Technical Reference Guide

imagePROGRAF

PRO-4000
PRO-2000

Canon

Revision 0

May 1, 2016

Application

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Caution

Use of this manual should be strictly supervised to avoid disclosure of confidential information.

Recommended System

Browser: Adobe Acrobat Reader 7.0 or later

(To see the movie or animation, Adobe Flash Player is required.)

Service document data capacity: 10 MB

Operation confirmed OS: Windows 7

Revision History

Revision	Date	Revised items
00	May 2016	New edition

Applicable Products

PRO-2000	Q51-2607-000
PRO-4000	Q51-2617-000

CONTENTS

CHAPTER 1

MECHANISM

1-1. Main Unit Configuration

1-1-1. Main Unit Configuration

Paper feed mechanism

It is the mechanism of loading, feeding and ejecting the roll paper or cut sheet (manual feed).

The feature of this printer is as follows.

· Paper feed:

The paper is fed from the roll unit (the upper roll unit and the lower roll unit*) in feeding.

To feed the paper is switched automatically by utilizing the PAPER ENTRY SENSOR in the PAPER FEED ROLLER part, the ROLL PAPER ENTRY SENSOR in the upper/lower roll unit, and the active roll brake unit.

In addition, to improve accuracy in feeding the roll paper, the torque in the ACTIVE ROLL BRAKE UNIT is controlled.

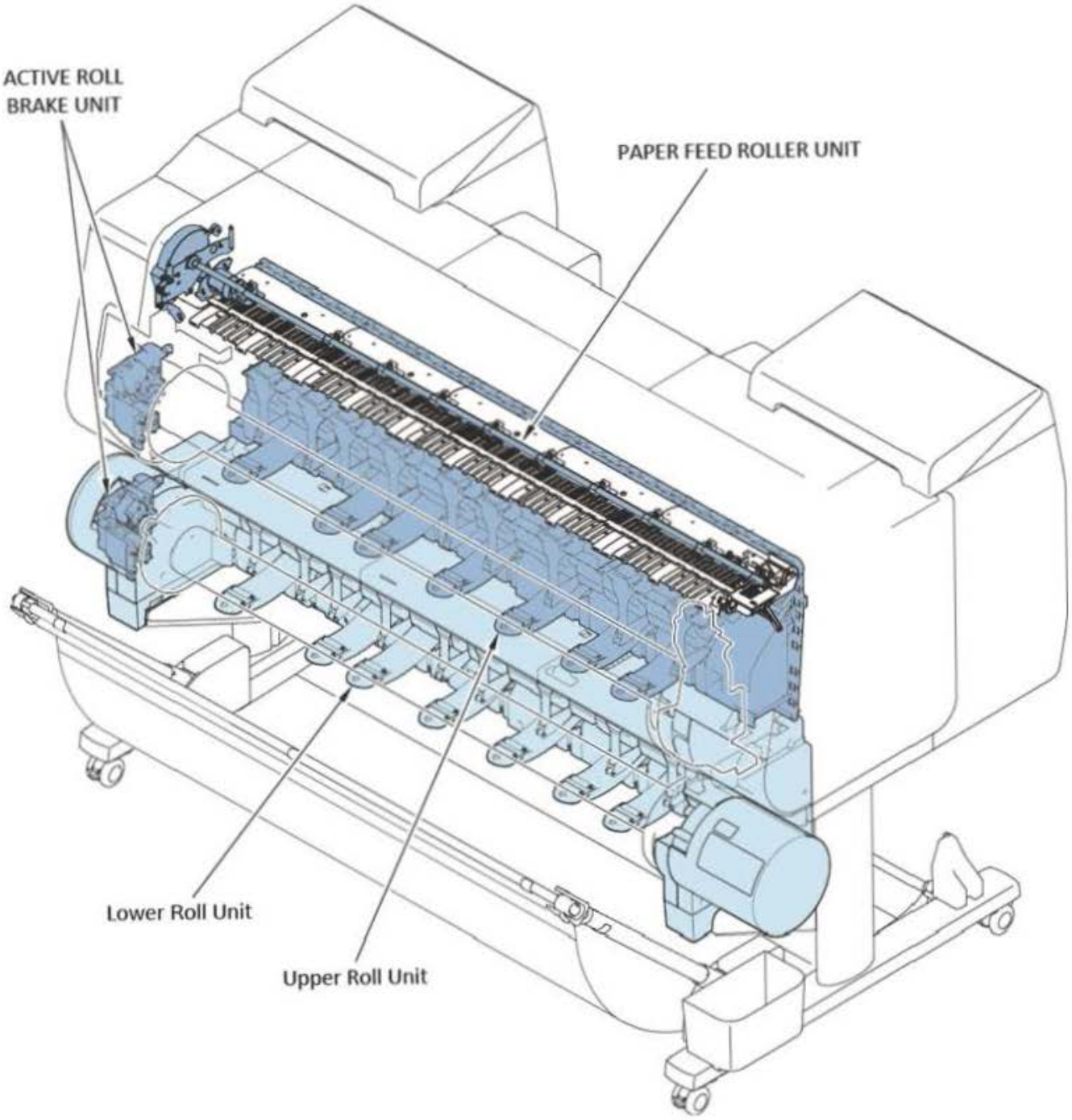
*: The lower roll unit is the option.

· Paper ejection:

In addition to ejecting paper to the output stacker, take-up paper ejection to the lower roll unit is newly adopted. In the take-up paper ejection, the outward and inward take-up paper ejections are available.

By utilizing the active roll unit, the weight is no longer needed.

Point	**▪ Active roll brake unit** Function of the active roll brake unit is as follows. **- To improve roll paper feed accuracy:** Torque change caused by such as the roll paper diameter, the weight, and the slack (caused by the back tension change) is controlled, and accuracy in feeding the paper is improved in printing. **- To feed roll paper:** When the roll paper is installed, feeding the roll paper and switching the upper and lower roll paper is automatically performed. **- To take-up roll paper:** By monitoring the torque change and rolling up the paper in an appropriate timing, the weight is no longer needed.


ACTIVE ROLL
BRAKE UNIT
PAPER FEED ROLLER UNIT
Lower Roll Unit
Upper Roll Unit

Ink Supply Mechanism

Ink inside the ink tank is supplied to the print head through the ink supply tube.

Ink is supplied to the print head by utilizing the water-head-difference, or by the negative pressure generated from the pump roller drive. When ink amount inside the ink tank is sufficient, you can replace the old ink tank with new one without interrupting the printing. In the current models, the initial ink filling check is executed only for the no-ejection detection units after ink is filled; however, in this printer, two kinds of the remaining ink detection pins (detecting ink-full and no-ink in the sub ink tank) are adopted to this printer. Therefore a mechanism problem at the initial ink filing can be detected in early stage without wasting ink.

Purge Unit

To maintain the high quality print, maintenance of the print head (cleaning, capping, wiping) is performed. The purge motor (to drive the purge main cam and pump roller) and wiper blade motor (to drive the wiper blade) are installed.

Carriage Unit

It fixes the print head and ink supply tube, and moves left to right.

To reduce uneven printing, an acceleration sensor is newly adopted to this printer.

In addition, the vibration information from the acceleration sensor is utilized to strengthen the function which identifies each error (the paper jam error, the overload error and the encoder error).

Print Head Management Sensor Unit

The nozzle check to detect the non-ejection nozzle in the print head is adopted.

The information of the detected non-ejection nozzle is utilized for non-ejection complementary and for recovery.

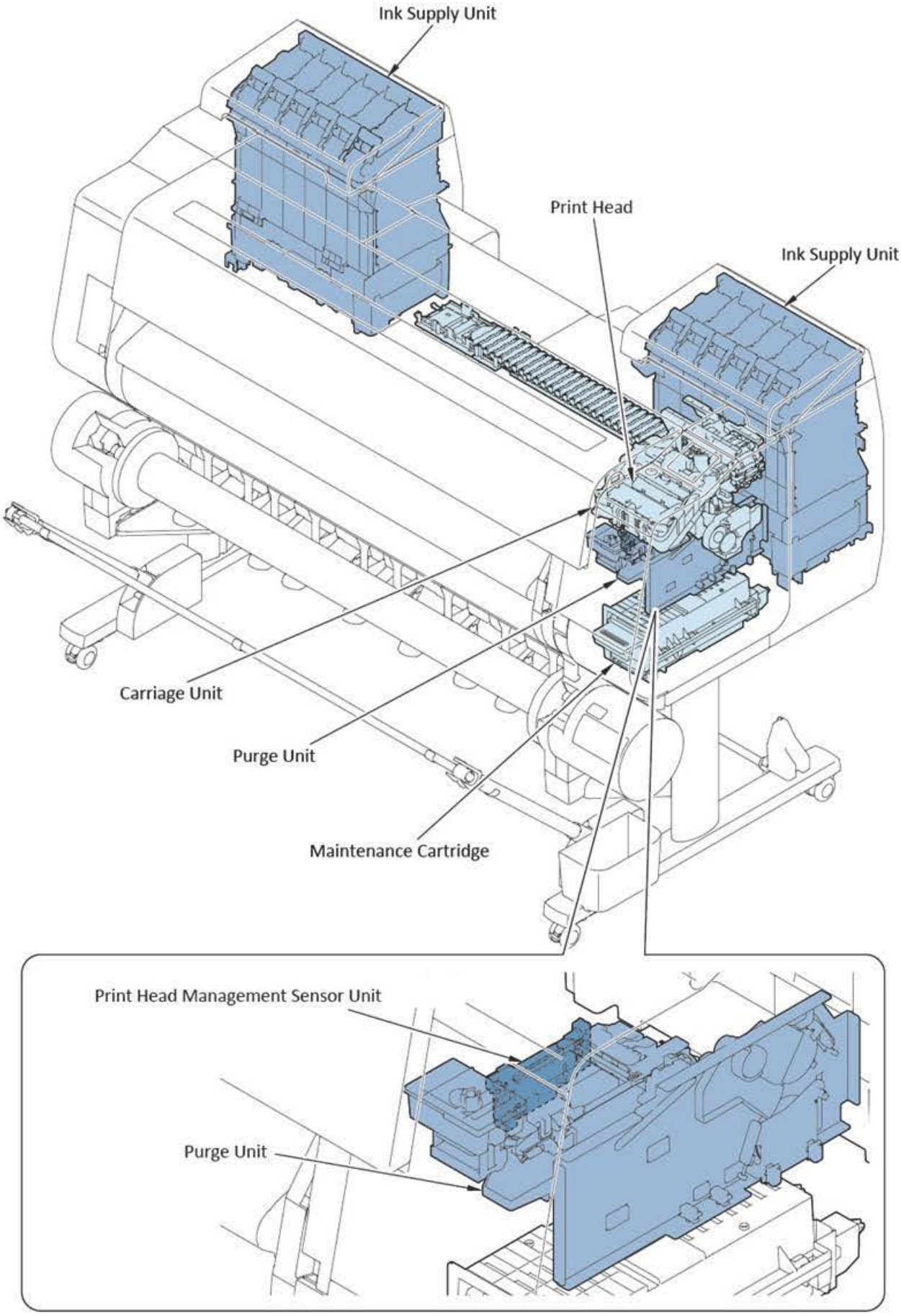
Print Head:

It receives the print signal from the main PCB, and ink from the ink supply unit is ejected.

Maintenance cartridge:

It collects ink ejected from purging and pre-printing ejection in the purge unit.

If the amount of collected ink recorded to the memory in the maintenance cartridge is exceeded than specified amount, an error occurs and operation is stopped.


Ink Supply Unit
Print Head
Ink Supply Unit
Carriage Unit
Purge Unit
Maintenance Cartridge
Print Head Management Sensor Unit
Purge Unit

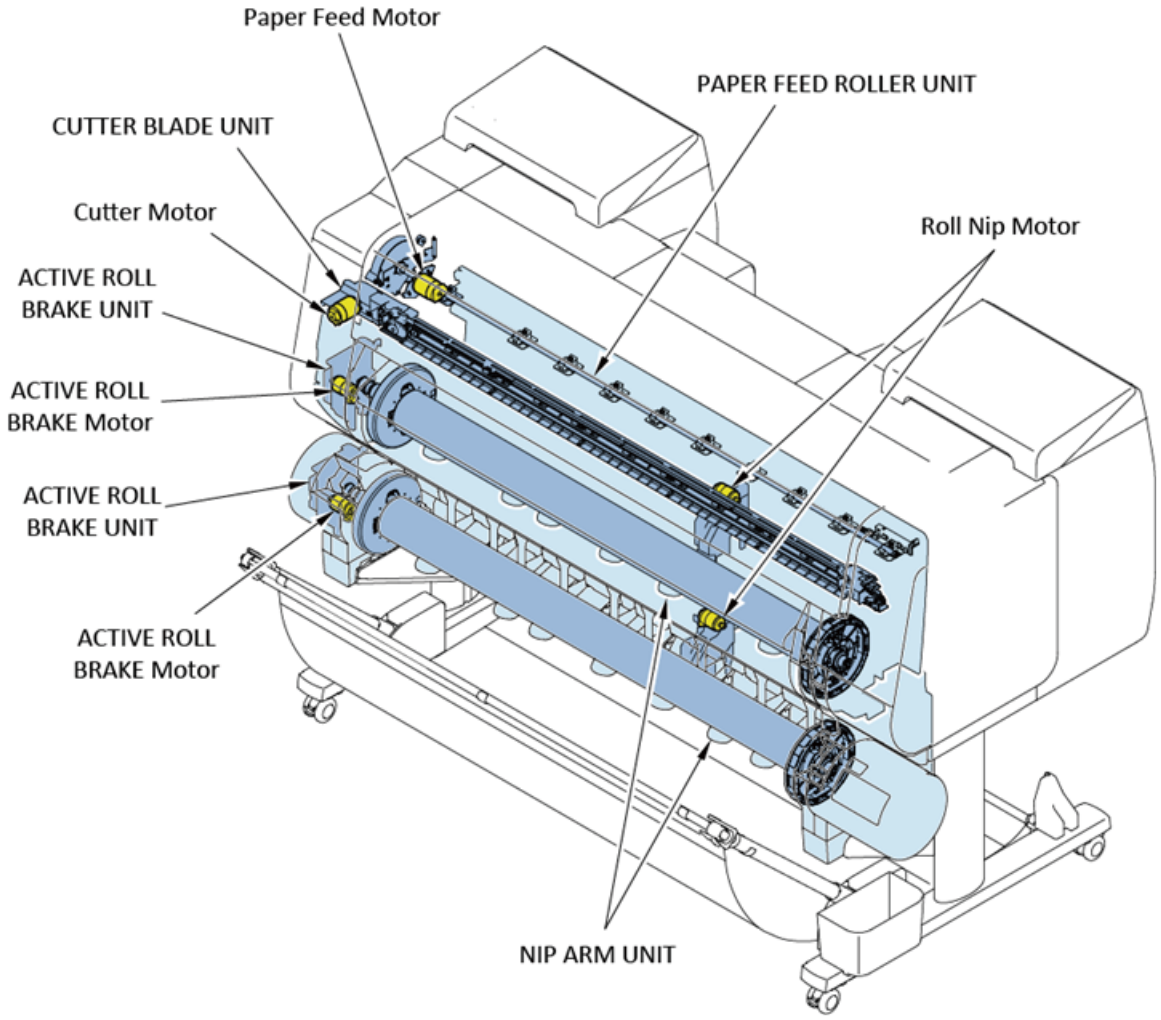
1-2. Operation Principle

1-2-1. Paper Feed Mechanism

1. Configuration

In the paper feed mechanism, it consists of the upper roll paper feed part, the lower roll paper feed part (option), the feed roller part, and the paper ejection part. In addition, the sensors to detect the each performance and paper condition are installed.

Power of the paper feed mechanism:

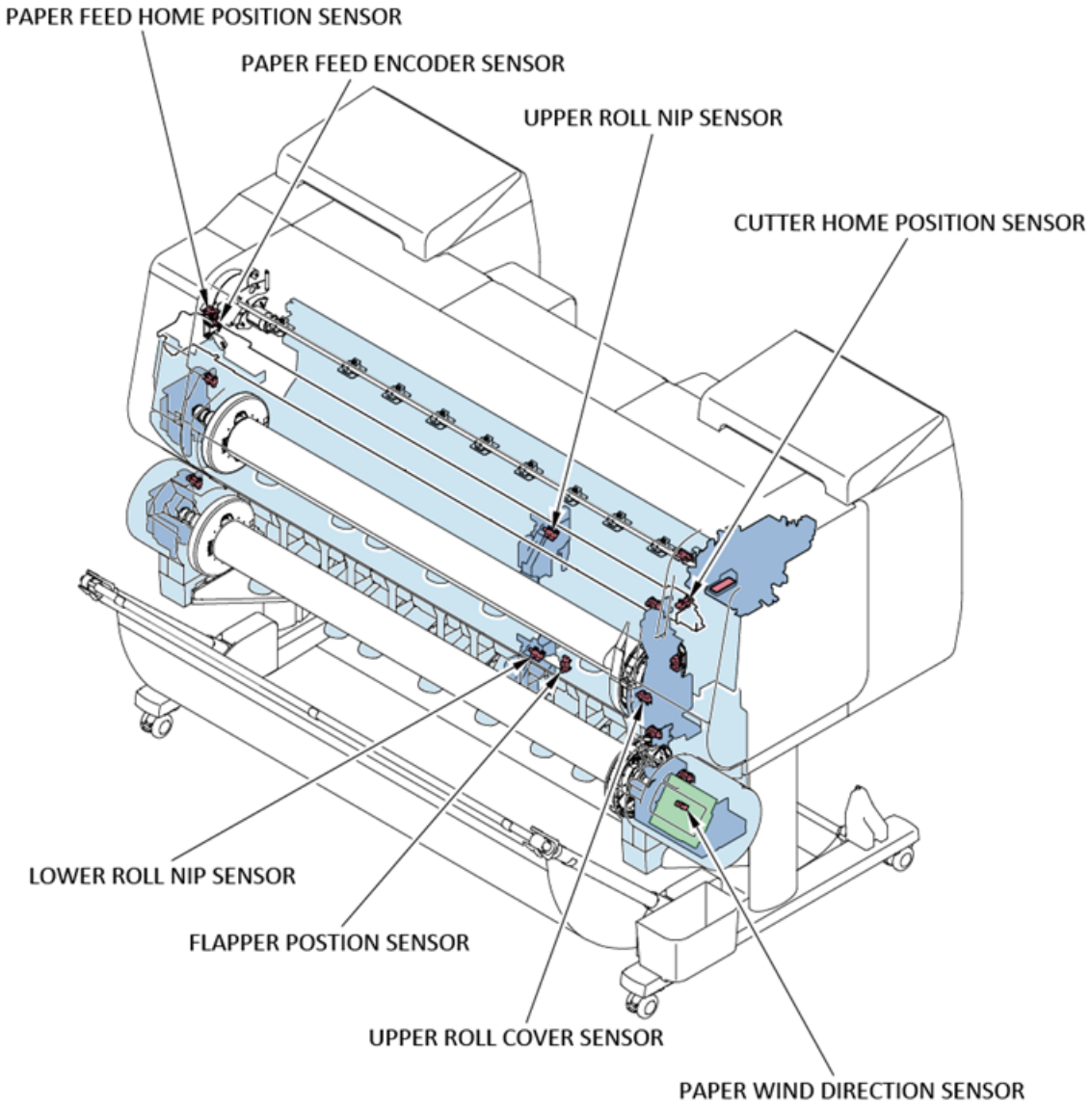


Units to be driven	Power supply source
ACTIVE ROLL BRAKE UNIT	ACTIVE ROLL BRAKE Motor
NIP ARM UNIT	Roll Nip Motor
PAPER FEED ROLLER UNIT	Paper Feed Motor
CUTTER BLADE UNIT	Cutter Motor

Sensor

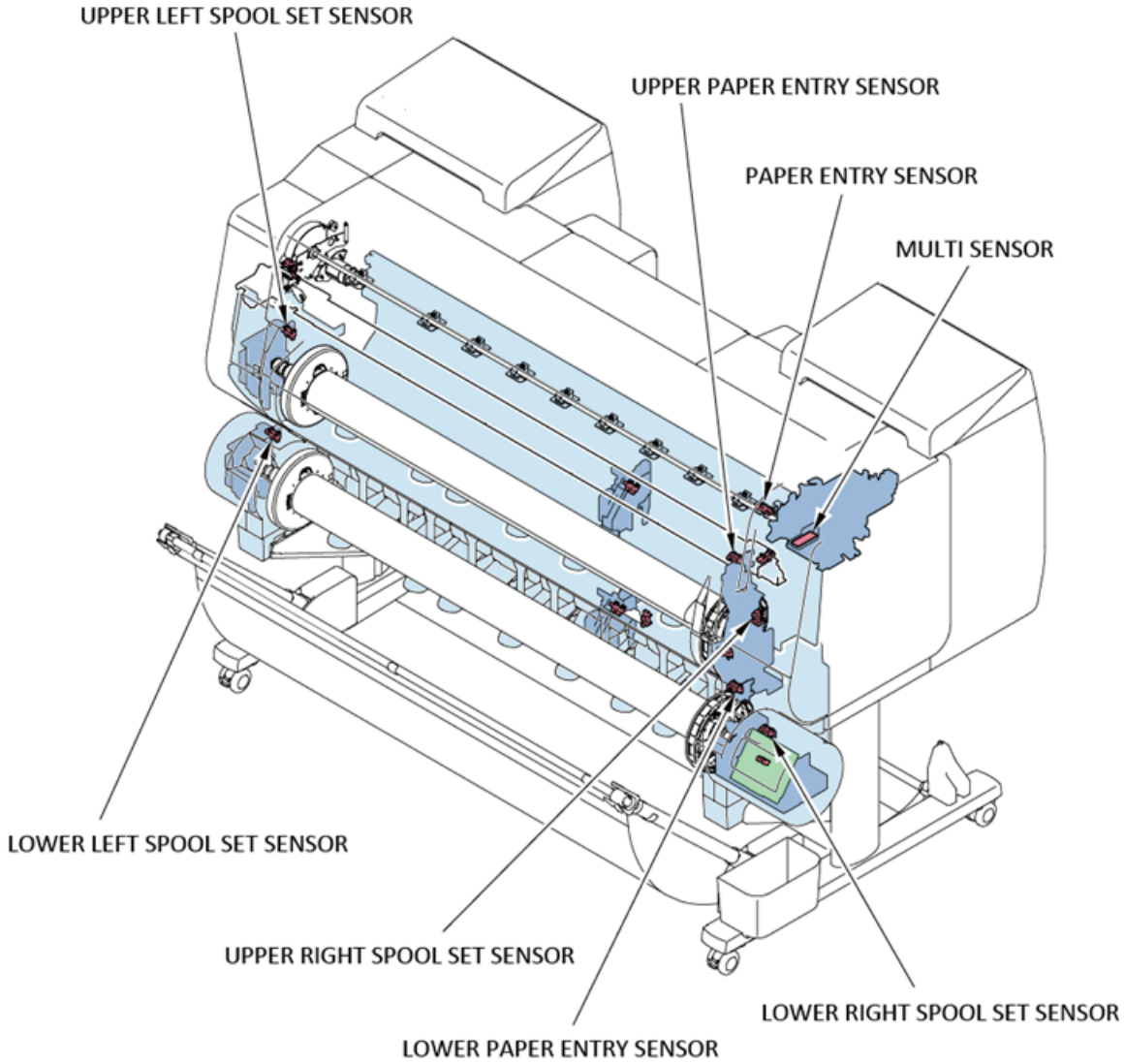
In the paper feed mechanism, two kinds of sensors, which detect the mechanism movement and position of the feeding paper, are installed to this printer.

Sensors to detect the mechanism movement:



Name of sensor	Detection
PAPER FEED ENCODER SENSOR	Detects the rotation amount of the paper feed roller.
PAPER FEED HOME POSITION SENSOR	Detects the home position of the paper feed roller.
UPPER ROLL NIP SENSOR	Detects the roll nip arm status of the upper roll unit.
LOWER ROLL NIP SENSOR	Detects the roll nip arm status of the lower roll unit.
CUTTER HOME POSITION SENSOR	Detects the position of the cutter unit.
UPPER ROLL COVER SENSOR	Detects the cover opening and closing in the upper roll unit.
FLAPPER POSTION SENSOR	Detects status of the separation flapper in the lower roll unit.
PAPER WIND DIRECTION SENSOR	Detects that either the inward winding or the outward winding was selected in the lower roll unit.

Sensors to detect the paper:



Name of sensor	Detection
MULTI SENSOR	It is installed in the carriage unit, and detects the paper edge and paper width in the carriage unit.
PAPER ENTRY SENSOR	Detects the paper presence near the paper feed roller.
UPPER PAPER ENTRY SENSOR	Detects the paper presence in the upper roll paper feed part.
LOWER PAPER ENTRY SENSOR	Detects the paper presence in the lower roll paper feed part.
UPPER RIGHT SPOOL SENSOR	Detects the spool unit presence in the right side of the upper roll paper feed part.
UPPER LEFT SPOOL SENSOR	Detects the spool unit presence in the left side of the upper roll paper feed part.
LOWER RIGHT SPOOL SENSOR	Detects the spool unit presence in the right side of the lower roll paper feed part.
LOWER LEFT SPOOL SENSOR	Detects the spool unit presence in the left side of the lower roll paper feed part.

2. Paper feed mechanism

Paper feed

In this printer, there are three ways to feed the paper as follows.

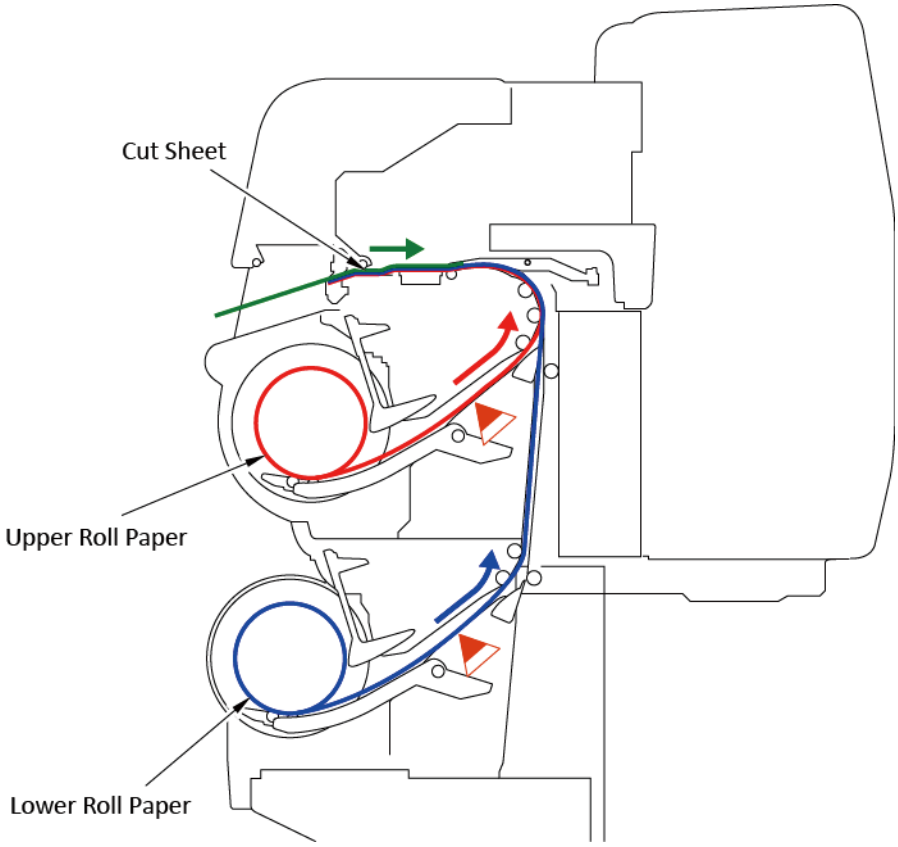
1) Feeds from the upper roll unit.

2) Feeds from the lower roll unit. (The lower roll unit is the option.)

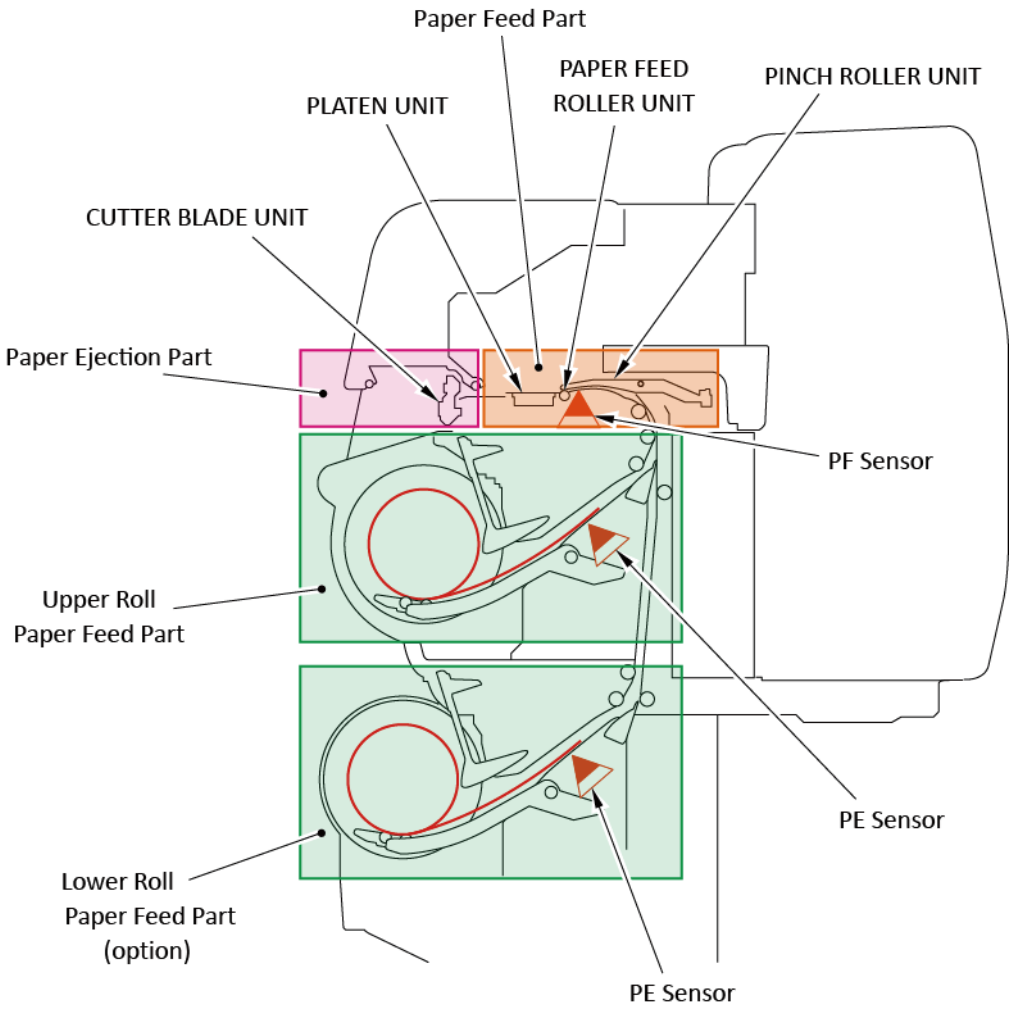
3) Feeds the cut sheet manually.

Note:

If the paper type, the size, and the rest are the same in the upper and lower roll paper, then the upper roll paper will be fed first.



Roll paper feeding



Paper separation and paper feed:

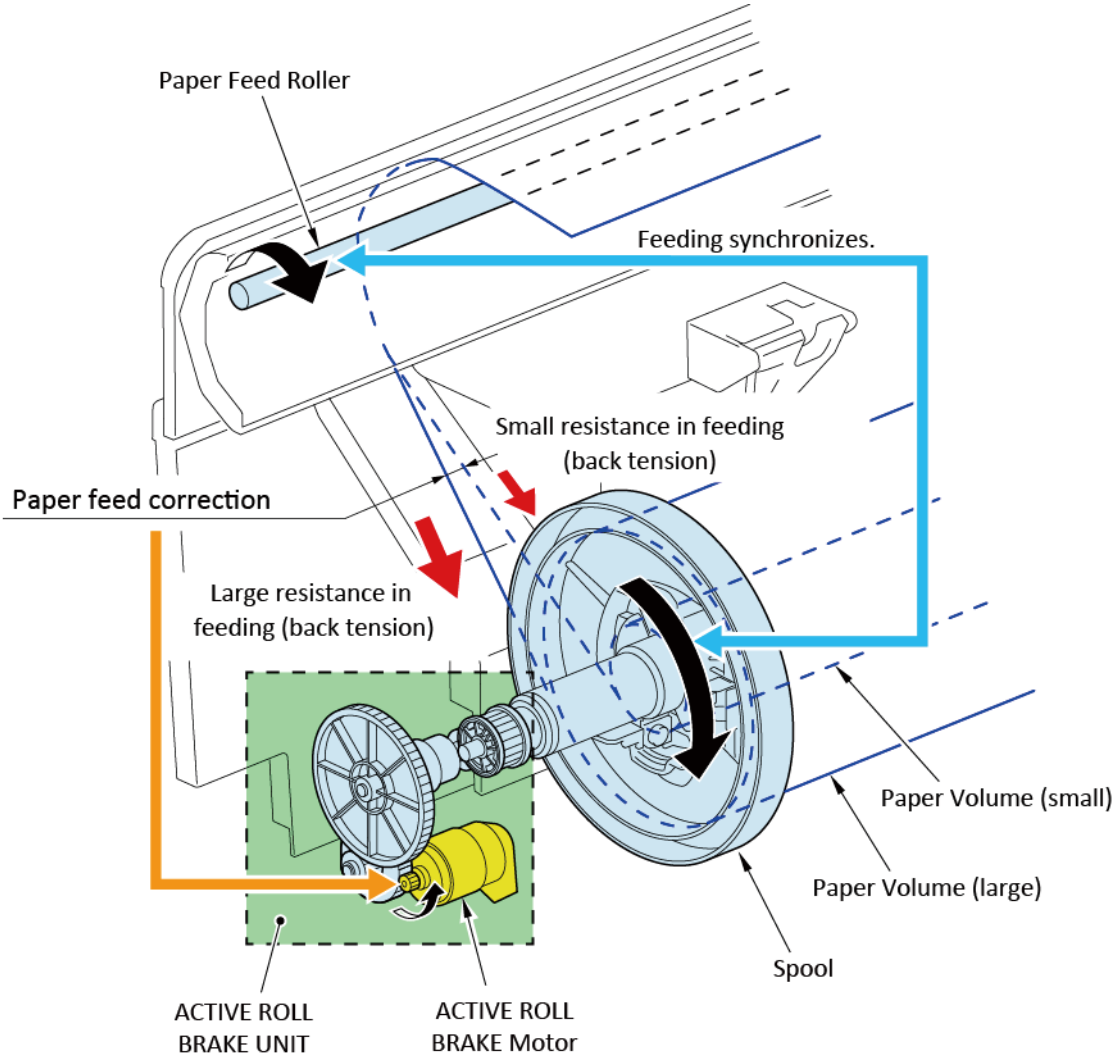
When the roll paper is set and rotated, the paper is separated by the separation flapper. To feed the roll paper, the spool unit is rotated while the paper is nipped by the nip roller. A friction force generated by the nip roller pressure on the roll paper is used to feed the paper.

Paper feeding:

In feeding the roll paper, paper width and paper skew are detected by the multi sensor. In case that the paper skew or paper width needs to be corrected, the paper is repeatedly fed forward and backward by the ACTIVE ROLL BRAKE UNIT, then slack and skew on the roll paper is corrected. In feeding paper and printing, air suction is performed by the platen unit to prevent paper floating. In addition, to reduce uneven printing in feeding direction, the following is performed for control and correction.

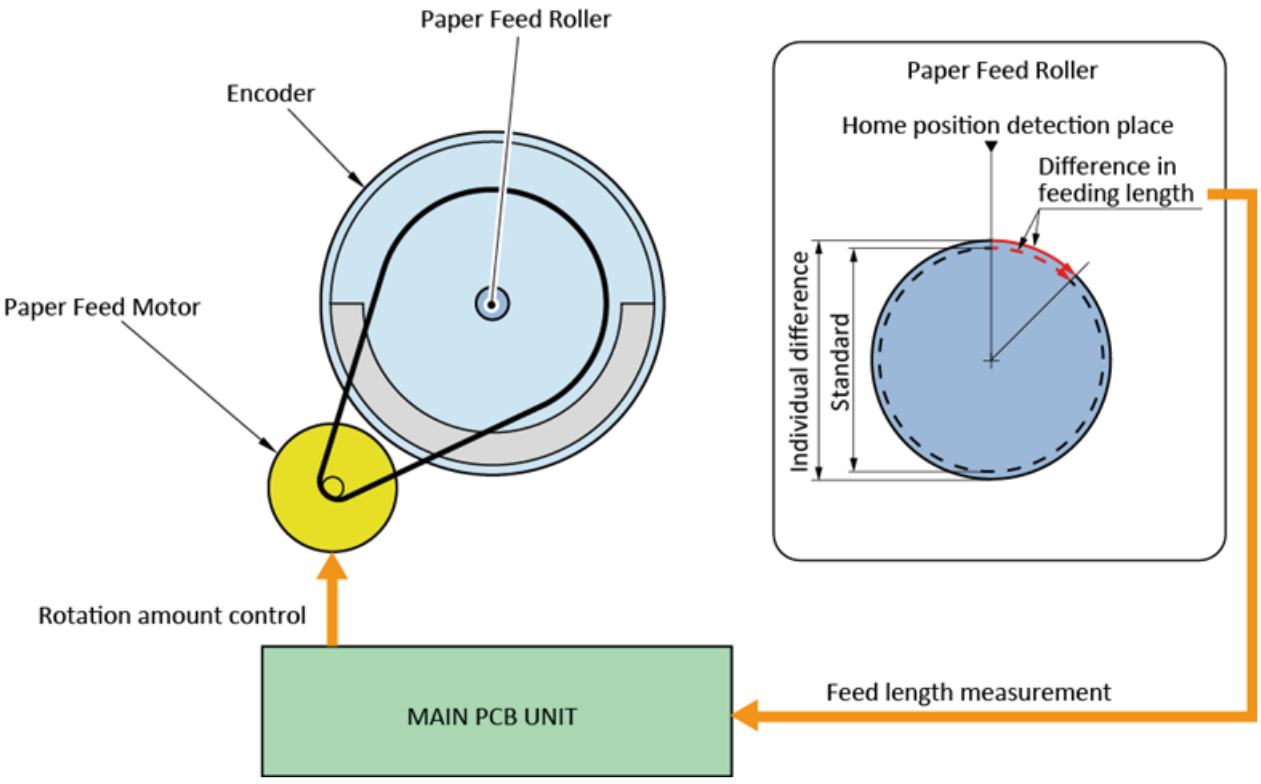
1) Torque control in feeding paper:

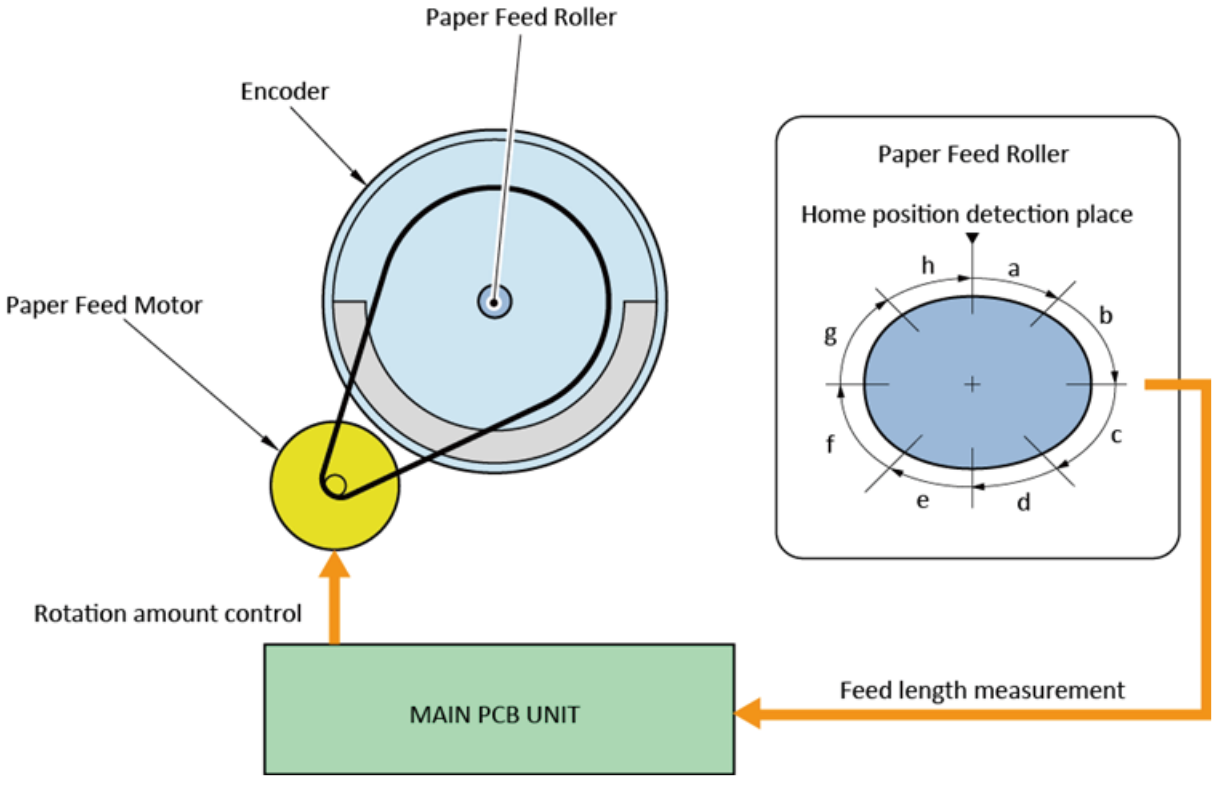
An inertial force acts on the roll paper in feeding. The inertial force acts to the resistance direction of the feeding, or acts to the slack direction. This force is changed by the amount of paper remaining. It is detected by the ACTIVE ROLL BRAKE UNIT, and the feed length is constant by having the torque controlled.



2) Paper feed correction (eccentric correction):

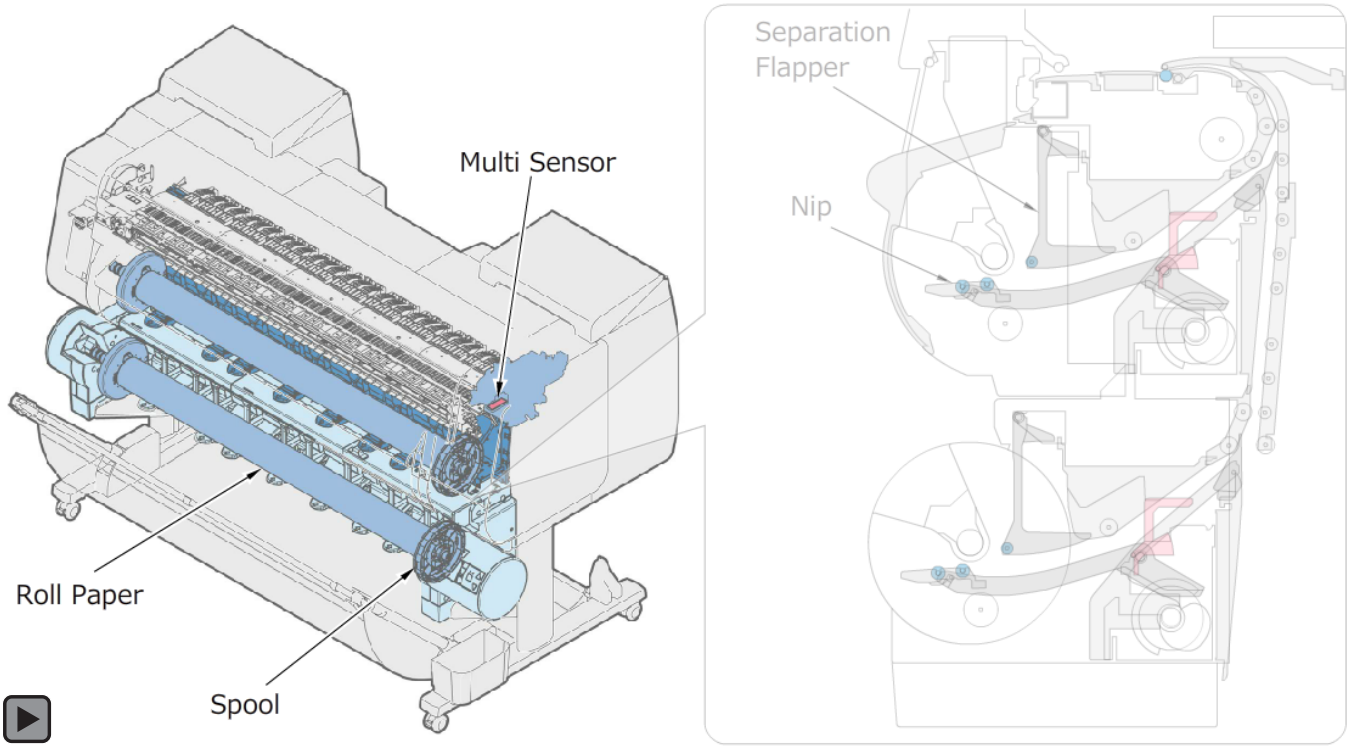
The individual difference in size or distortion of the PAPER FEED ROLLER will make a difference in the paper feed amount although the amount of rotation is the same. Therefore, to have the paper feed amount constant, the amount of paper feed roller rotation is controlled.





Switching the upper and lower roll paper feed:

In case that the roll paper is specified to feed from another roll paper feed unit while the one roll paper has been already set onto the platen, the spool and paper feed roller will be rotated in reverse direction, then the roll paper which was set first is rewound to the standby position. The roll paper which was set and specified later will be fed first.



Paper cut:

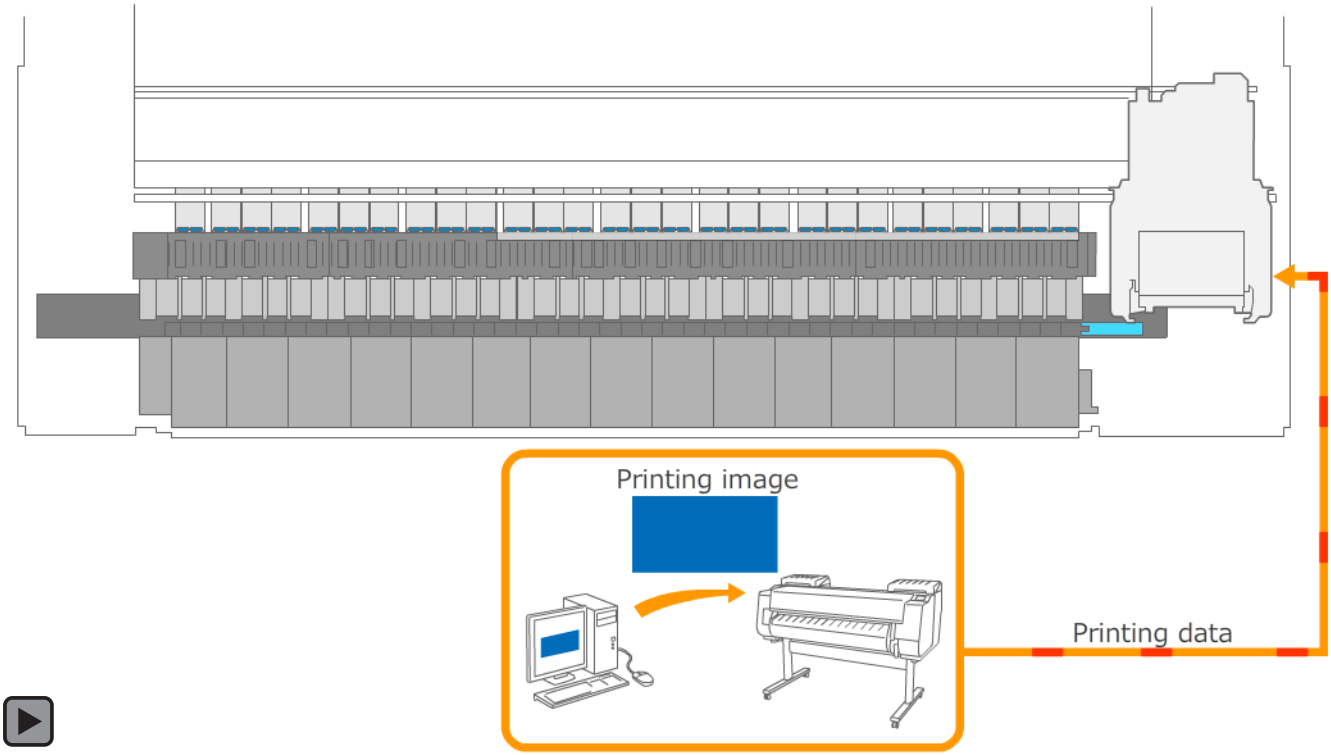
If “automatic cutting” is selected as the cut mode, the roll paper is automatically cut after printed.

In addition, the pre-cut is performed in advance in the following cases.

- When the leading edge of the roll paper is not straight in feeding.
- When the borderless printing, the leading and tailing edge of the roll paper is cut.

To cut the paper straight, the amount of minimum cut is given for each paper type.

(For more details, see the user manual)



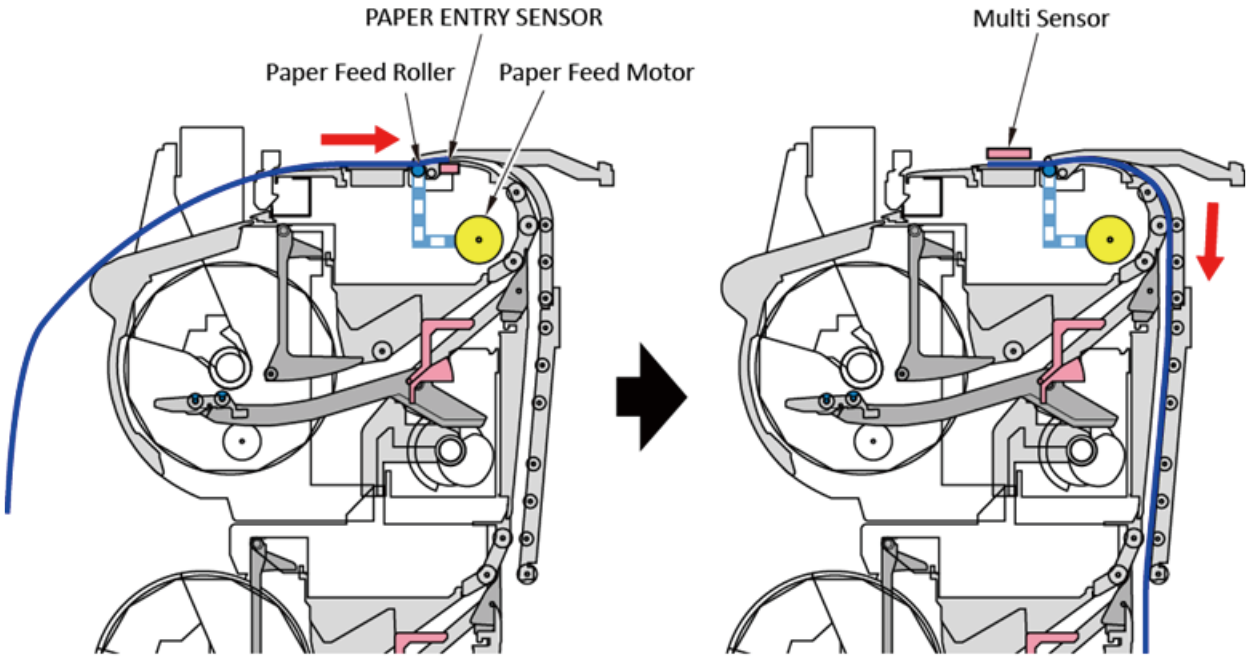
Cut sheet feeding:

The cut sheet is usable by feeding it manually.

Flow of feeding the cut sheet is as follows:

1. Lift the release lever up to release the paper feed roller and pinch roller.
2. Insert the cut sheet manually between the paper feed roller and pinch roller.
3. Lower the release lever to nip the paper with the paper feed roller and pinch roller.
4. The paper feed roller is rotated in normal direction, and the paper tail edge is detected by the PAPER ENTRY SENSOR.
5. After the detection, the paper feed roller is rotated in reverse direction, and the sheet is fed into the printer.
6. The sheet edge (the side of edge when printing) is detected by the multi sensor.
7. The printer becomes the standby mode.

Note: When the cut sheet is fed manually, the paper skew is not corrected.



3. Take-up paper ejection

In this printer, there are three ways to eject the paper as follows.

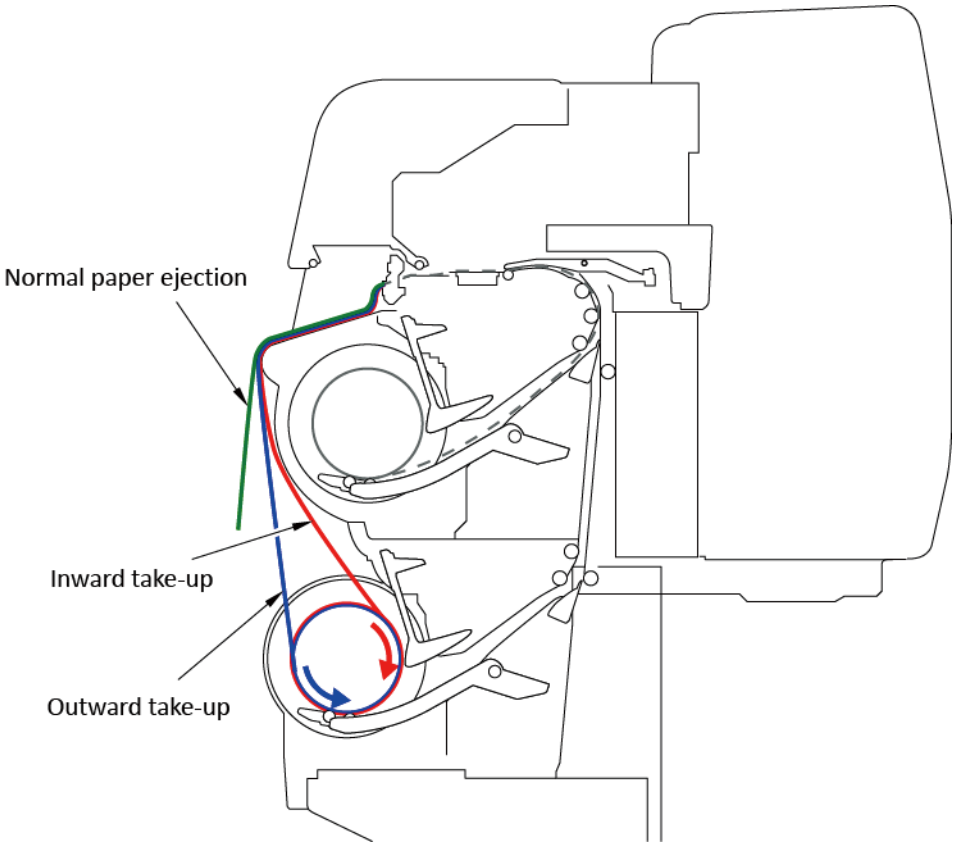
· Normal ejection (ejects to the output stacker.)

· Outward take-up by the lower roll unit.

· Inward take-up by the lower roll unit.

Note:

The take-up paper ejection can be performed only when the lower roll unit is installed and is set as the take-up mode.

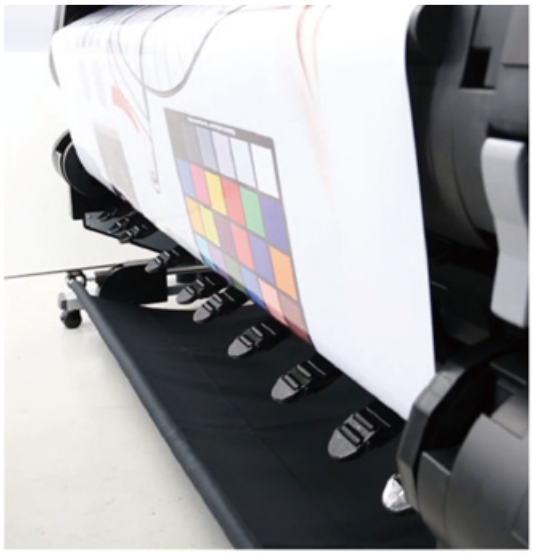


Taking-up inward & outward

In addition to the outward take-up in the current models, the inward take-up is newly adopted to this printer. In the inward take-up, the printed side comes inside. Scratches and smears on the printing face can be prevented by winding the paper toward inward when storing, transporting, and cutting.

Taking-up

The current size of the roll core and the torque is identified and the torque is controlled, then, the tension in taking up is optimized automatically. The weight which is used in the current large size printer is no longer needed.

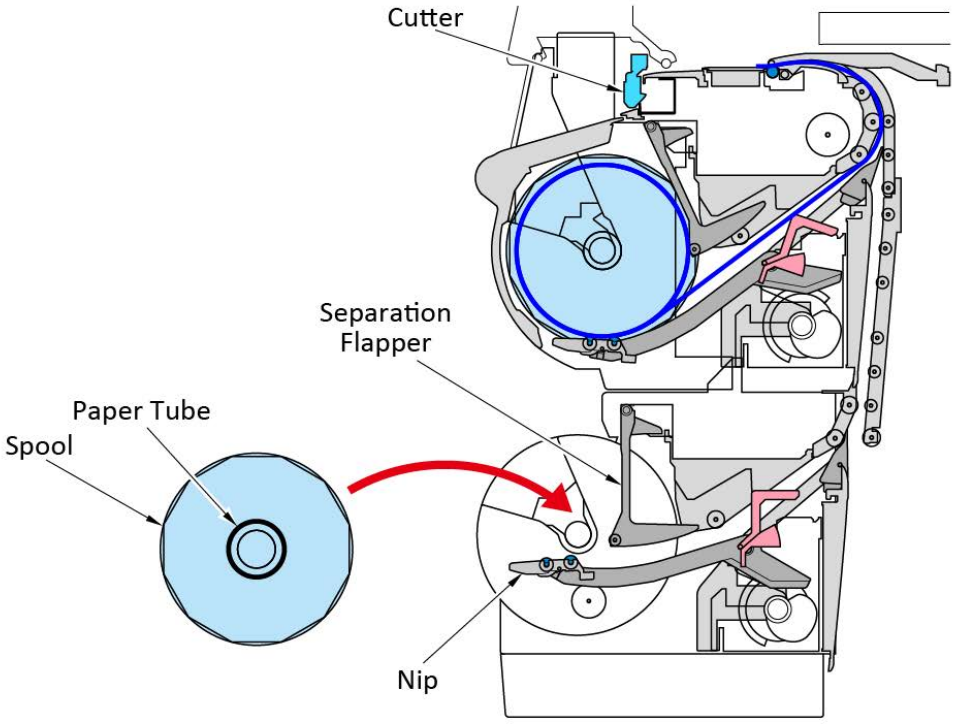


Tension is optimized by the Active Roll Brake Unit.

Taking-up the paper end

The nip pressure is controlled, and the paper end is rolled up automatically.

(For more details, see the movie.)

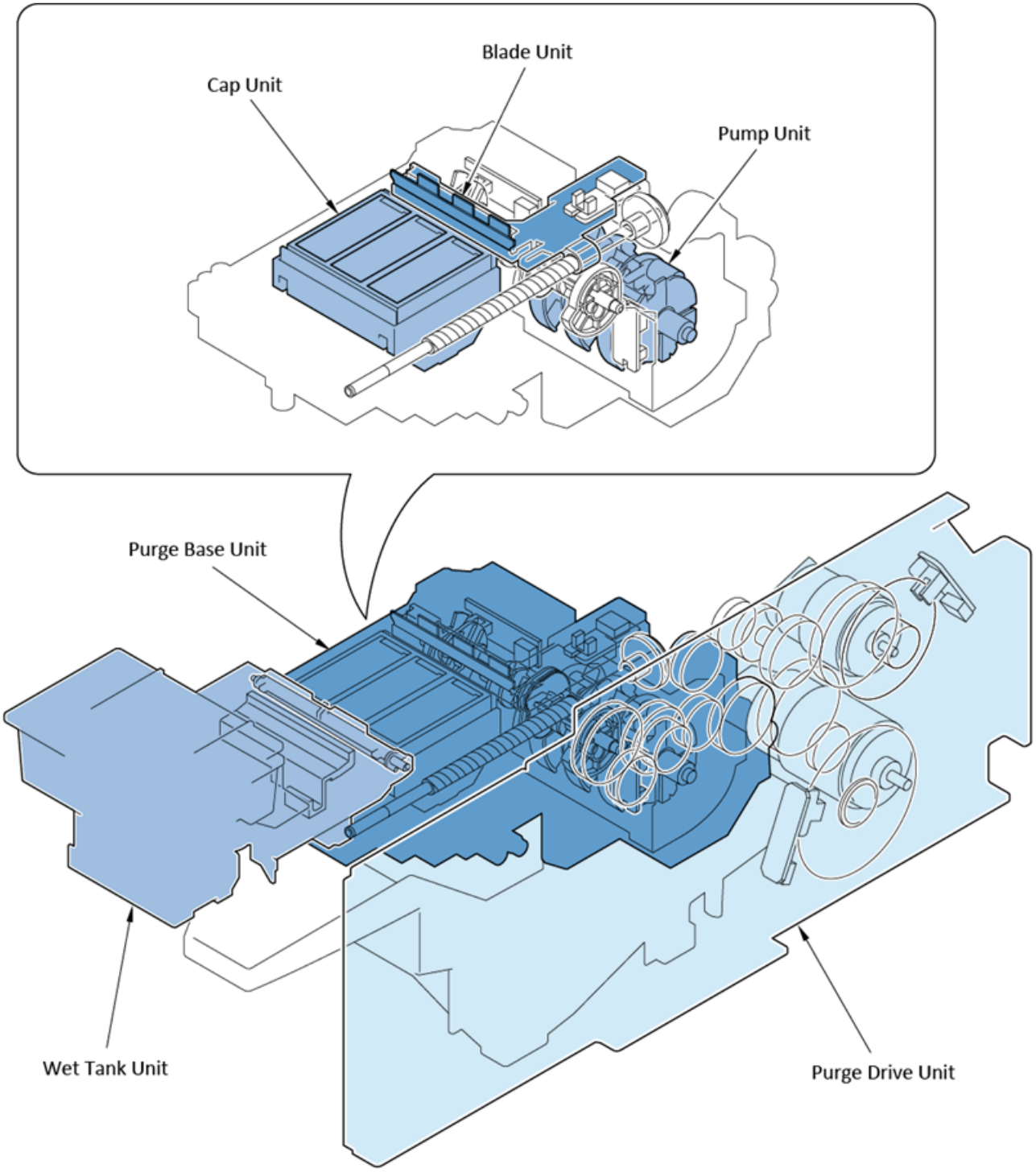


1-2-2. Purge Unit

1. Configuration

The purge unit consists of the purge base unit, the purge drive unit, and the wet tank unit.

The purge base unit consists of the cap unit, the blade unit, and the pump unit.



2. Function of Purge Unit

The function of the purge unit is to perform maintenance against the print head nozzle (for ejecting ink) and to prevent the non-ink ejection. To be more precise, the following three maintenances are performed.

Capping:

If the nozzles are exposed to the air, moisture of ink will get dried and ink becomes hard. To prevent this, the print head should be always capped except when printing is performed.

Cleaning:

By vacuuming ink from the nozzles, the ink flow path in the print head will be filled with a new ink, and dusts and bubbles are eliminated from the ink flow path.

Wiping:

The rubber wiper wipes the print head surface, removing dust and ink droplet.

In the pigment-based ink model, to improve wiping, the wiper blade is moistened with the wet liquid (glycerin).

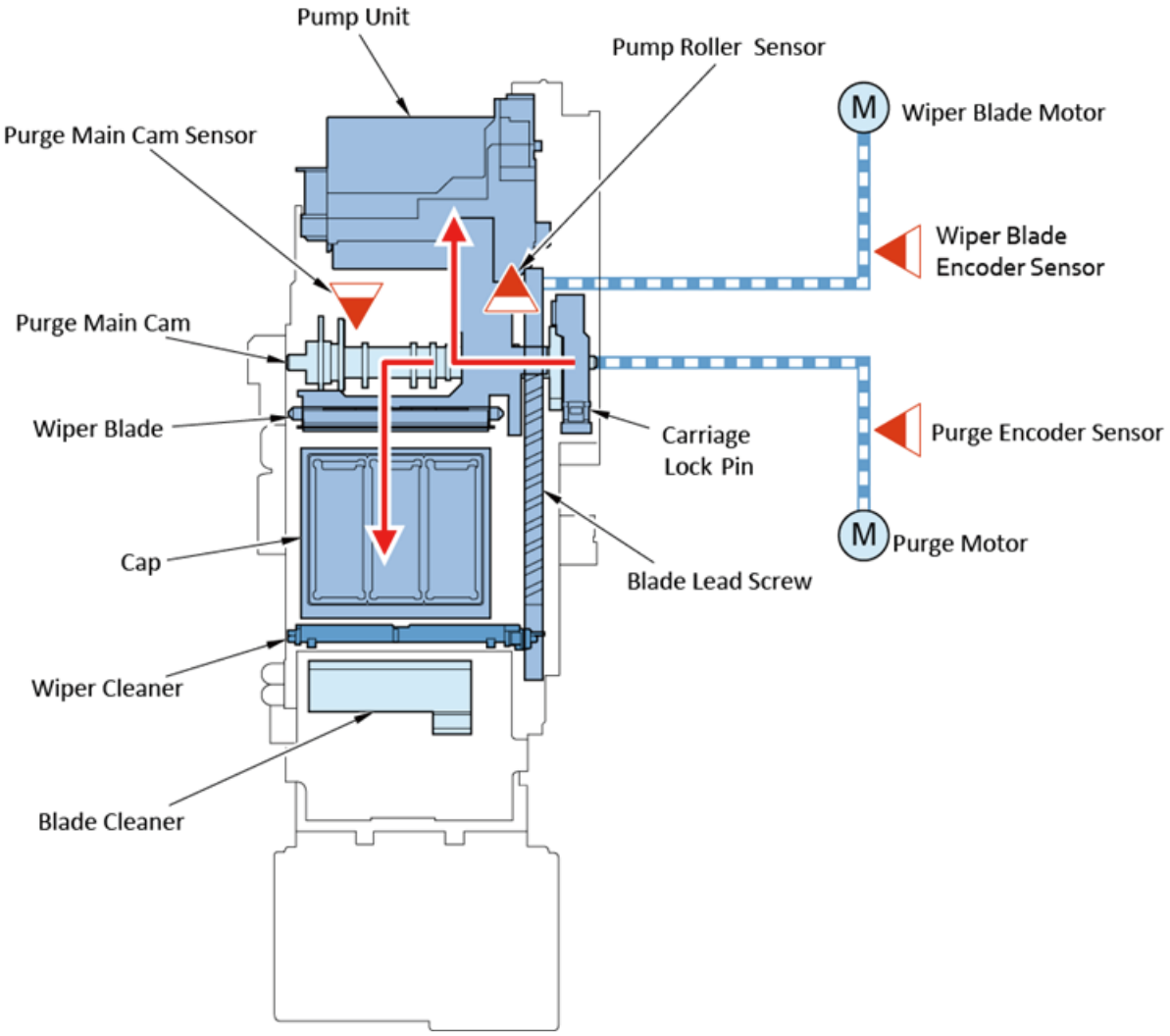
For details of purpose and operation for each maintenance, see “4.Capping”, “5.Cleaning” and “6.Wiping.”

3. Drive power transmission & Problem detection

Transmission of the drive power to the Purge Unit:

The drive for the purge unit is supplied from the purge motor and wiper motor.

The direction of the motor rotation and performance is as follows.

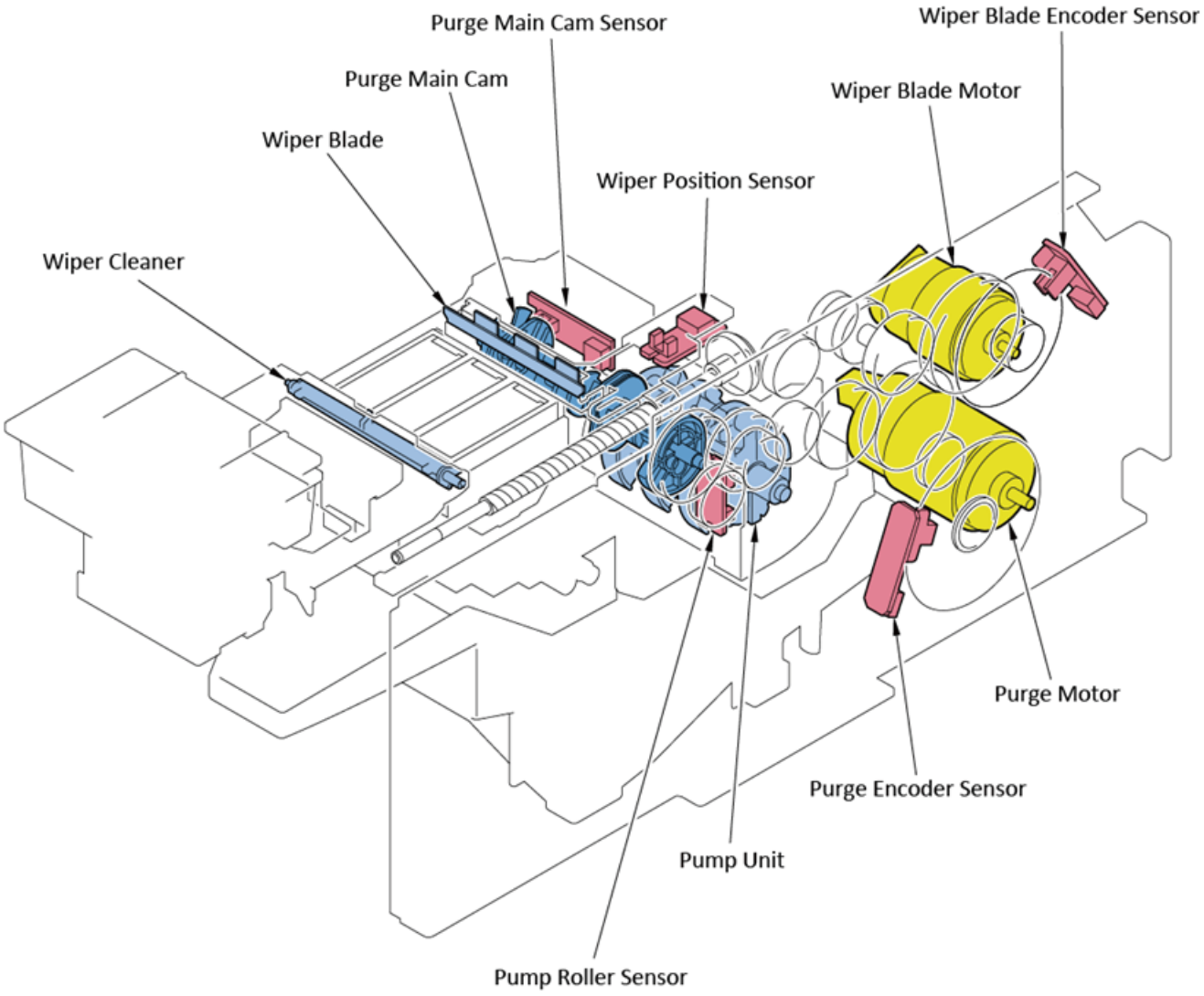


Drive Motor	Rotation Direction	Destination of Power Transmission	Performance
Purge Motor	Normal direction	Purge Main Cam	The cap is moved up and down. The air valve is opened and closed. The carriage is locked and unlocked.
	Reverse direction	Pump Unit	Purging is performed.
Wiper Blade Motor	Normal direction	Blade Lead Screw	The print head surface is wiped off.
	Reverse direction	Blade Lead Screw	The wiper blade is returned.

Detection of problem:

Abnormal movement in the purge unit is detected by the purge main cam sensor, the pump roller sensor, the wiper position sensor, the purge encoder sensor, and the blade encoder sensor.

The function of each sensor is as follows.



Name of Sensor	Function
Purge Main Cam Sensor	By detecting rotation of the purge main cam, detects the abnormal movement of the valve in opening and closing while capping and cleaning.
Pump Roller Sensor	By detecting rotation of the pump unit, detects the abnormal cleaning behavior.
Wiper Position Sensor	By detecting movement of wiping direction for the wiper blade, detects the abnormal wiping behavior.
Purge Encoder Sensor	By reading the disk film slit, detects the movement amount and speed of the purge motor.
Wiper Blade Encoder Sensor	By reading the disk film slit, detects the movement amount and speed of the wiper blade motor.

4. Capping

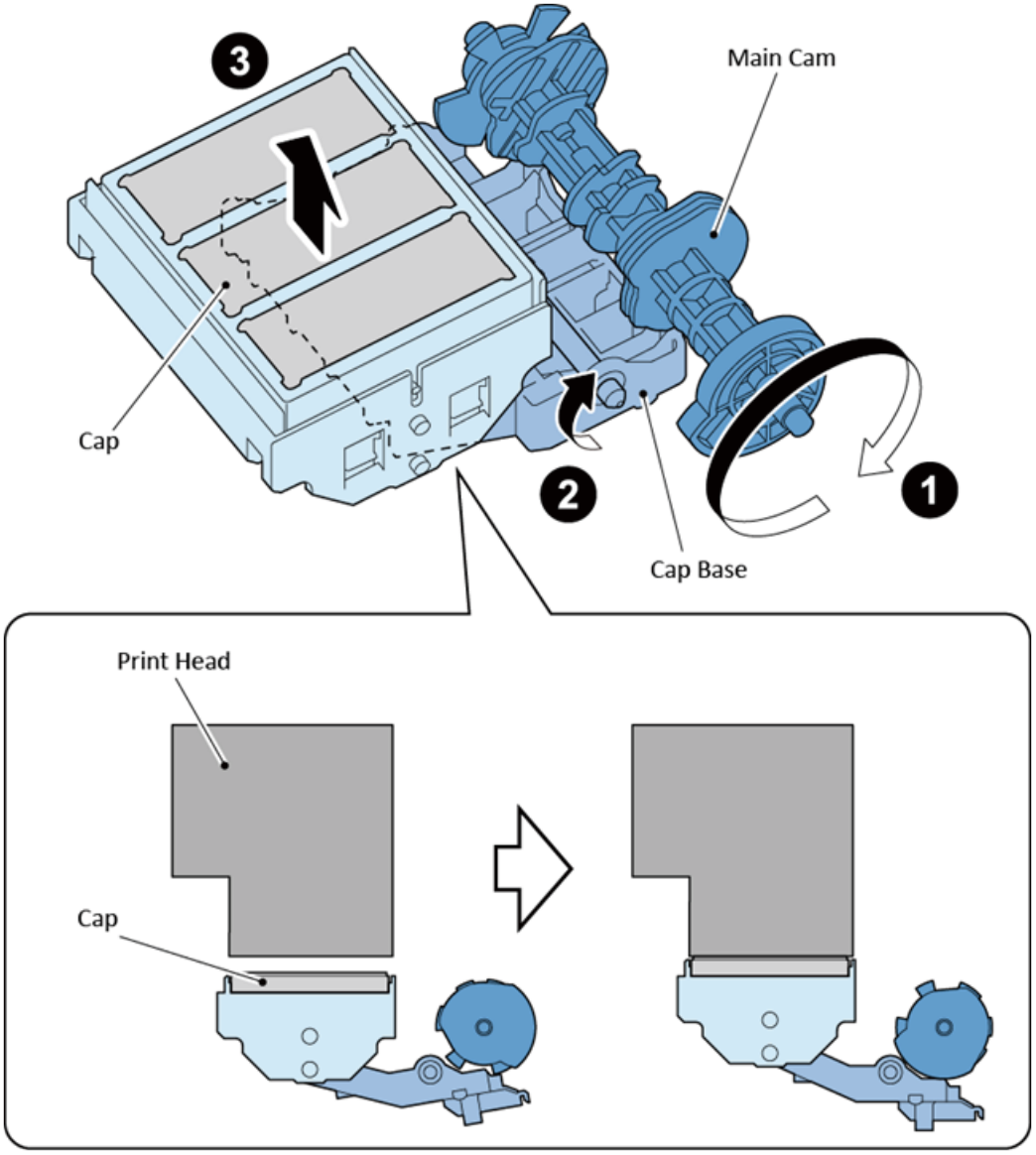
Purpose of Capping:

To prevent clogging caused by the dried ejection slot and to prevent the print failure caused by dusts on the print head, the cap in the purge unit and print head surface are attached each other tightly.

Capping procedures:

Capping is performed in the following procedures:

1) The drive from the purge motor is transmitted to the main cam and it is rotated. (“No. 1” in the diagram below)
2) The main cam pushes up the cap base. (“No. 2” in the diagram below)
3) The cap moves up to fit to the print head surface. (“No. 3” in the diagram below)

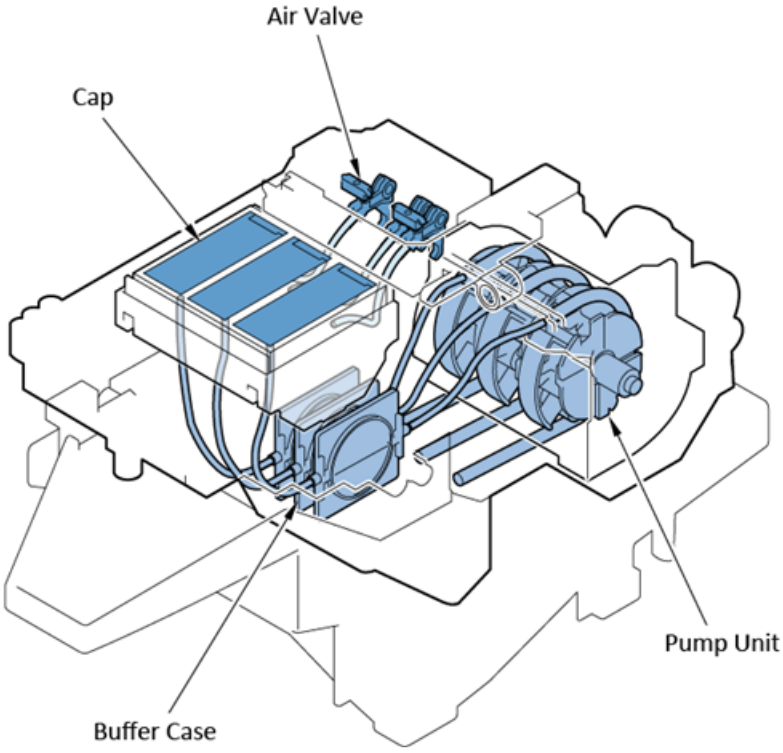


5. Cleaning

Purpose of Cleaning:

By sucking out ink from the nozzles, the ink flow passage in the print head is filled with new ink, and eliminates the dusts and bubbles from the passage.

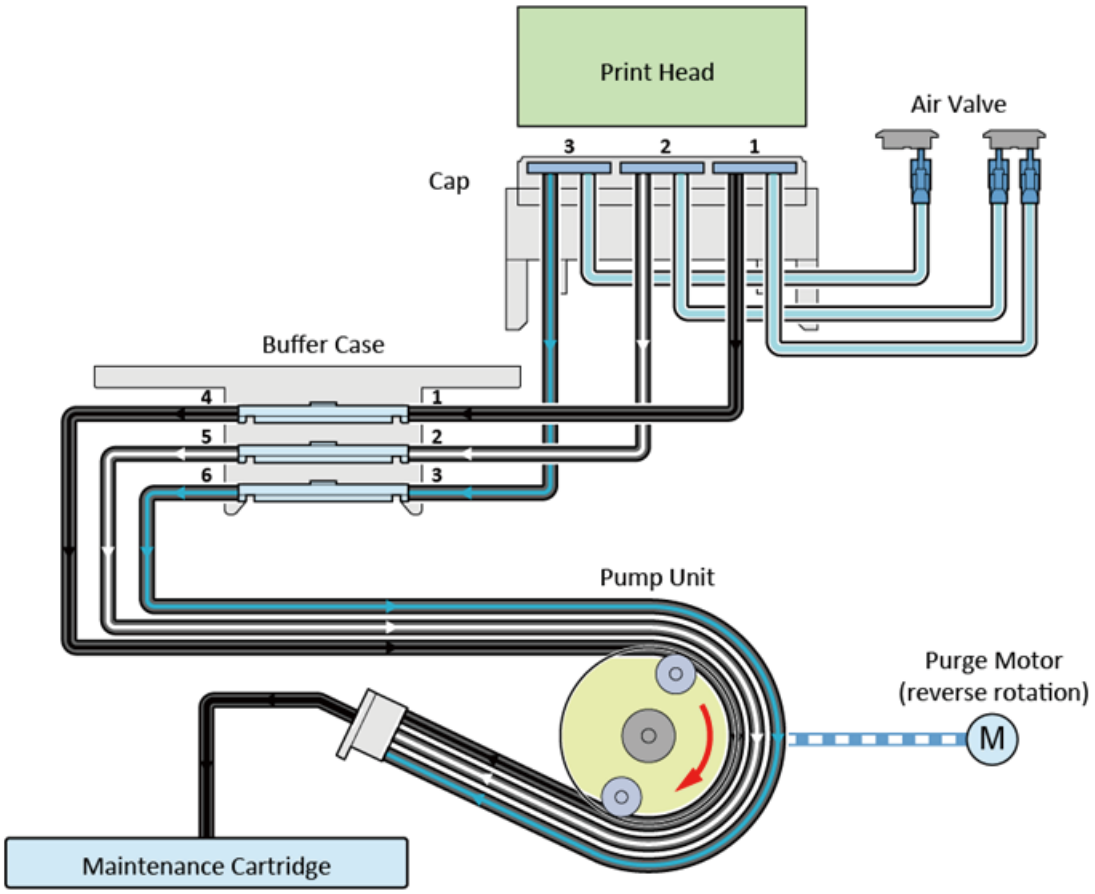
[Configuration]



Cleaning procedures:

1) The cap is attached to the print head surface tightly after capping.
2) The air valve is closed.
3) The pump unit is rotated in normal direction, and the negative pressure is generated inside the ink tube.
4) The pump unit is rotated in reverse direction, and the negative pressure inside the ink tube is released.

[Conceptual diagram of cleaning]



Other mechanism

To maintain good performance in the ink ejection, the pre-print ink ejection and the air intake are adopted besides the cleaning.

Pre-printing ink ejection:

It is a function that ejects ink to the cap in the purge unit before printing or ejects ink to the platen absorber and cap while printing. By performing the pre-print ink ejection, ink droplets and dusts adhering on surface of the print head can be removed.

Air suction:

It is a function that sucks ink ejected from purging and ink accumulated on the cap from pre-ink ejection. If the amount of the ejected ink gets exceeded than specified amount, the air suction is performed to prevent ink leakage.

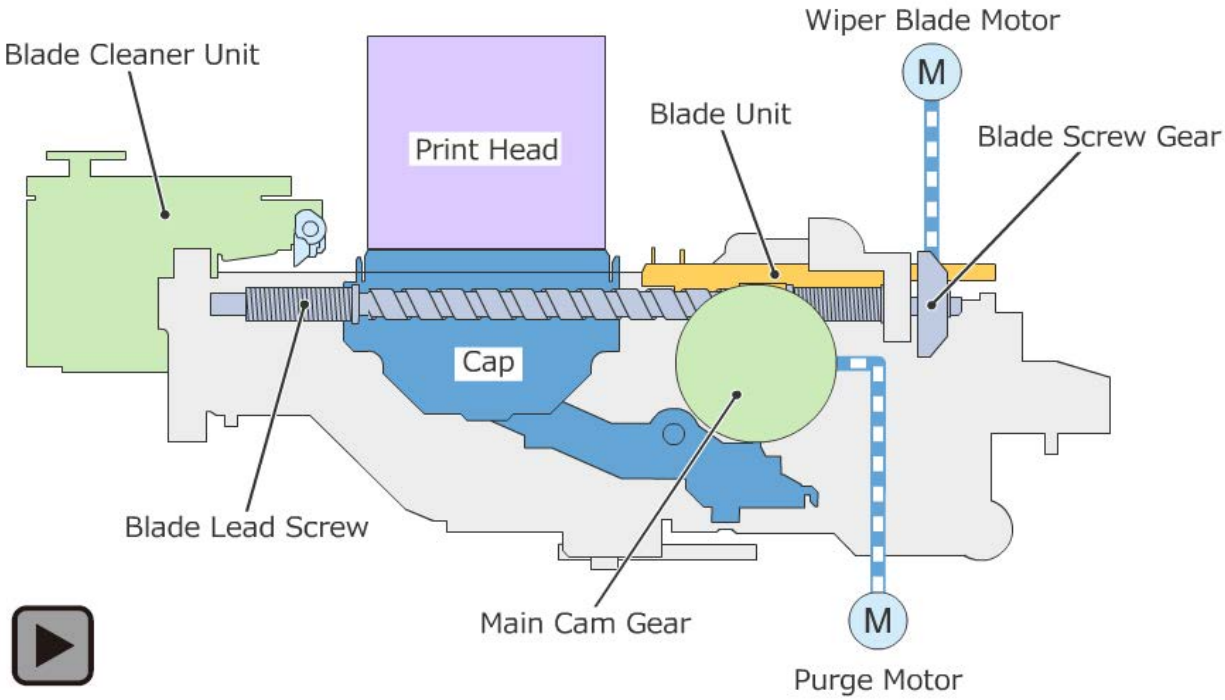
6. Wiping

Purpose of Cleaning:

It is to wipe off ink droplets and dusts adhering on the surface of the print head with the wiper blade to prevent the print head nozzles from clogging.

Wiping procedures:

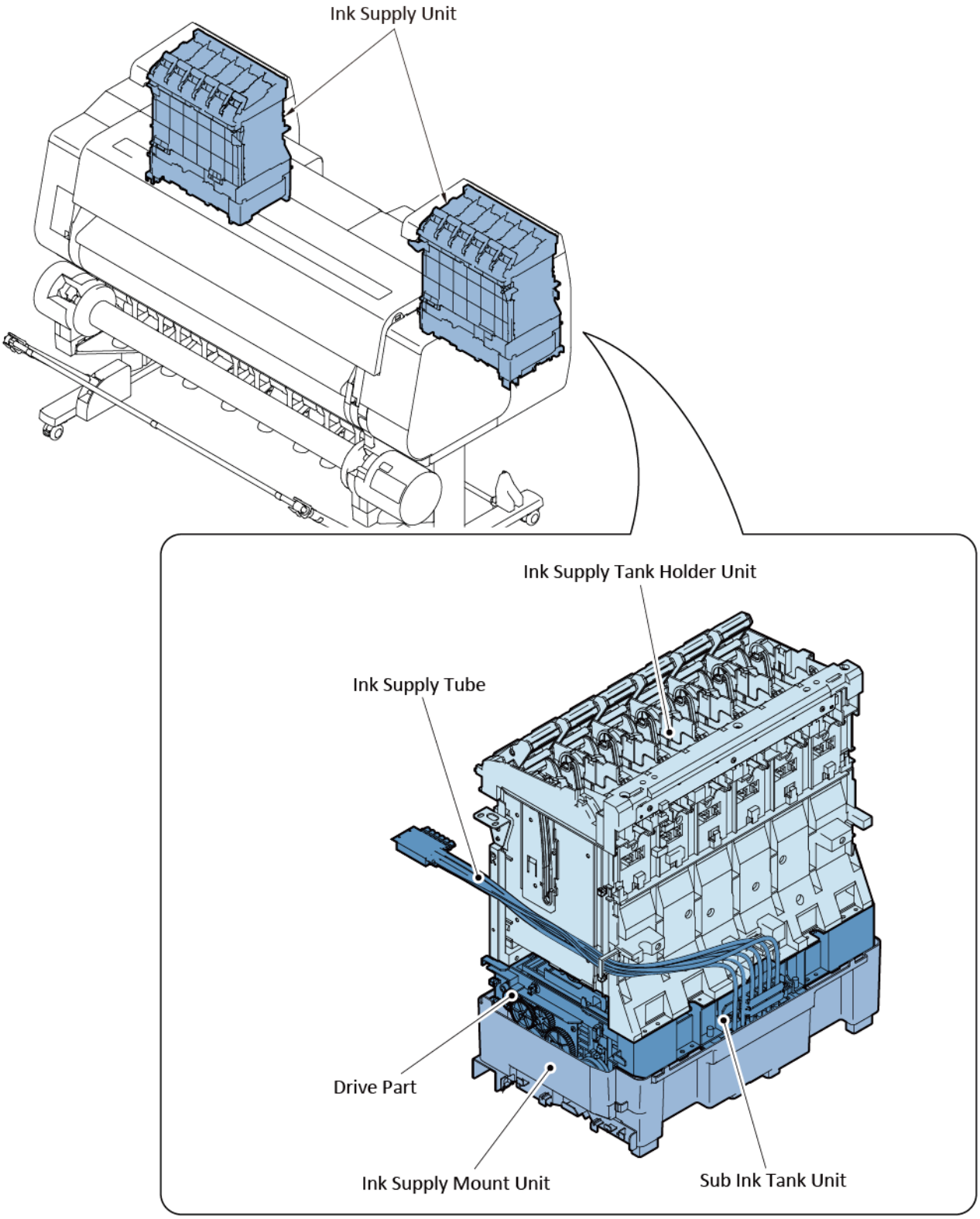
1) The main cam is rotated by the drive transmitted from the purge motor (normal rotation) and then the cap gets lower.
2) The lead screw is rotated by the drive transmitted from the wiper blade motor (normal rotation).
3) The wiper blade is moved and wipes off the print head surface.
4) The wiper wipes off the dusts and ink droplets adhering on the wiper blade with the wiper cleaner.
5) The wet liquid is attached to the wiper blade.
6) The blade unit is returned by the drive transmitted from the wiper blade motor (reverse rotation).



1-2-3. Ink Supply Unit

1. Configuration

In this ink supply unit, the ink tank holder unit, the sub ink tank unit, and the ink supply mount unit are consisted. The same ink supply unit is installed both in the left and the right.



2. Function of ink supply unit

Ink supply

Ink inside the ink tank is supplied to the print head.

For detail of ink supply, see “3. Ink supply / Agitation > Ink supply.”

Agitation

The pigment-based ink may be settled out by leaving it for a long period. To resolve this problem, the agitation is performed.

For details of the agitation performance, see “3. Ink supply / Agitation > Agitation performance.”

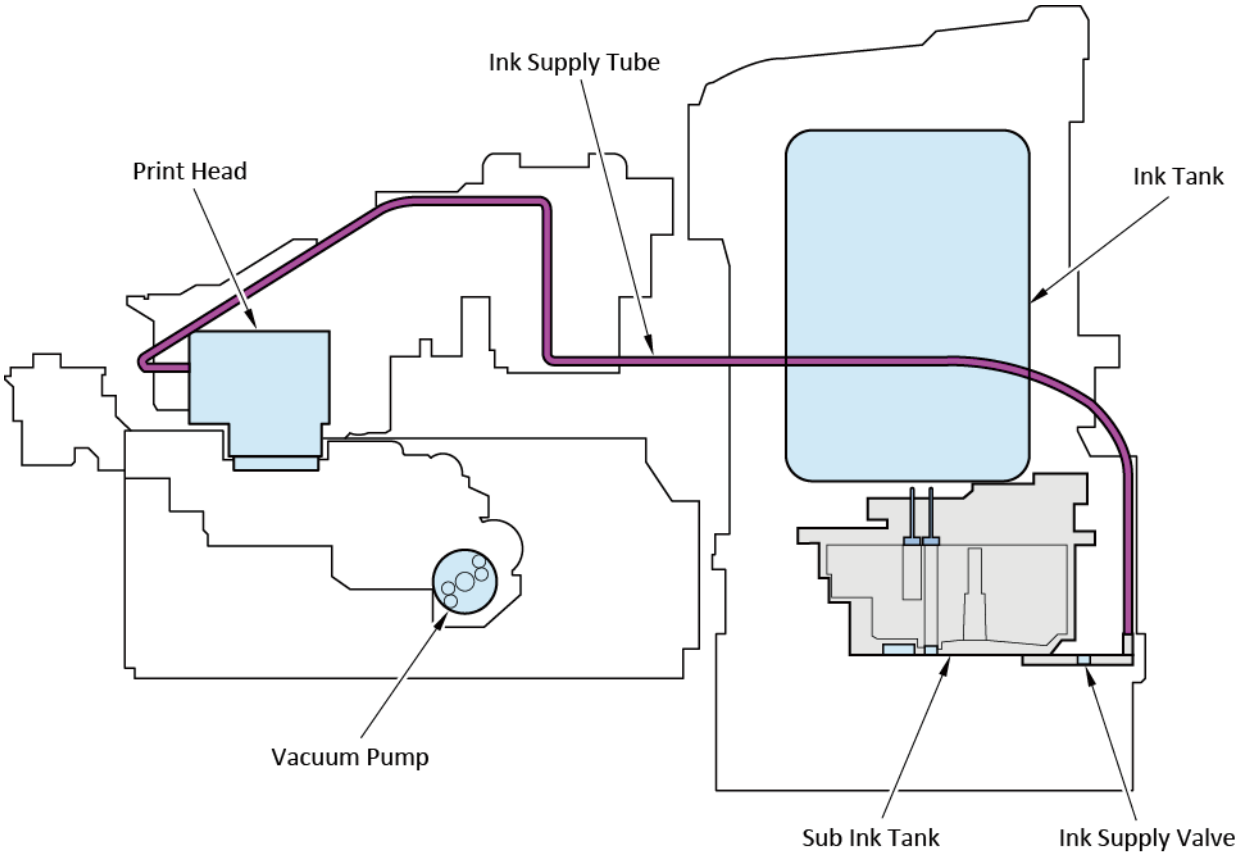
Remaining ink management

To detect the remaining ink amount, the dot count and remaining ink detection pins are installed to this printer.

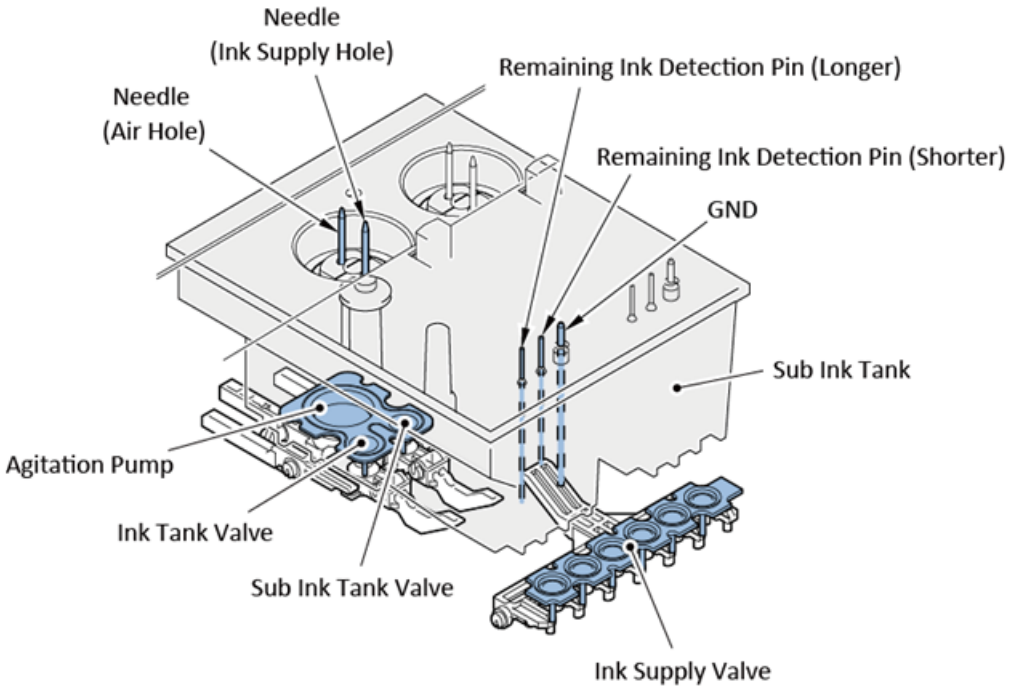
For details of the remaining ink amount management, see “4. Drive power transmission and problem detection > Remaining ink detection.”

3. Ink supply / Agitation

[Conceptual diagram of ink supply flow]



[Detail of sub ink tank]



Ink Supply

1. Process of ink supply

   1) Ink supply from the ink tank to the ink supply valve:

      As the ink tank is installed, the ink tank is pierced by the two needles (for supplying ink and air) in the sub ink tank. When the ink tank valve and sub ink tank valve are opened, ink in the ink tank is flowed from the needle (ink supply hole) into the ink supply valve via the sub ink tank.

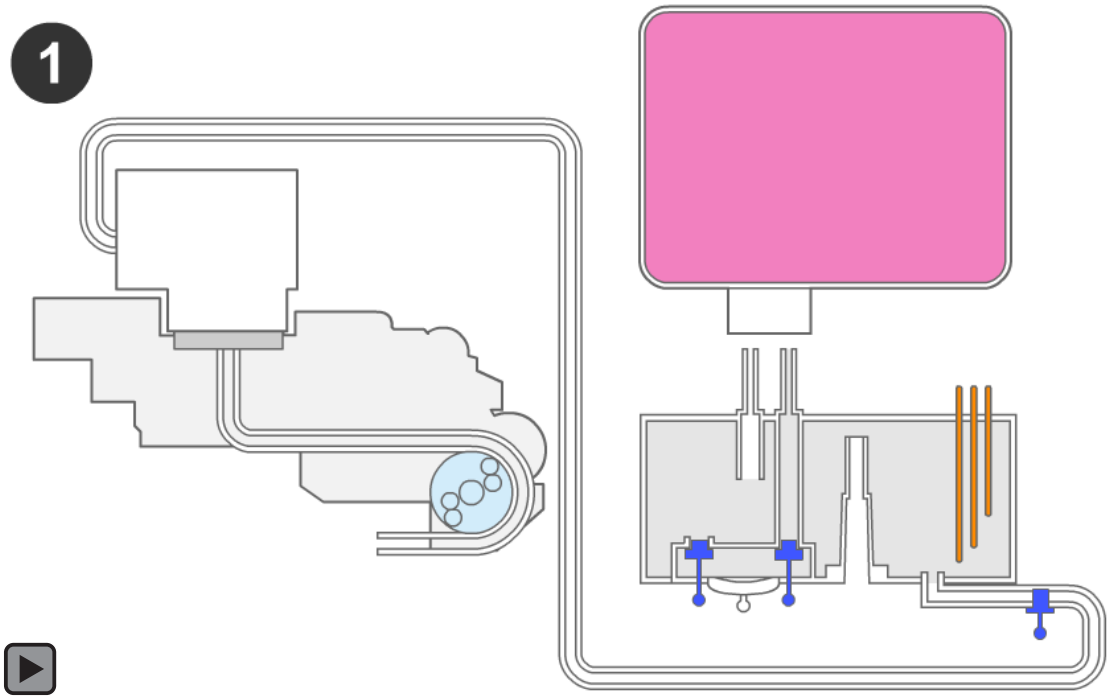
   2) Ink supply from the ink supply valve to the print head:

      Ink is filled into the print head by capping the print head, driving the vacuum pump and opening the ink supply valve.

   3) Ink supply while printing:

      The ink supply valve is opened while printing. Ink is supplied from the ink tank as ink in the print head is consumed. The sub ink tank is installed to this printer. When ink amount remains in the sub ink tank, you can replace the old ink tank with new one without interruption while printing.

[Process of ink supply]



Mechanism of ink supply

	Outline of performance	Ink Tank Valve	Sub Ink Tank Valve	Ink Supply Valve
1.	The ink tank is installed.	Opened	Opened	Opened
2.	Ink is flowed from the ink tank into the sub ink tank.	Opened	Opened	Opened
3.	The ink supply valve is closed and the vacuum pump is rotated. (Refer to the ink supply valve check) (By rotating the purge motor in reverse direction, the vacuum pump is driven.)	Closed	Closed	Closed
4.	The ink supply valve is opened. (Print head ink filling check) (Ink filled in the sub ink tank is flowed into the print head from the ink supply valve.)	Closed	Closed	Opened
5.	The ink supply valve is closed and the vacuum pump is rotated. (By rotating the purge motor in reverse direction, the vacuum pump is driven.)	Opened	Opened	Closed
6.	The ink supply valve is opened. (The ink supply valve in the sub ink tank is opened, and ink is flowed into the print head.)	Opened	Opened	Opened
7.	Filling ink to the print head is completed.	Opened	Opened	Opened
8.	Printing is performed. (Remaining ink amount is decreased.)	Opened	Opened	Opened
9.	Printing is continued while the ink tank is replaced due to no-ink.	Opened	Opened	Opened

2. Flow of the initial ink filling check:

The remaining ink detection pins installed in the sub ink tank enable the initial ink filling check precisely.

1) Print head installation check:

If failure in installing the print head is detected, to check the status of the print head installation is prompted.

2) Sub ink tank ink filling check:

When filling ink to the sub ink tank, the remaining ink detection pin (longer) detects whether ink in the sub ink tank is increasing. Then, it detects that ink has been filled from the ink tank to the sub ink tank properly. At initial ink filling, or after ink tank replacement, if the remaining ink detection pin was not turned on although the ink amount in the ink tank exceeded the threshold level, an error, "Reserve tank ink filling error (231x)" occurs.

3) Ink supply valve check :

(Procedure "No. 3" in the description of movie)

After ink is filled to the sub ink tank, the remaining ink detection pin (shorter) detects that ink level in the sub ink tank is not decreasing while the ink supply valve and ink tank valve are closed. Then, it detects whether the ink supply valve is closed properly. If failure in filling ink to the sub ink tank is detected by the remaining ink detection pin, an error, "Ink supply valve leak at initial ink filling (EC33-402x) error" occurs.

4) Print head ink filling check:

(Procedure No. 4 in the description of movie)

When the ink tank valve is closed and the ink supply valve is opened, the vacuum pump in the purge unit is driven; then, ink level in the sub ink tank becoming low is detected. In addition, detecting low ink level in the sub ink tank allows the following detection.

a) If the ink supply valve is opened properly.

b) If the cap or pump in the purge unit is performed properly.

After ink was filled to the sub ink tank, if filling ink to the tube and print head had not been done properly, an error, "vacuum error at initial ink filling (EC3F-402F)" occurs.

5) Nozzle ejection check:

Non-ejection nozzles are detected by the head management sensor.

Agitation

It is to circulate ink for the purpose of preventing ink from settling out by leaving it for a long period. The ink agitation is performed for the predetermined time according to the elapsed time since the previous agitation. The agitation is performed about 20 minutes at a maximum. After the agitation is performed, the standing time is reset and counting is restarted.

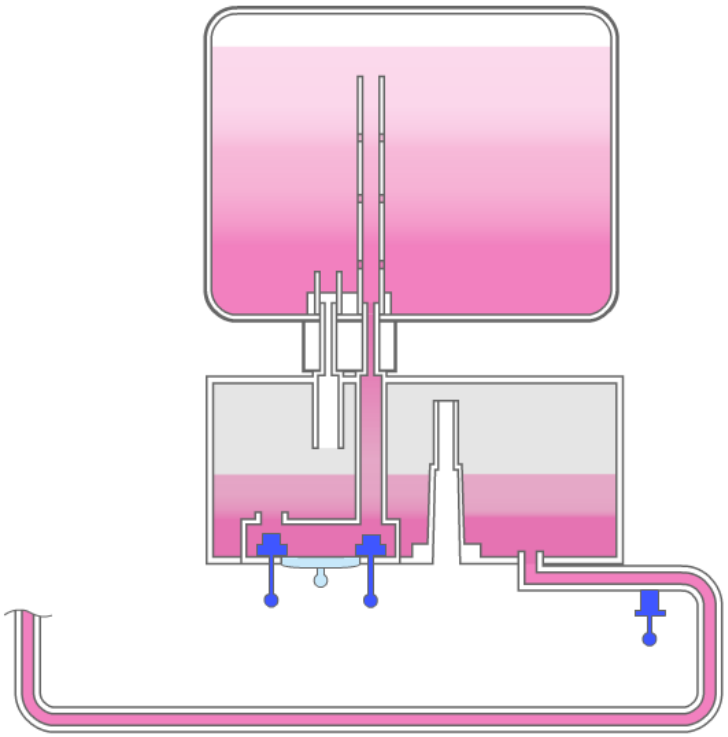
1) When to perform the agitation:

- When the power is turned on. (or before feeding a first page when the print job is set and the power is turned on while the auto power is turned on.)
- Recovering from sleep.
- Starting printing.
- Before cleaning.

2) Cases that performing agitation is interrupted:

Cases	Performance of agitation after stopped
When the print job was received.	After the print job is finished, agitation is performed for the specified time.
When the tank cover was opened.	After the tank cover is closed, the agitation is restarted.
When cleaning was executed.	After agitating the minimum time, cleaning is executed, and then, when the cleaning is completed, the rest of agitation is performed.
When the power source was turned off.	When the power source is ON again, the agitation is executed from the beginning, including the time that the printer had been stood since the previous power-OFF.

[Process of agitation]

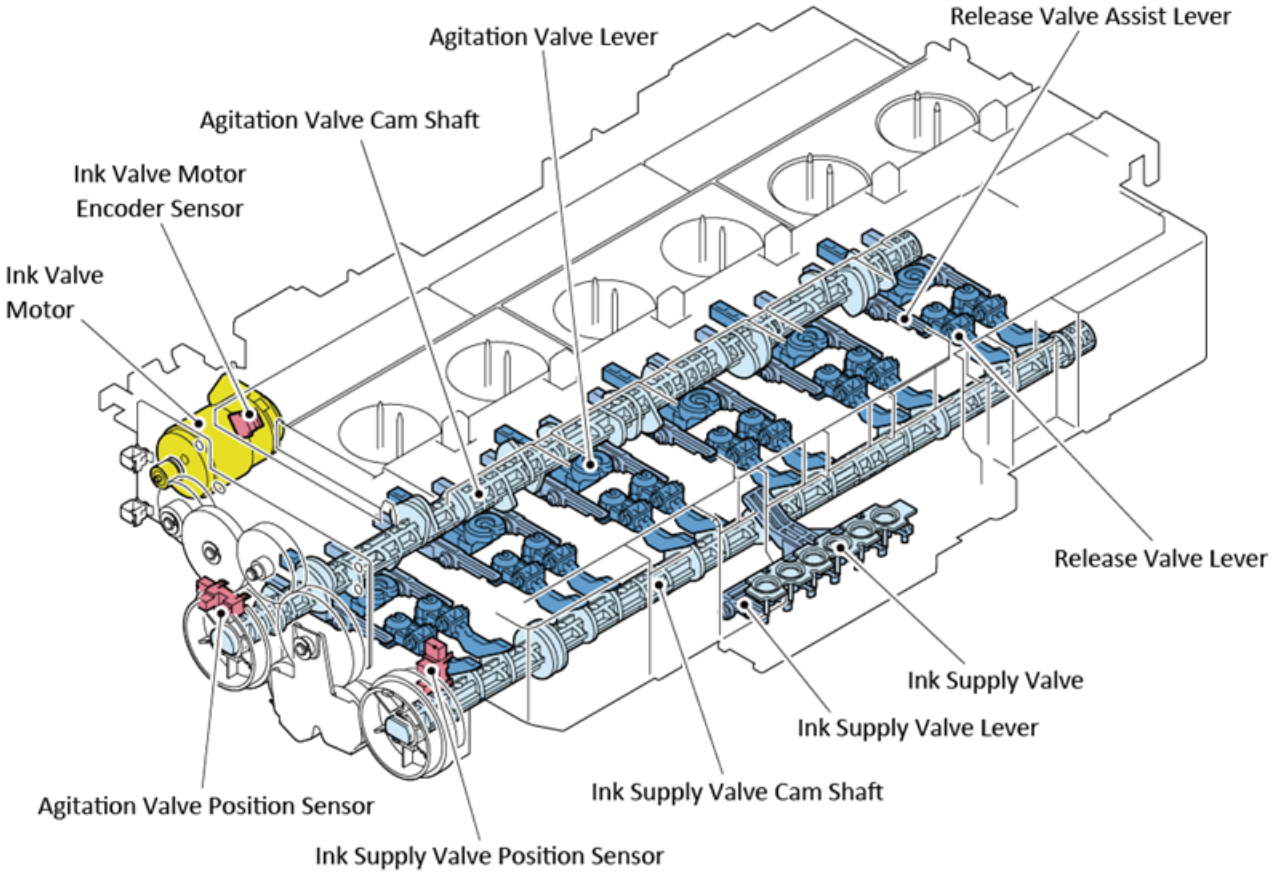


Mechanism of ink supply

No	Outline of performance	Ink Tank Valve	Sub Ink Tank Valve	Ink Supply Valve
1	Circulation is performed by agitating.			
1-1	The ink supply valve is opened.			Opened
1-2	The agitation pump is performed, and ink in the ink tank and sub ink tank is circulated.	Opened/ Closed	Opened/ Closed	Opened
2	Agitating ink in the sub ink tank is performed.			
2-1	The ink supply valve is opened.			Opened
2-2	The agitation pump is driven, and ink in the sub ink tank is circulated.	Opened	Opened	Opened

4. Drive power transmission and problem detection

[Ink supply mechanism of drive parts]



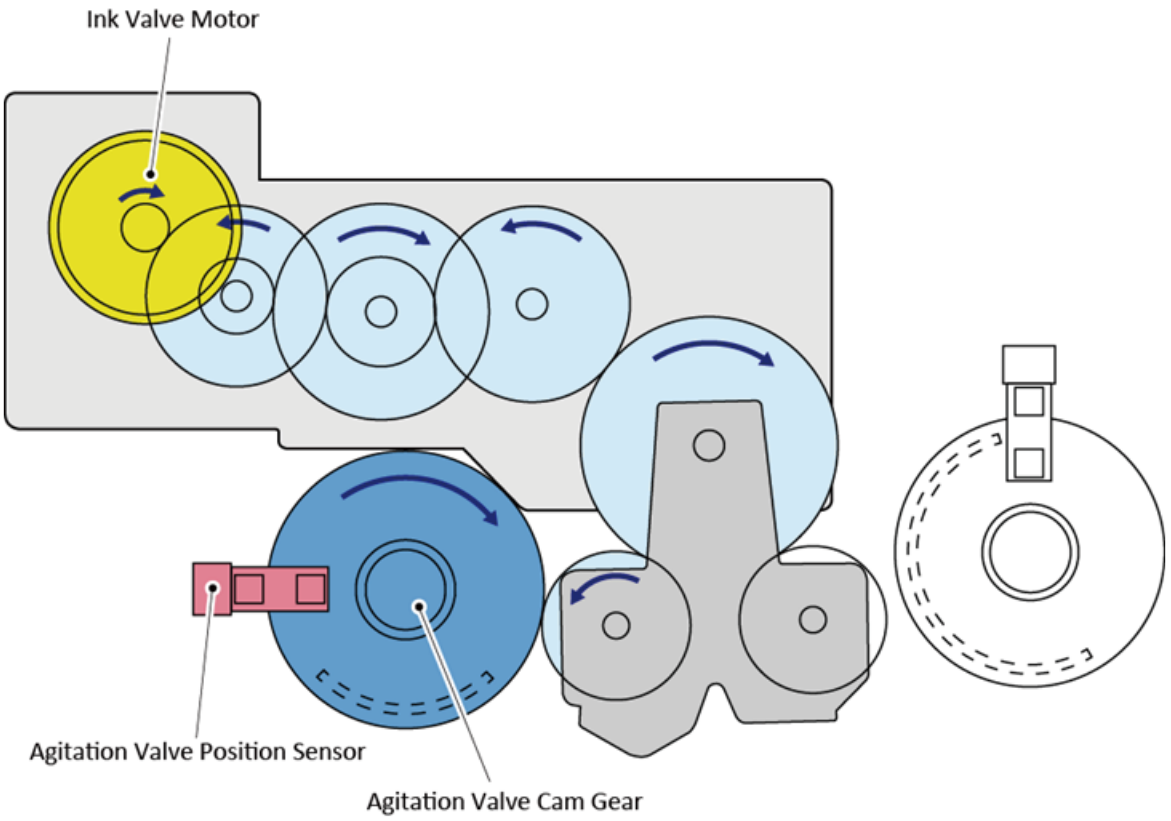
Drive power transmission:

The drive power for the ink supply unit comes from the ink valve motor in the sub ink tank unit.

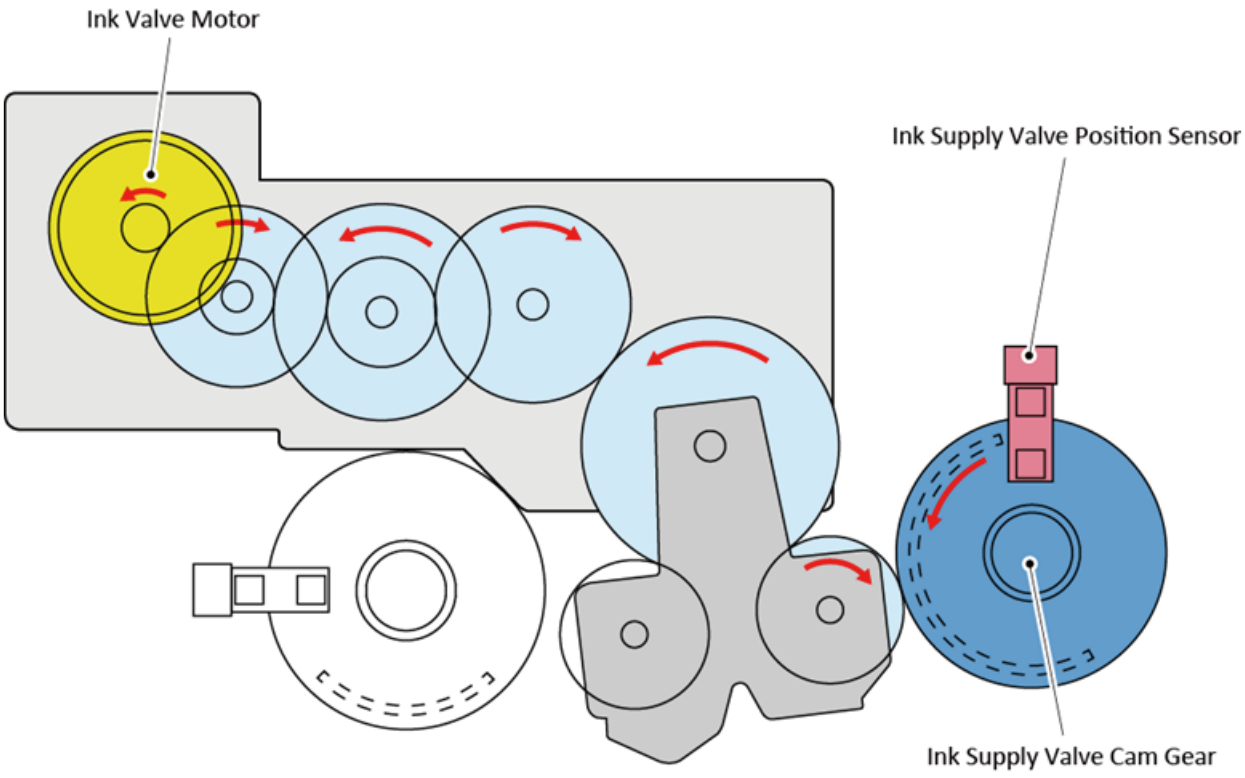
The destination of drive power transmission and performance is as follows.

Direction of Rotation	Destination of Drive Power Transmission	Performance
Rotates in normal direction	Agitation valve cam shaft	The ink tank valve and sub ink tank valve are opened and closed. The agitation pump is driven.
Rotates in reverse direction	Ink supply valve cam shaft	The ink supply valve is opened and closed.

[Rotation in normal direction]



[Rotation in reverse direction]



Problem detection

Name of Sensor	Detection	Detected Error
Agitation Valve Position Sensor	Detects the behavior of the cam shaft by detecting the flag of the agitation valve cam gear passing through and blocking out the light by the flag of the agitation valve cam gear.	· Time out error of left and right agitation drive (EC33-2604) · Time out error of right agitation drive (EC33-2605) · Time out error of left agitation valve drive (EC33-2606)
Ink Supply Valve Position Sensor	Detects the behavior of the cam shaft by detecting the flag of the agitation valve cam gear passing through and blocking out the light by the flag of the ink supply valve cam gear.	· Time out error of left and right ink supply drive (EC33-2601) · Time out error of right ink supply valve drive (EC33-2602) · Time out error of left ink supply drive (EC33-2603)
Ink Valve Motor Encoder	Detects the movement amount and speed of the ink valve motor by reading the slit in the disk film.	· Left and right ink valve motor error (EC33-2F3A) · Right ink valve motor error (EC33-2F3B) · Left ink valve motor error (EC33-2F3C)

Remaining ink detection

How to detect the remaining amount of ink:

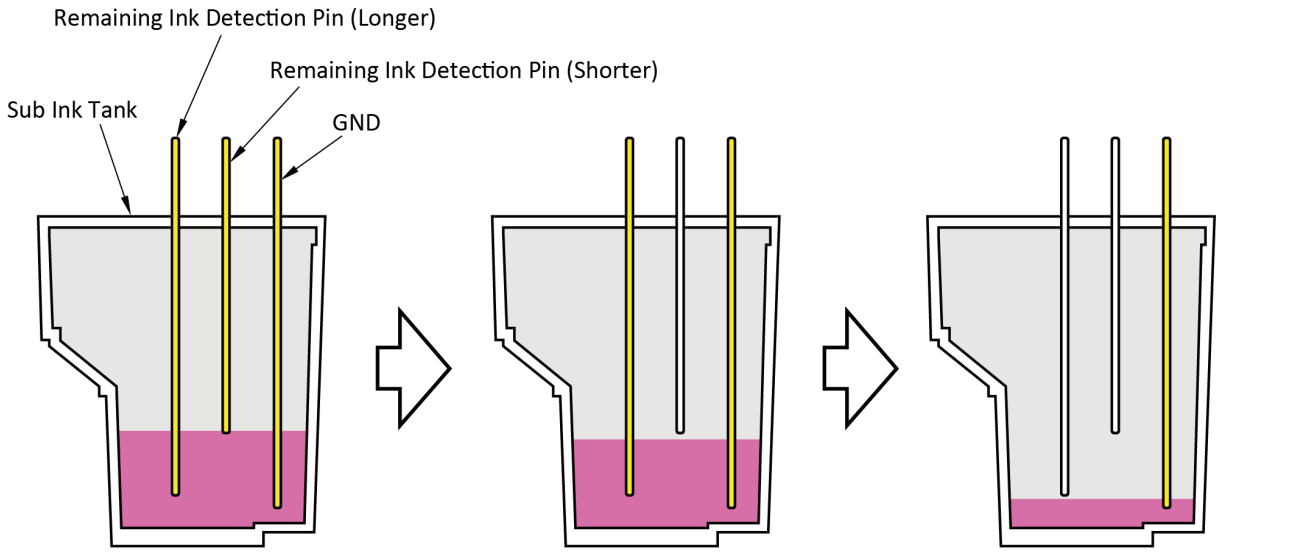
To detect the remaining amount of ink, the following two methods are adopted to this printer.

- Detected by the dot count
- Detected electrically by the remaining ink detection pin installed in the sub ink tank

How to detect by the remaining ink detection pin in the sub ink tank:

Remaining Ink Detection Pin	Detection
Remaining Ink Detection Pin (Shorter)	Detects that the sub-ink tank is full with ink. If ink level gets lower than the remaining ink detection pin (shorter), “no-ink in the ink tank” is displayed on the printer operation panel.
Remaining Ink Detection Pin (Longer)	Detects that there is no amount of ink in printing.

[Transition status of ink level in the sub ink tank]

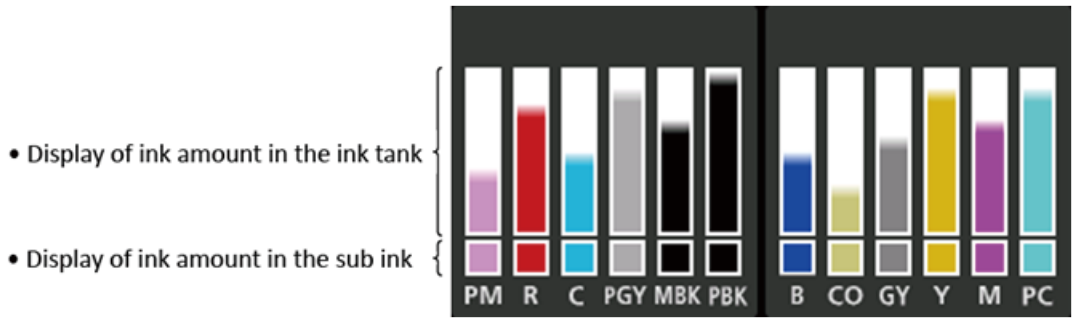


[When ink is remained in the ink tank] [When ink is run out in the ink tank] [When ink is run out in the sub ink tank]

Ink amount display:

The remaining amount of ink for each color in the ink tank and sub ink tank is displayed on the LCD.

[How to check ink amount displaying on the operation panel]



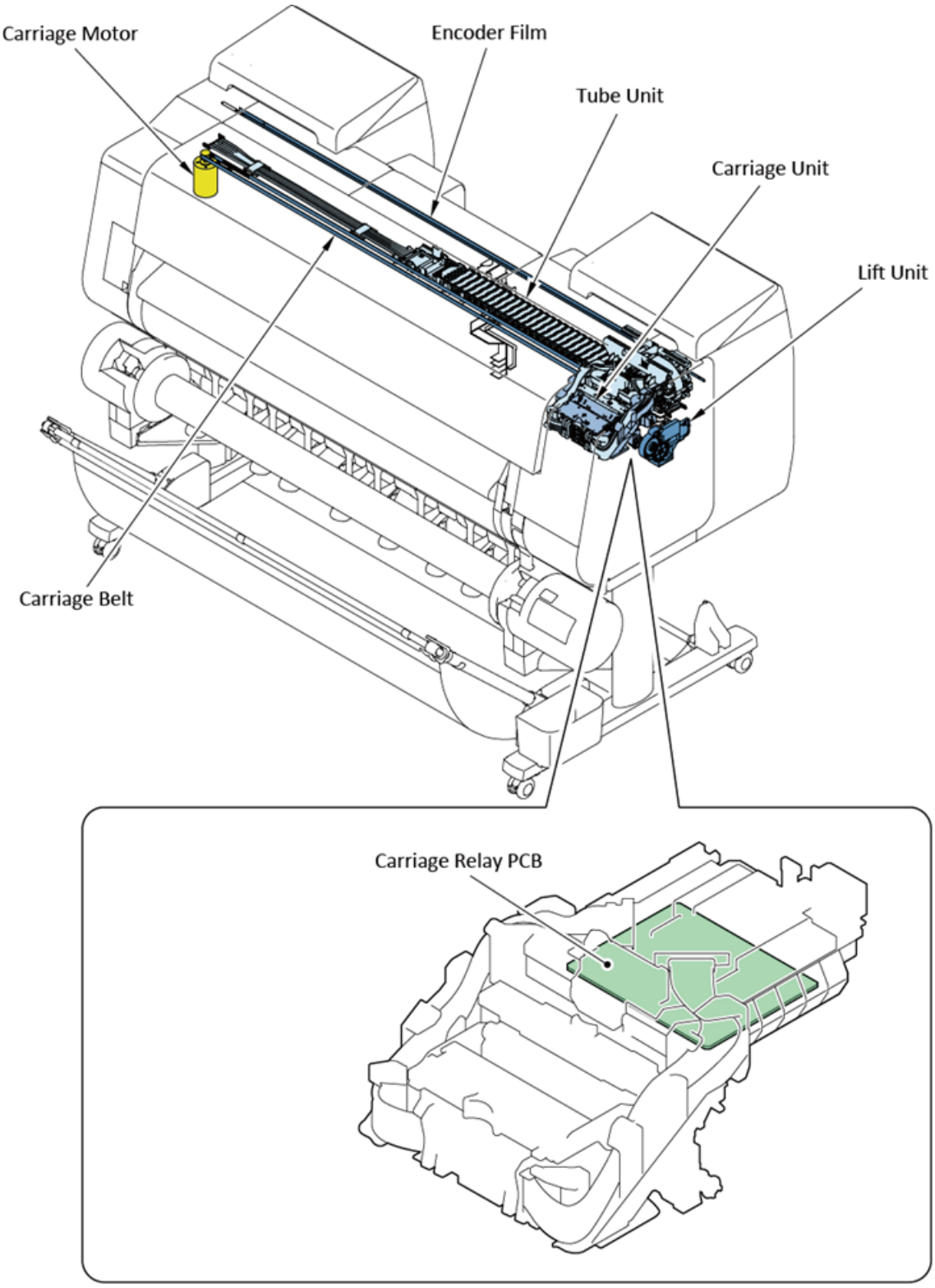
Display of ink amount and Status of ink:

Ink Level	Ink Amount	How to detect
	Ink amount remains in the ink tank.	It is detected by the dot count in the ink tank.
	Remaining ink amount is small.	It is detected by the dot count in the ink tank.
	Ink in the ink tank is run out.	If it is detected that ink level gets lower than remaining ink detection pin (shorter) in the sub ink tank, “no-ink in the ink tank” will be displayed on the printer operation panel. After that, the dot count in the sub ink tank is started. Printable until it is detected by the dot count that ink in the sub ink tank is run out.
	Ink in the sub ink tank is run out.	If the dot count in the sub ink tank is reached to the certain value and running out of ink is detected before printing, it is unable to print. If ink level becomes lower than the remaining ink detection pin (longer) while printing, the print job will be interrupted.
	The remaining ink amount is unknown.	When it is detected that the amount of ink consumption (the dot count in the ink tank) is exceeded than the specified amount.

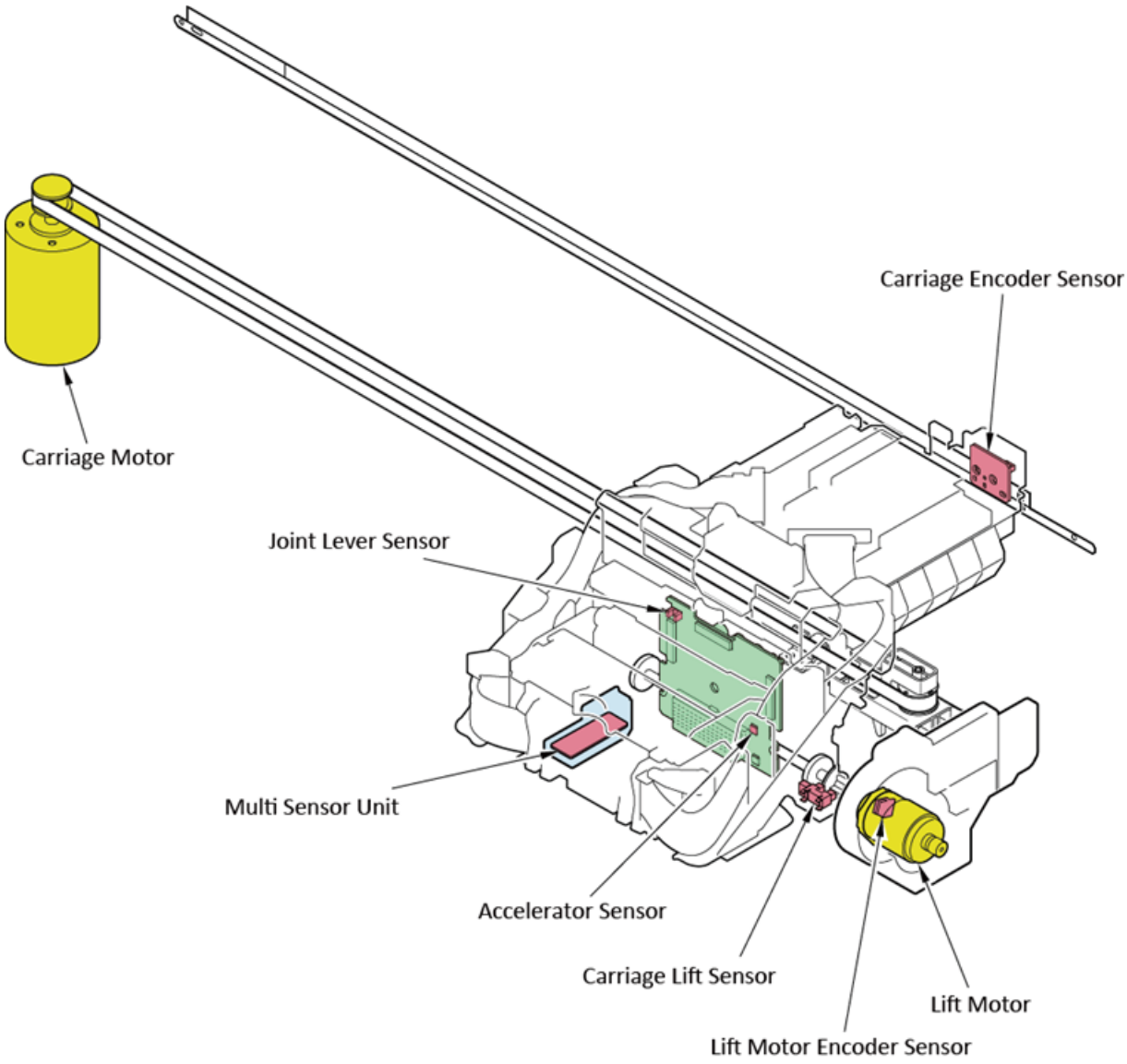
1-2-4. Carriage Unit

1. Configuration

1) Layout of unit:



2) Layout of sensor/ motor:



Sensors function:

Name of Sensor	Detection Performance
Carriage Encoder Sensor	Reads the slit in the encoder film, and detects the carriage unit movement amount moving left to right and the speed.
Multi Sensor Unit	The photo sensor receives the reflected light from the LED light radiated from the LED to the paper (the printing pattern in the color calibration).
Acceleration Sensor	Detects the carriage unit vibration and shock direction. The vibration information is used to reduce uneven printing. The information of the shock direction is used to identify the error.
Joint Lever Sensor	Detects that the joint lever is opened and closed.
Carriage Lift Sensor	Detects that the flag of the carriage lift cam rotated by the lift motor power is switched.
Lift Motor Encoder Sensor	By detecting the amount of motor movement (after detecting the flag in the carriage lift cam switched), detects whether the head-to-paper distance has been moved to the desired position.

Motors function:

Name of Motor	Performance
Carriage Motor	Source of power to move the carriage unit to the right direction.
Lift Motor	Source of power to switch the carriage height.

2. Function of Carriage Unit

Function of the carriage unit is to receive printing order (an electrical signal), moves the print head left to right, and ejects ink to accurate place from the nozzles. For the purpose of achieving these, the following functions are installed to this printer.

- Reduces unevenness in printing by controlling carriage speed evenly.
- Corrects ink dot placement both in the accelerating zone and decelerating zone by ejecting ink at different timing.
- Corrects misplaced printing position caused by mechanical accidental error.
- Improves accuracy of the ink dot placement by optimizing the carriage height.
- Prevents the nozzles from clogging while printing.
- Various adjustments and detection by the multi sensor.

1) Reducing uneven printing by equalizing the carriage speed:

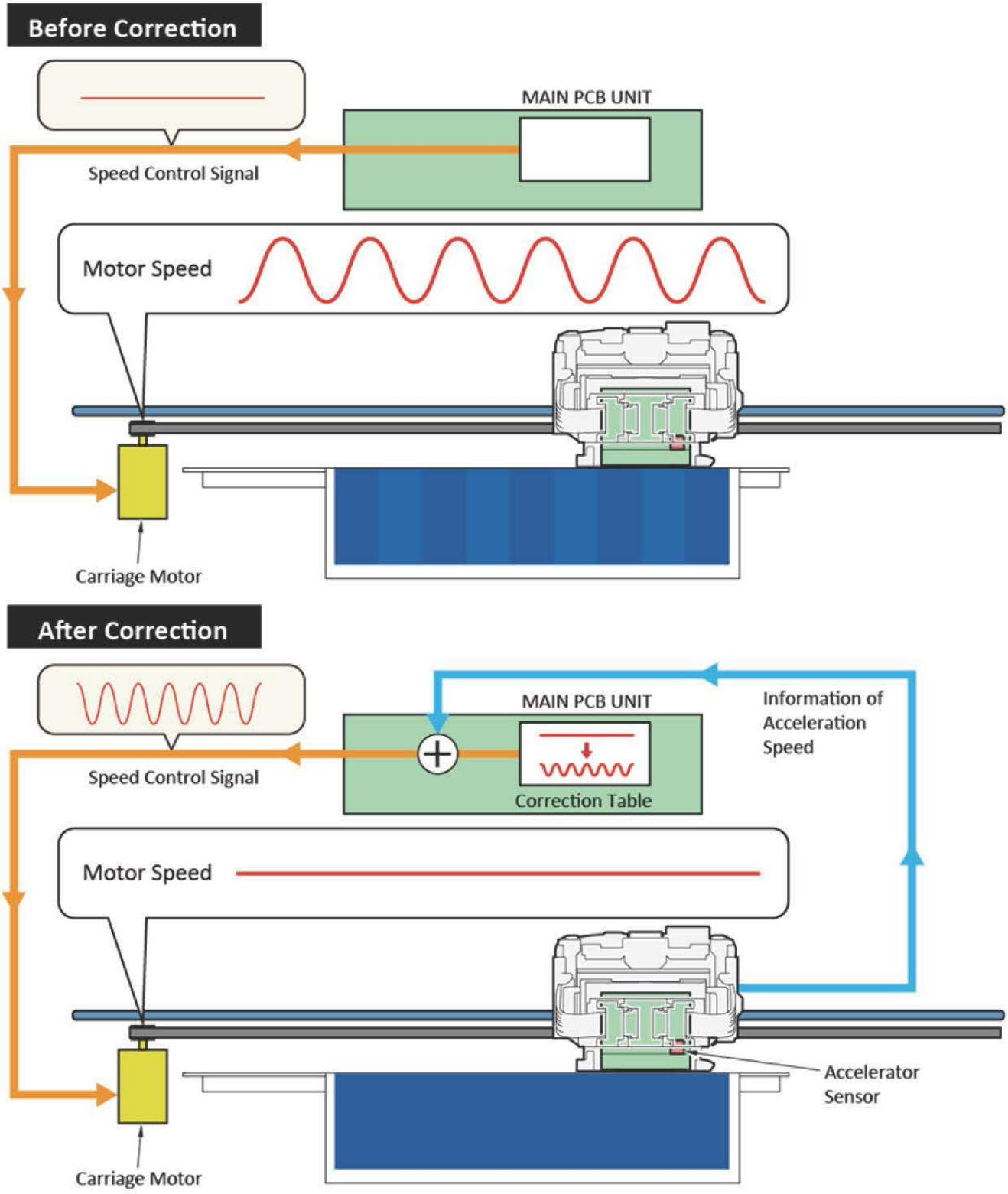
a) Equalizing the carriage speed by the motor torque correction:

The correction table which corrects uneven carriage speed caused by the carriage motor torque (the anti phase signal) is equipped to this printer. By controlling the motor speed, uneven printing (occurs in about 5 mm to 7 mm interval) caused by inconstant speed, which is caused by the motor torque, is reduced. This correction is also adopted to the current LEP.

b) Equalizing carriage speed by acceleration correction signal:

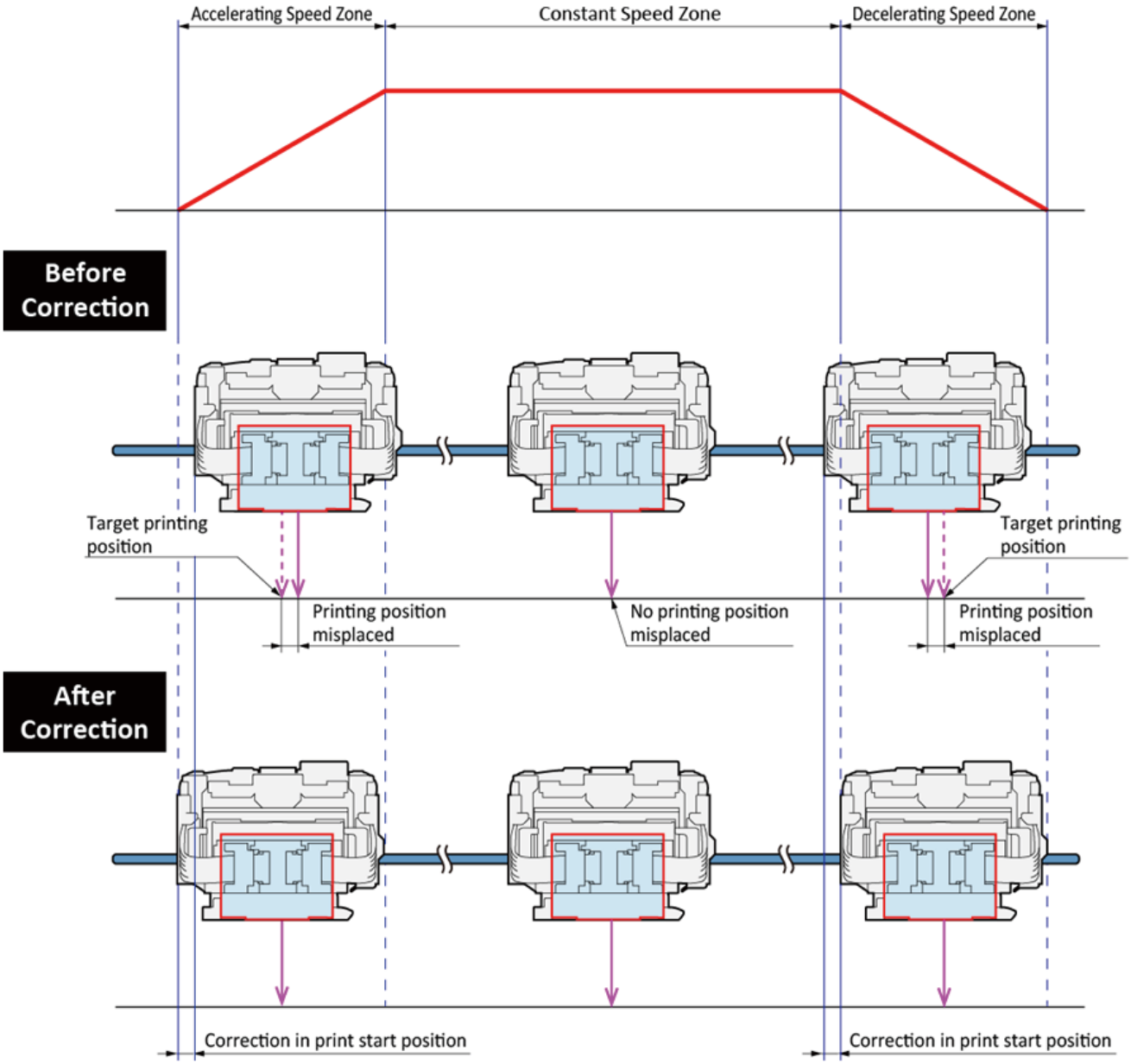
The acceleration sensor is newly adopted to this printer to achieve high quality print and to improve carriage speed equalization, besides equalizing the carriage speed by the motor torque correction table. The acceleration information read by the acceleration sensor during moving carriage is fed back to the motor torque correction table, and the carriage speed is controlled in real time.

Image of the carriage feeding speed correction:



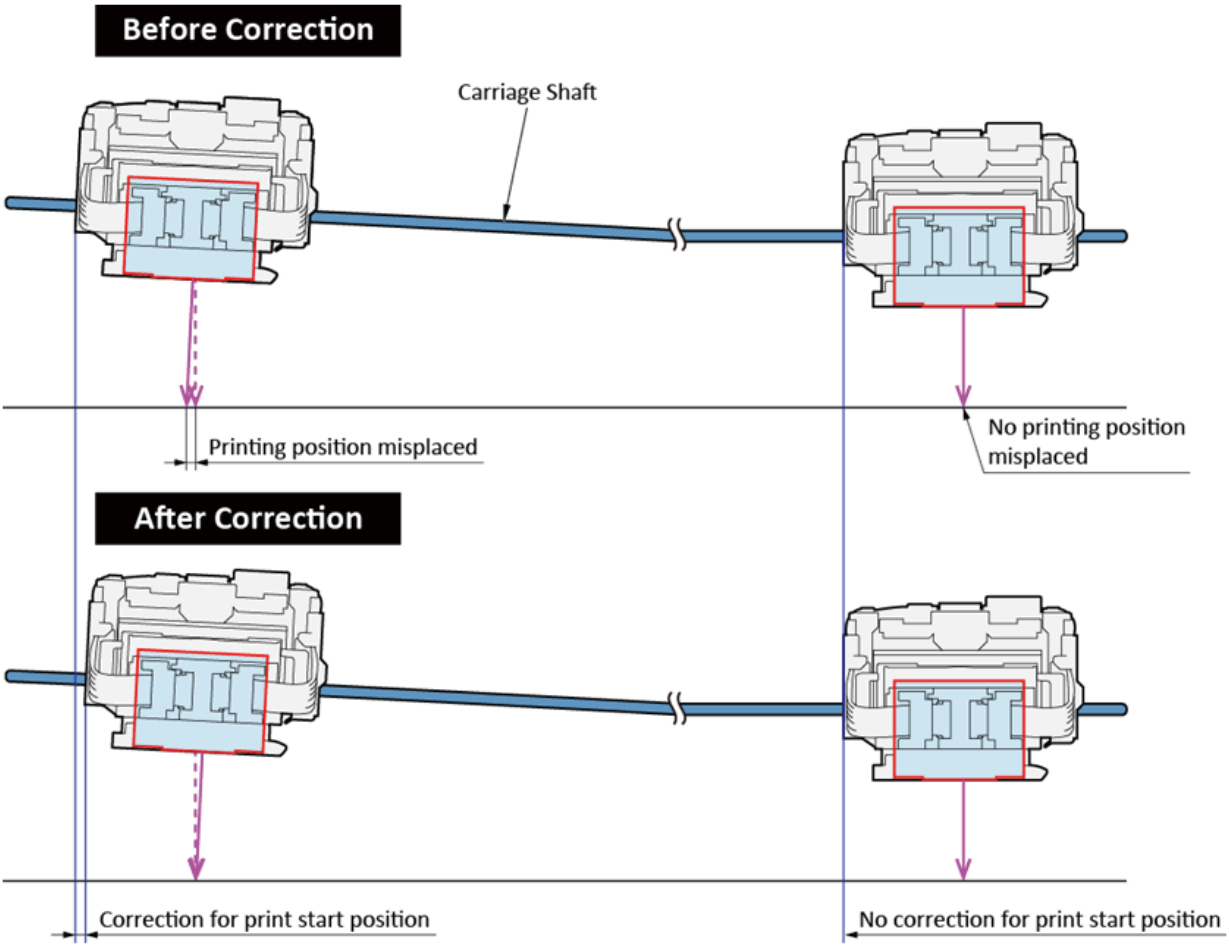
2) Correcting ink dot placement in the accelerating and decelerating speed zone:

It controls timing of ink ejection against the ink dot misplacement caused by the carriage speed in the acceleration and deceleration zone. When the carriage speed is constant at all times, ink dot can be landed to the desired printing position while speed from ink ejection to the ink dot landing is included. In this product, to improve printing speed, printing is performed while the carriage is accelerated and decelerated in the printing area. If timing of ink ejection is controlled evenly without considering the difference in speed between the accelerating / decelerating zone and the constant speed zone, printing error occurs against the desired printing position (refer to the "Before correction" in the picture below). By controlling print start timing with considering difference in speed between the accelerating / decelerating speed zone and the constant speed zone, misplacement of a printing position can be avoided.



3) Correcting misplacement of printing position caused by mechanical error:

This correction is to perform against misplacement of the printing position in scanning direction, which cannot be corrected by the print head alignment in the user mode. The correction tables are provided for the both direction. Applying this correction table, which is created for each print start position, can prevent faulty printing.



4) Improving ink dot placement accuracy by optimizing the carriage height:

As the carriage height gets wider, ink mist, which is generated when ink is ejected from the print head and the ink dot is landed to the paper, increases. When the carriage height gets narrow, the print head may be contacted.

To print in accurate carriage height, the print head is adjusted to optimum height automatically according to the paper type and environment (temperature / moisture) before printing. The carriage height has 6 positions as follows.

Position	Distance from the print head nozzle to the platen	Main Usage
Lowest (SL)	1.0mm	
Low (L)	1.4mm	Carriage lock, Wiping
Slightly lower (M1)	1.6mm	
Standard (M2)	1.8mm	
Slightly higher (M3)	2.2mm	
Higher (H)	2.6mm	

Procedure to change the carriage height

To change the carriage height is performed in the following procedure.

1) Connects to the coupling:

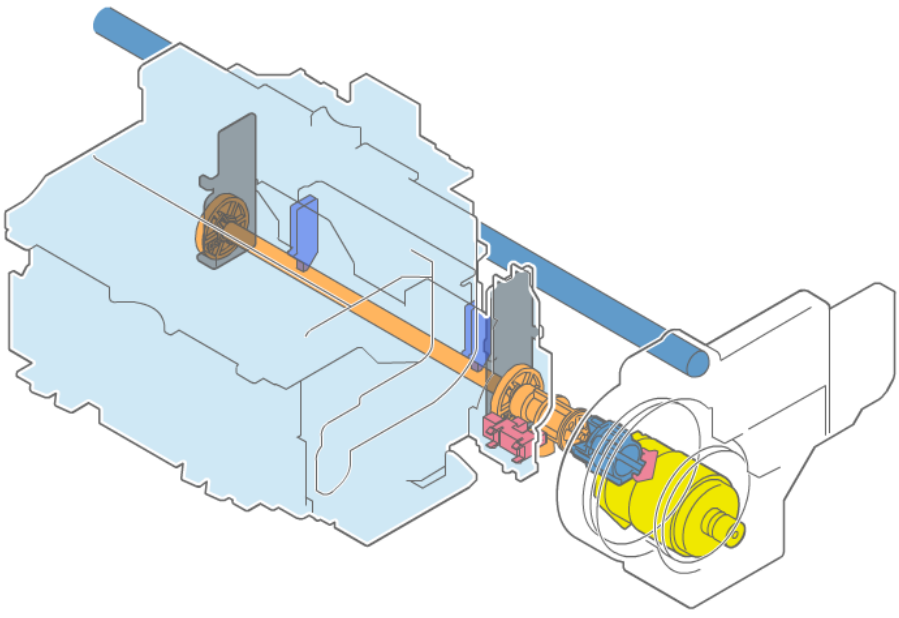
By power from the carriage motor, the carriage unit is moved to the certain place to change the carriage height, and connects to the coupling.

2) Changes the carriage height:

The power from the lift motor is transmitted to the carriage cam shaft, and the carriage lift cam is rotated. With the cam rotated, the carriage front part is moved up and down, and the carriage height is switched to optimum height.

3) Stops the lift motor:

As the carriage unit front part is moved to the desired carriage height, the lift motor stops, and to change the carriage height is completed.



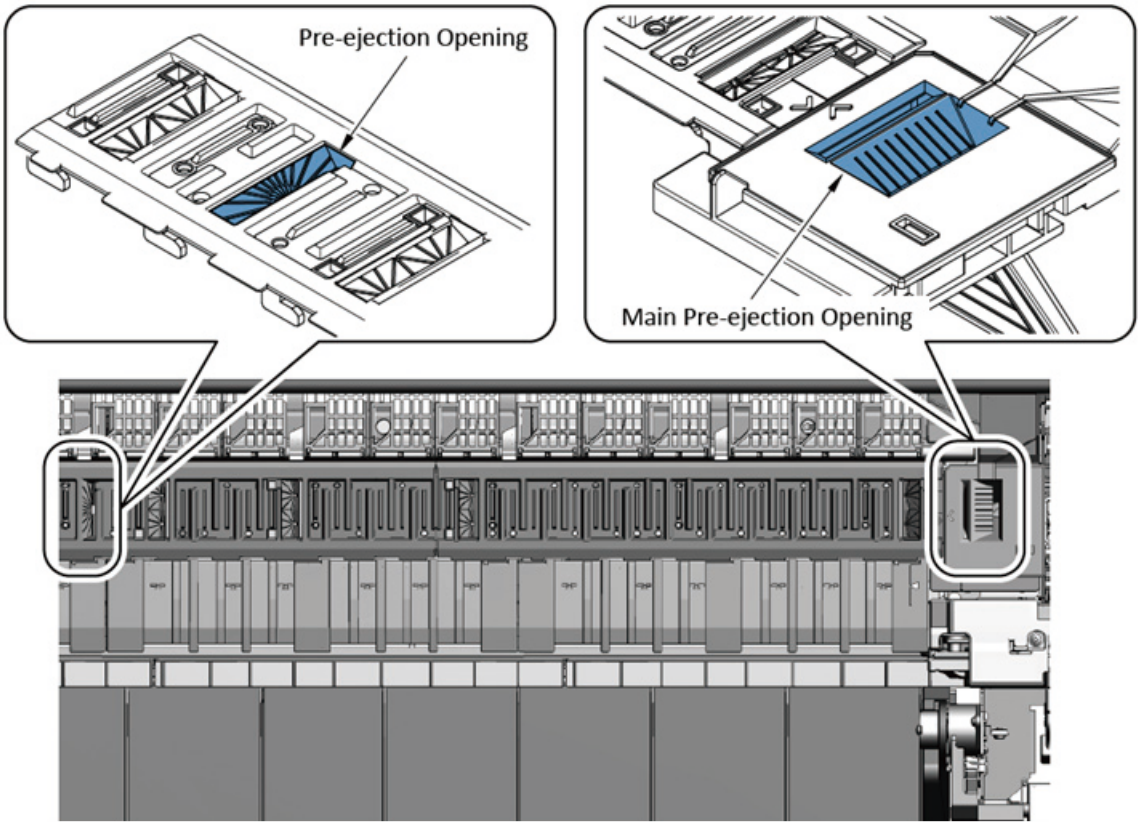
Process to change the carriage height:

Process	Performance
1	The carriage unit is moved to the carriage height changed position, and connects to the coupling of the lift unit.
2	The power in the lift motor is transmitted to the carriage cam shaft, and the carriage cam is rotated. Flag switchover in the lift cam sensor is detected, and the movement amount is detected by the lift cam encoder sensor.
3	The carriage unit front part is moved to optimal height for the carriage height.
4	The lift motor stops.

5) Function to prevent the nozzles from clogging while printing:

To achieve high quality print, pre-ejection is performed while printing.

The old ink inside the nozzles, the air bubble, and the mixed color ink are ejected. In addition, the dusts are removed. Place to perform the pre-ejection is based on the paper detection result.



6) Various adjustment and detection by the multi sensor:

To improve accuracy of printing position, the paper width and paper position are measured automatically. Print to outside of the paper can avoid. The multi sensor is also used for GAP detection, print head alignment, paper feed adjustment, color calibration, and etc.

Configuration

The multi sensor consists of the paper edge detection part, the GAP detection part, and the density detection part. The light-emitting part (LED) and the light-receiving part (photo sensor) are installed in each part.

A) Paper edge detection:

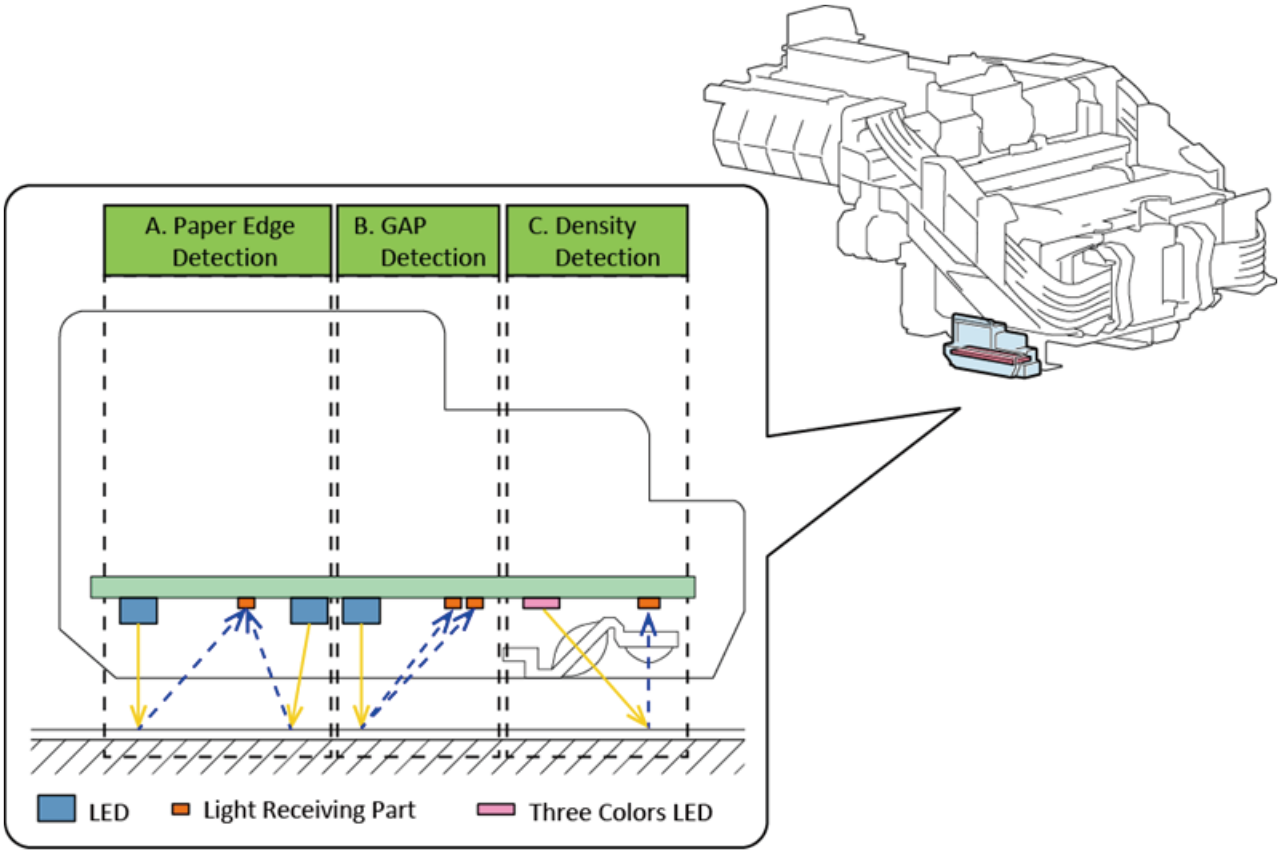
LED (the A in the picture below) light is radiated to a paper. The reflected light from the LED light is received by the photo sensor, then, it detects the paper edge, the paper width, and the paper skew.

B) GAP detection:

LED (the B in the picture below) light is radiated to a paper and the reflected light from the LED light is received by two photo sensors. The height between the print head and the paper is measured and is adjusted.

C) Density detection:

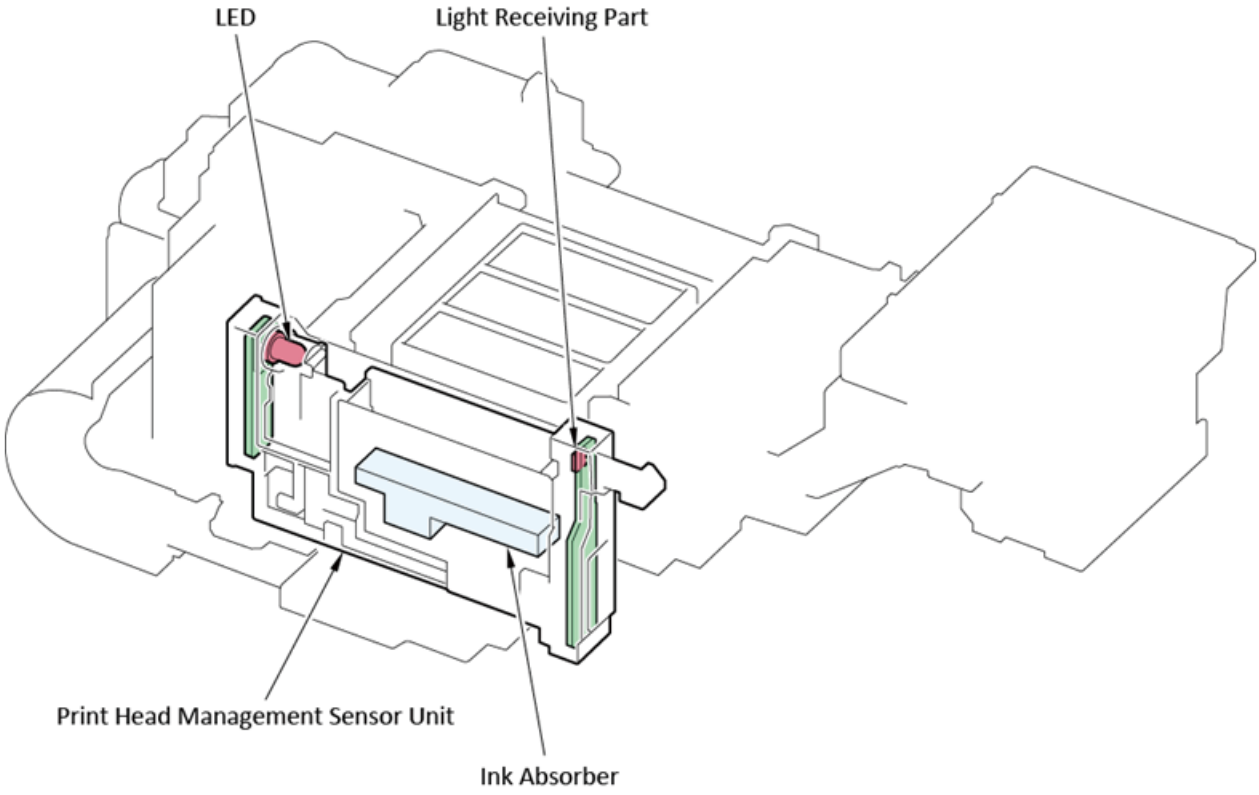
In the printed printing pattern, the reflected light from the LED light which is radiated from three colors LED (the C in the picture below) is received by the photo sensor, and the color calibration is performed.



1-2-5. Print Head Management Sensor Unit

1. Configuration

The print head management sensor is composed of the LED, the light receiving part, and the ink absorber.



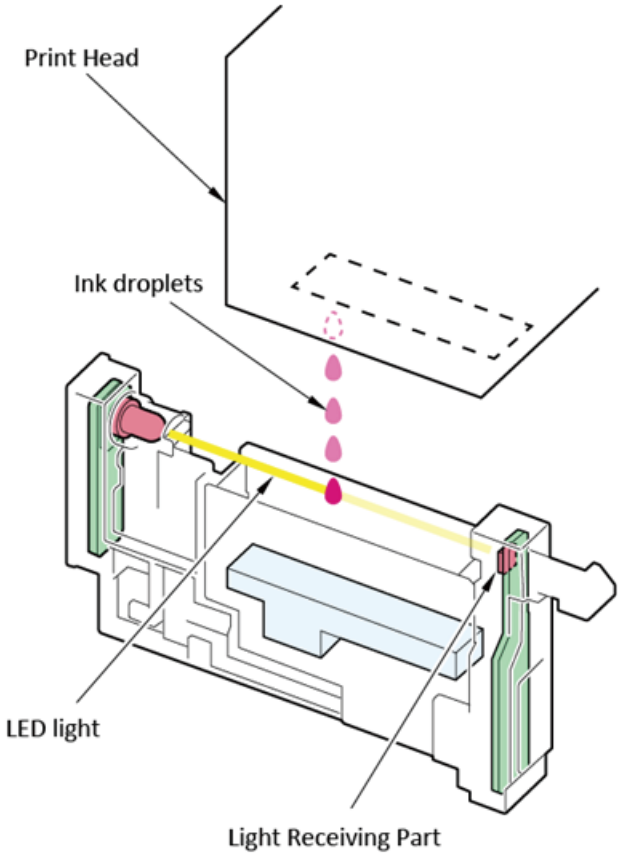
2. Operation outline

The sensor receives the LED light while non-ejection detection is performing.

The LED light is blocked by ink ejected from the print head; as a result, the amount of received light in the sensor is changed. When the LED light is not blocked, the amount of light is not changed.

The nozzle of which the amount of light is not changed, it is judged as the non-ejection nozzle.

The result of non-ejection detection is saved to the RAM area after the non-ejection detection is performed. It is used for recovering by cleaning or non-ejection complementary. Deterioration of the printing quality due to non-ejection of ink can be prevented.



3. Non-ejection detection process flow

Non-ejection nozzles' detection is performed in the following order.

1) Optical axis adjustment

Outline:

To implement the non-ejection detection, the appropriate head management sensor position is detected and the non-ejection detection position is determined against all the nozzles.

When to implement:

- At initial setting
  - After initial filling in the initial setting, "Optical axis adjustment" -> "Detecting non-ejection" is performed automatically.
- After the HEAD MANAGEMENT SENSOR UNIT replacement.
- After removing and installing the PRINT HEAD.
- After ink filling after transportation
- If there are more than 100 nozzles not matched with the previous result of non-ejection detection, then, the optical axis adjustment after the recovery cleaning is performed.

2) Non-ejection detection

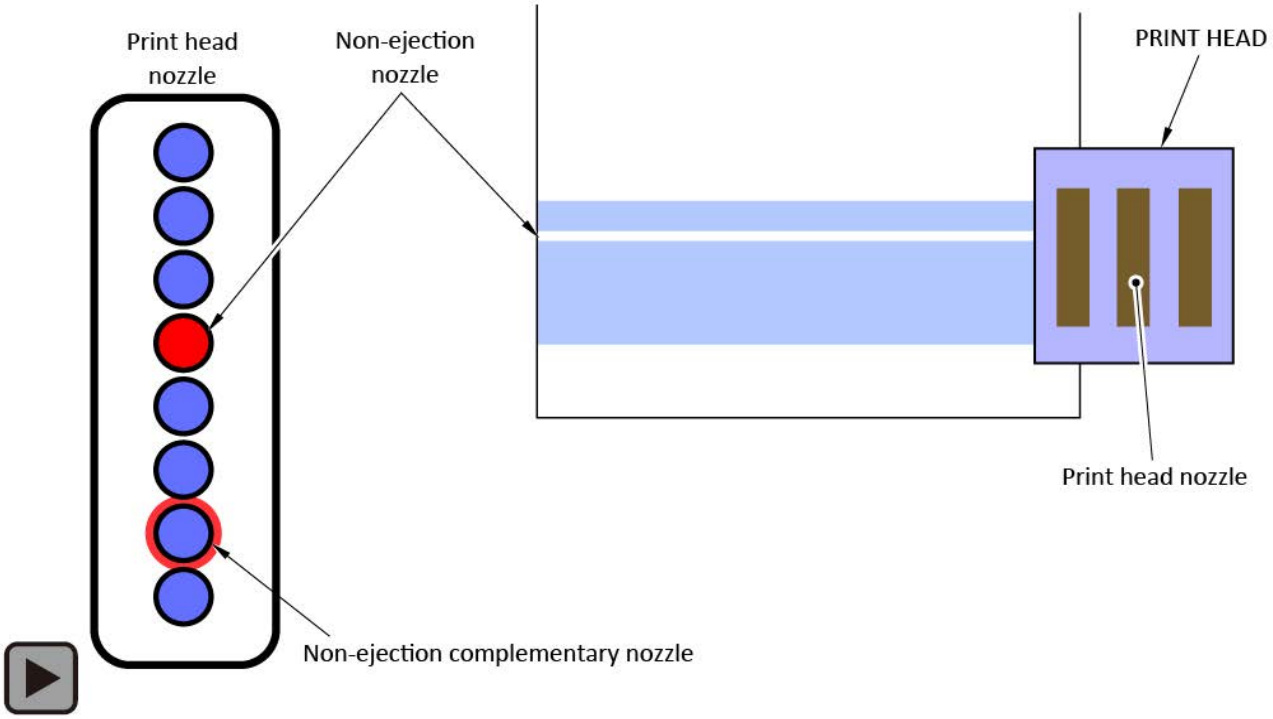
When to implement:

- When filling ink at setting
- After conducting various cleaning.
- After the specified amount of ink (by dot count) is ejected since the previous non-ejection detection performance.
- After printing number of papers set by the customer since the previous non-ejection detection performance (It is performed between pages even while the print jobs are executing.).
- After replacing the PRINT HEAD.
- After ink filling after the transportation.
- After 168-hours elapsed since the previous ejection.

3) Recovery operation after detecting the non-ejection

The following operation is performed after the clogging nozzle is detected.

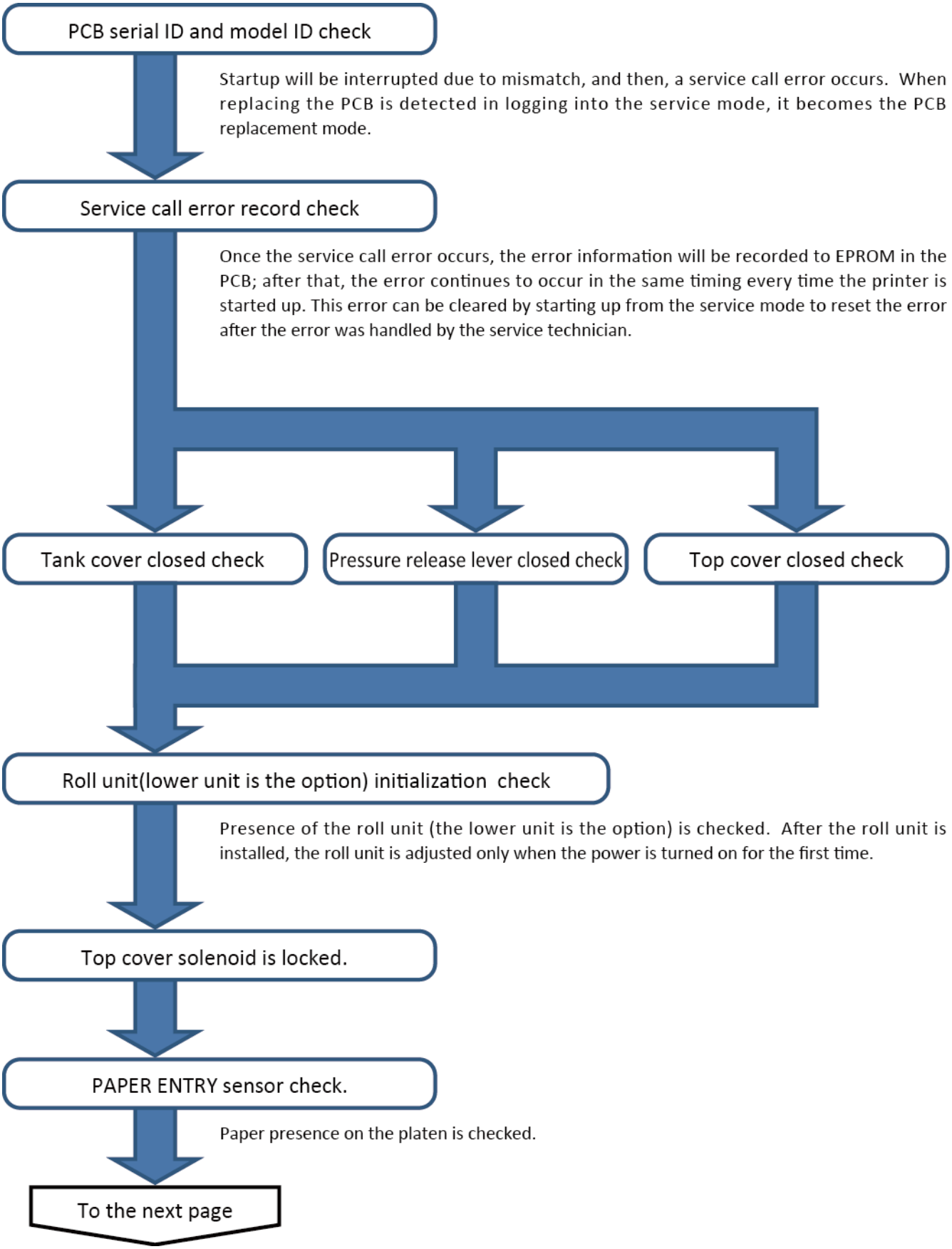
- The nozzles are recovered by cleaning.
- Ejection from the clogging nozzle is stopped. Non-ejection is complemented by ejection from the other nozzles.

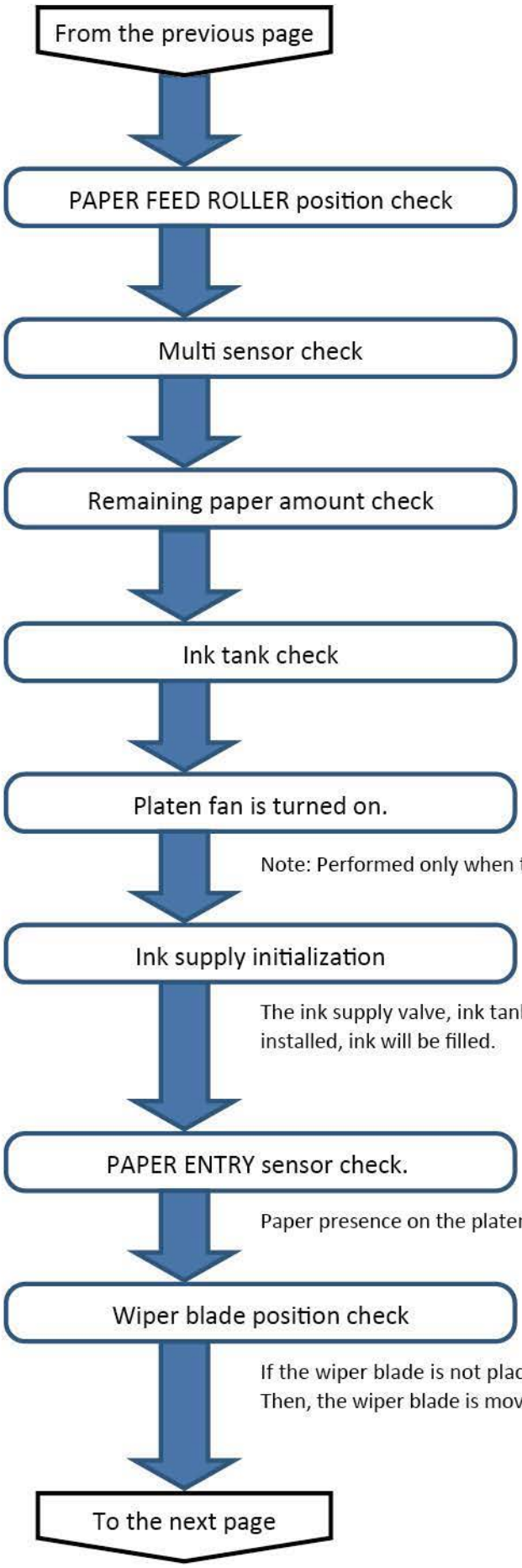

Print head nozzle
Non-ejection nozzle
PRINT HEAD
Print head nozzle
Non-ejection complementary nozzle

1-3. Initial Flowchart

1-3-1. Initial Flowchart

The flowchart below shows the initial printer operation from power-on till the printer gets ready for printing.



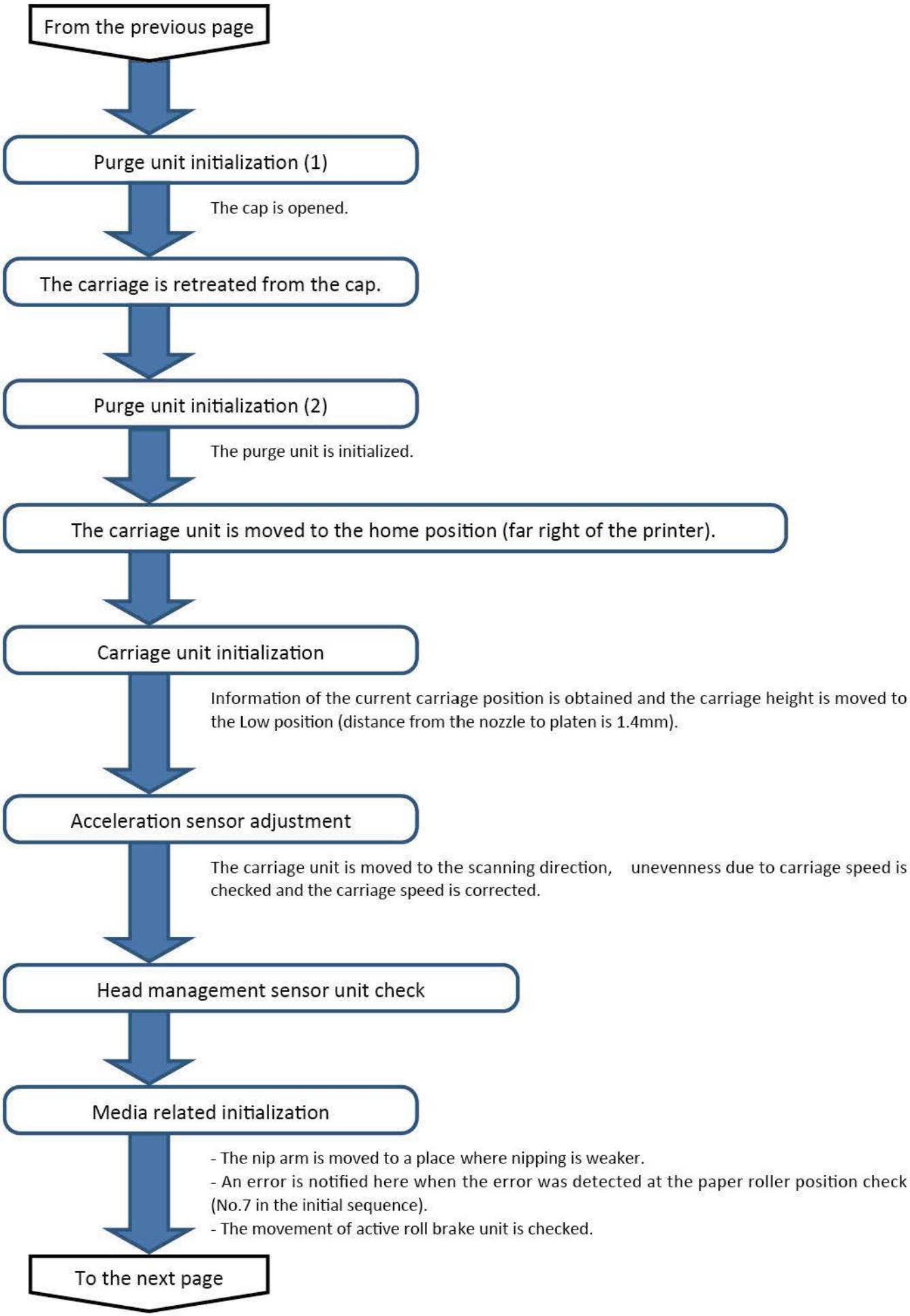


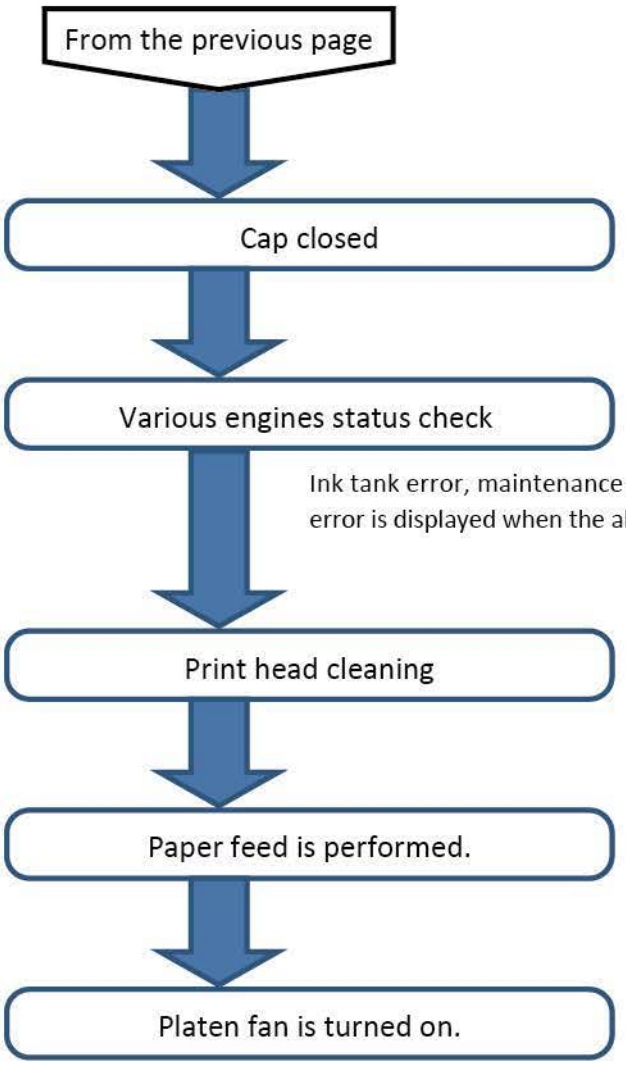
Note: Performed only when the paper is set.

The ink supply valve, ink tank valve, and sub ink tank will be opened. If the ink tank has been installed, ink will be filled.

Paper presence on the platen is checked.

If the wiper blade is not placed on the home position, the carriage is retreated from the cap. Then, the wiper blade is moved to the home position.


From the previous page
Purge unit initialization (1)
The cap is opened.
The carriage is retreated from the cap.
Purge unit initialization (2)
The purge unit is initialized.
The carriage unit is moved to the home position (far right of the printer).
Carriage unit initialization
Information of the current carriage position is obtained and the carriage height is moved to the Low position (distance from the nozzle to platen is 1.4mm).
Acceleration sensor adjustment
The carriage unit is moved to the scanning direction, unevenness due to carriage speed is checked and the carriage speed is corrected.
Head management sensor unit check
Media related initialization
- The nip arm is moved to a place where nipping is weaker.
- An error is notified here when the error was detected at the paper roller position check (No.7 in the initial sequence).
- The movement of active roll brake unit is checked.
To the next page



Ink tank error, maintenance cartridge error, print head error, and engines are checked. An error is displayed when the abnormal behavior is detected.

Note: Only when the paper is set.