Water, Sanitation, and Shelter Equipment

For Emergencies and Longer Term Use

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Information on the purpose, development and use of the Oxfam Packs

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Humanitarian Department

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Oxfam is a partnership of people committed to relieve poverty, distress, and suffering in any part of the world.

We believe in the essential dignity of people and in their capacity to overcome the problems they face, whether they stem from natural, social, political, or economic conditions.

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Cover photo by Howard Davies/Oxfam

Development and use of Oxfam Water and Sanitation Equipment Packages

Background

For many years Oxfam (GB) and other agencies involved in relief, medical aid, and development work around the world have been acutely aware of the health hazards created by inadequate water supplies. Adequate supplies of good quantity and quality water, along with sanitation, health care, food supplies, and housing. are important for the overall well being of any group of people, whether displaced or not.

Where time and expertise are available for longer-term programmes, the most appropriate and cost-effective water-supply schemes can be worked out, each one related to the nature of the particular water source and the availability of expertise, equipment, and materials. But where urgent and often difficult emergency conditions prevail, there is a need for simpler and quicker solutions.

Oxfam, with its extensive field experience in water supply, collaborated with Imperial College, Surrey University and others in the late 1970s in a two-year study to research, design, and develop a series of water equipment packages. These were to comprise equipment and materials in standard kit form for easy transport to areas of need. These studies were completed and the first equipment packages were assembled and prepared for overseas use.

The water equipment packages were first used in 1982 to provide a safe water supply in a refugee camp for Miskito Indians in Honduras, where some 10,000 people were drinking polluted water from the local river, which caused much sickness and even death. In response to an appeal from the United Nations High Commissioner for Refugees (UNHCR), water equipment was dispatched by air, accompanied by an engineer to ensure correct installation. Within three days of arrival, the pumps were providing water to a small emergency hospital; the first of the storage tanks was filling up, and

soon all the Miskito people were able to enjoy a safe water supply. Their health was much improved as a result.

In 1984-1985, Sudan and Ethiopia suffered serious drought and famine conditions, and plane loads of Oxfam water equipment were flown in to provide water for up to 700,000 people in refugee camps and feeding centres. These operations were then the largest emergency water projects Oxfam had ever undertaken, involving 60 British engineers working alongside Sudanese and Ethiopian colleagues. A huge amount of water equipment consisting of over 40km of piping, 114 pumps, and 206 tanks, made it possible to pump, store, treat, and distribute millions of litres of water each week.

During conflict and massacre in 1994, up to 2 million people fled from Rwanda in fear of their lives, initially to Tanzania and then into Zaire. In the refugee camp in Ngara, Tanzania, Oxfam set up water systems for 430,000 refugees; the first camp there was then the largest refugee camp in the world. Some months later Oxfam established water supplies for 750,000 refugees in and around Goma in Zaire. In and around Rwanda Oxfam constructed and operated water systems for 1.7 million people and provided equipment and technical support to other agencies for another 0.5 million people. Some 250km of pipe were laid, and 13,000m³ of storage tanks were erected by teams consisting of 60 international and national engineers and refugee workers. Whilst the interventions at this time focussed on water supply, Oxfam was becoming increasingly aware of the health benefits of a more integrated approach and thus it undertook a programme of sanitation and hygiene promotion in a number of refugee camps.

Oxfam were again called upon to take the lead role for water supplies, along with sanitation work in the Balkans in April 1999, when 460,000 people fled into Albania and 260,000 into
a from the province of Kosovo in neighboring FRY. Experience gained from previous emergencies around the world had clearly demonstrated the health benefits of undertaking hygiene promotion and community mobilisation to maximise the potential health (and social) benefits of the work in water supply and sanitation that Oxfam

was being called upon to undertake. In Albania the huge number of camps (up to 700) meant that while Oxfam undertook work to provide water and sanitation services in camps for 100,000 people, it also took a key role in coordination of water sanitation work, supporting agencies to provide assistance to another 60,000 people. In the two main camps of Stankovick 1 and 2 in Macedonia, large water treatment and storage facilities were provided for 70,000 people within a few weeks of people arriving. Here a team of 5 international engineers and national technicians worked in collaboration with a team of hygiene promoters, designed to ensure that assumptions made about provision of facilities met the needs of the refugees.

Later that year around the other side of the world in East Timor, in mid September 1999, almost the entire population of 700,000 people was displaced when the people of East Timor declared their desire to become independent. A team of 9 international engineers in East Timor, again working in conjunction with a team of hygiene promoters, undertook and coordinated all work on water supplies and sanitation, based upon use of the highly mobile “rapid response kits” for the larger concentrations of dispersed and moving populations. Subsequently as the situation stabilised rehabilitation work was undertaken in urban centres.

Since the water equipment packages were first introduced, they have proved themselves invaluable. They have been used for the last 18 years in nearly every major emergency water programme around the world, in countries such as Jordan, Iraq, Uganda, Bangladesh, Somalia, Kenya and Angola, in addition to those countries mentioned above. Used in conjunction with the experience and skill developed by the Oxfam engineers, the kits have made Oxfam one of the leading operational agencies in the world for emergency water supply. The water equipment packages are accepted and used by many other organisations such as the National Red Cross and Red Crescent Societies, ICRC, UNICEF and UNHCR, and are specified by the United Nations office of IAPSO (Inter-Agency Procurement Service Office).

Constructing water systems: costs and time involved

Ngara, Tanzania 1994

Initially 250,000 refugees were taking all their water directly from a small, heavily contaminated lake at Benaco. Within six weeks, the teams of engineers and refugees had built a water-treatment system, consisting of 16 Oxfam tanks, several kilometres of pipelines and three-stage pumping, which produced 1,500,000 litres per day. After another three months the population had increased to 420,000 and there were three camps, for which Oxfam had laid 50km of pipeline, erected 42 tanks, and installed 20 surface water and borehole pumps.

These services can be broken down as follows:
Surface pumping, storage, treatment, and distribution for 150,000 people.
Borehole pumping, storage, treatment and distribution for 100,000 people.
Storage, treatment and distribution for 180,000 people.

Costs were as follows:
Equipment purchasing, freighting, construction costs, office and staff costs: $9.5/person
Operation and maintenance cost per year (including all overheads): $1.85/person.

Goma 1994

It took six weeks for Oxfam to build water systems to provide about 10 litres/person/day for 650,000 people. This included developing water sources for 400,000 people (250,000 had water provided by trucks), and providing all storage, treatment, and distribution facilities.

At the end of six months, the facilities had been upgraded and extended to cater for 754,000 refugees and provide 10-15 litres per person per day at WHO standards, within an average distance of 250

metres to water-distribution stands, with one tap provided for every 200 people (approximately).

Services can be broken down as follows:
Surface pumping, storage, treatment and distribution for 196,000 people.
Gravity supply, storage, treatment and distribution for 335,000 people.
Storage and distribution for 203,000 people (water supplied by truck).

Costs were as follows:
Equipment purchasing, freighting, construction costs: $8 to $10/person.
Operation and maintenance cost per year: $1.50/person.

Sanitation Equipment

The importance of proper excreta disposal and vector control in the prevention of disease and the promotion of health has long been acknowledged. In the past, however, development of an effective capacity lagged behind the development of the Oxfam Water Supply equipment, for which Oxfam (OGB) has gained its traditional reputation for excellence. To start to address this, new sanitation kits are being developed to supplement the existing sanitation kits. Additionally, Oxfam has published a Practical Health Guide, entitled *Disease Prevention through Vector Control*. Another Guide is in preparation, dealing with excreta disposal in emergency situations.

Shelter Equipment

Over the years, shelters and plastic sheeting designed and used by Oxfam have offered simple and durable shelter to thousands of displaced people and refugees who have no other means to protect themselves from wind, rain, and sun. Continuous developments in the design and production of plastic sheeting have led to an improvement on the original Oxfam shelter design; the shelter now uses a sheet, coloured white on one side and grey on the other, thereby minimising the amount of heat that the shelter absorbs. The most recent development has produced a tunnel shaped shelter, which offers more headroom for users and conforms to SPHERE standards.

Description of individual equipment packages

Introduction

These equipment packages have been devised by the Oxfam Public Health Engineering Team and others to help provide a reliable water supply, primarily for emergency situations such as in refugee camps and disaster-relief operations. The equipment is designed to be readily available, easily transported, simple to use, rapidly assembled, and fully self-contained, to provide an adequate water supply at moderate cost.

There are a number of equipment packages, covering a wide range of possible requirements, each designed to serve a particular purpose in providing a water supply, sanitation or shelter. Each equipment package is a grouping of a particular type of equipment, such as pipes and storage tanks, and consists of a selection of kits relevant to that package. The type and number of kits that will be needed from each package depend on many factors, such as the type of water source and the quantity of water required. These factors should be established before any kits are ordered. Also, most equipment packages have their own manual giving detailed information on use and assembly, and these should be consulted before ordering specific kits.

The packages of equipment available are as follows:

1. Water Storage equipment
2. Water Distribution equipment
3. Water Pumping equipment
4. Water Filtration equipment
5. Coagulation and Disinfection equipment
6. Borehole Drilling equipment
7. Borehole Pumping equipment
8. Hand dug Well equipment
9. Water Testing equipment
10. Oxfam water container
11. Excreta Disposal equipment

12. Vector Control equipment
13. Shelter and Plastic Sheeting

Brief introductory details of each package of equipment are given in this booklet.

General technical information for water equipment

Combinations of kits can be made up from the various equipment packages, with all the necessary items including spare parts, tools, and instructions for assembly. The equipment packages are designed with the following characteristics:

- Combinations of kits can be ordered as required.
- The equipment packages provide drinking water of suitable quality for general use, when the source is adequate.
- The equipment packages deliver an acceptable quantity of water to meet basic community needs, when the yield of the source is adequate.
- The equipment packages are cost-effective.
- The equipment packages are light in weight and easily transported by air and road.
- The water equipment packages are complete with instructions for assembly.
- The equipment is designed for rapid installation on site within hours of arrival by a team of semi-skilled workers, with some supervision from an experienced engineer.
- The equipment requires little maintenance and low levels of energy.
- The equipment is easy to dismantle, move, and re-assemble elsewhere.
- It is designed for a long-working life in the field.

Water Storage Equipment (yellow manual) Covering 11m³, 45m³, 70m³, 95m³ "Oxfam" tanks and 6m³, 10m³, 30m³ flexible PVC tanks

Substantial water-storage capacity is a major advantage in monitoring, improving, treating, and distributing water obtained from surface sources, and in providing continuous supplies. This range of tanks is designed to meet various water storage and treatment needs.

The tanks consist of circular corrugated galvanised steel walls, which are normally erected at ground level. The walls are supplied in segments and bolted together. A strong reinforced waterproof rubber liner is then fitted, pipe connections are made; and a roof is positioned. When siting and installing tanks, the use of local gradients should be carefully considered, to minimise pumping requirements. Care must be taken to protect tanks and machinery and to provide easy access.

The 45m³, 70m³, and 95m³ tanks are suitable for water supply to the general population; the 11m³ tank has been designed to ease the problems experienced by small field hospitals, clinics, and feeding centres with an inadequate or intermittent water supply. The 11m³ tank is smaller than the other storage tanks, but the design is the same, and it allows management by a specific hospital, clinic, or feeding centre. Also the 11m³ tank is used to contain specialised water treatment processes inside; namely the upflow clarifier and roughing filter kits.

Typically these tanks should be ordered to provide half a day's storage, based on a consumption figure of 15 litres per person per day, which could then be increased at a later date to provide a day's storage.

The lightweight rapid response water storage tanks consist of 6m³ trucking bladder tank for use in water transport, 10m³ bladder tank for static water storage and 30m³ onion tank for water treatment and storage. This equipment can rapidly deployed, then dismantled and moved to other locations and is best used to provide a start up

package in the absence of a detailed assessment and where affected populations are likely to be highly mobile. The relatively higher equipment costs and lack of suitability for anything other than short term water supply, means that the deployment of the “rapid response kits” should be used only where appropriate.

Oxfam code	**Description**	**Cost (£)**
T11	11m^3 tank steels, liner, roof	1300
T45L/R/S	45m^3 Tank liner, roof and steels	2260
T70L/R/S	70m^3 Tank liner, roof and steels	2760
T95L/R/S	95m^3 Tank liner, roof and steels	3050
TBT10	10m^3 bladder PVC Tank	1200
TRR30	30m^3 Onion PVC Tank	2100
TRT6	6m^3 Trucking Bladder PVC Tank	1000

Water Distribution Pack (light blue manual) Covering layflat, PVC, and PE pipe kits

This Pack consists of pipes and fittings necessary for transporting water from source to storage and/or from storage to users. It contains 500 metres of 90mm diameter UPVC pipe, with joints. The Pack includes coils of 63mm PE pipe, used for connection between the main 90mm pipe and water-distribution stands, which are provided ready for assembly with water-saving taps. The 63mm pipe coming in coils, can be quickly rolled out and left on the ground surface and as it does not need to be buried in the short term, it lends itself to use as a water main, but with less capacity than the 90mm UPVC pipe which needs to be buried. All the necessary fittings for connections are included. More or less piping can be ordered, according to the site requirements.

Distribution kits consist of tapstands complete with 6 outlets using water saving Talflo taps, which are provided with end caps to convert these to 4 outlets if required. These are also designed to be able to be split into two sections and with purchase of further fittings can be converted to 2 or 3 outlet tapstands.

Layflat hose is the pipe most recently used in its emergency response and is included in distribution/layflat rapid fittings kit. 75mm diameter layflat hose (fire hose) is provided in the kit, which is compact, easily transported and quickly laid out, though is only suitable for short term use, as the pipe is not as strong as rigid wall pipe systems, it has higher head losses and cannot be buried in trenches. Thus the DLR kit should usually only be considered for use with the rapid response bladder and onion tanks. The distribution adaptation kit provides a range of fittings to enable connection into MSF standard fittings, ICRC/IFRC standard fittings and to connect to 4” pipework.

Finally a range of specifications have been put together for larger pipe sizes in the event that population size and concentration demand this. These kits are not stocked but can be quickly ordered if required.

Oxfam code	Description	Cost (£)
DA	Distribution Adaptation Kit	480
DF2	63mm ∅ Distribution Fittings Kit	274
DF3	90mm ∅ Distribution Fittings Kit	660
DLR	Distribution Layflat/Rapid Fittings Kit	1,600
DMU3	90mm ∅ (OD) uPVC Distribution Main Kit, 500m	875
DPP2	63mm ∅ (OD) PE Distribution Pipe	60
DS-1	Distribution Tapstand (1" galvanised pipe)	165

The following kits are not Oxfam Stock Items but can be ordered if required

DFU4	*110mm ∅ (OD) Distribution Fittings Kit for HEP$_3$O and uPVC pipe*	*675*
DFU6	*160mm ∅ (OD) Distribution Fittings Kit for HEP$_3$O and uPVC pipe*	*1,160*
DMP3	*90mm Æ (OD) PE Distribution Main Kit, 500m in coils*	
DMU4	*110mm ∅ (OD) Hep$_3$O Distribution Main Kit, 500m*	*2,775*
DMU6	*160mm ∅(OD) Hep$_3$O Distribution Main Kit, 500m*	*3,000*

Water Pumping Pack (red manual)
Covering 2” and 4” centrifugal suction pumps

The Water Pumping equipment offer a range of three heavy-duty self-priming centrifugal pumps close-coupled to reliable and economical diesel engines, P2 for lower flows, P4 for high flows and P4H for high flows at higher heads. A lighter petrol driven pump, PR2 is also available for carrying on water trucks or other mobile uses. Sufficient hose and fittings are included to enable the pumps to be used either singly or in combinations for pumping water in a wide variety of situations. It is necessary to select the right number and combination of pumps for a given situation. These pumps are intended for immediate use in emergency situations. They are not necessarily the best solution for longer-term pumping needs.

Although the suction pumps are intended primarily for pumping clean water, they will pump relatively turbid water with no problems in the short term. They are not, however, intended for use as trash or sludge pumps.

The following information on pumping capacities is provided for guidance only. Detailed information provided in the pumping manual should be consulted.
P2: 9 litres/sec at 10m total head or 3.6 litres/sec at 20m total head (3300rpm)
PR2: 7 litres/sec at 10m total head or 3.9 litres/sec at 20m total head (3600rpm)
P4: 28 litres/sec at 10m total head or 19 litres/sec at 20m total head (2250rpm)
P4H: 30 litres/sec at 40m total head or 22 litres/sec at 50m total head (2200rpm)

The engines and pumps are supplied with the necessary pipe connections and spare parts for 6,000 hours’ running. Additional kits for major repair/overhaul are also available.

Oxfam code	Description	Cost (£)
P2-ALLI	2" Atalanta Diesel	2400
PR2-ALBS	2" Pumpsets, Petrol, Lightweight	475
P4-ALLI	4" Pumpsets Diesel	3650
P4H-GRLI	4" Pumpset Kit, high head	6250
PF	Pump Fittings Kit	80

Water Filtration Pack (green manual)
Covering roughing and slow sand filtration

Oxfam uses two basic types of filtration process for treatment of physically and microbiologically contaminated (surface) water:

1. Water (surface) with high physical contamination (which often have high microbiological contamination too), needs to be treated using roughing filters prior to being treated by slow sand filters. Thus the primary function of roughing filters is to reduce physical contamination – though they do also have a limited ability to reduce microbiological contamination.
2. Water (surface) with low physical contamination but with high microbiological contamination can be treated using slow sand filters alone. Thus the primary function of slow sand filters is to eliminate microbiological contamination – they have limited ability to cope with high levels of physical contamination.

The roughing filters kits are designed so that the raw water flows upwards, hence being called upflow roughing filters, which greatly improve their cleaning efficiency, by using gravity outflow to backwash accumulated solids built up in the roughing filter. This is further improved by placing media on a raised floor, which creates a void below it, enabling further efficiencies in cleaning. The number of roughing filters required depends upon primarily; raw water quality and required production capacity and this should be assessed/calculated and appropriate designs drawn up before construction starts. For optimum performance Roughing filters should be run at a maximum surface-loading rate of 0.6 $m^3/m^2/hr$. This means each T11 tank should be run to produce $3.2m^3$/hour.

The Slow Sand Filtration Pack consists of a large raw-water storage and settlement tank of $95m^3$ capacity, followed by a $70m^3$ tank containing a slow sand gravity filter. The standard water-storage tanks may be used in conjunction with this pack to store treated water (number of tanks to suit requirements). This Slow Sand Filtration Pack is designed to meet diverse field conditions, but as it usually takes several weeks to set up, it is often not used in the early stages of an emergency. The recommended filter throughput has been

increased from the rather conservative $0.1m^3/m^2/hr$ to $0.2m^3/m^2/hr$, which although increasing the required level of cleaning and the system head loss, is still well within standard slow sand filtration operation practice. When the unit is operating at the design rate, over 150,000 litres of water are produced over a 24-hour period, enough water for more than 15,000 people, at 10 litres per person per day.

The only materials which are required for the installation of these kits and which are not included in the kits are sand and gravel.

Oxfam code	**Description**	**Cost (£)**
FF	Filtration fittings kit	2,295
FRF	Roughing filter kit	1,800

Coagulation and Disinfection equipment (purple manual)
Covering upflow clarifier, chlorine and aluminium sulphate dosing options

The use of chemicals to assist in treatment of water is often necessary where water needs to be provided from these contaminated surface water sources in the early stages of an emergency. While the use of the roughing and slow sand filtration (see Oxfam filtration equipment manual), should be considered for post emergency situations as these treatment methods are more sustainable and appropriate, the relative speed and efficiency of using chemical treatment methods justifies their use during the early stages of an emergency response.

Where high levels of suspended solids exist in the water, reduction is necessary in order to be able to disinfect effectively with chlorine and for aesthetic reasons. While effective intake design and plain sedimentation can remove larger particles, colloidal (very fine) matter and organic material such as algae is often difficult to remove without use of a coagulant. Also natural sedimentation of solids suspended in water is often slow, but is readily assisted by addition of a coagulant, which causes the solid particles to aggregate together and so to form larger masses, which settle more rapidly. The coagulant most commonly used by Oxfam is aluminum sulphate crystals (Oxfam code FAS), which, though not a very strong coagulant, does have the advantage that it can be air freighted easily and is quite commonly available in different parts of the world.

The use of chlorine to “disinfect” water is very common and while only able to kill pathogens such as bacteria and viruses under the right conditions, its ease of use, availability and cheapness means it has a significant ability to improve the quality of water. Oxfam uses chlorine in two forms; HTH - calcium hypochlorite granules and slow dissolving chlorine tablets.

While pressure filtration/straining systems of one variety or another are commonly available in package water treatment plants, Oxfam has rarely used these due to their relative level of complexity, and lack of

robustness. Thus Oxfam has developed a completely new piece of equipment for use with water treated by coagulants and this can be built inside an Oxfam T11 tank. The Upflow clarifier kit, has a number of unique design features to enable it to be engineered to fit into a “rapid response package”.

Oxfam code	**Description**	**Cost (£)**
FAS	Aluminum sulphate (1/2 tonne)	180
FASD	Alum suction side dosing kit	450
FCCD	Chlorine constant rate dosing kit	360
FCH	HTH chlorine powder 10kg	20
FCT	Chlorine tablets (tricloroisocyanuric acid) 10kg	36
FFP	Floating pot chlorinator kit	42
FUC	Upflow clarifier for T11 tank	2,760

Oxfam code	***Description***
FDO	*Chlorine/aluminum sulphate dosing pump*
FEC	*Electrolytic sodium hypochlorite generator*
FMF	*Microfiltration membrane for protozoa removal*

Borehole Drilling Equipment

In most emergency situations the use of springs or surface water offers the most appropriate source to meet immediate needs. However, experience has shown that often it is necessary to exploit groundwater by drilling boreholes.

Three drilling packages have been identified and specified according to Oxfam's requirements, based around trailer-mounted drilling rigs, using a hydraulic drive system, which can be towed by four-wheel drive pick-up/truck. The package includes all the equipment necessary for drilling in a variety of geological formations, from soft sands through to hard rock.

The final contents of each drilling package will always vary according to the needs of the particular programme and the formations it has to work in. Thus for this reason none of these packages are kept in stock, but they can typically be available within 2-4 weeks of an order being placed. A borehole inspection kit is also available for use in checking condition of new or existing wells.

The following equipment is capable of drilling 6" holes in most conditions, based upon 60m deep wells lined with nominal 4" casing in sediments and unlined 4" holes in basement rock.

Oxfam code	***Description***	***Cost (£)***
BC4	*Borehole Compressor (for 4" dia. Oxfam well design)*	
BDH4	*Down-the-Hole Hammer (for 4" dia. Oxfam well design)*	
BDR4	*Drilling rig (for 4" dia. Oxfam well design)*	*20,000*
BMP4	*Mud pump (for 4" dia. Oxfam well design)*	

The following equipment is capable of drilling 8" holes in most conditions, based upon 100m deep wells lined with nominal 6" casing in sediments and unlined 6" holes in basement rock.

Oxfam code	*Description*	*Cost (£)*
BC6	*Borehole Compressor (for 6" dia. Oxfam well design)*	
BDH6	*Down-the-Hole Hammer (for 6" dia. Oxfam well design)*	
BDR6	*Drilling rig (for 6" dia. Oxfam well design)*	*33,500*
BMP6	*Mud pump (for 6" dia. Oxfam well design)*	

The following equipment is capable of drilling 10" holes in most conditions, based upon 200m deep wells lined with nominal 8" casing in sediments and unlined 8" holes in basement rock.

Oxfam code	*Description*	*Cost (£)*
BC8	*Borehole Compressor (for 8" dia. Oxfam well design)*	
BDH8	*Down-the-Hole Hammer (for 8" dia. Oxfam well design)*	
BDR8	*Drilling rig (for 8" dia. Oxfam well design)*	*54,500*
BMP8	*Mud pump (for 8" dia. Oxfam well design)*	

Borehole Pumping Equipment Covering progressive cavity, electric submersible pumps and handpumps

A variety of different types of pumps have been indentified and specifications developed for these. The electrical and diesel powered pumps for larger boreholes enable water to be pumped from completed boreholes to storage tanks or trucks, whilst handpumps can be installed in smaller boreholes or hand dug wells.

An electric submersible pump package consisting of three different pumps coupled to the same motor and generator enable a range of different pumping heads and outputs to be achieved giving maximum flexibility where borehole yields may be unknown. The pump is supplied with a generator, control panel, rising mains, electrical cable, running spares, and the necessary fittings and equipment for completion of the head works.

The progressive cavity (PC) pumps being powered by a diesel engine, have the advantage of being easier to maintain, not having any electrical components, and providing a nearly fixed quantity of water over a wide total head range.

Two hand pumps have been specified, one suitable for use in shallow tube wells with a capacity to pump from up to 12 m depth and another deeper well pump, which can be used to pump from depths of up to 45m.

Oxfam code	***Description***	***Cost (£)***
BI	*Borehole Inspection Kit*	*5,200*
BPC	*Progressive Cavity Borehole Pump Kit*	*5,100*
BPCR2	*2" Rising Column for PC Pump*	*2,000*
BSPE	*Submersible Borehole Pump Electric Kit*	
BSP8	*8GS55 Lowara Submersible Pump*	
BSP12	*12GS55 Lowara Submersible Pump*	
BSP16	*16GS55 Lowara Submersible Pump*	
WSHP	*Shallow well hand pump (12m max)*	
WDHP	*Deep well hand pump (12-45m)*	

Hand Dug Well Equipment (brown manual) Covering well auger survey, well digging, dewatering and desludging kits

This package of equipment has been prepared to assist in the various aspects of well digging by hand. It consists of a well-excavation kit and tools kit, including tripods, winches, digging tools, earth-lifting buckets, safety helmets, and concrete tools.

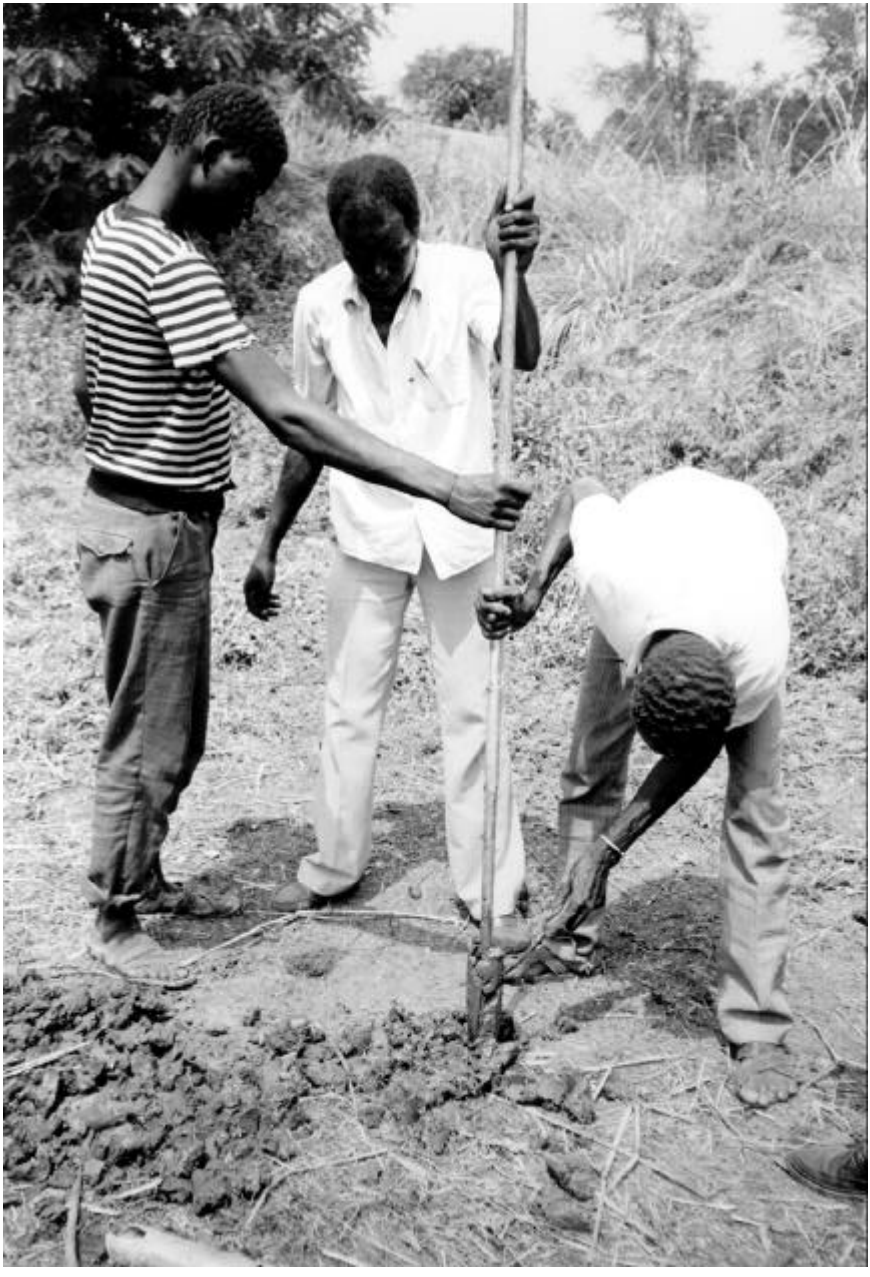
An additional tool is the Survey Auger Kit, which is used for ground-water exploration before the start of well-digging operations. The Auger is hand-operated, normally by two people, to a maximum depth of 15m, but only in soft formations. It also contains a hand-operated test pump for assessing the capacity of the water-bearing strata.

Well lining can be undertaken either by using curved, corrugated, galvanised sheets or more slowly, with concrete rings, either pre-cast or cast *in situ*. The curved, corrugated, galvanised steel sheets are supplied in segments, three of which make a ring 1.5m in diameter and 0.6m deep. The joining arrangement allows for the sheets to be readily assembled and inserted on-site or at the bottom of a well during deepening operations. The steel shuttering moulds for pre-cast concrete rings of 1.5m diameter and 1.2m diameter, and for *in situ* casting of 1.5m diameter rings, are designed to make concrete rings of consistent thickness, depth, and diameter. The moulds are robust and suitable for long-term and repeated use. They include a base plate and a concrete ring lifting device.

The original Oxfam dewatering kit, which consists of a compressed air-powered diaphragm pump, enables safe, effective, and comparatively noiseless dewatering to take place during well-digging operations. Several other options can be considered, from a hand-lifted bucket system, a SW Duplex hand-operated pump, an electric submersible pump. The selection of the right lifting system will depend on local conditions and other factors and should be made at the programme design stage.

Recent emergency responses where existing wells have been flooded and filled with mud, have required the use of the dewatering/desludging kit, with electric submersible pump and generator for rapid cleaning of wells. The same kit, with its high solids/ sludge handling capacity, can also be used to empty pit latrines.

Oxfam code	Description	Cost (£)
WAS	Survey Auger Kit	2,650
WET	Tool Kit for Well Excavation	610
WFA	Well Digging First Aid Kit	120
WL+P	Hand Dug Steel Well Liner (5m of non-perforated + perforated sheets)	525
WPC	Dewatering Kit (Mobile Air Pump and Compressor)	4,400
WSDP	Electric dewatering/desludging pump kit with petrol generator	
WT6	Well Tripod Kit	3,100
WPCT	Compressor Air Tools Kit (for use with WPC compressor)	1,210

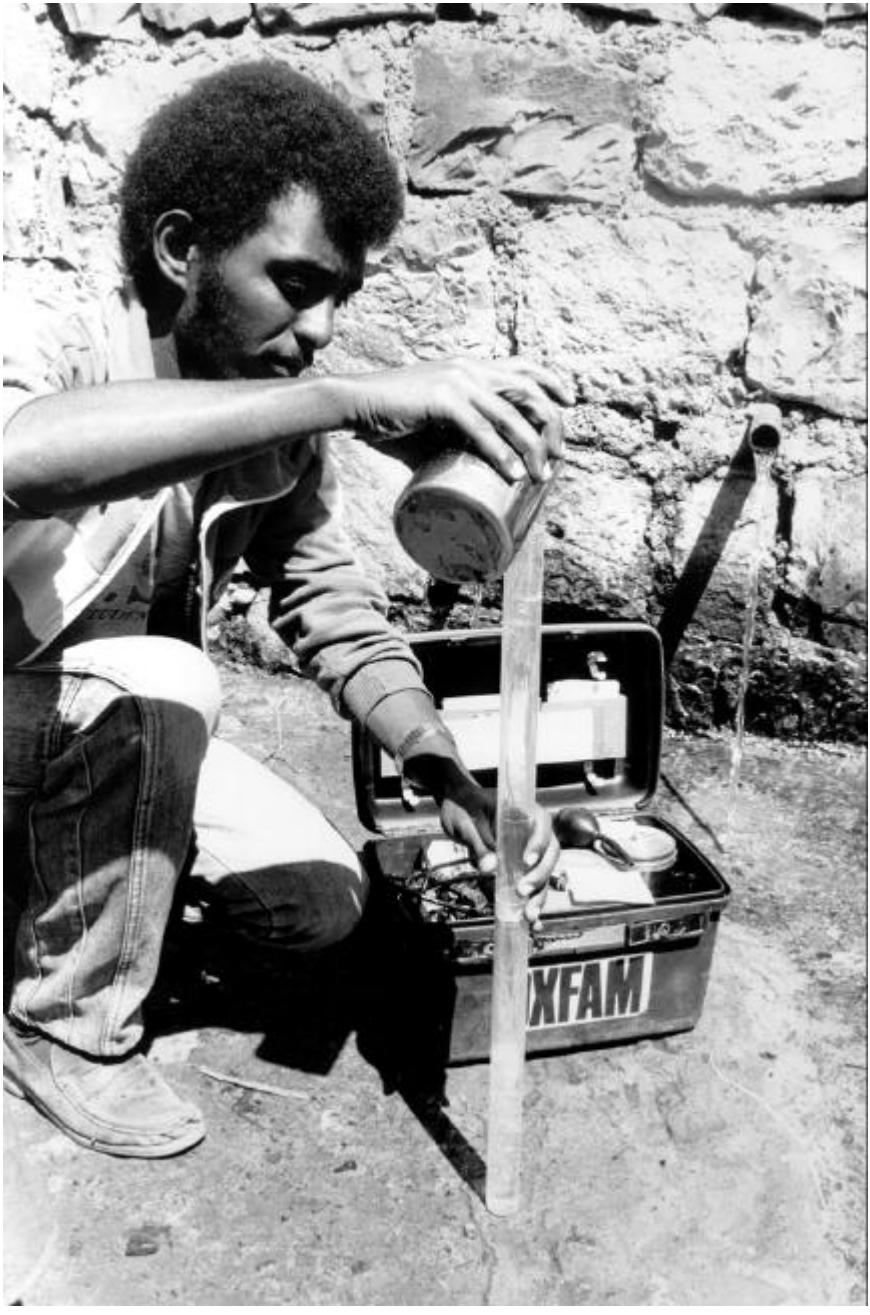


Delagua/Water Test Kit (red brochure) Covering Delagua kit and measuring and testing kit

The Kit has been designed for field-testing water for the key quality tests: faecal pollution (E Coli), turbidity, chlorine residual, and pH, without supporting laboratory facilities. The Kit is easily carried by one person and is equipped with it own rechargeable power unit, incubator, and consumables.

Some further physico-chemical parameters are not covered by the Delagua test kit. Equipment for tests such as Iron, Aluminium and electrical conductivity, are included in the Oxfam Measuring and Testing kit, details of which are listed in the back of this manual. This kit also includes equipment for conducting jar tests to determine suitable levels of coagulant dosage when using coagulants such as aluminium sulphate.

Oxfam code	Description	Cost (£)
FK	DelAgua Water Testing Kit – 240v	1,060
FK10	DelAgua Water Testing Kit – 110v	1,060
FMT	Measuring and Testing Kit	375


XFAM

Oxfam water container

The importance of having a water container in an emergency situation can not be over estimated. Often refugees fleeing from conflict will arrive in a refugee camp or a village with virtually no possessions. One of the first activities they will need to carry out is the collection of water. Therefore the rapid distribution of water containers in emergency situations is crucial, which is why Oxfam has developed a 14 litre water container.

The three driving forces behind the design were:

1) **Cleanliness:** studies have shown that while it is important to have a clean water source, the majority of water contamination takes place at the household level where water is stored and distributed. The Oxfam water container addresses this problem with the following features:

- A push on cap provides a hygienic seal. The cap is attached to the lid of the water container so that people not do need to improvise caps, after the original lid is lost (lid comes with Oxfam name/logo but these can be supplied plain without logo).
- The lid of the water container can be taken off so that the inside of the container can be cleaned periodically.
- Where the wall meets the base a curved surface prevents dirt and bacteria lodging in corners and enables better cleaning.
- A plastic tap option is available for increased cleanliness.

2) **Stackability:** normally, in the first phase of an emergency many water containers are transported to the site. 40 twenty-litre rigid water containers have an equivalent volume to 180 Oxfam water containers, which means there is a considerable saving on freight costs.

3) **Durability:** the water container, if treated correctly, should last many years. Many of the collapsible plastic types of water containers only last about 1 week in the arduous refugee camp conditions. Features are:

- Plastic easy grip handle
- Bottom ridge to prevent scraping of the base

- Reinforced top to prevent ovalling
- Tough durable UV treated plastic (suitable for food & drinking water)

The Oxfam water container has featured in the British Millenuim Dome, as part of the Design Councils innovative designs exhibition.

Oxfam code	**Description**	**Cost (£)**
TWC	14 litre Water Container (Pallet of 180 units)	520
TWCT	14 litre Water Container with tap	


OXFAM

Excreta Disposal Equipment

The importance of good sanitation practices, especially excreta disposal, can not be overestimated. The majority of diseases affecting refugee populations, such as diarrhea, typhoid, cholera and hepatitis A are all from faeco-oral contamination. Studies have shown. (Esrey 1986, 1991) that whilst improvements in water quality alone produced limited reductions in childhood diarrhea by 15-20%, the greatest reduction was attributable to safer excreta disposal (36%) and hand washing, food protection and improvements in domestic hygiene (33%).

A number of kits and a sanitation manual are in preparation or have been prepared to help address excreta disposal in emergency situations. For the first phase immediate response there is a kit for setting up defecation fields. A new self-supporting plastic slab, 1.2m x 1.1m, is being developed which will come with a pre-made super-structure for rapid latrine construction. There is a latrine digging kit to ensure that all the tools for latrine construction are immediately available before time can be spent sourcing tools locally. After the initial response, it is often necessary to upgrade facilities to make them more suitable for family use and thus more sustainable; to this end, a kit is available to construct domed concrete squatting slabs and sanplat concrete slabs.

Oxfam code	Description	Cost (£)
LD	Latrine digging kit	403
LF	Defecation field/trench latrine kit	240
LP	Plastic squatting plate kit	
LS	Latrine slab kit	2,300
LOP	Self supporting plastic slab	
LST	Latrine superstructure kit (plastic sheeting)	

Vector Control Equipment

Vector control through spraying is one of a range of techniques that can be used. Oxfam has a sprayer for use with various types of insecticides. Safety outfits must always be used with them and a separate order should be placed for this kit.

The primary focus of the control techniques will be on controlling insects and rodents, which are the main carriers of vector-borne diseases such as malaria. A number of kits are being developed. The flytrap is stocked for use in situations where the threat of diarrhoeal diseases is increased by large fly populations. The kit consists of a tapering plastic bag, which traps and drowns flies by attracting them with the smell of a non-poisonous liquid bait, made from a blend of protein meals.

Solid waster disposal can be difficult to tackle where a large amount of rubbish builds up quickly. The use of "builders ballast sacks", which can be quickly and cheaply deployed, may offer a suitable method for setting up a solid waste disposal system.

Oxfam code	**Description**	**Cost (£)**
XBN	Bale of 100 Impregnated Bednets	338
XFT	Fly Traps (50 in box)	75
XRB	*25 Rubbish Disposal Bags (1m^3) for 2,500 people*	*140*
XS	*Insecticide Sprayer*	*47*
XSO	*Vector/Chemical Safety Outfit (for 2 people)*	*80*

Shelter Equipment covering Oxfam summer and winter shelter and plastic sheeting

Oxfam has continued its long-term involvement in emergency shelter, a basic need for survival, by developing a new standard hot climate shelter system. The new standard shelter is available both as a specification and as single-unit kits.

The deployment of previous tented systems has been limited by production times, stockpiling capacity, shipping time, and cost. The new Oxfam shelter is assembled, rather than being manufactured, from construction materials readily available worldwide. Shelter kits are stockpiled by Oxfam to allow time for regional materials procurement to be arranged.

The shelter is modular, allowing for different family sizes. It is a tunnel form, 3.6m square in plan, with 1.8m head height along the ridge. The structure is three arches of 63mm Ø MDPE water pipe, located on pegs cut from steel reinforcement bar. These arches are joined with a ridge and purlins, also made from reinforcement bar, and braced internally with polypropylene rope, removing the need for external guys. This structure is covered with standard 7 x 4m UNHCR plastic sheeting, laced at the ends with a drawstring so that it can be tied back to the location pegs. The plastic sheet is then trenched into the ground along the shelter sides. Doors can easily be fitted, also cut from standard UNHCR sheeting.

The kit is transported inside a sack measuring 1.8m x 0.5m x 0.5m, onto which are printed instructions for assembly. The main arches are segmented, joined by sleeving 50mm Ø MDPE between the segments. The materials used in the shelter can be used following the emergency phase as part of 'intermediate' shelter solutions, built by migrants, offering a roof structure and roof sheeting. It can also be used by agencies as a cheap and easily available alternative to tents for clinics, feeding centres, and small-scale warehousing. The cost of the materials alone for the shelter is approximately one third of the cost of basic tent systems for emergency family shelter, and a fraction of the cost of many systems used by agencies for infrastructure.

Full instructions and guidelines are being prepared for specification, procurement, implementation programmes, assembly, and use. An insulated cold-climate shelter system is also under development, for use with a space heater, based on the same principles and using the same structural system. Again, many of the materials used are commonly distributed to assist migrants returning to their damaged homes to make temporary repairs.

Oxfam always seeks to support localised solutions for shelter, to increase the appropriateness of response and the benefits to migrants and their hosts. It does recognise that, in some situations, localised solutions will not be possible immediately and that it may be necessary to import shelter materials from the region.

Oxfam code	**Description**	**Cost (£)**
SESL	Warm Climate Family Shelter (Large)	90
SPE-1	Woven Flexible Tarpaulin	100
SPE-2	Reinforced (Braided) Flexible Tarpaulin	
SESS	*Warm Climate Family Shelter (Small)*	*60*

Acknowledgements and credits

The original development of the Water Packs was made possible with the generosity and professional skill of the University of Surrey and the Public Health Engineering section of Imperial College, London. Since then, active development and evolution of the water kits has continued, based on field experience and with continued input from the University of Surrey and others.

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