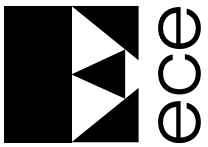
COMPACT LABORATORY MIXERS

Models CLM4 and CLM6

OWNER'S MANUAL

NOVA-TECH
INTERNATIONAL
800 Rockmead Dr Ste 102 • Houston, TX 77339-2112
Tel: (281) 359-8538 • Toll Free Tel: (866) 433-6682
Fax: (281) 359-0084 • Toll Free Fax: (866) 433-6684
sales@novatech-usa.com • www.novatech-usa.com



EC Engineering

Table of Contents

Rev 16 Sep 2003

Packing list

To minimize the chances of damage during shipment, the CLM system is packed in two boxes. The first contains the base unit (and optional carrying case if ordered); the second contains all the other components. Please check that all the items listed below are present and undamaged, and contact ECE or your dealer if there is any problem.

Box 1

- CLM base unit, 4 or 6 station.

Box 2

- Sample containers (jars) - 4 or 6 depending on unit.
- Plastic bag containing jar fittings: stopcock, cap, threaded adapter, tubing adapter, tubing, and adjustment tool for speed presets.
- Plastic bag containing spare sets of jar fittings, and three Robertson (square drive) screwdriver bits.
- For each jar: 50 mL beaker; 5 mL syringe; 1 mL syringe.
- Baffle / dosing module – 4 or 6 station.
- White plastic background curtain.
- Power cord.
- Dust cover.
- Owner's manual.

If desired, the entire CLM system can (after unpacking) be stored and transported fully assembled, with jars and baffle module in place, in the smaller double-wall shipping carton (or optional carrying case). The equipment will be well enough protected if it is handled with reasonable care - a little more than is sometimes provided by the shipping companies.

Serial number

Each CLM unit has a unique four-digit serial number. This can be found on the back of the base unit, immediately below the power cord receptacle.

Safety precautions

Please read the entire manual before attempting to unpack, set up, or operate the equipment and pay attention to all the warnings, cautions and notes. Failure to do so may result in injury to the operator or damage to the equipment.

1. This equipment has been designed to operate on either a 115 V 60 Hz or a 230 V 50/60 Hz AC power supply, as specified at the time of ordering. The electrical requirements for each unit are indicated on the label above the power receptacle on the rear of the case. Do not attempt to use the equipment with any other power source than is indicated on this label.
2. The system has been designed to be reasonably drip and splash resistant, but it is not waterproof. Avoid submerging the unit or subjecting it to unnecessary amounts of water. Take reasonable care to prevent water entering the ventilation openings on the back of the unit, or around the right-side end cover. If water does enter, immediately disconnect the equipment from the power supply. Leave the equipment to drain and dry out completely, then have it checked by a qualified electrician before using again.
3. The jar support platform (illuminated diffuser) is sealed to the base unit and can accept spillage from the jars. From time to time, check that the diffuser is not cracked or damaged, and that there is no visible leakage of water through the joint between the diffuser and the base.
4. Do not hold the paddles while they are turning, or in any other way try to stop them from rotating. This could cause injury or damage the drive mechanism.
5. The main power supply to the unit is protected by a 2 amp fuse. Repeated failure of this fuse indicates a faulty electrical condition and the equipment should be checked by a qualified electrician. Do not replace the fuse with one of a higher rating.

1. Introduction

The so-called jar test is an old water treatment test procedure, first introduced in the 1930s. It has remained essentially unchanged since then, although there have been various refinements such as increased mixing speeds and the use of square jars instead of cylindrical beakers.

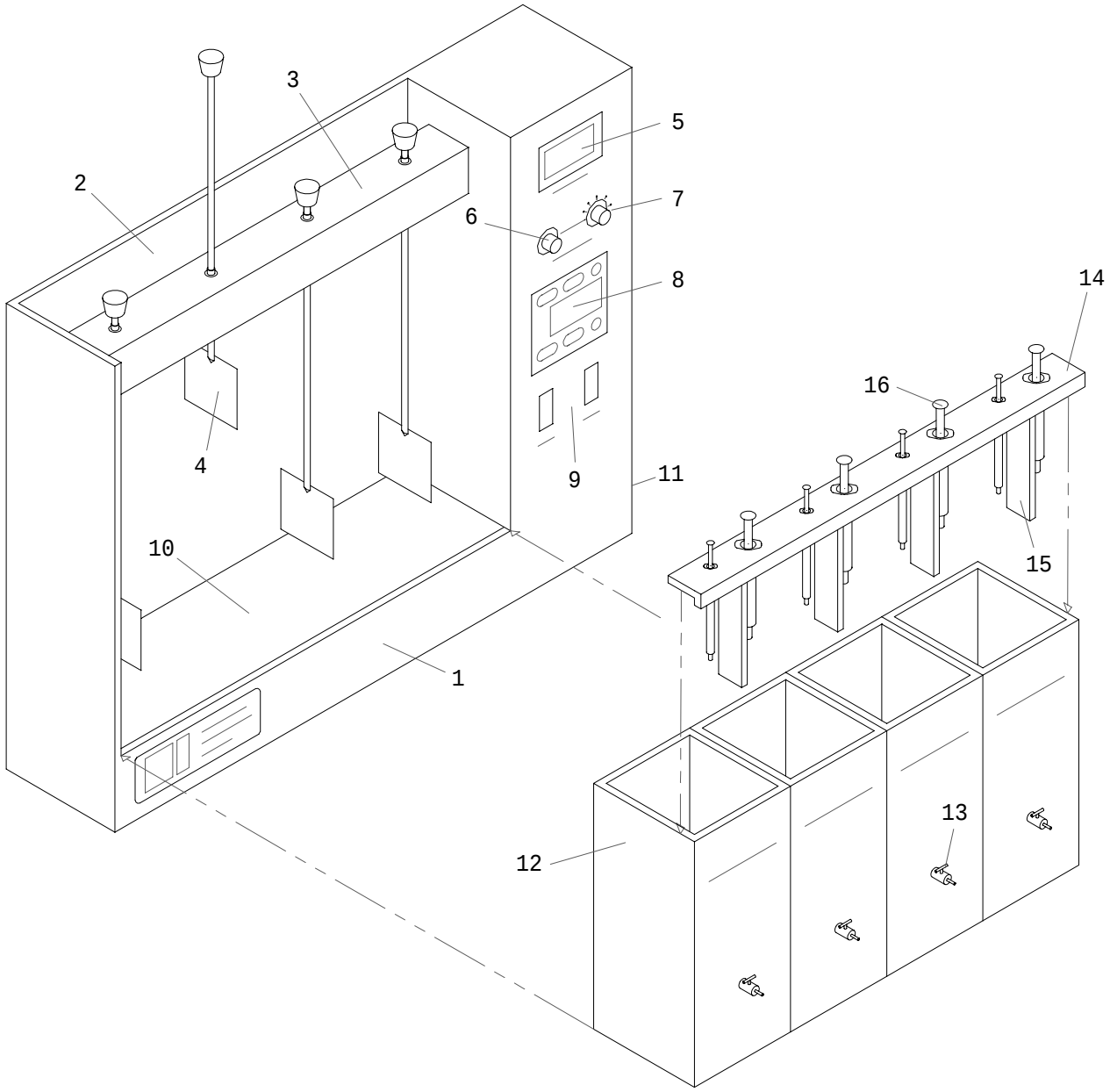
As basic as the jar test may be, it remains one of the best methods of assessing and optimizing the various processes and options available for treatment of potable and other types of water. Properly done, it can provide a great deal of information during all phases of a treatment system's development - initial process screening and development, equipment sizing, operational optimization, and evaluation of potential alternative treatment processes. All this can be achieved at relatively little cost, and without the need for a great deal of high-tech knowledge and expertise.

However, unlike most analytical procedures used in the water supply industry, there is no standardization of jar testing procedures and the results are almost always open to different interpretations and conclusions. Therefore, a great deal of thought and care, as well as more than a little experience, is essential if the jar test procedure is to achieve its full potential.

Equipment for conducting jar tests has been available for a long time, but most of the available units tend to be bulky, heavy, and subject to various operating problems. The CLM system offers several significant improvements in the areas of small size, light weight, portability, ease of operation, and low cost.

It is not the intent of this manual to discuss in detail all the various planning, objectives, calculations, procedures, and other considerations that are involved in conducting a jar test; this information is available from many different sources. Rather, the intent is to describe the aspects of the procedures that are specific to the CLM system.

Four and six station CLM units are available. The only difference between them is the number of stations – all other features and functions are identical.



The drawing shows the main features of the CLM systems. The four-place CLM 4 is shown - except for the number of stations, the six-place CLM 6 is identical.

The base unit (1) includes jar support base, mixer drive system, paddles, light, and controls. A solid black vertical surface (2) behind the jars provides a uniform background for observation of samples. A white plastic curtain sheet is supplied for insertion behind the jars for work with color removal and similar processes.

The mixer drive assembly (3) is part of the base unit. Paddles (4) can be lifted and parked, or lowered for service, in a single, one-handed operation.

Mixer speed is indicated by a digital tachometer (5) and can be adjusted by means of a continuously variable control (6) or five switch-selectable, adjustable preset speeds (7). A digital clock with dual alarm count down / count up timers (8) and mixer and light switches (9) are built into the control panel.

A high-intensity dual-tube fluorescent lighting system (10) is built into the base. The good lighting and close jar spacing make it easy to document test results photographically.

The built-in internal cooling fan (11) greatly reduces the possibility of misleading results caused by sample heating.

One-litre square sample jars (12) are used, with subsurface sampling being done by means of a miniature quick-connect stopcock system (13)

The CLM system uses a removable module (14) with baffles (15) and chemical dosing syringes (16). The baffles prevent vortexing and air entrainment at the high mixing intensities available, and the syringes allow accurate, simultaneous dosing of chemicals.

EC Engineering

CLM COMPACT LABORATORY MIXER - MAIN FEATURES

2. Equipment description

Main components

The main components of the CLM system are shown in the diagram. These are:

1. Base unit. This consists of the jar support base with back plate and end housing, paddles, paddle drive system, drive motor, speed controls and indicator, fluorescent lamp, cooling fan, 16V DC power supply, and controls.
2. Sample containers (jars). Either four or six individual sample containers are supplied with the CLM, depending on the model. Each jar is graduated at the 1 L mark and with 5% volume increments. Sample ports, with removable stopcock, cap, adapters, and tubing, are provided.
3. Dosing / baffle module. This serves two functions. The first is to provide baffling in the jars, to prevent vortexing at high mixer speeds. The second is to provide a holder for chemical dosing syringes, so that chemicals can be added simultaneously and accurately to all jars.

The CLM system is shipped in two corrugated cardboard cartons. The system can be stored or carried, fully assembled with all components in place, in the smaller of these cartons if handled with reasonable care.

Following are some details on the components that make up the CLM system.

Base unit

Components

The base unit includes:

- The main structure (jar support base, end housing, and back plate). The end housing has a removable cover for access to the internal components.
- Paddle system, consisting of aluminum housing, drive shaft and bearings, helical gears, stainless steel vertical-shaft paddles, and paddle shaft bearings.
- On / off switches for mixer and light.

- Mixer drive motor with speed controller, digital tachometer, and shaft coupling.
- A high-efficiency, long-life fluorescent lamp with solid-state electronic ballast.
- Cooling fan.
- 16 volt DC power supply for motor and tachometer system.
- Built-in combination dual count down / count up digital alarm timers and clock.
- Mixer speed control and preset speed selector switch.
- Power cord receptacle with fuse holder, and power cord.

Base unit controls

The controls on the base unit are:

1. Mixer on / off switch. When the mixer is not in use, this switch should be left in the “off” position, rather than simply turning the motor speed control to a very low setting. This will avoid any unexpected paddle operation if the speed control knob is accidentally moved.
2. Light on / off switch. This switch controls the built-in fluorescent lamp in the base unit, and the cooling fan. The fan runs whenever the lamp is on.
3. Mixer speed presets selector. This control allows selection of any one of five preset mixer speeds (see Item 4 below) or the continuously-variable speed adjustment control immediately to its left.
4. Preset mixer speeds. Five adjustable preset mixer speed settings are provided. The speeds are adjusted by means of a small screwdriver-type tool inserted through the front panel holes at each of the five locations. Normally, the speeds would be set to those most commonly used, and changed only infrequently. In potable water testing, for example, typical preset speeds might be 300, 60, 45, 30, and 20 rpm.
5. Continuously-variable speed control. This control provides continuously-variable speed adjustments from minimum speed (about 10 rpm) up to maximum (about 300 rpm). If this control is preferred (over the presets) for slower speeds, it may be convenient to adjust Preset 1 to give the desired high speed. The selector knob can then be used to switch between high speed (for coagulant addition) and slower speeds (for flocculation) without the need to vary the continuous adjustment control over its full range each run.

6. Clock / timer. The built-in clock / timer has two independent count-down / count-up alarm timers, in addition to a digital clock.

   Select one or other of the timers, or the clock, using the selector buttons near the top of the timer.

   Set countdown times using the hours, minutes, and seconds buttons (holding any of these buttons down causes its count to continuously increase). Press the Start / Stop button to start the count-down period. After the count-down time has elapsed, the alarm will sound (for one minute unless silenced) and the timer will start to count up. If no countdown time is set, the timer will start counting up as soon as the Start / Stop button is pressed. Both timers can be used simultaneously and independently.

   Pressing the Start / Stop button after the countdown time has elapsed will silence the alarm. Pressing it again will recall the countdown time previously set. Pressing it a third time will re-start the count-down period.

   To set the clock time, press and hold down the Clock button until the display starts flashing (about three seconds) then set the time using the H, M, and S buttons. Press the Clock button again to return to normal operation. To change between am/pm and 24-hour time, press and hold the Stop / Start button.

Sample jars

The CLM uses one-litre sample containers (jars), supplied as standard equipment with the unit. Additional jars or fittings are obtainable separately.

The threaded adapter supplied with each jar is inserted into the sample port on the front of the jar, snugly tightened, and normally left permanently in position. Depending on whether subsurface sampling is required, either a stopcock or cap (both supplied with each jar) is attached to the threaded adapter. Usually, the stopcock would be used, together with the supplied tubing adapter and sample tubing.

Baffle / dosing module

The baffle / dosing module serves two functions. The first is to provide baffling in the jars, to reduce vortexing and air entrainment at high mixer speeds. The second is to provide a holder for chemical dosing syringes, so that chemicals can be added simultaneously and accurately to all jars.

The module is designed to use standard 1 mL and 5 mL syringes (included with the CLM unit) for chemical dosing. It can hold one syringe of each size for each station. The syringes are filled with the appropriate amounts of each chemical to be dosed, and inserted into the module. This is then placed on the base unit, the mixer is started, and the chemicals dosed to all stations simultaneously. The baffle / dosing module can be removed from the base unit after the mixer speed has been reduced, or chemical dosing has been completed.

When not in use, the baffle / dosing module can be conveniently stored along the top of the back plate of the base unit, with the baffles hanging down behind the back plate. In this position, the module is always conveniently available, and does not take up any significant space or interfere in any way with operation.

Shipping cartons

To minimize the chances of damage during shipment, the CLM system is packed in two cartons. The first contains the base unit, in its foam support (or optional carrying case if ordered). The second contains all the other components.

If desired, the entire CLM system can (after unpacking) be stored and / or transported fully assembled, with jars and baffle module in place, in the smaller double-wall shipping carton (or optional carrying case). If this is done, the equipment in its carton or case should be handled with a reasonable degree of care.

If the system is to be transported by a commercial carrier and might therefore be subjected to some very rough handling, we recommend that the original two-carton packaging be used.

Optional carrying case

The optional CLM4 carrying case is fitted with cubed foam inserts. The foam cubes can be removed as desired to create custom recesses for the items to be carried.

As initially supplied, the foam inserts are configured to snugly fit the CLM4 base unit. Additional items such as reagent bottles, dosing syringes, sample beakers, or other accessories can be accommodated by removing foam cubes as desired. To maximize the space available for accessories, all the internal foam cubes can be removed, leaving only the outside perimeter of foam. If this is done, individual items should be separated from each other using bubble wrap, thin foam sheet, paper towels, or other suitable divider material.

When returning the CLM4 unit to the carrying case, be sure that it is oriented so that the unit is upright when being carried (top of the CLM4 towards the handle of the case).

3. Jar test procedures

The basic objective of the so-called jar testing procedure is to simulate, as far as is practical, the processes that are being, or might be, used in a full-scale treatment plant. Because there are fundamental differences between batch and continuous flow processes, the jar test does have its limitations. Nevertheless, it can prove very useful as a simple, rapid, and economical means of evaluating how well proposed water treatment processes can be expected to work, and in determining certain process parameters such as chemical dosages and reaction times.

Of course, each situation will be unique, with its own circumstances and objectives. Therefore, only a simplified, general test procedure can be given; this must be modified as required by the specific situation.

Following is a suggested basic jar test procedure.

1. Insert the desired fittings (either a stopcock or a cap) into the sample ports of one or more of the square 1 L containers (jars). Both types of fittings are inserted into the screwed adapter on the jars with a quarter to half turn, until snug - do not over-tighten.

   The supplied tubing adapter and sample tubing may be inserted in the discharge side of the stopcock, if desired. If depth sampling is not required, use of the caps instead of the stopcocks will make handling a little easier and will reduce the likelihood of breakage.

2. Fill the jars to the 1 L mark with the water being tested.

3. Raise the paddles, place the jars in position on the base, and lower the paddles into the jars.

4. For each of the test stations being used, fill syringes with the appropriate amount of stock chemical (such as alum coagulant and/or polymer) and insert these into the holes in the baffle / dosing module. Place the module along the tops of the jars, with the front flange clipped over the jars. This ensures that the baffles are held snugly against the front of the jars, which is important in reducing the amount of vortexing and air entrainment at high mixer speeds.

5. Start the mixer motor and set it to the desired speed (usually full speed for the coagulant addition stage).[1] For operation at full mixer speed, the

[1] Note that the paddle shafts have some free play in their sleeves, and the paddles may therefore “wobble” slightly. The clearance between the paddle shaft and sleeve is deliberate, and is carefully controlled to ensure that there is no binding of the shafts (which is a common problem with some other available jar mixers). It does not indicate a problem with the CLM unit.

baffle / dosing module should be used; otherwise, the contents of the jars may be subject to excessive vortexing and air entrainment.

6. Inject the chemicals by pressing down on the syringe plungers. All stations can be dosed virtually simultaneously. For simulation of the short, high-intensity “flash mixing” often used in coagulant addition, the mixer speed should be reduced after a time corresponding as closely as possible to the actual mixing time that would be used in a full-scale plant. In many cases, this would be almost immediately after coagulant addition.

7. The baffle / dosing module can be removed, if desired, as soon as the mixer speed has been reduced to below about 200 rpm. Subsequent addition of chemicals such as polymers is not as critical as the initial coagulant addition, and does not require the use of the dosing module. The baffles have negligible effect below mixer speeds of about 100 rpm.

8. Set the mixer speeds to provide the mixing intensity desired for the first flocculation stage. One or more of the five preset speeds can be selected, or the continuously-variable control can be used. The preset speeds are adjustable by means of a small screwdriver-type tool (provided with the CLM) inserted through the holes in the front panel at each location. This tool may be conveniently stored in the small hole provided on the top of the aluminum paddle drive housing.

   Note that mixer speeds will probably vary slightly from time to time because of factors such as different number of jar stations in use, temperature differences, etc. These small variations are normal and will not affect the results of the jar test in any significant way.

9. Set and start the built-in count-down timer.

10. Turning on the lamp in the base of the unit will greatly improve observation of floc formation and other processes taking place. When first switched on, the lamp will take several minutes to reach full brightness. Because the built-in cooling fan prevents excessive heating of the diffuser base and sample jars, the lamp may be left on throughout a jar test run if desired.

11. In most cases, a black background will be best for observing particles in water contained in the jars. However, for some processes (such as color removal) a white background will be more appropriate; in these cases, simply insert the supplied white plastic curtain sheet behind the jars.

12. At the end of the first flocculation time period, adjust the mixer speed and reset the timer. Repeat as appropriate for the number of flocculation stages desired.

13. After completion of the flocculation stages, lift the paddles and park them in their upper supports. Allow the contents of the jars to settle for the desired periods.

14. Carry out observation, sampling, and evaluation procedures as desired.

4. Maintenance

General

The CLM requires very little maintenance, other than cleaning, occasional minor lubrication, and replacement of items such as lamps and timer batteries.

Cleaning

The unit should be cleaned up immediately after each run, particularly the jars. If solids such as floc are allowed to dry out on component surfaces, they may be much more difficult to remove later. Rinse with clean water, or wipe down with a damp cloth, as appropriate. ***Do not use organic solvents such as acetone or alcohol, which may damage plastic surfaces or paint finishes.***

Lubrication

All bearings in the CLM system are oil-impregnated bronze, and should require lubrication only very rarely. If the mixer system seems rough or noisy, apply a small amount of light oil to the paddle shaft bearing sleeves.

Fuse replacement

The electrical system of the CLM is protected by a 2 amp fuse, located in the small drawer underneath the power cord receptacle. To replace the fuse, remove the power cord and pull out the drawer using a small flat-blade screwdriver in the slot at the top of the drawer front. A spare fuse is supplied with the CLM, and is located in the fuse drawer immediately in front of the active fuse at the rear. Insert the new fuse, close the drawer, and plug in the power cord.

If the fuse blows repeatedly, have the electrical system checked by a qualified electrician.

Lamp replacement

The fluorescent lamps in the CLM units have a rated life of at least 12,000 hours, equivalent to over 30 years' operation at an hour each day. Therefore, it should very seldom be necessary to replace the lamp. However, if it becomes necessary to do so for some reason, follow these steps:

1. Remove the right side cover plate from the base unit (six screws).

2. Place the base unit on its back and remove the two screws on the bottom which secure the lamp socket.
3. Gently pull the lamp socket and lamp outwards (towards the right side of the unit) enough to allow the lamp to be grasped. Unplug the lamp from the socket (a gentle pull is all that is needed) and plug in the new lamp[2].
4. Notice that there is a lamp support clip near the bottom left end of the CLM base unit, below the diffuser. Push the lamp / socket assembly back into the base of the CLM until the lamp is felt to engage the support clip.
5. Align the lamp socket with the screw holes in the CLM base, and replace the screws.

Timer battery replacement

The built-in timer is powered by a 1.5 volt alkaline button cell (GPA76 or equivalent) which should last for several years in normal use. If the timer display becomes dim, the cell should be replaced. To do this, remove the right side cover plate from the base unit. Use a coin or other tool to remove the small circular battery cover on the back of the timer unit. Install the new cell and replace the battery cover and right side cover plate. Set the current time as described in Section 2.

Tools

Most of the screws used in the CLM are Robertson (square drive) type. Although these screws should rarely need to be removed, a set of three Robertson bits is supplied with the CLM system.

Also included is a small screwdriver-type tool for adjusting the mixer speed presets. This may be conveniently stored in the opening provided near the right end of the paddle drive assembly.

[2] Lamps are compact fluorescent type with 2G11 base (Philips PL-L, Osram Sylvania Dulux L, GE Biax, or equivalent); 36 or 39 watt (CLM 4), or 50 watt (CLM 6)

5. Specifications

Unit	***CLM 4***	***CLM 6***
Basic features		
Number of stations	4	6
Sample volume	1.0 L	1.0 L
Sample container (jar) volume	1.3 L	1.3 L
Mixer speed range	15 to 300 rpm	15 to 300 rpm
Electrical supply options (specified at time of ordering)	115VAC 60Hz 230VAC 50Hz	115VAC 60Hz 230VAC 50Hz
Maximum current draw	0.6A (115V version) 0.3A (230V version)	0.6A (115V version) 0.3A (230V version)
Dimensions		
Base unit	500 x 380 x 105 mm (19.6 x 15.0 x 4.1 in.)	680 x 380 x 105 mm (26.8 x 15.0 x 4.1 in.)
Shipping carton (base unit)	595 x 470 x 190 mm (23.5 x 18.5 x 7.5 in.)	780 x 470 x 190 mm (30.7 x 18.5 x 7.5 in.)
Shipping carton (accessories)	515 x 420 x 140 mm (20.2 x 16.2 x 5.5 in.)	710 x 420 x 140 mm (28.0 x 16.2 x 5.5 in.)
Weights		
Base unit	6.5 kg (14.2 lb)	8.1 kg (17.8 lb)
Base unit with carton, shipping weight	7.5 kg (16.4 lb)	9.3 kg (20.5 lb)
Accessories (jars, baffle module, etc.)	3.4 kg (7.4 lb)	4.7 kg (10.3 lb)
Accessories with carton, shipping weight	4.4 kg (9.7 lb)	5.9 kg (13.0 lb)
Total equipment weight	9.8 kg (21.6 lb)	12.8 kg (28.1 lb)
Total shipping weight	11.9 kg (26.1 lb)	15.2 kg (33.5 lb)
Materials of construction		
Base unit and baffle / dosing module	PVC with epoxy paint coating	
Paddles and shafts	Stainless steel	
Paddle drive housing	Aluminum	
Paddle system bearings	Oil-impregnated bronze	
Paddle system gears	Hardened steel	
Sample jars	Clear acrylic	
Background curtain	White styrene plastic	
Dust cover	Fabric-backed vinyl	

MIXING INTENSITY vs PADDLE SPEED
FOR ECE 1 LITRE SQUARE JAR