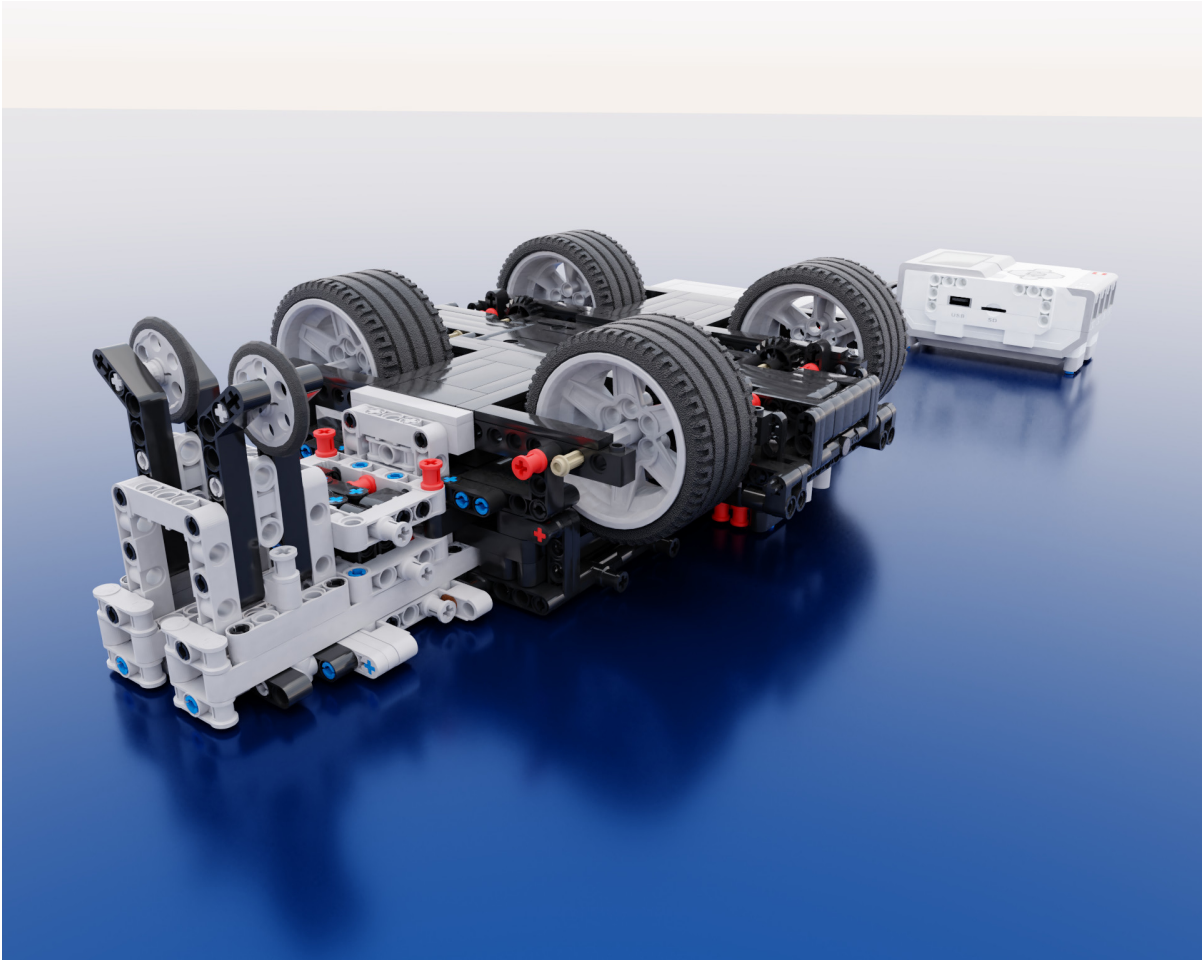


Operator's Manual

LL-2

Film and Print Processor



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Notices

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Setting Up

This chapter covers how to set up the processor in a safe environment.

Any time you are setting up your processor in a new location, refer to this chapter.

Safety Instructions

Read, understand, and follow the warnings below for safe and reliable operation.

- Do not use processor if any cables are damaged.
- Do not use processor if liquids have entered EV3 P-Brick.
- Do not use processor if liquids have entered motor unit.
- Do not place processor on a wet surface (e.g. in a darkroom sink).
- If placing the processor near a sink, point the front of the rotation base towards the sink. The EV3 P-Brick and motor unit are placed a safe distance away from the sink.
- Place EV3 P-Brick and motor unit a safe distance from any water source.
- Do not place cables in areas where they can be accidentally hit or tripped upon.
- Do not splash water or chemicals onto EV3 P-Brick.
- Minimize touching the EV3 P-Brick with very soaked hands. Excessive amounts of liquid that collect on your hands may splash onto the EV3 P-Brick during operation.

Some gloves easily collect water which splashes onto the EV3 P-Brick. Always keep your gloves dry.

- Clean up spills when they happen. If the developing tank is rotating, be careful not to hit it or the rotating tires while you are cleaning.
- Place the developing tank on the rotation base and make sure it rotates in a stable manner without falling or walking off. Use rubber bands to stop the developing tank from walking off the rotation base if necessary. See 'Mounting Tanks and Drums' on page 7 for more information.
- Do not attempt disassembly of processor, even if it is made of LEGO parts. It is easy to accidentally bend axles and other parts in a way that causes mechanical imbalances and more.



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Processor Overview

The LL-2 processor is primarily designed for rotary processing of B&W and color films in virtually all formats using JOBO tanks: 35mm, 120/220, 4x5", 8x10", and Ultra Large Format (ULF). May also be used for processing B&W and color prints up to 20x24".

Supported JOBO tanks and drums are the 2500 series, 2800 series, and 3000 series (Expert).

Use with JOBO Expert drums for the ultimate in uniform development of large format sheet films.

Rotary processing significantly lowers chemical usage; this holds true especially when processing many rolls of film at once, or with larger formats (4x5", 8x10", ULF).

With the right developers, rotation can produce high quality results indiscernable from standard inversion. You will need to adjust development times for your film-developer combination. Recommendations are discussed in 'Specific Processes' on page 35.

Intended for use by fine art photographers, the LL-2 processor increases productivity by allowing ① quick and precise fine tuning of individual processes with a variety of built-in tools and ② consistent repeatable processing. These are the hallmarks of high precision processing for image making as an art form.

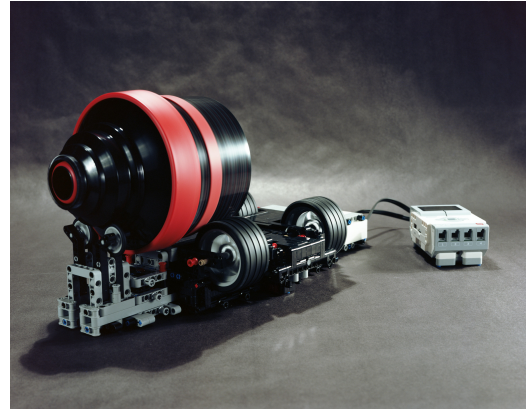
A user interface allows you to program every detail of a process. This includes rotation speeds, agitation (customizable bi-directional rotation), processes with up to 20 named steps with different times (for development, fixing, washing), temperature compensation (the development time is compensated to work under the ambient room temperature given process target temperature), etc.

Programs may be given a name and saved in profiles on a microSD card (included inside the EV3 P-Brick). Minute adjustments can be programmed and saved as necessary. There are a few real-time measurements displayed to assist you in making adjustments.

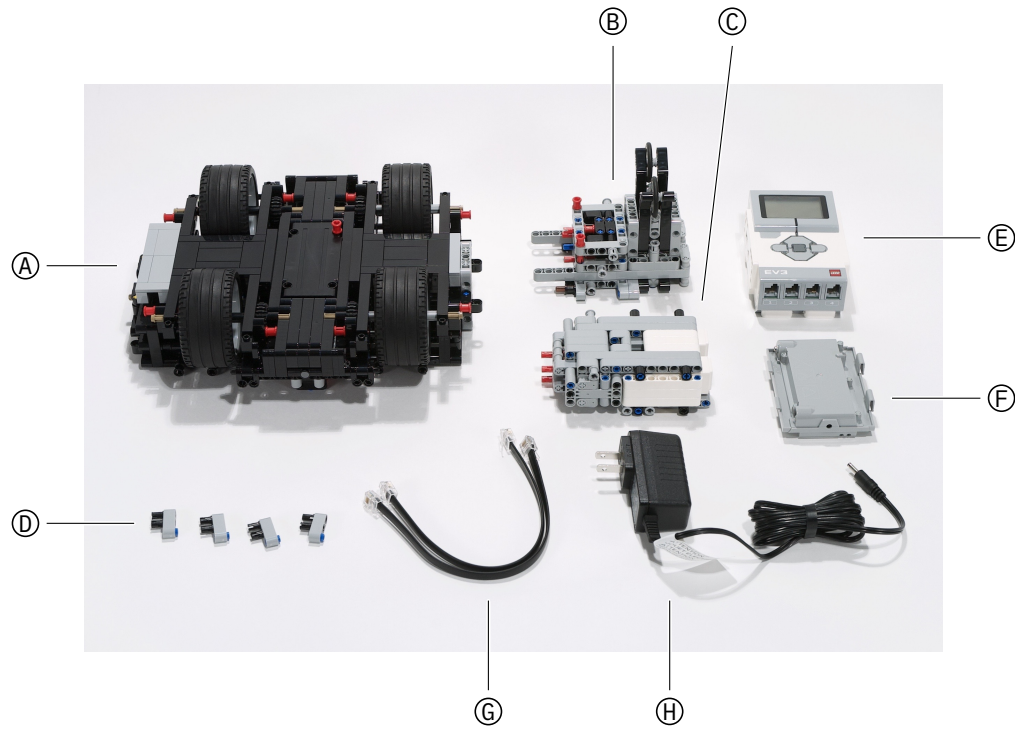
A timer interface allows you to precisely monitor and run a whole process. All process steps are timed. Alarms are signaled indicating when to pour chemicals out. Agitation with bi-directional rotation is automatically started when appropriate.

All you have to do is select START/STOP and pour chemicals in or out after audible alarms to complete a process consistently. This is a seamless workflow. Programming adjusts the behavior of the timer interface for maximum flexibility and customizability.

NOTE: The LL-2 processor may also be used for color processing of films and prints when used with an external temperature controlled water bath. See 'Specific Processes' on page 35 for more information.



Package Contents



Ⓐ Rotation Base

Ⓑ LL-225 Extension

Ⓒ Dual-Medium Motor Unit

Ⓓ 4× LL Feet for EV3

Ⓔ EV3 P-Brick

Ⓕ EV3 Rechargeable Battery

Ⓖ EV3 Cables

Ⓗ Transformer 10V (Charger)

Ⓘ Funnel with Flex Hose

⓵ 4× 1000ml Bottles

Ⓚ 4× ½ gal. Water Container

Ⓛ 4× Rubber Bands

Organizing your Workspace

Clear a space on a table or counter top for the processor. Make sure there are no objects nearby which can obstruct rotation in the middle of processing.

Place the rotation base on a flat level surface. The rotation base should sit in a stable manner without any shaking.

Though not necessary, it is recommended you place the processor next to a sink; this allows you to quickly grab the developing tank and pour out wash water or chemicals during processing.



Always point the front of the rotation base towards the sink. The motor and P-Brick should not be next to the sink.¹

If necessary, you may use a tempered water bath for maintaining chemical temperature (as pictured).

Connections & Accessories

The processor consists of multiple individual components which are connected together for complete operation.

The motor unit is connected to drive the rotation base. The EV3 P-Brick (computer) is connected using cables to control the motors. Batteries are connected to power the P-Brick. The charger is connected to recharge the batteries. Extensions are connected to physically support different developing tanks sitting on the rotation base.

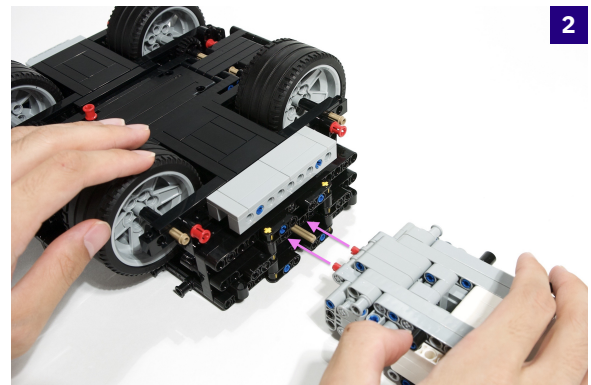
The idea is a processor made of high quality components which can be replaced or even upgraded in time for maximum flexibility and customization.

Motor

The motor unit is connected to the back of the rotation base via an axle; rotation is transmitted from the motors through the axle to the tires on the rotation base then the developing tank.

Place the motor unit and rotation base on the same flat surface. Slide the motor unit straight into the rotation base and plug it in firmly. The motor unit will connect to the rotation base. You may need to rotate the tires (on rotation base) with your hands while connecting the motor unit. This action rotates the axle into the proper position for an easy connection.²

Slide the motor unit away from the rotation base to disconnect.



P-Brick

The EV3 P-Brick works as a controller. It allows you to interact with the processor via a user interface and runs software for motor control, timing, and more.

Rechargeable Battery

The P-Brick is powered by batteries. The EV3 Rechargeable Battery is the most convenient to use. You may recharge the battery without removing it from the P-Brick.

Press the two tabs and remove the back cover of the P-Brick.³ Remove any AA batteries in the P-Brick and insert the EV3 Rechargeable Battery. Snap in place.⁴ Store unused back cover in original boxes.

Fully charge the battery before first use.

Plug the battery into a wall outlet using the supplied power cord. A red light is lit indicating charging. Once fully charged, the red light goes out and a green light is lit.

It takes three to four hours to charge a fully drained battery.

A full charge will last for multiple processing runs; the number of runs you can perform is dependent on motor power usage (speed setting) and rotational load of the developing tanks. Even when rotating the heaviest loads (JOBO Expert drum filled to recommended maximum volume) at the highest speed, you can still perform three or four complete runs.

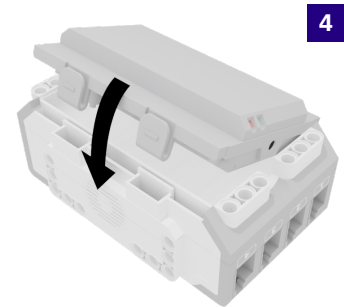
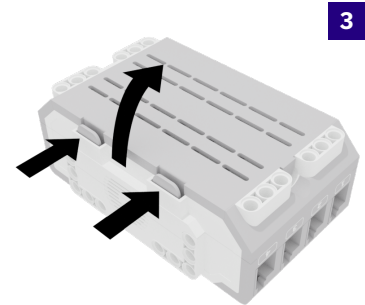
The battery voltage drops as the battery level decreases. A warning is signaled when the battery level is low (voltage is 6.9V or lower). It is recommended to turn off the processor and fully recharge the batteries. You may also charge the batteries while the processor is running; charging will take significantly more time.

The low battery warning activates long before the battery is completely dead. There is still enough charge left to complete any currently running process. The warning is simply saying it is not recommended to start a **new** process at the current battery level.

You may simply perform as many processing runs as possible until the low battery warning is displayed. Then turn off the P-Brick and fully recharge before continuing.

NOTE: To prolong battery life, do not store batteries for extended periods of time at full or zero charge. Do not store batteries or electronics at elevated temperatures. Do not leave battery plugged in when fully charged.

NOTE: The processor software implements speed regulation to minimize differences in rotation speed at differing battery levels. This has been tuned to ensure consistent processing.



AA Batteries

The processor can also run optimally on six AA batteries (rechargeable or alkaline).

Press the two tabs and remove the back cover of the P-Brick.³ Insert AA batteries with appropriate orientation.⁵ Re-attach back cover.

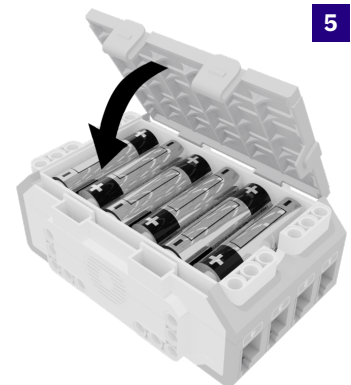
- **Never mix different types of batteries.**
- **Never mix old and new batteries.**
- **Never use damaged batteries.**
- **With rechargeable batteries, recharge all six AA batteries at once to full charge.**
- **Remove batteries from P-Brick when not in use.**

A full charge will last for multiple processing runs; the number of runs you can perform is dependent on battery capacity (rated in mAh), motor power usage (speed setting), and rotational load of the developing tanks.

The low battery warning activates long before the battery is completely dead. There is still enough charge left to complete any currently running process. The warning simply states it is not recommended to start a **new** process at the current battery level.

You may simply perform as many processing runs as possible until the low battery warning is displayed. Then turn off the P-Brick, remove all six AA batteries, and recharge or replace.

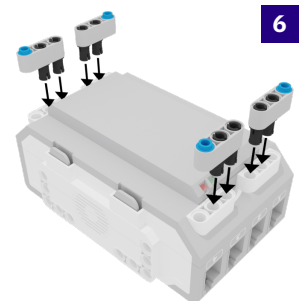
NOTE: We recommend using batteries with a rated capacity of 2000mAh or higher. Be sure to use batteries suited for high drain devices. It is optimal to use NiMh rechargeable batteries.



Feet

Attach feet to the bottom of the P-Brick. The feet create a stable platform while preventing scratching of the back cover or EV3 Rechargeable Battery.⁶

Never use the processor without installing feet on the P-Brick.



Cables

Cables are used to connect the P-Brick to the motors (which drive the rotation base). Plug ends of two cables into the motor unit. Plug the other ends into any of the output ports (A, B, C, D) on the P-Brick. Bend the cables as necessary for a comfortable fit.⁷



Mounting Tanks and Drums

The processor can rotate JOBO tanks and drums which are one of the 2500 series, 2800 series, or 3000 series (Expert).

Place the developing tank horizontally on the rotation base. The following general guidelines apply for **all** tanks and drums.

- **Always point the developing tank opening away from the motor unit.**
- **Make sure the developing tank sits perfectly flat on the rotation base.**
- **Make sure the developing tank sits in a stable manner and cannot easily fall off the rotation base.**

2500 and 2800 series

Connect the LL-225 extension when using any 2500 series tanks for films, or 2800 series drums **only** for prints up to 12x16".

Pull the two red pins up until they snap in place.⁸

Place the extension and rotation base on the same flat surface. Slide the extension straight into the rotation base and plug it in firmly. The extension will connect to the rotation base.⁹

Push the two red pins back down to lock the extension and prevent accidental disconnection from the rotation base.

Place the developing tank on the rotation base.¹⁰

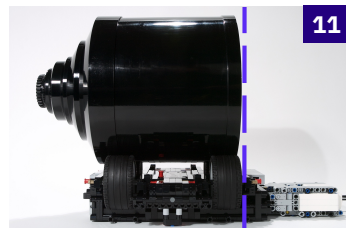
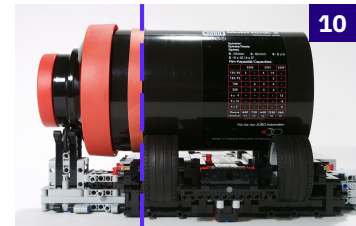
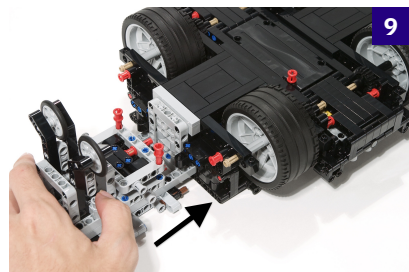
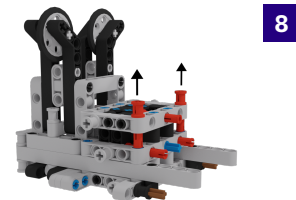
Note that one red rubber band has been wrapped around the developing tank. This rubber band lines up with the front tires and prevents the tank from moving backwards during rotation. The extension already prevents the tank from moving forward. No second rubber band is required.

3000 series (Expert)

The 3006 drum for up to 6× 4x5"-5x7" and 3010 drum for up to 10× 4x5" do not require the use of any extensions or rubber bands. Simply place the drum on the rotation base as pictured; make sure to line up the rear edge of the drum with the rear edge of the rotation base's rear tire. These particular drums do not move back and forth provided the rotation base is perfectly leveled (as it should be).¹¹

The 3005 drum for up to 5× 5x7"-8x10" and 3062 drum for prints up to 11x14" require the use of two rubber bands to prevent the tank from moving back and forth. You may purchase larger rubber bands for the Expert drums from **mekiner.com**.

The 3063 drum for prints up to 20x24" requires the LL-2B plug-in extension and two rubber bands. At the time of writing, this extension is still undergoing testing and is not for sale yet. The extension will be sold separately and extra instructions will be supplied with the extension.



Storage Bottles & Containers

The processor comes with four chemical storage bottles (1000ml capacity each).¹²

These bottles are optimized for both storage and easy handling during processing. They are an essential part of making processing more convenient.

A wide mouth opening allows quick filling and emptying. Graduation markings on the side allow quick and easy measuring. The wall of the bottles transmit heat sufficiently. You may place the bottles in a tempered water bath to accurately control the temperature of your chemicals.

Use only one type of chemical per bottle to prevent cross contamination.

E.g. A bottle used for developers should be reserved only for developers. Do not put fixer in it.

Extra unused bottles can store rinse water. Rinse water is used for the washing stage of a process.

Also included are four $\frac{1}{2}$ gal. containers for storing rinse water.¹³

These water containers have graduations for easy measuring, are conveniently sized for easy handling, and their design maximizes space-saving. Four bottles fit in any 8x10" darkroom tray. That's 8 liters of water stored in a mere 8x10" footprint.

There are enough bottles and containers to store sufficient volumes of rinse water for most processes.

Additional Items

Though the processor comes with multiple extra items, it does not include everything you need to begin processing. You might require:

- JOBO Tanks or Drums. Film and prints must be loaded into JOBO tanks or drums before processing is possible. Not included.
- Changing Bag or Tent. Used for loading films into tanks without a darkroom. The inside of the changing bag or tent is total darkness.
- Darkroom Thermometer. Used to accurately measure and monitor the temperature of your chemicals.
- Graduates & Stirring Paddle. Used to accurately measure and mix chemicals.
- Additional Storage Bottles. You may need additional darkroom chemical storage bottles for storing more chemicals. Available to order from Mekiner.
- Additional Water Containers. You may need additional water containers to store more rinse water. Available to order from Mekiner.



- **Additional Rubber Bands.** You may additionally need rubber bands installed on different developing tanks to prevent unwanted movement. Durable rubber bands sized for different developing tanks are available to order from Meker.
- **Separate Plastic Container or Tray.** It is necessary to perform stabilizer and wetting agent steps in a separate container to prevent chemical contamination with JOBO tanks and reels. You should be able to fill the container with enough chemicals to physically cover your film.
- **Cleaning Cloth.** Used only for cleaning spills or other messes.
- **Drying Cloth.** Used only for drying tanks, drums, and processor components. A chamois cloth is recommended.

2

Programming

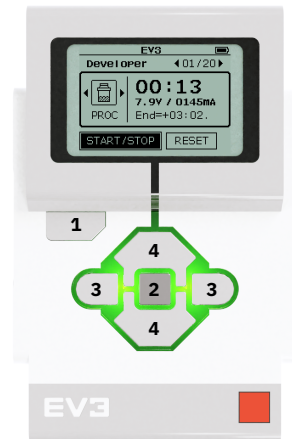
Setting up your processor physically is only the first step. This chapter will guide you through how to configure and program the LL Processor software to meet your processing demands.

Basics of the P-Brick

The P-Brick is what runs the processor software that allows you to monitor and control what the processor does. This section will go over some of the basic information about the built-in P-Brick software; if you want to know more refer to LEGO documentation.

Brick Buttons:

- 1 *Back*: Go back within menus & programs. Also used to abort programs and shut down the P-Brick.
- 2 *Center*: Behaves as an OK button. Also used to select items.
- 3 *Left & Right*: User interface navigation. Mainly used to change processor parameters.
- 4 *Up & Down*: User interface navigation. Mainly used to move up and down through menu entries.



Powering On:

To power on the P-Brick, press *Center*. The brick light turns red and a startup screen is displayed. When ready, the brick light turns green.



Powering Off:

To turn off the P-Brick, press *Back* one or more times until a shutdown dialog is displayed. Press *Right* and *Center* to select and begin shut down. Selecting or pressing *Back* again will simply exit the shutdown dialog; no shutdown occurs.



The Main Interface

Upon powering on the P-Brick, the main interface of the EV3 is displayed.

A notification bar at the top shows information such as battery level, Bluetooth, WiFi, USB connections, and brick name (set to EV3 by default).

There are four screens/tabs available in the main interface; you may navigate between these screens by pressing *Left* or *Right*.

Pressing *Up* or *Down* scrolls through items in each screen.

Pressing *Center* selects an item; for opening and running programs, selecting folders, etc.

Run Recent:

The Run Recent screen shows any EV3 programs which have been run recently. The LL Processor program will show on this screen after being run.



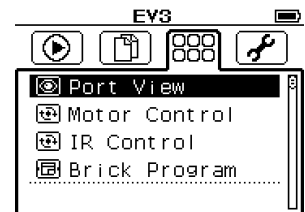
File Navigation:

The File Navigation screen acts as a file browser. You may open files and run programs through here. Used to access the pre-inserted SD Card and run the LL Processor program.



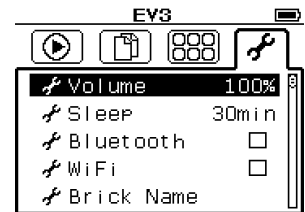
Brick Applications:

The Brick Application screen allows you to open a host of multiple built-in applications for viewing sensor readings on input ports, testing motor control, writing programs on the brick, data logging, and more.



Brick Settings:

The Brick Settings screen allows you to change multiple settings for sleep times, speaker volume, brick name, Bluetooth, WiFi, and more.



LL Processor Software

A high quality microSD card comes pre-inserted into the P-Brick; it contains the LL Processor program which controls the processor.

If you have already run the LL Processor program recently, then it will appear in the Run Recent screen. You can simply select the program to start.

If not, go to the File Navigation screen, select SD_Card, and open the Applications folder. Then select the LL Processor program to start.





NOTE: Normally the processor is given one test run before being shipped out; this means the LL Processor program should already be shown in the Run Recent screen.

Main Menu

Upon opening LL Processor, a menu with a list of options is displayed.

- * Press or hold *Up* or *Down* to scroll through menu options.
- * Press *Center* to select an option.

There are 4 options:

- 1  Exit: This exits the main menu and goes back to the P-Brick interface. Pressing the *Back* button is a shortcut for this option.
- 2  Process: This opens the process timer which manages and monitors a film/print process. See 'Process Timer' on page 23 for more information.
- 3  Setup: This opens the Setup menu for configuring the process timer and software.
- 4  Info: Shows current software version for LL Processor.











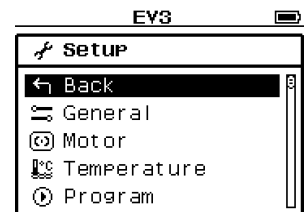
Software Configuration

Before performing any film/print process, you must configure the processor software and timer using the Setup menu.


You can create and manage profiles which describe any process using up to 20 steps each with different processing times, temperature compensation setup, and modes (different modes are used for monitoring the different types of steps regularly encountered in darkroom processing).

Profiles also include settings for development tank size, rotation speeds, brick light, display information, etc.

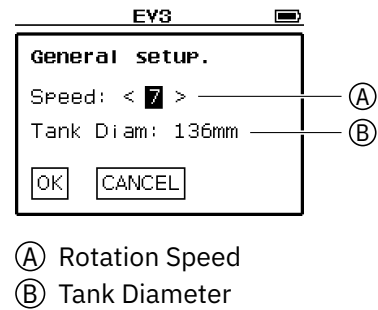
The Setup menu has entries  General,  Motor,  Temperature,  Program,  Profile,  Light,  Display, and  Reset.



General Configuration

The  General dialog allows you to set the rotation speed and input the diameter of your developing tank.

- * Press *Up* or *Down* to move around.
- * Press *Left* or *Right* to change the value of a setting/parameter.
- * Press *Center* to select OK or CANCEL. OK saves settings into P-Brick. CANCEL exits without saving.
- * Press *Back* to go back; same as selecting CANCEL.



- (A) Rotation Speed
- (B) Tank Diameter

Rotation Speed: Input a number from 1 to 7 indicating speed from slowest to fastest.

The default speed is the fastest (7).

If you want to convert this speed into RPM (revolutions per minute) for your specific developing tank, please use the speed calculator display; see 'Info Display' on page 20.

For information about recommended speeds for specific processes, see 'Specific Processes' on page 35.


Tank Diameter: Input the outer diameter of your developing tank in millimeters here. The system will use this value to perform calculations for controlling motor rotation, measuring developing tank rotation speed in RPM, and more.

The default tank diameter is 136mm.

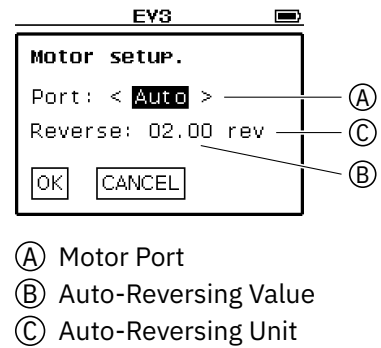
Here is a table of processor-compatible developing tank/drum series.

Tank/Drum Series	Used For	Outer Diameter
JOBO 2500 Series	Film	136mm
JOBO 2800 Series	Prints	136mm
JOBO Expert Drums	LF Sheet Film & Prints	210mm

Motor Configuration

The  Motor dialog allows you to set the motor port connections and auto-reversing interval.

- * Press *Up* or *Down* to move around.
- * Press *Left* or *Right* to change the value of a setting/parameter.
- * Press *Center* to select OK or CANCEL. OK saves settings into P-Brick. CANCEL exits without saving.
- * Press *Back* to go back; same as selecting CANCEL.



Motor Port: The motor is connected to one or more output ports (A, B, C, D) on the P-Brick using cables. You can tell the software to send power to motors connected to any combination of output ports.

The default port used is Auto; this tells the software to auto-detect which ports are connected to a motor via cable and use them.

Do not change this setting from the default unless you know what you are doing. It is recommended to use the default port auto-detection only. There should be no need to do otherwise.

Auto-Reversing: The processor comes with a smooth auto-reversing system that automatically reverses the direction of rotation of the developing tank in a smooth manner after a certain number of revolutions (of the developing tank).

By default, this is set to auto-reverse every 2.00 revolutions.

Do not change this setting from the default unless you know what you are doing. The auto-reversing of the tank rotation is what allows fully functional and even development of your films and prints. Inputting wrong values can cause processing defects.

You can turn auto-reversing on or off by selecting the Auto-Reversing Unit and pressing *Left* or *Right* to switch between the values *rev* or [*off*]. Switching auto-reversing off makes it easier for you to measure the RPM of the tank; with no reversing action, the speed of rotation is constant and easier to read. See 'Info Display' on page 20 for more information.


Temperature Compensation

The reaction rate of the developer changes based on temperature. Lower temperatures mean the developer reacts slower and more time is required for normal development. Higher temperatures mean the developer reacts faster and less time is required for normal development.

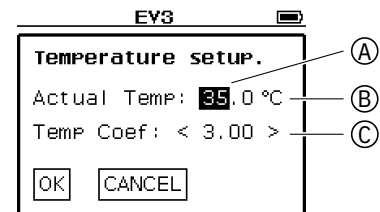
Taking temperature into account is essential for precise development. There are two approaches:

- ① **Temperature Control:** Partially submerge the developing tank in a tempered water bath to control the temperature. The water bath keeps the temperature of your chemicals exactly how you want it for consistent development regardless of the ambient room temperature.
- ② **Temperature Compensation:** Develop at the differing ambient room temperatures, but calculate how much time needs to be added or removed to ensure consistent development regardless.

The LL processor was designed using the temperature compensation approach.

The  Temperature dialog allows you to setup the temperature compensation system.

- * Press *Up* or *Down* to move around.
- * Press *Left* or *Right* to change the value of a setting/parameter.
- * Press *Center* to select OK or CANCEL buttons. OK saves settings into P-Brick. CANCEL exits without saving.
- * Press *Back* to go back; same as selecting CANCEL.





- Ⓐ Actual Temperature
- Ⓑ Temperature Mode
- Ⓒ Temperature Coefficient

Actual Temperature: Input the current temperature of your developer. The system will use this to calculate the appropriate temperature compensation for programmed process times.

E.g. If you are processing some films and your chemicals have a temperature of 18°C, input 18°C as the actual temperature.

The default actual temperature is 20°C (68°F).

See 'Programming Steps' on page 18 for more information on how temperature compensation is applied to times for specific processing steps.

The temperature compensation system is also capable of doing real-time compensation based on readings from a temperature sensor (optional, not included with processor). This allows the processor software to act as a temperature compensating timer for film and print development in trays. To use this feature, navigate the screen using *Up* or *Down*, highlight Ⓑ Temperature Mode, and press *Left* or *Right* to switch between °C and . The  icon indicates the software will use a sensor to read the temperature.

NOTE: You can only input the actual temperature in Celsius, not Fahrenheit.

Temperature Coefficient: You can input the temperature coefficient for your developer.

The temperature coefficient is a number which represents the rate of development with respect to temperature.

If your developer has a temperature coefficient of T, it means that the developing time must be multiplied by T for each 10°C (18°F) decrease in temperature or divided by T for each 10°C (18°F) increase in temperature, to achieve normal development.

The default temperature coefficient is 2.5. This value matches the Ilford time-temperature charts and is a proper approximate value for most standard developers that gives excellent results in the appropriate temperature range; keep reading.

Here is a table of the temperature coefficients for some developers:

Developer	Coefficient
Metol	1.3
Paraminophenol	1.5
Ferrous oxalate	1.7
Pyrogallol	1.9
Metol-Hydroquinone	1.9
Hydroquinone	2.5
Glycin	2.3

When the actual temperature coefficient isn't precisely known, use the default value of 2.5, input the standard developing time for 20°C (68°F), and choose a developer temperature in between 18°C (65°F) and 24°C (75°F) to keep the error within $\pm 10\%$. The closer the temperature is to 20°C (68°F), less compensation is applied to the standard developing time and any error is reduced.

NOTE: The chemistry manufacturer instructions override anything stated here; some manufacturers give data about processing times for different films at different temperatures. Follow them whenever you can. Test yourself to see what processing results you find satisfactory regardless of whatever is stated here.


NOTE: Keep the temperature of your developer constant when using temperature compensation for maximum consistency and accuracy. It is recommended to develop at ambient room temperature whenever possible.


CAUTION: Using final compensated development times that are less than 5 minutes may cause uneven development. Test run the process timer to make sure the final time is 5 minutes or over. See 'Process Timer' on page 23 and 'Specific Processes' on page 35 for more information.

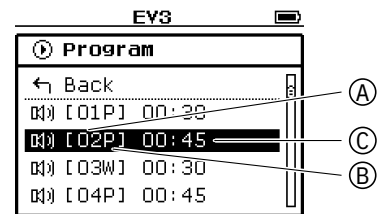
NOTE: Color processing is meant to be done at a standardized higher temperature (around 38°C (100°F)). Do **not** use temperature compensation for color. For information on color processing with the LL processor, see 'Specific Processes' on page 35.

Programming Steps

All darkroom processing can be broken down into multiple steps where films or prints are placed in different baths (e.g. water, developer, fixer) at a certain temperature for a certain amount of time with a certain type of agitation (e.g. rotating developing tank, occasionally inverting tank, rocking trays holding prints or films, washing with rotation or running water).

The  Program menu allows you to input the description of an entire process with up to 20 steps.

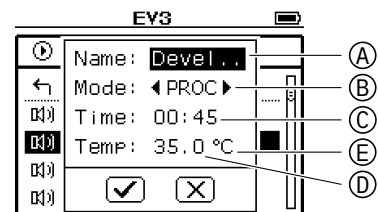
- * Press or hold *Up* or *Down* to scroll through the list of process steps.
- * Press *Center* to select/edit a process step.
- * Press *Back* to exit menu; same as selecting .



- (A) Step Number
- (B) Step Mode
- (C) Step Time

Upon selecting a process step, the step editor window is opened.

- * Press *Up* or *Down* to move around.
- * Press *Left* or *Right* to change the value of a setting/parameter.
- * Press *Center* to select or . Also used to select (A) Step Name for editing. saves any changes. exits step editor without saving.
- * Press *Back* to go back; same as selecting .



- (A) Step Name
- (B) Step Mode
- (C) Step Time
- (D) Step Temperature
- (E) Step Temperature Mode

Step Name: Each step in a process is assigned a name. This allows you to specify a brief description for each step, a necessity for when you re-read or edit process steps in the future. Specifying a name also allows you to easily identify what step you're on during processing; the name is displayed on the process timer screen.

A name can contain up to 13 characters. The default name used is Step (Number Here).

To edit the name, navigate the screen using *Up* or *Down*, highlight (A) Step Name, then press *Center*. An interactive keyboard will be displayed.

Step Mode: Each step has a mode. The process timer behaves differently for each mode; multiple modes allow the monitoring of the different type of steps which occur regularly in darkroom processing.

There are four modes:

- 1 **Process Mode:** [PROC] Rotation motors are activated. The developing tank is filled with chemistry (or water) and films or prints are agitated using rotation for the duration of the step. The timer alarm sounds 10 seconds before the specified step time. This gives you time to empty all chemistry from the developing tank by the specified step time; it takes roughly 10 seconds to pour all chemistry out of the tank.
- 2 **Wash Mode:** [WASH] Rotation motors are activated. A wash cycle consists of filling the developing tank with fresh rinse water, continuously rotating the tank, and emptying the tank of the now contaminated rinse water. Multiple consecutive wash cycles (30 seconds each) make up the duration of the step, and completely wash any films or prints. The timer alarm sounds at the end of each wash cycle (every 30 seconds).

- 3 **Timer Mode:** [TIME] Rotation motors are not activated. The timer simply runs and alarms at the specified step time. This mode is used for timing any steps which do not involve rotating the developing tank with the processor. E.g. Hand inverting the developing tank instead of using rotation. E.g. Washing films or prints under running water.
- 4 **Metronome Mode:** [METR] Same as TIME mode, plus an internal metronome which sounds a beep once every second. When working in the dark, it can be convenient to be able to measure a duration of time by listening to the metronome rather than looking at the display. This feature is useful for timing the dodging and burning of prints.

When **(B)** Step Mode is highlighted, press *Left* or *Right* to change.

Step Time: Each process step has different times. You can input any time up to nearly an hour (59:59).

The default step time is 00:00.

To adjust the step time, navigate the screen using *Up* or *Down*, highlight either the minute or second inputs, and press or hold *Left* or *Right*. Holding down *Left* or *Right* activates accelerated adjustment of time using increments of 5 instead of 1.

Inputting a time of 00:00 is the same as telling the software there is no time; the step will run indefinitely until manually stopped.

NOTE: The step time you input is the uncompensated time. Temperature compensation is applied to the inputted time; the actual time used is computed during processing.

Step Temperature: Inputting a step temperature tells the software that the specified step time is only valid at the specified step temperature, and temperature compensation will be automatically applied if necessary.

The default step temperature is 20°C (68°F).

To adjust the step temperature, navigate the screen using *Up* or *Down*, highlight the temperature numbers, and press or hold *Left* or *Right*.


E.g. Suppose you input a step time of 7:30 and step temperature of 20°C (68°F). During processing, the timer will count up to 7:30 when the actual temperature of your chemicals is 20°C (68°F). If the actual temperature is not 20°C (68°F), then temperature compensation will be activated. Lets say the actual temperature is 22°C (72°F); the time will be automatically decreased to 6:15 to compensate for the developer reacting quicker due to the increased temperature.

There are cases where you do **not** want any alteration of times for a specific step (no temperature compensation). E.g. Washing and presoaking times for black and white films are generally the same regardless of temperature; when you wash B/W films for 5 minutes, you simply wash for 5 minutes whether you process at 20°C (68°F), 22°C (72°F), or etc.

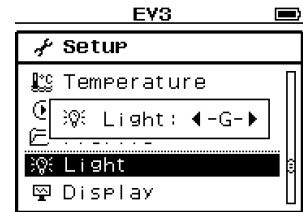
Navigate the screen using *Up* or *Down*, highlight **(E)** Step Temperature Mode, and press *Left* or *Right* to switch between °C and OFF. The OFF icon indicates no temperature compensation will be applied; the step time will be used directly.

NOTE: You can only input the step temperature in Celsius, not Fahrenheit.

Brick Light

The  Light dialog allows you turn the brick light (for buttons) on or off for dark-room use.


- * Press *Left* or *Right* to change brick light setting.
- * Press *Center* to save setting.
- * Press *Back* to exit dialog without saving.



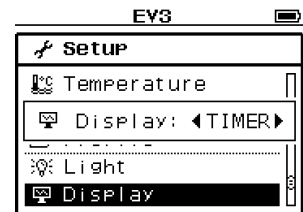
There are three different brick light settings: -G- (Green), -R- (Red), and OFF.

The default brick light setting is -G- (Green).

Info Display

The  Display dialog allows you to change what is displayed in the timer display during processing.

- * Press *Left* or *Right* to change timer display setting.
- * Press *Center* to save setting.
- * Press *Back* to exit dialog without saving.



There are two different timer display settings: TIMER (a countdown of how much time is left is displayed) and SPEED (the rotation speed in RPM of the developing tank is calculated and displayed in real-time).


The default timer display setting is TIMER (a countdown).


The SPEED setting is what allows you to measure the rotation speed. Fill the developing tank with water (the same volume of water you would use for processing), run the processing timer, and read Speed=XXrpm on the display. You can try pouring different amounts of water or placing different tanks with (or without) different reels to measure how the rotation speed varies with different loads. Try loading dummy film into the tank and using water if you want to perform a more realistic simulation (dry-run) of your processing without using any chemicals. Dry-runs with dummy film loaded give the most accurate simulation; some reels behave differently when there is no film loaded (e.g. the JOBO J2509N reel for 4x5 sheet film with 'black panels' doesn't rotate at a constant speed with no film loaded).

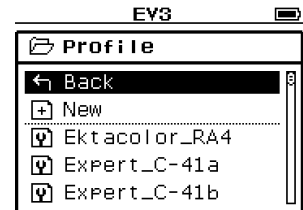
See 'Process Timer' on page 23 for more information.


Managing Profiles

All settings (stated in previous sections) are saved into the P-Brick. However, they can also be saved into profiles a.k.a configuration files on the pre-inserted microSD card. Once a profile is saved, it can be reloaded for future use or even edited as you make changes to your setup.

The  Profile browser allows you to manage profiles.


- * Press or hold *Up* or *Down* to scroll through the list of profiles.
- * Press *Center* to select an entry.
- * Press *Back* to exit the Profile browser; same as selecting  Back.

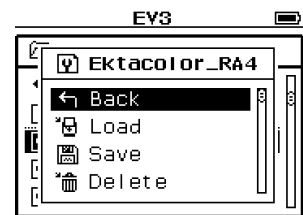


To create a new profile, select  New. An interactive keyboard will be displayed. Input the name of your new profile using the keyboard. A default name will have already been input; this default is an automatically generated indexed name guaranteed to be new and unique regardless of how you organize your profiles in the file system.




All profiles saved in the microSD card are displayed in the browser. No profiles are displayed if none exist.

Selecting a profile will open a file menu containing a list of file operations (like right-clicking a file on a computer).

- * Press or hold *Up* or *Down* to scroll through the menu.
- * Press *Center* to select an operation.
- * Press *Back* to exit the menu; same as selecting  Back.




There are currently four different file operations.

- 1  Load: Load the profile into the P-Brick. Once loaded, you can go to other menus under  Setup to view and edit. Or you can simply run the process timer ( Process) with the newly loaded settings.


Any changes made to loaded settings are remembered in the sense that you can reboot the P-Brick any number of times and the changes would remain intact. However, the changes are **not** saved back into the profile automatically. You must save any changes into the profile manually.

Loading a profile overwrites any settings currently loaded into the P-Brick. Save existing settings from the P-Brick into a profile as necessary.

Before any action is taken, a confirmation window is displayed asking if you wish to continue.


- 2  Save: Save settings from the P-Brick into the profile. The settings stored in the profile will be overwritten.

Before any action is taken, a confirmation window is displayed asking if you wish to continue.








- 3  Delete: Delete a profile permanently.

This action cannot be undone. Do not delete a profile unless you are certain it does not hold any valuable information.


Before any action is taken, a confirmation window is displayed asking if you wish to continue.

- 4  Rename: Rename a profile. An interactive keyboard will be displayed; you can edit the name.

Combine multiple operations to perform higher level effects.

Effect	Operations
Copy Profile	<ol style="list-style-type: none"> 1  Load: Load profile into P-Brick. 2  New: Create new profile copy with loaded settings.
Edit Profile	<ol style="list-style-type: none"> 1  Load: Load profile into P-Brick. 2  Setup: Edit any settings under setup menu. 3  Save: Save edited settings back into profile.
New Empty Profile	<ol style="list-style-type: none"> 1  Reset: Reset settings in P-Brick to empty defaults. 2  New: Create new empty profile.

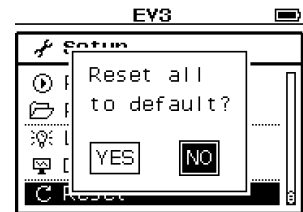
Reset Settings

The  Reset operation resets all settings to their default values; the settings currently loaded in the P-Brick are overwritten.

Use this operation when you want to wipe all settings to a blank state and input entirely new settings from scratch.

Before any action is taken, a confirmation window is displayed asking if you wish to continue.

NOTE: Resetting only wipes the settings currently loaded in the P-Brick; your profiles are left untouched.



3

Processing


You now know how to program the description of a process into the software. This chapter describes how to execute a program using the process timer and perform actual processing.

Process Timer


A process consists of multiple steps where we place films or prints in different chemical baths for different periods of time.


The process timer monitors and times each step of an entire process; you control the processing of your films or prints through the process timer. It keeps track of the elapsed times and sounds an alarm when action is required (e.g. pouring out chemicals, replacing water at the end of a wash cycle). It also manages the rotation motors (starting and stopping agitation accordingly).

The process timer is effectively a fully programmable general purpose darkroom timer which can be used both with the processor and without the processor (using the EV3 standalone).

To open the process timer, run the LL Processor app and select  Process.


- * Press *Up* or *Down* to move around.
- * Press *Left* or *Right* to change parameter (wrapped with ◀ and ▶).
- * Press *Center* to select START/STOP or RESET.
- * Press *Back* to go back to Main Menu.

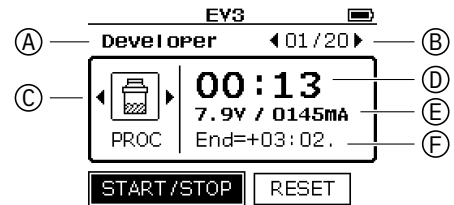
Step Navigator: The process timer has 20 steps (corresponding to programmed steps in the  Program menu). Each step has its own time (both elapsed time and programmed time with or without temperature compensation) and mode.







Navigate the screen using *Up* or *Down*, highlight  Step Navigator, and press *Left* or *Right* to move backwards or forwards through different steps. You may hold down the buttons to move between steps more rapidly.





Data for each step is saved as you perform a process. You can revisit previously completed steps.


All data for the current session is erased once you exit the process timer.

Step Name: The name of the current step is displayed at the top of the screen; you can easily identify what step you are on using this name. This name can be edited in the  Program menu; see 'Programming Steps' on page 18.






-  Step Name
-  Step Navigator
-  Step Mode
-  Step Elapsed Time
-  Electrical Information
-  Message Line

Step Mode: A step has four different modes:  PROC,  WASH,  TIME, and  METR.

The default mode used for a step is programmed in the  Program menu.

For more information about programming and the behavior of different step modes, read 'Programming Steps' on page 18.

Navigate the screen using *Up* or *Down*, highlight  Step Mode, and press *Left* or *Right* to change the step mode. This does not change the step mode in the  Program menu; it simply changes the step mode used for the current session. Upon exiting the process timer, the current session is closed and all step modes are reset to their default programmed values.

You should not need to change  Step Mode while running a process. Unless absolutely necessary, simply program the default step mode and stick with it.

Step Elapsed Time: The amount of time for which a step has been run (elapsed time) is displayed in large font. This time counts up from 00:00 as the timer runs. Upon exiting the process timer, the current session is closed and elapsed times for all steps are reset to 00:00.


Electrical Information: The display also shows the voltage and electrical current consumption of the battery (updated in real time).

You may use this information to check motor load (how hard the motor is working) and battery level.

The higher the rotational load, the higher the electrical current drawn by the motors.

The lower the voltage is, the lower the battery level is.

Message Line: Instructions and information for the user are specified within a single line of text. This includes:



- Signal water changes (when to refill the tank with fresh water) at the end of each wash cycle.
- Display countdown for remaining time before the end of a step. Temperature compensation is already applied. The countdown displays time left in "real world time".
- Display rotation speed of the developing tank in RPM. This is configured using the  Display menu. See 'Info Display' on page 20 for more information.

If a step has already been completed, the line 'Completed.' is displayed.

All instructions which require immediate intervention of the user are accompanied by an audible alarm.

Starting & Stopping Timer

Select START/STOP to start or stop the timer.

Upon starting the timer, the brick button light will start flashing. Rotation motors are activated when using PROC or WASH modes.  Message Line now displays either a timer countdown or rotation speed reading; behavior is set in  Display menu, see 'Info Display' on page 20 for more information.

Upon stopping the timer, the brick button light stops flashing. Rotation motors are deactivated. If the step has reached completion, the process timer automatically navigates to the next step. The timer does not start automatically for the next step. Select START/STOP again to continue with the next step.

In PROC mode, an alarm is sounded when there are only 10 seconds remaining. This indicates the step has reached completion. Stop the timer and pour chemicals out of the tank.

In WASH mode, an alarm is sounded at the end of each wash cycle (every 30 seconds). This indicates a water change is required. Stop the timer, pour out rinse water, refill tank with fresh rinse water, and start the timer again to continue with the next wash cycle.

NOTE: At the end of a wash cycle, the timer is reset to the start time of the next wash cycle. E.g. A water change is signaled at 1:00. Even if you stop the timer at 1:07, ⓐ Step Elapsed Time is reset to 1:00.

In TIME and METR modes, an alarm is sounded at the programmed time. This indicates the step has reached completion.

Resetting Timer

Select RESET to reset ⓐ Step Elapsed Time to 00:00. This allows you to restart a step if necessary.

General Operations for Processing

In general, processing consists of the following operations:

- ① Pour chemicals into developing tank (depending on step).
- ② Select START/STOP to begin processing for step.
- ③ Pour out chemicals when alarm is signaled. Pour back into bottles if you intend to reuse.
- ④ Repeat the procedure above for every step or wash cycle (there are multiple wash cycles in a single step) until processing is completed.

NOTE: If you are using a JOBO tank with a cog lid (no red cap), pour in chemicals while the tank is rotating. In this case, select START/STOP before pouring in the chemicals rather than after. See 'Processing Instructions' on page 26 for more information.

Processing Instructions

This section details the procedure for processing films or prints. It is assumed you have already setup your processor and programmed a process into the software.



Always follow 'Safety Instructions' on page 1 when attempting any procedures stated here.

Make sure batteries have enough charge for a processing run. A full charge can be used for multiple runs. For more information, see 'Rechargeable Battery' on page 5 and 'Low Battery' on page 32.

- (1) Mix chemicals before use. Place all chemicals to be used for processing in the supplied wide-mouth bottles. Wide-mouth bottles allow quick pouring from the bottle into the developing tank and from the developing tank back into the bottle (if you intend to save or re-use your chemicals) without the use of any funnels.

Place bottles in a heated water bath if you are processing at higher than room temperature. Make sure all chemicals are at operating temperature before beginning processing.

NOTE: For more information about bottles, see 'Storage Bottles & Containers' on page 8.

NOTE: For more information on what volumes of chemicals are required for a process, see 'Chemical Volumes' on page 31.

- (2) Load developing tank (or print drum) with films or prints in total darkness. Once the tank is loaded, you may expose the tank to daylight (the films or prints inside are protected from all light).

NOTE: Read JOBBO manuals for information on loading films or prints into different reels and tanks (or drums). At the time of writing, these manuals are available at <https://www.jobbo-usa.com/manuals>.

CAUTION: Make sure all tanks and reels are completely dry before loading films or prints. Even the smallest droplets of water that come into contact with films or prints will affect development in the area of contact. This results in an unevenly developed image; parts of the image are less developed than others.

- (3) Fill the supplied water containers with enough rinse water for multiple cycles of film washing. You may use any unused bottles or extra containers for rinse water storage as well. Use room temperature water for black and white processes.


NOTE: For information on required volumes for rinse water see (6.2).

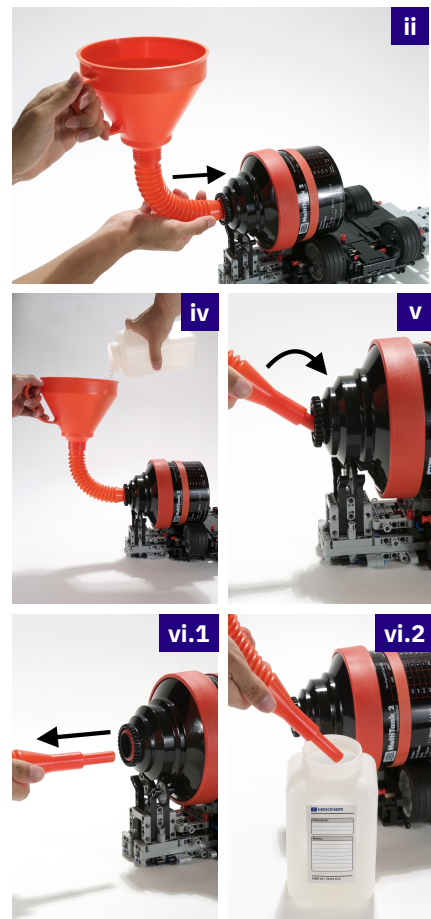
NOTE: For color processes, use water around 4°C (8°F) over process temperature (generally 38°C (100°F)). Place water containers in a tray filled with warm water (as pictured on right). In spite of the cooling that occurs before use, the temperature remains within tolerance for proper washing.

NOTE: Any 8x10" darkroom tray can hold up to 4 × $\frac{1}{2}$ gal. water containers for storing up to 8 liters of water.



NOTE: Storing rinse water in separate bottles and containers allows convenient access and relatively more consistent water temperatures. Repeatedly fetching water from the sink (or another water source) is avoided; this minimizes the possibility of wet hands, accidental splashes, and spills (a preventative measure).

- (4) Power on the EV3 P-Brick. Open the LL Processor app and select  Process. The process timer should be displayed.
- (5) Begin actual processing.
 - (5.1) Before beginning each chemical step, make sure START/STOP is already highlighted so you can simply press *Center* to start or stop the process timer.
 - (5.2) Pour chemicals into developing tank and start rotation as soon as possible.
 - (5.2.a) If your JOBO tank has a cog lid, chemicals should be poured in while the tank is rotating. The processor comes with a funnel with a flexible hose and grab handle.
 - i. Place the developing tank on the rotation base; read guidelines in 'Mounting Tanks and Drums' on page 7. Place your bottle in front of the rotation base. You will need immediate access to it for quick pouring.
 - ii. Hold the funnel (using the grab handle) and hose in a bent position using two hands and push the tip of the hose into the center of the developing tank opening. The hose should go all the way in without any force. The hose is secured upon complete insertion. You may now take your hand off the hose and hold the grab handle with one hand only.
 - iii. Press *Center* (select START/STOP) to begin processing (rotation is activated).
 - iv. Pour chemicals into the funnel (to the developing tank) at a **steady rate**.
 - v. After pouring is complete, some chemicals may remain in the funnel hose. Tilt the hose and pour the remaining chemicals into the tank.
 - vi. **1** Untilt the funnel hose and pull it straight out of the developing tank (along with the funnel). **2** Shake the hose lightly to expel any small chemical droplets into the bottle **or** sink.
 - vii. Place the funnel and bottle on the counter top; make sure they are easily accessible; you will need them later.



Practice this procedure with water first. Make sure you are confident in your ability to pour without any spilling or overflowing before attempting with chemicals.

You should be able to finish pouring chemicals into the tank at or before 10 to 15 seconds.

NOTE: The timer is running. You must start pouring **immediately** after starting rotation, no delays.

CAUTION: Pouring too quickly or at a non-constant speed **will** cause chemicals to overflow the JOBO lid.

NOTE: JOBO Expert drums do not have a hole for the funnel hose to go through on the inside of the tank lid. Because of this, the funnel hose cannot be inserted completely. You only need to gently insert the hose as pictured.



- (5.2.b) If your JOBO tank has an inversion style lid (with red cap), chemicals should be poured in before starting rotation.

Pour chemicals into the tank, place the red cap on the tank lid, invert the tank 2 or 3 times, place the tank on the rotation base, and press *Center* (select START/STOP).

NOTE: The moment you finish pouring your chemicals into the tank, processing is started. Get the tank onto the rotation base and start the motors as quickly as possible.

NOTE: The older JOBO 2800 series print drums come with a beaker lid. Chemicals are poured through the tank opening into a "beaker". The chemicals do not come into contact with prints inside until the drum is positioned sideways (chemicals will empty from the beaker lid into the tank). Do **not** invert the tank; simply place the red cap on the tank lid, place the print drum sideways on the rotation base and quickly press *Center* (select START/STOP) to start rotation as soon as possible.



- (5.3) The developing tank is rotating. An audible alarm is signaled 10 seconds before the end of a step. Press *Center* (select START/STOP) to stop the rotation motors. Quickly pick up the developing tank and pour chemicals back into the corresponding bottle. You may dump chemicals into the sink instead (if it is safe to do so).

If your JOBO tank has an inversion style lid (with red cap), pick up the developing tank, remove the red cap, then pour chemicals out.

You should be able to perform instructions for this step in one or two swift motions. Practice this.



- (5.4) Repeat the previous instructions for all chemical steps until complete.

- (6) At the end of a process, films or prints must be washed properly to remove any residual chemicals that **will** cause long term image degradation. Some processes have additional washes in between different chemical baths (e.g. E-6 chrome film development).

Washing is a programmed step of the process timer (using WASH mode). See 'Programming Steps' on page 18 and 'Starting & Stopping Timer' on page 24 for more information.

Washing is done in the same manner as any chemical step, the only difference being we use fresh rinse water which is replaced over multiple wash cycles (30 seconds each).

NOTE: The final wash (after films or prints have been fixed, not including washes in between chemical steps) may be done in a dedicated external film or print washer. Unload films or prints from tank and place in the external washer. You may set the process step mode to TIME and time the washing (outside processor) using the processor software.

- (6.1) Before beginning each wash cycle, make sure START/STOP is already highlighted so you can simply press *Center* to start or stop the process timer.
- (6.2) Pour fresh rinse water into the developing tank and start rotation as soon as possible. Use pour-in procedure from (5.2), but with the following difference:

Always start rotation **after** pouring in rinse water, not before. This applies even for tanks with a JOBO cog lid. This ensures proper washing; all films or prints are guaranteed to be rotated in rinse water for a full 30 seconds regardless of the time used for pouring via funnel.

Use the same or slightly higher volumes of rinse water than volumes used for all other chemicals. As a rule of thumb:

$$\text{Rinse Water Volume} = \begin{cases} 300\text{ml} & \text{if Chemical Volume} < 200\text{ml} \\ 1\frac{1}{4} \times \text{Chemical Volume} & \text{otherwise} \end{cases}$$

Do not use more rinse water than the maximum volume for your developing tank. If the calculated rinse water volume is higher than the maximum volume, use the maximum volume only. There is still a sufficient amount of rinse water for thorough washing. Maximum volumes are listed in 'Chemical Volumes' on page 31.

E.g. If you use 300ml of chemicals, use $1\frac{1}{4} \times 300\text{ml} = 375\text{ml}$ of rinse water for each wash cycle. A 5:00 wash consists of $10 \times 00:30$ wash cycles. The total volume of rinse water required is $10 \times 375\text{ml} = 3.75\text{L}$. For the sake of easy measuring, you may round up and use 400ml of rinse water per cycle instead. A 5:00 wash with 10 cycles then requires a total volume of $10 \times 400\text{ml} = 4\text{L}$ of rinse water.

- (6.3) An audible alarm is signaled every 30 seconds (at the end of each wash cycle). The message 'Change water.' is displayed indicating rinse water needs to be replaced. Press *Center* (select START/STOP) to stop the rotation motors. Quickly pick up the developing tank and pour out water into the sink (not bottles). Use pour-out procedure from (5.3).

NOTE: Washing for longer times does no harm. If unsure about timing for washes, go for a longer time: the safest choice. Use this advice with moderation; soaking your films or prints in any liquid for excessive amounts of time will cause damage.

- (6.4) Repeat the previous instructions for all remaining wash cycles until complete.

- (7) After many different film processes (not prints), films are soaked in wetting agent or stabilizer (for some color processes, depends on chemistry manufacturer).

Unload films from tank (and reels) and place into a separate tray. Agitate in the beginning and let films sit for a certain amount of time (depends on chemistry manufacturer instructions). Remove films then hang to dry.

NOTE: JOBO does not recommend using wetting agent or stabilizer with their developing tanks or reels; it sticks to the plastic and may cause processing issues over time.

NOTE: Even if you do not use gloves when processing (simply holding the bottles and developing tanks with your hands without any skin contact with chemicals), it is a must to wear gloves during the wetting agent and stabilizer steps. You have to manually agitate all films in a tray; when doing this gloves are the only way to avoid skin-chemical contact.



CAUTION: Do not let hands with gloves soaked in water, wetting agent, or stabilizer go near the EV3 P-Brick! Turn off the EV3 P-Brick before doing this step (before unloading films from the tank or pouring wetting agent in trays). This action alone rids you of any reason to touch the EV3, and is a very important preventative measure for ensuring no accidental splashing of liquids on the EV3! Use a separate timer if needed.

- (8) Clean up. Thoroughly rinse funnel in running water if used in process. Shake off excess water then leave to dry.

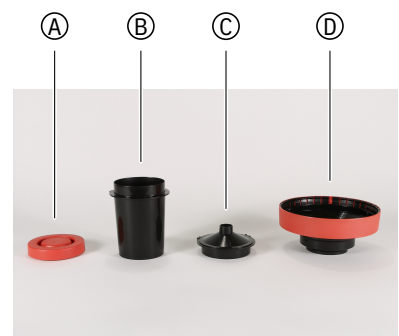
Thoroughly rinse developing tanks and reels in running water. Shake off excess water then leave to dry. If you intend to perform another process, make sure all tanks and reels are completely dry; you may use a towel reserved for this purpose **only**. Gently wipe the inside and outside of the tank. Do not contaminate the towel with any chemicals or dirt.

A chamois cloth works great for drying. It is highly recommended.

With the exception of 3000 series drums (Expert), it is possible to disassemble the tank lid into several components (pictured on right). Remove the red cap if used. Remove the light trap funnel (for 2500 series) or beaker (for 2800 series) by turning counter-clockwise. Rinse and dry each component individually before reassembly.

Always clean up after a process. This is part of proper care and maintenance.

Read more at 'Proper Care & Maintenance' on page 45.



- (A) Red Cap
- (B) Light Trap Beaker
- (C) Light Trap Funnel
- (D) Tank Lid

Chemical Volumes

For each step in a process, films or prints are rotated with chemicals in the developing tank.

All JOBO tanks come with a label specifying the minimum volumes of chemicals required to physically cover a certain number of films or prints. Do not use less than the minimums; this causes defective processing.

The minimum volumes are just that: "minimums". Using more chemicals is perfectly fine and does not cause over-development. More volumes may be required for certain developers (and dilutions) to ensure no over-exhaustion of chemicals when processing a certain number of films or prints.

Minimum volumes assume the processor and developing tank are perfectly leveled (as they should be).

NOTE: More information about minimum volumes (capacities) for different tanks and drums are also available in the JOBO manuals. At the time of writing, these manuals are available at <https://www.jobo-usa.com/manuals>.

Below is a table of the maximum volumes you may place in different developing tanks or print drums. These volumes take into account how much chemicals can be filled in the tank without any leaking (when tanks are loaded with the maximum number of reels (if applicable) and positioned sideways on the rotation base), in addition to the load and forces placed on the rotation base and motors.

NOTE: These maximum volumes work well within the mechanical limits of the processor for reliable operation. You may use as much chemicals as needed provided you do not exceed the maximum volumes.

Tank/Drum	Used For	Maximum Volume
JOBO 2521 or 2523	Film: 2× 35mm, 2× 120, 1× 220, 6× 4x5"	500ml
JOBO 2551 or 2553	Film: 5× 35mm, 6× 120, 3× 220, 12× 4x5"	1100ml
JOBO 2563	Film: 6× 35mm, 6× 120, 3× 220, 12× 4x5"	1250ml
JOBO 2583 (2523 + 2650)	Film: 8× 35mm, 10× 120, 5× 220, 18× 4x5"	1250ml
JOBO 2820	Prints: 4x5"	450ml
JOBO 2830	Prints: Up to 9.5x12"	1200ml
JOBO 2840 (2820 + 2870)	Prints: Up to 12x16"	1250ml
JOBO 2850 (2830 + 2870)	Prints: Up to 16x20"	1250ml
JOBO Expert 3006	Film or Prints: 6× 4x5" to 5x7"	600ml
JOBO Expert 3010	Film or Prints: 10× 4x5"	600ml
JOBO Expert 3005	Film or Prints: 5× 5x7" to 8x10"	900ml
JOBO 3062	Prints: Up to 11x14"	1250ml
JOBO 3063	Prints: Up to 20x24"	1250ml

System Warnings

Every time the process timer (⌘ Process) is opened, a system check is performed. Different warnings are triggered when there is a problem; this may be an incorrect motor connection, low battery level, etc.

A popup is displayed describing the warning. Press *Back* or *Center* to exit.

Identify and correct the underlying problem before continuing. If you choose to continue anyways, proceed at your own risk.

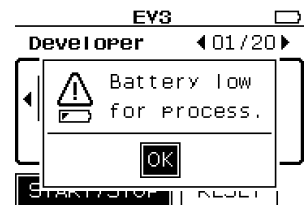
Low Battery

The Low Battery warning is triggered when the battery level is too low to perform a complete process. The battery isn't almost dead. There is still enough charge left to complete any currently running process. The warning is simply saying it is not recommended to start a new process at the current battery level.

This warning only activates when the timer isn't running to ensure no interruptions occur mid-processing.

What to Do: Fully recharge or replace batteries before beginning another process.

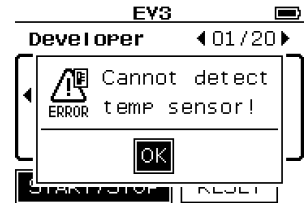
NOTE: For more information about batteries, see 'Rechargeable Battery' on page 5 and 'AA Batteries' on page 6.



Cannot Detect Temperature Sensor

The Cannot Detect Temperature Sensor warning is triggered when the software cannot detect an external temperature sensor for real-time temperature compensation (configured in ⌘ Temperature setup; see 'Temperature Compensation' on page 16 for more information).

What to Do: Connect temperature sensor to any of the input ports (1, 2, 3, 4) on the EV3 P-Brick.



Cannot Detect Motors

The Cannot Detect Motors warning is triggered when the software cannot detect any motors connected to specified output ports on the EV3 P-Brick (configured in ⌘ Motor setup; see 'Motor Configuration' on page 15 for more information).

This warning never activates when using Auto motor port detection.

What to Do: Connect motors via cables to output ports specified in ⌘ Motor setup.



Time Limit

The Time Limit warning is triggered when the processor has been left running for extended periods of time (the timer reaches 1 hour and 40 minutes). The motors are stopped immediately.

What to Do: Reset the timer if you wish to restart the current step, simply continue to the next step, or stop the process entirely.



4

Specific Processes


This chapter details recommendations for rotary processing with different types of film and print processes.

Do not expect to get good results with rotary processing by following instructions for other forms of agitation such as trays, dip n' dunk, and inversion. Different agitation methods may require different development times. It is important to establish development times and procedures for rotary processing specifically.

Please start with the following recommendations and fine tune as necessary to achieve the processing results you desire. Read the chemistry manufacturer instructions for rotary processing if available.



Black and White Film


Here is a general outline of the black and white process. It is assumed all chemicals and water are at room temperature and you have already set up the temperature compensation system (with  Temperature dialog).

Most black and white films are processed at temperatures between 18°C (65°F) to 24°C (75°F). Process your films within the temperature range specified for your specific film-developer combination.

Rotation Speed: 7 (for all JOBO tanks)

Name	Type	Time	Temp	Notes
Programmed Steps				
(1) Pre-wet	PROC	5:00	OFF	Pour the same volume of water as used for the developer into the tank and start rotation. A pre-wet reduces developer action and allow the use of hand inversion development times with continuous agitation. Another alternative is to reduce the development time and remove the pre-wet step altogether.
(2) Developer	PROC	X:XX	20°C	Input development time used for hand inversion at 20°C (68°F). Temperature compensation is enabled.
(3) Stop Bath	PROC	1:00	OFF	Pour in stop bath and start rotation. This stops development immediately and reduces carry over of developer into fixer.
(4) Rapid Fixer	PROC	5:00	OFF	Pour in rapid fixer and start rotation. You may need to use a longer fixing time with different fixer-film combinations. Fixer times do not change with temperature; temperature compensation is off.
(5) Final Wash	WASH	5:00	OFF	Pour in water and start rotation. Replace with fresh water every 30 seconds. This results in 10 water changes over 5 minutes. Feel free to use longer washing times if necessary.
Non-Programmed Steps				
(6) Wetting Agent	N/A	0:30	N/A	Do not use the processor to time this step. Use a separate timer instead. Unload films from tank and place in a separate container filled with wetting agent. Gently agitate films for first few seconds, then let films sit for the remainder of time.
(7) Dry	N/A	N/A	N/A	Hang films to dry in a clean dust-free environment.

Notes

Input all programmed steps into the  Program menu. Perform all non-programmed steps outside the processor. Follow procedures for pouring chemicals and other guidelines from 'Processing Instructions' on page 26.

Make sure you use an adequate volume of developer to prevent over-exhaustion and under-development. Remember that using higher volumes does not cause any over-development; you are simply using more chemicals and placing more load on the rotation motors.

When using developer dilutions, keep in mind the development time will be different for each dilution. When a developer is diluted more, more chemicals needs to be poured into the tank; this is because there aren't enough active developing agents to provide normal development.

A certain minimum volume of developer is required to develop a certain surface area of films. This minimum volume will differ for each individual developer from many different manufacturers.

When there is less film in the tank, less developing agent is required and you can use even lower volumes of chemicals. For more information about chemical volumes, see 'Chemical Volumes' on page 31.

If you do not wish to perform a pre-wet step, reduce hand inversion development times by around 15%.

This is just a starting point. Test to find what development times you find satisfactory. Make sure you also read about any rotary processing times for your film/developer/dilution combination from the manufacturer instructions.

The final wash removes fixer from films; any fixer left in films will affect image stability and permanence. The standard wash time (5:00) is sufficient for commercial standards. A wash time of 10:00 should be sufficient for archival standards.

You may use an external dedicated film washer instead. If using the JOBO 2500 series tanks, it is also possible to wash with running water using the JOBO Cascade Film Washer.

Though optional, you may use a hypo-clearing agent or wash aid after fixing to allow removal of fixer from films with shorter final wash times. Depending on the manufacturer, hypo-clear is used with or without separate rinse steps. Program all steps from manufacturer instructions into the processor.

Wetting agent helps the film dry without any water spots. Though optional, it is inexpensive and guarantees no spots especially in areas with hard tap water.

Color Negative Film

There are two different types of processes for color negatives: the 2-bath C-41 and 3-bath C-41 processes.

Here is a general outline of the 2-bath process. It is assumed that all chemicals are being maintained at working temperature (varies depending on chemistry manufacturer) using an external tempered water bath.

Rotation Speed: 7 (for all JOBO tanks)

Name	Type	Time	Temp	Notes
(0) Pre-heat	N/A	5:00	N/A	Partially submerge the developing tank in water at the same or higher temperature (up to +5.5°C (10°F)) than developer for about 5 minutes. Do not let any water get inside the tank. Do not program this step into the processor.
Programmed Steps				
(1) Pre-wet	PROC	2:00	OFF	Pour the same volume of water as used for the developer into the tank and start rotation. Water should be at the exact same temperature as the developer.
(2) Developer	PROC	X:XX	OFF	Use time from manufacturer instructions (around 3:15). Temperature compensation is disabled for color processing.
(3) Bleach-Fix	PROC	X:XX	OFF	Use time from manufacturer instructions (around 4:00 or 6:30).
(4) Final Wash	WASH	X:XX	OFF	Use time from manufacturer instructions (around 3:00). Pour in water and start rotation. Replace with fresh water every 30 seconds.
Non-Programmed Steps				
(5) Stabilizer	N/A	X:XX	N/A	Do not use the processor to time this step. Use a separate timer instead. Use time from manufacturer instructions. This is generally around 1:00. Unload films from tank and place in a separate container filled with stabilizer. Gently agitate films for first few seconds, then let films sit for the remainder of time.
(6) Dry	N/A	N/A	N/A	Hang films to dry in a clean dust-free environment.

Here is a general outline of the 3-bath process. Temperatures and rotation speeds are the same as with the 2-bath process.

Name	Type	Time	Temp	Notes
(0) Pre-heat	N/A	5:00	N/A	Same as pre-heat from 2-bath process.
Programmed Steps				
(1) Pre-wet	PROC	2:00	OFF	Same as pre-wet from 2-bath process.
(2) Developer	PROC	X:XX	OFF	Same as developer from 2-bath process.
(3) Bleach	PROC	X:XX	OFF	Use time from manufacturer instructions (around 6:30).
(4) Wash #1	WASH	X:XX	OFF	Use time from manufacturer instructions (around 3:00). Pour in water and start rotation. Replace with fresh water every 30 seconds.

Name	Type	Time	Temp	Notes
Programmed Steps (Continued)				
(5) Fixer	PROC	X:XX	OFF	Use time from manufacturer instructions (around 6:30).
(6) Final Wash	WASH	X:XX	OFF	Same as final wash from 2-bath process.
Non-Programmed Steps				
(7) Final Rinse	N/A	X:XX	N/A	Similar (but not the same) to stabilizer from 2-bath process.
(8) Dry	N/A	N/A	N/A	Hang films to dry in a clean dust-free environment.

Notes

Input all programmed steps into the \odot Program menu. Perform all non-programmed steps outside the processor. Follow procedures for pouring chemicals and other guidelines from 'Processing Instructions' on page 26.

The pre-heat and pre-wet heat the outside and inside of the tank respectively using tempered water. As a result, no significant cooling of the developer will occur immediately. The pre-wet water is colored when poured out due to the absorption of film anti-halation dyes. The short pre-wet time has almost no effect on film density.

The plastic tank serves as an insulator which reduces the amount of temperature drop during rotation without any temperature control. E.g. The temperature of chemicals in a JOBO tank which has been pre-heated and pre-wetted drops from 38°C (100.4°F) to 33.6°C (92.5°F) after around 6 minutes in a room with an ambient temperature of 20°C (68°F).

Use a working temperature 1°C (2°F) higher than stated in the chemistry manufacturer instructions. The higher temperature compensates for the temperature drop. E.g. Many C-41 kits use a standardized temperature of 38°C (100.4°F). In this case, use a working temperature of 38°C+1°C = 39°C (102.2°F).

This should be an excellent starting point to getting **printable normal density negatives** when processing in environments with room temperatures between 20°C (68°F) and 30°C (86°F).

General Advice for Color Processing

Establish your own working procedures and repeat them consistently to achieve quality color processing.

One-shot processing allows consistent quality and is highly recommended. Mix the minimum amount of chemicals needed, develop multiple films in one run, then dump chemicals. It is still economical to dump chemicals after only one use because rotary processing uses less chemicals than all other methods.

Use water with a consistent pH (like distilled water). Tap water from different areas will have a different pH.

Store chemicals in completely filled bottles. There should be no air in the bottle that will increase oxidization of color chemicals. An exception, bleaches should be stored in closed bottles with air inside; aeration is beneficial for bleaches. For increased storage life, you may refrigerate chemicals in temperatures at or above 5°C (40°F). Warm chemicals before use.

Color Slide Film

There are two different types of processes for color slides: the 3-bath E-6 and 6-bath E-6 processes.

Here is a general outline of the 3-bath process. It is assumed that all chemicals are being maintained at working temperature (varies depending on chemistry manufacturer) using an external tempered water bath.


Rotation Speed: 7 (for all JOBO tanks)

Name	Type	Time	Temp	Notes
(0) Pre-heat	N/A	5:00	N/A	Partially submerge the developing tank in water at the same or higher temperature (up to +5.5°C (10°F)) than developer for about 5 minutes. Do not let any water get inside the tank. Do not program this step into the processor.
Programmed Steps				
(1) Pre-wet	PROC	2:00	OFF	Pour the same volume of water as used for the developer into the tank and start rotation. Water should be at the exact same temperature as the developer.
(2) 1st Developer	PROC	X:XX	OFF	Use time from manufacturer instructions (around 6:15). Temperature compensation is disabled for color processing.
(3) Wash #1	WASH	X:XX	OFF	Use time from manufacturer instructions (around 2:30). Pour in water and start rotation. Replace with fresh water every 30 seconds.
(4) Color Developer	PROC	X:XX	OFF	Use time from manufacturer instructions (around 6:00).
(5) Wash #2	WASH	X:XX	OFF	Use time from manufacturer instructions (around 2:30). Pour in water and start rotation. Replace with fresh water every 30 seconds.
(6) Bleach-Fix	PROC	X:XX	OFF	Use time from manufacturer instructions (around 6:00).
(7) Final Wash	WASH	X:XX	OFF	Use time from manufacturer instructions (around 4:00). Pour in water and start rotation. Replace with fresh water every 30 seconds.
Non-Programmed Steps				
(8) Stabilizer	N/A	X:XX	N/A	Do not use the processor to time this step. Use a separate timer instead. Use time from manufacturer instructions. This is generally around 1:00. Unload films from tank and place in a separate container filled with stabilizer. Gently agitate films for first few seconds, then let films sit for the remainder of time.
(9) Dry	N/A	N/A	N/A	Hang films to dry in a clean dust-free environment.

Here is a general outline of the 6-bath process. Temperatures and rotation speeds are the same as with the 3-bath process.

Name	Type	Time	Temp	Notes
(0) Pre-heat	N/A	5:00	N/A	Same as pre-heat from 3-bath process.
Programmed Steps				
(1) Pre-wet	PROC	2:00	OFF	Same as pre-wet from 3-bath process.
(2) 1st Developer	PROC	X:XX	OFF	Same as first developer from 3-bath process.
(3) Wash #1	WASH	X:XX	OFF	Use time from manufacturer instructions (around 2:00). Pour in water and start rotation. Replace with fresh water every 30 seconds.
(4) Reversal Bath	PROC	X:XX	OFF	Use time from manufacturer instructions (around 2:00).
(5) Color Developer	PROC	X:XX	OFF	Use time from manufacturer instructions (around 4:00 or 6:00).
(6) Pre-Bleach	PROC	X:XX	OFF	Use time from manufacturer instructions (around 2:00).
(7) Bleach	PROC	X:XX	OFF	Use time from manufacturer instructions (around 6:00).
(8) Fixer	PROC	X:XX	OFF	Use time from manufacturer instructions (around 4:00).
(9) Final Wash	WASH	X:XX	OFF	Same as final wash from 3-bath process.
Non-Programmed Steps				
(10) Final Rinse	N/A	X:XX	N/A	Similar (but not the same) to stabilizer from 3-bath process.
(11) Dry	N/A	N/A	N/A	Hang films to dry in a clean dust-free environment.

Notes

Input all programmed steps into the  Program menu. Perform all non-programmed steps outside the processor. Follow procedures for pouring chemicals and other guidelines from 'Processing Instructions' on page 26.

Just like with color negatives, the pre-heat and pre-wet steps help minimize any drop in temperature.

Use a working temperature 1°C (2°F) higher than stated in the chemistry manufacturer instructions. The higher temperature compensates for the temperature drop which occurs when the tank is rotating without being submerged in tempered water. E.g. Many E-6 kits use a standardized temperature of 38°C (100.4°F). In this case, use a working temperature of 38°C+1°C = 39°C (102.2°F).

This should be an excellent starting point to getting **normal density slides** when processing in environments with room temperatures between 20°C (68°F) and 30°C (86°F).

One shot processing and mixing chemicals with distilled water are highly recommended for consistent results. Store all chemicals except bleach in filled bottles with no air to prevent oxidization. Read more in 'General Advice for Color Processing' on page 39.


Color Prints from Negatives

Here is a general outline of the RA-4 process for making Type C prints from color negatives. It is assumed all chemicals are being maintained at a working temperature of 35.3°C (95.5°F) using an external tempered water bath.

Rotation Speed: 7 (for all JOBO tanks)

Name	Type	Time	Temp	Notes
(0) Pre-heat	N/A	5:00	N/A	Partially submerge the developing tank in water at the same or higher temperature (up to +5.5°C (10°F)) than developer for about 5 minutes. Do not let any water get inside the tank. Do not program this step into the processor.
Programmed Steps				
(1) Pre-wet	PROC	0:30	OFF	Pour the same volume of water as used for the developer into the tank and start rotation. Water should be at the exact same temperature as the developer.
(2) Developer	PROC	X:XX	OFF	Use rotary times from manufacturer instructions (around 0:45 or 1:00). Temperature compensation is disabled for color processing.
(3) Stop Bath	PROC	0:30	OFF	Immediately halts development of print. Use any black and white stop bath. Stop bath is not included with RA-4 processing kits.
(4) Wash #1	PROC	0:30	OFF	Rinses the tank.
(5) Bleach-Fix	PROC	X:XX	OFF	Use rotary times from manufacturer instructions (around 0:45 or 1:00).
(6) Final Wash	WASH	X:XX	OFF	Use time from manufacturer instructions (around 1:30). Pour in water and start rotation. Replace with fresh water every 30 seconds.
Non-Programmed Steps				
(7) Dry	N/A	N/A	N/A	Hang films to dry in a clean dust-free environment.

Notes

Input all programmed steps into the  Program menu. Perform all non-programmed steps outside the processor. Follow procedures for pouring chemicals and other guidelines from 'Processing Instructions' on page 26.

The development time for prints is so short that the developer temperature hardly drops once the tank has been pre-heated and pre-wetted.

It is recommended to use a starting temperature of 35.3°C (95.5°F). The developer temperature will only drop to around 35°C (95°F) or 34.7°C (94.5°F) inside the tank; this assumes a room temperature between 20°C (68°F) and 30°C (86°F).

The developer temperature is kept within $\pm 0.3^\circ\text{C}$ (0.5°F) of the process standard (35°C (95°F)). Basically, it is possible to follow the tolerances of the standard RA-4 process perfectly.

Use a minimum of 61ml of chemicals for an 8x10" print area. E.g. A 16x20" print which has 4 times the area of an 8x10" requires a minimum of $4 \times 61 = 244$ ml of chemicals.

Although one shot processing gives maximum quality results, it should be noted that RA-4 chemicals are quite strong and can be used several times before any noticeable decrease in quality. See manufacturer instructions for details about capacity.

Store all chemicals except bleach-fix in filled bottles with no air to prevent oxidization. Read more in 'General Advice for Color Processing' on page 39.

5

Proper Care & Maintenance

This chapter quickly covers proper care and maintenance for your processor. Quickly read through and follow all guidelines here to ensure a longer working life span for all equipment.

Cleaning

It is important to regularly clean all equipment. Please do not over-clean equipment; clean only when necessary.

- Clean items with a slightly dampened cloth. It is easy to scratch the plastic, so be gentle. Do not use abrasive materials.
- After a process, dry any wet components. Disconnect extensions and shake off excess water, then dry gently with a cloth. Gently swipe off any water droplets on the rotation base.
- Dry developing tanks and drums using instructions on page 30.

Storage

It is important to store all equipment in a safe environment to ensure no damage or deterioration over the years.

- Store processor, tanks, and drums in a clean and dust-free environment. Over the years, dust can enter even the finest crevices and cause problems. This advice applies for any equipment.
- Do not store items (especially batteries and electronics) at higher temperatures. Store items at room temperature.
- Do not store tanks or drums with lids locked on according to JOBO's recommendation.
- Do not store items when wet. Dry items before storage.
- You may use the original boxes for long term storage. They are very durable and designed to protect processor components.

Transport

The LL-2 processor is one of the most portable processors ever made. It can be easily transported using the original boxes.

The original boxes are meant to be reused for transport purposes. **Do not throw them away.**

- Before packing, disconnect all extensions, motor units, and cables. This should take only a minute.
- Place items in original boxes; the original foam inserts provide maximum protection during transport.

Maintenance

The LL-2 processor requires almost no maintenance provided you follow the previously stated proper care guidelines. Plastic gears and axles will wear out after years of use; these parts can be replaced.

Repair

Eventually, you may need to send your processor back to Mekiner for repair. We will check and replace all worn components for a fee; you will have to pay for the cost of parts.

CAUTION: Do not try to open up any part of the processor yourself. You can easily damage internal components.

CAUTION: Do not try replacing parts yourself. Replacing parts incorrectly may cause uneven wearing or damage of components over time.

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