--- I heard that the design office of an associate of mine had purchased an imageRUNNER C3200, so I went over to take a look for myself. My first surprise was seeing how compact the unit is. You can get full-color operation out of a machine that small?

Kuribayashi: If your associate was replacing a color copying machine, you should have noticed quite a lot of newly freed space. What did you think?

--- Yes, I found the evidence of the opened up space. There was a lot of new paraphernalia around the office, like a guitar and an old vintage PC. (Laughs) You were in charge of the hardware development, weren't you, Kuribayashi-san?

Kuribayashi: The print engine, to be exact. This converts electronic data coming into the unit to print out toner images on paper.

--- And your efforts to make this engine more compact contributed to more efficient usage of office space...

Kuribayashi: Making the unit more compact was important, but the mission given to the development team was to "maintain image quality while increasing operating speed by 50% and greatly reducing costs."

--- That sounds absurd! It's like asking a manager of a baseball team to "keep up visitor numbers and win 50% more games, while cutting player salaries." Any players in their right mind would be looking for a new team pretty quickly.

---Inside of the machine
Canon's compact color network digital MFP was realized through the adoption of a cleaner-less structure and densely packed components, such as toner cartridges.

Kuribayashi: Canon had been highly evaluated by creative professionals around the world for its full-color copying machines, but we had to meet all of these conditions, in order to enter the office-use market with a color network digital MFP.

--- I understand, but...

Kuribayashi: Did you look inside the machine? There are four toner cartridges in the print engine, one each for yellow, magenta, cyan and black (YMCK), but each cartridge is quite small.

--- I think I remember those cartridges. Is this structure very different from what you have had until now?

Kuribayashi: It's a "cleaner-less system." In other words, we eliminated the mechanism that removes residue toner on the photosensitive drum. We did this by thoroughly reevaluating the materials and processing of the toner and drum, as well as of the structure and control methods for the mechanisms around the many drums related to toner image formation. We ended up increasing transfer efficiency from less than 95% in conventional products to more than 98%.

--- Forgive me, but an improvement of three percentage points doesn't sound like such a huge advance.

Kuribayashi: On the contrary. In terms of the amount of residue toner left on the drum, the improvement is from 5% to 2%, equivalent with a decrease of 60%.

--- A 60% reduction in one fell swoop! Now that's big! (Laughs)

Kuribayashi: Residue toner left on the drum after a page is output can impact succeeding pages. In previous print engines, a cleaning blade was used to remove this toner, and a tank was needed to collect it.

--- I've heard from laser beam printer engineers that the cleaning mechanism is always difficult to develop.

Kuribayashi: But with 60% less residue toner on the drum after each printout, it becomes possible to completely rethink the frequency and methods of cleaning the drum. If you were to liken a network digital MFP to the human body, the cleaning system would be the liver and kidneys. Our bodies produce several kinds of

wastes, including sweat, carbon dioxide gas, feces (also known as stool), and urine. These wastes exit the body in different ways. Sweat is released through pores (tiny holes) in the skin. Water vapor and carbon dioxide are exhaled (breathed out) from the lungs. And undigested food materials are formed into feces in the intestines and excreted from the body as solid waste in bowel movements.

--- Urine, which is produced by the **kidneys**, contains the by-products of our body's metabolism - salts, toxins, and water - that end up in our blood. The kidneys and **urinary tract** (which includes the ureters, bladder, urethra, and the kidneys) filter and eliminate these waste substances from our blood. Without the kidneys, waste products and toxins would soon build up in the blood to dangerous levels.

--- In addition to eliminating wastes, the kidneys and urinary tract also regulate many important body functions. For example, the kidneys monitor and maintain the body's balance of water, ensuring that our tissues receive enough water to function properly and be healthy.

--- When you're asked to give a urine sample during a doctor's visit, the results reveal how well your two kidneys are working. For example, blood, protein, or white blood cells in the urine may indicate injury, infection, or inflammation of the kidneys, and glucose in the urine may be an indication of diabetes.

---Although the two kidneys work together to perform many vital functions, people can live a normal, healthy life with just one kidney. In fact, some people are born with just one of these bean-shaped organs. If one kidney is removed, the remaining one will enlarge within a few months to take over the role of filtering blood on its own.

--- Every minute, more than 1 quart (about 1 liter) of blood passes through the kidneys, adding up to about 425 gallons (1,609 liters) of blood each day. About a quarter of our blood is in our kidneys at any one time, and the kidneys cleanse all of the blood in the body about every 50 minutes.

--- In addition to filtering blood, producing urine, and ensuring that body tissues receive enough water, the kidneys also regulate blood pressure and the level of vital salts in the blood. By regulating salt levels through production of an enzyme called **renin** (as well as other substances), the kidneys ensure that blood pressure is regulated.

--- The kidneys also secrete a hormone called **erythropoietin** (pronounced: eh-rith-row-**poy**-uh-ten), which stimulates and controls the body's red blood cell production (red blood cells carry oxygen throughout the body). In addition, the kidneys help regulate the acid-base balance (or the pH) of the blood and body fluids, which is necessary for the body to function normally.
The kidneys are located just under the rib cage in the back, one on each side. The right kidney is located below the liver, so it's a little lower than the left one. Each adult kidney is about 5 inches (about 13 centimeters) long, 3 inches (about 8 centimeters) wide, and 1 inch (about 3 centimeters) thick. Each has an outer layer called the **cortex**, which contains the filtering units. The center part of the kidney, the **medulla** (pronounced: muh-**duh**-luh) has 10 to 15 fan-shaped structures called **pyramids**. These drain urine into cup-shaped tubes called **calyxes** (pronounced: **kay**-luh-seez). A layer of fat surrounds the kidneys to cushion and help hold them in place.

--- Here's how the kidneys filter blood: Blood travels to each kidney through the **renal artery**, which enters the kidney at the **hilus** (pronounced: **hie**-luss), the indentation in the kidney that gives it its bean shape. As it enters the cortex, the artery branches to envelope the **nephrons** (pronounced: **neh**-fronz) - 1 million tiny filtering units in each kidney that remove the harmful substances from the blood.

--- Each of the nephrons contains a filter called the **glomerulus** (pronounced: gluh-**mer**-yoo-lus), which contain a network of tiny blood vessels known as capillaries. The fluid filtered from the blood by the glomerulus then travels down a tiny tube-like structure called a **tubule** (pronounced: **two**-byool), which

adjusts the level of salts, water, and wastes that are excreted in the urine.

--- Filtered blood leaves the kidney through the **renal vein** and flows back to the heart.

The continuous blood supply entering and leaving the kidneys gives the kidneys their dark red color. While the blood is in the kidneys, water and some of the other blood components (such as acids, glucose, and other nutrients) are reabsorbed back into the bloodstream. Left behind is urine. Urine is a concentrated solution of waste material containing water, **urea** (pronounced: yoo-**ree**-ah, a waste product that forms when proteins are broken down), salts, amino acids, by-products of bile from the liver, ammonia, and any substances that cannot be reabsorbed into the blood. Urine also contains **urochrome** (pronounced: **yur**-uh-krome), a pigmented blood product that gives urine its yellowish color.

--- The **renal pelvis**, located near the hilus, collects the urine flowing from the calyxes. From the renal pelvis, urine is transported out of the kidneys through the **ureters** (pronounced: **yur**-uh-ters), tubes that carry the urine out of each kidney to be stored in the urinary **bladder** - a muscular collection sac in the lower abdomen.

--- The bladder expands as it fills and can hold about half a liter (2 cups) of urine at any given time (an average adult produces about 1 1/2 liters, or 6 cups, of urine per day). An adult needs to produce and excrete at least one third of this amount in order to adequately clear waste products from the body. Producing too much or not enough urine may indicate illness.

--- When the bladder is full, nerve endings in its wall send impulses to the brain. When a person is ready to urinate, the bladder walls contract and the **sphincter** (pronounced: **sfink**-ter, a ring-like muscle that guards the exit from the bladder to the urethra) relaxes. The urine is ejected from the bladder and out of the body through the **urethra** (pronounced: yoo-**ree**-thruh), another tube-like structure. The male urethra ends at the tip of

the penis; the female urethra ends just above the vaginal opening.
Like other systems in the body, the entire urinary tract is subject to diseases and disorders. In children, the more common of these include:

--- As a fetus develops in the womb, any part of the urinary tract can grow to an abnormal size or in an abnormal shape or position. One of the more common congenital abnormalities (meaning abnormalities that exist at birth) is duplication of the ureters, in which a kidney has two ureters coming from it instead of one. This defect occurs in about one out of every 125 births and can cause the kidney to develop problems with repeated infections and scarring over time.

--- Another congenital problem is **horseshoe kidney**, where the two kidneys are fused (connected) into one arched kidney that usually functions normally, but is more prone to develop problems later in life. This condition is found in one out of every 500 births.

--- Glomerulonephritis (pronounced: gluh-**mer**-yoo-lo-nih-fry-tis) is an inflammation of the glomeruli, the parts of the filtering units (nephrons) of the kidney that contain a network of capillaries (tiny blood vessels). The most common form of this condition is post-streptococcal glomerulonephritis, which usually occurs in young children, most often following an untreated case of strep throat. More than 95% of children with this type of nephritis recover fully, but a few can have permanent kidney damage that eventually requires dialysis or a kidney transplant.

--- Hypertension (high blood pressure) can result when the kidneys are impaired by disease. The kidneys control blood pressure by regulating the amount of salt in the body and by producing the enzyme **renin** that, along with other substances, controls the constriction of muscle cells in the walls of the blood vessels.

--- Kidney (renal) failure can be acute (sudden) or chronic (occurring over time and usually long lasting or permanent). In

either form of kidney failure, the kidneys slow down or stop filtering blood effectively, causing waste products and toxic substances to build up in the blood.

--- Acute kidney failure may be due to bacterial infection, injury, shock, heart failure, poisoning, or drug overdose. Treatment includes correcting the problem that led to the failure and sometimes requires surgery or **dialysis** (pronounced: die-**ah**-luh-sis). Dialysis involves using a machine or other artificial device to remove the excess salts and water and other wastes from the body when the kidneys are unable to perform this function.

--- Chronic kidney failure involves a deterioration of kidney function over time. In children, it can result from acute kidney failure that fails to improve, birth defects of the kidney, chronic kidney diseases, repeated kidney infections, or chronic severe high blood pressure. If diagnosed early, chronic kidney failure in children can be treated, but usually not reversed. The child will usually require a kidney transplant at some point in the future.

--- Kidney stones (or nephrolithiasis, pronounced: nih-fro-lih-**theye**-ah-sis) result from the buildup of crystallized salts and minerals such as calcium in the urinary tract. Stones (also called **calculi**, pronounced: **cal**-kyoo-lie) can also form after an infection. If kidney stones are large enough to block the kidney or ureter, they can cause severe abdominal pain. But the stones usually pass through the urinary tract on their own. In some cases, they may need to be removed surgically.

--- Nephritis (pronounced: nih-**fry**-tis) is any inflammation of the kidney. It can be caused by infection, an autoimmune disease (such as lupus), or it may be **idiopathic** (which means the exact cause may not be known or understood). Nephritis is generally detected by high levels of protein and blood in the urine.

--- Nephrosis is a type of kidney disease associated with a group of symptoms and chemical imbalances (collections of excessive amounts of fluid in body tissues, decreased blood protein levels, water and salt retention, and increased levels of

fats in the blood). Nephrosis may result from specific kidney diseases or a reaction to drugs. Some forms of nephrosis are hereditary. It's most common in children ages 18 months to 4 years and is more prevalent in boys.

--- Urinary tract infection (UTI) is infection of a part of or throughout the urinary tract, usually caused by bacteria. UTIs are most commonly caused by intestinal bacteria, such as *E. coli*, which are normally found in feces. These bacteria can cause infections anywhere in the urinary tract, including the kidneys. Most UTIs occur in the lower urinary tract, especially in the bladder and urethra. UTIs are about equally common in males and females during the first year of life. However, uncircumcised males are about 10 times more likely than circumcised males to develop a UTI before age 1. In school-age children, girls are three times more likely to develop UTIs than boys; this may be because girls have shorter urethras than boys.

--- Vesicoureteral reflux (VUR) (pronounced: veh-sih-ko-yoo-**ree**-teh-rul **ree**-flux) is a condition in which urine abnormally flows backward (or refluxes) from the bladder into the ureters. It may even reach the kidneys, where infection and scarring can occur over time. VUR occurs in 1% of children and tends to run in families. It's often detected after a young infant or child has a first urinary tract infection. Most children outgrow mild forms of VUR, but if severe and untreated, VUR can lead to permanent kidney damage and kidney failure later in life. **Wilms' tumor** is the most common kidney cancer occurring in children. It is diagnosed most commonly between 3 and 5 years of age and affects males and females equally.

-- If you were to liken the digital MFP to a building, it would be the toilets and sewage disposal facilities. The water distribution system and system for conveying sewage from any building in which plumbing fixtures are installed shall be connected, respectively, to a public water main and a sanitary or combined sewer if either or both are available and, regarding the sewer, if the department determines that connection thereto is feasible. The department shall determine that connection is feasible if : 1. the sewer is of adequate capacity to receive all sewage flowing

from the building; 2. the sewer is in adequate physical condition to receive such sewage; 3. no physical obstacles exist between the boundaries of the lot or tract of land on which the building is located and the sewer, which would make connection to the sewer impracticable; 4. the elevation of the sewer in relation to the lot or tract of land on which the building is located is such that conveyance of the sewage from the building to the sewer is not impracticable; 5. the sewer is located in the same drainage area as all or most of the lot or tract of land on which the building is located; and 6. no other factor reasonably related to the conveyance of sewage from the building to the sewer would make such connection impracticable or
undesirable as a proper means of sewage disposal .

--- What if a public water main is not available?

--- Then an individual potable water supply shall be provided,

--- And where neither a sanitary nor a combined sewer is available to which the department determines that connection is feasible?

--- Then a private sewer or private sewage disposal system shall be provided. All such private systems shall be provided subject to the approval of the commissioner and of any other agency or agencies having jurisdiction, and constructed in accordance with the requirements of reference standard
RS-16 and, with respect to the construction of individual on site private sewage disposal systems, in accordance with the specifications and standards prescribed by the commissioner, in consultation with the commissioner of environmental protection, pursuant to section six hundred forty three of the charter. Extensions of public sewers and water mains shall sewer. The connection shall be made in accordance with the applicable standards of the department of environmental protection.

--- will a public water supply system, and a sanitary or combined sewer for the purpose of conveying sewage, be deemed available to a one- and two-family dwelling if a property line of such dwelling is within one hundred feet (measured along a street,

alley, or right-of-way) of the public water supply system or the sewer?

--- Yes. the connection shall be made in accordance with the applicable standards of the department of environmental protection.

--- Where two or more one- or two-family dwellings are to be constructed on a tract of land, or where a substantial improvement of any other type of building or buildings is contemplated on a tract of land, the public water supply system and/or the sanitary or
combined sewer may be declared available thereto by the agencies having jurisdiction thereon even though the distances specified in subparagraphs (a) and (b) of sub section 16 of the building code are exceeded no well or individual water supply may be installed for any purpose without the approval of the commissioner and of the department of health and the department of environmental protection. Design and maintenance of system for conveying sewage from building.

---The system for conveying sewage from the building shall be designed,constructed and maintained to guard against fouling, deposit of solids, and clogging, and shall be provided with adequate cleanouts so arranged that the pipes may be readily cleaned.

--- Woll there be an Exclusion of certain substances from the plumbing system?

--- In regard to DETRIMENTAL OR DANGEROUS MATERIAL.- No person shall deposit, by any means, any of the following into the building drainage system or sewer: ashes, cinders, rags, flammable, poisonous, or explosive liquids, gases, oils, grease, or any other material that could obstruct, damage, or overload such system, or that could interfere with the normal operation of the sewage treatment processes.

--- Wastes from hospitals, chemical plants, laundries, abattoirs, or any other industrial wastes that could be detrimental to the

public sewer or public health, shall be treated before such Title 27 in Subchapter 16 339 wastes are discharged into the public sewer. At the time of the filing of plumbing plans for any hospital, chemical plant, laundry, abattoir, or any other industrial structure, a statement shall be filed with the commissioner indicating the substances, ingredients, or matter, that will be discharged into the sewer, together with written approval of the department of environmental protection for the method of treatment of said substance, ingredient or matter, before it is discharged into the public sewer.

--- Plumbing fixtures, devices, and appliances shall be provided with adequate
protection to prevent contamination of food, water, sterile goods, and similar materials by backflow of sewage. The fixture, device, or appliance shall be
connected indirectly with the building drainage system
when necessary.

---The drainage of all sanitary and storm water below the crown level of
the street sewer, or below a level where backflow from the street sewer is possible, shall be conveyed to a sewage ejector and/or sump through a system of subhouse drains, and lifted into the street sewer or disposal system.

--- Storm water falling or coming to rest on property on which new
buildings or substantial horizontal enlargements are to be constructed, and on all streets and other paved areas constructed or altered in connection with the construction
of such new buildings or substantial horizontal enlargements, shall be disposed of in accordance with the requirements of reference standard RS-16 and the rules and regulations of the department of environmental protection. No person providing a system for disposing of storm water, as required by this subdivision, shall in any way alter, relocate or affect any existing drainage system on the property, except in accordance with the provisions of section 19-146 of title nineteen of the administrative code. Except as otherwise permitted by his code,

no person shall perform land contour work, as defined in section 19-146 of this code, which work causes storm water to flow across sidewalks or onto an adjacent property. For purposes of this subdivision, the term "substantial horizontal enlargement" shall have the meaning given such term in subdivision (a) of section P110.2 of reference standard RS-16.

--- In Local Law 103-1989. These are the Required plumbing fixtures.-Every dwelling
unit in buildings classified in occupancy groups J-2 and J-3 shall have at least one water closet, one lavatory, one kitchen-type sink, and one bathtub or shower. All
other buildings shall be equipped with the number and types of plumbing fixtures required by reference standard RS-16. Smooth surfaces required.-Plumbing fixtures
shall be made of smooth, nonabsorbent material and shall be free from fouling surfaces.

--- For light andventilation requirements of rooms or spaces containing plumbing fixtures, see subchapter twelve of this chapter.

---Piping, fixtures, or equipment
shall be located so as not to interfere with the normal operation of windows, or doors and other exit openings.
--- Plumbing fixtures shall be located so that they are readily accessible to the users.

---Each fixture directly connected to the drainage system shall be equipped with a liquid-seal trap, except as otherwise provided in this subchapter. The drainage system shall
be designed to provide adequate air circulation in all pipes with no danger of siphonage, aspiration, or forcing of trap seals under conditions of ordinary use.

--- Each vent terminal shall extend to the outdoor air and be located and installed so as to minimize the possibility of clogging and the return of foul air to the building.

--- All materials and equipment used in the plumbing and gas systems
shall be free from defects, and shall be designed, constructed, and installed so as to give satisfactory service for their expected life.

--- Any plumbing materials or equipment condemned by the commissioner because
of wear, damage, defects, or sanitary hazards shall not be used or re-used for plumbing purposes.

--- Where a plumbing drainage system is subject to backflow of sewage from
the public sewer, suitable provision shall be made to prevent its overflow in the building.

--- Test of plumbing system.-The plumbing system shall be subjected to such tests as will readily disclose all leaks and defects in the work or in the material used.

---Plumbing systems shall be maintained in a safe and serviceable condition from the standpoint of both operation and health.

--- Sewage or other waste shall not be discharged into surface or subsurface water unless it has been discharged by a method subject to the approval of the commissioner and of the department of health and the department of environmental protection.

--- Water service piping shall be installed at least four feet below exterior grade, and building house sewers shall be installed at least three feet below exterior grade. Plumbing piping in exterior building walls shall be adequately protected against freezing by insulation or heat, or by both.

--- Where pipes pass through construction required to have a fire-resistance rating, they shall comply with the requirement of section 27-343 of article five of subchapter five of this chapter.

--- It shall be unlawful for any utility company to supply gas to a building, place or premises in which new meters other than replacement are required until a certificate of approval of gas installation from the department of buildings is filed with such utility company. When new gas service piping has been installed it shall be lockedoff by the utility either by locking the gas service line valve or by installing a locking device on the outside gas service line valve. The lock shall not be removed until the gas meter piping (other than utility owned) and gas distribution piping has been inspected and certified as required by the department of buildings as being ready for service.

--- When alterations, extensions or repairs to existing gas meter piping or gas distribution piping requires the shut-off of gas flow to a building, the utility shall be notified by the owner or his or her authorized representative.

--- For Drainage systems -In addition to the permits required under provisions of subchapter one of this chapter, the following permits shall also be required. Permits for the installation of the building house sewer from the street line to, and including, the spur connection at the street sewer shall be obtained from the department of environmental protection, except that, in conjunction with the issuance of a permit for the construction or alteration of a structure within the curbline, the commissioner may issue a permit for connection with a sewer or drain.

--- Permits for sidewalk and street openings shall be obtained from the department of transportation.

--- Local Law 65-1996 - The construction of drainage systems shall be in accordance with the requirements of reference standard RS-16.

--- and ARTICLE 4…. HOSPITAL AND INSTITUTIONAL PLUMBING?

--- Hospital and institutional plumbing shall be installed in accordance with all of the applicable requirements for plumbing

and gas piping of this subchapter and in accordance with the specific modifications of reference standard RS-16.
.
--- When alterations are made requiring the addition of two or more plumbing fixtures
in an existing building, or when a building is remodeled for an extension in size or change in use in which plumbing, drainage, or gas piping work is involved, all the new work shall be made to conform to all the applicable sanitary requirements of this code and the affected portions of the system made adequate for the added load.

-- Every new plumbing and gas piping system and every part of an existing system that has been altered, except for ordinary repairs, shall be inspected and tested to determine compliance with code requirements except that the Title 27 in Subchapter 16

--- The holder of a plumbing permit shall give at least two days prior written
notice to the commissioner that the plumbing workcovered by the permit is ready for Inspections and test.

--- Except for outside leaders and perforated or open jointed drain tile (subsoil drains), the piping of plumbing drainage and venting systems shall be verified as to materials and shall be tested upon completion of the rough piping installation and proven to be watertight. The commissioner may require the removal of any cleanout plugs to ascertain
that the prescribed pressure has been reached in all parts of the system.

--- A water test shall be applied to the drainage system either in its entirety or in sections after rough piping has been installed. If applied to the entire system, all openings in the piping, except the highest opening, shall be tightly closed and the system filled with water to the point of overflow. If the system is tested in sections, each opening, except the highest opening of the section

under test, shall be tightly plugged and each section filled with water. No section shall be tested with less than a ten foot head of water. In
testing successive sections, at least the upper ten feet of the following section shall be tested, so that no joint or pipe in the building (except the uppermost ten feet of the system) shall have been submitted to a test of less than ten foot head of water. The water shall be kept in the system or in the portion under test for a least fifteen minutes before inspection starts; the system shall then be tight at all points.

---An air test may be used only when permission for this type of test is obtained from the
commissioner. The air test shall be made by attaching an air compressor testing apparatus to any suitable opening and, after closing all other inlets and outlets of the system, forcing air into the system until there is a uniform gauge pressure of * five psi. This pressure shall be held, without introducing additional air, for a period of at least fifteen minutes.

--- After the plumbing fixtures have been set and their traps filled with water,
the entire drainage system shall be verified as to materials and shall be tested and proven gastight by either a smoke test or a peppermint test.

--- Smoke test?

The smoke test shall be made by filling all traps with water and then introducing into the
entire system a pungent, thick smoke produced by one or more smoke machines. When the smoke appears at stack openings on the roof, these openings shall be closed and a pressure
equivalent to a one inch water column shall be maintained for the period of the inspection.

--- A Peppermint test?

---The peppermint test shall be made by introducing two ounces of oil of peppermint

into the roof vent terminal of every line or stack to be Title 27 / Subchapter 16
tested. The oil of peppermint shall be followed at once by ten quarts of hot water (one hundred sixty degrees Fahrenheit or higher), whereupon all roof vent terminals shall be sealed. The detection of the odor of peppermint at any trap or other point in the system shall determine the location of any leaks. Persons who have come in contact with oil of peppermint shall be excluded from the test area.

--- A Building house sewer?

---The building house sewer shall be tested by inserting a test plug at the point
of connection with the street sewer before such connection is made. The building house sewer shall then be filled with water under a head of at least ten feet. The water level at the top of the test head of water shall not drop for at least fifteen minutes.

--- The Water systems?

--- Upon completion of a section of a water system or of the entire water system, the
completed section or system shall be verified as to materials, and shall be tested and proven tight under a water pressure of at least twenty-five percent greater than the working pressure under which it is to be used. The water used for tests shall be obtained from a potable source of supply.

--- Gas piping systems?

--- Upon completion of the installation of a section of a gas system or of the entire gas system, and before appliances are connected thereto, the completed section or system shall be verified as to materials, and tested and proven tight as follows:
a. Distribution pressures up to one-half psig. The completed piping is to be tested with a non-mercury gauge at a pressure of three pounds per square inch gauge (psig) for a minimum of thirty minutes.

b. Distribution pressures over one-half psig through three psig. The completed piping is to be tested at fifty psig for a minimum of thirty minutes. c. Distribution pressures over three psig through fifteen psig. The completed piping is to be tested at one hundred psig for a minimum of one hour.
d. Distribution pressures above fifteen psig. The completed piping is to be tested to twice the maximum allowable operating pressure, but not less than one hundred psig, for a minimum of one hour.

--- Meter piping shall be pressure tested in
accordance with the requirements of the serving utility?

--- These requirements shall be either the same as those for testing distribution piping in paragraph one of this subdivision, or if different, the piping shall be certified by the local utility as being tested in compliance with
their requirements.

---Notwithstanding the above, all coated or wrapped pipe shall be pressure tested at a minimum of ninety psig.

--- In Local Law 65-1996 we address individual sewage systems. Where public sewers are deemed not available according to subdivision (e) of section 27-901 of article one of this subchapter, an individual on site private sewage disposal system shall be installed in accordance with the requirements of this subchapter. When public sewers are made available, the individual on site private sewage disposal system shall be abandoned in a manner prescribed by the commissioner, and the building house sewer shall be connected to the available public sewer within six months of the date of notification that the sewer has been accepted to receive flow by the agency or agencies having jurisdiction.
Thus, We successfully raised the efficiency of the individual parts to achieve a 60% reduction in the amount of waste generated.

-- The less residue, the more efficient

--- The fruit of all of your efforts...

Kuribayashi: We were able to remove the tanks for residue toner located in various parts of the machine, collecting all of the cleaning functions in a single unit. The number of components needed was also slashed, contributing to higher reliability in a more compact size. And the potential of damage to the drum by a cleaning blade was also removed, which means a longer drum lifespan.

--- Bravo, Mr. Manager

(music/ lights out)

--- What challenges did you have to overcome to meet the demand for a 50% increase in operating speed?

Kuribayashi: In short, we had to simplify the structure and raise operating speed. You might say that achieving both of these tasks was an absolute must. Software and hardware engineers alike faced numerous difficulties in making this happen. In the print engine design, the fully integrated image-transfer method is a prime example.

--- How could an image be transferred without a fully integrated system?

Kuribayashi: Well, there is the multi-transfer system used by color laser beam printers. This is a method of outputting in full color by affixing each toner onto the paper in the order of yellow, magenta, cyan and black. With the full integrated system, the toners are first transferred to some kind of intermediate media, where the four-color image is made and transferred to the paper in a single process.

--- What is so difficult about the multi-transfer system?

Kuribayashi: You will always face discrepancies in the behavior and toner fixing attributes of paper, owing to differences in paper type, thickness and surface characteristics. There are many kinds of

paper available today, so many that we cannot control the characteristics of the paper our customers use.

--- Yes, that sounds like a job for paper manufacturers. (Laughs)

Kuribayashi: Which is why it is actually quite difficult to control each toner through four revolutions per page.

--- And the fully integrated system resolves this issue?

Kuribayashi: Well, in our system, the toners are first transferred in order onto the intermediate transfer belt, a media with we completely control, and it is here that a full color mirror image is created. This image is transferred to the paper in a single process. All we need is for the properties of the paper being used to remain constant for one process.

--- Meaning that you no longer have to worry about paper characteristics?

Kuribayashi: Well, moving very thin paper through the machine at high speed would still lead to problems such as paper rolling, waving and slanting. We had to evaluate this product with a truly wide range of paper types, and the teamwork of the many project members involved in paper transfer was an absolute requirement to succeed.

--- The term "fully integrated" makes it sound very elegant, but it sounds like you didn't neglect even the most tedious tasks...

Kuribayashi
"...in the end, we were able to form the foundations for achieving our initial mission of maintaining image quality, increasing speed by 50% and slashing costs." (Kuribayashi)

Kuribayashi: If you look at the mechanism from the side, you will see that the belt travels an inverted-triangle course. The four toners are transferred to the intermediate transfer belt at the top of the course, and the image is transferred to the paper at the "peak" at the bottom of this course. When I talked about "gathering all of the

toilets in one place," I was referring to the fact that residue toner appears only on the intermediate transfer belt. And while a fusing unit is needed to heat the toner and fix it firmly to the paper, by locating this unit at the bottom of the inverted triangle, we were able to make the product itself more compact.

--- The more I hear about this structure, the more it reminds me of trimming fat from meat.

(music/ lights out)

Kuribayashi: The fusing unit generates heat, so we also had to devote considerable energy to processing exhaust heat to ensure that the internal temperature would not rise too much. But in the end, we were able to form the foundations for achieving our initial mission of maintaining image quality, increasing speed by 50% and slashing costs.

--- Good for you!

Kuribayashi: The best part was making our product affordable to general office users, who hesitated about purchasing full-color business machines because of price.

--- Looks like you are a cinch to win this year's Pennant Race!

--- I have heard that when Canon developed its first monochrome network digital MFPs in the imageRUNNER series, the project team completely reevaluated the development process, and that active use of modules and unit components made future product development much faster. The fact that the lineup is growing rapidly seems to underscore this point. We've already seen the extent to which Kuribayashi-san and his people improved the print engine. But with this many fundamental technologies and technology assets behind you, the work must have been fairly easy.

Yamada
"This (image-processing) component makes photograph data more like an actual photo print and text characters very sharp." (Yamada)

Yamada: Let me guess that you are not very familiar with color image processing.

--- You mean, it wasn't simple? Well, of course monochrome means handling only a single color. This expands to four with YMCK output, which means about four times the difficulty, I would guess...

Yamada: Full color means a whole lot more than that!

Sugaya: As soon as we heard the word color, we faced the issue of how to handle the many dozen times of data involved with color over that of monochrome.

--- Many dozen times?

Yamada: To output in full color, eight to 10 bits of data must be handled for each color. In addition, image data contains not only the image itself, but also data related to the attributes of the image. That's where the "several dozens times" of data comes from. For the sake of our discussion, let's say it is about 40 times the data needed for monochrome output.

--- Well, now that you mention it, I see what you mean. So, you had 40 times as many engineers as monochrome network digital MFP development projects?

Yamada: Of course not. Only about twice as many.

(Music/lights out)

The new T-MIC aberration adjustment method makes possible sharp expressions, even of text in light colors, without jagged edges and moir. The image-processing chip is filled with Canon's proprietary know-how and patented technologies.

--- In that case, the development time was 40 divided by 2, or 20 times as long?

Yamada: We wouldn't even have the product out yet, and we wouldn't be having this discussion today. (Laughs)

--- We wouldn't, would we? (Laughs) Yamada-san, you were in charge of...

Yamada: The color graphic engine. This component makes photograph data more like an actual photo print and text characters very sharp, and sends data to the Kuribayashi-san's print engine. In short, my task was image processing.

--- Handling both photographs and text simultaneously?

Yamada: Even in one image, there are different looks to the portions where text is central, and those where the image is central. For example, we employed the dual direct mapping computing process to achieve high color reproduction when either copying or printing the photo portion of documents. Also, we employ T-MIC, a new aberration adjustment process to achieve sharp expressions, even of text and thin lines in light colors, without jagged edges and more.

(music/lights out)

The main circuit board of the imageRUNNER C3200 has three LSIs, each of which has twice the scale of its monochrome counterpart to improve performance and handle full-color data.

--- Is that the thing inside this chip, where the heat sink is standing?

Yamada: Yes, that's the Color iR Controller, the heart of the imageRUNNER C3200.

--- A dedicated large-scale integrated circuit (LSI) designed to smoothly process data and control commands. It was explained to me using the example of a roundabout in Europe. I see there are two LSIs attached to this circuit board, which means double the usage of the iR Controller for monochrome network digital MFPs?

Yamada: Not precisely. The work done by each LSI is different. One is an SOC (System-On-Chip) called the MEDOC, designed especially for device control, while the other is a color graphics engine called GRAVES. The Color iR Controller has many times the internal chip gate arrays than its monochrome counterpart. (The number of gate arrays determines the scale of an LSI.) Ours would be more like a roundabout at a 3D intersection.

--- Handling 40 times the traffic on a 3D intersection... Something like a wheel-less car flying through downtown Manhattan in a science fiction movie.

Yamada: You're catching on. (Laughs)

--- Sugaya-san was in charge of the "UFR," but what, to be precise, does that mean?

Sugaya: UFR stands for "Ultra Fast Rendering," or creating the image data that gets passed on to Yamada-san's graphic engine and ultimately Kuribayashi-san's print engine sections of the imageRUNNER C3200.

--- "Really, really fast rendering." (Laughs) If you look up the word "rendering" in the dictionary, you get definitions like "interpretation" and "portrayal." Am I right to think of this as "creating data to be passed on to the print engine?"

Sugaya: Absolutely right. Handling by the print engine is so fast that it is capable of handling 32 pages per minute (ppm), which means the data must be created just as quickly.

--- Like 40 times as quickly?

Sugaya: How much data do you think there is for one letter-size page's worth of data?

--- Let me see. A digital camera photograph of about 1 MB in size prints out fairly well at letter size.

Sugaya: Roughly 100 MB.

--- The first hard disk drive I ever bought only had 20 MB of space...

Sugaya: So, printing out 32 ppm means processing 3.2 GB of data every minute.

--- Now that's what I call muscle work.

(music/ lights out)

Sugaya
"One of the core technologies of UFR is shifting part of the work to the computer. We made use of some of the data processing capabilities of today's PCs."

Sugaya: One approach we could take to handle it would be to add huge amounts of expensive high-speed memory and raise the clock speed.

--- But you didn't select that approach?

Sugaya: For cost reasons, we went with a different method. One of the core technologies of UFR is shifting part of the work to the computer. We made use of some of the data processing capabilities of today's PCs.

--- I bought a new PC recently, and the clock speed was 2 GHz...

Sugaya: PCs are not simply faster these days. Faster models are developed and marketed extremely rapidly. There is no reason not to take advantage of this speed. In effect, we are outsourcing the "heavy" data processing that troubled us so in the past, to the computer.

Rationalizing Print Data Formation to Achieve High Throughput
--- What exactly do you mean by "outsourcing to the computer?"

Sugaya: When text and images are displayed on a Windows™ PC screen, or print commands are sent to a printer, the original data

travels via Windows GDI, the standard input/output interface for images. Using conventional methods, the printer driver installed in the PC operating system would send this data to the printer, which would translate it before finally starting the rendering process.

--- That sounds like a difficult job. But UFR changes all this?

Sugaya: In as far as the data comes from the Windows GDI, the process is the same. However, the work needed to facilitate rendering is done within the PC instead of the printer.

Explanation of UFR
The PDL is data in vector format, which is easy for printers to process, but the "heavy" processing needed to create was shifted to the PC side to significantly raise overall throughput.
--- Sounds something like retort meals. Just heat it up, and it's ready to eat.

Sugaya: If you use that allegory, it would be most like the freeze-dried food astronauts eat in space, since the data must be as "light" as possible to shorten the time needed to send it from the PC to the printer.

--- Get an instant meal by pouring hot water on it on the printer side. All you have to do is have the PC prepare and dry it in advance.

Sugaya: This is the process in which the data is converted into what we call the display list format. Anyone who has used a color printer has probably been irritated by the time it takes to do this on the printer side, because the weight of the data creates a bottleneck.

--- How fast does the PC processor have to be?

Sugaya: The clock speed should be about 450 MHz or higher, with 1 GHz as a very comfortable level.

--- I'm safe, then, with my 2 GHz, and my PC even has another 1 GHz to spare. So, why not also let the PC do the actual rendering?

Sugaya: A good question. But to do that, 100 MB of data per A4-size sheet would have to be created on the PC side. A new bottleneck would be created trying to send this volume of data to the printer.

--- I see. It is as if you outsourced the final assembly of a product to an overseas factory, but the components were so heavy that the plane carrying them couldn't get off the runway.

Sugaya: That's it. Diversifying production locations is just like dividing up data formation locations. We had to create our system after considering overall efficiency, cost and throughput, and taking into account the best shipping routes.

An Algorithm Made in Australia Gets Packaged into Hardware
SURF chip The SURF chip is a hardware component that makes possible high-speed rasterizing (creation of bit map data). This chip employs the originally developed image-processing algorithm that used to be called OpenPage.

--- What other secrets does the UFR hold?

(music/lights out)

Sugaya: We used the SURF chip, a special hardware solution to achieve ultrahigh-speed rendering. This is a truly amazing technology.

--- You don't hesitate to blow your own horn on that one. (Laughs)

Sugaya: Not my horn. The technology comes from Australia. (Laughs) We used a high-performance algorithm developed over a span of many years at Canon Information Systems Research Australia (CiSRA) in Sydney.

--- You get great waves in Australia, so you called it SURF, right?

Sugaya: Actually, I think it's an abbreviation for Scaleable Ultra-fast Rendering Function. Speed was the number one priority in developing the imageRUUNER C3200, so we made an ASIC

(customized LSI) and packaged it into the hardware. CiSRA's algorithm offers scalability, or the capacity to also package the ASIC into software if necessary.

--- And when the printer finishes the rendering process?

Sugaya: A bit map of 100 MB per page is created. That's where my job ends. I pass the baton to Yamada-san and the others and wished them well.

Yamada: With as many as 100 MB of data traveling through the printer, time is measured in seconds. We had to achieve some major innovations to realize 32 ppm following the efforts of everyone else to speed things up.

--- You're talking about that 3D roundabout.

Yamada: Even with a 3D intersection, a 100-MB card is just too big. More like an extremely long train than a car. If you let it move, you would have lots of railway crossings that never open up.

--- And that's bad?

Yamada: Concurrent processing is one of the main features of the imageRUNNER series. These are MFPs because they handle processes such as copying, faxing and scanning simultaneously. If you always kept some data waiting at railway crossings, you wouldn't have concurrent processing.

--- How did you resolve the issue?

Yamada: I don't know if I can tell you...

--- I promise to keep it off the record.

Yamada: The secret is slices.

--- Excuse me?

Yamada: We cut up the 100 MB of data and send it in slices.

--- You divide the data up into precise units and then process it?

Yamada: You've got it. These slices are the units in which the data travels within the printer and the fine points of each image are added.

--- Like slicing up a salmon, sprinkling salt on the slices, soaking them in vinegar and steaming them in rice wine...

Yamada: That's very close to the way it happens. But the image transferred to and output by the print engine is not slices, but the entire fish, head and all. We hide the kitchen work and only show the customer the fast and high-quality image output.

--- And you were able to speed up the processing?

Yamada: The work my colleagues did to enhance the speed in their areas was a good stimulus. So, in our part, we never keep the customer waiting. In fact, we achieved quite an amount of leeway in the speed department. (Laughs)

--- That's scary. (Laughs)

(music/lights out)

Yamada: I said that full color means 40 times the data of monochrome printing, but the same 40 times is required for copying and scanning images, as well. To realize concurrent processing of all of these functions, we simply had to make innovations to raise printing speed.

As the First imageRUNNER C3200 Leaves the Factory, Thousands of Canon Employees Exchange Congratulations
This image was used to evaluate the imageRUNNER C3200 when printing Adobe Postscript data.

--- During development, when did each of you feel the most accomplishment?

Yamada: When the prototype was delivered, we pressed the button, and the first page was output. It was a relief to see that a visible image had come out, even though that was only the start of the real work. (Laughs)

--- And that was how long before sales began?

Yamada: Let's say several months. It was certainly less than a year ago.

--- And Sugaya-san?

Sugaya: Me, too, when that first page came out, because when a print command comes from the PC, my part of the project links the entire system, handling image processing from the UFR to the print engine. And then there were also the times that we demonstrated the prototype in front of people inside and outside the company, including President Mitarai and the chief executive of our Product Operations.

--- Those would be satisfying times.

Sugaya: To tell the truth, a lot of people in different divisions inside Canon couldn't wait for us to finish. We received numerous queries, to which we had to reply, "Not yet," or "Wait a little longer," for about three months. Some people even worried about our progress, asking how we could keep top management waiting so long.

--- I'll bet you had to have nerves of steel against that kind of pressure.

Sugaya: It motivated us to move quickly, and in the end we were able to finish on schedule. What a relief that was!

--- And how about Kuribayashi-san?

Kuribayashi: When we hit the "Copy" button, and a copy actually came out. Strangely enough, it suddenly hit me that I had been building a copying machine, because I had been telling myself it was a printer all along. (Laughs) And it was enough for me that the

first page came out in full color. In days gone by, I remember prototypes that didn't even output the paper, let alone the paper with an image on it.

Sugaya: We believed that we would get a color image because we had done so years earlier using simulation software. It took us four and a half years to complete the imageRUNNER C3200, the longest single development period I've seen since I joined Canon.

--- How did you feel when the first model left the factory? Were you there to see it happen?

Yamada: It was one of the happiest days of my life. I wasn't able to be there, but I got an e-mail when it happened.

--- I'll bet it was cc'ed to dozens of people, too.

Sugaya: No, not really dozens. Thousands of people in divisions from production to marketing were involved, so the copy list numbered in the quadruple digits.

Yamada: And who knows how many people transferred the same message to us with congratulations?

--- That sounds like a chain letter that actually makes everyone happy.

---This word “happy” has a meaning etymologically linked to "lucky," from *hap* which is the prefix for "chance, or fortune." “Happy” in the sense of "very glad," was first recorded c.1390. The stem is derived from *eadig* (from *ead* as in "wealth, riches") and *gesælig,* which has become the word “*silly”*. From Greek, a great majority of the European words for "happy" at first meant "lucky." An exception is Welsh, where the word used first meant "wise." Used in World War II and after as a suffix (e.g. *bomb-happy, flak-happy*) expressing "dazed or frazzled from stress." The word *Happiness* was first recorded 1530. *Happy hour, meaning*

an "early evening period of discount drinks and free hors-d'oeuvres at a bar" is first recorded 1961. *Happy-go-lucky* is from 1672. *Happy as a clam* (1636) was originally *happy as a clam in the mud at high tide,* when it can't be dug up and eaten.

--- Hard clams can be found by walking in the shallows of lower Bays with bare feet. The hard clam, *Mercenaria mercenaria,* is a bivalve found in greatest abundance in the more saline areas of the Chesapeake Bay and near-shore ocean waters. It is an important member of the suspension-feeding, benthic fauna of the lower Chesapeake Bay, where it exists in salinities above 12 parts per thousand. Unlike the oyster, which tolerates a fairly wide range of salinity levels, the hard clam does well only in the saltier waters of the open Bay and ocean.

--- The hard clam is known by many names: round clam, quahog, littleneck, cherrystone and chowder clam. In most stages the hard clam has thick hard shells that contrast with the thin, easily broken shells of the soft-shell. "Littleneck" refers to the two barely visible siphons that can be seen in freshly shucked clams just below one of the cut muscles. They are separate from each other and short, so the hard clam does not burrow deeply.

--- A thick tan shell, usually egg- or heart-shaped, with concentric growth lines on its exterior. Its white interior has a deep purple stain surrounding its muscle scar, and its hinge has three white cardinal teeth. This species may grow to a width of four inches.

--- The life cycle of the hard clam includes a pelagic larval phase and relatively sedentary benthic juvenile and adult phases.

--- Hard clams begin their adult lives as males, often become females with greater maturity, and require individuals of both sexes for reproduction.

--- Clams develop functional male gonads during the first or second year of life.

--- Spawning cycles are affected mainly by water temperature and the availability of food, and thus vary according to latitude. Spawning often occurs in "pulses" and may continue for months, but usually there are one or more distinct spawning peaks.

--- In the Chesapeake Bay region, spawning usually commences when temperatures rise above 20-23 degrees C (68-73 degrees Fahrenheit.

--- Female fecundity is high, and individuals can release 16 million to 24 million eggs per spawn, although laboratory studies often have recorded values of only 1-3 million eggs, and only a few will reach maturity.

--- Individuals may release as many as 60 million eggs during one season.

--- Eggs are 70 to 73 microns in diameter and are surrounded by a gelatinous membrane. Eggs and sperm of adults are expelled in the water current and fertilization occurs externally in the water column.

--- In the Bay area, the most significant growth occurs in spring and fall, when abundant food and optimum water temperatures coincide. Growth decreases in summer and stops altogether in winter. Growth rate also decreases with age, and when this happens, clams become thicker, rather than increasing in shell length.

--- Most larval stages of the hard clam swim toward light (or opposite force of gravity), so most are concentrated in the surface waters and are dispersed by wind, waves, and current.

--- The pediveliger stage is the final larval stage before settlement and metamorphosis to juveniles. At this stage the organism has a foot that extends from its shell.

--- Once the hard clam settles to Bay bottom, it uses its foot to dig into the mud, and secretes a calcium carbonate shell that increases in size as the clam's internal organs grow.

--- The most growth takes place in temperatures between 10 C (50 F) and 25 C (77 F). A cross-section of a hard clam's shell usually reveals a clam's age. Hard clams may live for more than 30 years, and occasionally reach 50 years.

--- The hard clam's natural enemies include several species of rays and the Atlantic blue crab. In some clam culture operations, fencing devices are used to protect the nursery areas of small hard clams.

--- The hard clam is given its grade name based on its size: chowders run more than 3 1/2 inches in width, cherrystones are 2 1/2 to 3 1/2 inches, top necks are 2-2 1/2 inches, and little necks are around 2 inches.

--- Clams, such as the northern quahog, are bivalves, meaning that they have shells consisting of two halves, or valves. The valves are joined at the top, and the adductor muscles on each side hold the shell closed. If the adductor muscles are relaxed, the shell is pulled open by ligaments located on each side of the umbo.

--- The clam's foot is used to dig down into the sand, and a pair of long siphons that extrude from the clams's mantle out the side of the shell reach up to the water above (only the exit points for the siphons are shown). Clams, such as the northern quahog, are filter feeders. Water and food particles are drawn in through one siphon to the gills where tiny, hair-like cilia move the water, and the food is caught in mucus on the gills. From there, the food-mucus mixture is transported along a groove to the palps which push it into the clam's mouth. The second siphon carries away the water. The gills also draw oxygen from the water flow.

--- The mantle, a thin membrane surrounding the body of the clam, secretes the shell. The oldest part of the clam shell is the umbo, and it is from the hinge area that the clam extends as it grows.

--- Most hard clams become reproductively active at approximately 1 year of age (Loosanoff 1936, 1942) and will continue to produce broods throughout their lives, with no reproductive senescence observed (Walker and Hefferman, 1996).

--- Owing to their commercial importance, the typical lifespan of *Mercenaria* is approximately between 4 and 8 years of age, the peak of their commercial marketability. At this age, most hard clams measure between 2 - 4 inches, which places them in the littleneck (2.0 - 2.9 inch) and cherrystone (3.0 - 4.0 inch) categories. Those hard clams which grow above 4.0 inches are termed chowders or quahogs (Busby, 1986).

--- The natural lifespan of *Mercenaria* is generally unknown; however, counts of growth rings indicate that the hard clam, in the absence of predation or commercial exploitation, may live as long as 40 years. Growth has been observed to cease after the age of 15 years, with annual growth at this age slowed to approximately 1mm per year (Loesch, and Haven, 1973).

--- Size classes for *Mercenaria mercenaria* have been designated as follows to standardize commercial conventions: Seed clams: < 1"; Beans: 1.0 - 1.5 "; Buttons: 1.5 - 2.0"; Littlenecks: 2.0 - 2.5"; Topnecks: 2.5 - 3.0"; Cherrystones: 3.0 - 4.0"; Chowders: >4.0".

--- Local variations in growth rates are extreme throughout the entire geographic range, and seasonal differences in growth also occur (Ansell, 1968). In northern areas of the geographic range, growth in *M. mercenaria* occurs only during the summer when water temperatures approach 20 °C, the optimum growth temperature for this species.

--- During winter, growth ceases altogether in water temperatures below 5 - 6 °C. In southern areas of the range, growth is more continuous. For example, in South Carolina and Georgia, hard clam growth is rapid in fall and spring, tends to slow throughout the winter months, and is slowest during the summer. *Mercenaria* in Florida may have growth rates 3 times those for *Mercenaria* in more northern waters (Barile et al., 1986)

--- Water temperature sets the limits for growth; however other factors, such as food availability and degree of crowding also influence growth rates. Crenshaw et al., 1996 showed that hard clams reared at high densities (>360 per square foot) tended to take longer to reach the same size as those reared under more moderate (~30 per square foot) conditions.