

Printing / copying process and the key functions

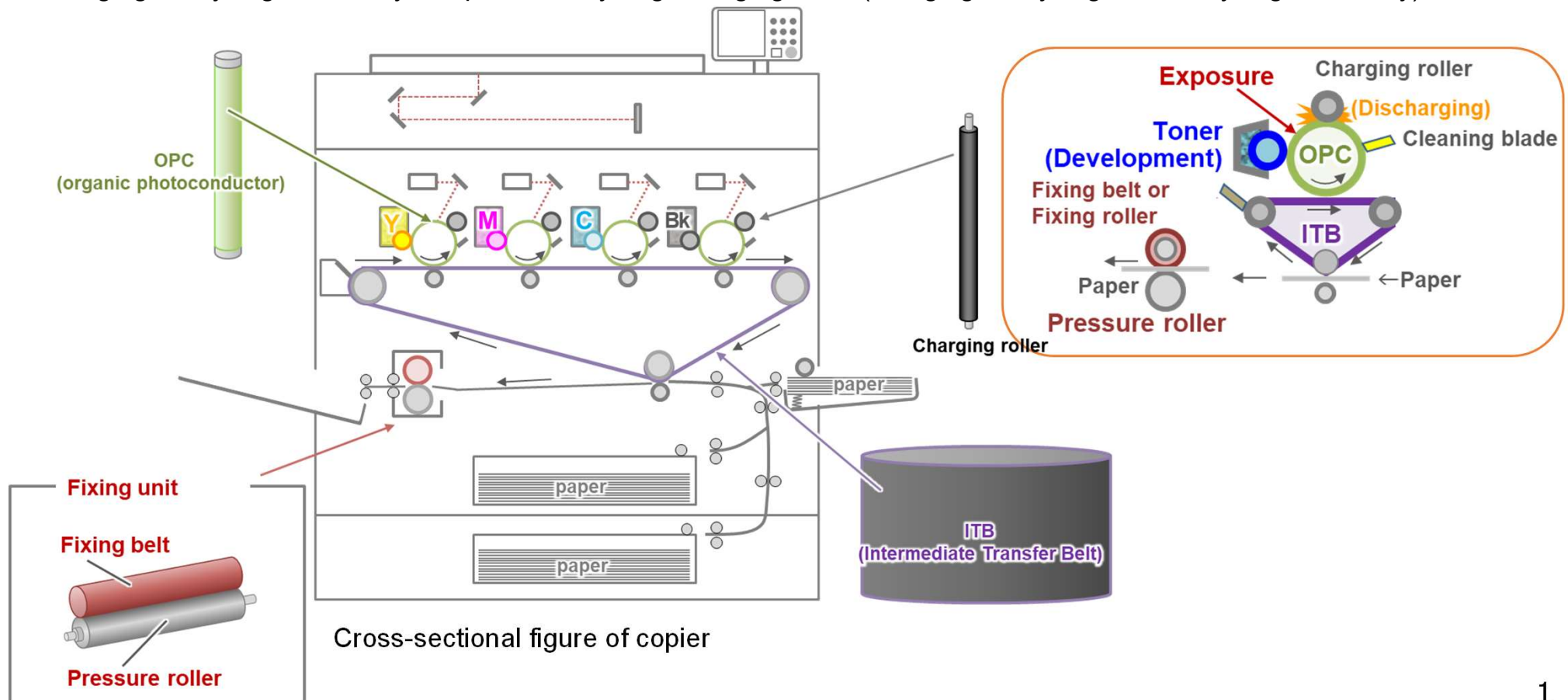
■ Sliding function

Functions essential for printers and copiers, such as lubrication, water and oil repellency, chemical resistance, and charging-ability for driving and sealing parts (rollers, bearings, gears, separation plates, inkjet heads, sheets, flanges, rings, etc.)

■ Required characteristics of materials used in parts and units

Two or more functions need to be satisfied simultaneously with a single material.

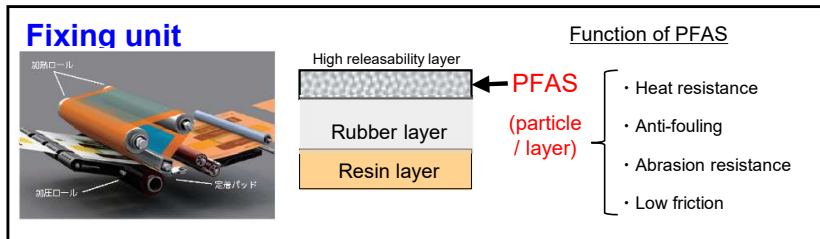
- Lubricity and sliding property: e.g. motors, bearings, gears, grease, lubricants (high durability, high reliability)
- Flame retardancy, chemical resistance, and water repellency: e.g. packing, O-ring, inkjet head (high durability, high reliability)
- Charging ability, high durability, shape accuracy: e.g. charging roller (charging ability, high durability, high reliability)



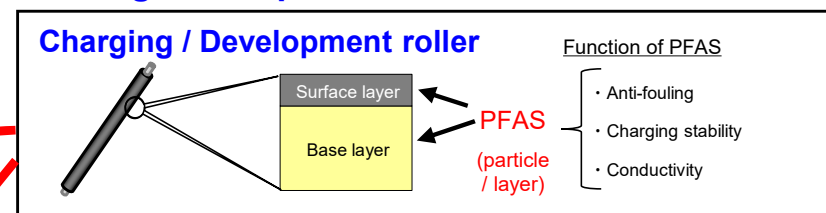
Essential use of PFAS required in the printing / copying process

Breakdown illustration of each unit/component, for which alternative material for PFAS is not available.

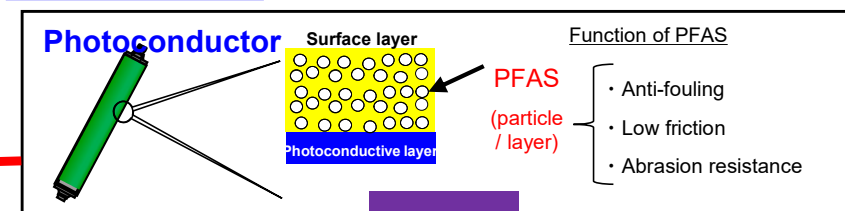
Slides 3 – 5 for more detailed explanation of using PFAS in [Fixing unit](#)



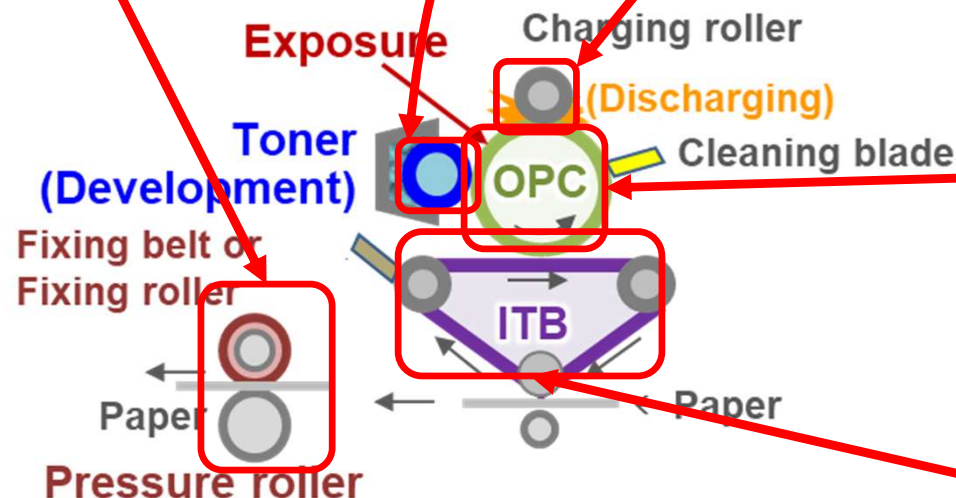
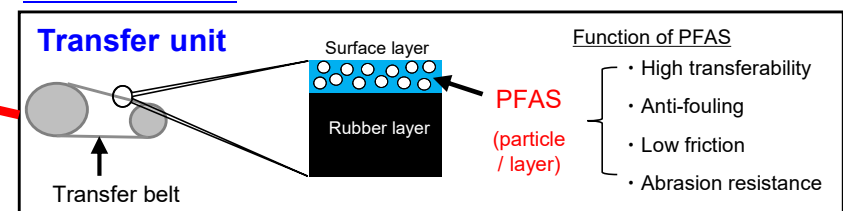
Slide 6 for more detailed explanation of using PFAS in [Charging/Development roller](#)



Slide 7 for more detailed explanation of using PFAS in [Photoconductor](#)



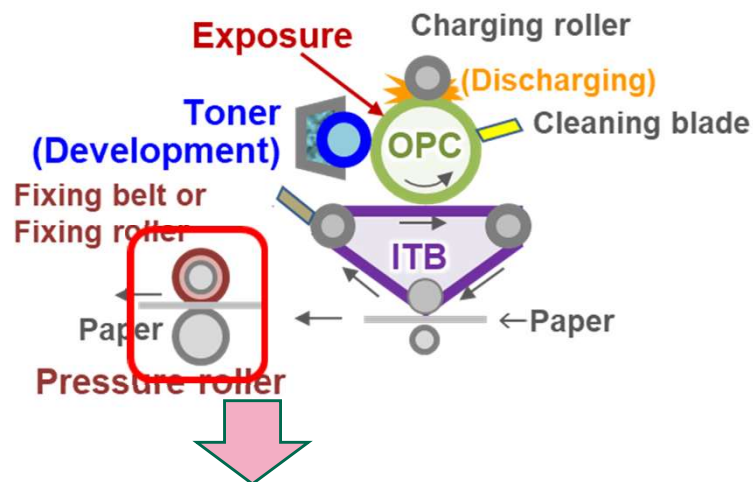
Slide 8 for more detailed explanation of using PFAS in [Transfer unit](#)



Slide 9 -10 for more detailed explanation of using PFAS in [other parts and units](#)

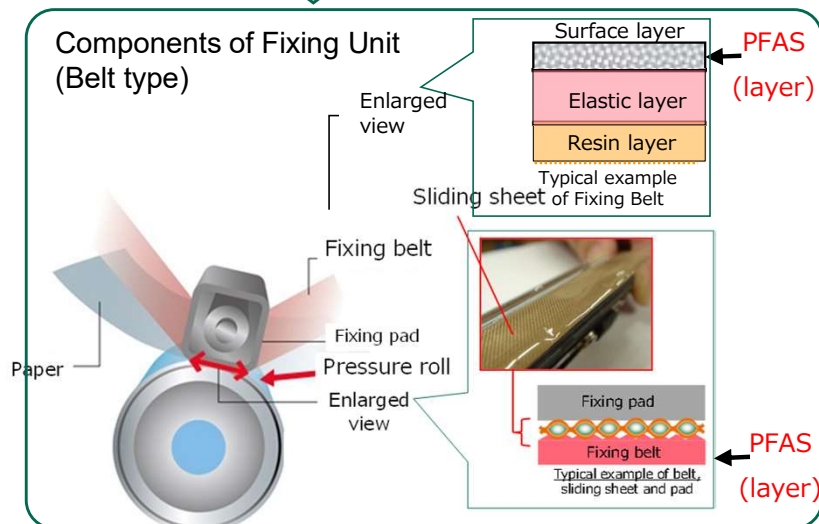
Parts/components of Fixing Unit

In the fixing process, the toner image is melted at a high temperature and fixed to the paper by applying heat and pressure, and the image must be completely duplicated without any omission of the original image data.

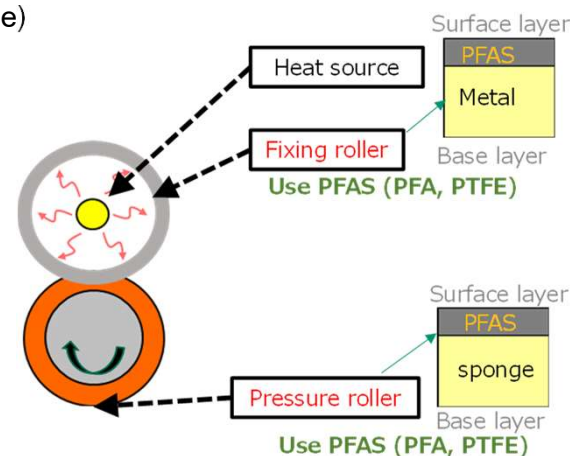


The essential use of PFAS and the reasons of no alternative

Necessary functions	It is required that the toner resin melted at a high temperature is fixed to the paper by applying pressure, and that the image formed with the toner is peeled from the fixing unit without missing. Because the components are constantly exposed to high temperatures of 150 to 250 degree Celsius, they must have heat resistance and flame resistance. Efficient heat transfer to melt toner on the paper, and flexibility to fit for surface of any type of papers which toner is put on. Abrasion resistance to talc, calcium carbonate, etc. contained in the paper. The sliding property must be able to reduce the load on the belt drive for a long life under high temperatures without damage.
Reasons of using PFAS	Because the material has all the properties of heat resistance, releasability, flame resistance, flexibility, water and oil repellency and abrasion resistance.
Reason of no alternative	There is no material which fulfils all properties, including combinations of materials.



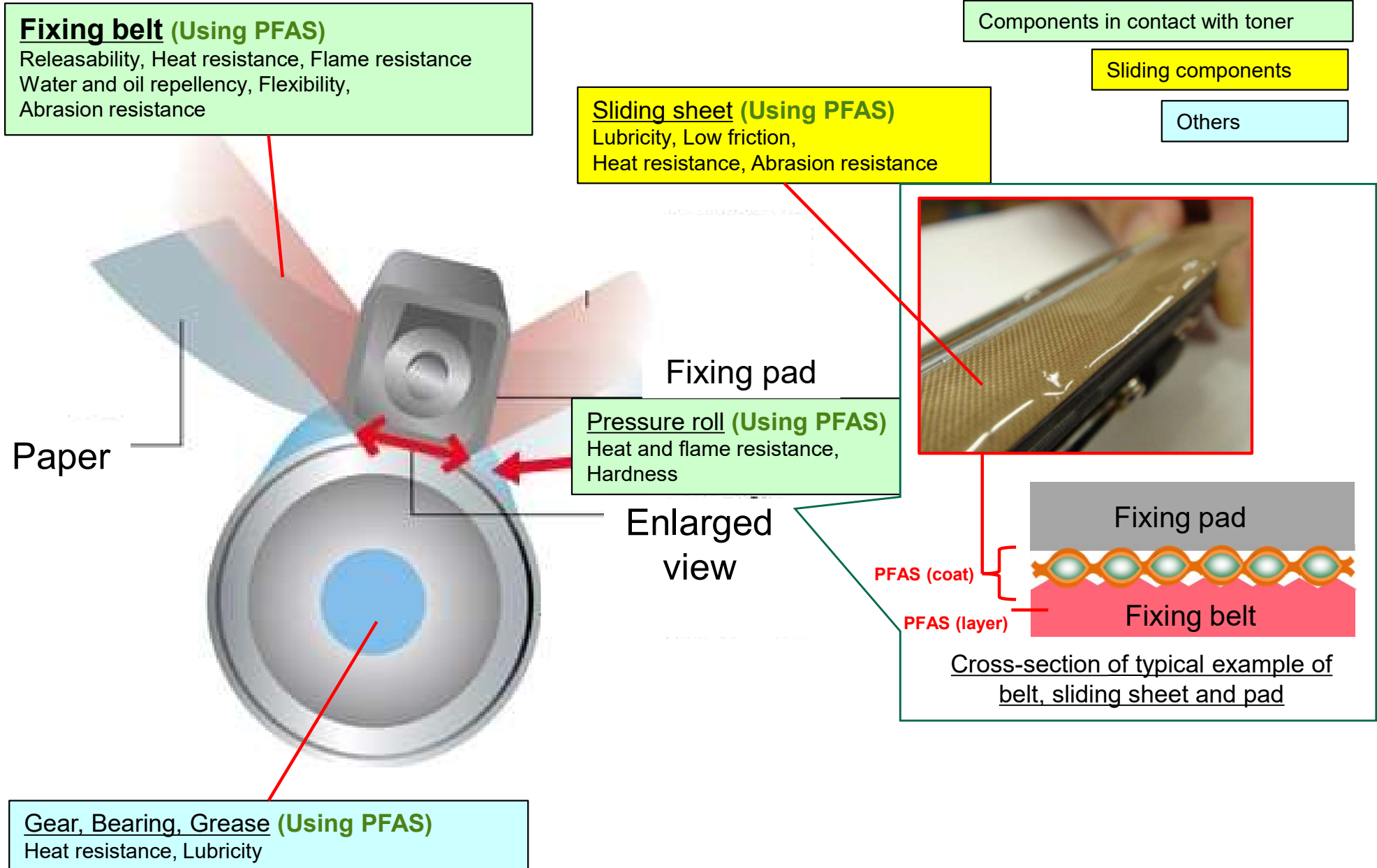
Components of Fixing Unit (Roll type)



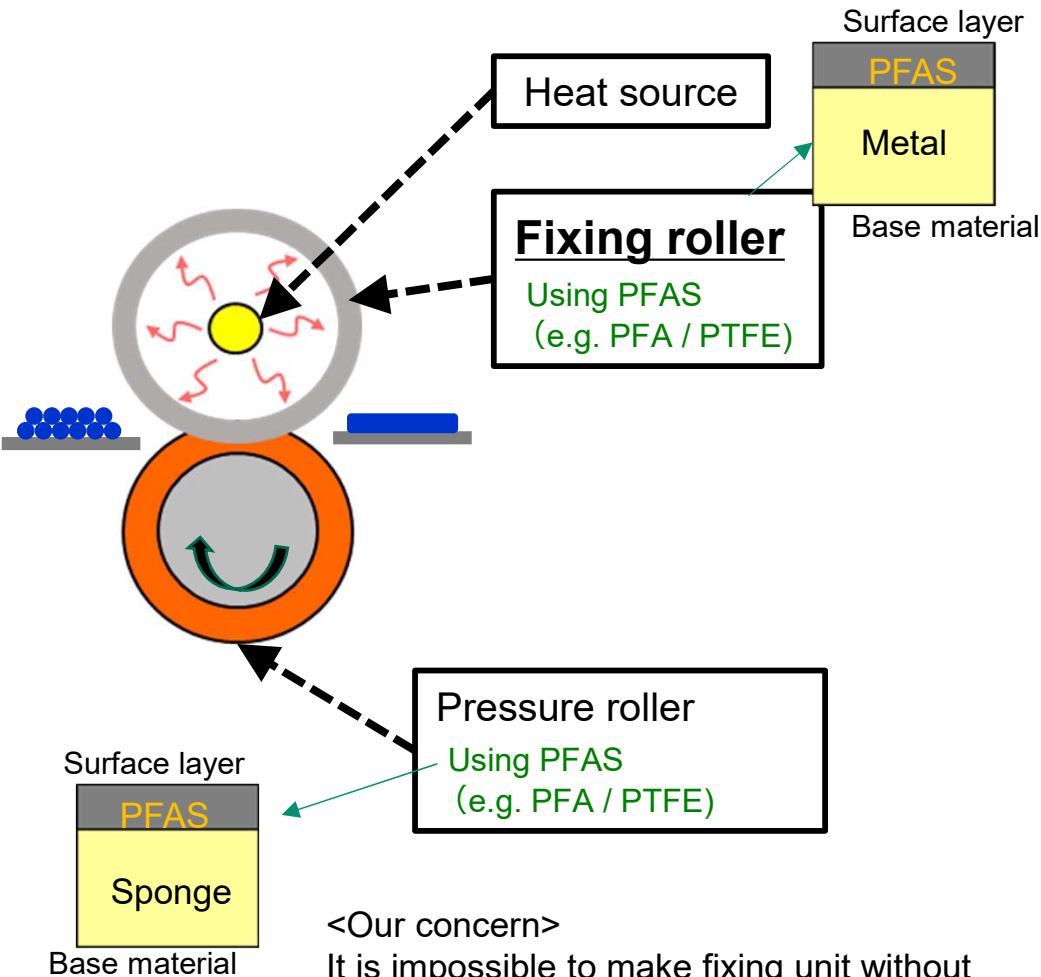
<Our concern>

It is impossible to make fixing unit without PFAS materials. Electronic photography printing (e.g. laser printer) cannot work appropriately without using PFAS materials.

[Details] Parts/components of “Belt-type” Fixing Unit



[Details] Parts/components of “Roller-type” Fixing unit



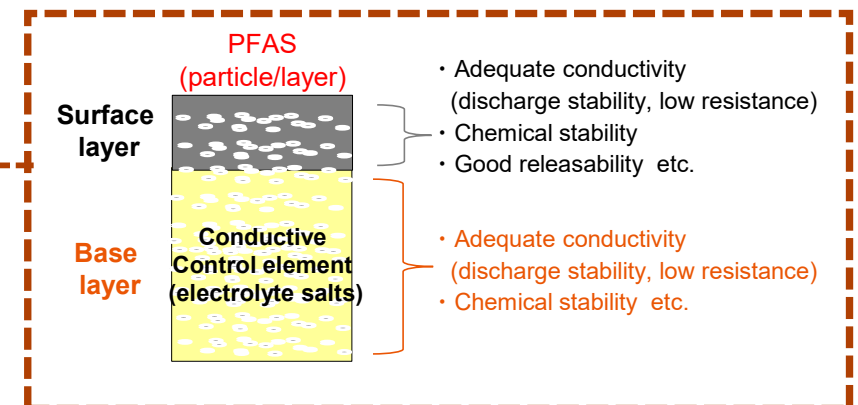
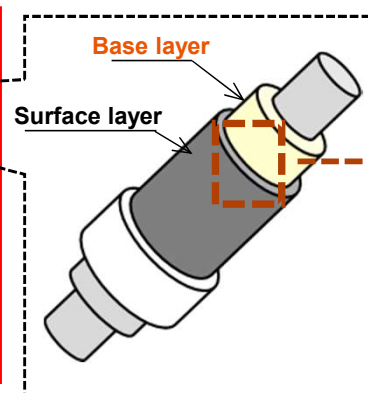
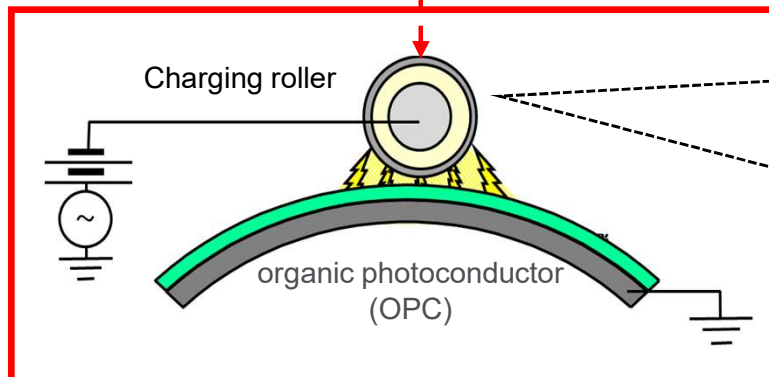
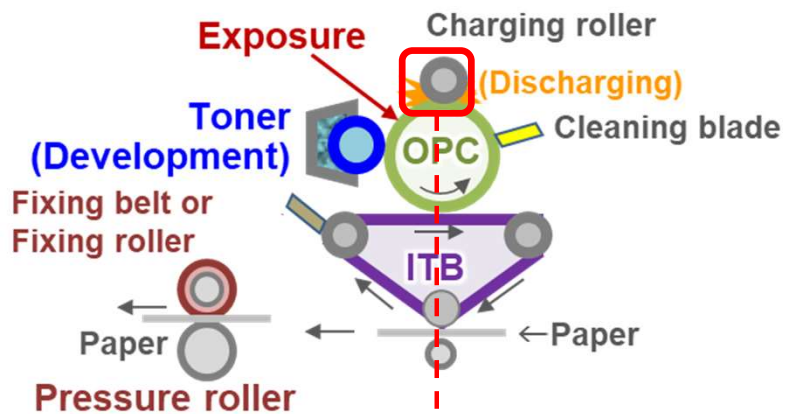
<Our concern>
It is impossible to make fixing unit without PFAS materials. Electronic photography printing (e.g. laser printer) cannot exist without using PFAS materials.

The essential use of PFAS and the reasons of no alternative	
Necessary functions	Components of fixing unit are continuously exposure to high temperature from 150 to 250 degrees Celsius. Therefore, they must be heat resistance and flame resistance. In addition, the high releasability is required to prevent adhesion of toner including melting toner. Furthermore, high abrasion resistance on surface of the components is necessary to maintain durability against friction due to the paper passing through the components. The surface of the pressure roller needs to slightly bend to make the contact between the heat roller and the pressure roller have a certain width so that the passing paper and toner image on it can be securely sandwiched between the heat roller and the pressure roller and heat can be transferred to the paper and toner. For this reason, the surface of the pressure roller must have flexibility.
The reason of using PFAS	Because the material has all the properties of heat resistance, releasability, flame resistance, flexibility, water and oil repellency and abrasion resistance.
The reason of no alternative	There is no material which fulfils all properties, including combinations of materials.

Parts/components of Charging / Development Roller Unit

The essential use of PFAS and the reasons of no alternative

- Charging unit is a roller shaped component that intentionally and uniformly accumulate positive or negative charges on the surface of the photoconductor to create an electrostatic latent image on the photoconductor layer.



Necessary functions

Adequate conductivity (balance between charging and discharging), good releasability, surface protection and durability are required. Particularly, both the surface layer and the base layer rotate rapidly above the organic photoconductor (OPC) drum, and discharge stability (prevention of abnormal discharging) is required under various environment conditions (high and low temperatures / humidity, etc.). To ensure a tolerance for preventing abnormal discharge, low resistance is required in the medium resistance range by controlling the surface resistance and the volume resistance. In addition, the base and surface layers need to have chemical stability to maintain constant electrical resistance even under constant exposure to high voltage (0.5kV to several kV: AC may be superimposed.). Furthermore, the surface layer requires good releasability (non-adhesiveness) because it is necessary to completely prevent toner, wax components, additives, etc. decomposed under high voltage from adhering to the surface of the charging roller.

Reasons of using PFAS

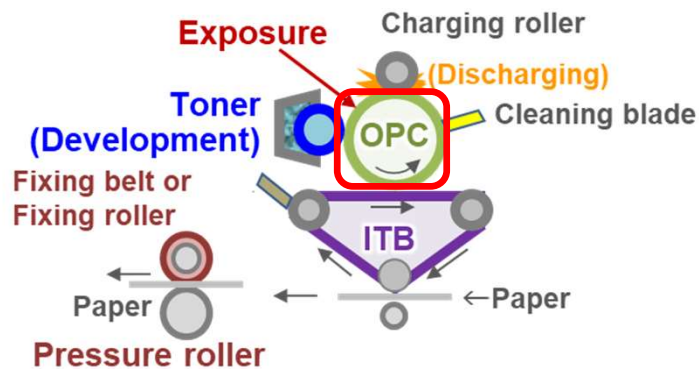
PFAS has all properties necessary for conductivity. Specifically, discharge stability, low resistance in the medium resistance range, durability (chemical stability) against electrical exposure and etc. If we can't use PFAS, the environmental impact will increase due to shortened product life and increased replacement frequency.

Reasons for no alternatives

There is no material which fulfils all these necessary functions, including combinations of materials.

Parts/components of Photoconductor unit

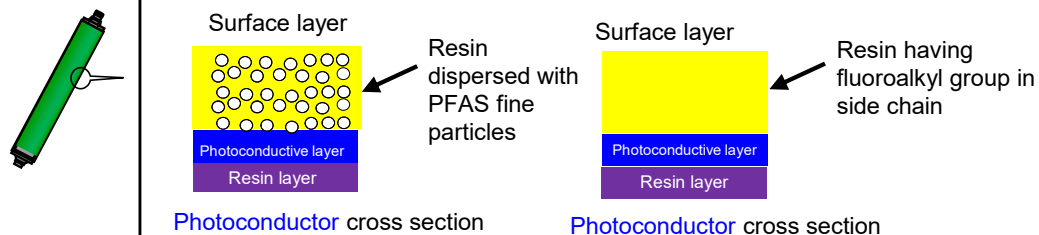
- The photoconductor is the central semiconductor components of the electrophotographic process. It serves the essential function to form an image on its surface by charging, exposure, and development, and then to transfer the image to the transfer unit, finally to clean the surface with the cleaning parts, and repeat the forementioned cycle.



The essential use of PFAS and the reasons of no alternative

Necessary functions	The photoconductor maintains the charged surface charge on the surface for a certain time or longer, forms an image by exposure/development process, transfers it to the transfer unit, and then is cleaned the surface. Since these processes are repeated at several million times while being rubbed by other components, it is essential to maintain the surface clean at all times (antifouling property), lubricity and abrasion resistance properties.
Reasons of using PFAS	Since PFAS is a material which exhibits all the properties of antifouling, lubricity and abrasion resistance.
Reasons for no alternatives	There are no materials which fulfils all properties, including combinations of materials.

There are two types of PFAS uses



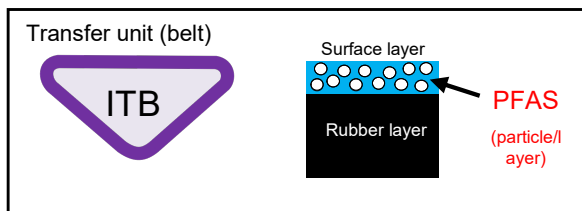
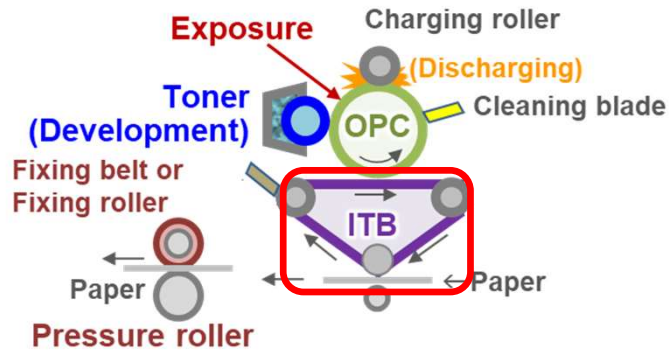
Required properties of the material	Resin dispersed with PFAS fine particles (PTFE)	Resin dispersed with inorganic fine particles (SILICA, ALUMINA)	Resin dispersed with organic fine particles (PMMA, SILICONE)
abrasion resistance	✓	✓	-
Antifouling property/ Lubricity	✓	-	✓

PMMA : Polymethyl Methacrylate

Required properties of the material	Resin having fluoroalkyl group in side chain	Resin having silyl group in side chain	Resin having alkyl group in side chain
abrasion resistance	✓	-	-
Antifouling property/ Lubricity	✓	✓	-

Parts/components of Transfer unit (Intermediate transfer belt: ITB)

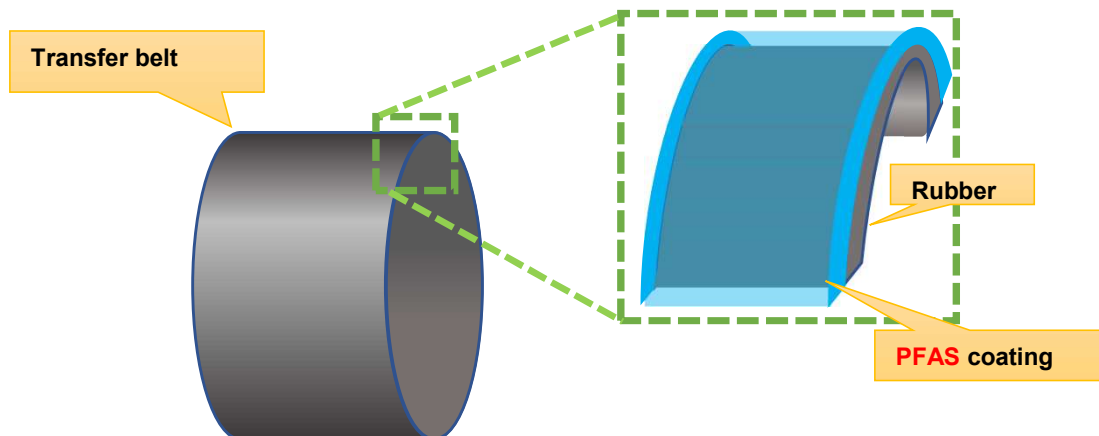
- The transfer unit is a component to move the toner image from the photoconductor to the paper. In this step, the transfer unit is pressed at a pressure of 1~10 N/cm² and a voltage of 1~10 kV is applied to transfer the toner image to the paper.



ITB: Intermediate transfer belt

The essential use of PFAS and the reasons of no alternative

Necessary functions	By applying a high voltage (1-10 kV) and high pressure (1-10N/cm ²) to the paper, it is required that the positively/negatively charged toner particles are moved from the transfer unit to the paper without missing any image portion. Flexibility is also required because the transfer unit follows media having different characteristics (e.g. surface shape and paper stiffness). Slidability (low friction) is also required for the cleaning blade for removing residual toner.
Reasons of using PFAS	Since the PFAS material exhibits all the characteristics of insulation (high-voltage resistance), releasability, flame retardancy, flexibility, water repellency, oil repellency and slidability (low friction).
Reasons for no alternatives	There are no materials which fulfils all properties, including combinations of materials.

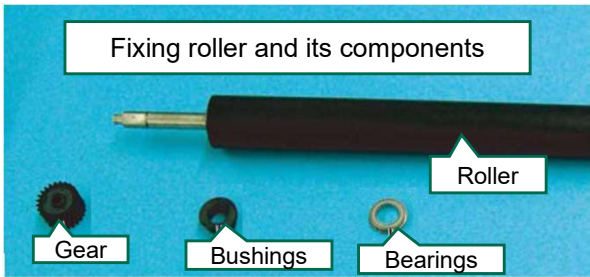
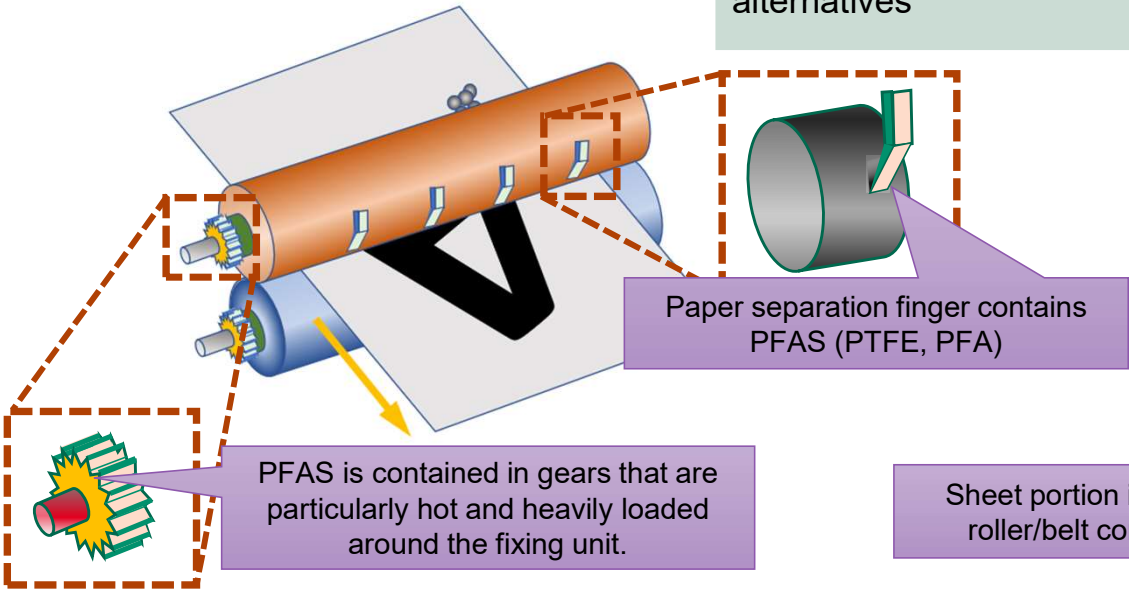


Other parts/units

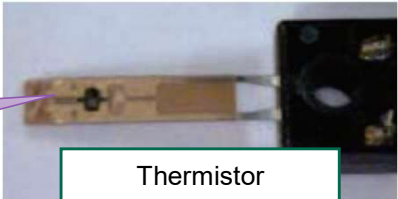
- Paper separation finger, Gear, Bushings, Grease, Conveying roller/belt, Thermistor, etc

The essential use of PFAS and the reasons of no alternative

Necessary functions	The components around the fixing unit must be heat resistant, especially since they are subject to high temperatures. In addition, conveying roller/belt must have toner adhesion resistant and wear resistance to maintain image quality, gears/bushings must have stable rotational movement performance for rollers under strong pressure, i.e., attrition resistant and sliding performance, and thermistors/paper separation finger must have attrition resistant, toner adhesion resistance, and sliding performance due to contact with the rollers/belt. Grease must also have extremely high sliding performance and attrition resistant.
Reasons of using PFAS	Because the material exhibits all the characteristics of heat resistant/toner adhesion resistance/attrition resistant /sliding performance and long life.
Reasons for no alternatives	There are no materials which fulfils all properties, including combinations of materials.

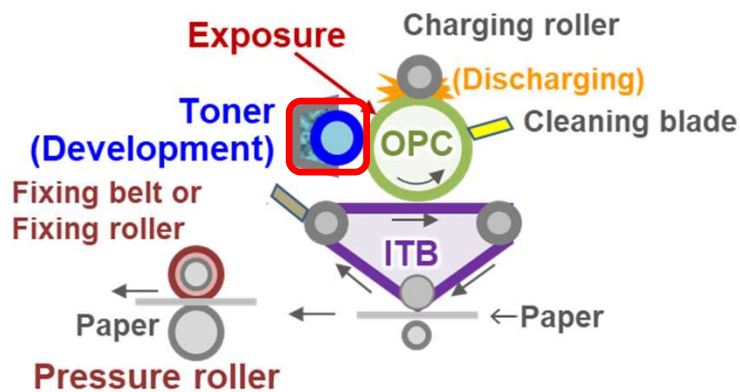


Sheet portion in contact with roller/belt contains PFAS



Other parts/units: Sealing component (End seal)

- The seal component prevents toner leakage from container and scattering within the printing area.
- To prevent toner leakage and scattering, seal components are arranged at both ends in the longitudinal direction of the roller and slide with the roller rotating at high speed.
- Therefore, high sliding property, low friction resistance and antifouling property are required.



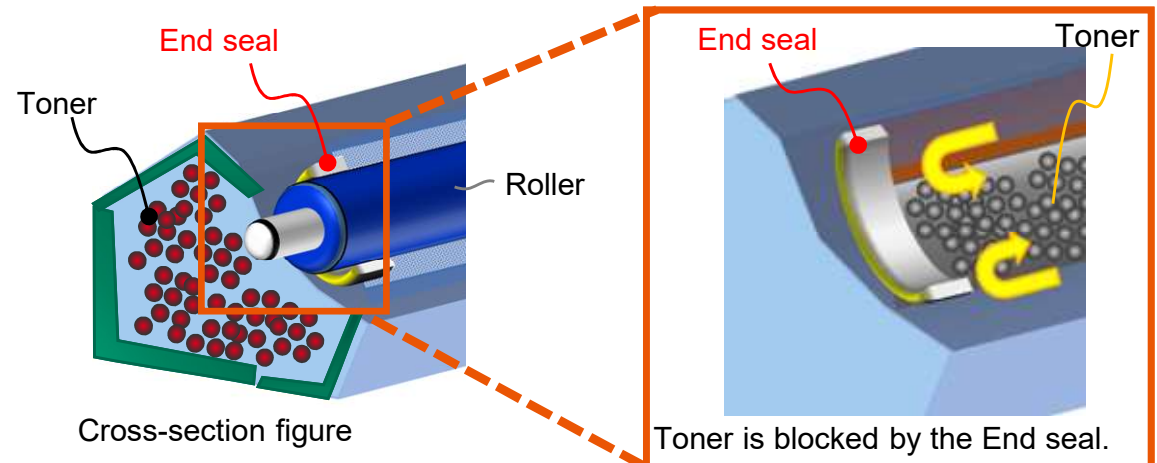
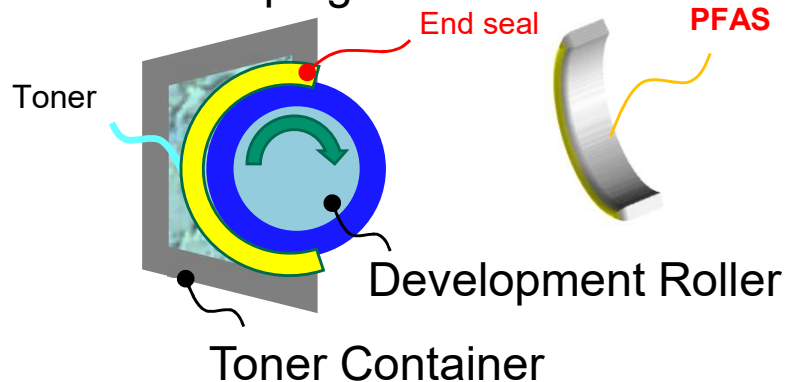
- Example: Configuration in which a sealing component is arranged at both ends of the roller

The essential use of PFAS and the reasons of no alternative

Necessary functions	To abut on a developing unit rotating at a high speed and hold toner in a developing container without leaking or scattering the toner. Therefore, high sliding property and low friction resistance are required. When the toner remaining on the photoconductor and the transfer belt is scraped by the cleaning blade, it is necessary to collect the toner in the waste toner container without toner scattering. Therefore, high slidability, low friction resistance, and antifouling properties are required. In order to abut against a parts rotating at high speed without clearance, it is necessary to have material properties that are flexible and can take a solid shape.
Reasons of using PFAS	Since the material exhibits all the characteristics of slidability / low friction resistance, antifouling, flexibility, and taking a solid shape.
Reasons for no alternatives	There are no materials which fulfils all properties, including combinations of materials.

- Seal component prevents toner leakage and scattering from the gap

Toner Developing unit



Note: Illustration without the roller.