; one vial per 200 amplifications.	As needed
Test kits/strips		
60	**Immunochromatographic tests** For the rapid identification of *M. tuberculosis*.	1200
61	**Line-probe assays in strips** For the rapid detection of resistance to rifampicin.	1000
Gel electrophoresis		
62	**Agarose** Universal use for separation of DNA fragments; range 100 base pairs (bp) to 20 kbp; melting point <90 °C; gel formation <45 °C.	100 g
63	**Boric acid** >99.5% for buffer.	1 kg
64	**Sodium acetate trihydrate** Analytical grade.	1 kg
65	**Ethidium bromide**	1 g
66	**TRIS** >99%; buffer grade.	3 × 1 kg
67	**EDTA** 99% for biochemistry.	250 g
68	**Gel load buffer** 6 × with Ficoll and bromophenol blue/xylencyan blue; 1 set of 6 × 1.8 ml fractions	1 set
Disinfectants		
Fumigation (BSC before filter change or emergency case)		

Table B5.1 *continued*

69	**Formalin** (CH_2O) Technical grade; ~37% stabilised with 10% methanol; MW 30.03 g/mol (sold in 1 litre plastic bottles).	2 litres
Other disinfectants (The amounts given are based on the preparation of approximately 4 litres/working day, to be adjusted to needs.)		
70	**Stable chlorine disinfectant** Sodium dichloroisocyanurate; 6 g per tablet; 1 g active chlorine per tablet; 100 tablets per pack (1–5 tablets per 5 litres of warm water).	5 packs
71	Alternative: **Calcium hypochlorite** ($Ca(ClO)_2$) Granules or tablets containing 70% available chlorine (usually requiring 5 g/l) (sold in 1 kg bottles).	5 bottles
72	Alternative: **Phenolic products** (e.g. triclosan, chloroxylenol, orthophenylphenol); to be used at concentrations of 5% (sold in 2.5 litre bottles).	20 bottles
73	Alternative: **Iodophores** A combination of iodine and an inert polymer such as polyvinylpyrrolidone; to be used at concentrations of 3–5% (sold in 2.5 litre bottles).	20 bottles
74	**Ethanol (70%) or isopropanol (2-propanol)** For alcohol-based disinfectants; only 1 litre/working day is required; approximately 250 litres/year (sold in 5 litre bottles).	50 bottles

Chapter B6:

Detailed specifications for selected items

Name of equipment: **Binocular bright field microscope**		**Code number:**
Tender specifications		**Bidder's specifications**
Quantity:	**Manufacturer:**	
	Type/model:	
	Country of origin:	
Description of function and use Microscope able to detect acid-fast bacilli (AFB), mainly in sputum smears, but also in other materials from suspected TB cases. The microscope will be used in TB microscopy centres, but in some settings will have additional uses (e.g. examining blood smears for malaria diagnosis). In the list below, specifications for uses other than TB diagnosis are given in italics.		
Main specifications		
Body Microscope to have a sturdy, stable base; its focus adjustment devices to be positioned to be comfortable for prolonged use and to allow for easy, exact movements. The body to be epoxy powder coated, heat treated and resistant to standard staining reagents, disinfectants and organic solvents used to clean lenses.		
Optical system Colour-corrected infinity optics with parafocal distance of 45 mm and tube length of 180 ± 20 mm. All optical parts (including objectives, eyepieces, lenses and prisms) to have anti-reflex coating. The entire optical system (all components, including fixation) to be 'anti-fungus' treated, with at least a 1-year warranty.		
Binocular eyepiece Binocular eyepiece, preferably with a tube that can be adjusted to an upper and lower position, so that it can be quickly adapted for laboratory workers of different heights. The tube to maintain parafocality while rotating through 360°, at an interpupillary distance of at least 50–75 mm. In some Asian countries, even smaller interpupillary distances (e.g. 48 mm) will be required. Viewing angle to be 30° and ergonomic.		
Eyepieces High-quality, paired eyepieces are required – achromatic, wide field, with 10× magnification. The eyepieces to have a minimum field number of 18, and preferably 20. Both eyepieces must have dioptre adjustment for maximum acuity; no pointer is required.		

Objectives

At least three plan achromatic objectives (10×, 40×, 100×) are needed; objectives ≥40× to be spring loaded.

- 10×, NA: 0.25
- 40×, NA: 0.65
- 50/60×, NA: 0.9 (for malaria testing)
- 100×, NA: 1.25 (for oil immersion)

If not preinstalled, objectives to be delivered in transparent, break-resistant, tightly closed containers, with objectives fixed in a stable position.

Marking and identification

All objectives to be engraved with the following information:

- name or code of the manufacturer
- magnification and numerical aperture
- sign: ∞.

100× objective to be marked (using words or a colour code) for use with immersion oil.

Nosepiece

Revolving nosepiece with a backwards incline, designed to accommodate four objectives. Ports not covered by an objective to be closed with a dust-proof screw plug made of metal or hard plastic.

The nosepiece to have a ribbed grip for easy rotation, a precision ball-bearing mechanism for smooth and accurate alignment, and precise stopping points. When changing from one objective to another, or rotating to the same objective, the object in the centre of the field should not appear to be displaced by more than 0.02 mm in any direction in the object plane.

Stage

The mechanical stage to be uniformly horizontal, with sides 140 mm ± 5 mm each.

The stage to have a spring-loaded slide holder, so that slides can be positioned safely and accurately, while allowing smooth travel in traverse directions. The travel range to be a least 75 mm × 30 mm (W × D); the knobs to be in a fatigue-proof position and suitable for right- or left-hand operation.

Condenser

Focusable Abbe-style substage condenser, 0.9/1.25, with rack and pinion arrangement incorporating an iris diaphragm.

Device for blue filter (approximately 32 mm) and/or other filters.

Substage illuminator

Modular illumination is preferable (e.g. a white light-emitting diode – LED – light source with a battery pack). Modules to be easy to change, preferably without tools or with a standard key that is included when delivered.

The substage illuminator to have a built-in variable light source (e.g. a 20–30 W, 6 V halogen lamp or 3 W, 6 V LED) with a constant power supply and automatic voltage surge protection. The light intensity to be adjustable and the on/off switch to be easily accessible. The lamp to have a lamp socket and the bulb to be easily replaceable. The housing for the light source to be designed to prevent dispersion of light and mounted to prevent heating the body of the microscope.

Focusing knobs

The microscope to have coaxial coarse and fine focusing knobs. The fine focusing movement to have a sensitivity of at least 500 µm/rotation over the entire coarse focusing range, and the total range to be at least 15 mm. The focusing knobs to be positioned on both sides, and the microscope to have a safety focusing stop arrangement.

All metallic parts of the microscope to be corrosion proof, acid proof and stain proof.

Optional

The manufacturer or supplier to provide a duly calibrated measurement instrument and demonstrate the specifications for the purchaser.

Electricity requirements

Supply voltage: 230 ± 10 V, AC, 50/60 Hz.
Voltage and plugs to be adapted to meet the country requirements.

Power consumption: approx. 30 W.

Conform to electrical safety standards IEC 60601-1, UL 61010-1, EN 61010-1.

Documentation

Manufacturer's certificate
The manufacturer must have a management system certified to ISO 9001 and a type-test certificate of relevant optical and mechanical tests.

Quality and safety standards met by the product must be listed.

Accessories

Dust cover, made of antistatic material.

One antistatic cleaning brush for each microscope.

One blue filter per microscope (wrapped separately in a box).

Options

Mirror unit
Plano-concave mirror, attachable to the base, for field use.

Battery pack
A 6 V DC battery pack with charger, that can work with a 230 V, AC, 50/60 Hz electricity supply and from the 12 V cigarette lighter socket in a car.

Case
A sturdy, lockable case for carrying or storing the microscope, with a handle and receptacles to hold accessories, objectives and eyepieces. The case to be padded and equipped with fixing points and straps to hold the microscope in place and to eliminate shocks during transportation.

A set of fuses for the illumination unit to be provided, if required.

If a special plug is needed for the country, a set of adapters to be provided.

Operation, maintenance and installation

Operation and maintenance manual
At least one set of operation, maintenance and service manuals for each microscope, written in United Nations languages (or at least in English) and preferably also in the official national language of the country requesting the microscope.

The manuals to include instructions for:

- setting up the microscope
- routine cleaning and maintenance (including how to change the bulb)
- changing the batteries inside the pack
- installing and using the mirror (for when the electric lamp is not working)
- planning periodic maintenance.

Installation and maintenance
The bidder to arrange for the equipment to be installed by certified or qualified personnel; any prerequisites for installation to be communicated to the purchaser in advance, in detail.

The bidder to also provide user training (including how to use and maintain the equipment) and a comprehensive maintenance plan. The cost of the maintenance plan to be defined and guaranteed over the period of warranty.

The supplier to provide an after-sale service that covers the whole country. The service to have competent staff, adequate infrastructure and sufficient spare parts to be able to respond to any complaints and to repair or replace the microscope within 14 days.

Standard maintenance tools All standard accessories, consumables and parts required to operate the equipment, including all standard tools and cleaning and lubrication material, to be included in the offer. Bidders must specify the quantity of every item included in their offer (including items not specified above).
Spare parts Each assembled microscope to be accompanied by an authorized list of accessories and spare parts.
If needed, a set of fuses for the illumination unit in use.
Two spare lamps for the illumination unit (spares are not usually required for LEDs).
Cleaning fluid.
Packing data Packing data are not necessarily part of the bidding process, but are required for shipment and for customs declarations.
Net weight.
Gross weight.
Dimensions (W × H × D) in cm.
Appliances must be transported upright (Y/N).
Customer's tariff number.
Warranty: At least one year.
Remarks The equipment offered, including its power supply, to be designed and constructed to operate properly and continuously in the conditions of the purchaser's country; the equipment may need to tolerate high humidity, ambient temperatures of 5–40 °C, fungi, and spikes in the electricity supply. Bidder may propose additional products to the requirements listed above.

Name of equipment:	Code number:
Binocular fluorescence microscope	

Tender specifications	Bidder's specifications
Quantity:	Manufacturer:
	Type/model:
	Country of origin:

Description of function and use

The microscope will be required to detect AFB, mainly in sputum smears, but also in other materials from suspected TB cases. The microscope will be used in TB microscopy centres with a high workload; microscopy examination with binocular fluorescence microscopes (FMs) can be up to five times faster than with a bright field microscope, and sensitivity is up to 10% higher than with conventional microscopy.

Comments:

FMs with mercury lamps require a continuous power supply and a darkroom. Mercury lamps are also expensive and have a short operating lifespan (200–250 hours).

An alternative is an FM with LEDs, which have a longer operating lifespan (15 000–20 000 hours) and do not require a darkroom.

Main specifications

Body

The microscope to have a sturdy, stable base; its focus adjustment devices to be positioned to be comfortable for prolonged use and to allow easy, exact movements.

The body to be epoxy powder coated, heat treated and resistant to standard staining reagents, disinfectants and organic solvents used to clean lenses.

Optical system

Colour-corrected infinity optics with parafocal distance of 45 mm and tube length of 180 ± 20 mm.

All optical parts (including objectives, eyepieces, lenses and prisms) to have anti-reflex coating. The entire optical system (all components, including fixation) to be "anti-fungus" treated with at least a 1-year warranty.

Binocular eyepiece

Binocular eyepiece, preferably with a tube that can be adjusted to an upper and lower position, so that it can be quickly adapted for laboratory workers of different heights. The tube to maintain parafocality while rotating through 360°, at an interpupillary distance of at least 50–75 mm. In some Asian countries, even smaller interpupillary distances (e.g. 48 mm) will be required. The viewing angle to be 30° and ergonomic.

Eyepieces

High-quality, paired eyepieces are required – achromatic, wide field and with 10× magnification. The eyepieces to have a minimum field number of 18, preferably 20.

Both eyepieces must have eyepiece dioptre adjustment for maximum acuity; no pointer is required.

Objectives

For fluorescence microscopy, at least two (preferably three) plan achromatic objectives are needed, corrected for use on slides without coverslips.

Objectives ≥40× to be of spring-loaded type.

- 10×, NA: 0.25
- 20×, NA: 0.40 (also for LED)
- 40×, NA: 0.65 (also for LED)
- 50×, NA: 0.80 (to replace 40×)
- 100×, NA: 1.25 (for oil immersion)

If not preinstalled, objectives to be delivered in transparent, break-resistant, tightly closed containers, with objectives fixed in a stable position.

Marking and identification

All objectives to be engraved with the following information:

- name or code of the manufacturer
- magnification and numerical aperture
- sign: ∞.

100× objective to be marked (using words or a colour code) for use with immersion oil.

Nosepiece

Revolving nosepiece with a backward incline, designed to accommodate four objectives. Ports not covered by an objective to be closed with a dust-proof screw plug made of metal or hard plastic.

The nosepiece to have a ribbed grip for easy rotation, a precision ball-bearing mechanism for smooth and accurate alignment, and precise stopping points. When changing from one objective to another, or rotating to the same objective, the object in the centre of the field should not appear to be displaced by more than 0.02 mm in any direction in the object plane.

Stage

The mechanical stage to be uniformly horizontal, with sides 140 mm ± 5 mm each.

The stage to have a spring-loaded slide holder, so that slides can be positioned safely and accurately, while allowing smooth travel in traverse directions. The travel range to be a least 75 mm × 30 mm (W × D); the knobs to be in a fatigue-proof position and suitable for right- or left-hand operation.

Condenser

Focusable Abbe-style substage condenser, 0.9/1.25, with rack and pinion arrangement incorporating an iris diaphragm.

Device for blue filter (approximately 32 mm) and/or other filters.

Substage illuminator

Modular illumination is preferable (e.g. a white LED light source with a battery pack). Modules to be easy to change, preferably without tools or with a standard key that is included when delivered.

The substage illuminator to have a built-in variable light source (e.g. a 20–30 W, 6 V halogen lamp or 3 W, 6 V LED) with a constant power supply and automatic voltage surge protection. The light intensity to be adjustable and the on/off switch to be easily accessible. The lamp to have a lamp socket and the bulb to be easily replaceable. The housing for the light source to be designed to prevent dispersion of light and mounted to prevent heating the body of the microscope.

If a mercury lamp is used:

- A lamp house for a 50 W mercury lamp with mirror and lens, three-dimensional adjustment and focus.
- Power supply with automatic igniter for mercury lamp, including a counter to track burning hours.
- Set of filters, including a cut-off filter.

If an LED is used:

- Fluorescence attachment for reflected light mode, with a blue LED light source and battery pack.
- Alternatively, a fluorescence attachment for transmitted light mode, with a blue LED light source to replace the light source of a bright field microscope.
- For each fluorescence attachment, a battery pack that can be installed between the power supply and the illumination unit (to act as an uninterrupted power supply [UPS] and filter against voltage surge).

Focusing knobs

The microscope to have coaxial coarse and fine focusing knobs. The fine focusing movement to have a sensitivity of at least 500 µm/rotation over the entire coarse focusing range, and the total range to be at least 15 mm. The focusing knobs to be positioned on both sides, and the microscope to have a safety focusing stop arrangement.

All metallic parts of the microscope to be corrosion proof, acid proof and stain proof.

Optional

The manufacturer or supplier to provide a duly calibrated measurement instrument and demonstrate the specifications to the purchaser.

Electricity requirements

Supply voltage: 230 ± 10 V, AC, 50/60 Hz.

Voltage and plugs to be adapted to meet the country requirements.

Power consumption: Will depend on the type of illumination (e.g. 20-400 W for a mercury lamp but only a few watts for an LED).

Conform to electrical safety standards IEC 60601-1, UL 61010-1, EN 61010-1.

Power supply with automatic igniter for mercury lamp with counter for burning hours.

Alternative for LED: Power supply, wide-range input.

Alternatively, battery pack may be used - together with a charger - as a UPS.

Protection class (in accordance with EN 60529).

Designed not to interfere with circuit radio (in accordance with EN 55014).

Documentation

Manufacturer's certificate

The manufacturer must have a management system certified to ISO 9001 and a type-test certificate of relevant optical and mechanical tests.

Quality and safety standards met by the product must be listed.

Accessories

Dust cover, made of antistatic material.

Battery pack

A 6 V DC battery pack, with charger, which can work with a 230 V, AC, 50/60 Hz electricity supply and from the 12 V cigarette lighter socket in a car.

Eye protection

If using an FM without a darkroom, a pair of well-fitting soft rubber pieces to protect the eyes and block stray light.

Case

A sturdy, lockable case for carrying or storing the microscope, with a handle and receptacles to hold accessories, objectives and eyepieces. The case to be padded and equipped with fixing points and straps to hold the microscope in place and to eliminate shocks during transportation.

One antistatic cleaning brush for each microscope.

At least one blue filter per microscope (wrapped separately in a box).

If a special plug is needed for the country, a set of adapters to be provided.

Operation, maintenance and installation

Operation and maintenance manual

At least one set of operation, maintenance and service manuals for each microscope, written in United Nations languages (or at least in English) and preferably also in the official national language of the country requesting the microscope.

The manuals to include instructions for:

- setting up the microscope
- routine cleaning and maintenance (including how to change the bulb)
- changing the batteries inside the pack
- installing and using the mirror (for when the electric lamp is not working)
- planning periodic maintenance.

Installation and maintenance

The bidder must arrange for the equipment to be installed by certified or qualified personnel; any prerequisites for installation to be communicated to the purchaser in advance, in detail.

The bidder to also provide user training (including how to use and maintain the equipment) and a comprehensive maintenance plan. The cost of the maintenance plan to be defined and guaranteed over the period of warranty.

The supplier to provide an after-sale service that covers the whole country. The service to have competent staff, adequate infrastructure and sufficient spare parts to be able to respond to any complaints, and to repair or replace the microscope within 14 days.

Standard maintenance tools

All standard accessories, consumables and parts required to operate the equipment, including all standard tools and cleaning and lubrication material, to be included in the offer. Bidders must specify the quantity of every item included in their offer (including items not specified above).

Spare parts

Each assembled microscope to be accompanied by an authorized list of accessories and spare parts.

A set of fuses for the illumination unit in use.

Two spare lamps for the illumination unit (for mercury lamps only; spares are not usually required for LEDs).

Packing data

Packing data are not necessarily part of the bidding process, but are required for shipment and for customs declarations.

Net weight.

Gross weight.

Dimensions (W × H × D) in cm.

Appliances must be transported upright (Y/N).

Customer's tariff number.

Warranty: At least one year.

Remarks

The equipment offered, including its power supply, to be designed and constructed to operate properly and continuously in the conditions of the purchaser's country; the equipment may need to tolerate high humidity, ambient temperatures of 5–40 °C, fungi, and spikes in the electricity supply.

Bidder may propose additional products to the requirements listed above.

Name of equipment:	Code number:
Binocular microscope with LED fluorescence capability	

Tender specifications		Bidder's specifications
Quantity:	Manufacturer:	
	Type/model:	
	Country of origin:	

Description of function and use

This microscope is required for the detection of acid fast bacilli (AFB), mainly in sputum smears, but also in other clinical materials. It can be used in microscopy laboratories for the detection of AFB, and if desired for other types of microscopic examinations, either in brightfield or fluorescence microscopy (FM).

Because of their high cost and lack of robustness, the classical fluorescence microscopy systems using mercury vapor lamps or other non-LED lamps are not recommended. They should only be used in laboratories performing a wide variety of tests in FM at widely differing excitation wavelengths, where LEDs would be impractical. In case only few FM applications with different excitation wavelengths are needed, modular LED FM systems with multiple or easily exchangeable LED lamps are preferred.

LED-based microscopy is recommended by WHO to be phased in as an alternative for conventional ZN microscopy in both high and low-volume laboratories if the following specifications are met.

Purchasers have at this moment three main options for replacement of existing microscopes with LED-FM.

- dual-use microscopes designed for simple switching between **reflected** FM and **transmitted** bright-field
- standard microscopes plus attachments consisting of special objectives and an LED light source that can adapt the microscopes for **reflected** FM
- standard microscopes plus an attachment consisting of an LED light source that is fitted onto the illumination system of the microscope to adapt it for **transmitted** FM.

Main specifications

Body

Sturdy, stable, base body with focus adjustment devices positioned for a prolonged comfortable use and easy, precise movement.

The body shall be epoxy powder coated durable metal, heat treated and resistant to standard reagents used for staining, organic solvents used for cleaning of lenses and disinfectants.

Optical system

All optical parts including objectives, eye pieces, lenses, prisms, should have anti-reflective and anti-fungal coating with a warranty of 1 year at minimum.

Binocular eyepiece

Binocular eyepiece, preferably with a tube flexible for use in an upper and lower position to ease the use by different lab workers, an ergonomic viewing angle of 30°, a tube rotatable through 360° at interpupillary distance ranging from at least 48-75 mm, maintaining parafocality.

Eyepieces

Paired, high-quality, achromatic, wide field, 10x magnification. The eyepieces should have a minimum field number of 18, an eyepiece diopter adjustment on at least one eyepiece and no pointer.

Objectives

For fluorescence microscopy, at least two infinity-corrected Plan Achromat objectives, corrected for use without cover glass (no-cover-slip slides).

Objectives ≥50x should be of spring-loaded type.

- 10x NA: 0.25 optional
- 20x NA: 0.40 essential
- 40-63x dry: essential for confirmation
- 100x NA: 1.25, for oil immersion (optional)

Marking and identification

All objectives should be engraved with the following information:

- name or code of the manufacturer
- magnification and numerical aperture (NA).

Nosepiece

Revolving nose piece to accommodate at least 4 objectives, any ports not covered by an objective should be closed with dust proof metallic or hard plastic screw caps.

The nose piece should be provided with ribbed grip for easy rotation on a precision ball bearing mechanism for smooth and accurate alignment with precise click stops. In changing from one objective to another or reintroducing the same objective by rotation, the object in the centre of the field should not appear displaced by more than 0.04 in the object plane in any direction.

Stage

Rectangular built in, uniformly horizontal, mechanical stage.

The stage should be provided with a spring-loaded slide holder for safe and exact positioning of the slide. The construction should allow a smooth travel in traverse directions.

Travel range of at least 75 x 30 mm (w x d), fatigue-proof position of knobs for movement, right or left-hand operation.

Condenser

Substage condenser of Abbe type, 0.9/1.25, with rack and pinion arrangement incorporating an iris diaphragm.

Substage illuminator

Substage illuminator for brightfield microscopy, with possibility to switch easily between FM and brightfield without tools with **either** a:

- built in light source (e.g. 20-30 W, 6 V halogen lamp), including a constant power supply with automatic voltage recognition and surge protector. The system should provide a light intensity adjustment device, and an easily accessible on/off switch. The lamp should be provided with a lamp socket for easy replacement of the bulb. The housing for the light source should be designed to prevent dispersion of light and mounted not to heat up the body of the microscope

or

- 3 W, 6 V white LED could be used, built-in or modular.

Fluorescence illumination

Fluorescence illumination, depending on microscope type may be:

- a built-in LED blue light source with maximum wavelength close to 450 nm for reflected light examination
- an LED blue light source attachment with maximum wavelength close to 450 nm that is fitted into a special objective for reflected light examination
- an LED blue light source attachment with maximum wavelength close to 450 nm that is fitted onto the illumination system of a standard microscope and sliding barrier 510 nm long-pass filter for transmitted light examination.

Focusing knobs

Co-axial coarse and fine focusing knobs capable of smooth fine focusing movement over the full range of coarse travel. The fine focusing movement should have a sensitivity of at least 500 µm per rotation over the entire coarse focusing range. Focusing knobs should be at both sides. A focusing stop safety arrangement should be provided, as well as a total range of at least 15 mm.

All metallic parts of the microscope to be corrosion proof, acid proof and stain proof.

Electricity requirements

Supply voltage: 100-230 ± 10 V, AC, 50/60 Hz
Voltage and plugs shall be adapted to those used inside the country.

Power consumption: Will depend on the illumination equipment (max. 30 W)

Conform to electrical safety IEC-60601-1, UL 61010-1, EN 61010-1.

Power supply, wide range input with 6 V converter.

Protection class (in accordance with EN 60529).

Designed not to interfere with circuit radio (in accordance with EN 55014).

Documentation

Manufacturer's certificate
The manufacturer must have a management system certified to ISO 9001 and a type-test certificate of relevant optical and mechanical tests.

Quality and safety standards met by the product must be listed.

Accessories

Dust cover, made of antistatic material.

Battery pack
Optional: Battery pack (6 V DC) with charger working with 100-230 V AC, 50-60 Hz supply, as well as from the cigarette lighter of a car, 12 V DC.

Eye protection
Optional: If using an FM without a darkroom, a pair of well-fitting soft rubber pieces to protect the eyes and block stray light.

One antistatic cleaning brush for each microscope.

At least one blue filter per microscope (wrapped separately in a box).

Optional: A self-standing mirror unit adapted to the space between base and substage condenser, providing bright illumination when used in brightfield.

If a special plug is needed for the country, a set of adapters is to be provided.

Operation, maintenance and installation

Operation and maintenance manual
At least one set of operation, maintenance and service manuals for each microscope, written in United Nations languages (or at least in English) and preferably also in the official national language of the country requesting the microscope.

The manuals to include instructions for:

- setting up the microscope
- routine cleaning and maintenance (including how to change the bulb)
- changing the batteries inside the pack
- installing and using the mirror (for when the electric lamp is not working)
- planning periodic maintenance.

Installation and maintenance
The bidder must arrange for the equipment to be installed by certified or qualified personnel; any prerequisites for installation to be communicated to the purchaser in advance, in detail.

The bidder to also provide user training (including how to use and maintain the equipment) and a comprehensive maintenance plan. The cost of the maintenance plan to be defined and guaranteed over the period of warranty.

The supplier to provide an after-sale service that covers the whole country. The service to have competent staff, adequate infrastructure and sufficient spare parts to be able to respond to any complaints, and to repair or replace the microscope within 14 days.

Standard maintenance tools All standard accessories, consumables and parts required to operate the equipment, including all standard tools and cleaning and lubrication material, to be included in the offer. Bidders must specify the quantity of every item included in their offer (including items not specified above).
Spare parts Each assembled microscope to be accompanied by an authorized list of accessories and spare parts.
Packing data Packing data are not necessarily part of the bidding process, but are required for shipment and for customs declarations.
Net weight.
Gross weight.
Dimensions (W × H × D) in cm.
Appliances must be transported upright (Y/N).
Customer's tariff number.
Warranty: At least one year.
Remarks The equipment offered, including its power supply, to be designed and constructed to operate properly and continuously in the conditions of the purchaser's country; the equipment may need to tolerate high humidity, ambient temperatures of 5–40 °C, fungi, and spikes in the electricity supply. Bidder may propose additional products to the requirements listed above.

Name of equipment:	**Code number:**
Water distiller (4 l/hour)	

Tender specifications		**Bidder's specifications**
Quantity:	**Manufacturer:**	
	Type/model:	
	Country of origin:	

Description of function and use

Water quality determines the quality of reagents, solutions and culture media in the laboratory.

Remarks

Fully automated water distillers need a constant water supply of sufficient pressure (usually 3 bar).

If the water pressure at the entrance of the laboratory is higher than 5 bar, it is to be regulated down to about 3 bar.

If the water pressure in the laboratory is low (less than 2 bar) or fluctuating, a simple manual distiller for tap water can be used, but it will need to be monitored.

Main specifications

Water distilling apparatus (with a capacity of at least 4 l/hour).

Wall-mounted distiller.

Double-walled housing, with the outer housing made of sheet steel, protected against rust (e.g. galvanised steel, powder coated with epoxy resin).

All parts in contact with steam or distilled water to be made of high-quality stainless steel.

Built-in storage tank to hold around 8 litres of distilled water.

Cooling coil (easily accessible and exchangeable).

Water supply connected through a built-in solenoid valve with sufficiently wide cross-section (e.g. ½ inch hose).

Water level regulator that switches off (i.e. stops heating and cooling the water supply) when the storage tank is full.

Mechanism to automatically restart the distiller when distilled water is withdrawn.

Electronic device to switch off the evaporator when impurities are detected (along with an indicator, such as an alarm or light, to show shut-down).

The evaporator to have an easily accessible drainage stopcock with hose.

Heating elements to be made of stainless steel.

Integral filter and flow-control system.

Cut-off in case of water supply shortage.

Distilled water to comply with the International Pharmacopoeia, be free from pyrogen and have a conductivity of ≤2.3 µS/cm at 20 °C.

Net weight: approximately 20 kg.

Electricity requirements

Supply voltage: 230 ± 10 V, AC, 50/60 Hz.

Voltage and plugs to be adapted to meet the country requirements.

Power consumption: Approximately 3 kW.

Conform to electrical safety standards IEC 60601-1, UL 61010-1, EN 61010-1.

Protection class (in accordance with EN 60529).

Designed not to interfere with circuit radio (in accordance with EN 55014).

Documentation

Manufacturer's certificate

The manufacturer must have a management system certified to ISO 9001.

Quality and safety standards met by the product must be listed.

Accessories

Electrical conductivity meter

If an electrical conductivity meter is not integrated into the distiller apparatus, an independent meter to be supplied, to be mounted at the withdraw point of distillate.

Hose and clamps required to install the distiller.

Additional storage tank (if larger amounts of water are required each day).

Operation, maintenance and installation

Operation and maintenance manual

At least one set of operation, maintenance and service manuals for each water distiller, written in United Nations languages (or at least in English) and preferably also in the official national language of the country requesting the distiller.

The manuals to include instructions for:

- setting up the distiller
- routine cleaning and maintenance
- planning for periodic maintenance.

Installation and maintenance

The bidder must arrange for the equipment to be installed by certified or qualified personnel; any prerequisites for installation to be communicated to the purchaser in advance, in detail.

The bidder to also provide user training (including how to use and maintain the equipment) and a comprehensive maintenance plan. The cost of the maintenance plan to be defined and guaranteed over the period of warranty.

The supplier to provide an after-sale service that covers the whole country. The service to have competent staff, adequate infrastructure and sufficient spare parts to be able to respond to any complaints and to repair or replace the distiller within 14 days.

Standard maintenance tools

All standard accessories, consumables and parts required to operate the equipment, including all standard tools and cleaning material, to be included in the offer. Bidders must specify the quantity of every item included in their offer (including items not specified above).

Spare parts

Each assembled distiller to be accompanied by an authorized list of accessories and spare parts.

Flexible tube and clamps (to withstand pressures up to 10 bar).

Packing data

Packing data are not necessarily part of the bidding process, but are needed for shipment and customs declarations.

Net weight.

Gross weight.

Dimensions (W × H × D) in cm.

Appliances must be transported upright (Y/N).

Customer's tariff number.

Warranty: At least three years.

Remarks

The equipment offered, including its power supply, to be designed and constructed to operate properly and continuously in the conditions of the purchaser's country; the equipment may need to tolerate high humidity, ambient temperatures of 5-40 °C, fungi, and spikes in the electricity supply.

Bidders may propose products additional to the requirements listed above.

Name of equipment:
Magnetic stirrer hot plate

Code number:

Tender specifications		**Bidder's specifications**
Quantity:	**Manufacturer:**	
	Type/model:	
	Country of origin:	

Description of function and use
A magnetic stirrer is used to dissolve ingredients for culture media or buffer solutions.

Main specifications

Sturdy case – coated and resistant to chemicals, dyes and disinfectants.

Speed range: 60–1200 rpm.

Heating plate
Made of aluminium, stainless steel or glass ceramic; resistant to scratches and chemicals.

Plate diameter: ≥135 mm, or (for right-angle plates) surface ≥140 cm^2.

Heat output: ≥600 W.

Heating temperature range: from room temperature to 250 °C.

Heating device and temperature regulation.

Safety circuit: 50 °C above hot-plate temperature.

Temperature setting.

Temperature accuracy at hot plate: ±5 °C.

Load on plate: up to 20 kg.

Permissible ambient temperature: 5–40 °C.

Permissible relative humidity: ≤80%.

Weight: <5 kg.

Electricity requirements

Supply voltage: 230 ± 10 V, AC, 50/60 Hz.
Voltage and plugs to be adapted to meet the country requirements.

Power consumption: Approximately 800 W.

Conform to electrical safety standards IEC 60601-1, UL 61010-1, EN 61010-1.

Protection class (in accordance with EN 60529).

Designed not to interfere with circuit radio (in accordance with EN 55014).

Documentation

Manufacturer's certificate
The manufacturer must have a management system certified to ISO 9001.

Quality and safety standards met by the product must be listed.

Accessories

Set of 10 magnetic bars: 1 × 15 mm, 2 × 20 mm, 2 × 25 mm, 1 × 30 mm, 2 × 40 mm, 2 × 50 mm.

Operation, maintenance and installation

Operation and maintenance manual

At least one set of operation, maintenance and service manuals for each hot plate, written in United Nations languages (or at least in English) and preferably also in the official national language of the country requesting the hot plate.

Installation and maintenance

The bidder must arrange for the equipment to be installed by certified or qualified personnel; any prerequisites for installation to be communicated to the purchaser in advance, in detail.

The bidder to also provide user training (including how to use and maintain the equipment) and a comprehensive maintenance plan. The cost of the maintenance plan to be defined and guaranteed over the period of warranty.

The supplier to provide an after-sale service that covers the whole country. The service to have competent staff, adequate infrastructure and sufficient spare parts to be able to respond to any complaints and to repair or replace the hot plate within 14 days.

Standard maintenance tools

All standard accessories, consumables and parts required to operate the equipment, including all standard tools and cleaning material, to be included in the offer. Bidders must specify the quantity of every item included in their offer (including items not specified above).

Spare parts

Each magnetic stirrer hot plate to be accompanied by an authorized list of accessories and spare parts.

Packing data

Packing data are not necessarily part of the bidding process, but are needed for shipment and for customs declarations.

Net weight.

Gross weight.

Dimensions (W × H × D) in cm.

Appliances must be transported upright (Y/N).

Customer's tariff number.

Warranty: At least one year.

Remarks

The equipment offered, including its power supply, to be designed and constructed to operate properly and continuously in the conditions of the purchaser's country; the equipment may need to tolerate high humidity (as high as 90% at 35 °C), ambient temperatures of 5–40 °C, fungi, and spikes in the electricity supply.

Bidders may propose products additional to the requirements listed above.

Name of equipment: Precision balance	Code number:

Tender specifications	Bidder's specifications
Quantity:	Manufacturer:
	Type/model:
	Country of origin:

Description of function and use	
A precision balance is mainly used to weigh dyes for staining solutions and components for culture media. Temperature variation and static electricity will cause precision balances to display erratic readings. Therefore, the balance is to be operated on an antistatic surface, in a room with a constant temperature and a steady relative humidity of >65%.	
Main specifications	
Electronic balance, weighing capacity 60 g, 120 g or 210 g.	
Tare range = full capacity by subtraction.	
Stabilization time: ≤5 seconds.	
Housing resistant to chemicals and cleaning materials.	
Stainless steel weighing pan, approximately 115 mm diameter.	
Adjustable feet (so the balance can be levelled).	
Waterproof display and keypad, sealed by a durable, flexible membrane.	
Background illuminated (backlit) display with digits at least 15 mm high.	
User-friendly menu (preferably in different languages but at least in English) so the balance can be configured to individual requirements.	
Level indicator to be close to the display or in the view field of the display.	
Built-in motorized calibration of weight with automatic adjustment.	
Readability: 0.001 g (1 mg).	
Repeatability: 0.001 g (1 mg).	
Linearity: 0.002 g (2 mg).	
Electricity requirements	
Supply voltage: 230 ± 10 V, AC, 50/60 Hz. Voltage and plugs to be adapted to meet country requirements.	
Power consumption: Low.	
Optional: Battery with a rechargeable battery pack and main power DC transformer.	
Conform to electrical safety standards IEC 60601-1, UL 61010-1, EN 61010-1.	
Protection class (in accordance with EN 60529).	
Designed not to interfere with circuit radio (in accordance with EN 55014).	

Documentation

Manufacturer's certificate

The manufacturer must have a management system certified to ISO 9001.

One certificate to state that the balance has been calibrated at the factory.

Quality and safety standards met by the product must be listed.

Accessories

Set of calibration weights.

Protective dust cover.

Weighing scoop, 90 mm, stainless steel.

Operation and maintenance manual

At least one set of operation, maintenance and service manuals written in United Nations languages (or at least in English) and preferably also in the official national language of the country requesting the precision balance.

Installation and maintenance

The bidder must arrange for the equipment to be installed by certified or qualified personnel; any prerequisites for installation to be communicated to the purchaser in advance, in detail.

The bidder to also provide user training (including how to use and maintain the equipment) and a comprehensive maintenance plan. The cost of the maintenance plan to be defined and guaranteed over the period of warranty.

The supplier to provide an after-sale service that covers the whole country. The service to have competent staff, adequate infrastructure and sufficient spare parts to be able to respond to any complaints and to repair or replace the balance within 14 days.

Standard maintenance tools

All standard accessories, consumables and parts required to operate the equipment, including all standard tools and cleaning and lubrication materials, to be included in the offer. Bidders must specify the quantity of every item included in their offer (including items not specified above).

Spare parts

Each balance to be accompanied by an authorized list of accessories and spare parts.

Packing data

Packing data are not necessarily part of the bidding process, but are needed for shipment and for customs declarations.

Net weight.

Gross weight.

Dimensions (W × H × D) in cm.

Appliances must be transported upright (Y/N).

Customer's tariff number.

Warranty: Five years.

Remarks

The equipment offered, including its power supply, to be designed and constructed to operate properly and continuously in the conditions of the purchaser's country; the equipment may need to tolerate high humidity (as high as 90% at 35 °C), ambient temperatures of 5–40 °C, fungi, and spikes in the electricity supply.

Bidders may propose products additional to the requirements listed above.

Name of equipment:
pH meter

Code number:

Tender specifications

Bidder's specifications

Quantity:

Manufacturer:

Type/model:

Country of origin:

Description of function and use

A pH meter is required to check the pH of buffer solutions and/or culture media solutions used in a general diagnostic TB laboratory.

Main specifications

Portable pH meter with waterproof housing (according to Ingress Protection 67).

Resolution: ≤0.01 pH units.

Accuracy: ±0.01 pH units.

Temperature measurement: ±0.1 °C accuracy.

Calibration with at least three standard calibration buffers (pH 4.0, 7.0, 10.0); automatic calibration preferred.

Calibration reminder: adjustable from 1 to 999 days.

Temperature compensation, preferably automatic.

Illuminated display with indication after stabilisation of measured values.

Multi-function display.

Options

Ability to store calibration data (day, month, year, zero point and two values for steepness of curve).

Complete good laboratory practice (GLP) compliance record.

Ability to store ≥500 measurements, automatically logged.

Password-protected data access.

Transport case, with additional compartments for a glass combination pH electrode with integrated temperature sensor, electrode holder swing arm and calibration buffers.

Electricity requirements

Supply voltage: 230 ± 10 V, AC, 50/60 Hz.

Voltage and plugs to be adapted to meet the country requirements.

Power consumption: Low.

Optional: Battery with a rechargeable battery pack and main power DC transformer.

Documentation

Manufacturer's certificate

The manufacturer must have a management system certified to ISO 9001.

A certificate to state that the pH meter has been calibrated at the factory.

Quality and safety standards met by the product must be listed.

Accessories

Optional: RS 232 interface cable for connecting the pH meter to a computer.

Optional: Software, preferably for installation under Windows.

Operation, maintenance and installation

Operation and maintenance manual

At least one set of operation, maintenance and service manuals written in United Nations languages (or at least in English) and preferably also in the official national language of the country requesting the pH meter.

Installation and maintenance

The bidder must arrange for the equipment to be installed by certified or qualified personnel; any prerequisites for installation to be communicated to the purchaser in advance, in detail.

The bidder to also provide user training (including how to use and maintain the equipment) and a comprehensive maintenance plan. The cost of the maintenance plan to be defined and guaranteed over the period of warranty.

The supplier to provide an after-sale service that covers the whole country. The service to have competent staff, adequate infrastructure and sufficient spare parts to be able to respond to any complaints and to repair or replace the pH meter within 14 days.

Standard maintenance tools

All standard accessories, consumables and parts required to operate the equipment, including all standard tools and cleaning and lubrication materials, to be included in the offer. Bidders must specify the quantity of every item included in their offer (including items not specified above).

Spare parts

Each pH meter to be accompanied by an authorized list of accessories and spare parts.

Supply of stock of calibration buffers.

Optional: Electrode.

Packing data

Packing data are not necessarily part of the bidding process, but are needed for shipment and for customs declarations.

Net weight.

Gross weight.

Dimensions (W × H × D) in cm.

Appliances must be transported upright (Y/N).

Customer's tariff number.

Warranty: Two years.

Remarks

The equipment offered, including its power supply, to be designed and constructed to operate properly and continuously in the conditions of the purchaser's country; the equipment may need to tolerate high humidity (as high as 90% at 35 °C), ambient temperatures of 5–40 °C, fungi, and spikes in the electricity supply.

Bidders may propose products additional to the requirements listed above.

Name of equipment: Analytical balance	Code number:

Tender specifications		Bidder's specifications
Quantity:	Manufacturer:	
	Type/model:	
	Country of origin:	

Description of function and use An analytical balance is needed to prepare media containing drugs, for DST. The balance may also be used to calibrate, recalibrate and maintain microlitre pipettes used in the laboratory, especially for molecular biology. Temperature variation and static electricity will cause analytical balances to display erratic readings. Therefore, the balance is to be operated on an antistatic surface, in a room with a constant temperature and a steady relative humidity of >65%.
Main specifications
Weighing capacity: 60–200 g.
Tare range = full capacity by subtraction.
Stabilization time: ≤5 seconds.
Housing resistant to chemicals and cleaning materials.
Glass doors (not plastic) that close tightly.
Stainless steel weighing pan, approximately 80 mm diameter.
Full glass windscreen, able to be opened on both sides and from the top cover.
Adjustable feet (so the balance can be levelled).
Waterproof display and keypad, sealed by a durable flexible membrane.
Background illuminated (backlit) display with digits at least 15 mm high.
User-friendly menu (preferably in different languages but at least in English) so the balance can be configured to individual requirements.
Level indicator to be close to the display or in the view field of the display.
Built-in motorized calibration of weight with automatic adjustment (or calibration using an external standard weight).
Readability: 0.0001 g (0.1 mg).
Repeatability: 0.0001 g (0.1 mg).
Linearity: 0.0002 g (0.2 mg).
Optional: Bidirectional RS 232C interface with ISO/GLP-compliant data export.
Electricity requirements
Supply voltage: 230 ± 10 V, AC, 50/60 Hz. Voltage and plugs to be adapted to meet the country requirements.
Power consumption: Low.
Protection class (in accordance with EN 60529).
Designed not to interfere with circuit radio (in accordance with EN 55014).

Documentation

Manufacturer's certificate

The manufacturer must have a management system certified to ISO 9001.

The manufacturer to provide a declaration of conformity to standards that apply to the product, including ingress protection rating and weight classifications and applications.

One certificate to state that the balance has been calibrated at the factory.

Certificates to be provided for each item supplied.

Quality and safety standards met by the product must be listed.

Accessories

Balance table with vibration bumpers, preferably granite isolator.

Protective dust cover.

Set of calibration weights.

Optional: Weighing scoop, 90 mm, stainless steel.

Optional: RS 232 interface cable.

Operation, installation and maintenance

Installation and maintenance

The bidder must arrange for the equipment to be installed by certified or qualified personnel at the place indicated, free of cost. Detailed installation prerequisites to be communicated to the purchaser in advance, especially for the electric power supply needed, including type of plug (or other way of connection).

Detailed instruction of laboratory personnel on use, function and maintenance of the equipment (user training), as well as a comprehensive maintenance plan (logbook with daily, weekly, monthly and quarterly maintenance checklist), to be provided.

The cost of the maintenance plan to be defined and guaranteed over the period of warranty.

The supplier to provide a functioning after-sale service covering the whole country. The service to have adequate infrastructure, competent staff and sufficient spare parts to be able to respond to any complaints and to repair or replace the balance within 14 days.

Standard maintenance tools

All standard accessories, consumables and parts required to operate the equipment, including all standard tools and cleaning and lubrication materials, to be included in the offer. Bidders must specify the quantity of every item included in their offer (including items not specified above).

Spare parts

Each balance to be accompanied by an authorized list of accessories and spare parts.

Packing data

Packing data are not necessarily part of the bidding process, but are needed for shipment and customs declarations.

Net weight.

Gross weight.

Dimensions (W × H × D) in cm.

Appliances must be transported upright (Y/N).

Customer's tariff number.

Warranty: At least three years.

Remarks

The equipment offered, including its power supply, to be designed and constructed to operate properly and continuously in the conditions of the purchaser's country; the equipment may need to tolerate high humidity (as high as 90% at 35 °C), ambient temperatures of 5-40 °C, fungi, and spikes in the electricity supply.

Bidders may propose products additional to the requirements listed above.

Name of equipment:	Code number:
Gas burner for biological safety cabinet	

Tender specifications		Bidder's specifications
Quantity:	Manufacturer:	
	Type/model:	
	Country of origin:	

Description of function and use A safety gas burner allows flame control with ignition on demand and is suited for work in a BSC.
Main specifications
Compact design (W × H × D, max.130 mm × 60 mm × 170 mm); stainless steel and glass with fire-proof controls; for use in a BSC.
Nozzles for the use of natural and propane/butane gas.
Gas input filter to protect magnetic valve.
Working pressure for natural gas: 18-25 mbar.
Working pressure for propane or butane: 20-50 mbar.
Operation mode: both hands free, with foot switch, automatic ignition.
Two modes: conventional short term (flame during pressed foot on switch) and flexible start-stop function with timer.
Stable flame in strong laminar air flow.
Ignition and flame control.
Automatic cut-off of gas supply when re-ignition fails for more than 15 seconds.
Alarm: audible, with display on dysfunction.
Overheating protection.
Integrated drains for liquids accidentally spilled into the burner head.
Removable burner heat.
Adjustable burn time (1 sec - ≥60 min).
Tilting of the instrument to both sides possible.
Electricity requirements
Supply voltage: 230 ± 10 V, AC, 50/60 Hz. Voltage and plugs to be adapted to meet the country requirements.
Power consumption: Approximately 50 W.
Protection class (in accordance with EN 60529).
Designed not to interfere with circuit radio (in accordance with EN 55014).
Documentation
Manufacturer's certificate The manufacturer must have a management system certified to ISO 9001. Certificates to be provided for each item supplied.
Quality and safety standards met by the product must be listed.

Accessories

Glass spatter guard: a glass cylinder fitted to surround the flame for protection against spattering infectious material.

Adapter for the connection of gas cartridge (e.g. CV 360 or C 206 including pressure-reducing valve and gas safety hose of 500 mm).

Gas safety hose with safety clamps on both sides, 750–1000 mm long.

Operation, maintenance and installation

Operation and maintenance manual

At least one set of operation, maintenance and service manuals written in United Nations languages (or at least in English) and preferably also in the official national language of the country requesting the gas burner.

Installation and maintenance

The bidder must arrange for the equipment to be installed by certified or qualified personnel; any prerequisites for installation to be communicated to the purchaser in advance, in detail.

The bidder to also provide user training (including how to use and maintain the equipment) and a comprehensive maintenance plan. The cost of the maintenance plan to be defined and guaranteed over the period of warranty.

The supplier to provide an after-sale service that covers the whole country. The service to have competent staff, adequate infrastructure and sufficient spare parts to be able to respond to any complaints and to repair or replace the gas burner within 14 days.

Standard maintenance tools

All standard accessories, consumables and parts required to operate the equipment, including tools to maintain and change nozzles, to be included in the offer. Bidders must specify the quantity of every item included in their offer (including items not specified above).

Spare parts

Each safety burner to be accompanied by an authorized list of accessories and spare parts.

Nozzle according to the gas used.

Packing data

Packing data are not necessarily part of the bidding process, but are needed for shipment and customs declarations.

Net weight.

Gross weight.

Dimensions (W × H × D) in cm.

Appliances must be transported upright (Y/N).

Customer's tariff number.

Warranty: Two years.

Remarks

The equipment offered, including its power supply, to be designed and constructed to operate properly and continuously in the conditions of the purchaser's country; the equipment may need to tolerate high humidity (as high as 90% at 35 °C), ambient temperatures of 5–40 °C, fungi, and spikes in the electricity supply.

Bidders may propose products additional to the requirements listed above.

Name of equipment: Micro-incinerator	Code number:
Tender specifications	**Bidder's specifications**
Quantity:	**Manufacturer:**
	Type/model:
	Country of origin:

Description of function and use The micro-incinerator allows sterilization of metal inoculating loops without a flame and is suited for work in a BSC.
Main specifications
Heating element of ceramic surrounded by isolating cover.
Quick infrared heating to temperatures ≥800 °C for fast sterilization.
Stand with suction-cup feet (or equivalent) for stable, safe operation.
Possibility to fix the incinerator to a stand at different angles.
Electricity requirements
Supply voltage: 230 ± 10 V, AC, 50/60 Hz, and appropriate DC power supply. Voltage and plugs to be adapted to meet the country requirements.
Power consumption: 2000 W.
Protection class (in accordance with EN 60529).
Designed not to interfere with circuit radio (in accordance with EN 55014).
Documentation
Manufacturer's certificate The manufacturer must have a management system certified to ISO 9001. Certificates to be provided for each item supplied.
Quality and safety standards met by the product must be listed.
Accessories
Attached loop holder if desired.
Operation, installation and maintenance
Operation and maintenance manual At least one set of operation, maintenance and service manuals, written in United Nations languages (or at least in English) and preferably also in the official national language of the country requesting the micro-incinerator.

Installation and maintenance

The bidder must arrange for the equipment to be installed by certified or qualified personnel; any prerequisites for installation to be communicated to the purchaser in advance, in detail.

The bidder to also provide user training (including how to use and maintain the equipment) and a comprehensive maintenance plan. The cost of the maintenance plan to be defined and guaranteed over the period of warranty.

The supplier to provide an after-sale service that covers the whole country. The service to have competent staff, adequate infrastructure and sufficient spare parts to be able to respond to any complaints and to repair or replace the micro-incinerator within 14 days.

Standard maintenance tools

All standard accessories, consumables and parts required to operate the equipment, including all standard tools and cleaning material, to be included in the offer. Bidders must specify the quantity of every item included in their offer (including items not specified above).

Spare parts

Each micro-incinerator to be accompanied by an authorized list of accessories and spare parts.

Packing data

Packing data are not necessarily part of the bidding process, but are needed for shipment and for customs declarations.

Net weight.

Gross weight.

Dimensions (W × H × D) in cm.

Appliances must be transported upright (Y/N).

Customer's tariff number.

Warranty: Two years.

Remarks

The equipment offered, including its power supply, to be designed and constructed to operate properly and continuously in the conditions of the purchaser's country; the equipment may need to tolerate high humidity (as high as 90% at 35 °C), ambient temperatures of 5–40 °C, fungi, and spikes in the electricity supply.

Bidders may propose products additional to the requirements listed above.

Name of equipment:	Code number:
Biological safety cabinet class I	

Tender specifications	Bidder's specifications
Quantity:	Manufacturer:
	Type/model:
	Country of origin:

Description of function and use
This BSC is used in a TB laboratory for processing specimens consisting of liquefaction of sputa and handling cultures of tubercle bacilli. This type of BSC is not adequate for handling volatile or toxic chemicals or radionuclides. Before ordering a BSC, facility and engineering requirements to be checked. Organization of a periodical recertification of the BSC by an authorized agency to be in place.
Main specifications
The BSC to meet the requirements of EN 12469 or NSF 49.
External height ≤2200 mm including support stand, allowing an available space of at least 400 mm from the top of the BSC to the ceiling. Higher versions may be accepted, provided the 400 mm over the BSC is available to measure air velocity above the exhaust filter and to have enough space for changing the filter and for ducting and/ or a thimble connection to outlet.
Internal working area (approximate): ▪ For a BSC of 120 cm (4 ft): width 1150 mm × depth 630 mm × height 650-750 mm. ▪ For a BSC of 150 cm (5 ft): width 1450 mm × depth 630 mm × height 650-750 mm. ▪ For a BSC of 180 cm (6 ft): width 1700 mm × depth 630 mm × height 650-750 mm. A BSC of 120 cm (4 ft) provides the minimal space needed for safe work.
Inside finish: stainless steel, high quality (e.g. grade 304).
External housing, including screws, made of stainless steel or equivalent resistant galvanized (zinc-coated) sheet steel, subsequently powder coated and thermally hardened; minimum 80 µm thick, or other material that is hard-wearing, resistant to disinfectants and chemicals used in a TB laboratory, and abrasion resistant.
Vertical window: aerosol-tight, sliding, safety glass (laminated multilayer safety glass only), thickness ≥6.7 mm. Foldout windows made of tempered glass are also acceptable. Acrylic glass is not acceptable.
Working aperture: ≥170 mm measured from work surface to the bottom of the window.
Maximal lifting height of front window: 500 mm.
Ability to lock the window hermetically for gaseous disinfection for filter decontamination.
Single-piece working surface preferred. Alternatively: Working surface as segments.
Noise pressure level: ≤60 dbA.[1]

1 dbA refers to decibels expressed using the A scale, which roughly corresponds to the inverse of the 40 db (at 1 kHz) equal-loudness curve.

Internal fittings	
Optional (if a safety gas burner will be used): Gas tap with solenoid valve, optional right or left side. For a laboratory located in a seismic area, gas pipes are not recommended; small gas containers (approximately 200–400 ml) with butane gas directly fixed to the burner to be used instead. Not necessary when a micro-incinerator is used.	
Two plugs, 230 ± 10 V, AC, 50/60 Hz, protected with separate T5A (slow blow) fuse. Voltage and plugs adapted to those used in the country. **Warning:** Plugs inside the BSC may differ from the main connection to the electricity network.	
Flicker-free, low-glare, warm-coloured light, >1000 lux.	
Optional: ultraviolet C light (253.7 nm wavelength); 30 W with hour counter; with interlock with white light so that the UVC light can be switched on only when the white light source is switched off.	
Control display on the front of the BSC.	
Electrical control or indicators.	
Electronic fan control.	
Flow meter for air influx velocity.	
Operating hours indicator (counter).	
Optional: UV light timer.	
Filter and flow conditions	
Prefilter construction preferred; easily accessible filter change without tools preferred.	
High-efficiency particulate air (HEPA) filter (exhaust air filter); classification at least H14; conforming with EN 1822; metal framed.	
Inward air velocity: ≥0.38 m/s.	
Exhaust volume airflow/ inward volume airflow: 300–600 m^3/h.	
Blower system to be able to maintain the airflow within a minimum window (narrow limits) on voltage fluctuations. Data to be available on request.	
Alarms, visible or audible, for any unsafe condition of the BSC (e.g. airflow, window position). Possibility to shut down alarm for cleaning and maintenance.	
Electricity requirements	
Supply voltage: 230 ± 10 V, AC, 50/60 Hz. Voltage and plugs to be adapted to meet the country requirements.	
Lead fuse T16A (slow blow) or circuit breaker B16. The electrical regulations valid in the country of use as well as the relevant connection conditions are required.	
Power consumption (approximate): ▪ For a BSC of 120 cm (4 ft): 600 W. ▪ For a BSC of 150 cm (5 ft): 800 W. ▪ For a BSC of 180 cm (6 ft): 1000 W. Power consumption for plugs inside: Approximately 1000 W. Note: In areas with frequent breakdown of electricity, BSCs with low energy consumption can be of advantage. A UPS with lower capacity can be used.	Modify according to the BSC dimensions.
Conform to electrical safety standards IEC 60601-1, UL 61010-1, EN 61010-1.	
Protection class (in accordance with EN 60529).	
Designed not to interfere with circuit radio (in accordance with EN 55014).	

Documentation

Manufacturer's certificate

The manufacturer must have a management system certified to ISO 9001.

The manufacturer to individually test each BSC before shipment. The test report to be provided to the customer, with a duplicate fixed to the BSC. Tests to be performed with research-grade instruments for valid calibration:

- inflow air velocity
- filter leak scan for HEPA filter to document filter's efficiency and integrity
- operator protection – by discus test method specified in EN 12469.

Quality and safety standards met by the product must be listed.

Accessories

Table or support frame (support stand) for a working height 78 ± 2 cm, adjustable at least at three feet (points) to level.

A telescopic support stand is advisable for a flexible use.

Ergonomic laboratory chair, designed for infectious laboratory areas:

- adjustable height to suit different users, seat range approximately 400-490 mm
- adjustable-angle back rest (no arm rest)
- caster wheels (five)
- all metal parts chrome plated
- disinfectable with alcohol-containing disinfectants.

Air duct construction to hard duct out or thimble exhaust air from the BSC. The air duct to be made for the BSC offered and to fit precisely.

All standard accessories, consumables and parts required for the proper installation, operation and maintenance of the BSC to be included in the offer by the supplier, and to be specified and quantified.

Operation, installation and maintenance

Operation and maintenance manual

At least one set of operation, maintenance and service manuals, written in United Nations languages (or at least in English) and preferably also in the official national language of the country requesting the BSC.

Installation and maintenance

The bidder must arrange for the equipment to be installed by certified or qualified personnel; any prerequisites for installation to be communicated to the purchaser in advance, in detail.

The bidder to also provide user training (including how to use and maintain the equipment) and a comprehensive maintenance plan. The cost of the maintenance plan to be defined and guaranteed over the period of warranty.

The supplier to provide an after-sale service that covers the whole country. The service to have competent staff, adequate infrastructure and sufficient spare parts to be able to respond to any complaints and to repair or replace the BSC within 14 days.

Initial on-site testing (inward airflow velocity and aerosol leak test for the exhaust air filter) to be carried out and documented by a certified expert. Measurement results to be printed out for documentation in the maintenance record.

Warranty starts with certification on site.

Standard maintenance tools All standard accessories, consumables and parts required to operate the equipment, including all standard tools and cleaning equipment, to be included in the offer. Bidders to specify the quantity of every item included in their offer (including items not specified above). If special tools are needed (e.g. to change the filters), they must be provided.
Spare parts Each assembled BSC to be accompanied by an authorized list of accessories and spare parts.
At least one, and preferably two, additional sets of HEPA filter as specified above .
Warning: Special clamps may be needed to fix HEPA filter.
Three prefilters.
Packing data Packing data are not necessarily part of the bidding process, but are needed for shipment and customs declarations.
Net weight.
Gross weight.
Dimensions (W × H × D) in cm.
Appliances must be transported upright (Y/N).
Customer's tariff number.
Warranty: Three years, except for filters and UV lamp.
Remarks The equipment offered, including its power supply, to be designed and constructed to operate properly and continuously in the conditions of the purchaser's country; the equipment may need to tolerate high humidity (as high as 90% at 35 °C), ambient temperatures of 5–40 °C, fungi, and spikes in the electricity supply. Bidders may propose products additional to the requirements listed above.

Name of equipment:	Code number:
Biological safety cabinet class II	

Tender specifications		Bidder's specifications
Quantity:	Manufacturer:	
	Type/model:	
	Country of origin:	

Description of function
The class II BSC is used in a TB laboratory for processing specimens consisting of liquefaction of sputa and handling cultures of tubercle bacilli. This type of BSC is not adequate for handling volatile or toxic chemicals or radionuclides.
Before ordering a BSC, facility and engineering requirements to be checked.
Organization of a periodical recertification of the BSC by an authorized agency to be in place.
Main specifications
The BSC to meet the requirements of class IIA2 NSF 49 or class II EN 12469; specifically, with regard to inward airflow (≥0.40 m/s according to EN 12469:2000 or ≥0.50 m/s according to NSF 49:2004).
External height ≤2200 mm including support stand, allowing an available space of at least 400 mm from the top of the BSC to the ceiling. Higher versions may be accepted, provided the 400 mm over the BSC is available to measure air velocity above the exhaust filter, and to have enough space for changing the filter and for ducting and/ or a thimble connection to outlet.
Internal working area (approximate): ▪ For a BSC of 120 cm (4 ft): width 1150 mm × depth 630 mm × height 650-750 mm. ▪ For a BSC of 150 cm (5 ft): width 1450 mm × depth 630 mm × height 650-750 mm. ▪ For a BSC of 180 cm (6 ft): width 1700 mm × depth 630 mm × height 650-750 mm. A BSC of 120 cm (4 ft) provides the minimal space needed for safe work.
Inside finish: stainless steel, high quality (e.g. grade 304).
External housing, including screws, made of stainless steel or equivalent resistant galvanized (zinc-coated) sheet steel, subsequently powder coated and thermally hardened; minimum 80 µm thick, or other material that is hard-wearing, resistant to disinfectants and chemicals used in a TB laboratory, and abrasion resistant.
Vertically adjustable sliding window: aerosol-tight, sliding, safety glass (laminated multilayer safety glass only), thickness ≥6.7 mm, counterbalanced.
High optical transmission, but absorption of UV light; minimal reflection.
Working aperture: ≥170 mm measured from work surface to the bottom of the sash window.
Maximal lifting height of front window: 500 mm.
Ability to lock the window hermetically for gaseous disinfection for filter decontamination.
Single-piece working surface with integrated (V-shaped) front air grill. Alternative: Working surface as segments.

Noise pressure level: ≤60 dbA.	
Internal fittings	
Optional (if a safety gas burner will be used): Gas tap with solenoid valve, optional right or left side. For a laboratory located in a seismic area, gas pipes are not recommended; small gas containers (approximately 200-400 ml) with butane gas directly fixed to the burner to be used instead. Not necessary when a micro-incinerator is used.	
Two plugs, 230 ± 10 V, AC, 50 Hz, protected with separate T5A (slow blow) fuse. Voltage and plugs adapted to those used in the country. **Warning**: Plugs inside the BSC may differ from the main connection to the electricity network.	
Flicker-free, low-glare, warm-coloured light, >1000 lux.	
Optional: ultraviolet C (UVC) light (253.7 nm wavelength); 30 W with hour counter; with interlock with white light so that the UVC light can be switched on only when the white light source is switched off.	
Control display on the front of the BSC.	
Electrical control or indicators.	
Electronic fan control.	
Flow meter for air inflow velocity.	
Flow indicator or meter for air downflow velocity.	
Operating hours indicator (counter).	
Optional: UV light timer.	
Filter and flow conditions.	
Prefilter construction preferred; easily accessible, filter change without tools preferred.	
High-efficiency particulate air (HEPA) filter (exhaust air filter); classification at least H14; conforming with EN 1822; metal framed.	
Air downflow velocity: ▪ NSF 49-2002: Requires compliance with the manufacturer's set points, or downflow velocity with a deviation of <0.025 m/s from a nominal set point. ▪ EN 12469: Airflow velocity should be between 0.25 and 0.50 m/s and is defined by the manufacturer according to the construction. Additionally, no individual measurement should differ by more than 20% of the value requested by the manufacturer within the limits given.	
Air circulation volume flow: ▪ For a BSC of 120 cm (4 ft): 700-1200 m^3/h. ▪ For a BSC of 150 cm (5 ft): 1000-1500 m^3/h. ▪ For a BSC of 180 cm (6 ft): 1200-1900 m^3/h.	Modify according to the BSC dimensions.
Influx air velocity: ▪ According to NSF 49, the average airflow velocity at front aperture should be 0.51 m/s for class A2. ▪ EN 12469 does not subclassify within class II BSC. The average airflow velocity at front aperture should be at least 0.4 m/s, according to the manufacturer's specifications.	
Exhaust volume airflow/fresh airflow inward: ▪ For a BSC of 120 cm (4 ft): 300-600 m^3/h. ▪ For a BSC of 150 cm (5 ft): 400-700 m^3/h. ▪ For a BSC of 180 cm (6 ft): 500-900 m^3/h.	Modify according to the BSC dimensions.
Blower system to be able to maintain the airflow within a minimum window (narrow limits) on voltage fluctuations. Data to be available on request.	

Alarms, visible and/or audible, for any unsafe condition of the BSC (e.g. airflow, window position, hardware or software errors). Possibility to shut down alarm for cleaning and maintenance.	
Electricity requirements	
Supply voltage: 230 ± 10 V, AC, 50/60 Hz. Voltage and plugs to be adapted to meet the country requirements.	
Lead fuse T16A (slow blow) or circuit breaker B16. The electrical regulations valid in the country of use as well as the relevant connection conditions are required.	
Power consumption (approximate): ▪ For a BSC of 120 cm (4 ft): 600 W. ▪ For a BSC of 150 cm (5 ft): 800 W. ▪ For a BSC of 180 cm (6 ft): 1000 W. Power consumption for plugs inside: Approximately 1000 W. Note: In areas with frequent breakdown of electricity supply, BSCs with low energy consumption can be an advantage; a UPS with lower capacity can be used.	Modify according to the BSC dimensions.
Conform to electrical safety standards IEC 60601-1, UL 61010-1, EN 61010-1.	
Protection class (in accordance with EN 60529).	
Designed not to interfere with circuit radio (in accordance with EN 55014).	
Documentation	
Manufacturer's certificate The manufacturer must have a management system certified to ISO 9001. The manufacturer to individually test each BSC before shipment. The test report to be provided to the customer, with a duplicate fixed to the BSC. The tests to be performed with research-grade instruments for valid calibration according to test methods outlined in EN 12469 or NSF 49. The test report to contain at least data on: ▪ inflow air velocity ▪ downflow air velocity ▪ filter leak scan for both filters' efficiency and integrity.	
Quality and safety standards met by the product to be listed.	
Accessories	
Table or support frame (support stand) for a working height of 78 ± 2 cm, adjustable at least at three points (feet) to level. A telescopic support stand is advisable for a flexible use.	
Ergonomic laboratory chair, designed for infectious laboratory areas: ▪ adjustable height to suit different users, seat range approximately 400-490 mm ▪ adjustable-angle back rest (no arm rest) ▪ caster wheels (five) ▪ all metal parts chrome plated ▪ disinfectable with alcohol-containing disinfectants.	
Air duct construction to hard duct out or thimble exhaust air from the BSC. The air duct to be made for the BSC offered and fit precisely.	
Depending on the ventilation system for the containment room, a motorised flap in the hood and a trigger for the external ventilator or equivalent regulatory device may be needed.	
All standard accessories, consumables and parts required for the proper installation, operation and maintenance of the BSC to be included in the offer by the supplier and to be specified and quantified.	

Operation, maintenance and installation

Operation and maintenance manual

At least one set of operation, maintenance and service manuals, written in United Nations languages (or at least in English) and preferably also in the official national language of the country requesting the BSC.

Installation and maintenance

The bidder must arrange for the equipment to be installed by certified or qualified personnel; any prerequisites for installation to be communicated to the purchaser in advance, in detail.

The bidder to also provide user training (including how to use and maintain the equipment) and a comprehensive maintenance plan. The cost of the maintenance plan to be defined and guaranteed over the period of warranty.

The supplier to provide an after-sale service that covers the whole country. The service to have competent staff, adequate infrastructure and sufficient spare parts to be able to respond to any complaints and to repair or replace the BSC within 14 days.

Initial on-site testing (aerosol leak test, recirculating air filter, exhaust air filter, airflow measurements inside the BSC and inward/exhaust airflow) to be carried out by a certified expert. Measurement results to be printed out for documentation in the maintenance record.

Warranty starts with certification on site.

Standard maintenance tools

All standard accessories, consumables and parts required to operate the equipment, including all standard tools and cleaning equipment, to be included in the offer. Bidders to specify the quantity of every item included in their offer (including items not specified above).

If special tools are needed (e.g. to change filters), they must be provided.

Spare parts

Each assembled BSC to be accompanied by an authorized list of accessories and spare parts.

At least one, and preferably two, additional sets of HEPA filters as specified above.

Warning: Special clamps may be needed to fix HEPA filter.

Three prefilters.

Packing data

Packing data are not necessarily part of the bidding process, but are needed for shipment and customs declarations.

Net weight.

Gross weight.

Dimensions (W × H × D) in cm.

Appliances must be transported upright (Y/N).

Customer's tariff number.

Warranty: Three years, except for filters and (UV) lamp.

Remarks

The equipment offered, including its power supply, to be designed and constructed to operate properly and continuously in the conditions of the purchaser's country; the equipment may need to tolerate high humidity (as high as 90% at 35 °C), ambient temperatures of 5–40 °C, fungi, and spikes in the electricity supply.

Bidders may propose products additional to the requirements listed above.

Name of equipment:	Code number:
Uninterrupted power supply with battery pack for BSC	

Tender specifications	Bidder's specifications

Quantity:	Manufacturer:
	Type/model:
	Country of origin:

Description of function and use
The UPS must be used in any settings that have frequent problems in the electricity network (e.g. surges, sags, spikes and blackouts) to assure and back up the function of the BSC, so that any current work can be finalized and all potentially infectious sources closed. If the BSC is connected to a generator, the UPS will maintain the function of the BSC during the time needed for the generator to start and to provide full power.
Main specifications
UPS: microprocessor controlled, line interactive, online continuous transducer, 20 minutes.
Booster function to regulate up voltage breakdown to 170 V.
Buck function to regulate down voltage increase up to 280 V.
Filter to protect against voltage spikes.
Protection against overload and short circuit.
Advanced battery check for automated periodic battery inspection.
Indicators for status (e.g. normal function, net down, working on battery, loading battery, battery capacity).
Sleep mode if item consuming power is shut off.
Power: 230 V ± 25%, 50 Hz or 60 Hz (± 10%) with automatic recognition.
Battery: maintenance-free, automatic shut-off before reaching the level of discharge from which recharging to the original capacity will no longer be possible.
Time for recharging: approximately 4 hours to reach at least 90% of total capacity.
Outlet voltage: 230 V ± 3%, 50 or 60 Hz ± 0.5% (if the country's standard voltage is 110 V AC, adjustment will be needed).
Changeover time: <5 msec.
Efficiency coefficient: approximately 98%, on battery >85%.
Noise at 1 m distance <48 dBA.
Permissible ambient temperature and relative humidity: 0-40 °C and 95% (not condensing).
Electricity requirements
Supply voltage: 230 ± 10 V, AC, 50/60 Hz. Voltage and plugs to be adapted to meet the country requirements.
Power consumption: Approximately 1500 W (depending on the model chosen).

Protection class (in accordance with EN 60529).

Designed not to interfere with circuit radio (in accordance with EN 55014).

Documentation

Manufacturer's certificate

The manufacturer must have a management system certified to ISO 9001.

Quality and safety standards met by the product to be listed.

Accessories

Battery pack.

Connection (cable and fittings) for battery pack.

Operation, maintenance and installation

Operation and maintenance manual

At least one set of operation, maintenance and service manuals, written in United Nations languages (or at least in English) and preferably also in the official national language of the country requesting the UPS.

Installation and maintenance

The bidder must arrange for the equipment to be installed by certified or qualified personnel; any prerequisites for installation to be communicated to the purchaser in advance, in detail.

The bidder to provide user training (including how to use and maintain the equipment) and a comprehensive maintenance plan. The cost of the maintenance plan to be defined and guaranteed over the period of warranty.

Standard maintenance tools

All standard accessories, consumables and parts required to operate the equipment, including all standard tools and cleaning material, to be included in the offer. Bidders to specify the quantity of every item included in their offer (including items not specified above).

Spare parts

Each UPS to be accompanied by an authorized list of accessories and spare parts.

Packing data

Packing data are not necessarily part of the bidding process, but are needed for shipment and customs declarations.

Net weight.

Gross weight.

Dimensions (W × H × D) in cm.

Appliances must be transported upright (Y/N).

Customer's tariff number.

Warranty: At least two years for UPS; at least five years for battery pack.

Name of equipment: Mini-shaker/vortex	Code number:
Tender specifications	**Bidder's specifications**
Quantity:	**Manufacturer:**
	Type/model:
	Country of origin:
Description of function and use The mini-shaker is for use in a BSC.	
Main specifications	
Sturdy housing; metal; coated; disinfectable.	
Design feature: flat construction.	
Strong orbital movements.	
Rotation speed: 0-2500 rpm. Orbit: ≥4 mm.	
Standing on four rubber feet designed to prevent sliding of the instrument during shaking.	
Two operating modes: continuous and touch function.	
Head: about 20 mm.	
Slip-resistant stand.	
Overheating protection.	
Permissible ambient temperature and relative humidity: 5-40 °C and ≤80%.	
Weight: 2.5-5 kg.	
Electricity requirements	
Supply voltage: 230 ± 10 V, AC, 50/60 Hz. Voltage and plugs to be adapted to meet the country requirements.	
Power consumption: 50-100 W.	
Protection class (in accordance with EN 60529).	
Designed not to interfere with circuit radio (in accordance with EN 55014).	
Documentation	
Manufacturer's certificate The manufacturer must have a management system certified to ISO 9001.	
Quality and safety standards met by the product to be listed.	
Operation, maintenance and installation	
Operation and maintenance manual At least one set of operation, maintenance and service manuals for each mini-shaker, written in United Nations languages (or at least in English) and preferably also in the official national language of the country requesting the mini-shaker.	

Installation and maintenance The bidder must arrange for the equipment to be installed by certified or qualified personnel; any prerequisites for installation to be communicated to the purchaser in advance, in detail. The bidder to also provide user training (including how to use and maintain the equipment) and a comprehensive maintenance plan.
Standard maintenance tools All standard accessories, consumables and parts required to operate the equipment, including all standard tools and cleaning material, to be included in the offer. Bidders to specify the quantity of every item included in their offer (including items not specified above).
Spare parts Each mini-shaker to be accompanied by an authorized list of accessories and spare parts.
Fuses.
Packing data Packing data are not necessarily part of the bidding process, but are needed for shipment and for customs declarations.
Net weight.
Gross weight.
Dimensions (W × H × D) in cm.
Appliances must be transported upright (Y/N).
Customer's tariff number.
Warranty: Two years.
Remarks The equipment offered, including its power supply, to be designed and constructed to operate properly and continuously in the conditions of the purchasers's country; the equipment may need to withstand high humidity, fungi, thunderstorms and spikes in the electricity supply. Appropriate packaging to be provided for longer storage. Bidders may propose products additional to the requirements listed above.

Name of equipment: Incubator		Code number:
Tender specifications		**Bidder's specifications**
Quantity:	**Manufacturer:**	
	Type/model:	
	Country of origin:	
Description of function and use The incubator is used to allow growth of TB bacilli on culture media.		
Main specifications		
Chamber made of stainless steel, easy to clean.		
Housing: corrosion resistant, made of either stainless steel or zinc galvanized sheet metal coated with epoxy, hardened by heat treatment.		
Double doors, double lock.		
Inner doors: security glass.		
Volume of interior housing: ≥600 litres, corresponding to a capacity of about 2000–2200 TB culture tubes.		
Designed specially for temperatures up to 70 °C, optimised for living cultures at 37 °C.		
Temperature variation at 37 °C: ≤0.1 °C.		
Temperature overshoot within this limit.		
Temperature range: 30 °C (at least 5 °C above ambient temperature) to 70 °C.		
Adjustable over-temperature protection controller – TWW protection class 3.1; or electronic temperature limiter – TWB protection class 2.		
Uniformity of temperature inside the chamber (deviation ≤0.2 °C).		
Two high-grade temperature sensors (class A) with mutual monitoring and taking over performance at same working temperature.		
Integrated programmable timer.		
Programs stored on power failure.		
Adjustable air flap for preheated fresh air intake.		
Vent connection with restrictor flap.		
Display of temperature.		
Alarm: audible, with display on dysfunction.		
Function signals for operating mode.		
Optional: Long-term logging (ring store) internal memory to save temperature and error states, with time stamp to the minute.		
Optional: Serial RS 232 interface with software for readout of data with PCL3-compatible printer.		
Electricity requirements		
Supply voltage: 230 ± 10 V, AC, 50/60 Hz. Voltage and plugs to be adapted to meet the country requirements.		
Power consumption: Approximately 2000 W.		

Protection class (in accordance with EN 60529).

Designed not to interfere with circuit radio (in accordance with EN 55014).

Documentation

Manufacturer's certificate

The manufacturer must have a management system certified to ISO 9001.

One certificate to state that the incubator has been calibrated at the factory to 37 °C.

Quality and safety standards met by the product to be listed.

Accessories

One or two additional perforated stainless steel shelves, nontipping, to match four shelves per incubator.

Operation, maintenance and installation

Operation and maintenance manual

At least one set of operation, maintenance and service manuals, written in United Nations languages (or at least in English) and preferably also in the official national language of the country requesting the incubator.

Installation and maintenance

The bidder must arrange for the equipment to be installed by certified or qualified personnel; any prerequisites for installation to be communicated to the purchaser in advance, in detail.

The bidder to also provide user training (including how to use and maintain the equipment) and a comprehensive maintenance plan. The cost of the maintenance plan to be defined and guaranteed over the period of warranty.

The supplier to provide an after-sale service that covers the whole country. The service to have competent staff, adequate infrastructure and sufficient spare parts to be able to respond to any complaints and to repair or replace the incubator within 14 days.

Standard maintenance tools

All standard accessories, consumables and parts required to operate the equipment, including all standard tools and cleaning equipment, to be included in the offer. Bidders to specify the quantity of every item included in their offer (including items not specified above).

Spare parts

Each incubator to be accompanied by an authorized list of accessories and spare parts.

A set of fuses.

Packing data

Packing data are not necessarily part of the bidding process, but are needed for shipment and for customs declarations.

Net weight.

Gross weight.

Dimensions (W × H × D) in cm.

Appliances must be transported upright (Y/N).

Customer's tariff number.

Warranty: Two years for regulator; five years for heating coils.

Remarks

The equipment offered, including its power supply, to be designed and constructed to operate properly and continuously in the conditions of the purchaser's country; the equipment may need to tolerate high humidity (as high as 90% at 35 °C), ambient temperatures of 5-40 °C, fungi, and spikes in the electricity supply.

Bidders may propose products additional to the requirements listed above.

Name of equipment: Centrifuge	Code number:

Tender specifications	Bidder's specifications
Quantity:	Manufacturer:
	Type/model:
	Country of origin:

Description of function and use	
The centrifuge will be used in a TB laboratory to spin down mycobacteria in liquefied, decontaminated materials. The compartments containing the centrifuge tubes (buckets) need to be absolutely aerosol tight and closed by transparent lids. At least 3000 G will be required for efficient sedimentation within 20 minutes of centrifugation. The centrifuge should preferably be a desk-top one; stand-alone models are also suitable, but are more expensive.	
Main specifications	
Metal housing, chamber stainless steel.	
Cooling capacity at maximum speed at +4 °C.	
Standby cooling.	
Induction motor, brushless drive.	
Rotor with swing-out buckets, at least four positions.	
Rotor buckets with aerosol-tight, transparent, clipping lids.	
Inserts for buckets adapted to 50 ml centrifuge tubes, conical.	
Inserts for buckets adapted to 15 ml centrifuge tubes, conical.	
Capacity: about 20 × 50 ml.	
Maximum revolutions per minute: approximately 4500 rpm, corresponding to a radius of approximately 15 cm.	
Relative centrifugal force (rcf): approximately 3400 G.	
Noise level at maximum speed: not more than 60 dbA.	
Programmable for all parameters (switchable between rpm and rcf) of a run; large display.	
Soft start and different acceleration levels (1–9); different braking levels (1–9) and brake force cut-off.	
Input and recall of programs; at least 20 storage positions.	
LCD display (protected against splash of liquids) for indication of run time, speed (rpm) or rcf (after entering centrifugation radius) – switchable, actual temperature, time left to finish run.	
Imbalance switch-off.	
Motor overheating protection.	
Chamber overheating protection.	
Rotor recognition for appropriate over-speed protection.	
Safety lock of lid during run and as long as the rotor is moving.	
Possibility of mechanical opening of lid if there is current blackout.	

Electricity requirements

Supply voltage: 230 ± 10 V, AC, 50/60 Hz.

Voltage and plugs to be adapted to meet the country requirements.

Power consumption: Approximately 1800 W.

Conform to electrical safety standards IEC 60601-1, UL 61010-1, EN 61010-1.

Excess-voltage category II.

Protection class (in accordance with EN 60529).

Designed not to interfere with circuit radio (in accordance with EN 55014).

Documentation

Manufacturer's certificate

The manufacturer must have a management system certified to ISO 9001.

One certificate to state that the centrifuge has been calibrated at the factory.

Quality and safety standards met by the product to be listed.

Operation, maintenance and installation

Operation and maintenance manual

At least one set of operation, maintenance and service manuals, written in United Nations languages (or at least in English) and preferably also in the official national language of the country requesting the centrifuge.

Installation and maintenance

The bidder must arrange for the equipment to be installed by certified or qualified personnel; any prerequisites for installation to be communicated to the purchaser in advance, in detail.

The bidder to also provide user training (including how to use and maintain the equipment) and a comprehensive maintenance plan. The cost of the maintenance plan to be defined and guaranteed over the period of warranty.

The supplier to provide an after-sale service that covers the whole country. The service to have competent staff, adequate infrastructure and sufficient spare parts to be able to respond to any complaints and to repair or replace the centrifuge within 14 days.

Standard maintenance tools

All standard accessories, consumables and parts required to operate the equipment, including all standard tools and cleaning equipment, to be included in the offer. Bidders to specify the quantity of every item included in their offer (including items not specified above).

Spare parts

Each centrifuge to be accompanied by an authorized list of accessories and spare parts.

Device for mechanical opening of the centrifuge after automatic blocking as consequence of currency blackout.

Lubricants for movable parts and gaskets.

Spare fuses.

Packing data

Packing data are not necessarily part of the bidding process, but are needed for shipment and customs declarations.

Net weight.

Gross weight.

Dimensions (W × H × D) in cm.

Appliances must be transported upright (Y/N).
Customer's tariff number.
Warranty: Three years.
Remarks The equipment offered, including its power supply, to be designed and constructed to operate properly and continuously in the conditions of the purchaser's country; the equipment may need to tolerate high humidity (as high as 90% at 35 °C), ambient temperatures of 5–40 °C, fungi, and spikes in the electricity supply. Bidders may propose products additional to the requirements listed above.

Name of equipment:
Autoclave

Code number:

Tender specifications

Bidder's specifications

Quantity:

Manufacturer:

Type/model:

Country of origin:

Description of function and use

Autoclaves are used for sterilization of infectious or clean materials.

Remarks

Many countries have very strict regulations on the construction, use, maintenance and location of autoclaves within the laboratory department. For sterilization of infectious waste, some countries allow autoclaves with fractionated prevacuum or at least pulsed heat-up (over-pressure pulses) only.

Main specifications

Vertical autoclave, universal basic version for microbiological standard laboratory to sterilize liquids, instruments, glassware, plastic articles or general infectious waste.
Single-wall construction; chamber, door, doorframe, bolts made of corrosion-resistant material and able to prevent stress cracking.
Pressure vessel compliant with international standards.
Chamber volume: ≥70 litres.
Heating device (steam generator) horizontally mounted, preferably separated from the chamber with minimal water volume (4–7 litres).
Air removed by upward displacement.
Automatic water feed; connection to a demineralised water supply.
Integrated pump to equalize pressure variations in external supply lines.
Automatic level control before, during and after the sterilization cycle.
Low-water-level cut-out device.
Fast safety lid lock.
Lid lock by a circumferential, durably heat- and pressure-resistant seal.
Control lock-out switch that prevents starting a cycle if the door is not locked safely.
Control that prevents opening the door until chamber is depressurized.
Temperature-dependent door-locking system according to international standard.
Maximum operating pressure: 2.5 bar. Maximum operating temperature: 134 °C (273 °F).
Sterilisation timer: 1–250 minutes.
Instrument sterilization timer: up to 72 hours.
Timer-controlled sterilization of load at night.

A visual chamber gauge, which easily identifies pressure in the chamber, must be accessible to the operator as a backup to the control readout when no electrical power is available.
Microcomputer control system.
The control panel to be mounted so that the components sensitive to steam and heat are protected.
Large LCD display showing: ▪ temperature ▪ steam pressure ▪ sterilization time ▪ stage of cycle ▪ alarm information.
Preselection of languages for menu-presented instructions, at least including English.
Protected keyboard with acoustic confirmation signal.
An access code to prevent programming changes of cycle parameters by unauthorized persons. A key lock is not recommended.
Presetting of at least four programs: two for liquids, one for solids, one for waste.
Load capacity: approximately 25 kg of waste or 25 kg of solids or 20 litres of liquid.
Batch documentation: batch number, date, temperature, pressure and sterilization phase; built-in printer satisfying GLP and standard operating procedure (SOP) requirements, and/or storage device (RS 232).
Exhaust air filtration with condensate sterilization for emission-free sterilization of infectious pathogens; equipped with filter cartridge of 0.2 µm pore size, with easy access for replacement.
Autoclave equipped for prevacuum, gravity and flash cycles.
For autoclaves used in media kitchen: dual, built-in temperature probes (e.g. two PT-100 sensors), one flexible for accurately monitoring sample temperatures to ensure appropriate media or buffer sterilization device for rapid cooling.
Safety valves; over-pressure relief valve.
Low-water-level interrupt.
Over-temperature and over-pressure protection limiter.
Lid interlock.
Alarm: audible, with display on dysfunction.
All information on alarm to be in full writing and not based on a code.
Even with a total control failure, all mechanical safety features must be left intact.
RS 232 interface for direct connection to a personal computer (PC), and programs for conforming documentation, diagrams, storage, printout.
Optional: A manual control that can run a complete cycle manually in case of system failure.
Electricity requirements
Supply voltage: 230 ± 10 V, AC, 50/60 Hz; plug type adapted to the country or three-phase 380 V, 50 Hz.
Power consumption: 3 kW or 4.5 kW.
16A fuses.

Re-setable over-current breaker fitted for protection.

Conform to electrical safety standards IEC 60601-1, UL 61010-1, EN 61010-1.

Protection class (in accordance with EN 60529).

Designed not to interfere with circuit radio (in accordance with EN 55014).

Documentation

Manufacturer's certificate

The manufacturer must have a management system certified to ISO 9001.

One certificate to state that the autoclave has been calibrated at the factory.

Certificates for design and safety regulations.

Quality and safety standards met by the product to be listed.

Accessories

Steel stand, appropriately coated for corrosion protection or made of stainless steel.

Optional: In areas with possible earthquakes, this stand to be designed to meet the seismic requirements according to the zone assignment.

Three stainless steel wire baskets; diameter and height adjusted so that two fit into the autoclave at the same time.

Two stainless steel wire baskets; diameter and height adjusted so that one fits into the autoclave.

Three stainless steel buckets with lid; diameter and height adjusted so that two fit into the autoclave at the same time (usually 380 mm × 290 mm).

Two stainless steel buckets with lid; diameter and height adjusted so that one fits into the autoclave.

Chemical indicator tape for sterilization.

Biological indicator.

Tool to open the autoclave in case of electricity breakdown (if needed).

Operation, maintenance and installation

Operation and maintenance manual

At least one set of operation, maintenance and service manuals, written in United Nations languages (or at least in English) and preferably also in the official national language of the country requesting the autoclave.

Installation and maintenance

The bidder must arrange for the equipment to be installed by certified or qualified personnel; any prerequisites for installation should be communicated to the purchaser in advance, in detail.

The bidder to also provide user training (including how to use and maintain the equipment) and a comprehensive maintenance plan. The cost of the maintenance plan to be defined and guaranteed over the period of warranty.

The supplier to provide an after-sale service that covers the whole country. The service to have competent staff, adequate infrastructure and sufficient spare parts to be able to respond to any complaints and to repair or replace the autoclave within 14 days.

Standard maintenance tools

All standard accessories, consumables and parts required to operate the equipment, including all standard tools and cleaning and lubrication material, to be included in the offer. Bidders to specify the quantity of every item included in their offer (including items not specified above).

Spare parts Each autoclave to be accompanied by an authorized list of accessories and spare parts.
Set of autoclave internal fuses (if any).
Sealing ring for lid.
Packing data Packing data are not necessarily part of the bidding process, but are needed for shipment and for customs declarations.
Net weight.
Gross weight.
Dimensions (W × H × D) in cm.
Appliances must be transported upright (Y/N).
Customer's tariff number.
Warranty: For pressure vessel and valves, at least five years; for heating elements, at least three years.
Remarks The equipment offered, including its power supply, to be designed and constructed to operate properly and continuously in the conditions of the purchaser's country; the equipment may need to tolerate high humidity (as high as 90% at 35 °C), ambient temperatures of 5–40 °C, fungi, and spikes in the electricity supply. Bidders may propose products additional to the requirements listed above.

Name of equipment:	**Code number:**
Hot-air oven	

Tender specifications		**Bidder's specifications**
Quantity:	**Manufacturer:**	
	Type/model:	
	Country of origin:	

Description of function and use

The hot-air oven is used to dry and sterilize glassware and small laboratory materials after cleaning and before reuse.

Main specifications

Chamber made of stainless steel, easy to clean.

Housing: preferably stainless steel or at least with a durable, corrosion-resistant coating of metal (e.g. galvanized sheet metal coated with epoxy, hardened by heat treatment).

Volume of interior housing: ≥250 litres for regional/reference laboratories, 125 litres for other laboratories.

Two doors, double lock.

Temperature range: from 10 °C above ambient to +250 °C.

Forced air ventilation by air fan.

Air fan: <58 dB at full speed; speed adjustable.

Adjustable air flap for preheated fresh air intake.

Vent connection with restrictor flap.

Alarm: audible, with display on dysfunction.

Switch-off function at approximately 10 °C above the temperature set.

Digitally adjustable electronic temperature controller, TWW protection class 3.1.

Mechanical temperature limiter at fixed value 10 °C above maximal hot-air oven temperature (250 °C).

Integrated programmable timer.

Programs stored on power failure.

Display of temperature.

Function signals for operating mode.

Optional: Serial RS 232 interface with software for readout of data with PCL3-compatible printer.

Electricity requirements

Supply voltage: 230 ± 10 V, AC, 50/60 Hz.

Voltage and plugs to be adapted to meet the country requirements.

Power consumption: 2400 W (during heating); adaptation of heating power according to the preset temperature value.

Conform to electrical safety standards IEC 60601-1, UL 61010-1, EN 61010-1.

Protection class (in accordance with EN 60529).

Designed not to interfere with circuit radio (in accordance with EN 55014).
Documentation
Manufacturer's certificate The manufacturer must have a management system certified to ISO 9001. One certificate to state that the hot-air oven has been calibrated at the factory for +160 °C.
Quality and safety standards met by the product to be listed.
Accessories
One additional set of perforated stainless steel shelves, nontipping, if less than two are provided with the hot-air oven.
Operation, maintenance and installation
Operation and maintenance manual At least one set of operation, maintenance and service manuals, written in United Nations languages (or at least in English) and preferably also in the official national language of the country requesting the oven.
Installation and maintenance The bidder must arrange for the equipment to be installed by certified or qualified personnel; any prerequisites for installation to be communicated to the purchaser in advance, in detail. The bidder to also provide user training (including how to use and maintain the equipment) and a comprehensive maintenance plan. The cost of the maintenance plan to be defined and guaranteed over the period of warranty. The supplier to provide an after-sale service that covers the whole country. The service to have competent staff, adequate infrastructure and sufficient spare parts to be able to respond to any complaints and to repair or replace the oven within 14 days.
Standard maintenance tools All standard accessories, consumables and parts required to operate the equipment, including all standard tools and cleaning material, to be included in the offer. Bidders to specify the quantity of every item included in their offer (including items not specified above).
Spare parts Each hot-air oven to be accompanied by an authorized list of accessories and spare parts.
A set of fuses, if used inside the instrument for regulation.
Packing data Packing data are not necessarily part of the bidding process, but are needed for shipment and for customs declarations.
Net weight.
Gross weight.
Dimensions (W × H × D) in cm.
Appliances must be transported upright (Y/N).
Customer's tariff number.
Warranty: Three years for regulation; five years for heating coils.
Remarks The equipment offered, including its power supply, to be designed and constructed to operate properly and continuously in the conditions of the purchaser's country; the equipment may need to tolerate high humidity (as high as 90% at 35 °C), ambient temperatures of 5–40 °C, fungi, and spikes in the electricity supply. Bidders may propose products additional to the requirements listed above.

Name of equipment: Thermal anemometer	Code number:

Tender specifications		Bidder's specifications
Quantity:	Manufacturer:	
	Type/model:	
	Country of origin:	

Description of function and use An anemometer is a device for measuring the velocity of air or gas flow. In a TB laboratory, an anemometer is used to determine the airflow into, out of and inside a BSC, in order to test the flow functions of a BSC.
Main specifications
Sturdy and easily cleaned instrument case.
Foil-protected keyboard.
Instrument with batteries (freely movable and independent of external electricity supply).
Low-battery condition indicated on display.
Small sensor (<15 mm) attached with a telescopic probe tip (extension to about 1 m length), suited also for measurements in small ducts.
Indicator at the probe and at the lower end of the telescope for optimal alignment to the direction of the measured airflow.
Suitable cap for sensor to ensure zero adjustment.
Wide temperature range, at least 0–70 °C.
Indication of velocity and temperature.
Compensation for variations in airstream temperature by a second thermistor that simultaneously senses the actual airstream temperature.
Different velocity ranges; at least one of 0–2 m/s.
Real-time display of velocities.
Memory containing about 99 locations.
Storage of current velocity and temperature on demand.
Indication for "memory full".
Storage functions to display average, maximal and minimal values of velocity or temperature on recall.
Resolution of velocity reading: 0.01 m/s.
Resolution of temperature reading: 0.1 °C.
Electricity requirements
Supply voltage: Battery
Documentation
Manufacturer's certificate The manufacturer must have a management system certified to ISO 9001. One certificate to state that the anemometer has been calibrated at the factory.

Quality and safety standards met by the product to be listed.

Accessories

Optional: Data logger as an extension and software for processing the data on a PC.

Operation, maintenance and installation

Operation and maintenance manual

At least one set of operation, maintenance and service manuals, written in United Nations languages (or at least in English) and preferably also in the official national language of the country requesting the anemometer.

Maintenance

The supplier to provide an after-sale service that covers the whole country. The service to have competent staff, adequate infrastructure and sufficient spare parts to be able to respond to any complaints and to repair or replace the anemometer within 14 days.

Standard maintenance tools

All standard accessories, consumables and parts required to operate the equipment, including all standard tools and cleaning material, to be included in the offer. Bidders to specify the quantity of every item included in their offer (including items not specified above).

Spare parts

Each anemometer to be accompanied by an authorized list of accessories and spare parts.

Packing data

Packing data are not necessarily part of the bidding process, but are needed for shipment and for customs declarations.

Net weight.

Gross weight.

Dimensions (W × H × D) in cm.

Appliances must be transported upright (Y/N).

Customer's tariff number.

Warranty: Three years.

Remarks

The equipment offered, including its power supply, to be designed and constructed to operate properly and continuously in the conditions of the purchaser's country; the equipment may need to tolerate high humidity (as high as 90% at 35 °C), ambient temperatures of 5–40 °C, fungi, and spikes in the electricity supply.

Appropriate packaging should be provided for long-term storage.

Bidders may propose products additional to the requirements listed above.

Name of equipment: Inspissator	Code number:

Tender specifications	Bidder's specifications

Quantity:	Manufacturer:
	Type/model:
	Country of origin:

Description of function and use The inspissator is required for the preparation of egg-based media.
Main specifications
Housing and chamber made of polished stainless steel.
Temperature range: 25-85 °C
Maximal temperature: 95 °C.
Working temperature: 85 °C.
Temperature deviation: ±0.75 °C.
Automatic temperature control and regulation.
Overheating protection and automatic shut-off.
Water level sensor. (Instruments with hot air, ventilated or not, through the chamber are not recommended.)
Automatic shut-off on lowered water level.
Electronic timer, 0-6 hours.
Capacity: >350 tubes (16-18 mm in diameter, 125-160 mm in length) or universal bottles.
Racks for tubes in slant position; angle adjustable; covering full capacity of the instrument.
Alarm: audible, with display on dysfunction.
Electricity requirements
Supply voltage: 230 ± 10 V, AC, 50/60 Hz. Voltage and plugs to be adapted to meet the country requirements.
Power consumption: 600-3000 W.
Protection class (in accordance with EN 60529).
Designed not to interfere with circuit radio (in accordance with EN 55014).
Documentation
Manufacturer's certificate The manufacturer must have a management system certified to ISO 9001. One certificate to state that the inspissator has been calibrated at the factory.
Quality and safety standards met by the product to be listed.
Accessories
Optional: Inserts for universal bottles.
Operation, maintenance and installation

Operation and maintenance manual

At least one set of operation, maintenance and service manuals for each inspissator, written in United Nations languages (or at least in English) and preferably also in the official national language of the country requesting the inspissator.

Installation and maintenance

The bidder must arrange for the equipment to be installed by certified or qualified personnel; any prerequisites for installation to be communicated to the purchaser in advance, in detail.

The bidder to also provide user training (including how to use and maintain the equipment) and a comprehensive maintenance plan. The cost of the maintenance plan to be defined and guaranteed over the period of warranty.

The supplier to provide an after-sale service that covers the whole country. The service to have competent staff, adequate infrastructure and sufficient spare parts to be able to respond to any complaints and to repair or replace the inspissator within 14 days.

Standard maintenance tools

All standard accessories, consumables and parts required to operate the equipment, including all standard tools and cleaning material, to be included in the offer. Bidders to specify the quantity of every item included in their offer (including items not specified above).

Spare parts

Each inspissator to be accompanied by an authorized list of accessories and spare parts.

One additional set of racks covering full capacity of the instrument for a second batch.

Packing data

Packing data are not necessarily part of the bidding process, but are needed for shipment and for customs declarations.

Net weight.

Gross weight.

Dimensions (W × H × D) in cm.

Appliances must be transported upright (Y/N).

Customer's tariff number.

Warranty: Five years for the heating coil; at least one year for the electronics.

Remarks

The equipment offered, including its power supply, to be designed and constructed to operate properly and continuously in the conditions of the purchaser's country; the equipment may need to tolerate high humidity (as high as 90% at 35 °C), ambient temperatures of 5–40 °C, fungi, and spikes in the electricity supply.

Bidders may propose products additional to the requirements listed above.

Name of equipment:	Code number:
Refrigerator with freezer compartment	

Tender specifications		Bidder's specifications
Quantity:	Manufacturer:	
	Type/model:	
	Country of origin:	

Description of function and use Only for use with water solutions.
Main specifications
Energy classification A.
100% CFC- and HFC-free.
Total usable capacity: 300 ± 20 litres.
Refrigeration compartment optimally regulated at 4-8 °C.
Separate freezing compartment, freezing to at least -22 °C; volume 50 ± 10 litres. Optional: A refrigerator without freezing compartment may be used. The size of the refrigerator needs to be adjusted to the requirements of the laboratory.
Temperature control settings and gauges in each compartment.
Automatic defrosting.
Four shelves of safety glass.
Humidity regulation.
Variable door liner arrangement. Right-hand mounted door, reversible.
Usable up to 40 °C ambient temperature.
Adjustable feet for levelling.
Fungus-resistant door gasket.
Electricity requirements
Supply voltage: 230 ± 10 V, AC, 50/60 Hz. Voltage and plugs to be adapted to meet the country requirements.
Power consumption: Approximately 150 W.
Conform to electrical safety standards IEC 60601-1, UL 61010-1, EN 61010-1.
Protection class (in accordance with EN 60529).
Designed not to interfere with circuit radio (in accordance with EN 55014).
Documentation
Manufacturer's certificate The manufacturer must have a management system certified to ISO 9001. Declaration of conformity to the requirements of standards and regulations of the directives that apply to the product, including energy classification, gas used as refrigerant, climate class. One certificate to state that the refrigerator has been calibrated at the factory.

Quality and safety standards met by the product must be listed.

Operation, maintenance and installation

Operation and maintenance manual

At least one set of operation, maintenance and service manuals for the refrigerator, written in United Nations languages (or at least in English) and preferably also in the official national language of the country requesting the refrigerator.

Installation and maintenance

The bidder must arrange for the equipment to be installed by certified or qualified personnel; any prerequisites for installation to be communicated to the purchaser in advance, in detail.

The bidder to also provide user training (including how to use and maintain the equipment) and a comprehensive maintenance plan. The cost of the maintenance plan to be defined and guaranteed over the period of warranty.

The supplier to provide an after-sale service that covers the whole country. The service to have competent staff, adequate infrastructure and sufficient spare parts to be able to respond to any complaints and to repair or replace the refrigerator within 14 days.

Standard maintenance tools

All standard accessories, consumables and parts required to operate the equipment, including all standard tools and cleaning material, to be included in the offer. Bidders to specify the quantity of every item included in their offer (including items not specified above).

Spare parts

Each refrigerator to be accompanied by an authorized list of accessories and spare parts.

Packing data

Packing data are not necessarily part of the bidding process, but are needed for shipment and for customs declarations.

Net weight.

Gross weight.

Dimensions (W × H × D) in cm.

Appliances must be transported upright (Y/N).

Customer's tariff number.

Warranty: Three years.

Remarks

The equipment offered, including its power supply, to be designed and constructed to operate properly and continuously in the conditions of the purchaser's country; the equipment may need to tolerate high humidity (as high as 90% at 35 °C), ambient temperatures of 5-40 °C, fungi, and spikes in the electricity supply.

Bidders may propose products additional to the requirements listed above.

Name of equipment: Freezer	Code number:

Tender specifications	Bidder's specifications
Quantity:	Manufacturer:
	Type/model:
	Country of origin:

Description of function and use The freezer is mainly used to store strains, enzymes and other temperature-sensitive reagents.
Main specifications
Energy classification A+.
100% CFC- and HFC-free.
One-door freezer, to be used as free-standing freezer.
Capacity (gross): ≥140 litres.
Dimensions (W × D × H): approximately 60 cm × 60 cm × 85 cm.
Net (interior compartment) W × D × H: approximately 47 cm × 43 cm × 69 cm.
Cooling system, static.
Defrosting of freezing compartment, initiated manually.
Temperature range of freezer compartment: -9 °C to - 25 °C.
Housing material and door: steel, coated, white.
Door hinges right or left as desired, reversible.
Fungus-resistant door gasket.
Door with key lock.
Adjustable feet for levelling.
Interior container made of white plastic.
Four shelves in the freezing compartment, at least three closed with a freezing flap.
External digital temperature display for freezer compartment.
Malfunction warning signal.
Climate class SN-T.
Refrigerant: Fluorocarbohydrogen free (R600a).
Electricity requirements
Supply voltage: 230 ± 10 V, AC, 50/60 Hz. Voltage and plugs to be adapted to meet the country requirements.
Power consumption: Approximately 150 W.
Conform to electrical safety standards IEC 60601-1, UL 61010-1, EN 61010-1.
Protection class (in accordance with EN 60529).
Designed not to interfere with circuit radio (in accordance with EN 55014).

Documentation

Manufacturer's certificate

The manufacturer must have a management system certified to ISO 9001.

Declaration of conformity to the requirements of standards and regulations of the directives that apply to the product, including energy classification, gas used as refrigerant, climate class.

One certificate to state that the freezer has been calibrated at the factory.

Quality and safety standards met by the product must be listed.

Operation, maintenance and installation

Operation and maintenance manual

At least one set of operation, maintenance and service manuals for the freezer, written in United Nations languages (or at least in English) and preferably also in the official national language of the country requesting the freezer.

Installation and maintenance

Any prerequisites for installation to be communicated to the purchaser in advance, in detail.

The supplier to provide an after-sale service that covers the whole country. The service to have competent staff, adequate infrastructure and sufficient spare parts to be able to respond to any complaints and to repair or replace the freezer within 14 days.

Standard maintenance tools

All standard accessories, consumables and parts required to operate the equipment, including all standard tools and cleaning material, to be included in the offer. Bidders to specify the quantity of every item included in their offer (including items not specified above).

Spare parts

Each freezer to be accompanied by an authorized list of accessories and spare parts.

Packing data

Packing data are not necessarily part of the bidding process, but are needed for shipment and for customs declarations.

Net weight.

Gross weight.

Dimensions (W × H × D) in cm.

Appliances must be transported upright (Y/N).

Customer's tariff number.

Warranty: Three years.

Remarks

The equipment offered, including its power supply, to be designed and constructed to operate properly and continuously in the conditions of the purchaser's country; the equipment may need to tolerate high humidity (as high as 90% at 35 °C), ambient temperatures of 5–40 °C, fungi, and spikes in the electricity supply.

Bidders may propose products additional to the requirements listed above.

Chapter B7:

Detailed technical specifications for molecular biology techniques

Name of equipment: **PCR workstation**	**Code number:**
Tender specifications	**Bidder's specifications**
Quantity:	**Manufacturer:**
	Type/model:
	Country of origin:

Description of function and use The workstation is used to prepare reagents under clean conditions to avoid contamination with DNA.
Main specifications
Exterior dimensions (H × W × D): approximately 700 mm × 750 mm × 600 mm.
Interior working area (W × D): approximately 700 mm × 500 mm.
Exterior: stainless steel or powder-coated metal.
Interior: stable formed stainless steel.
Side panels transparent, able to absorb wavelengths below 400 nm.
Overhead UV light for DNA decontamination; two lamps, 25 W each.
Separate, switchable, UV air-sterilizing circulation unit; UV lamp (25 W).
Timer and key lock for UV lamp; timer operates only when key lock is on.
Overhead white light; 15 W; at least 800 lux.
At least two plug outlets built into the chamber; AC 230 ± 10 V; 50 Hz; 5A fuse.
Electricity requirements
Supply voltage: 230 ± 10 V, AC, 50/60 Hz. Voltage and plugs to be adapted to meet the country requirements.
Power consumption: Depends on the electrical equipment used inside the workstation; maximum 1200 W.
Conform to electrical safety standards IEC 60601-1, UL 61010-1, EN 61010-1.
Protection class (in accordance with EN 60529).
Designed not to interfere with circuit radio (in accordance with EN 55014).

Documentation
Manufacturer's certificate The manufacturer must have a management system certified to ISO 9001 and a type-test certificate of relevant optical and mechanical tests.
Quality and safety standards met by the product must be listed.
Operation, maintenance and installation
Operation and maintenance manual At least one set of operation, maintenance and service manuals written in UN languages (or at least in English) and preferably also in the official national language of the country requesting the workstation.
Installation and maintenance The bidder must arrange for the equipment to be installed by certified or qualified personnel; any prerequisites for installation to be communicated to the purchaser in advance, in detail. The bidder to also provide user training (including how to use and maintain the equipment) and a comprehensive maintenance plan. The cost of the maintenance plan to be defined and guaranteed over the period of warranty. The supplier to provide an after-sale service that covers the whole country. The service to have competent staff, adequate infrastructure and sufficient spare parts to be able to respond to any complaints and to repair or replace the workstation within 14 days.
Standard maintenance tools All standard accessories, consumables and parts required to operate the equipment, including all standard tools and cleaning and lubrication materials, to be included in the offer. Bidders to specify the quantity of every item included in their offer (including items not specified above).
Spare parts Each workstation to be accompanied by an authorized list of accessories and spare parts.
Set of fuses for the workstation.
Two UV lamps.
Packing data Packing data are not necessarily part of the bidding process, but are needed for shipment and for customs declarations.
Net weight.
Gross weight.
Dimensions (W × H × D) in cm.
Appliances must be transported upright (Y/N).
Customer's tariff number.
Warranty: Two years.
Remarks The equipment offered, including its power supply, to be designed and constructed to operate properly and continuously in the conditions of the purchaser's country; the equipment may need to tolerate high humidity (as high as 90% at 35 °C), ambient temperatures of 5–40 °C, fungi, and spikes in the electricity supply. Bidders may propose products additional to the requirements listed above.

Name of equipment:	**Code number:**
PCR thermocycler	

Tender specifications	**Bidder's specifications**
Quantity:	**Manufacturer:**
	Type/model:
	Country of origin:

Description of function The thermocycler is used in a TB laboratory to amplify fragments of mycobacterial DNA.
Main specifications
Thermocycler, Peltier elements.
Block for 96 × 0.2 ml tubes; possibility to use block with 48 × 0.5 ml tubes and 96-well PCR plates.
Blocks must be resistant to oxidation.
Heating rate: 4 °C/s.
Cooling rate: 2 °C/s.
Temperature range (block): 4–100 °C.
Regulating accuracy for block temperature: ±0.1 °C.
Temperature uniformity at 70 °C (block): ±0.4 °C.
Internal memory for at least 50 programs with up to 99 steps/program, freely editable.
Heatable lid with automatic height adaptation.
Electromechanical lid blocking to prevent accidental opening during a run.
Temperature range for lid: 80 °C to at least 103 °C.
Optional: Interface for remote control via PC; activated RS 232 serial port.
Electricity requirements
Supply voltage: 230 ± 10 V, AC, 50/60 Hz. Voltage and plugs to be adapted to meet the country requirements.
Power consumption: Approximately 500 W.
Conform to electrical safety standards IEC 60601-1, UL 61010-1, EN 61010-1.
Protection class (in accordance with EN 60529).
Designed not to interfere with circuit radio (in accordance with EN 55014).
Documentation
Manufacturer's certificate The manufacturer must have a management system certified to ISO 9001. One certificate to state that the thermocycler has been calibrated at the factory and certified according to ISO 13485 quality regulations.
Quality and safety standards met by the product must be listed.

Operation, maintenance and installation
Operation and maintenance manual At least one set of operation, maintenance and service manuals written in UN languages (or at least in English) and preferably also in the official national language of the country requesting the thermocycler.
Installation and maintenance The bidder must arrange for the equipment to be installed by certified or qualified personnel; any prerequisites for installation to be communicated to the purchaser in advance, in detail. The bidder to also provide user training (including how to use and maintain the equipment) and a comprehensive maintenance plan. The cost of the maintenance plan to be defined and guaranteed over the period of warranty. The supplier to provide an after-sale service that covers the whole country. The service to have competent staff, adequate infrastructure and sufficient spare parts to be able to respond to any complaints and to repair or replace the thermocycler within 14 days.
Standard maintenance tools All standard accessories, consumables and parts required to operate the equipment, including all standard tools and cleaning and lubrication materials, to be included in the offer. Bidders to specify the quantity of every item included in their offer (including items not specified above).
Spare parts Each thermocycler to be accompanied by an authorized list of accessories and spare parts.
Set of fuses, if used separately in the instrument.
Packing data Packing data are not necessarily part of the bidding process, but are needed for shipment and customs declarations.
Net weight.
Gross weight.
Dimensions (W × H × D) in cm.
Appliances must be transported upright (Y/N).
Customer's tariff number.
Warranty: Two years.
Remarks The equipment offered, including its power supply, to be designed and constructed to operate properly and continuously in the conditions of the purchaser's country; the equipment may need to tolerate high humidity (as high as 90% at 35 °C), ambient temperatures of 5-40 °C, fungi, and spikes in the electricity supply. Bidders may propose products additional to the requirements listed above.

Name of equipment:
Microlitre centrifuge

Code number:

Tender specifications

Bidder's specifications

Quantity:

Manufacturer:

Type/model:

Country of origin:

Description of function and use

The centrifuge is designed for routine applications in molecular biology.

Main specifications

Robust metal housing; compact design with chemical-resistant (coated) housing.

Easy-to-clean, smooth rotor chamber that is resistant to acids, alkalines, disinfectants used in the laboratory.

Low access height (≤23 cm) and space-saving design (≤24 cm × 32 cm; W × D).

Optional: Centrifuge with a built-in cooling system, adjustable in 1 °C steps; cooling down to at least 4 °C and able to keep this temperature at maximum speed. It should have a precool feature and stand-by cooling.

Microprocessor-controlled centrifuge.

Standard rotor with a capacity of at least 18 positions; aerosol-tight (chemical-resistant coated); exchangeable.

Maintenance-free motor.

Maximal relative centrifuge force: 15 000 G.

Automatic lid lock, starting with and during run of rotor.

Option: Automatic opening at the end of the run.

Emergency unlock for electricity blackout.

LCD display; protected; showing time and relative centrifugal force or speed in rcf or rpm.

Speed adjustable in 100 rpm steps.

If a keypad is used, it should be foil protected.

Timer for runs between 30 seconds and 30 minutes and an option for continuous operation for longer runs.

Short time operation by pressing a time button for short spin.

Adjustment of running time in steps of 30 seconds.

Short acceleration time to maximum rcf in ≤20 seconds.

Short breaking time from maximum rcf in ≤20 seconds.

Noise level: ≤58 dbA.

Electricity requirements

Supply voltage: 230 ± 10 V, AC, 50/60 Hz.
Voltage and plugs to be adapted to meet the country requirements.

Power consumption: Approximately 250 W.

Conform to electrical safety standards IEC 60601-1, UL 61010-1, EN 61010-1.

Protection class (in accordance with EN 60529).

Designed not to interfere with circuit radio (in accordance with EN 55014).

Documentation

Manufacturer's certificate

The manufacturer must have a management system certified to ISO 9001.

One certificate to state that the centrifuge has been calibrated at the factory.

Quality and safety standards met by the product must be listed.

Accessories

Optional: Adapter set; reduction device for smaller tubes to be centrifuged in the standard rotor to maximal rotor capacity, for 0.5 ml and 0.2 ml tubes.

Operation, maintenance and installation

Operation and maintenance manual

At least one set of operation, maintenance and service manuals written in UN languages (or at least in English) and preferably also in the official national language of the country requesting the microlitre centrifuge.

Installation and maintenance

The bidder must arrange for the equipment to be installed by certified or qualified personnel; any prerequisites for installation to be communicated to the purchaser in advance, in detail.

The bidder to also provide user training (including how to use and maintain the equipment) and a comprehensive maintenance plan. The cost of the maintenance plan to be defined and guaranteed over the period of warranty.

The supplier to provide an after-sale service that covers the whole country. The service to have competent staff, adequate infrastructure and sufficient spare parts to be able to respond to any complaints and to repair or replace the microlitre centrifuge within 14 days.

Standard maintenance tools

All standard accessories, consumables and parts required to operate the equipment, including all standard tools and cleaning and lubrication material, to be included in the offer. Bidders must specify the quantity of every item included in their offer (including items not specified above).

Spare parts

Each centrifuge to be accompanied by an authorized list of accessories and spare parts.

Packing data

Packing data are not necessarily part of the bidding process, but are needed for shipment and customs declarations.

Net weight.

Gross weight.

Dimensions (W × H × D) in cm.

Appliances must be transported upright (Y/N).

Customer's tariff number.

Warranty: One year.

Remarks

The equipment offered, including its power supply, to be designed and constructed to operate properly and continuously in the conditions of the purchaser's country; the equipment may need to tolerate high humidity, ambient temperatures of 5-40 °C, fungi, and spikes in the electricity supply.

Bidders may propose additional products to the requirements listed above.

Name of equipment: Ultrasonic bath	Code number:

Tender specifications		Bidder's specifications
Quantity:	Manufacturer:	
	Type/model:	
	Country of origin:	

Description of function and use The ultrasonic bath is used for disruption of bacterial cells to release DNA.
Main specifications
Robust stainless steel housing.
Bowl made of special cavitation-proof stainless steel.
Working frequency: 35 kHz or 37 kHz.
Timer for 1–30-minute use and continuous operating.
Heater for water-bath; adjustable between 30 °C and 80 °C.
Safety shut-down after 12 hours.
Timer and heater adjustable by knob or foil keypad.
Warning indicator for over temperature.
Volume:1.5–2 litres.
Cock, outlet for water.
Electricity requirements
Supply voltage: 230 ± 10 V, AC, 50/60 Hz. Voltage and plugs to be adapted to meet the country requirements.
Power consumption: Approximately 100 W for high frequency (HF) power and heating.
Conform to electrical safety standards IEC 60601-1, UL 61010-1, EN 61010-1.
Protection class (in accordance with EN 60529).
Designed not to interfere with circuit radio (in accordance with EN 55014).
Documentation
Manufacturer's certificate The manufacturer must have a management system certified to ISO 9001. One certificate to state that the ultrasonic bath has been calibrated at the factory.
Quality and safety standards met by the product must be listed.
Accessories
Swimming racks; foamed polyvinyl chloride (PVC) or PE; heat resistant to ≥80 °C; positions for 1.5 or 2.0 ml standard reaction tubes.
Optional: Swimming racks; foamed PVC or PE; heat resistant to ≥80 °C; positions for 0.5 ml standard reaction tubes.
Optional: Swimming racks for larger test-tubes.

Operation, maintenance and installation

Operation and maintenance manual

At least one set of operation, maintenance and service manuals, written in UN languages (or at least in English) and preferably also in the official national language of the country requesting the ultrasonic bath.

Installation and maintenance

The bidder must arrange for the equipment to be installed by certified or qualified personnel; any prerequisites for installation to be communicated to the purchaser in advance, in detail.

The bidder to also provide user training (including how to use and maintain the equipment) and a comprehensive maintenance plan. The cost of the maintenance plan to be defined and guaranteed over the period of warranty.

The supplier to provide an after-sale service that covers the whole country. The service to have competent staff, adequate infrastructure and sufficient spare parts to be able to respond to any complaints and to repair or replace the ultrasonic bath within 14 days.

Standard maintenance tools

All standard accessories, consumables and parts required to operate the equipment, including all standard tools and cleaning and lubrication material, to be included in the offer. Bidders to specify the quantity of every item included in their offer (including items not specified above).

Spare parts

Each ultrasonic bath to be accompanied by an authorized list of accessories and spare parts.

Packing data

Packing data are not necessarily part of the bidding process, but are needed for shipment and customs declarations.

Net weight.

Gross weight.

Dimensions (W × H × D) in cm.

Appliances must be transported upright (Y/N).

Customer's tariff number.

Warranty: Two years.

Remarks

The equipment offered, including its power supply, to be designed and constructed to operate properly and continuously in the conditions of the purchaser's country; the equipment may need to tolerate high humidity, ambient temperatures of 5–40 °C, fungi, and spikes in the electricity supply.

Bidders may propose additional products to the requirements listed above.

Name of equipment: Thermo-shaker	**Code number:**

Tender specifications	**Bidder's specifications**
Quantity:	**Manufacturer:**
	Type/model:
	Country of origin:

Description of function and use The thermo-shaker is used especially for molecular diagnostic test systems such as hybridization and incubation within a defined temperature profile.
Main specifications
Sturdy, compact housing; coated to resist corrosion; resistant to chemicals, alcoholic disinfectants and 1.5% hypochlorite.
Standing on four rubber feet designed to prevent sliding of the instrument during shaking.
At least two Peltier elements.
Thermo-blocks resistant to 1.5% hypochlorite solution.
Optional: Exchangeable thermo-blocks, at least one with trays for 12 hybridisation strips and one with 24 slots for the incubation of 1.5 ml standard reaction tubes.
Optional: Removable transparent lid.
Incubation temperature: ranging from 4 °C to 99 °C in steps of 1 °C.
Heating rate: 5 °C/second.
Cooling rate: 4 °C/minute from 99 °C to 20 °C, and 1 °C/minute from 20 °C to 4 °C.
Accuracy of incubation temperature: at least ±0.5 °C.
Shaking time: adjustable from 0 hours to at least 72 hours.
Shaking frequency for hybridisation block: 0 (no shaking at all) or 150–400 rpm in steps of 50 rpm.
Mixing amplitude: approximately 3 mm.
Memory for at least six programs, with different program steps for temperature and shaking; at least 10 program steps.
Display for 48 good readable digits; LCD; hermetically sealed against droplets (liquid splashing).
Keyboard for programming, also sealed against droplets.
Operating temperature and humidity range: 0–35 °C, 70% relative humidity.
Electricity requirements
Supply voltage: 230 ± 10 V, AC, 50/60 Hz. Voltage and plugs to be adapted to meet the country requirements.
Power consumption: Approximately 150 W.
Conform to electrical safety standards IEC 60601-1, UL 61010-1, EN 61010-1.
Protection class (in accordance with EN 60529).
Designed not to interfere with circuit radio (in accordance with EN 55014).

Documentation
Manufacturer's certificate The manufacturer must have a management system certified to ISO 9001. One certificate to state that the thermo-shaker has been calibrated at the factory.
Quality and safety standards met by the product to be listed.
Accessories
Thermometer suited for regular temperature checks; to feature a wire plunge sensor (e.g. Pt100) and a metering precision of 1/10 class B (AT = ±0.03 °C) in the range of 0–100 °C.
Operation, maintenance and installation
Operation and maintenance manual At least one set of operation, maintenance and service manuals, written in UN languages (or at least in English) and preferably also in the official national language of the country requesting the thermo-shaker.
Installation and maintenance The bidder must arrange for the equipment to be installed by certified or qualified personnel; any prerequisites for installation to be communicated to the purchaser in advance, in detail. The bidder to also provide user training (including how to use and maintain the equipment) and a comprehensive maintenance plan. The cost of the maintenance plan to be defined and guaranteed over the period of warranty. The supplier to provide an after-sale service that covers the whole country. The service to have competent staff, adequate infrastructure and sufficient spare parts to be able to respond to any complaints and to repair or replace the thermo-shaker within 14 days.
Spare parts Each thermo-shaker to be accompanied by an authorized list of accessories and spare parts.
One extra lid.
Set of fuses.
Packing data Packing data are not necessarily part of the bidding process, but are needed for shipment and for customs declarations.
Net weight.
Gross weight.
Dimensions (W × H × D) in cm.
Appliances must be transported upright (Y/N).
Customer's tariff number.
Warranty: At least two years.
Remarks The equipment offered, including its power supply, to be designed and constructed to operate properly and continuously in the conditions of the purchaser's country; the equipment may need to tolerate high humidity, ambient temperatures of 5–40 °C, fungi, and spikes in the electricity supply. Bidders may propose additional products to the requirements listed above.

Name of equipment: Microlitre pipettes	**Code number:**

Tender specifications	**Bidder's specifications**
Quantity:	**Manufacturer:**
	Type/model:
	Country of origin:

Description of function and use Microlitre pipettes are used for molecular biology procedures; a set of different volumes is required.
Main specifications
Single-channel microlitre pipettes.
Fully autoclavable (121 °C); UV-resistant material.
Adjustable volume range of each pipette: a. 0.5–10 µl b. 10–100 µl c. 100–1000 µl.
Increments: a. At least 0.1 µl fine adjustment b, c. At least 0.5 µl fine adjustment (0.1 µl preferred).
Accuracy: a. At least ±5–1% (first value applies to smallest volume, last one to the largest volume in the stated range). b, c. At least ±3–0.6% (first value applies to smallest volume, last one to the largest volume in the stated range).
Precision: a. At least 3–0.4% (first value applies to smallest volume, last one to the largest volume in the stated range). b. At least 0.7–0.2% (first value applies to smallest volume, last one to the largest volume in the stated range). c. At least 0.3–0.2% (first value applies to smallest volume, last one to the largest volume in the stated range).
Three defined stops (single-button operation preferred): ▪ take-up from the first stop ▪ dispensing and blow out ▪ tip ejection.
Easy and safe tip ejection mechanism.
Fixation of adjusted volume.
Slim pipette shaft.
Cone for standard tips.
Documentation
Manufacturer's certificate The manufacturer must have a management system certified to ISO 9001. One certificate to state that the pipette has been calibrated at the factory.
Quality and safety standards met by the product must be listed.

Operation, maintenance and installation
Operation and maintenance manual At least one set of operation, maintenance and service manuals for each microlitre pipette, written in UN languages (or at least in English) and preferably also in the official national language of the country requesting the microlitre pipette.
Installation and maintenance The supplier to provide an after-sale service that covers the whole country. The service to have competent staff, adequate infrastructure and sufficient spare parts to be able to respond to any complaints and to repair or replace the microlitre pipette within 14 days.
Standard maintenance tools All standard accessories, consumables and parts required to operate the equipment, including all standard tools and cleaning and lubrication material, to be included in the offer. Bidders to specify the quantity of every item included in their offer (including items not specified above).
A maintenance kit, with full documentation and tools for in-laboratory calibration according to ISO 9000, are part of the procurement.
Spare parts
Gaskets.
Lubricants.
Each microliter pipette to be accompanied by an authorized list of accessories and spare parts.
Packing data Packing data are not necessarily part of the bidding process, but are needed for shipment and for customs declarations.
Net weight.
Gross weight.
Dimensions (W × H × D) in cm.
Appliances must be transported upright (Y/N).
Customer's tariff number.
Warranty: Two years.
Remarks The equipment offered to be designed and constructed to operate properly and continuously in the conditions of the purchaser's country; the equipment may need to tolerate high humidity, ambient temperatures of 5–40 °C and fungi. Bidders may propose additional products to the requirements listed above.

Name of equipment:
Emergency spill kit, cleaning set

Code number:

Tender specifications	**Bidder's specifications**
Quantity:	**Manufacturer:**
	Type/model:
	Country of origin:
Description of function The kit is used in case of accidental spillage of infectious material in the laboratory.	
Main specifications	
FFP3 mask with expiration valve; three pieces.	
Head cover; two pieces.	
Protection glasses; two pieces.	
Overall, single use; two pieces.	
At least 10 pairs of overshoes.	
At least five autoclave-proof plastic bags; 1000 mm × 700 mm; with biohazard sign.	
At least two pairs of thick-walled household rubber gloves (to pick up shards and sharps).	
Disposable gloves; one package of each size (small, medium and large).	
Forceps or crucible tongs to pick up sharps.	
Container for sharps.	
Absorbent paper tissue; at least 500 mm × 500 mm; 1 kg.	
MTB-approved concentrated disinfectant for dilution.	
Bottle with spray head, 1 litre.	
Alcoholic disinfectant, 1 litre.	
Concentrated formalin solution (>30%), 1 litre; fumigation device.	
5 litre pressure spray bottle for disinfectant.	

Annex B1:

Conditions of electricity power supply

This annex provides definitions and explanations to make countries aware of potential problems with electricity power supply that could affect operator safety and the life expectancy of equipment.

Spikes

In developing countries, power fluctuations in the electricity grid are common, and alternating current (AC) power lines are subject to many different kinds of voltage disturbances. Spikes – that is, pulses of high voltage and current – are generally caused by equipment with high energy requirements (e.g. an elevator) being switched on or off, or by lightning. Spikes usually last for only microseconds. Transistors used in almost all electronic devices (e.g. motherboards and regulatory devices) are sensitive to spikes and need be protected. Power boards (also known as power strips or multi-outlet power boards) are available with protection against power spikes. If lightning is frequent, boards with protection against spikes of more than 10 000 volts (V) and 10 000 amperes (A) should be purchased. For areas without lightning, protection against spikes of more than 3500 V and 3500 A should be sufficient.

Power boards with protection against spikes are not expensive, but they can be unreliable or of poor quality. To ensure that high-quality boards are purchased, it is best to check reports on the internet on the quality of different types of board.

Surges and sags

Surges and sags are periods of high or low voltage; they are less severe than spikes, but last from a few seconds to a few minutes. Surges and sags are usually caused by faults with the power suppliers or by other devices on the line. Electrical laboratory equipment is usually designed to tolerate ±15% fluctuation in the operating voltage. If local fluctuations exceed this range, a voltage stabilizer should be installed. The cost of a voltage stabilizer will depend on the power consumption of the connected devices. Heating coils are not usually susceptible to fluctuations (lower voltage simply prolongs the duration of heating); therefore, it is advisable to check whether the regulatory part of the electrical set-up of individual items of equipment (e.g. incubators, hot-air ovens and distillers) can be stabilized separately.

Brownouts and blackouts

Other problems with electricity supply include:

- brownouts – longer sags lasting several minutes or hours;
- blackouts – periods of (near) zero voltage, usually caused by suppliers or by blown fuses or tripped breakers.

Depending on the duration of the blackouts, an electric generator may be needed. To safeguard against brownouts or blackouts lasting for several minutes, an uninterrupted power supply (UPS) is needed. The battery life needed in the UPS will depend on the average duration of blackout and the time needed to safely finalize the work that uses the laboratory equipment (e.g. about 20 minutes for biological safety cabinets [BSCs] and centrifuges).

Return surges (i.e. potentially damaging periods of high voltage) often occur when power returns at the end of a blackout; they can also result from laboratory generators being started.

Grounding

It is important to check that the electricity supply to the laboratory is properly grounded at the point where the supply enters the building and after distribution of phases at each plug. The frequency required for new equipment should be checked, because an electrically driven motor will lose most of its power if connected to the wrong frequency.

For more details and specific advice for a country, or to solve specific problems, it is advisable to contact an electrical engineer.

Annex B2:

Biological safety cabinets

This annex provides important information for those ordering biological safety cabinets (BSCs).

Directed airflow BSCs can provide protection for laboratory staff and reduce the risk of airborne infection. Unfortunately, the terminology for this equipment is often ambiguous, which sometimes causes laboratories to procure the wrong equipment. This annex sets out the difference between laminar flow hoods and BSCs, to ensure that laboratories are aware of the important differences in the design and intended use of these two types of equipment.

Laminar flow hoods

Laminar flow hoods are also known as "laminar airflow units", "horizontal and vertical outflow cabinets" and "clean-air workstations". They must NOT be used for handling infectious agents. These hoods are simply designed to create clean and dust-free conditions in laboratory working areas, and are used to prevent the contamination of sensitive devices in industries such as pharmaceutical manufacturing and biotechnology.

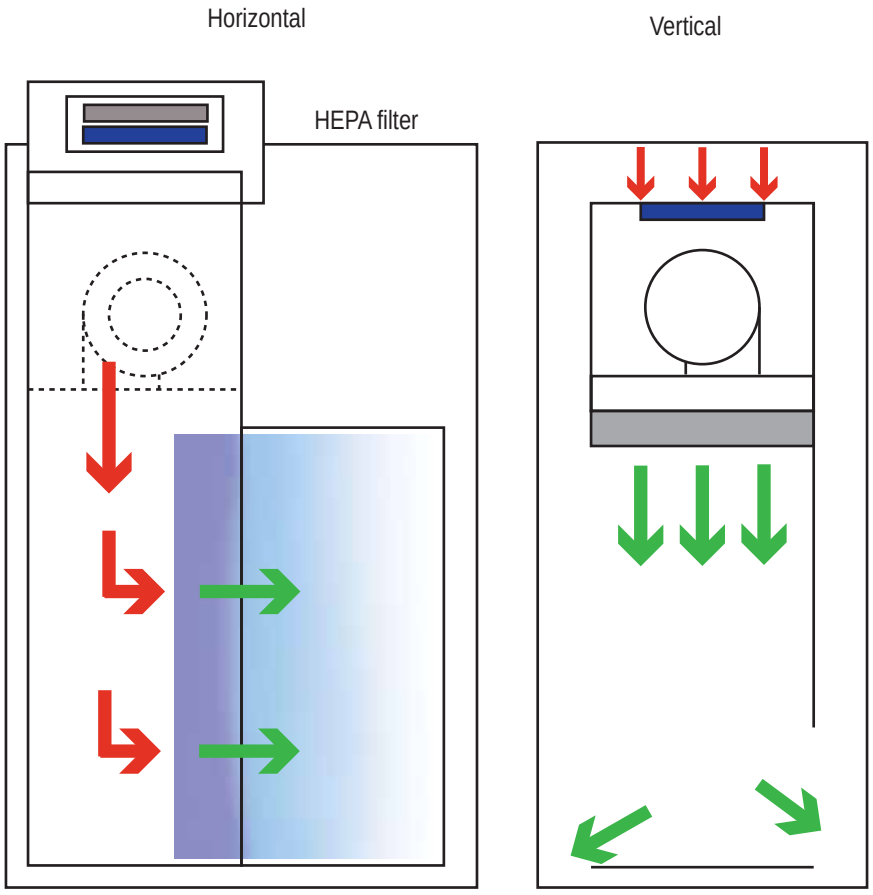
In a laminar flow hood, air is drawn from a high-efficiency particulate air (HEPA) filter, and blown in a smooth, laminar flow over a working area into the room. Cabinets are usually constructed from stainless steel, with no joins or gaps, to prevent attachment of spores and growth of microorganisms.

Types of laminar flow hoods

As shown in Figure AB2.1, airflow in laminar flow hoods can be horizontal or vertical. Whatever the type of airflow, laminar flow hoods provide product protection only. Laminar flow hoods must NOT be used when working with any form of biological or chemical hazard, because the operator and the surrounding environment will be exposed to any potentially infectious aerosol created on the workbench.

Horizontal airflow benches can be used for preparing culture media or handling other noninfectious reagents or solutions, but must NOT be used with potentially carcinogenic or allergenic materials.

Vertical airflow benches also blow air out into the room.



HEPA, high-efficiency particulate air
Notes: red arrows represent room air; green arrows represent sterile air.

Figure AB2.1 Laminar flow hoods

Biological safety cabinets

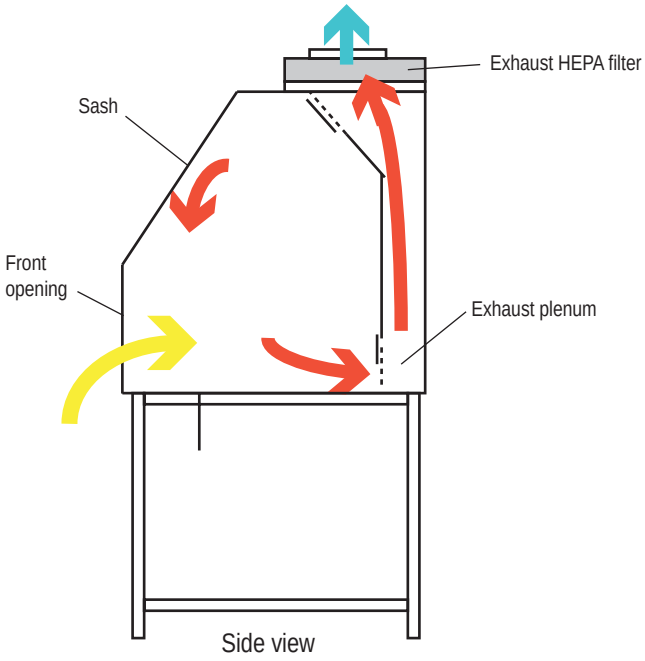
Biological safety cabinets protect people and the environment from infectious agents and – depending on the classification – may offer varying degrees of particle protection for products. Infectious agents must be handled in a BSC, NOT in a laminar flow hood.

Classification of biological safety cabinets

Class I

In a class I BSC (shown in Figure AB2.2), room air is drawn in through a front opening at a constant velocity. The air passes over the work surface and is discarded from the cabinet through the exhaust duct. Aerosols or other particles that might be generated during work are sucked away from the laboratory worker by the directional airflow into the duct. The front opening allows the operator to perform the work while observing through a window screen. According to EN 12469, a carefully maintained inward flow of room air of between 0.7 m/s and 1.0 m/s should be established.

Although airflow is directed away from the worker, the air is not HEPA filtered, so products are not protected. Air can be hard ducted out of the laboratory or extracted through a thimble if external exhaust fans are installed. If possible, the external exhaust fan should be located at the very end of the exhaust pipes and interconnected with the BSC fan, so that the BSC cannot be switched on unless the external extractor fan is on. Maintaining a slightly negative pressure in the duct will prevent leakage of contaminated air into the laboratory.



HEPA, high-efficiency particulate air
Notes: the yellow arrow represents room air; red arrows represent contaminated air; the blue arrow represents HEPA-filtered air.

Figure AB2.2 Schema for airflow for a class I biological safety cabinet

Class II

A class II BSC is designed to extend the protection features of class I, to protect sensitive materials from contaminated room air. Types of class II BSC include:

- class II (EN 12469), which complies with European norm standards;
- class IIA1, class IIA2, class IIB1 and class IIB2 (NSF 49), which comply with National Sanitation Foundation standards (United States).

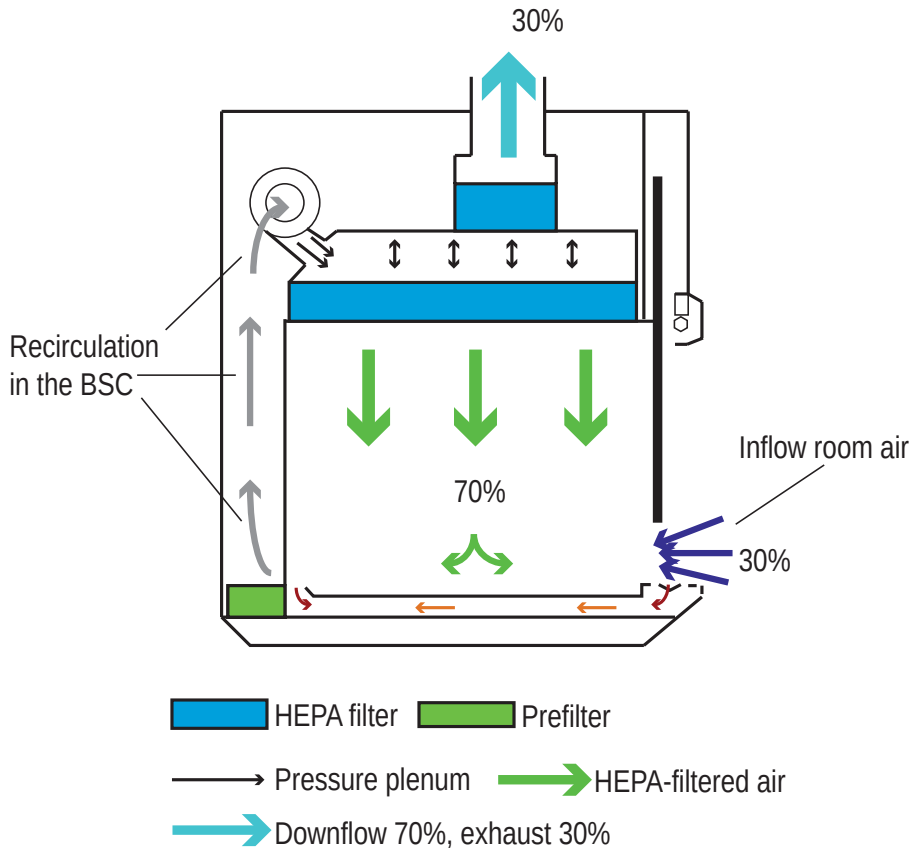
A class II BSC differ from a class I BSC in that design features in the class II allow only HEPA-filtered air to flow over the work surface. This air is sucked through the front and back grid, back to the system.

As shown in Figure AB2.3, class II BSCs have a front access opening and a carefully maintained inward flow of room air though a front intake grill. The air supply passes through a HEPA filter before flowing downward as a vertical (ideally laminar) flow. The airflow is split just above the working surface so that about half enters the intake grill (together with newly entering room air) and the other half passes through the rear exhaust grill. Any particles generated at the working surface are captured by the downward flow and eliminated. The total air is then discarded through the rear plenum into a space between the supply and the exhaust HEPA filters. The relative size of both filters determines the percentage of recirculated air passing through the supply filter.

If possible, the exhaust air from a class IIA BSC should be ducted out through a thimble connection to a dedicated duct with an extraction fan outside. The exhaust air from a class IIB BSC should be hard ducted to the outside. A separate extractor fan with sufficient capacity is needed when the BSC is part of the ventilation system, to create and maintain a lowered pressure in the laboratory.

Laboratories should:

- discourage use of class IIA1 BSCs because they may have contaminated ducts and plenums at a positive pressure to the room;
- ensure that class IIB1 and class IIB2 BSCs are hard ducted to the outside; this means that the building exhaust system must be precisely matched to the airflow requirements specified by the manufacturer for both volume and static pressure; thus, certification of these BSCs is more difficult.



BSC, biological safety cabinet; HEPA, high-efficiency particulate air

Figure AB2.3 Class II A2 biological safety cabinet, air flow pattern

As shown in Table AB2.1, NSF 49 differs from EN 12469.

Table AB2.1 Comparison of requirements for NSF 49 and EN 12469

	NSF 49	EN 12469
Airflow		
Class I	Not specified.	Inward flow of ≥0.7 m/s and ≤1.0 m/s.
Class II	Class IIA (with an inward flow of ≥0.38 m/s) should be discouraged because they may have contaminated ducts and plenums at positive pressure to the room. Class IIA2 have an inward flow of 0.5 m/s.	Does not differentiate between class IIA1 and class IIA2; the inward flow should be at least 0.4 m/s, and above this value according to manufacturers' specifications.
Downflow		
All types	Requires compliance with the manufacturers' set points or downflow velocity within a deviation of 0.025 m/s from a nominal set point.	Requires airflow velocity to be >0.25 m/s and <0.50 m/s, and defined by the manufacturer according to the equipment design. No individual measurement should differ by more than 20% of the value requested by the manufacturer.

Class III

Class III BSCs are hermetically sealed, with two HEPA filters on the exhaust system, and all procedures conducted through arm-length rubber gloves. Class III BSCs are used in high-level (Level 4) containment labs and are NOT required in a TB laboratory.

Certification of BSCs

A BSC must be checked and certified for biosafety and all other functions before delivery. The test results must be documented and provided with the BSC. The packing must have an indicator stating that the cabinet was kept in an upright position during the entire transportation.

The following tests of a BSC are required in the laboratory:

- airflow smoke pattern tests
- air inflow velocity test
- air downflow velocity profile test
- HEPA filter leak test
- alarm function verification;
- exhaust system performance
- cabinet integrity test (for class IIA1 cabinets with positive-pressure contaminated plenums only)
- ultraviolet germicidal intensity (UVGI), if installed.

The following tests of a BSC are also recommended:

- lighting intensity test
- vibration test
- noise-level test
- electrical tests (leakage, ground circuit resistance and polarity).

Frequency of testing

A BSC should be tested:

- at initial installation (on site, before initial use)
- at least annually after initial installation
- after replacing filters
- after repair work is carried out or the cabinet is moved.

Prerequisites for laboratory preparedness before installing a BSC

This section provides information that will help laboratories to avoid major pitfalls in planning and designing TB laboratories.

Issues to consider in locating a BSC are as follows.

- In general, a BSC must be located away from main traffic areas, doors and air-supply or exhaust diffusers that may disturb or interrupt airflow.
- A BSC plus its stand is usually 2.15–2.30 m high. The exhaust air must be ducted out (and, in some BSCs, exhaust filters have to be changed from the top); therefore, space should be left between the exhaust grid and the ceiling of the laboratory. An exhaust pipe with a cross-section of about 400 cm^2 (20 cm × 20 cm) is commonly used to prevent resistance to the airflow; hence, the room ceiling should be high enough to accommodate the BSC and exhaust pipe.
- Whenever possible, a clearance of 30 cm or greater should be provided on each side (including back to wall) of the cabinet to allow for access.
- If recirculation is used (not recommended), a minimum clearance of 30 cm must be provided between the exhaust outlet on top of the cabinet and any overhead obstructions.
- For installation of an exhaust system with appropriate cross-section and thimble construction (see Annex B3), a minimum clearance of 45 cm will be required.

Issues to consider in ensuring that a BSC is used safely are as follows.

- For ducted cabinets, the extractor fan on the exhaust system should be located at the terminal end of the ductwork.
- Failure of the exhaust airflow should signal an alarm to the user.
- To prevent pressurization or failure of exhaust flow from the cabinet, when hard ducted out or with bypass construction, an anti-backflow device to prevent reverse airflow through the HEPA filter may be required.

Options for connecting a BSC are as follows:

- direct connection – cabinet and the external ventilator have to be switched on at the same time;
- direct connection with a bypass – an anti-blowback valve is needed; the external ventilator may work for 24 hours a day; when the cabinet is switched off, the bypass valve in the duct will open in order to extract the air from the room;
- connection via a thimble construction (an option not valid for class IIB BSC) – this option is illustrated in Annex B3.

Proper planning for heating, ventilation and air-conditioning will be the work of an engineer. The staff available locally for maintenance should also be taken into account. Laboratories should plan properly before requesting tenders for a BSC. The following professional associations may be useful in the planning process:

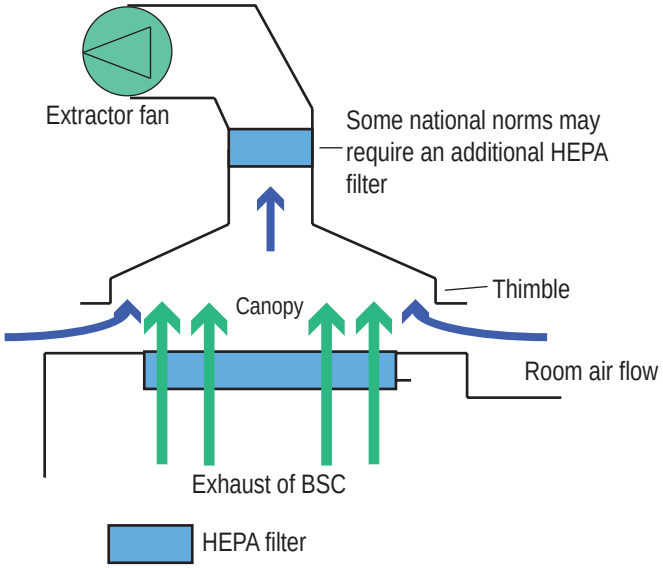
- American Biological Safety Association – http://www.absa.org/index.html
- American Industrial Hygiene Association, Biosafety – http://www2.umdnj.edu/eohssweb/aiha/technical/biosafety.htm
- American Society of Microbiologists – http://www.asm.org/policy/.

Annex B3:

Thimble connection

This annex discusses the construction of a thimble connection within a BSC. A thimble connection (shown in Figure AB3.1) requires the installation of an external extractor fan, preferably located at the very end of the exhaust pipes. A slightly negative pressure maintained in the duct prevents leakage of contaminated air into the laboratory.

A thimble exhaust system is NOT suitable for a class IIB BSC.



BSC, biological safety cabinet; HEPA, high-efficiency particulate air

Figure AB3.1 Schematic representation of thimble connection

The external fan may be switched on separately from the BSC. Alternatively, the fan can be coupled via a relay circuit with a caster so that when the BSC is switched off, the external fan still runs for some time. The BSC should be equipped with an interconnection, so that the BSC cannot be switched on unless the external extractor fan is also turned on.

According to national regulations for some countries, an additional HEPA filter, preferably located at the beginning of the exhaust pipe right after the influx of room air, is required to protect the external environment from potentially contaminated air from the laboratory room. The external fan must be efficient enough to ensure negative pressure in the duct despite the additional HEPA filter and its expected loading.

When the external fan is switched on, air will be extracted from the room according to the setting of the extractor fan, which should be regulated according to the air volume rate needed to establish the desired lowered pressure within the laboratory room. If the BSC is also switched on, its exhaust air and some of the additional room air will be expelled (as long as the total exhaust air rate of the BSC is less than the adjusted volumetric flow rate of the extractor fan).

Advantages of a thimble connection

Advantages of a thimble connection are that:

- no adjustments have to be made to the cabinet, and the pressure in the room will be nearly constant;
- to keep a controlled constant lower pressure (e.g. –30 Pa) within the containment room, a damper for the exhaust or supply air (or both) will be needed; the components include controller electronics and airflow measurements;
- in case of a blackout, the air flowing back to the room with lowered pressure will pass through the thimble and will not "wash off" bacteria from the HEPA filter.

Anti-blowback valves and fire flaps are usually recommended, depending on the climatic conditions. A heat exchanger, humidifier or air-conditioning may also be advisable.

If more than one BSC is installed, laboratories should take precautions to balance the exhaust air from the room, depending on which BSC is switched on (compensation for the airflow resistance in the exhaust pipe) and how many cabinets are switched on at the same time. Some manufacturers offer thimbles with motorized flaps that can be regulated for this purpose.

To balance needs and costs at a particular setting and obtain a suitable solution, laboratories should consult an engineer qualified in heating, ventilation and air-conditioning.

Finally, an assured service for maintenance covering the installation as a whole is essential.

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