FAO PLANT PRODUCTION AND PROTECTION PAPER 214

ISSN 0259-2517

Agricultural Hand Tools in Emergencies:

Guidelines for Technical and Field Officers

FAO PLANT PRODUCTION AND PROTECTION PAPER 214

Agricultural Hand Tools in Emergencies:

Guidelines for Technical and Field Officers

John E. Ashburner
FAO Consultant

Josef Kienzle
FAO Plant Production and Protection Division

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
Rome, 2013

ISBN 978-92-5-107486-2

Contents

Preface

FAO has been intricately involved with activities emanating from emergency situations for many decades. Under such circumstances, not only is assistance required urgently but it is also essential to ensure that it is sufficient both in quantity and quality. Overall objectives are carefully focused on encouraging sustainable recovery programmes and although this will eventually involve the use of power sources of a higher level, there remains a widespread need for handtools by the smallscale farmer. Such tools may appear simple at first glance but failure to understand the importance of selecting the correct tool and to ensure that it is of adequate quality for the job required is fundamental for the success of any recovery programme.

A draft document was released in 2001 under the title "*Guidelines for the technical specifications and procurement of agricultural hand tools*" and this has served as a reference document for the technical and emergency services of FAO for the past decade. It was and still is frequently consulted by FAO Field Officers and other aid agencies and NGOs. It is therefore opportune to update the material.

The present Guidelines have been prepared in an entirely different style and in two distinct Parts. The aim of **Part I** is to make it "user-friendly" to Field Officers. It is very brief in text but amply illustrated with photographs so that each tool can be clearly identified even by non-technical staff. The commonly used terms for the tools in French and Spanish have also been included. The objective is to ensure that an appropriate tool can be ordered and supplied for the task in hand.

Part II is a more technical document designed for use by FAO staff in Headquarters, Regional and Country Offices together with suppliers, manufacturers and inspection companies. The objective is to clearly indicate FAO procurement procedures, to provide detailed technical specifications for a range of agricultural hand tools and to describe how the quality of these tools may be tested.

The information is based upon the considerable experience that the technical services of the Plant Production and Protection Division (AGP) have accumulated in this respect. It also takes full account of the standards developed in East Africa and their related hand tool testing procedures.

It will be of interest to FAO staff involved with procurement and project management. It provides information which will assist suppliers and manufacturers to better appreciate the fundamental importance of supplying detailed and precise information when participating in international tenders. And finally it will be of benefit to inspection companies to more fully appreciate the reasons for and the nature of the test procedures which are described in the technical specifications.

Clayton Campanhola,

Director, Plant Production and Protection Division, FAO

Acknowledgements

The authors would like to acknowledge the groundwork provided for this document over the past two decades. Goolam Oodally, Agricultural Engineer in the former Agricultural Engineering Service (AGSE) of FAO developed the first draft of the Guidelines in the 1990s. Keith Elliot further developed them in 2001 when they were eventually released on the FAO Website as "*Guidelines for the technical specifications and procurement of agricultural hand tools*".

A number of officers from the FAO Emergency Operations Division together with staff from their field projects have provided feedback and suggestions regarding earlier drafts, particularly as these regard streamlining procedures.

Rudolph Holtkamp contributed valuable insights arising from his mission to Burundi in 2003 where he looked specifically into the quality standards for hoes. Lawrence Clarke in his role as Chief of the Agricultural Engineering Branch (AGSE) provided the necessary oversight and linked the various pieces together up to his retirement in 2006. Keith Elliot prepared a first draft for a revised edition in 2010.

Technicians and senior staff from the Kenya Bureau of Standards, the Uganda National Bureau of Standards and the Tanzania Bureau of Standards provided additional information and a number of the illustrations. These institutions also welcomed Brian Sims (FAO Consultant) for a technical visit during 2011 when further clarifications were offered and photographic opportunities set up for his visit.

Mr. Mukesh K. Srivastava from the Statistics Division provided excellent advice and guidance on sampling methods for larger quantities of hand tools.

Rodney Byers of the Chillington Tool (Thailand) Co. Ltd. has provided valuable technical information and conducted Josef Kienzle from the Plant Production and Protection Division (AGPM) on a visit to their factory outside Bangkok in 2011.

Serge Tissot (AGSE), Brian Jackson (AGSE) and the authors have continued to update the various technical specifications of the handtools and regularly updated the database on the technical specifications. There has also been continued discussion with the Procurement Service of FAO and they have reviewed the section on Procurement and assisted in revising the sampling procedures to be used during external inspections.

Many of the diagrams are based upon recognised international or national standards but these have been extensively modified to improve clarity. Whilst prepared by the lead author, they were finalised with assistance from Mario Alessandri from the Infrastructure and Facilities Management Branch and Magda Morales (FAO Consultant).

Part I

Practical Guidelines

1. Why supply hand tools in field projects?

Any serious gardener knows that the process of digging and cultivating by hand is a very arduous task. In the rural areas of many developing countries, particularly in sub-Saharan Africa this job is mainly undertaken by women. In contrast the men tend to seek other activities, often in the towns and much more rarely do they wield a hoe.

The standard emergency response of FAO to a crisis is to provide the target beneficiaries with basic kits to enable them to start up farming operations again as soon as possible. These kits usually contain some seeds and fertilizer together with a hand tool, most commonly a hand hoe but perhaps also a machete, a sickle, an axe, a shovel or another tool.

FIGURE 1

(Photograph: Josef Kienzle)

FAO is a major actor amongst those organisations that provide emergency response kits and thus has a considerable market share in the procurement and delivery of hand tools. It follows that FAO has a responsibility to

ensure that any tools supplied meet acceptable standards of quality and are also appropriate for the needs of the beneficiaries. FAO is also very much aware that it is dealing directly with very vulnerable and often the least privileged groups particularly women and rural youth.

Such provision of hand tools should only be viewed as a contribution towards a short term solution during a limited timeframe following the emergency. It is not intended that such procurements should be repeated for each subsequent agricultural campaign and if this is eventually deemed necessary, such a measure should only be undertaken following careful monitoring and an in-depth needs assessment study.

In the unlikely event that a repeat-order is approved, then priority should be given to local procurement where local suppliers and fabricators, including blacksmiths, can become involved. In this way support can be given towards developing local industries and infrastructure which in turn will contribute towards a more sustainable rural infrastructure. This philosophy supports the approach currently being suggested by the World Food Programme[1] and more recently by FAO known as "Purchase for Progress" or P4P.

A major objective of FAO is to encourage the use of agricultural equipment which can improve productivity and profitability whilst making the task of achieving this easier to undertake. This means that more sophisticated tools might prove to be more suitable, particularly as a project moves on to the rehabilitation phase. Some equipment which falls within this category includes jab planters, animal drawn rippers and carts or even single-axle walk-behind or ride-on tractors. Field staff should however be aware that the introduction of such equipment will depend not only on its technical specification but also on social and cultural aspects. The recipient communities will need to accept at least in part the challenges and risks of adopting such a higher level of mechanization.

The Plant Production and Protection Division (AGP) is convinced that in order to maintain the interest of rural youth in modern farming techniques, efforts must be made to introduce market oriented and commercial farming systems. The necessary equipment could be offered to farmers through local vendors, a principal objective of the P4P initiative. Some farmers would eventually also become service providers offering mechanised farm services or establishing local repair and maintenance workshops.

1 http://www.wfp.org/purchase-progress

The ultimate goal would be to achieve a sustainable agricultural system in which agricultural tools and agricultural mechanization each have a role to play and where there would be no further need for FAO to procure hand tools during an emergency.

2. Selection and procurement

2.1 INTRODUCTION

The objective of **Part I** of these guidelines is to assist FAO Field Officers with the selection and procurement of agricultural hand tools. These are often included as part of the inputs supplied under emergency programmes but may also be needed for rehabilitation or development projects. One of the most important aspects is the correct identification and description of the tools which are required. A number of factors can influence this decision and these are discussed.

The next step is to consider possible procurement options. International procurement for large orders is often preferred but there may be strong reasons for also including local procurement as a possibility for at least part of the order. Field Officers may become involved in the case of local procurement and to these ends an overview is provided of FAO procurement procedures. This is dealt with in greater detail in **Part II**.

Detailed technical specifications for each hand tool will eventually need to be drawn up. Field Officers may wish to make a first draft of these although they will have to be technically cleared in FAO Headquarters through the responsible technical division (AGP). Certain basic specifications will however need to be determined in the field and these are described. The assistance of field staff will be of particular importance if part of the order is to be purchased from local sources.

During the procurement process through international tenders, the hand tools which have been ordered directly by FAO Headquarters or under their direct supervision will be inspected by an internationally recognised inspection company. This is to ensure that the quality of the goods conforms to those which were offered by the supplier. During this inspection the packaging and the quantities shipped will be checked and some laboratory tests may also be carried out. Field Officers are not involved at this stage. These test procedures are fully described in **Part II**.

2.2 SELECTION OF APPROPRIATE TOOLS

When selecting tools for farming operations the first step is to consider which of these could be most appropriately targeted by the intervention.

They will of course depend upon the scale of the farming operations envisaged and on the local farming conditions, including the soil types, crops, weed species and agro-ecological conditions. The farm household environment and the cultural conventions of the region should also be considered. Indeed there may be additional and important local cultural factors such as the precise tool shape, the handle length or even the colour of any paint, to mention only some of these aspects recorded by FAO in the past. This serves to emphasise that **above all and wherever possible, the farmers and/or any other beneficiaries should be directly consulted.**

Emergency interventions are generally not the time to introduce innovative tools. There may however be exceptions and for instance, on several occasions a few jab planters, animal-drawn rippers and other equipment for practising conservation agriculture have been supplied. Such an approach however must always be fully supported with a seriously designed training programme to ensure that the farmers are adequately prepared to use any radically different or innovative farming methodology.

The project may be collaborating with other organisations and these should also be consulted regarding the tool selection.

It will eventually be necessary to determine the overall quantity for each type of tool that is required. This is normally based on complete or partial sets which will be assigned to a family grouping but this can differ from project to project. Field Officers should provide any essential or specific guidance in this respect.

2.3 PRELIMINARY SPECIFICATION OF HAND TOOLS

Field Officers may be unfamiliar with the range of hand tools available and with their nomenclature. This can be particularly difficult when language issues are involved. Hand tools frequently have a local name with which they may not be familiar.

Preference amongst potential beneficiaries can lead to important hints as to which tool to select. Potential beneficiaries should **ALWAYS** be consulted if at all possible. Discussion with the intended users, with local collaborating organisations and with others can normally narrow down the identification of the tool (or tools) really required.

A specification for the tool will then need to be drawn up. The Field Officer plays a vital role in this task but does not need to be an engineer.

A photograph of the tool required is a very useful first step. This can immediately resolve any language issues.

Normally however, certain other details are needed and these are described more fully below in **Section 3**.

2.4 THE FAO PROCUREMENT PROCESS

FAO procurement procedures are governed under Manual Section 502 – "*Procurement of Goods, Works and Services*" dated 1 January 2010[2]. This establishes the principles and procedures that apply to the procurement of all goods, works and services on behalf of FAO.

However, procurement procedures are constantly in process of change and the Manual is accordingly regularly updated. As such, the latest version should always be checked.

The procedures described as of this date are summarised in **Part II** below.

2.5 VOUCHER SCHEMES AND INPUT TRADE FAIRS

Sometimes tools are locally available but the intended beneficiaries lack sufficient purchasing power to acquire them. In these circumstances, the use of Voucher Schemes and Input Trade Fairs may be appropriate. FAO is developing guidelines for use of vouchers and input trade fairs, although currently these approaches tend to be used more frequently for seeds[3] than for tools.

There are some distinct advantages to this approach. It can be timely and cost-effective as the tools are already in the locality. It can offer the farmers a greater choice of tools and take account of their particular preference. Perhaps more importantly, it helps to further develop the existing national and local agricultural tool and equipment supply network.

2.6 SOURCING TOOLS FROM THE INFORMAL SECTOR

Although local blacksmiths and other artisans cannot produce the large quantities of tools frequently required for emergency projects, they may be able to supply part of the requirements. They often represent an important part of the local manufacturing and maintenance network for

[2] see http://intranet.fao.org/manual_sections (this website is only available internally to FAO staff – external enquiries should be sent directly to the Organization)

[3] see http://www.fao.org/fileadmin/templates/tc/tce/pdf/Input_Trade_Fairs.pdf

agricultural tools in the region and it is important that interventions by FAO contribute towards development not only of the farming sector but also this aspect of rural infrastructure. In particular FAO must ensure that any project intervention does not undermine existing agricultural support networks and leave them in a weaker state when aid is withdrawn. Furthermore local blacksmiths are frequently the only manufacturers of some types of tools specific to a certain region and to which farmers are accustomed. For these reasons sourcing tools from the small scale informal sector must be considered.

Two alternative local procurement methods can be adopted:

- Direct procurement from a cooperative of blacksmiths or artisans;
- Procurement through NGOs or other aid-funded projects that can provide the blacksmiths or artisans with the designs, manufacturing jigs and raw materials. However it is advisable in this case that the FAO Procurement Service (CSAP) and AGP be consulted.

2.7 LOCAL SOURCING OF COMPONENTS

Under some circumstances, although it may not be possible to locally source the entire tool, at least some of the components might be suitable for local supply. This is frequently the case with hoes where the blades are normally imported but the handles are usually obtained locally. Indeed, importing large quantities of handles such as for hoes causes severe logistical problems as they are very bulky and hence very expensive to transport to the field sites.

It is important to note that many of the problems encountered with hand tools arise from the use of handles made from cheap unseasoned softwood, coupled with poor manufacturing quality. Breakage, loose tool heads, and unsatisfactory grips are typical problems leading to poor productivity and possible injury to the operator.

Suitable hardwoods are generally available and seasoning can be carried out naturally or with kilns. The cost increase for a quality handle over that of a cheap one is usually modest and easily justified. However, it may not even be necessary to supply a handle at all – the farmer himself is often well versed in fitting a suitable handle to his tool and will make sure it is a good handle. This will completely avoid the logistical problem referred to above.

2.8 STORAGE AND DELIVERY

Prior to the receipt of goods, adequate storage and protection facilities should be prepared together with a recording system for the receipt and

distribution of the goods. The storage, handling and distribution should be undertaken with particular care in order to prevent any deterioration of implement quality and to ensure they are distributed on time to farmers for their intended purpose.

When tools are being delivered as part of a tool and seed package at the start of the planting season it is particularly important that they are delivered on time. A delay in planting after the start of the season can have a serious impact on crop yield.

2.9 TRAINING NEEDS

The present guidelines concern agricultural hand tools. It has been mentioned that under certain circumstances innovative tools to facilitate the practice, for instance of conservation agriculture might be included in the input package. In this case, it is essential that a "Training" component be included in the project budget. This should be **SUBSTANTIAL** and **SUFFICIENT** to ensure that this new technology is properly introduced to the beneficiaries. It must be emphasised that failure to ensure such a measure will be counter-productive in the long term.

Similar training needs arise during the introduction of simple post-harvest and irrigation equipment but this is beyond the scope of the present document.

3. Outline specifications

3.1 INTRODUCTION

The technical specifications for agricultural hand tools form the basis for the contract between FAO and the supplier of the tools selected. Proper technical specifications ensure that the tool that was initially identified as the most suitable for a particular purpose is the one that is delivered to farmers and that the tools delivered are in conformity with what has been requested.

At first glance it may appear that the specifications are overly complex for simple agricultural hand tools. However, inadequate or incomplete specifications may result in suppliers delivering a poor quality product that would not be suitable for its intended use. In addition, insufficiently detailed specifications may provide an opportunity for suppliers delivering poor quality or inappropriate goods to claim that they have met the agreed specifications. In such cases FAO risks being held liable for payment of the goods even though they may not meet the quality requirements. It is therefore very important that sufficiently detailed and accurate specifications are established to protect the recipients of the tools and FAO.

This section of the Guidelines describes the detailed information needed when a request for hand tools is initiated. It is not intended that the reader should become a specialist in drawing up specifications but it does indicate the information which will be needed before they can be finalised and technically cleared by the unit responsible (AGP).

3.2 BASIC FORM, DIMENSIONS AND WEIGHT

The main input expected of field staff is to indicate the shape and dimensions of the tool. Some other details may also be needed such as capacity and or the tool weight. Combining this information with good photographs and diagrams makes the whole process much easier and these should be sent to FAO HQ when requesting assistance in formulating specifications.

Generally only the critical parameters are specified such as those that affect the use, acceptance and performance of the tool. For tools selected from

trade catalogues these dimensions can usually be found in the manuals. For tools brought in from the field these dimensions can be measured directly.

The handle design should also be described in the case that there is a preference. This applies particularly to shovels and spades.

3.3 HANDLES

The possibility of local sourcing for tool handles has already been mentioned above under **Section 2.7**. This must be clearly indicated for each tool and included in the outline specifications sent for processing.

3.4 MATERIAL SPECIFICATIONS

The main materials used in the fabrication of agricultural hand tools and workshop equipment are steel and its alloys. Steel is made by the addition of small quantities of carbon to iron. The carbon content determines the characteristics of the steel and hence its suitability when manufactured into a tool. Inclusion of these details into the specifications does not need to be attempted by field staff. However, any particular characteristics required for the materials of the equipment should be mentioned (e.g. a wooden or plastic handle).

3.5 HEAT TREATMENT

The steel used in the manufacture of the tools will also be heat treated so that optimum characteristics are achieved. This process of heating and cooling the steel is beyond the scope of these guidelines. However the results of successful heat treatment can be measured through what is known as a hardness test. The details of the testing requirements which are included in the technical specification of individual tools do not need to concern the Field Officer but they are described in the technical guidelines under **Part II**.

3.6 DELIVERY

The Field Officer should clearly indicate where the consignment is to be delivered and a target date should be included if possible. Delivery will normally be to a central store but sometimes delivery to one or more field destinations may be requested. This information will be included in the finalised technical specifications and will clearly have an effect on the freight costs.

3.7 OTHER ASPECTS

The technical specifications also include additional details which tend to be fairly standard and do not need to overly concern the Field Officer. These include the tool markings, any preservative treatment and the packaging.

3.8 SPECIAL SPECIFICATIONS FOR LOCAL MANUFACTURE AND PROCUREMENT

Agricultural tools are most commonly sourced by FAO from large international manufacturers. However for a variety of reasons some or even all of the order may be sourced from local informal enterprises or local/regional small or medium-scale formal enterprises. The specifications for the tools in these cases will reflect the type of tool and quality that could be expected from these sources.

For blacksmiths, the specifications generally need to be based on designs that blacksmiths in the area are familiar with together with samples of finished products that they can copy and against which their finished products can be judged. It is important that photographs of these tools and accurate measurements of their dimensions and weights are recorded and sent to FAO HQ who can then assist in drafting the specifications.

For well equipped and formal local manufacturers the same specifications as those expected of international manufacturers can be drawn up, whereas for those operating at a lower technical level, the specifications drawn up need to reflect the capabilities of the enterprise. The specifications to be drawn up are generally narrower and refer to a specific tool that the manufacturer already produces or will be copying. The specifications consist primarily of defining the basic form, the dimensions and the weight together with drawings and/or photographs emphasising critical areas. Generally the material composition is not specified although sometimes (as for the blacksmiths) specific reference may be made as to categories of scrap material that should be used, as a raw material.

If local procurement from a small local manufacturer is being considered, then the local FAO Field Officer should obtain the basic technical details and photographs of the tools to be procured and initiate discussions with FAO HQ technical support services regarding the feasibility of local manufacture and the preparation of appropriate specifications.

4. Descriptions of hand tools

4.1 INTRODUCTION

The objective of this Section is to provide a description of a range of the most common hand tools which have been supplied to FAO projects. In most cases, important aspects are highlighted that need to be mentioned during the identification stage for the tools in order for the detailed specifications to be finalised.

4.2 HOE

HOUE *AZADON*

The main types of hoes are as follows:

- Heavy digging hoes with short handles.
- Light weeding hoes with long handles to allow the operator to stand upright and easily manipulate the hoe with both hands.
- Light planting hoes with short handles for planting.

It is important also to specify the weight of the hoe which is required. Generally speaking, lighter models should be chosen for female or Asian beneficiaries.

Secondly, the manner by which the hoe is to be fitted to the handle must be detailed.

There are three possibilities (Figure 2):

- by a Spike (or tang)
- by a Raised Eye
- by a Sunken Eye

Preference for a particular "Eye" can depend on the preference of the potential user. However, experience has shown that a raised eye is more suitable for hard dry soils whereas a sunken eye is preferable for wetland, softer soils.

FIGURE 2
Digging hoes with Spike, Raised Eye and Sunken Eye

(Photograph: Chillington Tool Co.)

4.3 FORK HOE

HOUE TRIDENT
AZADON DE TRES DIENTES

Apart from the hoes described above, the target beneficiaries may prefer the fork hoe (Figure 3). As described above for the more conventional hoe, the Field Officer should determine the most suitable tool weight and the method for attaching the handle (spike, raised eye or sunken eye).

FIGURE 3
Fork Hoe - 2 kg and of rather poor quality

(Photograph: John Ashburner)

4.4 DOUBLE-HEADED HORTICULTURAL HOE

SERFOUETTE
AZADON/TENEDOR HORTICOLA

The short-handled implement shown in Figure 4 may be requested when horticultural activities are being encouraged. The two heads should be described (e.g. Hoe and 3-tined fork), the approximate tool weight and the overall length of the head.

FIGURE 4
Double-headed Horticultural Hoe

(Photograph: John Ashburner)

4.5 MALODA

This is a light straight handled hoe, commonly used in Sudan but different designs and shapes are used in other countries (Figure 5). The Field Officer should report the requested weight of the blade without the handle together with the main dimensions in order for the specifications to be drawn up by AGP.

FIGURE 5
A range of shapes for the Maloda - the three on the left from Sudan and the right hand one from Nicaragua

(Photograph: John Ashburner)

4.6 MACHETE OR CUTLASS

MACHETTE *MACHETE*

There is a wide range of blade shapes for machetes but it is the experience of FAO that almost all orders are for one of the models illustrated below. The Model numbers are those assigned in China although the chosen supplier for an international tender does not necessarily have to be located in that country.

The Field Officer should identify the model which is required for the project, if necessary using one of the photographs below for identification purposes. The blade length required will also need to be specified as again, several options are normally available.

It is strongly recommended that wooden rather than plastic handles are requested.

FIGURE 6
Machete type M208 with blade length 19 inches

(Photograph: Dingzhou Jade Machete Tools Manufacturing Co. Ltd.)

FIGURE 7
Machete type M206 (normally with a blade length of 18 inches)

FIGURE 8
Machete type M212 (normally with a blade length of 16 inches)

FIGURE 9
Machete type M204 (normally with a blade length of 16 inches)

(All Photographs: Unknown)

4.7 MATTOCK AND PICKAXE

PIOCHE *PICO*

Mattocks are commonly used for opening up new land, the cutting edge being used to cut roots and the digging edge for primary tillage on very

FIGURE 10
Mattock with a digger point and wider cutter blade popular in South America

(Photograph: Imacasa, El Salvador)

FIGURE 11
Pickaxe with chisel and point

(Photograph: Silverline, UK)

hard ground. Pickaxes are primarily used for digging and building works. The types most frequently procured by FAO are illustrated in Figures 10 and 11.

4.8 SPADE AND SHOVEL

BECHE et PELE *AZADA Y PALA*

Spades are primarily digging implements whereas shovels are used to move loose or unconsolidated materials over short distances. Although there is a wide range of designs available, two main types are normally procured by FAO as illustrated in Figures 12 and 13.

FIGURE 12
Rectangular spade with socket fitting to a D-handle

(Photograph: Corona, UK)

FIGURE 13
Round mouth shovel with socket fitting to handle

(Photograph: Ames, USA)

The Field Officer should decide whether a handle should be supplied with the tool (rarely the case). The grip on the handle may be T shaped, D shaped or a straight shaft. If there is a preference then this should also be stated. Alternatively, the technical specifications will indicate that either type of handle will be acceptable.

4.9 GARDEN RAKE

RATEAU *RASTRILLO*

FIGURE 14
Garden rake with 14 teeth

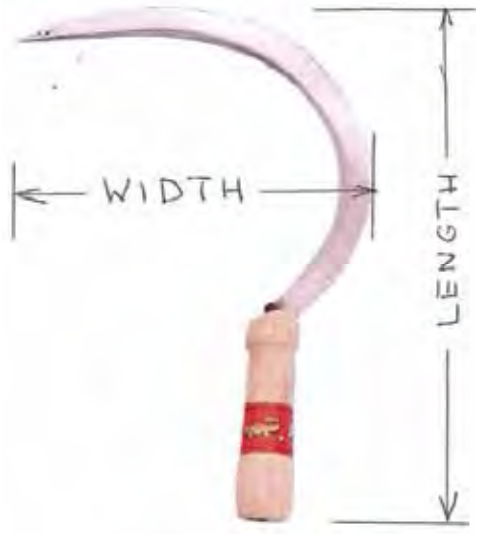
(Photograph: Unknown)

Rakes supplied to FAO projects generally have from 12 to 14 teeth, are made from a single forging and are supplied without handles (see Figure 14). The Field Officer should confirm whether this is suitable or describe an alternative model should this be required.

4.10 SICKLE

FAUCILLE *SEGADORA*

FIGURE 15
Principle dimensions to supply for sickles



(Photo Chillington Tool Co.)

The size and shape of sickles can vary from region to region and so it is important that the Field Officer makes a careful study of the type which will be acceptable to the beneficiaries.

A commonly used shape is illustrated in Figure 15. It would be preferable to submit a photograph of the requested model. In addition, the overall length and width should be measured and included with the request.

One should also measure the total length along the cutting edge of the blade.

4.11 AXE

HACHE *HACHA*

The most commonly requested axe is a 3.5 lb model known as a light felling axe and designed to cut across the grain of the wood. It is asymmetrical in that it has only a single cutting edge. Should an alternative model be required, the particular requirements should be described by the Field Officer and if possible, a photograph supplied.

FIGURE 16
Felling axe with asymmetrical head

(Photograph: Faithfull Power Plus, UK)

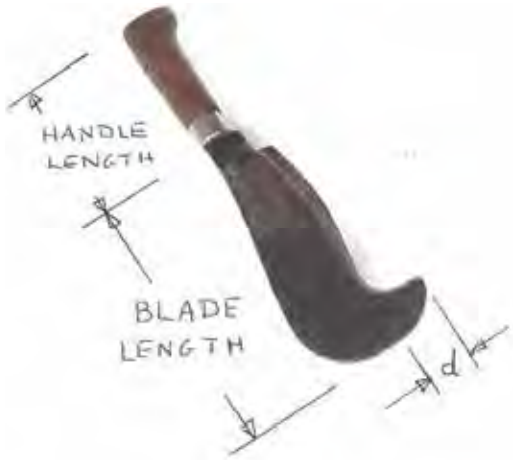
Handles are not normally requested. Generally speaking, if no handle is ordered, it is better to specify a round eye as this type of handle is easier to make locally. If ordered with a handle, an elliptical eye is preferred as shown in Figure 16.

4.12 BILLHOOK

SERPE *MACHETE*

The billhook is a cutting tool for smaller woody material and for bushes. It is occasionally acquired for FAO projects and is illustrated in Figure 17. The Field Officer should record the principal dimensions as indicated and its weight. A photograph will further assist for the detailed specifications to be prepared by the FAO technical support services.

FIGURE 17
Principal dimensions to record for a billhook



(Photograph: Unknown)

4.13 GRASS CUTTER

COUPE-COUPE *CORTADORA DE HIERBA*

This tool should be defined by the overall blade length, the blade width and its thickness. Preference should also be indicated for the type of handle (wooden is recommended).

FIGURE 18
Grass cutter

(Photo Chillington Tools)

4.14 WATERING CAN

ARROSOIR *REGADERA*

Most watering cans procured by FAO have a capacity of from 10 to 12 litres although there have been exceptions – for instance a capacity of from 6 to 8 litres was procured for a project in Bangladesh, most probably more suitable for women.

The material of construction should be indicated – either galvanised metal sheet or plastic. Note that plastic is strongly recommended if the watering

FIGURE 19
Watering cans of plastic and galvanized sheet

(Photographs: Unknown and Sunway Co. Ltd, China)

cans are to be imported as they are less likely to be damaged during shipment.

The metal watering can is one of a number of tools which are well suited for local fabrication by rural artisans. This option should be seriously considered for at least part of the total order. These will normally be made from galvanised sheet.

4.15 WHEEL BARROW

BROUETTE *CARRETILLA*

There is a wide range of designs for wheel barrows and hence if there is any particular preference, a photograph of the model should be submitted with the procurement request. Other information that should be supplied by the Field Officer includes the capacity of the carrying tray (often between 75 and 90 litres for FAO projects) and the total load capacity (normally 150 kg minimum). The tyre should be of rubber, either solid or pneumatic. The wheels should be metallic. Plastic is to be avoided both for the wheels and the tyres.

Wheelbarrows are manufactured in many developing countries and hence local procurement should again be seriously considered for at least part of the order.

FIGURE 20
Two alternative designs of wheel barrow

(Photographs: Unknown)

4.16 CARPENTER'S SAW - BOW SAW

SCIE EGOÏNE *SIERRA DE CARPINTERO*
SCIE A BUCHE *SIERRA A ARCO*

Two main types of saw are normally procured by FAO (Figures 21 and 22). The length of the blade should be stipulated. Selection of a suitable

blade length for the Bow Saw should be based upon a survey in the local market for the sizes available for replacement blades. Orders will normally also include 10 spare blades.

Secondly, the Field Officer should report what is to be cut. Normally this will be green wood but the material will determine the nature of the teeth which the responsible technical services will include in the finalised specifications.

FIGURE 21
Carpenter's saw

FIGURE 22
Bow saw

(Photographs: Unknown)

4.17 FILE

LIME *LIMA*

Flat files (Figure 23) are normally included in procurements when axes, machetes, mattocks or sickles are also being acquired. They should be ordered with handles. The Field Officer merely needs to indicate for which tool the file is required and the desired quantity.

FIGURE 23
Flat file

(Photograph: Unknown)

5. Conservation agriculture

5.1 TOOLS FOR CONSERVATION AGRICULTURE

Conservation Agriculture is based upon three fundamental principles, which are more fully described on the FAO Web-site[4]:

- Continuous minimum mechanical soil disturbance.
- Permanent organic soil cover.
- Diversification of crop species grown in sequences and/or associations.

One of the implements particularly useful to enable planting into mechanically undisturbed soil is the jab planter. Accordingly, it is described below.

5.2 JAB PLANTER

SEMOIR MANUEL POUR SEMIS DIRECT

MATRACA o PLANTADORA DIRECTA MANUAL

The jab planter facilitates seed to be planted through surface trash or through an existing crop cover without the soil being tilled previously. It is designed for use in systems where conventional mechanical tillage is not practised, the technique being known as conservation agriculture.

A wide range of jab planter models are available (Figure 24) and it is highly recommended that the Field Officer contact the technical services in AGP regarding appropriate project planning and equipment specification. It will be necessary to indicate the crops to be sown, whether graded seed will be available (rarely the case) and whether there is a requirement for the planter to also apply fertiliser.

The jab planter is an implement which should **only** be supplied when a carefully organised and relatively long term training programme can support the farmers. An emergency project is unlikely to be able to guarantee such a requirement but it may be possible for more long-term support to be arranged through other local projects. This has already been achieved, working with NGOs in some previous emergency projects.

[4] http://www.fao.org/ag/ca

FIGURE 24
Some of the models of jab planters available from two Brazilian manufacturers

(Photographs: John Ashburner and Brian Sims)

6. Tool repair - hand hoes

There is always of course the possibility to repair existing hoes once they have been worn down. This is another way to engage local blacksmiths in emergency or even rehabilitation and development programmes. FAO has acquired a number of positive experiences in this respect as illustrated below.

The problem is illustrated in Figure 25 where the badly worn hoes can no longer accomplish their "digging" task but they continue to be used for weeding. The original hoe and an even more worn example are shown in Figure 26.

FIGURE 25
Used hoes in Burundi. The use of each is approximately (from left to right) "more than 5 years", about 4 years and two years

(Photograph: Rudolf Holtkamp)

Rehabilitation programmes of hoes by local blacksmiths have been undertaken in several countries or regions with good results, including Burundi, Darfur and South Sudan (Figure 27). In Kenya, it is common practise that replacement blades are welded onto the remaining hoe eye (Figure 28).

FIGURE 26
The original shape of the hoe (top right) and an even more worn example (bottom left)

(Photograph: Rodolf Holtkamp)

FIGURE 27
A "rehabilitated" hoe made by a blacksmith in Burundi. Although the blacksmiths are unable to make the "eyes" they can rivet on a strong new blade

(Photograph: Rodolf Holtkamp)

FIGURE 28
Replacement blades welded onto old hoe eyes – Bondo District, Kenya

(Photograph: Josef Kienzle)

Part II

Technical Guidelines

1. Procurement procedures

1.1 FAO PROCUREMENT PROCEDURES

FAO procurement procedures are governed under Manual Section 502 – "*Procurement of Goods, Works and Services*" dated 1 January 2010[5]. This establishes the principles and procedures that apply to the procurement of all goods, works and services on behalf of FAO. The procedures described as of this date are summarised below.

However, procurement procedures continue to be adjusted and the Manual is accordingly regularly updated. As such, the latest version should always be checked.

1.1.1 Authority for procurement

The Procurement Service (CSAP) has overall responsibility for FAO procurement for which the Director, CSA has unlimited delegation of authority. Authority is also delegated to Field offices up to certain limits as follows:

- USD 100 000 for FAO Representations and Liaison Offices,
- USD 150 000 for Sub-Regional Offices
- USD 200 000 for Regional Offices and
- USD 250 000 in offices where an International Procurement Officer is located, although this limit might be set lower.

Procurement activities estimated to exceed these limits should always be discussed with CSAP prior to the initiation of a tender process to determine the appropriate procurement strategy, particularly in cases where, as further discussed below, there are considerations that support local sourcing.

The limits listed above for the Delegation of Authority can thus identify which office is best placed to undertake the function of "Buyer" (normally either the decentralized office or CSAP). It does not however determine

[5] see http://intranet.fao.org/manual_sections (this website is only available internally to FAO staff – enquiries from outside FAO should be sent directly to the Organization)

whether the tender process should be limited to local or regional suppliers or whether a larger international market should be invited.

1.1.2 Invitations to tender – international or local

Prior to issuing a tender, whether undertaken by CSAP or directly by the decentralized office, the Buyer and the Requester must consider whether the pool of vendors to be invited will include international suppliers or be limited to local or regional suppliers. There may even be justification for part of the tender to be launched internationally whilst the remainder is locally sourced.

In making this determination, due weight must be given to the principle objective of procurement which is to obtain the best value for money. In many cases, it is considered that **international tendering** supports this objective as it provides more complete knowledge of the market, the prices and the availability.

However, limiting sourcing to **local or regional suppliers** may be justified when one of the objectives of the project is to provide additional support to local enterprises, artisans and/or workshops. Procuring in the beneficiary countries has gained support in the donor community within the concept of Purchase for Progress already referred to above in **Part I**.

The issue to be addressed is how much more the Organization is willing or able to pay for local tools and what level of quality deviation it is willing to accept if local/regional procurement results in higher prices and/or lower quality. Furthermore, a decision must be made on whether "locally sourced" preference should be limited to locally produced/manufactured goods or whether this may also include goods procured from a local supplier even if they are produced or manufactured abroad. These issues must be addressed by the Field Officers along with the procurement staff during the procurement planning phase.

1.1.3 Evaluation criteria for local sourcing

In order to evaluate the potential cost of local sourcing, consideration can be given to awarding additional "points" or weight to locally sourced or manufactured products or to local suppliers at the time of developing the technical specifications and evaluation criteria. Usually handtools are tendered using an Invitation to Bid which generally requires award to the lowest offer meeting the technical specifications. However, MS 502.10.3 provides that up to 20 percent weight can be assigned to "*objectively measurable non-price criteria (e.g., delivery date, length of product*

warranties and quantifiable variations from technical specifications, such as material specifications".

Such objectively measurable criteria could also include local production by assigning a preference of up to 20 percent of the total criteria to local production of the hand tools. It should be noted that using such criteria implies that all other circumstances being equal, the Organization is willing to pay up to 20 percent more for locally produced or locally sourced goods. The offer must clearly demonstrate that the specified criteria have actually been met.

1.1.4 Specification of the goods

In all cases of procurement, detailed specifications will be drawn up and cleared by the responsible technical division (AGP). This is done in consultation with the Field Officers who AGP can advise on matters such as tool selection, design or specifications.

1.1.5 Current procurement procedures (ref. MS 502)

An invitation to tender will be prepared, based on the specifications. Once the "offers" are received, these will be analysed by the Procurement Service (CSAP) sometimes in liaison with the responsible technical division (AGP). The Buyer will normally be awarded based on the lowest cost of a technically compliant offer. There are however cases where an offer represents the best value for money when objectively measurable evaluation criteria are considered. These criteria must however, already have been established and weights assigned prior to the tender process.

Goods are normally subject to a full inspection prior to despatch by an internationally recognised inspection company. They may be also inspected again upon delivery to ensure that they arrive undamaged and with the complete quantity.

1.2 REGISTRATION AS A VENDOR

Only selected companies are invited to participate in international bids and so it is important that companies first register their general interest to supply tools to FAO. A new Vendor registration system has recently been launched and is accessible through the Internet and interfaced with the United Nations Global Marketplace (UNGM)[6]. This database is the

[6] https://www.ungm.org/

primary source for FAO to identify Vendors to be invited to tender. The registration procedure with UNGM is indicated under **Instructions**.

1.3 PRESENTING AN OFFER

Potential suppliers should take great care when presenting offers for international bids. All requested information must be supplied and this must be accurate.

In the past, a number of companies have been disqualified simply for not completing the bidding process as required, most commonly by not supplying all the information requested. For instance, a leaflet or photograph of the tool offered may be requested but if it is not submitted, it may be difficult for FAO to decide if the offer meets the specifications indicated.

Another common problem is that some dealers simply copy the tool specifications from the tender documents as their reply but without ensuring that the tool offered fully conforms to each detail specified. This is likely to be discovered when the order is inspected either prior to despatch or upon delivery. In the event that the tools are found to fail to meet the specifications then heavy penalties can ensue. It also can result in significant delays which considerably hinder the implementation of projects.

The main procedures that should be adhered to by the bidding companies include the following:

1. The bid document must specify exactly what is being offered and it must be possible for those evaluating the bids to verify from the documents alone that what is being offered either meets all the requirements specified in the tender document, or the extent to which they do not. This applies to the tool specifications, the packaging and the delivery to the required destinations within the stipulated time, together with any other requirements specified.
2. Some minor deviations from the initial tool specifications may be acceptable, but these must be fully stated in the bid document. If after technical evaluation the bid is accepted, then the specifications offered by the supplier in their bid, become the agreed specifications of the goods, which are then the specifications against which the order will be inspected.
3. The country of origin and the name and address of the manufacturer of each tool must be specified in the bid documents.

4. The potential suppliers must ensure that they are capable of fully satisfying all that they offer in their bid documents.

Occasionally a supplier will not fully understand certain aspects of the specifications indicated in the bid. This will always be clarified if requested by the FAO procurement service (usually CSAP). Any clarification issued will also be circulated to all other potential suppliers invited to bid.

1.4 DOUBLE CHECKING THE TOOL QUALITY

The specifications for the tools will often include a detailed description of the material, most commonly concerning the quality of the steel. There may also be certain characteristics stipulated such as strength, impact resistance and/or material hardness characteristics. All suppliers are strongly urged to check that the goods offered comply with these specifications or if not, describe exactly what is being offered as an alternative.

If necessary they should conduct the tests themselves. Alternatively they should check back with the original manufacturer regarding conformity.

Homogeneity within each consignment should also be carefully checked as deviations are likely to be picked up during the inspection process when statistically significant numbers of samples will be examined. It is understood that some manufacturers pool together tools of more homogeneous and better quality, selling them at a higher price. Suppliers taking part in the bids should ensure they are fully aware of the quality that they are offering. Heterogeneity in the quality for instance may arise due to the fact that a supplier is pooling the goods produced by separate manufacturers to meet a large order. It is for this reason that the sampling scheme described below in **Section 4.3** has been adopted by FAO.

2. Detailed specifications

2.1 INTRODUCTION

The technical specifications for agricultural hand tools form the basis for the contract drawn up between FAO and the supplier of the tools selected following the tendering process. These are designed to ensure that what is requested is what is delivered. This means that they are to ensure that the tool that was initially identified as the most suitable for a particular purpose is the one that is delivered to the beneficiaries.

At first glance it may appear that the specifications are overly complex for simple agricultural hand tools. However, poorly drawn up specifications may mean that a supplier who wins a bid may deliver a poor quality product that would not be suitable for its intended use. In addition, loose specifications may mean that the supplier can claim that they have met the agreed specifications and FAO would still be obliged to pay the supplier the full cost. It is therefore very important that good specifications are drawn up to protect both the beneficiaries of the tools and FAO.

This section describes and explains the reasons for some of the detailed specifications that are normally drawn up by FAO.

2.2 BASIC FORM, DIMENSIONS AND WEIGHT

The tool being requested is defined by specifications which describe its form, its principal dimensions including length, width and thickness, together with its weight. In cases where it is still difficult to explain exactly the nature of the tool required, an indicative sketch or photograph may be included in the technical specifications.

The range of acceptable dimensions and/or weight will be carefully determined during the process of preparing the detailed technical specifications for the bid documents. Should the range of these limits be too tight, few suppliers will be able to offer suitable goods, there will be little competition and the entire bid might have to be abandoned. A range which is too wide in contrast, may allow tools to be offered which are not entirely suitable for the job required.

2.3 HANDLES

Some agricultural hand tools are normally supplied without a handle, this being locally sourced within the country of destination. These include hoes, spades, shovels, *malodas*, rakes, and sometimes, axes and pickaxes. Most other tools are supplied with handles (machetes, sickles, files, billhooks).

It is important to note that many of the problems encountered with hand tools arise from the use of handles made from cheap unseasoned softwood, coupled with poor manufacturing quality. Breakage, loose tool heads, and unsatisfactory grips are typical problems leading to poor productivity and possible injury to the operator.

Technical specifications will be drawn up for handles to be supplied either with the tool offered in the bid document or to be procured locally within the country of delivery. In the case of wooden handles, these will normally specify that seasoned hardwoods should be used, this being further qualified by referring to the specific gravity and moisture content of the wood.

An example of how this is normally expressed is reproduced below:

> *"The handle should be made of a suitable hardwood with a specific gravity of 0.66 to 0.80 after seasoning to not more than 20 percent moisture content."*

The manner by which the handle is attached to the tool is also carefully specified. The following example refers to a wooden machete handle:

> *"All handles must be shaped and completed to a smooth finish with the rivets countersunk into the handle and metal edges recessed into the wood. It must be machine riveted to the blade at three places. The rivets must be of steel with maximum carbon content 0.15 percent and the washers of mild steel."*

2.4 MATERIAL SPECIFICATIONS

The main material used in the fabrication of agricultural hand tools and workshop equipment is steel of various grades. There is today still some use of "Railway Steel" for tool manufacture and where appropriate, FAO specifications have been broadened to accommodate this type of material. Apart from the Carbon content, the specifications define the acceptable ranges for Manganese, Silicon, Phosphorous and Sulphur together with Chromium in the case of axes.

The materials specifications being used by FAO in November 2012 are summarised in **Appendix 1**. These are continuously upgraded and so should only be considered as illustrative.

2.5 HEAT TREATMENT

The steel used in the manufacture of the tools will also be heat treated so that optimum characteristics are achieved. Although the heat treatment process is rarely mentioned in the specifications, the results are expected to meet certain criteria. These are verifiable through hardness testing of certain specific parts of the tool and the Rockwell C value must yield results within a specific range. A hardness test is non-destructive and may readily be undertaken by a modestly equipped laboratory.

The requirements for the hardness values currently being used by FAO in November 2012 are shown in **Appendix 2**. As with the material specifications, they should also only be considered as illustrative.

2.6 MARKING

Most agricultural hand tools carry markings placed by the manufacturer. The markings specified for agricultural hand tools will often require that one or more of the following appear:

1. Manufacturers name and/or trademark.
2. The nominal weight or size of the head.
3. The pattern number

2.7 PRESERVATIVE TREATMENT

Most tools are given a preservative treatment before despatch and this will be indicated in the technical specifications.

2.8 PACKAGING

There are normally certain packaging requirements which must be met, particularly when goods are being despatched by sea. In addition, heavy items without handles such as hoes, spades and shovels will always require packing in wooden boxes. This is to ensure that even during delivery to remote field stations under difficult conditions, the tools remain carefully packaged. Insecure cases can cause spillage of the tools with many ensuing problems of inventory control.

3. Strength and impact testing

3.1 INTRODUCTION

Apart from testing the hardness of some agricultural hand tools, they may also be required to pass certain strength tests and be resistant to impact damage. The tests described in this Section form part of the technical specifications in the tender documents. Many of the tests were first drawn up in the mid-1970s during a major rural road construction programme in Kenya. Indeed Kenya continues to test hand tools and has published a series of standards, as is also the case in Tanzania and Uganda.

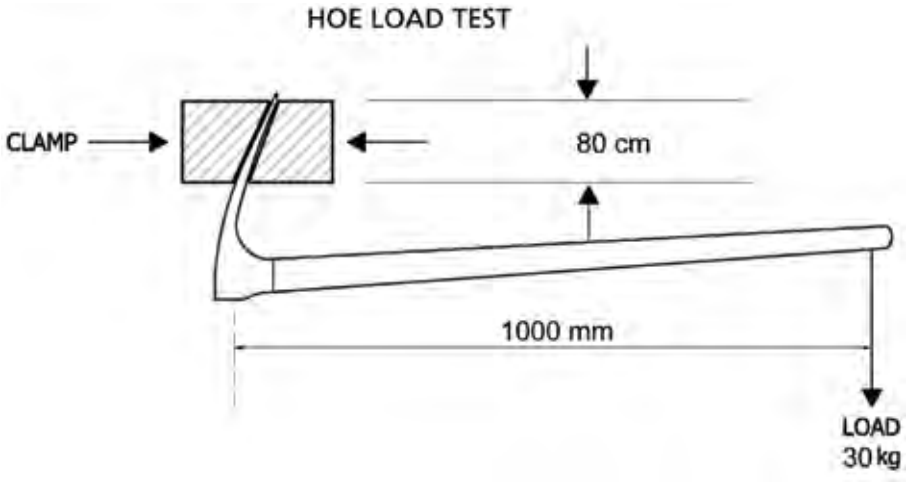
A number of tests have been adapted and applied to a range of agricultural hand tools over the past two decades. All of these, together with the various standards developed in East Africa have been considered whilst drawing up the test procedures described below.

A list of some of the most significant references concerning standards, specifications and testing is included in **Appendix 3**.

3.2 PLAIN HOES (JEMBES)

Strength Test: The tool is fitted with a temporary handle made from a metal tube and clamped as shown in Figure 1. A load of 30 kg is applied in

FIGURE 1
Clamping arrangement for hoes



increments of 5 kg, suspended from the handle at a distance of 1 000 mm from the eye (the handle may not necessarily be horizontal). On removal of the load, the tool must not show any permanent set, crack or sign of failure.

FIGURE 2
Clamping jig for hoes at the Kenyan Bureau of Standards

(Photograph: Brian Sims, courtesy of KEBS)

3.3 FORK HOES (JEMBES)

Strength Test: The tool is fitted with a temporary handle made from a metal tube and clamped with the handle vertical and supported below the head as shown in Figure 3. A load of 30 kg is applied in increments of 5 kg, suspended from one of the tines at a distance of 15 mm from the tip. On removal of the load, the tine must not show any permanent set, crack or any sign of failure. Each tine is tested in a similar manner.

FIGURE 3
Clamping arrangements for fork hoes

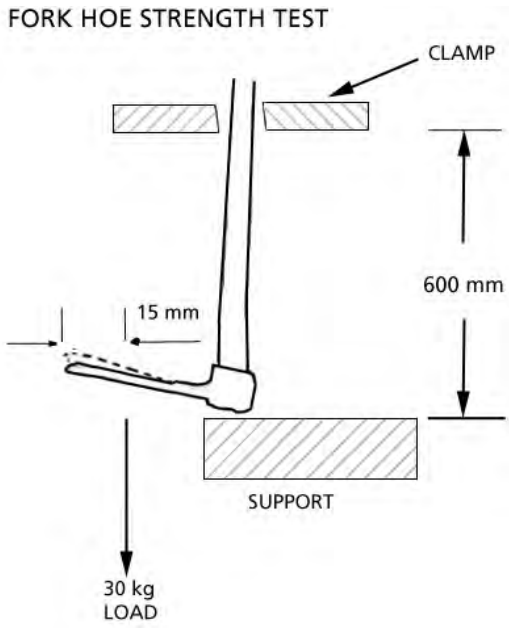


FIGURE 4
Clamping and loading arrangement for fork hoes

3.4 DOUBLE-HEADED HORTICULTURAL HOE

The name of this tool is not universally accepted and it is also sometimes called a combination fork and hoe. For clarity, it is illustrated below (Figure 5).

FIGURE 5
Double-headed horticultural hoe

(Photograph: John Ashburner)

Strength Test: The tool is tested in two stages. Firstly the hoe blade is tested as indicated above in **Section 3.2**. Then the fork tines are tested as described above in **Section 3.3.**

3.5 PICKAXES AND MATTOCKS

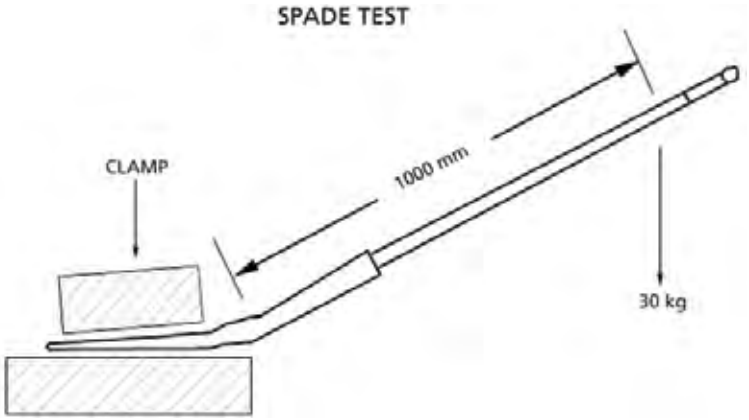
These tools are not subjected to strength tests but impact tests are undertaken as described below.

Impact Test: With a handle fitted, the tool is dropped by gravity a minimum height of 450 mm onto a rigidly supported 25 mm thick mild steel plate, so that one of the working points or edges strikes squarely. Repeat the test for the other working point or edge. There must be no damage to the head or cutting edge.

3.6 SPADES AND SHOVELS

Strength Test: The tool is fitted with a temporary handle made from a metal tube which is inserted fully into the socket and clamped as shown in Figure 6. A load of 30 kg is applied in increments of 5 kg, suspended from a point at a distance of 1 000 mm measured directly from the upper edge of the spade or shovel blade. The full load is then maintained for 2 minutes and on removal, the tool must not show any sign of damage to the blade or any permanent set in excess of 25 mm measured at the point of application of the load.

FIGURE 6
Clamping arrangements for spades and shovels



In the event that the tool to be tested is already fitted with a handle, then for long handles, the test remains the same but the load is applied precisely where indicated in Figure 6. In the case of a short handle (of 680 mm or 700 mm), the load should be increased to 40 kg and applied at the end of the handle.

3.7 RAKES

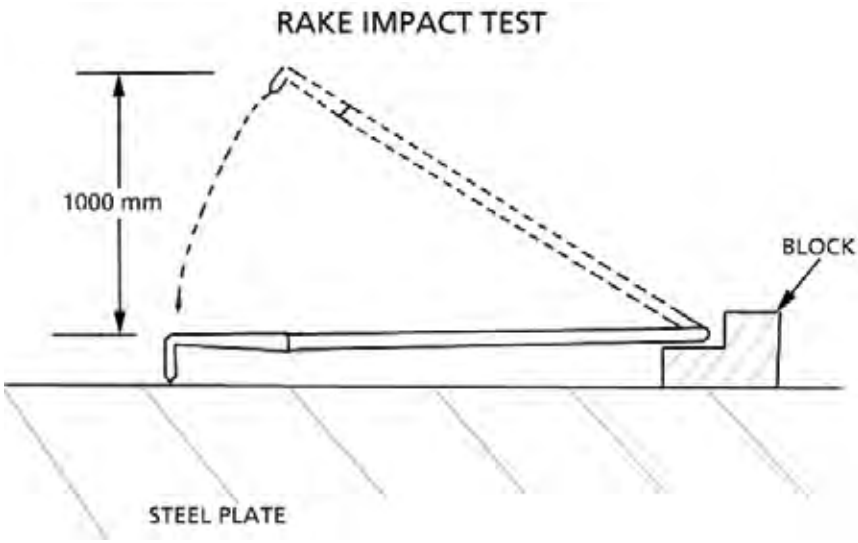
Strength Test: The handle is clamped in a vertical position with the rake head resting at the edge of a flat surface in similar fashion to that shown in Figure 3 for the fork hoe strength test. A load of 35 kg is suspended from the centre of any spike and maintained for two minutes.

The spike tested must not show any deformation or permanent set after removal of the load.

Impact Test: The rake is fitted with a hardwood handle the end of which is attached to a wooden base so that when resting on a flat surface, the handle is horizontal. The head is then raised to a height of one metre, pivoting about the base. The head is then dropped so that the spikes fall onto a horizontal steel plate (Figure 7).

This is repeated four times. The spikes must not flatten or chip and no damage must be suffered by the rake head.

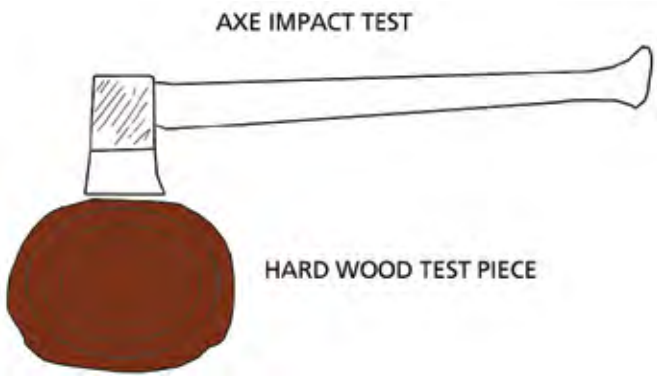
FIGURE 7
Impact test arrangement for rakes



3.8 AXES

Impact Test**:** The tool must withstand a minimum of twenty heavy blows across the grain of a round hardwood bar or log without damage to the cutting edge or loosening of the handle (Figure 8).

FIGURE 8
Impact test for an axe



3.9 MACHETES

Bending Test: The blade is inserted into a slot measuring 5 mm wide and 20 mm deep (Figures 9 and 10). A deflection of 45° at the handle end in each direction is applied and the test repeated 50 times. There must be no breakage, cracks or permanent set of the blade.

Impact Test: The tool must be used to apply a minimum of twenty heavy blows across the grain of a round hardwood bar. No damage should occur to the cutting edge nor should the handle be loosened.

FIGURE 9
Method of clamping to test the flexibility of machetes (slot dimensions: 5 mm x 20 mm)

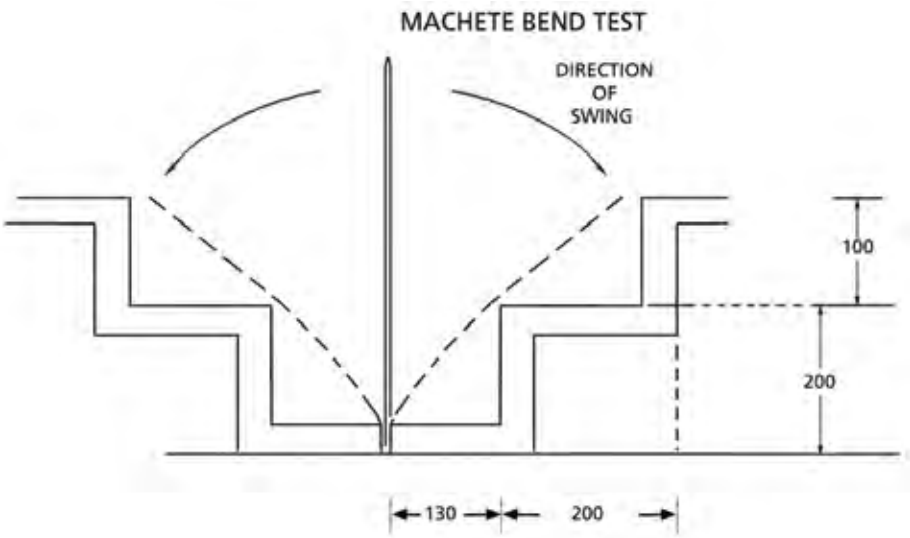


FIGURE 10
Apparatus for testing machetes at the Kenya Bureau of Standards

(Photograph: Brian Sims, courtesy of KEBS)

3.10 BILLHOOK

Impact Test: The tool must be used to apply a minimum of twenty heavy blows across the grain of a round hardwood bar or log (such as in

Figure 8). No damage should occur to the cutting edge nor should the handle be loosened.

3.11 SICKLES

Strength Test: Clamp the handle in a horizontal position such that the blade is also in a horizontal plane. Gradually apply a load of 5 kg to the blade tip and maintain this for 2 minutes. Now clamp the tool so that the blade is turned over. Repeat the test, return the blade and again repeat testing until a total of four tests have been carried out.

Once the load is removed for the final time, there must be no signs of damage to the head or loosening of the handle, nor any permanent set in excess of 5 mm measured at the end of the blade.

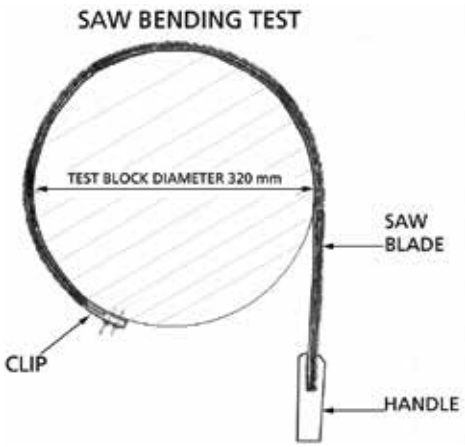
3.12 WATERING CANS AND WATER BUCKETS

Leakage Test: Fill the watering can or bucket completely with water and allow it to stand for four hours. There must be no sign of leakage.

3.13 CARPENTER'S SAW

This tool includes what are known as rip saws or cross-cut saws.

FIGURE 11
Flexibility test of saw blade around a test block



Bending Test: The end of the blade is inserted under the toe of a clip mounted on the side of a test block of 320 mm diameter.

With a handle fitted, it is bent round the block by hand as shown in Figure 11. It is then turned over and bent round the block in the other direction after which the blade must spring back to its original straightness.

4. Inspections

4.1 INTRODUCTION

Once the procurement has been arranged with the supplier, it is essential to ensure that what was originally specified and ordered complies with what is eventually delivered. Herein lays the very important role played by the inspection company which is contracted to verify conformity of the goods.

FAO normally requires that an inspection of agricultural hand tools be made prior to loading. However, due to the need for timeliness, particularly for emergency projects, this may not always be feasible and the inspection is then carried out in the country of delivery.

4.2 THE SCOPE OF THE INSPECTION

The inspection will cover all aspects described in the technical specifications including the topics described above in **Sections 1 and 3**. In the event that an offer has been accepted for which the supplier has explained that the goods comply with specifications which differ to those originally requested, then these adjusted specifications become those which have been contracted and so are those against which the inspection must be carried out (see **Section 1.3b** above).

Some aspects of the inspection are quite obvious such as the overall quantity of the goods, the marking(s) on the tools, any specified preservative treatment and the packaging. Other aspects require more detailed attention such as the tool dimensions, surface finishing and weight. Yet others may involve testing in a laboratory, including the material composition, the tool strength and its impact resistance.

4.3 LOT ACCEPTANCE SAMPLING

The typical number of hand tools acquired in an order for an emergency project often amounts to several thousands and it is clearly impractical to carry out detailed testing of the entire consignment. Some of the procedures for verification of quality may be destructive and so usually an inspection is carried out using representative sampling procedures. The first thing to notice is that the order or shipment is unlikely to be entirely homogenous although it could most probably be so within certain parts.

These are known as *"lots"* each of which comprises a collection of similar products. These will be assumed to be identical in type, size, condition and time of production, etc. and samples will be taken at random from each *"lot"* for inspection.

This procedure is called *Lot Acceptance Sampling*[7] or more simply, *Acceptance Sampling*, the purpose of which is to decide whether to accept or reject the lot.

4.4 SAMPLE SELECTION

Various options are available for selecting a representative sample and this will depend upon the characteristics of the shipment. If the entire shipment is believed to be of homogenous quality then in effect, the shipment will comprise a single *lot*. A sample of specified size may then be selected directly upon opening the shipment.

If the *lot* is composed of boxes (for instance, each from a different manufacturer) then it may be more practical to conduct the sampling in two stages. First select a sample number of boxes and then select a sample of items from within each selected box.

Once the samples have been selected, they should be indelibly marked (for example 1, 2, 3, etc.) and the box from which they were taken also marked so that each can be sourced back to the box from which it was taken. **After testing, all samples should be retained securely** by the inspection company until their release has been authorised by FAO. This is done as a precaution in the event that a claim against any failed tests is made.

4.5 SAMPLE SIZE

The size of the sample to be selected from a given lot is decided on the basis of statistical consideration and a permitted level of tolerance. This needs to take due account of risks both to the consumer and the supplier or producer. The simplest rule for a decision would be that if the percentage of non conforming items in the sample is less than a pre-specified number, then the lot is accepted. Alternatively, the lot must be rejected.

The sampling system preferred by FAO for agricultural hand tools is one described by the Defence Contract Management Agency of the US. FAO

[7] These statistical procedures and related rules were developed by Dodge and Roaming and were originally applied to US military during World War II.

suggests that a Zero-based Acceptance Sample[8] be selected based on an Acceptable Quality Value of 2.5 percent. The suggested Sample sizes are then as indicated in Table 1. The fact that the sample size does not change for a number over 35,000 is based on statistical principles whereby in a sufficiently large population, increasing the sample size will not necessarily improve the quality of decision making.

Although alternative sampling methodologies could be used, it is felt that this procedure restricts to a reasonable number the size of the sample whilst still providing acceptable assurance that the requested tool quality has been achieved. The term "Zero-based" means that **ALL** samples inspected must comply with the specifications for compliance. Failure to so comply must therefore be fully detailed in the Inspection Report eventually submitted to FAO.

TABLE 1
Acceptable Quality Level (AQL) of 2,5%

LOT SIZE	SAMPLE SIZE
Less than 90	7
91 to 150	11
151 to 280	13
281 to 500	16
501 to 1200	19
1201 to 3200	23
3201 to 10,000	29
10,001 to 35,000	35
35,001 & over	40

4.6 LABORATORY TESTS

Whereas it is relatively simple to carry out visual checks during the inspection process, some of the other tests will generally require basic laboratory facilities and should be carried out by an accredited organization. The laboratory should be accredited to the International Standards Association (ISO), or to the International Federation of Inspection Agencies (IFIA) or equivalent.

Where testing agencies have acceptable facilities and competencies, but do not yet have ISO or IFIA membership or equivalent, then sub sampling could be carried out with a few samples being checked by an ISO accredited organization to ensure independence.

[8] See http://guidebook.dcma.mil/226/tools_links_file/stat-sample.htm

It is essential that test certificates can stand up to close scrutiny in a court of law should there be a failure to meet the specifications and the liquidated damages imposed on the supplier are legally contested. For this reason, it is also important that the samples tested are retained by the inspection company so that they can be retested should the test results be challenged.

APPENDIX 1

Specifications of materials for hand tools

The following specifications of the material of various types of hand tools have been drawn up by consulting various standards issued in Kenya, Uganda and Tanzania, together with those being used by FAO in November 2012. These are regularly updated and so they should be used for guidance only. The tools are more fully described and illustrated above in **Part I** of these Guidelines.

1.- Plain or fork hoe and horticultural hoe/fork

Constituent	Specified Range %
Carbon	0.40 – 0.80
Manganese	0.50 – 0.90
Silicon	0.35 maximum
Phosphorous	0.06 maximum
Sulphur	0.06 maximum

2.- Pickaxe and mattock

Constituent	Specified Range %
Carbon	0.40 – 0.65
Manganese	0.50 – 0.80
Silicon	0.30 maximum
Phosphorous	0.06 maximum
Sulphur	0.06 maximum

3.- Spade and shovel (of medium carbon steel)

Constituent	Specified Range %
Carbon	0.40 – 0.65
Manganese	0.50 – 0.80
Silicon	0.35 maximum
Phosphorous	0.06 maximum
Sulphur	0.06 maximum

4.- Machete, cutlass or grass slasher

Constituent	Specified Range %
Carbon	0.50 – 0.80
Manganese	0.50 – 0.90
Silicon	0.35 maximum
Phosphorous	0.06 maximum
Sulphur	0.06 maximum

5.- Sickle

Constituent	Specified Range %
Carbon	0.50 – 0.65
Manganese	0.50 – 0.80
Silicon	0.35 maximum
Phosphorous	0.06 maximum
Sulphur	0.06 maximum

6.- Rake (from a single forging)

Constituent	Specified Range %
Carbon	0.30 – 0.50
Manganese	0.50 – 0.80
Silicon	0.35 maximum
Phosphorous	0.06 maximum
Sulphur	0.06 maximum

7.-Axe and hatchet

Constituent	Specified Range %
Carbon	0.55 – 0.90
Manganese	0.50 – 0.80
Chromium	0.45 minimum
Silicon	0.35 maximum
Phosphorous	0.06 maximum
Sulphur	0.06 maximum

8.-File

Constituent	Specified Range %
Carbon	1.1 minimum
Manganese	0.45 maximum
Silicon	0.35 maximum
Phosphorous	0.06 maximum
Sulphur	0.06 maximum

APPENDIX 2

Rockwell C hardness values for hand tools

The values of Rockwell C quoted in the table below have also been drawn up by consulting various standards issued in Kenya, Uganda and Tanzania, together with those being used by FAO in November 2012. These are regularly updated and so they should be used for guidance only. The tools are more fully described and illustrated in **Part I** of these Guidelines.

Hand tool	Specific area on the tool	Rockwell C Range
PLAIN or FORK HOE	Hardness within 50 mm of the cutting edge	40/46.
PICKAXE or MATTOCK	Hardness within 50 mm of the cutting edge	40/55
Medium Carbon SPADE or SHOVEL	Hardness within 50 mm of the cutting edge	39/48
MACHETE, CUTLASS or GRASS SLASHER	Throughout the entire the blade	45/50
RAKE (from a single forging)	Teeth	22 min
AXE	Area immediately adjacent to the eye	25/30
	Hardness within 50 mm of the cutting edge	48/56
FILE	Throughout the entire the blade	56 min

FIGURE 12
Hardness testing machine in the laboratories of the Kenya Bureau of Standards

(Photograph: Brian Sims, courtesy of the Tanzanian Bureau of Standards)

APPENDIX 3

Bibliography

Armstrong, W. 1980. *Better Tools for the Job. Specifications for Hand Tools and Equipment.* Intermediate Technology Publications, London, U.K. 43 pp.

Defence Contract Management Agency. *Zero-Based Acceptance Sampling Plan.* (Available at http://guidebook.dcma.mil/226/tools_links_file/stat-sample.htm)

FAO, 1998. *Agricultural Implements Used by Women Farmers in Africa*. FAO, IFAD, Japan. 136 pp.

ILO, 1981. *Guide to tools and equipment for labour based road construction*, ILO, Geneva.

ITP, 1992. *Tools for Agriculture. A guide to appropriate equipment for smallholder farmers*. Intermediate Technology Publications, London, U.K.

Logan, W.B. (1997) *The Tool Book.* Smith & Hawken. Workman Publishing, New York. 302 pp.

Kenya Bureau of Standards, Nairobi:

KS 154: 2000 *Specification for plain and fork hoes (jembe)* (Third Revision, 2000) 13 pp.

KS 151: 2006 and ICS 25.140.01 *Panga - Specification* (Third Revision, 2000) 8 pp.

KS 204: Part 1: 1992 *Specification for shovels. Part 1. Mild steel shovels* (First Revision, 1992) 6 pp.

KS 06-204-2: 1992 *Specification for medium carbon shovels.* (First Revision, 1992) 7 pp.

KS 06-73: 1980 *Specification for picks, beater picks and mattocks.* (First Revision, 1980) 12 pp.

KS 06-295: 1982 *Specification for axes and hatchets.* 9 pp.

KS 152: 2003 *Specification for garden rakes.* 6 pp.

KS 1721: 2001 and ICS 25.100.40 *Specification for cross-cut and rip saws* 12 pp.

KS 1324: 1997 and ICS 67.160.20 *Specification for watering cans* 5 pp.

Uganda Bureau of Standards, Kampala:

US 220: 2003 *Hoes - Specification* (First edition 2003-07-31) 13 pp.

US 162: 2000 and ICS 65.060.01 *Specification for Machetes* (First Edition: 17th November 2000) 11 pp.

US 512: 2003 *Specification for axes and hatchets* (First Edition 2003-10-01) 10 pp.

US 199: 2001 and ICS 77.140.6 *Specification for shovels* (First Edition: November 2001) 11 pp.

US 518 – 1: 2004 *Agricultural equipment – Equipment for working the soil – Animal-drawn mouldboard plough – Part 1: Fixed type – Specification* (First Edition 2004-10-01) 9 pp.

Tanzania Bureau of Standards, Dar es Salaam:

TZS 242: 2011 *Forged hand hoe* (First edition 2003-07-31) 13 pp.

TZS 354: 2011 and ICS 65.060.01 *Machetes* (Second Edition 2011) 8 pp.

MEDC 10 (3385) P 2 *Farm implements – Method of sampling* (Draft Tanzania Standard) 5 pp.

Agricultural Hand Tools in Emergencies: Guidelines for Technical and Field Officers

FAO has been intricately involved with emergency programmes for many decades. Under such circumstances, not only is assistance required urgently but it is also essential to ensure that it is sufficient both in quantity and quality. Overall objectives are carefully focused on encouraging sustainable recovery and there is often an urgent need for agricultural hand tools. These may appear simple at first glance but selecting the correct tool and ensuring that it is of adequate quality is fundamental for the success of any recovery programme.

The aim of **Part I** of these Guidelines is to enable Field Officers to clearly identify and describe the agricultural hand tools required for the emergency projects with which they are involved. It is brief in text but amply illustrated with photographs so that each tool can be clearly specified even by non-technical staff.

Part II contains more technical details and is designed for use by FAO staff in Headquarters, Regional and Country Offices together with suppliers, manufacturers and inspection companies. Its objective is to clearly indicate FAO procurement procedures, to provide detailed technical specifications for a range of agricultural hand tools and to describe how the quality of these tools may be tested.

The publication forms part of FAO's effort to assist its member countries, FAO emergency staff and humanitarian partners to improve emergency preparedness and response effectiveness.

ISBN 978-92-5-107486-2 ISSN 0259-2517

9 789251 074862

I3197E/1/02.13