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Digital Image Transformations and Image Stacking of Latent Prints Processed Using Multiple Physical and Chemical Techniques

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Digital Image Transformations and Image Stacking of Latent Prints Processed Using Multiple Physical and Chemical Techniques

Danielle Tague

**Thesis Submitted
to the Eberly College of Arts and Sciences
at West Virginia University**

in partial fulfillment of the requirement for the degree of

**Master of Science in
Forensic and Investigative Science**

**Keith Morris, Ph. D., Chair
Jacqueline Speir, Ph. D.
Robert Johnson, Sgt.**

Department of Forensic and Investigative Science

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ABSTRACT

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Danielle Tague

Latent fingerprints are highly common among evidence that is found at crime scenes. While fingerprint evidence can be very reliable, comparison and identification of a print is highly affected by the quality of the fingerprint image. Fingerprint experts ideally want to have an image with the best quality possible, in order to make an accurate identification and avoid missing pertinent details. This is a thesis presented on the use of digital image processing to merge multiple images of one fingerprint to obtain a final image with greater quality. The research was conducted using different latent fingerprint processing techniques that have been widely used in the forensic science community: ninhydrin, DFO, zinc chloride, cyanoacrylate, and fluorescent dye-stains. The latents were photographed after each technique was utilized. Images of the same print under different wavelengths and filters were merged to create a final image with ideally better contrast, quality, and friction ridge detail than were observed in the original images prior to merging. Quality was determined using three different scoring methods; NFIQ, Bandey scale, and AFIX Tracker. A print was considered to be improved if the merged score was better than the scores of the original images. There were 12.1 % of prints that were improved based on NFIQ scores, 2.8 % based on Bandey scores, and 15.0 % based on AFIX match scores. Image fusion for increasing quality of latent fingerprint images is a method that shows small benefits for the examiner when performing a comparison.

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1. INTRODUCTION

Latent fingerprints are highly common among evidence that is found and collected at crime scenes. They can represent a unique individual, and are therefore very valuable to the examiner to identify possible suspects. While forensic experts are very knowledgeable about fingerprint identification and performing comparisons, there are many discussions regarding ways to improve the quality of a latent fingerprint image. Quality is essential when examining latent fingerprint images, and the importance of capturing a print with decent friction ridge detail can be pertinent to an investigation. Examiners strive to achieve the best level of quality in a fingerprint image in order to ensure performing their best analysis of the print when marking minutia and comparing latent prints. Low quality on a fingerprint causes difficulty in performing comparisons. The purpose of this study is to determine a method for increasing the quality of a single fingerprint by photographing the print under different conditions, and performing image fusion to create a final image of better quality for comparison. Better quality is defined as more contrast between the background and friction ridge detail of the fingerprint.

Image fusion technology is an increasingly effective method used in forensic analysis of material evidence. Other forensic disciplines have already begun using this technology, such as tool mark and handwriting examination. Experts utilize different lighting conditions and camera settings in order to capture multiple images of the evidence, and then merge these images together to obtain a better quality image than the original. Considering the substantial use and success of image fusion in areas such as surveillance, medical imaging, and biometrics, image fusion of latent fingerprints could become an important part of latent fingerprint identification.

A definition of image fusion that has been accepted among the remote sensing community is stated by Wang et al. as “data fusion is a formal framework in which are expressed means and tools for the alliance of data originating from different sources. It aims at obtaining information of greater quality; the exact definition of ‘greater quality’ will depend upon the application” [11]. Zitova and Flusser have discussed possibilities of error when referring to image registration in prior research, which will be addressed in this research. They stated that there is a possibility of localization error, matching error, alignment error, and test point error, but that each of these can be controlled by consistency checks and analysis by the examiner of the image [14].

Automated matching systems are typically the method of comparison for latent fingerprint identification. The algorithm matches prints based on the locations and rotations of extracted minutiae that are marked on the print [5]. The friction ridge impressions that compose the fingerprint must be of good quality in order for the minutia to be identified by the system. NIST states the importance of quality to biometrics and fingerprint identification systems:

“Performance of biometric systems is dependent on the quality of the acquired input samples. If quality can be improved, either by sensor design, by user interface design, or by standards compliance, better performance can be realized.” [5]

NIST determined that for the aspects of quality that cannot be controlled, there must be a way to analyze the quality of a sample. In 2004, they developed the NIST Fingerprint Image Quality (NFIQ) which predicts the expected matching performance of fingerprint images [5]. The 2004 NIST report *Fingerprint Image Quality* states that:

“Presenting the matcher with good quality fingerprint images will result in high matcher performance, and vice versa, the matcher will perform poorly for poor quality fingerprints.”

The important determination regarding this method is whether multiple images of the same fingerprint can be fused to create a new image with better quality. To determine this, each original fingerprint was given an NFIQ quality score. Once the multiple images of one print were merged, that image was also given an NFIQ quality score. The scores were then compared to determine if the merging of the original images improved the quality compared to the originals prior to merging. A second scoring system was used along with NFIQ, denoted the Bandey scale. The Bandey scale is a quality assessment based off of the examiners analysis of each individual print. All images were then uploaded into an automated matching system (AFIX) and minutiae extracted. The images were searched against a database of rolled tenprints, which contained the subjects fingerprint. Match scores for all fingerprints were recorded. If the image fusion was successful between multiple images of the same latent print, then the image quality of the new, merged image would be better, therefore resulting in higher match scores when searched on the automated matching system. A print was considered to be improved if the merged score was better than the scores of all the original images.

2. PREVIOUS RESEARCH

Research on image fusion and forensic evidence has been done with one common goal; to increase the quality of images used for comparisons by fusing multiple images together. This method has so commonly been used in areas such as medical imaging, surveillance, and biometrics, that it has adopted a very sound reliability within the scientific community. It is understandable that forensic scientists have begun to use this method and adapted it to use on forensic evidence photography. Specifically, pattern recognition is highly relevant to this method due to the intricate detail needed to make some comparisons.

Zhang [13] released an article analyzing the use of image fusion technology, combined with software integration, in feature extraction and image enhancement in material evidence photography. This research dealt with a variety of evidence such as tool mark impressions, handwriting impressions, and fingerprints deposited on curved surfaces. Figure 1 below is an image of a fingerprint on a curved surface. The print was imaged under two different lighting conditions, (A) and (B), and the two images were then merged to create the composite image (C). The research showed how fusing two lower quality images together with different information contained in each can result in a final image containing more information.

Figure 1 (A) and (B) show a fingerprint on a curved surface with lighting at two different angles. Image (C) is the merged image of (A) and (B) [13]

This article explores the use of pixel-level fusion, which is stated as ‘the mainstream method’ and the method that Photoshop uses to perform image fusion. Zhang [13] reported that Photoshop is a commonly used program to enhance material evidence images, discussed the validity of the method of image fusion using Photoshop, and concluded that the use of image fusion technology can be effective in the process of material evidence photography. Zhang stated that the method of image fusion can effectively solve any material evidence photograph problems relating ‘to a certain extent.’ [13] The statement “to a certain extent” implies that image fusion cannot make up for all evidence photography problems, and may not be able to help in cases of very low quality or missing detail.

Ross, S. Shah, and J. Shah [7] performed research on image mosaicing for fingerprints. The goal of their research was to take the information of two or more fingerprint impressions and create composite information, resulting in a more complete final image. They discussed two ways to combine the images; blending the impressions into a single mosaic or integrating the feature sets. Figure 2 shows two fingerprints (A) and (B) that were combined using image mosaicing to create the final image (C), which encompasses more information than the two individual prints [7].

Figure 2 (A) and (B) are partial prints, image (C) is the final print after image mosaicing was done on (A) and (B) [7]

Although Ross, S. Shah, and J. Shah [7] used Thin Plate Splines to create a composite, while this research utilized the Photoshop Auto-Blend algorithm, the goal of their study was similar; merge fingerprint impressions in order to obtain a better quality image, and obtain better match scores.

Joshitha and Selin [3] discussed image fusion using principal component analysis (PCA) for palm print recognition. The study focused on the use of PCA to fuse multiple images of the same palm print in order to obtain a full image of the print, and subsequently performing feature extraction to look at minutia, density map, and principal line map. This research showed that image fusion could create a higher quality composite image containing greater detail. They were able to determine that the matching accuracy was significantly improved through image fusion [3].

Research was not found which specifically involves fusing fingerprints that were processed using various physical or chemical techniques and imaged under multiple wavelengths and filters.

3. METHODOLOGY

3.1 Materials

- Nikon® D7100™
- Nikon® Nikkor 60mm f/2.8 Lens
- Neenah Exact Index cardstock 8.5 x 11 in.
- Fisherbrand 75 x 50 x 1mm microscope slides
- Plastic page protectors
- Air Science USA fuming chamber
- Cyanoacrylate glue
- Diazafluorenone (DFO), ninhydrin reagent, zinc chloride reagent
- Basic red 28, basic yellow 40, rhodamine 6G, and MBD dye stains
- Sirchie black fingerprint powder
- Alternative Light Source
- Orange and green band-pass filters
- Adobe Photoshop CC 2014 Photo Editing Software
- AFIX Tracker
- NIST Fingerprint Image Quality software

3.2 Methods

3.2.1 Fingerprint deposition

There were a total of 328 prints taken from one subject. The prints were deposited on four different substrates; glass (99), plastic (136), cardboard (26), and white paper (67). Each print was deposited from the same subjects left thumb to eliminate the variable of different friction ridge patterns. The prints were deposited with added sebaceous material to keep the deposits consistent; the subjects' finger was rubbed against her forehead to add some of the oils present on the forehead. The addition of sebaceous material to the finger prior to deposition was

necessary due to not enough oils being present on the finger. This was especially true when deposition occurred on paper and cardboard samples.

Processing of prints deposited on both porous and non-porous surfaces was done immediately to avoid saturation of the print into the porous substrate or the possibility of degradation due to light or other environmental conditions.

The prints were deposited on Neenah Exact Index cardstock 8.5 x 11 in. for the paper samples. They were deposited along the outer edge of the paper about 1 inch apart, and then immediately processed via either DFO, ninhydrin, or zinc chloride techniques. After processing was complete the prints were numbered. The glass samples were deposited on Fisherbrand 75 x 50 x 1mm microscope slides. Two to three prints were deposited on each slide, and then numbered after fuming with cyanoacrylate. The prints deposited on plastic were on plastic page protectors, and then numbered after fuming with cyanoacrylate. The cardboard samples were deposited on the inside of a cardboard box to avoid overlays of areas that had been touched and were processed immediately with DFO, ninhydrin, or zinc chloride.

3.2.2 Processing Techniques

Detection of each print began with optical techniques. Optical detection techniques have the advantage of being non-destructive, therefore preceding any other physical processing techniques. The prints were first analyzed via illumination with white light. Any friction ridge detail visible was to be photographed. Detail was unable to be photographed for any of the fingerprints viewed under oblique illumination because no detail was visible without processing. Analysis was then done using absorption and/or luminescence, depending on the substrate and processing technique. Varying wavelengths and filters were used to illuminate the prints based on the processing technique that was used.

3.2.2.1 DFO

DFO was used to develop a total of 58 latent prints on paper (32) and cardboard (26). The reagent produces a pale purple color upon reaction with the amino acids in a fingerprint. DFO is a popular technique because the developed marks show a strong luminescence and the process is very simple and rapid. The sample was first sprayed with the reagent until saturated and allowed to air dry. The sample was then heated for 40 minutes at 100 °C with ambient humidity. Once removed from the heat source, the fingerprint was viewed under multiple wavelengths ranging from 450 nm to 530 nm with orange goggles. The use of this reagent allows further processing to be done using Ninhydrin [8]. Images were captured for the DFO developed prints at 470 nm with an orange bandpass filter.

3.2.2.2 Ninhydrin

Ninhydrin was another reagent used to develop 61 total latent prints on paper (35) and cardboard (26). The chemical compound 2,2-Dihydroxyindane-1,3-dione reacts with the amino acids that are present in a fingerprint due to the eccrine component to create a dark purple coloration known as Ruhemann's Purple. The sample was sprayed until completely saturated by the reagent, allowed to air dry and heated to 80°C and 65% humidity for 40 minutes. The prints

were viewed under white light, with no goggles, and under white light with green goggles. Images were captured under white light with no filter, and under white light with a green bandpass filter. The latent prints that were previously processed with DFO were also subsequently processed with ninhydrin.

3.2.2.3 Zinc Chloride

Zinc chloride was used to further process the prints that were processed using ninhydrin on the paper samples, including the post-DFO ninhydrin treatment. Ninhydrin treatment does not interfere with further treatment by zinc chloride [9]. The aqueous reagent changes the purple color of the ridges that were a result of the ninhydrin to an orange/red color. The advantage of using this technique as a post-ninhydrin treatment is that it fluoresces under wavelengths from 490-505 nm and may bring out more friction ridge detail. The samples were sprayed with zinc chloride, allowed to dry, and heated to 80°C, at 65% humidity for 40 minutes. The prints were viewed at 490 nm with orange goggles. Images were captured at 490 nm with an orange bandpass filter.

3.2.2.4 Cyanoacrylate Fuming

Fingerprints deposited on the non-porous substrates (glass and plastic) were fumed with cyanoacrylate. A total of 235 prints were fumed. The samples were placed into the Air Science USA fuming chamber with a heat source, superglue, and a water source for humidity. The chamber was set at 80°C with humidity at 65%. The cyanoacrylate polymerized on the friction ridges to create white ridges with more contrast. After latent prints were fumed with cyanoacrylate, they were dye-stained with either basic yellow 40 (18 glass, 0 plastic), basic red 28 (33 glass, 40 plastic), MBD. (16 glass, 46 plastic), and rhodamine 6G (32 glass, 50 plastic). Each dye staining process required the prints to be submerged in the reagent for 5-10 seconds, allowed to dry, rinsed with distilled water, and allowed to air dry again. Each dye stain was used on both substrates, however the basic yellow 40 on the plastic substrate did not develop correctly, and due to being completely out of the reagent with a small time frame left to obtain images, it was determined that the number of images using other dye-stains were sufficient for the aim of the study, and the basic yellow 40 dye-stained prints on plastic were not a necessity to analyze the method. These prints were numbered 100-119, and were eliminated from the study.

Table 1. List of dye stains used after fuming, wavelengths, and filters

Dye Stain	Wavelength/filter
Basic Yellow 40	385, 450, 485 nm, orange filter
Basic Red 28	470, 500, 550 nm, orange filter
Rhodamine 6G	500, 515, 540 nm, orange filter
MBD	415, 450 nm, orange filter

3.2.2.5 Dusting using black powder

The only samples that were dusted with black powder were the prints deposited on glass, fumed with cyanoacrylate, and dye stained with basic red 28. After dusting the prints and photographing them, it was obvious that the prints had become degraded and had a significant loss in quality just by observation. Once observing this, it was decided that no other fingerprints would be dusted due to this subsequent processing worsening the quality of the print. The black powder seemed to not only stick to the friction ridges but to the background of the print. This may have been due to any extra reagent still present on the substrate.

3.2.3 Sequence of Processing Techniques

Processing techniques for any forensic evidence, whether it is fibers, drugs, hairs, or fingerprints, starts with the non-destructive methods first, and may be followed with processes that will help to enhance the quality of the fingerprint. Figure 3 shows the sequence of how the prints were processed. This was adapted from Champod's (2004) suggested sequence of processing techniques, which was used as a guideline for how the prints were processed [1].

Figure 3. Flow chart showing the sequence of processing techniques

*Only performed on prints deposited on glass, fumed with CA, and dye stained with basic red 28

3.2.4 Digital Image Processing and Forensics

The Scientific Working Group on Friction Ridge Analysis, Study and Technology (SWGFAST) presents standards for friction ridge impression digital imaging for latents or ten-prints. A latent that is being used as an item of evidence must be documented according to the SWGFAST guidelines. Also, image integrity must be maintained by keeping an image of the original fingerprint and any enhancements will be saved as separate images [10]. All original images were kept, along with all image enhancements saved separately for this study.

3.2.5 Image Contrast Adjustment

The contrast for each original image was adjusted using Photoshop CC 2014. This process was done by adjusting the histogram of each image to obtain the highest amount of contrast possible. The shadows, midtones, and highlights were adjusted by using the levels adjustment function to change the tonal range of the image and achieve higher contrast prior to merging the individual fingerprints. Images that had too low of a tonal range, therefore resulting in less contrast, were given a larger range between 0 and 255. The quality of the contrast was measured during this step by simply observing the print and the contrast between the friction ridges and the background, and by looking at the tonal range and histogram of each image.

Prior to performing image fusion on all samples, it was decided based on the first few samples done that the image contrast would be adjusted in order to give the best possible scenario. Without adjusting the contrast, the fused images contained very little information from the other images, and were mostly composed of one image. The contrast was adjusted in all images in order to eliminate that as a variable of image quality.

3.2.6 Digital Image Registration Using Photoshop Auto-Align

Digital image registration is the process of converting images of different data sets into one coordinate system. This process is used to align images that have different magnification, rotation, field of view, scale, translation, etc. It is also known as image alignment, and is essential in many image analysis processes, including image fusion [14]. One of the images of interest is the reference image, while the other image(s) are the target image(s). The target image(s) are spatially registered to align with the reference image. There are two types of image registration: area-based and feature-based [14]. In this study, feature-based registration was done by utilizing the Auto-Align command on Photoshop CC 2014. Feature-based registration uses fixed points in an image (line intersections, corners, edges, areas of high curvature, region features, etc.) and establishes a correspondence between these points. The Auto-Align command on Photoshop CC 2014 automatically aligns layers based on similar content in different layers. Once this correspondence between different layers is established, a transformation is done to map the target image to the reference image. Photoshop automatically chooses a reference layer based on the images uploaded by the user, and the matching content overlays itself [13].

Photoshop allows the user to register the images in the same step as merging the image, which will be discussed further in the next section. First, through the *File* menu, *Scripts > Load Files Into Stack* was selected. *Browse* was then selected, and multiple RGB images of the sample

print were highlighted and opened. The *Automatically Align Source Images* box was checked. This option uses the Auto-Align feature prior to stacking the images, which eliminates performing this action in a separate step. After all images loaded, each image was selected and cropped to adjust the aligned images and cut the edges.

The specific algorithm that Adobe uses to perform feature-based registration is unable to be released to the public. Since it is unknown what the algorithm that Adobe uses for this function is, a brief overview of possible feature-based algorithms will be discussed; canny-edge detector and detectors based on Laplacian [14]. These two algorithms are specifically used to establish correspondence between images by detecting edges.

3.2.6.1 Canny Edge Detector

One possible feature-based algorithm that Adobe may utilize for establishing correspondence is the canny edge detector. This algorithm applies a Gaussian filter to smooth the image and eliminate noise, finds the intensity gradients of the image, applies non-maximum suppression to get rid of spurious response to edge detection, applies a threshold to determine edges, and finalizes the edges by detecting and suppressing weak edges that are not connected to strong edges [4].

3.2.6.2 Laplacian of Gaussian

This algorithm uses a Gaussian kernel to convolve an input image at a certain scale, giving a scale-space representation. The scale-space representation scales the input image to the target image in order to complete registration. The Laplacian operator is applied and the result is computed. The Laplacian performs edge detection by highlighting regions of rapid intensity change [19]. After a correspondence is made, the images were rotated by the program to create an alignment based on the edges that were detected. Registration was performed between multiple images of one fingerprint, for all samples. The prints that were deposited on paper and cardboard were unable to be successfully registered; therefore they were also unable to be fused together. After attempting with each image and having reoccurring failure, it was decided to eliminate these samples from the sample set. This will be discussed further in section 4.5.

3.2.7 Digital Image Merging Using Photoshop Auto-Blend

Each individual image contains pertinent information. Information from multiple images can be combined to create a single image containing both sets of information. This composite image will provide more comprehensive information for analysis [13]. In this study, the Auto-Blend Layers feature on Adobe Photoshop CC 2014 was used to combine multiple images of the same fingerprint. This function applies layer masks to each layer to mask over- or under-exposed areas, or content differences, and create a composite image [13]. Once the images were registered and aligned with one another as outlined in the previous section, they were merged on Photoshop. Under the *Edit* menu, *Auto-Blend Layers* was selected, and then *Stack Images*. This process resulted in a blended image of all chosen layers. This blended image was merged into a single composite image, eliminating the separate layers, by selecting *Merge Layers* from the *Layer* menu. Figures 4 and 6 below show an example of four images of one fingerprint, and Figures 5 and 7 show their composite images, respectively, once layers were aligned, cropped, and merged. The individual layers and final merged image were each converted to grayscale

before being saved as a separate JPEG since the NFIQ program used for analysis required all images to be in JPEG format and grayscale. Table 2 gives the total number of images taken for each processing technique and the merged images.

Figure 4. Individual images of print #172 before merging. Deposited on glass and photographed under four different conditions; a) fumed with cyanoacrylate, b) dye-stained with Rhodamine 6G at 540 nm, c) dye-stained with Rhodamine 6G at 515 nm, d) dye-stained with Rhodamine 6G at 500 nm

Figure 5. Merged image of print #172

Figure 6. Individual images of print #16 before merging. Deposited on plastic and photographed under four different conditions; a) dye-stained with Basic Red 28 at 470nm, b) dye-stained with Basic Red 28 at 500nm, c) dye-stained with Basic Red at 550nm, d) fumed with cyanoacrylate

Figure 7. Merged image of print #16

Table 2. The total number of images for each process and merged images

Substrate	Processing Method	Total Images
Glass	Cyano	98
Glass	Basic Red 28	99
Glass	Basic Yellow 40	54
Glass	Rhodamine 6G	96
Glass	MBD	16
Glass	Merged	99
Plastic	Cyano	113
Plastic	Basic Red 28	118
Plastic	MBD	91
Plastic	Rhodamine 6G	90
Plastic	Merged	115

3.2.8 NIST Fingerprint Image Quality (NFIQ)

After each image was converted to grayscale and saved as a JPEG, they were all placed into a folder within the NFIQ program that would be set as the directory for the script that was entered into Linux. The NFIQ algorithm will only take an input image that is in ANSI/NIST or NIST IHEAD format or is compressed. The input images can be compressed using baseline JPEG or lossless JPEG, which was the case for this study. NFIQ assesses image quality by computing a feature vector using the quality image map and minutiae quality statistics produced by the MINDTCT minutia detection algorithm (Figure 8) [5].

The quality image map generated by the MINDTCT package measures the quality of regions of the print by detecting regions of low contrast, low ridge flow, and high curvature. These three conditions represent unstable areas in which minutiae detection is unreliable. The direction map, low contrast map, low flow map, and high curve map mark blocks of the fingerprint that are unreliable. The information from these individual maps is combined into one general map containing five levels of quality from 0 to 4. A score of 0 quality is regarded as the background and lowest quality, while a score of 4 is the highest quality [5]. The unstable areas are flagged when the score is lower than a 2. The quality is determined based on its proximity to blocks that were flagged in the maps.

The minutia quality is then determined by assessing the location of the minutia points within the quality map. The algorithm also takes into account pixel intensity statistics within the immediate neighborhood of the minutia. The minutia quality are rated as 0.5 or better, 0.6 or better, 0.75 or better, 0.8 and better, and 0.9 and better. Minutiae that have a quality lower than 0.5 are unreliable.

NFIQ combines the image quality map and the minutia quality assessment to create an 11-dimensional feature vector. Table 3 below shows the feature vector description [5].

Table 3. Feature vector description of MINDTCT algorithm [5]

	NAME	DESCRIPTION
1	foreground	number of blocks that are quality 1 or better; i.e. $\text{foreground} = \sum_{i=1}^4 U_i$ where U_i is number of blocks with quality i
2	total #of minutia	number of total minutiae found in the fingerprint
3	min05	number of minutiae that have quality 0.5 or better
4	min06	number of minutiae that have quality 0.6 or better
5	min075	number of minutiae that have quality 0.75 or better
6	min08	number of minutiae that have quality 0.8 or better
7	min09	number of minutiae that have quality 0.9 or better
8	quality zone 1	percentage of the foreground blocks of quality map with quality =1
9	quality zone 2	percentage of the foreground blocks of quality map with quality =2
10	quality zone 3	percentage of the foreground blocks of quality map with quality =3
11	quality zone 4	percentage of the foreground blocks of quality map with quality =4

The feature vector is used to input a Multi-Layer Perceptron neural network classifier. The output activation level of the neural network is used to determine the prints image quality score as an integer from 1 to 5 [5]. Figures 8 and 9 show fingerprint images and their NFIQ scores. Figure 8 is a print with an NFIQ score of 5, and figure 9 is a print with an NFIQ score of 1.

Figure 8. FP #159 stained with BR28, at 470nm

Figure 9. FP #159 stained with BR28, at 550nm

Figure 10. MINDTCT minugia detection process [5]

The commands to run NFIQ were entered into Linux and produced a quality score of an integer from 1 to 5 for each image next to the image file name in a separate text file. A score of 1 indicated the highest quality, and a score of 5 indicated the lowest quality [18]. The NFIQ source code was available for download through public domain and is under no license requirements.

3.2.9 Bandey Scale

All images were randomized and renamed by a peer in order to minimize subjectivity when rating each image using the Bandey scale. The five point scale (table 4) was created by Bandey to give a score from 0 to 4 that rates the amount of development of the print based on the examiner [17]. The purpose of utilizing the Bandey scale as an aspect of this study was to introduce a third type of image quality scoring system that is based on the examiner. This scoring method has the advantage of showing the significance of the merging based on what the examiner is viewing, which is importance since this is how an identification is performed.

Table 4. Bandey fingerprint quality grading scheme [17]

Grade	Description
0	No development
1	No continuous ridges; all discontinuous or dotty
2	One third of the mark comprised of continuous ridges; remainder show no development or dotty
3	Two thirds of the mark comprised of continuous ridges; remainder either show no development or dotty
4	Full development; whole mark comprised of continuous ridges

Figures 11 and 12 show fingerprint images that were scored using the Bandey scale. Figure 11 was scored as a 4, and figure 12 was scored as a 1. No fingerprints in this study were rated as a 0.

Figure 11. FP #10 CA fumed

Figure 12. FP #80 CA fumed

3.2.10 AFIX

Fingerprint identification is typically performed using an automated matching system. AFIX Tracker, which is a fingerprint, palmprint, and biometric identification system, is the first automated fingerprint identification system that is PC-based [15]. AFIX uses a minutia matching algorithm which first registers the images by translation, rotation, and scaling as needed. After registration is performed, minutia pairs are counted between both fingerprints. Two minutia are determined to correspond if they are located within a bounding box. The matching of minutia is used to then create the match score [16].

Each image was loaded into AFIX as a latent file at 1000 PPI, along with a rolled tenprint from the subject that was scanned at 500 PPI. The minutia were manually marked on all prints, then a search was ran for each print against all tenprints in the database. The database used was the Crime Scene Lab database that is utilized by West Virginia University. The search was set to show the top 20 matches for each latent fingerprint. Once each print was searched against the database, the match score, number of lines, and false non-matches were recorded for each latent.

The three scoring methods were chosen due to the different aspects of quality they each analyze. NFIQ specifically looks at image quality by assessing contrast in the image and the quality of the minutia. The Bandey scale determines quality by the examiner's analysis of which image is clearer for identification. The AFIX match scores give information about the quality of the image by identifying and counting minutia. Analyzing the images using these three scoring methods was important in order to cover the different ways that the quality of a fingerprint can be determined.

4. RESULTS AND DISCUSSION

4.1 NFIQ

The data represented in tables 5 and 6 show that the average NFIQ score for all of the merged samples was 2.8, while the average NFIQ score for all of the original images was 3.1. The average NFIQ score for the merged samples was lower than the original samples by 0.3. There were a higher percentage of merged images than original images with a score of 1, and a higher percentage of original images than merged images with a score of 5 (Figure 13). There were 122 prints where the merged image NFIQ score was greater than the average score of the original images for that print, and 92 where the average score of the original images was greater than or the same as the merged. Therefore, 57% of merged images had a higher NFIQ score than the average of their original images. Section 4.4 will discuss the improvement in quality more in depth.

Table 5. NFIQ scores and average score of all merged fingerprints

NFIQ of Merged (All Samples)	
<i>Score</i>	<i>Frequency</i>
1	64
2	39
3	34
4	26
5	51
Average Score	2.8

Table 6. NFIQ scores and average score of all original fingerprints

NFIQ of Originals (All Samples)	
<i>Score</i>	<i>Frequency</i>
1	220
2	94
3	91
4	113
5	257
Average Score	3.1

Figure 13. Percentages of each score from 1 (highest quality) to 5 (lowest quality) in original images vs. merged images

4.2 Bandey Scale

The data represented in tables 7 and 8 shows the Bandey scale scores of all merged and all original samples. The average score for all merged images and all original images based on the Bandey scale is 3.4, meaning there was a 0.0 difference between the average scores. When comparing the percentage of merged samples with a score of 4 to the percentage of original samples with a score of 4, there is a small amount of difference, but a higher percentage of the original images have a score of 4. There are more merged images than originals with a score of 3. Scores 0, 1, and 2 represent little to no ridge detail and are a very low percentage of the scores for the merged and the originals. There were 100 prints where the merged image Bandey score was greater than the average score of the original images for that print, and 114 where the average score of the original images was greater than or the same as the merged. Forty-seven percent of merged images had a greater Bandey score than the average of their originals.

Table 7. Bandey scale scores and average score of all merged images

Bandey Scale of Merged (All Samples)	
<i>Score</i>	<i>Frequency</i>
0	0
1	2
2	15
3	97
4	100
Average Score	3.4

Table 8. Bandey scale scores and average score of all original images

Bandey Scale of Originals (All Samples)	
<i>Score</i>	<i>Frequency</i>
0	0
1	4
2	54
3	318
4	399
Average Score	3.4

Figure 14. Percentages of each score from 0 (lowest quality) to 4 (highest quality) in original images vs. merged images

The results from the Bandey scale showed that there was very little distinction between images rated a 3 or a 4, but there were little to no images rated a 2 or below (Figure 14). Also, since both merged and original images had an average score of 3.4, it is difficult to determine using this scale if the merged images were of better quality.

4.3 AFIX

Average match scores, the average percentage of lines drawn between matching prints, number of matches, and number of non-matches were computed and recorded for each substrate and processing technique (Table 9). Refer back to table 2 for a list of total number of images for each substrate and process; the total matches compared with the amount of images inputted into AFIX for comparison show the percentage of true matches made (Table 10).

Table 9. Average match scores, average percent of lines drawn, number of matches, and number of non-matches for each processing technique

Substrate	Process	Average Match Score	Average Lines Drawn (%)	Matches	Non-Matches
Glass	Cyano	438908	43	73	25
Glass	Basic Red 28	423281	40	76	23
Glass	Basic Yellow 40	243426	39	37	17
Glass	Rhodamine 6G	366740	47	21	75
Glass	MBD	415742	42	10	6
Glass	Merged	364050	39	70	28
Plastic	Cyano	1604899	62	103	9
Plastic	Basic Red 28	1834425	58	112	5
Plastic	MBD	522405	54	83	6
Plastic	Rhodamine 6G	1325115	61	78	8
Plastic	Merged	1279411	58	106	9

Table 10. Percentage of true matches made by AFIX

Substrate	Process	% Matches
Glass	Cyano	74
Glass	Basic Red 28	77
Glass	Basic Yellow 40	69
Glass	Rhodamine 6G	78
Glass	MBD	63
Glass	Merged	71
Plastic	Cyano	91
Plastic	Basic Red 28	95
Plastic	MBD	91
Plastic	Rhodamine 6G	87
Plastic	Merged	92

The merged samples on glass had a higher percentage of true matches than the MBD and basic yellow 40 images, but was lower than the cyanoacrylate, basic red 28, and rhodamine 6G. The merged samples on plastic had a higher percentage of true matches than all original samples but the basic red 28. The graph in figure 15 gives a visual of the average match scores for each processing technique. The graph shows that there were significantly higher match scores for all prints that were deposited on the plastic substrates. It also shows that the average score for the merged plastic images were only higher than the prints processed with cyanoacrylate and then dye-stained with rhodamine 6G. The fingerprints deposited on glass show less range between average match scores. The average match score for the merged images is however higher than the basic yellow 40 dye-stained prints, but close or lower than the rest of the dye-stained prints. There were 80 prints where the merged image match score was greater than the average score of the original images for that print, and 134 where the average score of the original images was greater than or the same as the merged image.

Figure 15. Average match scores for each processing technique and substrate

There were 80 prints where the merged image match score was greater than the average score of the original images for that print, and 134 where the average score of the original images was greater than or the same as the merged image. The results from the AFIX match scores showed that merging did improve some of the images.

4.4 Quality Improvement

There were a large number of images where the quality of the merged image improved and was greater than the quality of the original image based on the NFIQ quality score and the match score from AFIX. However, the number of images that showed no improvement was slightly higher. The Bandey scale scores showed that there were very few merged images with improved quality and a high number of images where there was no improvement by merging. When looking at the fingerprints, 26 of the 214 prints were fully improved based on their NFIQ scores. The term “fully improved” implies that all original images were of lower quality than the final merged image; therefore the merged image would be the better image to use for comparison and identification. In comparison, there were 69 prints out of 214 where the merged image showed no improvement over any of the original images taken of that fingerprint prior to merging. This means that merging the images to obtain a better quality image was unsuccessful for those fingerprints. According to the Bandey scale, only 6 prints were full improved, and 102 prints showed no improvement. AFIX again shows similar results to the NFIQ scores; 32 prints were fully improved and 58 prints showed no improvement when merged (Table 11). The table also shows the individual images that had a lower quality than the merged image for that fingerprint. There were 329 out of 774 images that had a lower NFIQ score than the merged image of that same fingerprint, 199 images that had a lower Bandey scale score, and 349 images that had a lower match score. Although this is important data to consider, ideally the merged image would be of better quality than all of the individual images of that fingerprint rather than some of the images.

Table 11. NFIQ, Bandey, and AFIX results showing percentage of improvement in images and prints.

	NFIQ	Bandey	AFIX
Images with improved quality	329	199	349
Images with no improvement	445	575	417
Total Images	774	774	774
Percent Improvement	42.5%	25.7%	45.1%
Prints with improved quality	26	6	32
Prints with no improvement	69	102	58
Total prints	214*	214*	214*
Percent Improvement	12.1%	2.8%	15.0%

* Remaining prints not accounted for had one or more original images whose quality was less than the merged image, but did not have all original images quality improved

Section 4.1 showed the average scores for all merged versus all original images. They were then broken down into their substrate and processing technique in this section. For the glass substrate, the average NFIQ score for the merged images was 2.9, which is lower than the average scores of the originals for all other processes for glass. The average NFIQ score for the plastic merged images was 2.7, which is again lower than all other average scores for that substrate. Remember that for the NFIQ scale, the lower the number indicates a higher quality.

The Bandey results were less conclusive; the average merged image score for glass was 3.4, which was slightly lower than the cyanoacrylate, basic red 28, and basic yellow 40 at 3.5 each. The average was the same for rhodamine 6G and the merged. For the plastic samples, the average score for the original images of all process was 3.4, and the score for the merged was 3.3. Therefore, the Bandey results showed a small difference in quality, but indicated less quality in the merged images than the originals.

Table 12. NFIQ and Bandey scale scores and average score of glass, cyano

Glass Cyano		Bandey	
NFIQ			
<i>Score</i>	<i>Frequency</i>	<i>Score</i>	<i>Frequency</i>
1	27	0	0
2	17	1	0
3	11	2	9
4	17	3	32
5	26	4	57
Average Score	3.0	Average Score	3.5

Table 13. NFIQ and Bandey scale scores and average score of glass, basic red 28

Glass Basic Red 28		Bandey	
NFIQ			
<i>Score</i>	<i>Frequency</i>	<i>Score</i>	<i>Frequency</i>
1	23	0	0
2	10	1	0
3	10	2	5
4	15	3	37
5	41	4	57
Average Score	3.4	Average Score	3.5

Table 14. NFIQ and Bandey scale scores and average score of glass, basic yellow 40

Glass Basic Yellow 40		Bandey	
NFIQ			
<i>Score</i>	<i>Frequency</i>	<i>Score</i>	<i>Frequency</i>
1	16	0	0
2	6	1	0
3	7	2	5
4	11	3	17
5	14	4	32
Average Score	3.0	Average Score	3.5

Table 15. NFIQ and Bandey scale scores and average score of glass, MBD
Glass MBD

NFIQ		Bandey	
<i>Score</i>	<i>Frequency</i>	<i>Score</i>	<i>Frequency</i>
1	4	0	0
2	3	1	0
3	1	2	2
4	3	3	5
5	5	4	9
Average Score	3.1	Average Score	3.4

Table 16. NFIQ and Bandey scale scores and average score of glass, rhodamine 6G
Glass Rhodamine 6G

NFIQ		Bandey	
<i>Score</i>	<i>Frequency</i>	<i>Score</i>	<i>Frequency</i>
1	19	0	0
2	11	1	0
3	17	2	7
4	19	3	42
5	30	4	47
Average Score	3.3	Average Score	3.4

Table 17. NFIQ and Bandey scale scores and average score of glass, merged
Glass Merged

NFIQ		Bandey	
<i>Score</i>	<i>Frequency</i>	<i>Score</i>	<i>Frequency</i>
1	28	0	0
2	17	1	1
3	14	2	6
4	15	3	41
5	25	4	51
Average Score	2.9	Average Score	3.4

Table 18. NFIQ and Bandey scale scores and average score of plastic, cyano

Plastic Cyano

NFIQ		Bandey	
<i>Score</i>	<i>Frequency</i>	<i>Score</i>	<i>Frequency</i>
1	30	0	0
2	17	1	1
3	17	2	10
4	13	3	43
5	31	4	59
Average Score	3.0	Average Score	3.4

Table 19. NFIQ and Bandey scale scores and average score of plastic, basic red 28

Plastic Basic Red 28

NFIQ		Bandey	
<i>Score</i>	<i>Frequency</i>	<i>Score</i>	<i>Frequency</i>
1	37	0	0
2	11	1	0
3	10	2	10
4	14	3	55
5	46	4	53
Average Score	3.2	Average Score	3.4

Table 20. NFIQ and Bandey scale scores and average score of plastic, MBD

Plastic MBD

NFIQ		Bandey	
<i>Score</i>	<i>Frequency</i>	<i>Score</i>	<i>Frequency</i>
1	34	0	0
2	11	1	2
3	6	2	5
4	15	3	41
5	25	4	43
Average Score	2.8	Average Score	3.4

Table 21. NFIQ and Bandey scale scores and average score of plastic, rhodamine 6G

Plastic Rhodamine 6G

NFIQ		Bandey	
<i>Score</i>	<i>Frequency</i>	<i>Score</i>	<i>Frequency</i>
1	30	0	0
2	8	1	1
3	7	2	1
4	6	3	46
5	39	4	42
Average Score	3.2	Average Score	3.4

Table 22. NFIQ and Bandey scale scores and average score of plastic, merged

Plastic Merged

NFIQ		Bandey	
<i>Score</i>	<i>Frequency</i>	<i>Score</i>	<i>Frequency</i>
1	36	0	0
2	22	1	1
3	20	2	9
4	11	3	56
5	26	4	49
Average Score	2.7	Average Score	3.3

Figure 16. 3D bar graph showing the fraction of images that were improved by merging

Figure 16 shows the fraction of images that were improved. The chart is broken down by each processing method and the three quality assessment methods. Each bar indicates the percentage of these images of each processing method where the merged image was of greater quality than the individual images. It is consistent throughout the different variables that the NFIQ and AFIX (match score) quality assessments showed a greater percentage of images that were improved when compared to the Bandey scores. This could, as previously discussed, be due to the automated programs having the ability to notice a higher level of detail and more accurately rate the quality of an image.

4.5 Chi-square Test

The chi-square test was performed on the sets of data for the NFIQ scores and the Bandey scores to determine the significance of the scores generated. The goal of the study was to determine if merging of the images created a final image of better quality. Since there were images where the quality was increased by merging, the chi-square test will show whether there

is statistical significance to the results. Ultimately, it is important to determine if the higher scores of the merged images was due specifically to the merging or a result of chance. The chi-square test produced p-values which determine statistical significance. If the set of data has a p-value of greater than 0.05, the results are not statistically significant. If the set of data has a p-value of less than 0.05, the results are considered statistically significant, with a confidence level of 95% or higher. Tables 23 and 24 show the chi-square results for each scoring method. The results are broken down into the different processing techniques on both glass and plastic. The p-values were calculated for the actual individual image and merged image scores versus the expected individual and merged image scores to determine if the difference is significant, therefore that the merging is what created the higher quality score. Chi-square was chosen to analyze the data due to the categorical nature of the NFIQ and Bandey scores.

Table 23. Chi-square results for NFIQ scores

Substrate	Scoring Method	Processing Technique	p-value
Glass	NFIQ	R6G	0.38226949
Glass	NFIQ	MBD	0.90451039
Glass	NFIQ	BY40	0.8306395
Glass	NFIQ	BR28	0.144004627
Glass	NFIQ	Cyano	0.971752481
Plastic	NFIQ	Cyano	0.75973047
Plastic	NFIQ	BR28	0.01181183
Plastic	NFIQ	MBD	0.05568353
Plastic	NFIQ	R6G	0.00566486

Table 24. Chi-square results for Bandey scores

Substrate	Scoring Method	Processing Technique	p-value
Glass	Bandey	R6G	0.88443484
Glass	Bandey	MBD	0.8415516
Glass	Bandey	BY40	0.6552575
Glass	Bandey	BR28	0.781807749
Glass	Bandey	Cyano	0.53019083
Plastic	Bandey	Cyano	0.61477481
Plastic	Bandey	BR28	0.88136855
Plastic	Bandey	MBD	0.84243668
Plastic	Bandey	R6G	0.29313414

There were two p-values generated that were under 0.05 for the NFIQ scores: Basic Red 28 and Rhodamine 6G on plastic substrate. The plastic MDB stained images had a p-value of about 0.06, which is the lowest p-value that does not fall into the desired confidence level. Otherwise, the p-values for the majority of the samples are considerably high. The Bandey score results yielded no p-values equal to or less than 0.05. This shows that the merging may not have been the cause of the increased scores in the merged samples. Other factors could have caused a higher score, such as chance, or the possibility of a majority of the merged image being from one highly scored individual image of that fingerprint.

4.6 Analysis of Variance

Analysis of Variance (ANOVA) was performed on the data from the AFIX match scores. ANOVA is similar to chi-square; the test analyzes the statistical significance of the results to determine if the difference in the scores is a matter of chance or a result of the merging of images. Since the AFIX match score data is not categorical, this method of data analysis was chosen rather than the chi-square analysis. Table 25 shows the ANOVA results for the AFIX match scores. The variance between the original images and merged images was measured to give a p-value, similar to the chi-square analysis. A p-value of less than 0.05 indicated that there is statistical significance to the difference between the original and merged images, while a higher p-value indicated that there is no statistical significance.

Table 25. ANOVA results for AFIX match scores

Substrate	Scoring Method	Processing Technique	p-value
Glass	AFIX	BR28	0.287517
Glass	AFIX	Cyano	0.237732
Glass	AFIX	BY40	0.048759
Glass	AFIX	R6G	0.965876
Glass	AFIX	MBD	0.644709
Plastic	AFIX	BR28	0.034532
Plastic	AFIX	Cyano	0.2002
Plastic	AFIX	MBD	0.000136
Plastic	AFIX	R6G	0.844397

The p-value was less than 0.05 for three of the AFIX match scores. Again, these high p-values for most of the samples indicate that the increased scores of the merged images may have been due to chance, and not as a result of the merging.

4.7 Justification for Elimination of Cardboard and Paper Samples

The cardboard and paper latent print samples were discarded due to unsuccessful image registration and image fusion. The images would not register correctly; therefore image fusion did not create a composite image, but created one that could not be used in any case for analysis. Since Photoshop uses a feature-based algorithm to perform image registration, it is possible that the cardboard and paper latent prints did not have sufficient detail to allow the program to perform registration. Although the examiner could easily see the ridges, the Photoshop algorithm needed more defined friction ridge detail. This is a very important note to make when discussing this research. Based on this observation, it appears that the images that are being used must have enough detail for the algorithm to detect the features and edges that are needed to register the image.

4.8 Spurious Minutiae

The possibility of spurious minutia when conducting this experiment was of concern when merging the images on Photoshop. An examiner may allow for exclusion if spurious minutia are mistaken for real minutia, therefore they would have to take extra precaution to be sure to avoid false exclusion or identification due to spurious minutia. In order to avoid this

possible affect, the prints were examined after fusion to ensure that the process of fusing the images together created no spurious minutia.

4.9 Examiners' Subjectivity

Subjectivity was reduced as much as possible during this study. Programs with limited to no examiner input were chosen to assess the quality of the images in order to eliminate the quality being determined only by the examiner. Quality scores were assigned by NFIQ, which requires no human input, only loading the files into the folder within the program.

One way of eliminating bias is to perform a “blind” analysis. This is a practice that is accepted and expected within the forensic science community and is done in order to avoid subjectivity of the examiner when performing a comparison or identification. This is especially important in fingerprint analysis. The Bandey scale scores were assigned to images after the images were randomized, and renamed by a peer. This created the ability of the prints to be scored without the knowledge of which were the merged or original images, or which images were of the same fingerprint.

AFIX requires the examiner to manually mark minutia on each print. Although there is an option to auto-extract features, which was not done in this study, auto-extraction of features often marks spurious minutia and requires the examiner to manually alter the minutia.

5. CONCLUSION

This study was intended to determine whether or not the commonly used method of image fusion in multiple fields of study such as biometrics, surveillance, and medical imaging had the ability to improve the latent fingerprint identification process. Since image fusion is becoming increasingly popular in the forensics field, now is the time to determine how to implement this method into fingerprint processing to improve the quality of the images that examiners are using to make identifications.

Image fusion for increasing quality of latent fingerprints images is a method that shows small benefits for the examiner. Only 12.1% of the fingerprints were improved by merging based on the NFIQ scale, therefore it may be unnecessary for the examiner to merge the images, when at least one or more of the original images in 87.9% of the prints was of better or the same quality as the merged image. The Bandey scale test results showed that the examiner is unable to consider 2nd level detail as well as an automated system using a feature-based algorithm, because only 2.8% of the prints were considered to be improved upon merging. Considering this, the examiner would likely not notice a significant difference between the merged image and the original image quality. AFIX showed the highest percentage of improvement at 15.0%.

There should be considerable judgment used as to whether performing the image fusion will be useful. In order to judge this, the examiner could take multiple images of the print under different wavelengths and filters, and then examine the images for the quality of the friction

ridge detail. If there is an area of one image (A) of noticeably bad quality, but another image (B) where that same area shows more friction ridge detail, then the examiner may choose to merge the images together to create the composite image (C). However, unless one area of A is of better quality than the same area in B, the examiner may find it unnecessary to merge the images and simply use image B for analysis.

This study has given a better understanding of the process of image fusion for latent fingerprints, shown that only images of a certain quality can actually be merged, and that there seems to be very little variability between the quality of the merged images and the original images.

5.1 Future Research

Further research could be conducted using various other substrates, including those with curved edges, backgrounds with multiple colors, rough surfaces, etc. This study delved into the basic method to determine if image fusion would work effectively using Photoshop, create an image without spurious minutia, create an image of better quality, and be suitable for the examiner to perform an identification. Since we know that the method works, extensive research could be done on a multitude of substrates that create less quality in latent fingerprints and show less friction ridge detail.

Another possible addition to this study could be to look at the specific areas of the print that are being merged, and if the Photoshop algorithm is replacing the area of low quality with an area of definite better quality. This could be done by performing a quality assessment on sections of the fingerprints before and after merging, and evaluating the sections that were chosen to be merged into one image.

Determining a measurement of the amount of contrast or detail needed for Photoshop to be able to register and merge the images would be a very useful study. Efficiency and quality are both pertinent to performing analysis, but in order for the examiner to be efficient they must know if a certain image has too low of quality to be merged prior to putting the time and effort into doing so.

5.2 Field Application in Forensics

This method would be applicable to examiners whom have a latent fingerprint of questionable quality. If the print can be processed using a) multiple techniques, b) under multiple wavelengths, or c) under various filters to obtain multiple images of the same print, then the examiner could perform image fusion. Photoshop is an easily accessible program, is quick, efficient, and user-friendly. It would not take a considerable amount of time for an examiner to merge the images, nor would it be difficult to set up and perform.

It would be beneficial for examiners to understand the process of image fusion and that it can be done to increase quality of a latent fingerprint image.

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APPENDIX A

Camera Settings

FP #	Type	Substrate	Development	f number	Exposure time	Focal Length	Wavelength
137	O	Glass	Cyano	4	1/6	60	white
138	O	Glass	Cyano	4	1/2	60	white
139	O	Glass	Cyano	4	1/2	60	white
140	O	Glass	Cyano	4	1/5	60	white
141	O	Glass	Cyano	4	1/5	60	white
142	O	Glass	Cyano	4	1/5	60	white
143	O	Glass	Cyano	4	1/5	60	white
144	O	Glass	Cyano	4	1/5	60	white
145	O	Glass	Cyano	4	1/5	60	white
146	O	Glass	Cyano	4	1/5	60	white
147	O	Glass	Cyano	4	1/5	60	white
148	O	Glass	Cyano	11	1/25	60	white
149	O	Glass	Cyano	4	1/5	60	white
150	O	Glass	Cyano	4	1/5	60	white
151	O	Glass	Cyano	11	1/25	60	white
152	O	Glass	Cyano	4	1/4	60	white
153	O	Glass	Cyano	4	1/4	60	white
154	O	Glass	Cyano	25	2/5	60	white
155	O	Glass	Cyano	20	2/5	60	white
156	O	Glass	Cyano	32	2/5	60	white
157	O	Glass	Cyano	22	2/5	60	white
158	O	Glass	Cyano	25	2/5	60	white
159	O	Glass	Cyano	32	2/5	60	white
160	O	Glass	Cyano	22	2/5	60	white
161	O	Glass	Cyano	0.4	20	60	white
162	O	Glass	Cyano	25	2/5	60	white
163	O	Glass	Cyano	25	2/5	60	white
164	O	Glass	Cyano	24	2/5	60	white
165	O	Glass	Cyano	32	2/5	60	white
166	O	Glass	Cyano	22	2/5	60	white
167	O	Glass	Cyano	29	2/5	60	white
168	O	Glass	Cyano	40	2/5	60	white
169	O	Glass	Cyano	13	1/20	60	white
170	O	Glass	Cyano	18	1/20	60	white
171	O	Glass	Cyano	14	1/20	60	white
172	O	Glass	Cyano	16	1/20	60	white
173	O	Glass	Cyano	20	1/20	60	white
174	O	Glass	Cyano	20	1/20	60	white
175	O	Glass	Cyano	18	1/20	60	white
176	O	Glass	Cyano	9	1/20	60	white
177	O	Glass	Cyano	8	1/20	60	white
178	O	Glass	Cyano	10	1/20	60	white
179	O	Glass	Cyano	13	1/20	60	white
180	O	Glass	Cyano	11	1/20	60	white
181	O	Glass	Cyano	11	1/20	60	white
182	O	Glass	Cyano	8	1/20	60	white

183	O	Glass	Cyano	8	1/20	60	white
184	O	Glass	Cyano	10	1/20	60	white
185	O	Glass	Cyano	10	1/20	60	white
186	O	Glass	Cyano	8	1/20	60	white
187	O	Glass	Cyano	11	1/20	60	white
188	O	Glass	Cyano	9	1/20	60	white
189	O	Glass	Cyano	10	1/20	60	white
190	O	Glass	Cyano	13	1/20	60	white
191	O	Glass	Cyano	9	1/20	60	white
192	O	Glass	Cyano	9	1/20	60	white
193	O	Glass	Cyano	11	1/20	60	white
194	O	Glass	Cyano	13	1/20	60	white
195	O	Glass	Cyano	16	1/20	60	white
196	O	Glass	Cyano	18	1/20	60	white
197	O	Glass	Cyano	9	1/20	60	white
198	O	Glass	Cyano	10	1/20	60	white
199	O	Glass	Cyano	14	1/20	60	white
200	O	Glass	Cyano	16	1/20	60	white
201	O	Glass	Cyano	16	1/20	60	white
202	O	Glass	Cyano	14	2	60	white
203	O	Glass	Cyano	9	2	60	white
204	O	Glass	Cyano	7.1	1 3/10	60	white
205	O	Glass	Cyano	4	1/5	60	white
207	O	Glass	Cyano	4	1/5	60	white
208	O	Glass	Cyano	4	1/5	60	white
209	O	Glass	Cyano	4	1/5	60	white
210	O	Glass	Cyano	4	1/5	60	white
211	O	Glass	Cyano	4	1/5	60	white
212	O	Glass	Cyano	4	1/5	60	white
213	O	Glass	Cyano	4	1/5	60	white
214	O	Glass	Cyano	4	1/5	60	white
215	O	Glass	Cyano	4	1/5	60	white
216	O	Glass	Cyano	4	1/5	60	white
217	O	Glass	Cyano	4.5	1/4	60	white
218	O	Glass	Cyano	4	1/4	60	white
219	O	Glass	Cyano	4	1/4	60	white
220	O	Glass	Cyano	32	1/10	60	white
221	O	Glass	Cyano	32	1/10	60	white
222	O	Glass	Cyano	29	1/10	60	white
223	O	Glass	Cyano	29	1/10	60	white
224	O	Glass	Cyano	29	1/10	60	white
225	O	Glass	Cyano	29	1/10	60	white
226	O	Glass	Cyano	29	1/10	60	white
227	O	Glass	Cyano	25	1/10	60	white
228	O	Glass	Cyano	29	1/10	60	white
229	O	Glass	Cyano	20	1/25	60	white
230	O	Glass	Cyano	18	1/25	60	white
231	O	Glass	Cyano	16	1/25	60	white
232	O	Glass	Cyano	22	1/25	60	white
233	O	Glass	Cyano	18	1/25	60	white
234	O	Glass	Cyano	16	1/25	60	white
235	O	Glass	Cyano	13	1/25	60	white

137	O	Glass	Cyano + Basic Red 28	4	2 1/2	60	470
137	O	Glass	Cyano + Basic Red 28	9	2 1/2	60	550
137	O	Glass	Cyano + Basic Red 28	11	.1/13	60	white
138	O	Glass	Cyano + Basic Red 28	4	2 1/2	60	470
138	O	Glass	Cyano + Basic Red 28	4	2 1/2	60	550
138	O	Glass	Cyano + Basic Red 28	9	.1/25	60	white
139	O	Glass	Cyano + Basic Red 28	4	2 1/2	60	470
139	O	Glass	Cyano + Basic Red 28	5.6	10/13	60	550
139	O	Glass	Cyano + Basic Red 28	8	1/25	60	white
140	O	Glass	Cyano + Basic Red 28	4	10/13	60	470
140	O	Glass	Cyano + Basic Red 28	4.5	10/13	60	550
140	O	Glass	Cyano + Basic Red 28	8	1/25	60	white
141	O	Glass	Cyano + Basic Red 28	4	10/13	60	470
141	O	Glass	Cyano + Basic Red 28	4.5	10/13	60	550
141	O	Glass	Cyano + Basic Red 28	8	1/25	60	white
142	O	Glass	Cyano + Basic Red 28	4	10/13	60	white
142	O	Glass	Cyano + Basic Red 28	4.5	10/13	60	470
142	O	Glass	Cyano + Basic Red 28	7.1	1/25	60	550
143	O	Glass	Cyano + Basic Red 28	4	10/13	60	470
143	O	Glass	Cyano + Basic Red 28	4.5	10/13	60	550
143	O	Glass	Cyano + Basic Red 28	8	1/25	60	white
144	O	Glass	Cyano + Basic Red 28	4	10/13	60	470
144	O	Glass	Cyano + Basic Red 28	4.5	10/13	60	550
144	O	Glass	Cyano + Basic Red 28	8	1/25	60	white
145	O	Glass	Cyano + Basic Red 28	4	10/13	60	470
145	O	Glass	Cyano + Basic Red 28	5	10/13	60	550
145	O	Glass	Cyano + Basic Red 28	10	1/25	60	white
146	O	Glass	Cyano + Basic Red 28	4	10/13	60	white
146	O	Glass	Cyano + Basic Red 28	5	10/13	60	470
146	O	Glass	Cyano + Basic Red 28	11	1/25	60	550
147	O	Glass	Cyano + Basic Red 28	4	10/13	60	470
147	O	Glass	Cyano + Basic Red 28	4.5	10/13	60	550
147	O	Glass	Cyano + Basic Red 28	11	1/25	60	white
148	O	Glass	Cyano + Basic Red 28	4	10/13	60	470
148	O	Glass	Cyano + Basic Red 28	4	2	60	550
148	O	Glass	Cyano + Basic Red 28	5	10/13	60	white
149	O	Glass	Cyano + Basic Red 28	4.5	10/13	60	white
149	O	Glass	Cyano + Basic Red 28	4	2	60	470
149	O	Glass	Cyano + Basic Red 28	4	10/13	60	550
150	O	Glass	Cyano + Basic Red 28	4	10/13	60	470
150	O	Glass	Cyano + Basic Red 28	4	2	60	485
150	O	Glass	Cyano + Basic Red 28	5	10/13	60	550
150	O	Glass	Cyano + Basic Red 28	11	.1/25	60	white
151	O	Glass	Cyano + Basic Red 28	4	10/13	60	470
151	O	Glass	Cyano + Basic Red 28	4.5	10/13	60	550
152	O	Glass	Cyano + Basic Red 28	4	10/13	60	470
152	O	Glass	Cyano + Basic Red 28	4	10/13	60	550
152	O	Glass	Cyano + Basic Red 28	11	1/25	60	white
153	O	Glass	Cyano + Basic Red 28	4	10/13	60	470
153	O	Glass	Cyano + Basic Red 28	4	10/13	60	550
153	O	Glass	Cyano + Basic Red 28	10	1/25	60	white
154	O	Glass	Cyano + Basic Red 28	4	10/13	60	470

154	O	Glass	Cyano + Basic Red 28	4	10/13	60	550
154	O	Glass	Cyano + Basic Red 28	10	1/25	60	white
155	O	Glass	Cyano + Basic Red 28	4	10/13	60	470
155	O	Glass	Cyano + Basic Red 28	4	10/13	60	550
155	O	Glass	Cyano + Basic Red 28	10	1/25	60	white
156	O	Glass	Cyano + Basic Red 28	4	10/13	60	470
156	O	Glass	Cyano + Basic Red 28	4.5	10/13	60	550
156	O	Glass	Cyano + Basic Red 28	11	1/25	60	white
157	O	Glass	Cyano + Basic Red 28	4	10/13	60	470
157	O	Glass	Cyano + Basic Red 28	4	10/13	60	550
157	O	Glass	Cyano + Basic Red 28	11	1/25	60	white
158	O	Glass	Cyano + Basic Red 28	4	10/13	60	470
158	O	Glass	Cyano + Basic Red 28	4	10/13	60	550
158	O	Glass	Cyano + Basic Red 28	10	1/25	60	white
159	O	Glass	Cyano + Basic Red 28	4	10/13	60	470
159	O	Glass	Cyano + Basic Red 28	4	10/13	60	550
159	O	Glass	Cyano + Basic Red 28	11	1/25	60	white
160	O	Glass	Cyano + Basic Red 28	4	10/13	60	white
160	O	Glass	Cyano + Basic Red 28	4	10/13	60	470
160	O	Glass	Cyano + Basic Red 28	10	1/25	60	550
161	O	Glass	Cyano + Basic Red 28	4	10/13	60	470
161	O	Glass	Cyano + Basic Red 28	4	10/13	60	550
161	O	Glass	Cyano + Basic Red 28	10	1/25	60	white
162	O	Glass	Cyano + Basic Red 28	4	10/13	60	470
162	O	Glass	Cyano + Basic Red 28	4.5	10/13	60	550
162	O	Glass	Cyano + Basic Red 28	11	1/25	60	white
163	O	Glass	Cyano + Basic Red 28	4	10/13	60	470
163	O	Glass	Cyano + Basic Red 28	4	10/13	60	550
163	O	Glass	Cyano + Basic Red 28	10	1/25	60	white
164	O	Glass	Cyano + Basic Red 28	4	10/13	60	470
164	O	Glass	Cyano + Basic Red 28	4	10/13	60	550
164	O	Glass	Cyano + Basic Red 28	11	1/25	60	white
165	O	Glass	Cyano + Basic Red 28	4	10/13	60	470
165	O	Glass	Cyano + Basic Red 28	4	10/13	60	550
165	O	Glass	Cyano + Basic Red 28	11	1/25	60	white
166	O	Glass	Cyano + Basic Red 28	4	10/13	60	470
166	O	Glass	Cyano + Basic Red 28	5	10/13	60	550
166	O	Glass	Cyano + Basic Red 28	11	1/25	60	white
167	O	Glass	Cyano + Basic Red 28	4	10/13	60	470
167	O	Glass	Cyano + Basic Red 28	4.5	10/13	60	550
167	O	Glass	Cyano + Basic Red 28	11	1/25	60	white
168	O	Glass	Cyano + Basic Red 28	4	10/13	60	470
168	O	Glass	Cyano + Basic Red 28	5	10/13	60	550
168	O	Glass	Cyano + Basic Red 28	11	1/25	60	white
169	O	Glass	Cyano + Basic Red 28	4	10/13	60	470
169	O	Glass	Cyano + Basic Red 28	5.6	10/13	60	550
169	O	Glass	Cyano + Basic Red 28	11	1/25	60	white
202	O	Glass	Cyano + Basic Yellow 40	7.1	13	60	385
202	O	Glass	Cyano + Basic Yellow 40	4	3	60	450
202	O	Glass	Cyano + Basic Yellow 40	4.5	13	60	485
203	O	Glass	Cyano + Basic Yellow 40	8	13	60	385
203	O	Glass	Cyano + Basic Yellow 40	4	3	60	450

203	O	Glass	Cyano + Basic Yellow 40	4	13	60	485
204	O	Glass	Cyano + Basic Yellow 40	6.3	10	60	385
204	O	Glass	Cyano + Basic Yellow 40	4	3	60	450
204	O	Glass	Cyano + Basic Yellow 40	4	10	60	485
205	O	Glass	Cyano + Basic Yellow 40	5.6	10	60	385
205	O	Glass	Cyano + Basic Yellow 40	4.5	8	60	450
205	O	Glass	Cyano + Basic Yellow 40	4	10	60	485
206	O	Glass	Cyano + Basic Yellow 40	5	10	60	385
206	O	Glass	Cyano + Basic Yellow 40	5	8	60	450
206	O	Glass	Cyano + Basic Yellow 40	4	10	60	485
207	O	Glass	Cyano + Basic Yellow 40	5	10	60	385
207	O	Glass	Cyano + Basic Yellow 40	4	8	60	450
207	O	Glass	Cyano + Basic Yellow 40	4	10	60	485
208	O	Glass	Cyano + Basic Yellow 40	5.6	10	60	385
208	O	Glass	Cyano + Basic Yellow 40	4	8	60	450
208	O	Glass	Cyano + Basic Yellow 40	4	10	60	485
209	O	Glass	Cyano + Basic Yellow 40	5	10	60	385
209	O	Glass	Cyano + Basic Yellow 40	4	8	60	450
209	O	Glass	Cyano + Basic Yellow 40	4	10	60	485
210	O	Glass	Cyano + Basic Yellow 40	4.5	10	60	385
210	O	Glass	Cyano + Basic Yellow 40	4	8	60	450
210	O	Glass	Cyano + Basic Yellow 40	4	10	60	485
211	O	Glass	Cyano + Basic Yellow 40	5	10	60	385
211	O	Glass	Cyano + Basic Yellow 40	4	8	60	450
211	O	Glass	Cyano + Basic Yellow 40	4	10	60	485
212	O	Glass	Cyano + Basic Yellow 40	4.5	10	60	385
212	O	Glass	Cyano + Basic Yellow 40	4	8	60	450
212	O	Glass	Cyano + Basic Yellow 40	4	10	60	485
213	O	Glass	Cyano + Basic Yellow 40	5	10	60	385
213	O	Glass	Cyano + Basic Yellow 40	4	8	60	450
213	O	Glass	Cyano + Basic Yellow 40	4	10	60	485
214	O	Glass	Cyano + Basic Yellow 40	5	10	60	385
214	O	Glass	Cyano + Basic Yellow 40	4	8	60	450
214	O	Glass	Cyano + Basic Yellow 40	4	10	60	485
215	O	Glass	Cyano + Basic Yellow 40	5	10	60	385
215	O	Glass	Cyano + Basic Yellow 40	4	8	60	450
215	O	Glass	Cyano + Basic Yellow 40	4	10	60	485
216	O	Glass	Cyano + Basic Yellow 40	5	10	60	385
216	O	Glass	Cyano + Basic Yellow 40	4	8	60	450
216	O	Glass	Cyano + Basic Yellow 40	4	10	60	485
217	O	Glass	Cyano + Basic Yellow 40	9	10	60	385
217	O	Glass	Cyano + Basic Yellow 40	5	8	60	450
217	O	Glass	Cyano + Basic Yellow 40	4.5	10	60	485
218	O	Glass	Cyano + Basic Yellow 40	9	10	60	385
218	O	Glass	Cyano + Basic Yellow 40	5	8	60	450
218	O	Glass	Cyano + Basic Yellow 40	4	10	60	485
219	O	Glass	Cyano + Basic Yellow 40	8	10	60	385
219	O	Glass	Cyano + Basic Yellow 40	4.5	8	60	450
219	O	Glass	Cyano + Basic Yellow 40	4	10	60	485
220	O	Glass	Cyano + MBD	4	6	60	415
221	O	Glass	Cyano + MBD	4	6	60	415
222	O	Glass	Cyano + MBD	4	6	60	415

223	O	Glass	Cyano + MBD	4	6	60	415
224	O	Glass	Cyano + MBD	4	6	60	415
225	O	Glass	Cyano + MBD	4	6	60	415
226	O	Glass	Cyano + MBD	4	6	60	415
227	O	Glass	Cyano + MBD	4	6	60	415
228	O	Glass	Cyano + MBD	4	6	60	415
229	O	Glass	Cyano + MBD	4	6	60	415
230	O	Glass	Cyano + MBD	4	6	60	415
231	O	Glass	Cyano + MBD	4	6	60	415
232	O	Glass	Cyano + MBD	4	6	60	415
233	O	Glass	Cyano + MBD	4	6	60	415
234	O	Glass	Cyano + MBD	4	6	60	415
235	O	Glass	Cyano + MBD	4	6	60	415
170	O	Glass	Cyano + Rhodamine 6G	4	13	60	500
170	O	Glass	Cyano + Rhodamine 6G	5.6	13	60	515
170	O	Glass	Cyano + Rhodamine 6G	13	13	60	540
171	O	Glass	Cyano + Rhodamine 6G	4	13	60	500
171	O	Glass	Cyano + Rhodamine 6G	5	13	60	515
171	O	Glass	Cyano + Rhodamine 6G	18	13	60	540
172	O	Glass	Cyano + Rhodamine 6G	4	4	60	500
172	O	Glass	Cyano + Rhodamine 6G	4	4	60	515
172	O	Glass	Cyano + Rhodamine 6G	25	13	60	540
173	O	Glass	Cyano + Rhodamine 6G	4	13	60	500
173	O	Glass	Cyano + Rhodamine 6G	5.6	13	60	515
173	O	Glass	Cyano + Rhodamine 6G	13	13	60	540
174	O	Glass	Cyano + Rhodamine 6G	4	13	60	500
174	O	Glass	Cyano + Rhodamine 6G	4.5	13	60	515
174	O	Glass	Cyano + Rhodamine 6G	11	13	60	540
175	O	Glass	Cyano + Rhodamine 6G	4	13	60	500
175	O	Glass	Cyano + Rhodamine 6G	5	13	60	515
175	O	Glass	Cyano + Rhodamine 6G	11	13	60	540
176	O	Glass	Cyano + Rhodamine 6G	4	13	60	500
176	O	Glass	Cyano + Rhodamine 6G	4	13	60	515
176	O	Glass	Cyano + Rhodamine 6G	4.5	13	60	540
177	O	Glass	Cyano + Rhodamine 6G	4	13	60	500
177	O	Glass	Cyano + Rhodamine 6G	4	13	60	515
177	O	Glass	Cyano + Rhodamine 6G	4	13	60	540
178	O	Glass	Cyano + Rhodamine 6G	4	13	60	500
178	O	Glass	Cyano + Rhodamine 6G	4	13	60	515
178	O	Glass	Cyano + Rhodamine 6G	4	13	60	540
179	O	Glass	Cyano + Rhodamine 6G	4	13	60	500
179	O	Glass	Cyano + Rhodamine 6G	4	13	60	515
179	O	Glass	Cyano + Rhodamine 6G	5	13	60	540
180	O	Glass	Cyano + Rhodamine 6G	4	13	60	500
180	O	Glass	Cyano + Rhodamine 6G	4	13	60	515
180	O	Glass	Cyano + Rhodamine 6G	4	13	60	540
181	O	Glass	Cyano + Rhodamine 6G	4	13	60	500
181	O	Glass	Cyano + Rhodamine 6G	4	13	60	515
181	O	Glass	Cyano + Rhodamine 6G	4	13	60	540
182	O	Glass	Cyano + Rhodamine 6G	4	13	60	500
182	O	Glass	Cyano + Rhodamine 6G	5	13	60	515
182	O	Glass	Cyano + Rhodamine 6G	9	13	60	540

183	O	Glass	Cyano + Rhodamine 6G	4.5	13	60	500
183	O	Glass	Cyano + Rhodamine 6G	4	13	60	515
183	O	Glass	Cyano + Rhodamine 6G	6.3	13	60	540
184	O	Glass	Cyano + Rhodamine 6G	4	13	60	500
184	O	Glass	Cyano + Rhodamine 6G	4	13	60	515
184	O	Glass	Cyano + Rhodamine 6G	6.3	13	60	540
185	O	Glass	Cyano + Rhodamine 6G	4	13	60	500
185	O	Glass	Cyano + Rhodamine 6G	5.6	13	60	515
185	O	Glass	Cyano + Rhodamine 6G	10	13	60	540
186	O	Glass	Cyano + Rhodamine 6G	4	13	60	500
186	O	Glass	Cyano + Rhodamine 6G	4.5	13	60	515
186	O	Glass	Cyano + Rhodamine 6G	7.1	13	60	540
187	O	Glass	Cyano + Rhodamine 6G	4	13	60	500
187	O	Glass	Cyano + Rhodamine 6G	5	13	60	515
187	O	Glass	Cyano + Rhodamine 6G	9	13	60	540
188	O	Glass	Cyano + Rhodamine 6G	4	13	60	500
188	O	Glass	Cyano + Rhodamine 6G	4	13	60	515
188	O	Glass	Cyano + Rhodamine 6G	8	13	60	540
189	O	Glass	Cyano + Rhodamine 6G	4.5	13	60	500
189	O	Glass	Cyano + Rhodamine 6G	4	13	60	515
189	O	Glass	Cyano + Rhodamine 6G	6.3	13	60	540
190	O	Glass	Cyano + Rhodamine 6G	4	13	60	500
190	O	Glass	Cyano + Rhodamine 6G	4.5	13	60	515
190	O	Glass	Cyano + Rhodamine 6G	7.1	13	60	540
191	O	Glass	Cyano + Rhodamine 6G	4	13	60	500
191	O	Glass	Cyano + Rhodamine 6G	5.6	13	60	515
191	O	Glass	Cyano + Rhodamine 6G	10	13	60	540
192	O	Glass	Cyano + Rhodamine 6G	4	13	60	500
192	O	Glass	Cyano + Rhodamine 6G	5	13	60	515
192	O	Glass	Cyano + Rhodamine 6G	7.1	13	60	540
193	O	Glass	Cyano + Rhodamine 6G	4	13	60	500
193	O	Glass	Cyano + Rhodamine 6G	5.6	13	60	515
193	O	Glass	Cyano + Rhodamine 6G	5	13	60	540
194	O	Glass	Cyano + Rhodamine 6G	4	13	60	500
194	O	Glass	Cyano + Rhodamine 6G	5	13	60	515
194	O	Glass	Cyano + Rhodamine 6G	11	13	60	540
195	O	Glass	Cyano + Rhodamine 6G	4.5	13	60	500
195	O	Glass	Cyano + Rhodamine 6G	5.6	13	60	515
195	O	Glass	Cyano + Rhodamine 6G	16	13	60	540
196	O	Glass	Cyano + Rhodamine 6G	5	13	60	500
196	O	Glass	Cyano + Rhodamine 6G	11	13	60	515
196	O	Glass	Cyano + Rhodamine 6G	25	13	60	540
197	O	Glass	Cyano + Rhodamine 6G	4	13	60	500
197	O	Glass	Cyano + Rhodamine 6G	4.5	13	60	515
197	O	Glass	Cyano + Rhodamine 6G	7.1	13	60	540
198	O	Glass	Cyano + Rhodamine 6G	4	13	60	500
198	O	Glass	Cyano + Rhodamine 6G	4.5	13	60	515
198	O	Glass	Cyano + Rhodamine 6G	9	13	60	540
199	O	Glass	Cyano + Rhodamine 6G	4	13	60	500
199	O	Glass	Cyano + Rhodamine 6G	4	13	60	515
199	O	Glass	Cyano + Rhodamine 6G	9	13	60	540
200	O	Glass	Cyano + Rhodamine 6G	5	13	60	500

200	O	Glass	Cyano + Rhodamine 6G	8	13	60	515
200	O	Glass	Cyano + Rhodamine 6G	20	13	60	540
201	O	Glass	Cyano + Rhodamine 6G	5	13	60	500
201	O	Glass	Cyano + Rhodamine 6G	9	13	60	515
201	O	Glass	Cyano + Rhodamine 6G	22	13	60	540
137	M	Glass	Merged	N/A	N/A	N/A	N/A
138	M	Glass	Merged	N/A	N/A	N/A	N/A
139	M	Glass	Merged	N/A	N/A	N/A	N/A
140	M	Glass	Merged	N/A	N/A	N/A	N/A
141	M	Glass	Merged	N/A	N/A	N/A	N/A
142	M	Glass	Merged	N/A	N/A	N/A	N/A
143	M	Glass	Merged	N/A	N/A	N/A	N/A
144	M	Glass	Merged	N/A	N/A	N/A	N/A
145	M	Glass	Merged	N/A	N/A	N/A	N/A
146	M	Glass	Merged	N/A	N/A	N/A	N/A
147	M	Glass	Merged	N/A	N/A	N/A	N/A
148	M	Glass	Merged	N/A	N/A	N/A	N/A
149	M	Glass	Merged	N/A	N/A	N/A	N/A
150	M	Glass	Merged	N/A	N/A	N/A	N/A
151	M	Glass	Merged	N/A	N/A	N/A	N/A
152	M	Glass	Merged	N/A	N/A	N/A	N/A
153	M	Glass	Merged	N/A	N/A	N/A	N/A
154	M	Glass	Merged	N/A	N/A	N/A	N/A
155	M	Glass	Merged	N/A	N/A	N/A	N/A
156	M	Glass	Merged	N/A	N/A	N/A	N/A
157	M	Glass	Merged	N/A	N/A	N/A	N/A
158	M	Glass	Merged	N/A	N/A	N/A	N/A
159	M	Glass	Merged	N/A	N/A	N/A	N/A
160	M	Glass	Merged	N/A	N/A	N/A	N/A
161	M	Glass	Merged	N/A	N/A	N/A	N/A
162	M	Glass	Merged	N/A	N/A	N/A	N/A
163	M	Glass	Merged	N/A	N/A	N/A	N/A
164	M	Glass	Merged	N/A	N/A	N/A	N/A
165	M	Glass	Merged	N/A	N/A	N/A	N/A
166	M	Glass	Merged	N/A	N/A	N/A	N/A
167	M	Glass	Merged	N/A	N/A	N/A	N/A
168	M	Glass	Merged	N/A	N/A	N/A	N/A
169	M	Glass	Merged	N/A	N/A	N/A	N/A
170	M	Glass	Merged	N/A	N/A	N/A	N/A
171	M	Glass	Merged	N/A	N/A	N/A	N/A
172	M	Glass	Merged	N/A	N/A	N/A	N/A
173	M	Glass	Merged	N/A	N/A	N/A	N/A
174	M	Glass	Merged	N/A	N/A	N/A	N/A
175	M	Glass	Merged	N/A	N/A	N/A	N/A
176	M	Glass	Merged	N/A	N/A	N/A	N/A
177	M	Glass	Merged	N/A	N/A	N/A	N/A
178	M	Glass	Merged	N/A	N/A	N/A	N/A
179	M	Glass	Merged	N/A	N/A	N/A	N/A
180	M	Glass	Merged	N/A	N/A	N/A	N/A
181	M	Glass	Merged	N/A	N/A	N/A	N/A
182	M	Glass	Merged	N/A	N/A	N/A	N/A
183	M	Glass	Merged	N/A	N/A	N/A	N/A

184	M	Glass	Merged	N/A	N/A	N/A	N/A
185	M	Glass	Merged	N/A	N/A	N/A	N/A
186	M	Glass	Merged	N/A	N/A	N/A	N/A
187	M	Glass	Merged	N/A	N/A	N/A	N/A
188	M	Glass	Merged	N/A	N/A	N/A	N/A
189	M	Glass	Merged	N/A	N/A	N/A	N/A
190	M	Glass	Merged	N/A	N/A	N/A	N/A
191	M	Glass	Merged	N/A	N/A	N/A	N/A
192	M	Glass	Merged	N/A	N/A	N/A	N/A
193	M	Glass	Merged	N/A	N/A	N/A	N/A
194	M	Glass	Merged	N/A	N/A	N/A	N/A
195	M	Glass	Merged	N/A	N/A	N/A	N/A
196	M	Glass	Merged	N/A	N/A	N/A	N/A
197	M	Glass	Merged	N/A	N/A	N/A	N/A
198	M	Glass	Merged	N/A	N/A	N/A	N/A
199	M	Glass	Merged	N/A	N/A	N/A	N/A
200	M	Glass	Merged	N/A	N/A	N/A	N/A
201	M	Glass	Merged	N/A	N/A	N/A	N/A
202	M	Glass	Merged	N/A	N/A	N/A	N/A
203	M	Glass	Merged	N/A	N/A	N/A	N/A
204	M	Glass	Merged	N/A	N/A	N/A	N/A
205	M	Glass	Merged	N/A	N/A	N/A	N/A
206	M	Glass	Merged	N/A	N/A	N/A	N/A
207	M	Glass	Merged	N/A	N/A	N/A	N/A
208	M	Glass	Merged	N/A	N/A	N/A	N/A
209	M	Glass	Merged	N/A	N/A	N/A	N/A
210	M	Glass	Merged	N/A	N/A	N/A	N/A
211	M	Glass	Merged	N/A	N/A	N/A	N/A
212	M	Glass	Merged	N/A	N/A	N/A	N/A
213	M	Glass	Merged	N/A	N/A	N/A	N/A
214	M	Glass	Merged	N/A	N/A	N/A	N/A
215	M	Glass	Merged	N/A	N/A	N/A	N/A
216	M	Glass	Merged	N/A	N/A	N/A	N/A
217	M	Glass	Merged	N/A	N/A	N/A	N/A
218	M	Glass	Merged	N/A	N/A	N/A	N/A
219	M	Glass	Merged	N/A	N/A	N/A	N/A
220	M	Glass	Merged	N/A	N/A	N/A	N/A
221	M	Glass	Merged	N/A	N/A	N/A	N/A
222	M	Glass	Merged	N/A	N/A	N/A	N/A
223	M	Glass	Merged	N/A	N/A	N/A	N/A
224	M	Glass	Merged	N/A	N/A	N/A	N/A
225	M	Glass	Merged	N/A	N/A	N/A	N/A
226	M	Glass	Merged	N/A	N/A	N/A	N/A
227	M	Glass	Merged	N/A	N/A	N/A	N/A
228	M	Glass	Merged	N/A	N/A	N/A	N/A
229	M	Glass	Merged	N/A	N/A	N/A	N/A
230	M	Glass	Merged	N/A	N/A	N/A	N/A
231	M	Glass	Merged	N/A	N/A	N/A	N/A
232	M	Glass	Merged	N/A	N/A	N/A	N/A
233	M	Glass	Merged	N/A	N/A	N/A	N/A
234	M	Glass	Merged	N/A	N/A	N/A	N/A
235	M	Glass	Merged	N/A	N/A	N/A	N/A

FP #	Type	Substrate	Development	f number	Exposure time	Focal Length	Wavelength
1	O	Plastic	Cyano	10	1/125	60	white
10	O	Plastic	Cyano	8	1/200	60	white
11	O	Plastic	Cyano	8	1/200	60	white
12	O	Plastic	Cyano	8	1/200	60	white
120	O	Plastic	Cyano	9	1/160	60	white
121	O	Plastic	Cyano	9	1/160	60	white
122	O	Plastic	Cyano	8	1/160	60	white
123	O	Plastic	Cyano	8	1/160	60	white
124	O	Plastic	Cyano	8	1/160	60	white
125	O	Plastic	Cyano	8	1/160	60	white
126	O	Plastic	Cyano	8	1/160	60	white
127	O	Plastic	Cyano	7.1	1/160	60	white
128	O	Plastic	Cyano	8	1/160	60	white
129	O	Plastic	Cyano	8	1/160	60	white
13	O	Plastic	Cyano	8	1/200	60	white
130	O	Plastic	Cyano	9	1/160	60	white
131	O	Plastic	Cyano	9	1/160	60	white
132	O	Plastic	Cyano	9	1/160	60	white
133	O	Plastic	Cyano	9	1/160	60	white
134	O	Plastic	Cyano	9	1/160	60	white
135	O	Plastic	Cyano	9	1/160	60	white
136	O	Plastic	Cyano	9	1/160	60	white
15	O	Plastic	Cyano	8	1/200	60	white
16	O	Plastic	Cyano	8	1/200	60	white
17	O	Plastic	Cyano	8	1/200	60	white
18	O	Plastic	Cyano	7.1	1/200	60	white
19	O	Plastic	Cyano	8	1/200	60	white
2	O	Plastic	Cyano	9	1/125	60	white
20	O	Plastic	Cyano	8	1/200	60	white
21	O	Plastic	Cyano	8	1/200	60	white
22	O	Plastic	Cyano	8	1/200	60	white
23	O	Plastic	Cyano	5	1/320	60	white
24	O	Plastic	Cyano	5.6	1/320	60	white
26	O	Plastic	Cyano	5.6	1/320	60	white
27	O	Plastic	Cyano	5.6	1/320	60	white
28	O	Plastic	Cyano	5	1/400	60	white
29	O	Plastic	Cyano	5	1/400	60	white
3	O	Plastic	Cyano	7.1	1/200	60	white
30	O	Plastic	Cyano	5	1/400	60	white
31	O	Plastic	Cyano	5	1/400	60	white
32	O	Plastic	Cyano	9	1/125	60	white
33	O	Plastic	Cyano	9	1/125	60	white
34	O	Plastic	Cyano	9	1/125	60	white
35	O	Plastic	Cyano	10	1/125	60	white
36	O	Plastic	Cyano	9	1/125	60	white
38	O	Plastic	Cyano	8	1/125	60	white

39	O	Plastic	Cyano	9	1/125	60	white
4	O	Plastic	Cyano	8	1/200	60	white
40	O	Plastic	Cyano	9	1/125	60	white
41	O	Plastic	Cyano	45	1/5	60	white
42	O	Plastic	Cyano	40	1/5	60	white
43	O	Plastic	Cyano	40	1/5	60	white
44	O	Plastic	Cyano	40	1/5	60	white
45	O	Plastic	Cyano	40	1/5	60	white
46	O	Plastic	Cyano	45	1/5	60	white
47	O	Plastic	Cyano	45	1/5	60	white
48	O	Plastic	Cyano	45	1/5	60	white
5	O	Plastic	Cyano	8	1/200	60	white
50	O	Plastic	Cyano	45	1/3	60	white
51	O	Plastic	Cyano	45	1/3	60	white
52	O	Plastic	Cyano	45	1/3	60	white
53	O	Plastic	Cyano	45	1/3	60	white
54	O	Plastic	Cyano	45	1/3	60	white
55	O	Plastic	Cyano	45	1/3	60	white
56	O	Plastic	Cyano	45	1/3	60	white
57	O	Plastic	Cyano	45	1/3	60	white
58	O	Plastic	Cyano	45	1/3	60	white
59	O	Plastic	Cyano	45	1/3	60	white
6	O	Plastic	Cyano	8	1/200	60	white
60	O	Plastic	Cyano	45	1/3	60	white
61	O	Plastic	Cyano	8	1/160	60	white
62	O	Plastic	Cyano	7.1	1/160	60	white
63	O	Plastic	Cyano	7.1	1/160	60	white
64	O	Plastic	Cyano	7.1	1/160	60	white
65	O	Plastic	Cyano	7.1	1/160	60	white
66	O	Plastic	Cyano	7.1	1/160	60	white
67	O	Plastic	Cyano	7.1	1/160	60	white
68	O	Plastic	Cyano	7.1	1/160	60	white
69	O	Plastic	Cyano	8	1/160	60	white
7	O	Plastic	Cyano	7.1	1/200	60	white
70	O	Plastic	Cyano	8	1/160	60	white
71	O	Plastic	Cyano	8	1/160	60	white
72	O	Plastic	Cyano	8	1/160	60	white
73	O	Plastic	Cyano	7.1	1/160	60	white
74	O	Plastic	Cyano	7.1	1/160	60	white
75	O	Plastic	Cyano	8	1/160	60	white
76	O	Plastic	Cyano	8	1/160	60	white
77	O	Plastic	Cyano	8	1/160	60	white
78	O	Plastic	Cyano	8	1/160	60	white
79	O	Plastic	Cyano	8	1/160	60	white
8	O	Plastic	Cyano	8	1/200	60	white
80	O	Plastic	Cyano	8	1/160	60	white
81	O	Plastic	Cyano	7.1	1/160	60	white
82	O	Plastic	Cyano	7.1	1/160	60	white
83	O	Plastic	Cyano	7.1	1/160	60	white
84	O	Plastic	Cyano	8	1/160	60	white
85	O	Plastic	Cyano	7.1	1/160	60	white
86	O	Plastic	Cyano	7.1	1/160	60	white

87	O	Plastic	Cyano	8	1/160	60	white
88	O	Plastic	Cyano	8	1/160	60	white
89	O	Plastic	Cyano	9	1/160	60	white
9	O	Plastic	Cyano	8	1/200	60	white
90	O	Plastic	Cyano	9	1/160	60	white
91	O	Plastic	Cyano	9	1/160	60	white
92	O	Plastic	Cyano	7.1	1/160	60	white
93	O	Plastic	Cyano	8	1/160	60	white
94	O	Plastic	Cyano	8	1/160	60	white
95	O	Plastic	Cyano	8	1/160	60	white
96	O	Plastic	Cyano	9	1/160	60	white
97	O	Plastic	Cyano	8	1/160	60	white
98	O	Plastic	Cyano	8	1/160	60	white
99	O	Plastic	Cyano	9	1/160	60	white
1	O	Plastic	Cyano + Basic Red 28	4	8	60	470
1	O	Plastic	Cyano + Basic Red 28	4	8	60	500
1	O	Plastic	Cyano + Basic Red 28	14	8	60	550
10	O	Plastic	Cyano + Basic Red 28	4	6	60	470
10	O	Plastic	Cyano + Basic Red 28	4	6	60	500
10	O	Plastic	Cyano + Basic Red 28	13	6	60	550
11	O	Plastic	Cyano + Basic Red 28	4	6	60	470
11	O	Plastic	Cyano + Basic Red 28	4	6	60	500
11	O	Plastic	Cyano + Basic Red 28	14	6	60	550
12	O	Plastic	Cyano + Basic Red 28	4	6	60	470
12	O	Plastic	Cyano + Basic Red 28	4	6	60	500
12	O	Plastic	Cyano + Basic Red 28	14	6	60	550
13	O	Plastic	Cyano + Basic Red 28	4	6	60	470
13	O	Plastic	Cyano + Basic Red 28	4	6	60	500
13	O	Plastic	Cyano + Basic Red 28	14	6	60	550
14	O	Plastic	Cyano + Basic Red 28	4	6	60	500
14	O	Plastic	Cyano + Basic Red 28	13	6	60	550
14	O	Plastic	Cyano + Basic Red 28	8	1/200	60	white
14	O	Plastic	Cyano + Basic Red 28	4	6	60	470
15	O	Plastic	Cyano + Basic Red 28	4	4	60	470
15	O	Plastic	Cyano + Basic Red 28	4	4	60	500
15	O	Plastic	Cyano + Basic Red 28	11	4	60	550
16	O	Plastic	Cyano + Basic Red 28	4	4	60	470
16	O	Plastic	Cyano + Basic Red 28	4	4	60	500
16	O	Plastic	Cyano + Basic Red 28	14	4	60	550
17	O	Plastic	Cyano + Basic Red 28	4	4	60	470
17	O	Plastic	Cyano + Basic Red 28	4	4	60	500
17	O	Plastic	Cyano + Basic Red 28	11	4	60	550
18	O	Plastic	Cyano + Basic Red 28	4	4	60	470
18	O	Plastic	Cyano + Basic Red 28	4	4	60	500
18	O	Plastic	Cyano + Basic Red 28	10	4	60	550
19	O	Plastic	Cyano + Basic Red 28	4	4	60	470
19	O	Plastic	Cyano + Basic Red 28	4	4	60	500
19	O	Plastic	Cyano + Basic Red 28	9	4	60	550
2	O	Plastic	Cyano + Basic Red 28	4	8	60	470
2	O	Plastic	Cyano + Basic Red 28	4	8	60	500
2	O	Plastic	Cyano + Basic Red 28	14	8	60	550
20	O	Plastic	Cyano + Basic Red 28	4	4	60	470

20	O	Plastic	Cyano + Basic Red 28	4	4	60	500
20	O	Plastic	Cyano + Basic Red 28	10	4	60	550
21	O	Plastic	Cyano + Basic Red 28	4	4	60	470
21	O	Plastic	Cyano + Basic Red 28	4	4	60	500
21	O	Plastic	Cyano + Basic Red 28	9	4	60	550
22	O	Plastic	Cyano + Basic Red 28	4	4	60	470
22	O	Plastic	Cyano + Basic Red 28	4	4	60	500
22	O	Plastic	Cyano + Basic Red 28	11	4	60	550
23	O	Plastic	Cyano + Basic Red 28	4	6	60	470
23	O	Plastic	Cyano + Basic Red 28	4	6	60	500
23	O	Plastic	Cyano + Basic Red 28	4	5/8	60	550
24	O	Plastic	Cyano + Basic Red 28	4	10	60	470
24	O	Plastic	Cyano + Basic Red 28	4	10	60	500
24	O	Plastic	Cyano + Basic Red 28	14	10	60	550
25	O	Plastic	Cyano + Basic Red 28	4	10	60	470
25	O	Plastic	Cyano + Basic Red 28	4	10	60	500
25	O	Plastic	Cyano + Basic Red 28	16	10	60	550
26	O	Plastic	Cyano + Basic Red 28	4	10	60	470
26	O	Plastic	Cyano + Basic Red 28	4	10	60	500
26	O	Plastic	Cyano + Basic Red 28	14	10	60	550
27	O	Plastic	Cyano + Basic Red 28	4	10	60	470
27	O	Plastic	Cyano + Basic Red 28	4	10	60	500
27	O	Plastic	Cyano + Basic Red 28	13	10	60	550
28	O	Plastic	Cyano + Basic Red 28	4	10	60	470
28	O	Plastic	Cyano + Basic Red 28	4	10	60	500
28	O	Plastic	Cyano + Basic Red 28	11	10	60	550
29	O	Plastic	Cyano + Basic Red 28	4	6	60	470
29	O	Plastic	Cyano + Basic Red 28	4	6	60	500
29	O	Plastic	Cyano + Basic Red 28	11	10	60	550
3	O	Plastic	Cyano + Basic Red 28	4	8	60	470
3	O	Plastic	Cyano + Basic Red 28	4	8	60	500
3	O	Plastic	Cyano + Basic Red 28	13	8	60	550
30	O	Plastic	Cyano + Basic Red 28	4	6	60	470
30	O	Plastic	Cyano + Basic Red 28	4	6	60	500
30	O	Plastic	Cyano + Basic Red 28	11	6	60	550
31	O	Plastic	Cyano + Basic Red 28	4	6	60	470
31	O	Plastic	Cyano + Basic Red 28	4	6	60	500
31	O	Plastic	Cyano + Basic Red 28	10	6	60	550
32	O	Plastic	Cyano + Basic Red 28	4	6	60	470
32	O	Plastic	Cyano + Basic Red 28	4	6	60	500
32	O	Plastic	Cyano + Basic Red 28	11	6	60	550
33	O	Plastic	Cyano + Basic Red 28	4	6	60	470
33	O	Plastic	Cyano + Basic Red 28	4	6	60	500
33	O	Plastic	Cyano + Basic Red 28	10	6	60	550
34	<u>O</u>	Plastic	Cyano + Basic Red 28	4	6	60	470
34	O	Plastic	Cyano + Basic Red 28	4	6	60	500
34	O	Plastic	Cyano + Basic Red 28	13	6	60	550
35	O	Plastic	Cyano + Basic Red 28	4	6	60	470
35	O	Plastic	Cyano + Basic Red 28	4	6	60	500
35	O	Plastic	Cyano + Basic Red 28	13	6	60	550
36	O	Plastic	Cyano + Basic Red 28	4	6	60	470
36	O	Plastic	Cyano + Basic Red 28	4	6	60	500

36	O	Plastic	Cyano + Basic Red 28	9	6	60	550
38	O	Plastic	Cyano + Basic Red 28	4	6	60	470
38	O	Plastic	Cyano + Basic Red 28	4	6	60	500
38	O	Plastic	Cyano + Basic Red 28	9	6	60	550
39	O	Plastic	Cyano + Basic Red 28	4	6	60	470
39	O	Plastic	Cyano + Basic Red 28	4	6	60	500
39	O	Plastic	Cyano + Basic Red 28	10	6	60	550
4	O	Plastic	Cyano + Basic Red 28	4	8	60	470
4	O	Plastic	Cyano + Basic Red 28	4	8	60	500
4	O	Plastic	Cyano + Basic Red 28	14	8	60	550
40	O	Plastic	Cyano + Basic Red 28	4	6	60	470
40	O	Plastic	Cyano + Basic Red 28	4	6	60	500
40	O	Plastic	Cyano + Basic Red 28	11	6	60	550
5	O	Plastic	Cyano + Basic Red 28	4	6	60	470
5	O	Plastic	Cyano + Basic Red 28	4	6	60	500
5	O	Plastic	Cyano + Basic Red 28	14	6	60	550
6	O	Plastic	Cyano + Basic Red 28	4	6	60	470
6	O	Plastic	Cyano + Basic Red 28	4	6	60	500
6	O	Plastic	Cyano + Basic Red 28	14	6	60	550
7	O	Plastic	Cyano + Basic Red 28	4	6	60	470
7	O	Plastic	Cyano + Basic Red 28	4	6	60	500
7	O	Plastic	Cyano + Basic Red 28	13	6	60	550
8	O	Plastic	Cyano + Basic Red 28	4	6	60	470
8	O	Plastic	Cyano + Basic Red 28	4	6	60	500
8	O	Plastic	Cyano + Basic Red 28	11	6	60	550
9	O	Plastic	Cyano + Basic Red 28	4	6	60	470
9	O	Plastic	Cyano + Basic Red 28	4	6	60	500
9	O	Plastic	Cyano + Basic Red 28	10	6	60	550
41	O	Plastic	Cyano + MBD	4	13	60	415
41	O	Plastic	Cyano + MBD	5	20	60	450
42	O	Plastic	Cyano + MBD	5	20	60	415
42	O	Plastic	Cyano + MBD	5	20	60	450
43	O	Plastic	Cyano + MBD	5	20	60	415
43	O	Plastic	Cyano + MBD	5	20	60	450
44	O	Plastic	Cyano + MBD	5	20	60	415
44	O	Plastic	Cyano + MBD	5	20	60	450
45	O	Plastic	Cyano + MBD	5	20	60	415
45	O	Plastic	Cyano + MBD	5	20	60	450
46	O	Plastic	Cyano + MBD	5	20	60	415
46	O	Plastic	Cyano + MBD	5	20	60	450
47	O	Plastic	Cyano + MBD	5	20	60	415
47	O	Plastic	Cyano + MBD	5	20	60	450
48	O	Plastic	Cyano + MBD	5	20	60	415
48	O	Plastic	Cyano + MBD	5	20	60	450
49	O	Plastic	Cyano + MBD	5	20	60	415
49	O	Plastic	Cyano + MBD	5	20	60	450
50	O	Plastic	Cyano + MBD	5	20	60	415
50	O	Plastic	Cyano + MBD	5	20	60	450
51	O	Plastic	Cyano + MBD	5	20	60	415
51	O	Plastic	Cyano + MBD	5	20	60	450
52	O	Plastic	Cyano + MBD	5	20	60	415
52	O	Plastic	Cyano + MBD	5	20	60	450

53	O	Plastic	Cyano + MBD	5	20	60	415
53	O	Plastic	Cyano + MBD	5	20	60	450
54	O	Plastic	Cyano + MBD	5	20	60	415
54	O	Plastic	Cyano + MBD	5	20	60	450
55	O	Plastic	Cyano + MBD	5	20	60	415
55	O	Plastic	Cyano + MBD	5	20	60	450
56	O	Plastic	Cyano + MBD	5	20	60	415
56	O	Plastic	Cyano + MBD	5	20	60	450
57	O	Plastic	Cyano + MBD	5	20	60	415
57	O	Plastic	Cyano + MBD	5	20	60	450
58	O	Plastic	Cyano + MBD	5	20	60	415
58	O	Plastic	Cyano + MBD	5	20	60	450
59	O	Plastic	Cyano + MBD	5	20	60	415
59	O	Plastic	Cyano + MBD	5	20	60	450
60	O	Plastic	Cyano + MBD	5	20	60	415
60	O	Plastic	Cyano + MBD	5	20	60	450
61	O	Plastic	Cyano + MBD	5	20	60	415
61	O	Plastic	Cyano + MBD	5	20	60	450
62	O	Plastic	Cyano + MBD	5	20	60	415
62	O	Plastic	Cyano + MBD	5	20	60	450
63	O	Plastic	Cyano + MBD	5	20	60	415
63	O	Plastic	Cyano + MBD	5	20	60	450
64	O	Plastic	Cyano + MBD	5	20	60	415
64	O	Plastic	Cyano + MBD	5	20	60	450
65	O	Plastic	Cyano + MBD	5	20	60	415
65	O	Plastic	Cyano + MBD	5	20	60	450
66	O	Plastic	Cyano + MBD	5	20	60	415
66	O	Plastic	Cyano + MBD	5	20	60	450
67	O	Plastic	Cyano + MBD	5	20	60	415
67	O	Plastic	Cyano + MBD	5	20	60	450
68	O	Plastic	Cyano + MBD	5	20	60	415
68	O	Plastic	Cyano + MBD	5	20	60	450
69	O	Plastic	Cyano + MBD	5	20	60	415
69	O	Plastic	Cyano + MBD	5	20	60	450
70	O	Plastic	Cyano + MBD	5	20	60	415
70	O	Plastic	Cyano + MBD	5	20	60	450
71	O	Plastic	Cyano + MBD	5	20	60	415
71	O	Plastic	Cyano + MBD	5	20	60	450
72	O	Plastic	Cyano + MBD	5	20	60	415
72	O	Plastic	Cyano + MBD	5	20	60	450
73	O	Plastic	Cyano + MBD	5	20	60	415
73	O	Plastic	Cyano + MBD	5	20	60	450
74	O	Plastic	Cyano + MBD	5	20	60	415
74	O	Plastic	Cyano + MBD	5	20	60	450
75	O	Plastic	Cyano + MBD	5	20	60	415
75	O	Plastic	Cyano + MBD	5	20	60	450
76	O	Plastic	Cyano + MBD	5	20	60	415
76	O	Plastic	Cyano + MBD	5	20	60	450
77	O	Plastic	Cyano + MBD	5	20	60	415
77	O	Plastic	Cyano + MBD	5	20	60	450
78	O	Plastic	Cyano + MBD	5	20	60	415
78	O	Plastic	Cyano + MBD	5	20	60	450

79	O	Plastic	Cyano + MBD	5	20	60	415
79	O	Plastic	Cyano + MBD	5	20	60	450
80	O	Plastic	Cyano + MBD	5	20	60	415
80	O	Plastic	Cyano + MBD	5	20	60	450
81	O	Plastic	Cyano + MBD	5	20	60	415
81	O	Plastic	Cyano + MBD	5	20	60	450
82	O	Plastic	Cyano + MBD	5	20	60	415
82	O	Plastic	Cyano + MBD	5	20	60	450
83	O	Plastic	Cyano + MBD	5	20	60	415
83	O	Plastic	Cyano + MBD	5	20	60	450
84	O	Plastic	Cyano + MBD	5	20	60	415
84	O	Plastic	Cyano + MBD	5	20	60	450
85	O	Plastic	Cyano + MBD	5	20	60	415
85	O	Plastic	Cyano + MBD	5	20	60	450
86	O	Plastic	Cyano + MBD	5	20	60	415
120	O	Plastic	Cyano + Rhodamine 6G	14	13	60	500
120	O	Plastic	Cyano + Rhodamine 6G	14	13	60	515
120	O	Plastic	Cyano + Rhodamine 6G	14	13	60	540
121	O	Plastic	Cyano + Rhodamine 6G	14	13	60	500
121	O	Plastic	Cyano + Rhodamine 6G	14	8	60	515
121	O	Plastic	Cyano + Rhodamine 6G	14	8	60	540
122	O	Plastic	Cyano + Rhodamine 6G	14	13	60	500
122	O	Plastic	Cyano + Rhodamine 6G	14	13	60	515
122	O	Plastic	Cyano + Rhodamine 6G	14	13	60	540
123	O	Plastic	Cyano + Rhodamine 6G	14	13	60	500
123	O	Plastic	Cyano + Rhodamine 6G	14	13	60	515
123	O	Plastic	Cyano + Rhodamine 6G	14	13	60	540
124	O	Plastic	Cyano + Rhodamine 6G	14	13	60	500
124	O	Plastic	Cyano + Rhodamine 6G	14	13	60	515
124	O	Plastic	Cyano + Rhodamine 6G	14	13	60	540
125	O	Plastic	Cyano + Rhodamine 6G	14	13	60	500
125	O	Plastic	Cyano + Rhodamine 6G	14	13	60	515
125	O	Plastic	Cyano + Rhodamine 6G	14	13	60	540
126	O	Plastic	Cyano + Rhodamine 6G	6.3	15	60	500
126	O	Plastic	Cyano + Rhodamine 6G	16	13	60	515
126	O	Plastic	Cyano + Rhodamine 6G	16	13	60	540
127	O	Plastic	Cyano + Rhodamine 6G	14	15	60	500
127	O	Plastic	Cyano + Rhodamine 6G	14	15	60	515
127	O	Plastic	Cyano + Rhodamine 6G	14	15	60	540
128	O	Plastic	Cyano + Rhodamine 6G	14	15	60	500
128	O	Plastic	Cyano + Rhodamine 6G	14	15	60	515
128	O	Plastic	Cyano + Rhodamine 6G	14	15	60	540
129	O	Plastic	Cyano + Rhodamine 6G	14	15	60	500
129	O	Plastic	Cyano + Rhodamine 6G	14	15	60	515
129	O	Plastic	Cyano + Rhodamine 6G	14	15	60	540
130	O	Plastic	Cyano + Rhodamine 6G	14	15	60	500
130	O	Plastic	Cyano + Rhodamine 6G	14	15	60	515
130	O	Plastic	Cyano + Rhodamine 6G	14	15	60	540
131	O	Plastic	Cyano + Rhodamine 6G	14	15	60	500
131	O	Plastic	Cyano + Rhodamine 6G	14	15	60	515
131	O	Plastic	Cyano + Rhodamine 6G	14	15	60	540
132	O	Plastic	Cyano + Rhodamine 6G	4.5	13	60	500

132	O	Plastic	Cyano + Rhodamine 6G	14	15	60	515
132	O	Plastic	Cyano + Rhodamine 6G	14	15	60	540
133	O	Plastic	Cyano + Rhodamine 6G	4.5	13	60	500
133	O	Plastic	Cyano + Rhodamine 6G	13	13	60	515
133	O	Plastic	Cyano + Rhodamine 6G	13	2 1/2	60	540
134	O	Plastic	Cyano + Rhodamine 6G	14	15	60	500
134	O	Plastic	Cyano + Rhodamine 6G	14	4	60	515
134	O	Plastic	Cyano + Rhodamine 6G	14	4	60	540
135	O	Plastic	Cyano + Rhodamine 6G	14	15	60	500
135	O	Plastic	Cyano + Rhodamine 6G	14	15	60	515
135	O	Plastic	Cyano + Rhodamine 6G	14	4	60	540
136	O	Plastic	Cyano + Rhodamine 6G	6.3	15	60	500
136	O	Plastic	Cyano + Rhodamine 6G	14	13	60	515
136	O	Plastic	Cyano + Rhodamine 6G	14	4	60	540
87	O	Plastic	Cyano + Rhodamine 6G	4	13	60	500
87	O	Plastic	Cyano + Rhodamine 6G	9	13	60	515
87	O	Plastic	Cyano + Rhodamine 6G	29	13	60	540
88	O	Plastic	Cyano + Rhodamine 6G	4	13	60	500
88	O	Plastic	Cyano + Rhodamine 6G	7.1	13	60	515
88	O	Plastic	Cyano + Rhodamine 6G	25	13	60	540
89	O	Plastic	Cyano + Rhodamine 6G	4	13	60	500
89	O	Plastic	Cyano + Rhodamine 6G	8	13	60	515
89	O	Plastic	Cyano + Rhodamine 6G	29	13	60	540
90	O	Plastic	Cyano + Rhodamine 6G	4	13	60	500
90	O	Plastic	Cyano + Rhodamine 6G	6.3	13	60	515
90	O	Plastic	Cyano + Rhodamine 6G	22	13	60	540
91	O	Plastic	Cyano + Rhodamine 6G	4.5	13	60	500
91	O	Plastic	Cyano + Rhodamine 6G	10	13	60	515
91	O	Plastic	Cyano + Rhodamine 6G	25	13	60	540
92	O	Plastic	Cyano + Rhodamine 6G	4	13	60	500
92	O	Plastic	Cyano + Rhodamine 6G	10	13	60	515
92	O	Plastic	Cyano + Rhodamine 6G	18	13	60	540
93	O	Plastic	Cyano + Rhodamine 6G	4	13	60	500
93	O	Plastic	Cyano + Rhodamine 6G	5	13	60	60
93	O	Plastic	Cyano + Rhodamine 6G	16	13	60	540
94	O	Plastic	Cyano + Rhodamine 6G	4	13	60	500
94	O	Plastic	Cyano + Rhodamine 6G	5.6	13	60	515
94	O	Plastic	Cyano + Rhodamine 6G	20	13	60	540
95	O	Plastic	Cyano + Rhodamine 6G	4.5	13	60	500
95	O	Plastic	Cyano + Rhodamine 6G	11	13	60	515
95	O	Plastic	Cyano + Rhodamine 6G	29	13	60	540
96	O	Plastic	Cyano + Rhodamine 6G	4	13	60	500
96	O	Plastic	Cyano + Rhodamine 6G	7.1	13	60	515
96	O	Plastic	Cyano + Rhodamine 6G	25	13	60	540
97	O	Plastic	Cyano + Rhodamine 6G	4	13	60	500
97	O	Plastic	Cyano + Rhodamine 6G	5.6	13	60	515
97	O	Plastic	Cyano + Rhodamine 6G	20	13	60	540
98	O	Plastic	Cyano + Rhodamine 6G	4.5	13	60	500
98	O	Plastic	Cyano + Rhodamine 6G	11	13	60	515
98	O	Plastic	Cyano + Rhodamine 6G	29	13	60	540
99	O	Plastic	Cyano + Rhodamine 6G	4	13	60	500
99	O	Plastic	Cyano + Rhodamine 6G	10	13	60	515

99	O	Plastic	Cyano + Rhodamine 6G	25	13	60	540
1	M	Plastic	Merged	N/A	N/A	N/A	N/A
10	M	Plastic	Merged	N/A	N/A	N/A	N/A
11	M	Plastic	Merged	N/A	N/A	N/A	N/A
12	M	Plastic	Merged	N/A	N/A	N/A	N/A
120	M	Plastic	Merged	N/A	N/A	N/A	N/A
121	M	Plastic	Merged	N/A	N/A	N/A	N/A
122	M	Plastic	Merged	N/A	N/A	N/A	N/A
123	M	Plastic	Merged	N/A	N/A	N/A	N/A
124	M	Plastic	Merged	N/A	N/A	N/A	N/A
125	M	Plastic	Merged	N/A	N/A	N/A	N/A
126	M	Plastic	Merged	N/A	N/A	N/A	N/A
127	M	Plastic	Merged	N/A	N/A	N/A	N/A
128	M	Plastic	Merged	N/A	N/A	N/A	N/A
129	M	Plastic	Merged	N/A	N/A	N/A	N/A
13	M	Plastic	Merged	N/A	N/A	N/A	N/A
130	M	Plastic	Merged	N/A	N/A	N/A	N/A
131	M	Plastic	Merged	N/A	N/A	N/A	N/A
132	M	Plastic	Merged	N/A	N/A	N/A	N/A
133	M	Plastic	Merged	N/A	N/A	N/A	N/A
134	M	Plastic	Merged	N/A	N/A	N/A	N/A
135	M	Plastic	Merged	N/A	N/A	N/A	N/A
136	M	Plastic	Merged	N/A	N/A	N/A	N/A
14	M	Plastic	Merged	N/A	N/A	N/A	N/A
15	M	Plastic	Merged	N/A	N/A	N/A	N/A
16	M	Plastic	Merged	N/A	N/A	N/A	N/A
17	M	Plastic	Merged	N/A	N/A	N/A	N/A
18	M	Plastic	Merged	N/A	N/A	N/A	N/A
19	M	Plastic	Merged	N/A	N/A	N/A	N/A
2	M	Plastic	Merged	N/A	N/A	N/A	N/A
20	M	Plastic	Merged	N/A	N/A	N/A	N/A
21	M	Plastic	Merged	N/A	N/A	N/A	N/A
22	M	Plastic	Merged	N/A	N/A	N/A	N/A
23	M	Plastic	Merged	N/A	N/A	N/A	N/A
24	M	Plastic	Merged	N/A	N/A	N/A	N/A
25	M	Plastic	Merged	N/A	N/A	N/A	N/A
26	M	Plastic	Merged	N/A	N/A	N/A	N/A
27	M	Plastic	Merged	N/A	N/A	N/A	N/A
28	M	Plastic	Merged	N/A	N/A	N/A	N/A
29	M	Plastic	Merged	N/A	N/A	N/A	N/A
3	M	Plastic	Merged	N/A	N/A	N/A	N/A
30	M	Plastic	Merged	N/A	N/A	N/A	N/A
31	M	Plastic	Merged	N/A	N/A	N/A	N/A
32	M	Plastic	Merged	N/A	N/A	N/A	N/A
33	M	Plastic	Merged	N/A	N/A	N/A	N/A
34	M	Plastic	Merged	N/A	N/A	N/A	N/A
35	M	Plastic	Merged	N/A	N/A	N/A	N/A
36	M	Plastic	Merged	N/A	N/A	N/A	N/A
38	M	Plastic	Merged	N/A	N/A	N/A	N/A
39	M	Plastic	Merged	N/A	N/A	N/A	N/A
4	M	Plastic	Merged	N/A	N/A	N/A	N/A
40	M	Plastic	Merged	N/A	N/A	N/A	N/A

41	M	Plastic	Merged	N/A	N/A	N/A	N/A
42	M	Plastic	Merged	N/A	N/A	N/A	N/A
43	M	Plastic	Merged	N/A	N/A	N/A	N/A
44	M	Plastic	Merged	N/A	N/A	N/A	N/A
45	M	Plastic	Merged	N/A	N/A	N/A	N/A
46	M	Plastic	Merged	N/A	N/A	N/A	N/A
47	M	Plastic	Merged	N/A	N/A	N/A	N/A
48	M	Plastic	Merged	N/A	N/A	N/A	N/A
49	M	Plastic	Merged	N/A	N/A	N/A	N/A
5	M	Plastic	Merged	N/A	N/A	N/A	N/A
50	M	Plastic	Merged	N/A	N/A	N/A	N/A
51	M	Plastic	Merged	N/A	N/A	N/A	N/A
52	M	Plastic	Merged	N/A	N/A	N/A	N/A
53	M	Plastic	Merged	N/A	N/A	N/A	N/A
54	M	Plastic	Merged	N/A	N/A	N/A	N/A
55	M	Plastic	Merged	N/A	N/A	N/A	N/A
56	M	Plastic	Merged	N/A	N/A	N/A	N/A
57	M	Plastic	Merged	N/A	N/A	N/A	N/A
58	M	Plastic	Merged	N/A	N/A	N/A	N/A
59	M	Plastic	Merged	N/A	N/A	N/A	N/A
6	M	Plastic	Merged	N/A	N/A	N/A	N/A
60	M	Plastic	Merged	N/A	N/A	N/A	N/A
61	M	Plastic	Merged	N/A	N/A	N/A	N/A
62	M	Plastic	Merged	N/A	N/A	N/A	N/A
63	M	Plastic	Merged	N/A	N/A	N/A	N/A
64	M	Plastic	Merged	N/A	N/A	N/A	N/A
65	M	Plastic	Merged	N/A	N/A	N/A	N/A
66	M	Plastic	Merged	N/A	N/A	N/A	N/A
67	M	Plastic	Merged	N/A	N/A	N/A	N/A
68	M	Plastic	Merged	N/A	N/A	N/A	N/A
69	M	Plastic	Merged	N/A	N/A	N/A	N/A
7	M	Plastic	Merged	N/A	N/A	N/A	N/A
70	M	Plastic	Merged	N/A	N/A	N/A	N/A
71	M	Plastic	Merged	N/A	N/A	N/A	N/A
72	M	Plastic	Merged	N/A	N/A	N/A	N/A
73	M	Plastic	Merged	N/A	N/A	N/A	N/A
74	M	Plastic	Merged	N/A	N/A	N/A	N/A
75	M	Plastic	Merged	N/A	N/A	N/A	N/A
76	M	Plastic	Merged	N/A	N/A	N/A	N/A
77	M	Plastic	Merged	N/A	N/A	N/A	N/A
78	M	Plastic	Merged	N/A	N/A	N/A	N/A
79	M	Plastic	Merged	N/A	N/A	N/A	N/A
8	M	Plastic	Merged	N/A	N/A	N/A	N/A
80	M	Plastic	Merged	N/A	N/A	N/A	N/A
81	M	Plastic	Merged	N/A	N/A	N/A	N/A
82	M	Plastic	Merged	N/A	N/A	N/A	N/A
83	M	Plastic	Merged	N/A	N/A	N/A	N/A
84	M	Plastic	Merged	N/A	N/A	N/A	N/A
85	M	Plastic	Merged	N/A	N/A	N/A	N/A
86	M	Plastic	Merged	N/A	N/A	N/A	N/A
87	M	Plastic	Merged	N/A	N/A	N/A	N/A
88	M	Plastic	Merged	N/A	N/A	N/A	N/A

89	M	Plastic	Merged	N/A	N/A	N/A	N/A
9	M	Plastic	Merged	N/A	N/A	N/A	N/A
90	M	Plastic	Merged	N/A	N/A	N/A	N/A
91	M	Plastic	Merged	N/A	N/A	N/A	N/A
92	M	Plastic	Merged	N/A	N/A	N/A	N/A
93	M	Plastic	Merged	N/A	N/A	N/A	N/A
94	M	Plastic	Merged	N/A	N/A	N/A	N/A
95	M	Plastic	Merged	N/A	N/A	N/A	N/A
96	M	Plastic	Merged	N/A	N/A	N/A	N/A
97	M	Plastic	Merged	N/A	N/A	N/A	N/A
98	M	Plastic	Merged	N/A	N/A	N/A	N/A
99	M	Plastic	Merged	N/A	N/A	N/A	N/A

APPENDIX B

Results

FP #	Type	Substrate	Development	NFIQ	Bandey	Match	Match Score	Lines Drawn	Total Lines
1	O	Plastic	Cyano	5	4	Y	2970840	38	63
1	O	Plastic	Cyano + Basic Red 28	5	3	Y	164064	32	62
1	O	Plastic	Cyano + Basic Red 28	1	4	Y	3082720	39	62
1	O	Plastic	Cyano + Basic Red 28	1	4	Y	2900562	42	60
1	M	Plastic	Merged	2	4	Y	1882287	33	53
2	O	Plastic	Cyano	2	3	Y	1929642	39	50
2	O	Plastic	Cyano + Basic Red 28	3	4	Y	3229932	51	68
2	O	Plastic	Cyano + Basic Red 28	1	3	Y	2006818	38	63
2	O	Plastic	Cyano + Basic Red 28	5	4	Y	3522690	45	62
2	M	Plastic	Merged	1	4	Y	2991240	40	58
3	O	Plastic	Cyano	5	4	Y	2659316	38	58
3	O	Plastic	Cyano + Basic Red 28	5	3	Y	1569724	38	61
3	O	Plastic	Cyano + Basic Red 28	1	3	Y	3144288	42	64
3	O	Plastic	Cyano + Basic Red 28	3	4	Y	547338	22	60
3	M	Plastic	Merged	3	4	Y	1115961	33	54
4	O	Plastic	Cyano	4	4	Y	1921218	39	61
4	O	Plastic	Cyano + Basic Red 28	2	3	Y	1458310	35	68
4	O	Plastic	Cyano + Basic Red 28	2	3	Y	1644552	36	65
4	O	Plastic	Cyano + Basic Red 28	2	4	Y	2292802	41	67
4	M	Plastic	Merged	2	4	Y	1736235	45	69
5	O	Plastic	Cyano	5	2	Y	3462624	44	60
5	O	Plastic	Cyano + Basic Red 28	5	4	Y	1503166	38	65
5	O	Plastic	Cyano + Basic Red 28	5	3	Y	3316131	39	64
5	O	Plastic	Cyano + Basic Red 28	2	4	Y	2358765	43	63
5	M	Plastic	Merged	1	4	Y	2273466	39	54
6	O	Plastic	Cyano	5	4	Y	783224	26	46
6	O	Plastic	Cyano + Basic Red 28	4	4	Y	1140386	23	42
6	O	Plastic	Cyano + Basic Red 28	4	3	Y	864984	24	51
6	O	Plastic	Cyano + Basic Red 28	1	2	Y	703488	24	38
6	M	Plastic	Merged	3	3	Y	1018348	23	35
7	O	Plastic	Cyano	2	4	Y	902564	35	63
7	O	Plastic	Cyano + Basic Red 28	1	4	Y	1476840	31	63
7	O	Plastic	Cyano + Basic Red 28	5	4	Y	1395498	39	66
7	O	Plastic	Cyano + Basic Red 28	1	4	Y	841509	27	55
7	M	Plastic	Merged	1	3	Y	492507	27	55
8	O	Plastic	Cyano	2	4	Y	396960	24	52
8	O	Plastic	Cyano + Basic Red 28	5	3	Y	973420	34	66
8	O	Plastic	Cyano + Basic Red 28	3	3	Y	769098	33	63
8	O	Plastic	Cyano + Basic Red 28	5	2	Y	1767456	34	66
8	M	Plastic	Merged	3	4	Y	790972	28	62
9	O	Plastic	Cyano	5	3	Y	1000290	30	63
9	O	Plastic	Cyano + Basic Red 28	4	4	Y	802728	24	67
9	O	Plastic	Cyano + Basic Red 28	5	4	Y	936789	31	66
9	O	Plastic	Cyano + Basic Red 28	1	3	Y	1640296	34	66
9	M	Plastic	Merged	2	4	Y	943530	35	63
10	O	Plastic	Cyano	2	2	Y	7883128	58	74

10	O	Plastic	Cyano + Basic Red 28	5	4	Y	6957804	49	65
10	O	Plastic	Cyano + Basic Red 28	5	3	Y	6980113	59	75
10	O	Plastic	Cyano + Basic Red 28	1	3	Y	2172513	49	60
10	M	Plastic	Merged	2	3	Y	8725035	55	65
11	O	Plastic	Cyano	3	3	Y	6084673	49	63
11	O	Plastic	Cyano + Basic Red 28	1	3	Y	8689380	60	71
11	O	Plastic	Cyano + Basic Red 28	1	2	Y	7095093	61	75
11	O	Plastic	Cyano + Basic Red 28	1	4	Y	7161648	52	68
11	M	Plastic	Merged	3	4	Y	5966892	54	68
12	O	Plastic	Cyano	2	4	Y	9999999	65	75
12	O	Plastic	Cyano + Basic Red 28	5	3	Y	9999999	63	77
12	O	Plastic	Cyano + Basic Red 28	1	4	Y	9999999	66	77
12	O	Plastic	Cyano + Basic Red 28	1	3	Y	9588895	61	69
12	M	Plastic	Merged	5	3	Y	9511059	61	73
13	O	Plastic	Cyano	1	3	Y	2651465	35	63
13	O	Plastic	Cyano + Basic Red 28	4	3	Y	2144340	33	60
13	O	Plastic	Cyano + Basic Red 28	2	3	Y	2499276	39	60
13	O	Plastic	Cyano + Basic Red 28	1	4	Y	1557675	35	57
13	M	Plastic	Merged	1	3	Y	2491812	38	60
14	O	Plastic	Cyano + Basic Red 28	4	4	Y	3910162	43	63
14	O	Plastic	Cyano + Basic Red 28	1	4	Y	1955918	34	51
14	O	Plastic	Cyano + Basic Red 28	4	3	Y	5386450	50	68
14	O	Plastic	Cyano + Basic Red 28	5	3	N/A	N/A	N/A	N/A
14	M	Plastic	Merged	5	4	Y	3245600	40	62
15	O	Plastic	Cyano	4	3	Y	2207275	35	59
15	O	Plastic	Cyano + Basic Red 28	3	4	Y	1543184	43	63
15	O	Plastic	Cyano + Basic Red 28	1	3	Y	3905354	46	67
15	O	Plastic	Cyano + Basic Red 28	1	4	Y	2087400	42	66
15	M	Plastic	Merged	3	3	Y	2986944	47	69
16	O	Plastic	Cyano	2	3	Y	2014722	43	64
16	O	Plastic	Cyano + Basic Red 28	1	3	Y	3038532	42	64
16	O	Plastic	Cyano + Basic Red 28	1	4	Y	1089616	40	62
16	O	Plastic	Cyano + Basic Red 28	1	4	Y	1882228	41	63
16	M	Plastic	Merged	4	2	Y	569811	31	56
17	O	Plastic	Cyano	1	4	Y	4305059	47	74
17	O	Plastic	Cyano + Basic Red 28	5	4	Y	3061036	44	73
17	O	Plastic	Cyano + Basic Red 28	2	4	Y	2738840	46	73
17	O	Plastic	Cyano + Basic Red 28	1	4	Y	3918768	42	70
17	M	Plastic	Merged	2	3	Y	3020380	44	64
18	O	Plastic	Cyano	3	3	Y	3657276	46	61
18	O	Plastic	Cyano + Basic Red 28	1	4	Y	3428392	44	66
18	O	Plastic	Cyano + Basic Red 28	5	3	Y	1741276	34	68
18	O	Plastic	Cyano + Basic Red 28	4	3	Y	4628928	48	70
18	M	Plastic	Merged	1	3	Y	1852617	39	66
19	O	Plastic	Cyano	1	4	Y	2965624	43	77
19	O	Plastic	Cyano + Basic Red 28	1	2	Y	1408225	34	73
19	O	Plastic	Cyano + Basic Red 28	5	3	Y	3373890	41	71
19	O	Plastic	Cyano + Basic Red 28	2	4	Y	2774112	44	69
19	M	Plastic	Merged	1	3	Y	2938896	48	75
20	O	Plastic	Cyano	1	4	Y	4715616	48	67
20	O	Plastic	Cyano + Basic Red 28	1	3	Y	1092204	27	66
20	O	Plastic	Cyano + Basic Red 28	1	4	Y	2870316	36	64

20	O	Plastic	Cyano + Basic Red 28	3	3	Y	3143736	36	61
20	M	Plastic	Merged	3	3	Y	2924208	42	69
21	O	Plastic	Cyano	5	4	N/A	N/A	N/A	N/A
21	O	Plastic	Cyano + Basic Red 28	5	4	Y	779085	27	51
21	O	Plastic	Cyano + Basic Red 28	2	4	Y	864786	26	59
21	O	Plastic	Cyano + Basic Red 28	1	4	Y	980397	27	52
21	M	Plastic	Merged	5	1	Y	1339832	26	53
22	O	Plastic	Cyano	1	4	Y	454087	17	49
22	O	Plastic	Cyano + Basic Red 28	5	2	Y	322684	17	43
22	O	Plastic	Cyano + Basic Red 28	5	3	Y	362253	17	47
22	O	Plastic	Cyano + Basic Red 28	4	3	Y	361267	17	41
22	M	Plastic	Merged	4	3	Y	136268	11	29
23	O	Plastic	Cyano	3	3	Y	331211	17	29
23	O	Plastic	Cyano + Basic Red 28	5	2	Y	195755	17	25
23	O	Plastic	Cyano + Basic Red 28	5	4	Y	273751	17	34
23	O	Plastic	Cyano + Basic Red 28	5	4	Y	66330	15	23
23	M	Plastic	Merged	3	3	Y	190590	15	31
24	O	Plastic	Cyano	3	4	Y	314944	14	36
24	O	Plastic	Cyano + Basic Red 28	5	3	Y	400707	17	36
24	O	Plastic	Cyano + Basic Red 28	4	3	Y	460150	25	47
24	O	Plastic	Cyano + Basic Red 28	5	4	Y	460150	25	47
24	M	Plastic	Merged	4	3	Y	169510	11	41
25	O	Plastic	Cyano + Basic Red 28	5	4	Y	889200	25	40
25	O	Plastic	Cyano + Basic Red 28	3	4	Y	942084	26	42
25	O	Plastic	Cyano + Basic Red 28	5	4	Y	1155198	23	38
25	M	Plastic	Merged	1	2	Y	819582	23	31
26	O	Plastic	Cyano	1	3	Y	133653	13	23
26	O	Plastic	Cyano + Basic Red 28	5	3	Y	355623	17	37
26	O	Plastic	Cyano + Basic Red 28	4	3	N	42481	12	32
26	O	Plastic	Cyano + Basic Red 28	3	4	Y	147248	16	29
26	M	Plastic	Merged	4	3	Y	74460	12	31
27	O	Plastic	Cyano	1	3	Y	591612	21	34
27	O	Plastic	Cyano + Basic Red 28	5	4	Y	1939112	28	43
27	O	Plastic	Cyano + Basic Red 28	5	3	Y	961925	25	37
27	O	Plastic	Cyano + Basic Red 28	5	3	Y	1248992	23	40
27	M	Plastic	Merged	3	4	Y	187026	14	28
28	O	Plastic	Cyano	3	4	Y	420399	21	32
28	O	Plastic	Cyano + Basic Red 28	4	3	Y	948304	28	55
28	O	Plastic	Cyano + Basic Red 28	2	3	Y	646350	25	51
28	O	Plastic	Cyano + Basic Red 28	1	4	Y	391457	19	37
28	M	Plastic	Merged	3	2	Y	576035	23	43
29	O	Plastic	Cyano	3	3	Y	941904	24	43
29	O	Plastic	Cyano + Basic Red 28	5	2	Y	815025	25	50
29	O	Plastic	Cyano + Basic Red 28	1	3	Y	932976	31	60
29	O	Plastic	Cyano + Basic Red 28	1	4	Y	473675	25	49
29	M	Plastic	Merged	3	4	Y	1199421	31	50
30	O	Plastic	Cyano	1	3	Y	2274228	33	49
30	O	Plastic	Cyano + Basic Red 28	4	3	Y	1557472	28	45
30	O	Plastic	Cyano + Basic Red 28	1	4	Y	1338744	33	49
30	O	Plastic	Cyano + Basic Red 28	1	3	Y	512350	25	41
30	M	Plastic	Merged	1	3	Y	1044238	26	38
31	O	Plastic	Cyano	4	2	Y	632385	23	43

31	O	Plastic	Cyano + Basic Red 28	2	4	Y	874940	22	44
31	O	Plastic	Cyano + Basic Red 28	5	4	Y	942550	25	39
31	O	Plastic	Cyano + Basic Red 28	1	4	Y	482724	22	42
31	M	Plastic	Merged	1	4	Y	359908	21	44
32	O	Plastic	Cyano	2	3	Y	576422	22	39
32	O	Plastic	Cyano + Basic Red 28	5	3	Y	522198	18	40
32	O	Plastic	Cyano + Basic Red 28	1	3	Y	1073203	23	40
32	O	Plastic	Cyano + Basic Red 28	5	3	Y	127326	28	43
32	M	Plastic	Merged	3	3	Y	716900	20	41
33	O	Plastic	Cyano	3	3	Y	1144665	27	47
33	O	Plastic	Cyano + Basic Red 28	5	3	Y	600006	22	47
33	O	Plastic	Cyano + Basic Red 28	1	4	Y	760750	25	47
33	O	Plastic	Cyano + Basic Red 28	5	3	Y	575302	29	46
33	M	Plastic	Merged	2	4	Y	643377	21	48
34	O	Plastic	Cyano	2	3	Y	194082	21	33
34	<u>O</u>	Plastic	Cyano + Basic Red 28	<u>3</u>	<u>4</u>	<u>N</u>	<u>59640</u>	<u>10</u>	<u>37</u>
34	O	Plastic	Cyano + Basic Red 28	4	4	N	N/A	N/A	N/A
34	O	Plastic	Cyano + Basic Red 28	5	4	Y	177701	17	35
34	M	Plastic	Merged	2	4	Y	86072	14	39
35	O	Plastic	Cyano	1	4	Y	583065	21	33
35	O	Plastic	Cyano + Basic Red 28	5	3	Y	986742	27	44
35	O	Plastic	Cyano + Basic Red 28	1	3	Y	375564	21	41
35	O	Plastic	Cyano + Basic Red 28	5	3	Y	263130	14	25
35	M	Plastic	Merged	1	4	Y	721680	24	35
36	O	Plastic	Cyano	1	4	Y	71832	8	15
36	O	Plastic	Cyano + Basic Red 28	5	2	N	53650	10	33
36	O	Plastic	Cyano + Basic Red 28	5	3	Y	218960	16	29
36	O	Plastic	Cyano + Basic Red 28	4	3	Y	189134	11	19
36	M	Plastic	Merged	5	3	Y	28494	9	15
38	O	Plastic	Cyano	3	2	Y	232144	16	24
38	O	Plastic	Cyano + Basic Red 28	5	4	Y	371450	19	30
38	O	Plastic	Cyano + Basic Red 28	5	2	Y	162225	15	26
38	O	Plastic	Cyano + Basic Red 28	3	3	Y	424740	15	29
38	M	Plastic	Merged	3	3	Y	385630	14	27
39	O	Plastic	Cyano	2	2	Y	46497	11	20
39	O	Plastic	Cyano + Basic Red 28	5	2	Y	26936	8	22
39	O	Plastic	Cyano + Basic Red 28	5	3	Y	15246	6	23
39	O	Plastic	Cyano + Basic Red 28	3	3	N	N/A	N/A	N/A
39	M	Plastic	Merged	1	3	Y	46752	8	19
40	O	Plastic	Cyano	4	4	Y	329220	15	23
40	O	Plastic	Cyano + Basic Red 28	1	3	Y	291940	20	33
40	O	Plastic	Cyano + Basic Red 28	5	3	Y	461244	19	33
40	O	Plastic	Cyano + Basic Red 28	2	4	Y	216426	14	22
40	M	Plastic	Merged	2	4	Y	259136	16	24
41	O	Plastic	Cyano	3	4	Y	99270	15	26
41	O	Plastic	Cyano + MBD	5	4	Y	71988	12	37
41	O	Plastic	Cyano + MBD	5	3	Y	692199	27	48
41	M	Plastic	Merged	2	3	Y	53452	14	40
42	O	Plastic	Cyano	2	4	Y	880178	26	43
42	O	Plastic	Cyano + MBD	3	4	N/A	N/A	N/A	N/A
42	O	Plastic	Cyano + MBD	1	4	Y	1233707	31	54
42	M	Plastic	Merged	3	3	Y	758016	32	44

43	O	Plastic	Cyano	5	4	Y	678546	23	34
43	O	Plastic	Cyano + MBD	1	3	Y	1485520	31	50
43	O	Plastic	Cyano + MBD	1	3	Y	1197450	30	52
43	M	Plastic	Merged	5	3	Y	550900	27	50
44	O	Plastic	Cyano	3	4	Y	613620	21	40
44	O	Plastic	Cyano + MBD	3	4	Y	276858	18	43
44	O	Plastic	Cyano + MBD	1	4	Y	914172	21	41
44	M	Plastic	Merged	3	2	Y	465642	18	37
45	O	Plastic	Cyano	1	3	Y	1275534	26	29
45	O	Plastic	Cyano + MBD	4	3	N	31196	10	17
45	O	Plastic	Cyano + MBD	3	2	N	24748	10	17
45	M	Plastic	Merged	3	4	Y	115570	14	21
46	O	Plastic	Cyano	1	4	Y	1834641	23	28
46	O	Plastic	Cyano + MBD	4	4	Y	799124	29	43
46	O	Plastic	Cyano + MBD	1	4	Y	978600	28	53
46	M	Plastic	Merged	3	4	Y	625350	22	35
47	O	Plastic	Cyano	1	4	Y	688857	17	20
47	O	Plastic	Cyano + MBD	1	4	Y	1152819	27	39
47	O	Plastic	Cyano + MBD	2	4	Y	340408	17	28
47	M	Plastic	Merged	1	4	Y	433512	18	32
48	O	Plastic	Cyano	5	2	Y	231350	14	15
48	O	Plastic	Cyano + MBD	5	3	Y	538660	20	41
48	O	Plastic	Cyano + MBD	2	3	Y	595608	24	44
48	M	Plastic	Merged	4	4	Y	744150	25	44
49	O	Plastic	Cyano + MBD	5	4	Y	854260	20	43
49	O	Plastic	Cyano + MBD	2	4	Y	240312	17	42
49	M	Plastic	Merged	2	4	Y	179445	15	40
50	O	Plastic	Cyano	5	4	Y	980400	24	49
50	O	Plastic	Cyano + MBD	1	4	Y	280425	25	42
50	O	Plastic	Cyano + MBD	1	3	Y	461013	21	48
50	M	Plastic	Merged	2	3	Y	312902	17	47
51	O	Plastic	Cyano	5	3	N	45840	15	33
51	O	Plastic	Cyano + MBD	5	3	Y	338859	23	37
51	O	Plastic	Cyano + MBD	4	4	Y	242280	20	36
51	M	Plastic	Merged	5	3	N	89925	15	30
52	O	Plastic	Cyano	5	3	Y	741275	25	45
52	O	Plastic	Cyano + MBD	4	3	Y	332080	20	28
52	O	Plastic	Cyano + MBD	5	4	Y	751872	22	41
52	M	Plastic	Merged	1	4	Y	43180	10	19
53	O	Plastic	Cyano	5	3	Y	511537	19	24
53	O	Plastic	Cyano + MBD	1	4	Y	187216	16	29
53	O	Plastic	Cyano + MBD	1	4	Y	45264	12	25
53	M	Plastic	Merged	1	2	Y	197574	13	30
54	O	Plastic	Cyano	3	3	Y	783299	23	31
54	O	Plastic	Cyano + MBD	1	3	Y	798570	30	39
54	O	Plastic	Cyano + MBD	5	3	Y	1103808	32	44
54	M	Plastic	Merged	1	4	Y	254353	19	35
55	O	Plastic	Cyano	1	3	Y	234192	16	26
55	O	Plastic	Cyano + MBD	4	3	Y	368067	17	33
55	O	Plastic	Cyano + MBD	1	3	Y	845691	21	32
55	M	Plastic	Merged	1	4	Y	1045488	24	35
56	O	Plastic	Cyano	1	4	N	37476	8	33

56	O	Plastic	Cyano + MBD	1	2	Y	488088	24	55
56	O	Plastic	Cyano + MBD	4	3	Y	275706	18	50
56	M	Plastic	Merged	5	3	Y	1419806	34	54
57	O	Plastic	Cyano	1	4	Y	50292	12	24
57	O	Plastic	Cyano + MBD	1	2	Y	41040	15	27
57	O	Plastic	Cyano + MBD	5	4	Y	46240	10	23
57	M	Plastic	Merged	1	2	N	N/A	N/A	N/A
58	O	Plastic	Cyano	3	2	Y	765325	25	55
58	O	Plastic	Cyano + MBD	1	4	Y	326485	17	47
58	O	Plastic	Cyano + MBD	1	4	Y	259254	18	51
58	M	Plastic	Merged	1	4	N	38619	8	34
59	O	Plastic	Cyano	5	3	Y	565240	26	60
59	O	Plastic	Cyano + MBD	1	4	Y	897402	33	60
59	O	Plastic	Cyano + MBD	4	3	Y	435952	22	61
59	M	Plastic	Merged	2	3	Y	302192	22	59
60	O	Plastic	Cyano	1	4	Y	977756	26	40
60	O	Plastic	Cyano + MBD	5	4	Y	347544	27	35
60	O	Plastic	Cyano + MBD	5	3	Y	98096	16	43
60	M	Plastic	Merged	4	4	N	51312	12	40
61	O	Plastic	Cyano	5	3	N	N/A	N/A	N/A
61	O	Plastic	Cyano + MBD	5	4	N	N/A	N/A	N/A
61	O	Plastic	Cyano + MBD	2	4	N	N/A	N/A	N/A
61	M	Plastic	Merged	3	3	N	N/A	N/A	N/A
62	O	Plastic	Cyano	3	4	Y	318978	18	33
62	O	Plastic	Cyano + MBD	3	3	Y	113796	18	31
62	O	Plastic	Cyano + MBD	1	4	Y	47696	11	33
62	M	Plastic	Merged	5	4	Y	214016	16	28
63	O	Plastic	Cyano	1	4	Y	729014	26	37
63	O	Plastic	Cyano + MBD	5	3	Y	520464	28	39
63	O	Plastic	Cyano + MBD	5	3	Y	574636	19	46
63	M	Plastic	Merged	5	3	N	56804	11	32
64	O	Plastic	Cyano	1	4	Y	484592	31	53
64	O	Plastic	Cyano + MBD	4	3	Y	1789092	36	58
64	O	Plastic	Cyano + MBD	5	4	Y	1998990	35	61
64	M	Plastic	Merged	5	3	Y	1345281	29	55
65	O	Plastic	Cyano	1	2	Y	508600	20	43
65	O	Plastic	Cyano + MBD	2	4	Y	815764	23	54
65	O	Plastic	Cyano + MBD	4	4	Y	844398	27	60
65	M	Plastic	Merged	5	3	Y	1161545	35	51
66	O	Plastic	Cyano	4	4	Y	1101246	29	49
66	O	Plastic	Cyano + MBD	1	3	Y	1221840	30	48
66	O	Plastic	Cyano + MBD	5	3	Y	954315	27	49
66	M	Plastic	Merged	1	4	Y	2132889	33	43
67	O	Plastic	Cyano	5	3	Y	249830	14	21
67	O	Plastic	Cyano + MBD	1	4	Y	873356	22	37
67	O	Plastic	Cyano + MBD	1	4	Y	452616	24	42
67	M	Plastic	Merged	1	3	Y	494516	22	33
68	O	Plastic	Cyano	5	4	N	N/A	N/A	N/A
68	O	Plastic	Cyano + MBD	2	3	Y	676894	13	47
68	O	Plastic	Cyano + MBD	4	3	N	510192	18	42
68	M	Plastic	Merged	4	3	Y	591160	20	40
69	O	Plastic	Cyano	1	4	Y	58392	12	19

69	O	Plastic	Cyano + MBD	2	3	Y	44172	12	22
69	O	Plastic	Cyano + MBD	5	4	Y	377944	4	22
69	M	Plastic	Merged	4	3	Y	351356	17	25
70	O	Plastic	Cyano	5	4	N	272867	17	33
70	O	Plastic	Cyano + MBD	4	3	Y	788000	25	46
70	O	Plastic	Cyano + MBD	5	3	Y	139355	15	38
70	M	Plastic	Merged	1	2	Y	226980	18	38
71	O	Plastic	Cyano	2	3	Y	546720	17	28
71	O	Plastic	Cyano + MBD	2	1	Y	203360	16	26
71	O	Plastic	Cyano + MBD	2	4	Y	363375	17	34
71	M	Plastic	Merged	5	4	Y	518610	15	24
72	O	Plastic	Cyano	4	4	Y	948793	29	37
72	O	Plastic	Cyano + MBD	5	3	Y	377568	23	40
72	O	Plastic	Cyano + MBD	5	3	Y	1218425	25	31
72	M	Plastic	Merged	1	4	Y	657279	21	32
73	O	Plastic	Cyano	5	2	N	N/A	N/A	N/A
73	O	Plastic	Cyano + MBD	1	3	N	N/A	N/A	N/A
73	O	Plastic	Cyano + MBD	1	2	Y	39348	6	13
73	M	Plastic	Merged	1	4	N	N/A	N/A	N/A
74	O	Plastic	Cyano	3	3	Y	1175916	28	43
74	O	Plastic	Cyano + MBD	1	4	Y	45454	8	36
74	O	Plastic	Cyano + MBD	5	4	Y	312648	21	36
74	M	Plastic	Merged	2	4	Y	76275	15	30
75	O	Plastic	Cyano	5	4	N	37884	12	22
75	O	Plastic	Cyano + MBD	1	4	Y	80514	14	21
75	O	Plastic	Cyano + MBD	1	3	Y	55062	14	22
75	M	Plastic	Merged	1	4	N	N/A	N/A	N/A
76	O	Plastic	Cyano	3	3	Y	417163	17	23
76	O	Plastic	Cyano + MBD	1	4	Y	415837	17	31
76	O	Plastic	Cyano + MBD	4	4	Y	189405	15	24
76	M	Plastic	Merged	4	3	Y	625214	19	31
77	O	Plastic	Cyano	3	3	Y	2440284	38	46
77	O	Plastic	Cyano + MBD	1	3	Y	1445080	35	55
77	O	Plastic	Cyano + MBD	3	3	Y	896396	31	58
77	M	Plastic	Merged	5	3	Y	2046877	37	54
78	O	Plastic	Cyano	3	3	N	N/A	N/A	N/A
78	O	Plastic	Cyano + MBD	4	3	Y	54390	10	12
78	O	Plastic	Cyano + MBD	5	4	N/A	N/A	N/A	N/A
78	M	Plastic	Merged	5	3	Y	56864	8	12
79	O	Plastic	Cyano	3	4	Y	43230	11	20
79	O	Plastic	Cyano + MBD	1	4	Y	755520	16	26
79	O	Plastic	Cyano + MBD	1	3	Y	285810	21	32
79	M	Plastic	Merged	3	3	Y	213018	13	30
80	O	Plastic	Cyano	1	1	Y	14562	6	18
80	O	Plastic	Cyano + MBD	4	2	Y	308057	17	29
80	O	Plastic	Cyano + MBD	2	4	Y	143906	14	25
80	M	Plastic	Merged	2	3	Y	127413	13	29
81	O	Plastic	Cyano	1	4	Y	57830	10	18
81	O	Plastic	Cyano + MBD	4	3	Y	252630	15	22
81	O	Plastic	Cyano + MBD	1	4	Y	108800	10	14
81	M	Plastic	Merged	5	3	Y	446112	18	23
82	O	Plastic	Cyano	1	4	Y	4950880	20	32

82	O	Plastic	Cyano + MBD	1	1	Y	375459	21	44
82	O	Plastic	Cyano + MBD	5	3	Y	579176	26	44
82	M	Plastic	Merged	5	3	Y	807709	19	27
83	O	Plastic	Cyano	5	4	Y	1015680	30	47
83	O	Plastic	Cyano + MBD	3	3	Y	792400	25	47
83	O	Plastic	Cyano + MBD	2	4	Y	827232	24	44
83	M	Plastic	Merged	5	3	Y	599780	20	43
84	O	Plastic	Cyano	5	4	Y	744700	22	41
84	O	Plastic	Cyano + MBD	1	4	Y	409222	19	39
84	O	Plastic	Cyano + MBD	5	3	Y	608258	23	43
84	M	Plastic	Merged	2	4	Y	196740	15	34
85	O	Plastic	Cyano	4	4	Y	309552	16	29
85	O	Plastic	Cyano + MBD	5	4	Y	159504	16	40
85	O	Plastic	Cyano + MBD	5	3	Y	159860	10	23
85	M	Plastic	Merged	1	3	Y	388580	20	42
86	O	Plastic	Cyano	1	3	Y	3206440	40	73
86	O	Plastic	Cyano + MBD	1	3	Y	322074	18	28
86	M	Plastic	Merged	1	4	Y	664259	19	67
87	O	Plastic	Cyano	2	3	Y	1462748	28	36
87	O	Plastic	Cyano + Rhodamine 6G	5	4	Y	556358	22	30
87	O	Plastic	Cyano + Rhodamine 6G	5	3	Y	271894	14	30
87	O	Plastic	Cyano + Rhodamine 6G	1	4	Y	279633	17	25
87	M	Plastic	Merged	1	2	Y	328263	16	38
88	O	Plastic	Cyano	1	4	Y	1497300	42	65
88	O	Plastic	Cyano + Rhodamine 6G	1	4	Y	1608353	37	63
88	O	Plastic	Cyano + Rhodamine 6G	3	4	Y	1473654	39	62
88	O	Plastic	Cyano + Rhodamine 6G	5	4	Y	1882650	35	52
88	M	Plastic	Merged	1	3	Y	1865340	36	56
89	O	Plastic	Cyano	5	3	Y	2124200	38	54
89	O	Plastic	Cyano + Rhodamine 6G	2	3	Y	460377	27	46
89	O	Plastic	Cyano + Rhodamine 6G	1	4	Y	1172195	23	48
89	O	Plastic	Cyano + Rhodamine 6G	5	3	Y	980654	31	52
89	M	Plastic	Merged	2	3	Y	1983934	43	57
90	O	Plastic	Cyano	3	4	Y	1048850	25	48
90	O	Plastic	Cyano + Rhodamine 6G	1	3	Y	159290	17	35
90	O	Plastic	Cyano + Rhodamine 6G	1	3	Y	289125	15	39
90	O	Plastic	Cyano + Rhodamine 6G	1	1	Y	192672	16	30
90	M	Plastic	Merged	5	4	Y	1146912	24	48
91	O	Plastic	Cyano	5	3	Y	2229897	29	47
91	O	Plastic	Cyano + Rhodamine 6G	4	3	Y	198832	16	36
91	O	Plastic	Cyano + Rhodamine 6G	5	4	Y	202635	15	39
91	O	Plastic	Cyano + Rhodamine 6G	5	4	Y	319740	15	31
91	M	Plastic	Merged	3	3	Y	623414	22	45
92	O	Plastic	Cyano	3	3	Y	654040	20	31
92	O	Plastic	Cyano + Rhodamine 6G	5	4	Y	452624	16	31
92	O	Plastic	Cyano + Rhodamine 6G	2	3	Y	328600	20	31
92	O	Plastic	Cyano + Rhodamine 6G	5	3	Y	283408	16	21
92	M	Plastic	Merged	1	4	Y	1220525	25	36
93	O	Plastic	Cyano	4	3	Y	409830	15	26
93	O	Plastic	Cyano + Rhodamine 6G	5	3	N/A	N/A	N/A	N/A
93	O	Plastic	Cyano + Rhodamine 6G	1	2	N/A	N/A	N/A	N/A
93	O	Plastic	Cyano + Rhodamine 6G	5	4	N/A	N/A	N/A	N/A

93	M	Plastic	Merged	2	4	N	10626	7	11
94	O	Plastic	Cyano	2	3	Y	2564878	41	72
94	O	Plastic	Cyano + Rhodamine 6G	3	3	Y	3164800	46	61
94	O	Plastic	Cyano + Rhodamine 6G	5	4	Y	1996854	34	62
94	O	Plastic	Cyano + Rhodamine 6G	2	4	Y	1793016	36	64
94	M	Plastic	Merged	2	3	Y	3872127	53	70
95	O	Plastic	Cyano	2	4	Y	719348	28	47
95	O	Plastic	Cyano + Rhodamine 6G	1	3	Y	378325	25	38
95	O	Plastic	Cyano + Rhodamine 6G	1	4	Y	1189725	25	41
95	O	Plastic	Cyano + Rhodamine 6G	3	3	Y	1499524	26	34
95	M	Plastic	Merged	2	4	Y	1133233	29	46
96	O	Plastic	Cyano	5	4	Y	453992	22	35
96	O	Plastic	Cyano + Rhodamine 6G	5	4	N/A	N/A	N/A	N/A
96	O	Plastic	Cyano + Rhodamine 6G	5	3	N	N/A	N/A	N/A
96	O	Plastic	Cyano + Rhodamine 6G	5	4	N	N/A	N/A	N/A
96	M	Plastic	Merged	2	4	Y	201399	17	31
97	O	Plastic	Cyano	5	4	Y	376125	25	49
97	O	Plastic	Cyano + Rhodamine 6G	5	4	N	125685	15	26
97	O	Plastic	Cyano + Rhodamine 6G	5	4	Y	187410	15	25
97	O	Plastic	Cyano + Rhodamine 6G	1	3	Y	128618	14	29
97	M	Plastic	Merged	5	3	Y	197248	16	40
98	O	Plastic	Cyano	1	2	Y	294538	19	32
98	O	Plastic	Cyano + Rhodamine 6G	4	3	Y	203694	17	41
98	O	Plastic	Cyano + Rhodamine 6G	1	4	Y	246780	18	40
98	O	Plastic	Cyano + Rhodamine 6G	5	3	Y	159216	16	40
98	M	Plastic	Merged	5	4	Y	203544	18	36
99	O	Plastic	Cyano	3	3	N	499882	23	38
99	O	Plastic	Cyano + Rhodamine 6G	4	4	Y	276735	15	27
99	O	Plastic	Cyano + Rhodamine 6G	5	4	Y	711774	18	35
99	O	Plastic	Cyano + Rhodamine 6G	4	3	Y	238260	19	35
99	M	Plastic	Merged	5	4	Y	461264	16	30
120	O	Plastic	Cyano	4	4	Y	6877494	54	63
120	O	Plastic	Cyano + Rhodamine 6G	1	3	N	N/A	N/A	N/A
120	O	Plastic	Cyano + Rhodamine 6G	5	4	Y	1075173	33	54
120	O	Plastic	Cyano + Rhodamine 6G	3	3	Y	1373076	36	50
120	M	Plastic	Merged	1	3	Y	3412510	46	58
121	O	Plastic	Cyano	4	3	Y	6126840	54	69
121	O	Plastic	Cyano + Rhodamine 6G	5	4	Y	2159157	39	51
121	O	Plastic	Cyano + Rhodamine 6G	5	3	Y	4778960	47	64
121	O	Plastic	Cyano + Rhodamine 6G	1	4	Y	3253624	44	61
121	M	Plastic	Merged	1	4	Y	3926610	45	58
122	O	Plastic	Cyano	4	4	Y	9802572	62	72
122	O	Plastic	Cyano + Rhodamine 6G	5	3	Y	2460990	35	51
122	O	Plastic	Cyano + Rhodamine 6G	1	4	Y	4453830	51	63
122	O	Plastic	Cyano + Rhodamine 6G	1	4	Y	4965615	51	65
122	M	Plastic	Merged	1	3	Y	9999999	63	78
123	O	Plastic	Cyano	5	4	Y	6358688	56	71
123	O	Plastic	Cyano + Rhodamine 6G	5	4	N	255238	17	40
123	O	Plastic	Cyano + Rhodamine 6G	5	4	Y	1969434	27	51
123	O	Plastic	Cyano + Rhodamine 6G	1	4	Y	5815940	52	62
123	M	Plastic	Merged	4	4	Y	3467142	49	61
124	O	Plastic	Cyano	2	3	Y	1962741	33	58

124	O	Plastic	Cyano + Rhodamine 6G	2	3	Y	769522	26	40
124	O	Plastic	Cyano + Rhodamine 6G	1	4	Y	2411838	33	46
124	O	Plastic	Cyano + Rhodamine 6G	3	3	Y	2585255	41	53
124	M	Plastic	Merged	5	4	Y	492000	30	49
125	O	Plastic	Cyano	3	3	Y	547620	30	52
125	O	Plastic	Cyano + Rhodamine 6G	5	3	Y	154784	16	30
125	O	Plastic	Cyano + Rhodamine 6G	5	3	N	N/A	N/A	N/A
125	O	Plastic	Cyano + Rhodamine 6G	2	3	N	100512	16	32
125	M	Plastic	Merged	4	3	Y	662920	20	36
126	O	Plastic	Cyano	4	4	Y	3432518	43	60
126	O	Plastic	Cyano + Rhodamine 6G	1	3	Y	3820421	43	56
126	O	Plastic	Cyano + Rhodamine 6G	1	3	Y	1849392	27	35
126	O	Plastic	Cyano + Rhodamine 6G	5	3	Y	1956782	37	48
126	M	Plastic	Merged	3	3	Y	3223600	40	62
127	O	Plastic	Cyano	1	3	Y	1144330	22	56
127	O	Plastic	Cyano + Rhodamine 6G	5	3	Y	878725	25	36
127	O	Plastic	Cyano + Rhodamine 6G	2	4	Y	999288	24	39
127	O	Plastic	Cyano + Rhodamine 6G	3	3	Y	454938	22	33
127	M	Plastic	Merged	5	3	Y	915095	29	54
128	O	Plastic	Cyano	2	4	Y	3798144	42	60
128	O	Plastic	Cyano + Rhodamine 6G	5	4	Y	257124	19	33
128	O	Plastic	Cyano + Rhodamine 6G	5	3	Y	630683	23	38
128	O	Plastic	Cyano + Rhodamine 6G	1	4	Y	1282873	29	42
128	M	Plastic	Merged	5	4	Y	728620	20	32
129	O	Plastic	Cyano	5	4	Y	3457079	41	51
129	O	Plastic	Cyano + Rhodamine 6G	5	4	Y	4713236	44	48
129	O	Plastic	Cyano + Rhodamine 6G	5	3	Y	3214440	40	47
129	O	Plastic	Cyano + Rhodamine 6G	5	4	Y	2700445	37	47
129	M	Plastic	Merged	1	4	Y	3757776	44	45
130	O	Plastic	Cyano	5	4	Y	2078571	33	49
130	O	Plastic	Cyano + Rhodamine 6G	1	3	Y	2080080	30	47
130	O	Plastic	Cyano + Rhodamine 6G	1	4	Y	1891131	33	48
130	O	Plastic	Cyano + Rhodamine 6G	1	3	Y	1330210	31	45
130	M	Plastic	Merged	2	3	Y	1883343	31	45
131	O	Plastic	Cyano	1	3	Y	1524570	30	46
131	O	Plastic	Cyano + Rhodamine 6G	5	3	Y	794460	20	36
131	O	Plastic	Cyano + Rhodamine 6G	5	3	Y	968968	22	40
131	O	Plastic	Cyano + Rhodamine 6G	3	4	Y	836945	27	45
131	M	Plastic	Merged	1	4	Y	1052942	22	44
132	O	Plastic	Cyano	4	4	Y	366054	19	42
132	O	Plastic	Cyano + Rhodamine 6G	2	3	Y	388269	21	53
132	O	Plastic	Cyano + Rhodamine 6G	5	4	Y	506023	23	31
132	O	Plastic	Cyano + Rhodamine 6G	4	3	Y	300504	19	37
132	M	Plastic	Merged	1	3	Y	426456	24	44
133	O	Plastic	Cyano	5	4	Y	544103	19	38
133	O	Plastic	Cyano + Rhodamine 6G	5	3	N	N/A	N/A	N/A
133	O	Plastic	Cyano + Rhodamine 6G	1	4	Y	100485	11	25
133	O	Plastic	Cyano + Rhodamine 6G	1	3	Y	118720	14	24
133	M	Plastic	Merged	5	3	Y	259726	17	33
134	O	Plastic	Cyano	2	4	Y	2799664	49	72
134	O	Plastic	Cyano + Rhodamine 6G	5	4	Y	326135	19	32
134	O	Plastic	Cyano + Rhodamine 6G	1	3	Y	402200	25	31

134	O	Plastic	Cyano + Rhodamine 6G	1	4	Y	545076	27	39
134	M	Plastic	Merged	5	2	Y	1584448	38	58
135	O	Plastic	Cyano	5	4	Y	2481320	34	62
135	O	Plastic	Cyano + Rhodamine 6G	5	4	Y	1528227	27	55
135	O	Plastic	Cyano + Rhodamine 6G	1	3	Y	1656116	28	61
135	O	Plastic	Cyano + Rhodamine 6G	1	3	Y	2396352	32	63
135	M	Plastic	Merged	2	3	Y	2158704	38	61
136	O	Plastic	Cyano	5	3	Y	2127177	39	68
136	O	Plastic	Cyano + Rhodamine 6G	4	3	Y	3216450	41	67
136	O	Plastic	Cyano + Rhodamine 6G	1	4	Y	1699936	32	64
136	O	Plastic	Cyano + Rhodamine 6G	2	3	Y	1493600	32	53
136	M	Plastic	Merged	1	4	Y	2671536	42	75
137	O	Glass	Cyano	4	4	N	N/A	N/A	N/A
137	O	Glass	Cyano + Basic Red 28	5	4	N	N/A	N/A	N/A
137	O	Glass	Cyano + Basic Red 28	3	4	Y	82719	13	43
137	O	Glass	Cyano + Basic Red 28	1	4	Y	123102	14	34
137	M	Glass	Merged	2	1	N	N/A	N/A	N/A
138	O	Glass	Cyano	1	3	Y	67444	13	30
138	O	Glass	Cyano + Basic Red 28	3	4	N	N/A	N/A	N/A
138	O	Glass	Cyano + Basic Red 28	1	4	N	N/A	N/A	N/A
138	O	Glass	Cyano + Basic Red 28	4	3	Y	131220	15	42
138	M	Glass	Merged	1	4	Y	191862	19	48
139	O	Glass	Cyano	5	4	Y	101235	17	51
139	O	Glass	Cyano + Basic Red 28	1	3	N	N/A	N/A	N/A
139	O	Glass	Cyano + Basic Red 28	1	4	Y	94425	15	40
139	O	Glass	Cyano + Basic Red 28	3	3	N	N/A	N/A	N/A
139	M	Glass	Merged	2	4	Y	51077	13	40
140	O	Glass	Cyano	3	2	Y	64768	8	31
140	O	Glass	Cyano + Basic Red 28	4	3	N	N/A	N/A	N/A
140	O	Glass	Cyano + Basic Red 28	1	4	Y	115120	16	42
140	O	Glass	Cyano + Basic Red 28	4	4	Y	113595	15	42
140	M	Glass	Merged	2	3	N	N/A	N/A	N/A
141	O	Glass	Cyano	2	4	N	N/A	N/A	N/A
141	O	Glass	Cyano + Basic Red 28	5	2	N	N/A	N/A	N/A
141	O	Glass	Cyano + Basic Red 28	3	4	Y	83160	11	49
141	O	Glass	Cyano + Basic Red 28	1	4	N	62835	15	49
141	M	Glass	Merged	1	3	Y	82815	15	45
142	O	Glass	Cyano	1	3	Y	1233981	27	39
142	O	Glass	Cyano + Basic Red 28	5	4	Y	700425	33	43
142	O	Glass	Cyano + Basic Red 28	5	4	Y	1130942	31	41
142	O	Glass	Cyano + Basic Red 28	1	4	Y	454572	27	43
142	M	Glass	Merged	1	4	Y	1446048	32	41
143	O	Glass	Cyano	2	4	N	41382	11	34
143	O	Glass	Cyano + Basic Red 28	4	3	Y	181441	13	47
143	O	Glass	Cyano + Basic Red 28	1	4	Y	84370	11	48
143	O	Glass	Cyano + Basic Red 28	2	3	N	N/A	N/A	N/A
143	M	Glass	Merged	3	3	Y	58707	11	38
144	O	Glass	Cyano	5	4	Y	95863	17	36
144	O	Glass	Cyano + Basic Red 28	2	4	N	39127	11	43
144	O	Glass	Cyano + Basic Red 28	2	4	Y	268656	12	44
144	O	Glass	Cyano + Basic Red 28	2	3	Y	93119	13	39
144	M	Glass	Merged	1	4	Y	37770	10	31

145	O	Glass	Cyano	1	4	N	30074	11	33
145	O	Glass	Cyano + Basic Red 28	5	4	N	N/A	N/A	N/A
145	O	Glass	Cyano + Basic Red 28	5	4	Y	295108	22	48
145	O	Glass	Cyano + Basic Red 28	4	2	Y	58430	10	41
145	M	Glass	Merged	3	4	Y	89712	14	44
146	O	Glass	Cyano	4	4	Y	586700	20	46
146	O	Glass	Cyano + Basic Red 28	5	4	Y	669922	22	46
146	O	Glass	Cyano + Basic Red 28	2	3	Y	378735	21	55
146	O	Glass	Cyano + Basic Red 28	2	3	Y	475250	25	53
146	M	Glass	Merged	3	4	Y	637924	28	52
147	O	Glass	Cyano	1	3	Y	211701	17	53
147	O	Glass	Cyano + Basic Red 28	5	3	Y	366344	22	53
147	O	Glass	Cyano + Basic Red 28	5	4	Y	1070336	32	56
147	O	Glass	Cyano + Basic Red 28	1	3	Y	399968	15	59
147	M	Glass	Merged	1	3	Y	408768	24	57
148	O	Glass	Cyano	2	2	Y	346736	26	54
148	O	Glass	Cyano + Basic Red 28	4	4	Y	728838	27	60
148	O	Glass	Cyano + Basic Red 28	5	4	Y	972475	35	59
148	O	Glass	Cyano + Basic Red 28	4	3	Y	346786	22	53
148	M	Glass	Merged	5	4	Y	307608	21	55
149	O	Glass	Cyano	4	4	Y	1296800	32	59
149	O	Glass	Cyano + Basic Red 28	1	3	Y	524016	24	62
149	O	Glass	Cyano + Basic Red 28	5	3	Y	820204	28	56
149	O	Glass	Cyano + Basic Red 28	5	4	Y	562764	23	57
149	M	Glass	Merged	4	3	Y	68757	13	46
150	O	Glass	Cyano	1	3	Y	329023	19	58
150	O	Glass	Cyano + Basic Red 28	5	3	Y	645030	27	59
150	O	Glass	Cyano + Basic Red 28	5	3	Y	380673	23	57
150	O	Glass	Cyano + Basic Red 28	1	4	Y	708630	25	62
150	O	Glass	Cyano + Basic Red 28	5	4	Y	721008	24	61
150	M	Glass	Merged	3	3	Y	393652	28	60
151	O	Glass	Cyano	5	4	Y	410020	19	39
151	O	Glass	Cyano + Basic Red 28	5	3	Y	689568	24	45
151	O	Glass	Cyano + Basic Red 28	5	4	Y	692050	25	53
151	M	Glass	Merged	5	4	Y	488950	22	51
152	O	Glass	Cyano	2	4	Y	404092	26	47
152	O	Glass	Cyano + Basic Red 28	5	3	Y	447668	26	46
152	O	Glass	Cyano + Basic Red 28	1	4	Y	472600	25	54
152	O	Glass	Cyano + Basic Red 28	1	3	Y	458514	21	48
152	M	Glass	Merged	1	4	Y	385871	23	42
153	O	Glass	Cyano	5	4	Y	63908	13	46
153	O	Glass	Cyano + Basic Red 28	5	3	N	N/A	N/A	N/A
153	O	Glass	Cyano + Basic Red 28	5	4	N	92036	14	55
153	O	Glass	Cyano + Basic Red 28	3	3	Y	57918	14	55
153	M	Glass	Merged	1	3	N	46981	11	56
154	O	Glass	Cyano	5	4	Y	332325	25	52
154	O	Glass	Cyano + Basic Red 28	5	3	Y	1700480	32	50
154	O	Glass	Cyano + Basic Red 28	5	4	Y	1599708	33	55
154	O	Glass	Cyano + Basic Red 28	4	3	Y	292201	19	50
154	M	Glass	Merged	5	4	Y	1283040	30	54
155	O	Glass	Cyano	3	3	Y	879240	34	57
155	O	Glass	Cyano + Basic Red 28	5	4	Y	446952	22	55

155	O	Glass	Cyano + Basic Red 28	5	4	Y	466284	21	58
155	O	Glass	Cyano + Basic Red 28	4	4	Y	504609	21	51
155	M	Glass	Merged	1	3	Y	569400	24	55
156	O	Glass	Cyano	5	2	Y	515788	26	54
156	O	Glass	Cyano + Basic Red 28	5	4	Y	126405	15	50
156	O	Glass	Cyano + Basic Red 28	5	4	Y	208164	19	52
156	O	Glass	Cyano + Basic Red 28	1	4	Y	137880	20	50
156	M	Glass	Merged	1	4	Y	187188	19	48
157	O	Glass	Cyano	1	4	Y	118807	13	40
157	O	Glass	Cyano + Basic Red 28	5	4	Y	71862	14	46
157	O	Glass	Cyano + Basic Red 28	4	4	N	60330	6	43
157	O	Glass	Cyano + Basic Red 28	1	3	N	N/A	N/A	N/A
157	M	Glass	Merged	1	2	N	62460	10	45
158	O	Glass	Cyano	4	3	Y	744540	30	55
158	O	Glass	Cyano + Basic Red 28	5	4	Y	339411	23	54
158	O	Glass	Cyano + Basic Red 28	2	3	Y	128928	16	53
158	O	Glass	Cyano + Basic Red 28	4	3	Y	101040	15	50
158	M	Glass	Merged	3	3	Y	289199	19	51
159	O	Glass	Cyano	5	4	Y	1163650	25	51
159	O	Glass	Cyano + Basic Red 28	5	4	Y	345296	14	49
159	O	Glass	Cyano + Basic Red 28	1	4	Y	285192	24	47
159	O	Glass	Cyano + Basic Red 28	3	3	Y	299418	21	44
159	M	Glass	Merged	1	4	Y	243348	21	46
160	O	Glass	Cyano	3	4	N	N/A	N/A	N/A
160	O	Glass	Cyano + Basic Red 28	3	3	N	N/A	N/A	N/A
160	O	Glass	Cyano + Basic Red 28	5	4	N	N/A	N/A	N/A
160	O	Glass	Cyano + Basic Red 28	3	3	N	N/A	N/A	N/A
160	M	Glass	Merged	3	4	N	32983	6	50
161	O	Glass	Cyano	2	4	N	60630	15	50
161	O	Glass	Cyano + Basic Red 28	5	3	N	N/A	N/A	N/A
161	O	Glass	Cyano + Basic Red 28	5	3	Y	111202	14	51
161	O	Glass	Cyano + Basic Red 28	4	4	N	51160	10	44
161	M	Glass	Merged	1	3	N	66274	13	47
162	O	Glass	Cyano	4	4	Y	163240	14	48
162	O	Glass	Cyano + Basic Red 28	5	3	Y	152677	17	54
162	O	Glass	Cyano + Basic Red 28	2	4	Y	339045	21	54
162	O	Glass	Cyano + Basic Red 28	1	4	Y	91168	11	44
162	M	Glass	Merged	1	4	Y	197049	19	57
163	O	Glass	Cyano	1	4	Y	615725	25	52
163	O	Glass	Cyano + Basic Red 28	5	4	Y	736668	27	56
163	O	Glass	Cyano + Basic Red 28	2	3	Y	672917	31	53
163	O	Glass	Cyano + Basic Red 28	4	4	Y	71907	11	46
163	M	Glass	Merged	5	4	Y	216104	17	61
164	O	Glass	Cyano	2	3	Y	863164	31	63
164	O	Glass	Cyano + Basic Red 28	5	2	Y	846750	30	63
164	O	Glass	Cyano + Basic Red 28	1	4	Y	202900	20	65
164	O	Glass	Cyano + Basic Red 28	4	2	N	68376	12	57
164	M	Glass	Merged	2	4	Y	1239480	39	62
165	O	Glass	Cyano	1	4	Y	91924	14	51
165	O	Glass	Cyano + Basic Red 28	5	4	Y	387046	22	46
165	O	Glass	Cyano + Basic Red 28	1	4	Y	153670	22	46
165	O	Glass	Cyano + Basic Red 28	1	2	Y	109905	17	45

165	M	Glass	Merged	1	2	Y	729089	31	60
166	O	Glass	Cyano	4	3	Y	497574	22	61
166	O	Glass	Cyano + Basic Red 28	5	3	Y	709205	23	58
166	O	Glass	Cyano + Basic Red 28	1	3	Y	580814	26	65
166	O	Glass	Cyano + Basic Red 28	3	3	Y	735180	30	65
166	M	Glass	Merged	5	3	Y	732312	28	63
167	O	Glass	Cyano	1	3	Y	777800	25	63
167	O	Glass	Cyano + Basic Red 28	5	4	Y	1695078	33	56
167	O	Glass	Cyano + Basic Red 28	1	4	Y	979200	36	65
167	O	Glass	Cyano + Basic Red 28	2	4	Y	797720	28	61
167	M	Glass	Merged	4	3	Y	586386	27	53
168	O	Glass	Cyano	5	3	Y	333909	27	70
168	O	Glass	Cyano + Basic Red 28	5	4	Y	878130	30	65
168	O	Glass	Cyano + Basic Red 28	1	3	Y	454974	26	69
168	O	Glass	Cyano + Basic Red 28	3	4	N	294740	20	67
168	M	Glass	Merged	4	4	Y	955885	31	68
169	O	Glass	Cyano	4	2	Y	282055	19	55
169	O	Glass	Cyano + Basic Red 28	5	4	Y	288686	19	53
169	O	Glass	Cyano + Basic Red 28	5	4	Y	188272	16	54
169	O	Glass	Cyano + Basic Red 28	4	4	N	50325	11	52
169	M	Glass	Merged	5	3	Y	61110	14	40
170	O	Glass	Cyano	5	3	Y	103701	13	46
170	O	Glass	Cyano + Rhodamine 6G	5	3	N	N/A	N/A	N/A
170	O	Glass	Cyano + Rhodamine 6G	4	4	N	N/A	N/A	N/A
170	O	Glass	Cyano + Rhodamine 6G	1	2	Y	40095	11	36
170	M	Glass	Merged	1	3	Y	267360	20	40
171	O	Glass	Cyano	3	3	Y	183362	17	44
171	O	Glass	Cyano + Rhodamine 6G	1	4	N	N/A	N/A	N/A
171	O	Glass	Cyano + Rhodamine 6G	1	3	N	44544	5	44
171	O	Glass	Cyano + Rhodamine 6G	1	3	N	N/A	N/A	N/A
171	M	Glass	Merged	4	4	Y	423177	23	44
172	O	Glass	Cyano	5	4	N	N/A	N/A	N/A
172	O	Glass	Cyano + Rhodamine 6G	5	4	Y	88005	15	42
172	O	Glass	Cyano + Rhodamine 6G	2	4	Y	257166	21	47
172	O	Glass	Cyano + Rhodamine 6G	5	3	N	N/A	N/A	N/A
172	M	Glass	Merged	1	4	N	44132	4	44
173	O	Glass	Cyano	1	3	Y	73381	11	47
173	O	Glass	Cyano + Rhodamine 6G	4	3	Y	111969	13	49
173	O	Glass	Cyano + Rhodamine 6G	1	3	Y	244928	16	47
173	O	Glass	Cyano + Rhodamine 6G	2	4	Y	56340	12	40
173	M	Glass	Merged	4	4	N	42708	12	48
174	O	Glass	Cyano	5	2	N	N/A	N/A	N/A
174	O	Glass	Cyano + Rhodamine 6G	4	4	N	N/A	N/A	N/A
174	O	Glass	Cyano + Rhodamine 6G	2	4	N	N/A	N/A	N/A
174	O	Glass	Cyano + Rhodamine 6G	4	3	Y	76750	10	38
174	M	Glass	Merged	5	4	N	N/A	N/A	N/A
175	O	Glass	Cyano	3	4	Y	185215	17	41
175	O	Glass	Cyano + Rhodamine 6G	5	3	Y	74664	12	42
175	O	Glass	Cyano + Rhodamine 6G	2	3	Y	280200	15	40
175	O	Glass	Cyano + Rhodamine 6G	2	4	Y	151424	14	41
175	M	Glass	Merged	2	4	Y	300945	15	46
176	O	Glass	Cyano	5	3	Y	166680	10	37

176	O	Glass	Cyano + Rhodamine 6G	4	2	Y	262700	20	50
176	O	Glass	Cyano + Rhodamine 6G	2	3	Y	258592	16	46
176	O	Glass	Cyano + Rhodamine 6G	5	4	Y	86190	13	42
176	M	Glass	Merged	2	3	N	43870	10	39
177	O	Glass	Cyano	4	4	Y	693273	21	53
177	O	Glass	Cyano + Rhodamine 6G	5	2	Y	382060	20	50
177	O	Glass	Cyano + Rhodamine 6G	5	3	Y	177660	12	45
177	O	Glass	Cyano + Rhodamine 6G	5	4	Y	167705	17	40
177	M	Glass	Merged	2	4	Y	341700	20	54
178	O	Glass	Cyano	5	4	Y	681025	24	63
178	O	Glass	Cyano + Rhodamine 6G	5	4	Y	525132	29	64
178	O	Glass	Cyano + Rhodamine 6G	4	3	Y	110143	17	57
178	O	Glass	Cyano + Rhodamine 6G	4	3	Y	953440	32	67
178	M	Glass	Merged	5	3	Y	339100	20	51
179	O	Glass	Cyano	1	4	Y	609000	25	60
179	O	Glass	Cyano + Rhodamine 6G	5	4	Y	390540	23	50
179	O	Glass	Cyano + Rhodamine 6G	3	3	Y	421392	24	54
179	O	Glass	Cyano + Rhodamine 6G	3	3	Y	190145	17	55
179	M	Glass	Merged	1	4	Y	554591	19	56
180	O	Glass	Cyano	5	4	Y	1574055	35	55
180	O	Glass	Cyano + Rhodamine 6G	4	4	Y	120992	16	38
180	O	Glass	Cyano + Rhodamine 6G	5	2	Y	104992	17	46
180	O	Glass	Cyano + Rhodamine 6G	3	4	Y	682695	27	51
180	M	Glass	Merged	1	4	Y	412872	24	57
181	O	Glass	Cyano	5	4	Y	1417868	29	53
181	O	Glass	Cyano + Rhodamine 6G	2	4	Y	1050120	24	43
181	O	Glass	Cyano + Rhodamine 6G	3	3	Y	1096275	25	35
181	O	Glass	Cyano + Rhodamine 6G	5	4	Y	590018	26	43
181	M	Glass	Merged	2	3	Y	1225709	31	54
182	O	Glass	Cyano	5	4	Y	98604	12	40
182	O	Glass	Cyano + Rhodamine 6G	4	2	Y	72886	11	36
182	O	Glass	Cyano + Rhodamine 6G	3	3	Y	104868	12	40
182	O	Glass	Cyano + Rhodamine 6G	3	3	Y	98737	14	44
182	M	Glass	Merged	2	3	N	N/A	N/A	N/A
183	O	Glass	Cyano	3	4	N	31004	5	30
183	O	Glass	Cyano + Rhodamine 6G	1	4	Y	74136	12	35
183	O	Glass	Cyano + Rhodamine 6G	3	4	Y	74760	12	37
183	O	Glass	Cyano + Rhodamine 6G	4	4	Y	307350	18	38
183	M	Glass	Merged	5	3	N	N/A	N/A	N/A
184	O	Glass	Cyano	1	4	N	N/A	N/A	N/A
184	O	Glass	Cyano + Rhodamine 6G	5	4	Y	872620	28	52
184	O	Glass	Cyano + Rhodamine 6G	4	4	Y	312256	28	51
184	O	Glass	Cyano + Rhodamine 6G	4	3	Y	420680	26	54
184	M	Glass	Merged	2	3	Y	81168	12	38
185	O	Glass	Cyano	2	4	N	N/A	N/A	N/A
185	O	Glass	Cyano + Rhodamine 6G	5	4	Y	281898	18	33
185	O	Glass	Cyano + Rhodamine 6G	2	3	Y	116415	15	30
185	O	Glass	Cyano + Rhodamine 6G	4	3	N	10248	4	19
185	M	Glass	Merged	4	4	N	N/A	N/A	N/A
186	O	Glass	Cyano	2	4	Y	44625	15	38
186	O	Glass	Cyano + Rhodamine 6G	5	3	N	45266	13	53
186	O	Glass	Cyano + Rhodamine 6G	3	3	Y	160939	17	52

186	O	Glass	Cyano + Rhodamine 6G	5	4	Y	101403	19	55
186	M	Glass	Merged	3	4	N/A	N/A	N/A	N/A
187	O	Glass	Cyano	5	4	N	N/A	N/A	N/A
187	O	Glass	Cyano + Rhodamine 6G	4	4	Y	64590	10	38
187	O	Glass	Cyano + Rhodamine 6G	5	3	N	N/A	N/A	N/A
187	O	Glass	Cyano + Rhodamine 6G	3	3	Y	108200	10	36
187	M	Glass	Merged	4	4	N	45090	15	45
188	O	Glass	Cyano	2	2	N	N/A	N/A	N/A
188	O	Glass	Cyano + Rhodamine 6G	3	3	N	N/A	N/A	N/A
188	O	Glass	Cyano + Rhodamine 6G	3	4	N	7400	5	20
188	O	Glass	Cyano + Rhodamine 6G	5	4	N	25920	8	22
188	M	Glass	Merged	2	3	Y	15757	7	27
189	O	Glass	Cyano	3	3	N	69887	17	54
189	O	Glass	Cyano + Rhodamine 6G	1	4	Y	599844	28	55
189	O	Glass	Cyano + Rhodamine 6G	5	4	Y	497097	26	54
189	O	Glass	Cyano + Rhodamine 6G	3	4	Y	646775	25	48
189	M	Glass	Merged	4	4	Y	278649	21	48
190	O	Glass	Cyano	1	4	Y	1339380	35	56
190	O	Glass	Cyano + Rhodamine 6G	3	3	Y	1232152	29	49
190	O	Glass	Cyano + Rhodamine 6G	1	4	Y	652500	25	49
190	O	Glass	Cyano + Rhodamine 6G	5	3	Y	361077	23	53
190	M	Glass	Merged	1	4	Y	982731	31	59
191	O	Glass	Cyano	4	3	N	N/A	N/A	N/A
191	O	Glass	Cyano + Rhodamine 6G	1	3	Y	527525	25	51
191	O	Glass	Cyano + Rhodamine 6G	5	3	Y	1124730	30	53
191	O	Glass	Cyano + Rhodamine 6G	3	3	Y	345805	23	54
191	M	Glass	Merged	5	3	N	N/A	N/A	N/A
192	O	Glass	Cyano	2	3	Y	1347964	34	56
192	O	Glass	Cyano + Rhodamine 6G	5	4	Y	2791444	41	61
192	O	Glass	Cyano + Rhodamine 6G	5	4	Y	1097827	37	63
192	O	Glass	Cyano + Rhodamine 6G	5	4	Y	869006	34	62
192	M	Glass	Merged	5	3	Y	1077020	35	62
193	O	Glass	Cyano	2	4	Y	256305	21	50
193	O	Glass	Cyano + Rhodamine 6G	1	4	Y	181203	19	62
193	O	Glass	Cyano + Rhodamine 6G	1	4	Y	310152	24	64
193	O	Glass	Cyano + Rhodamine 6G	1	4	Y	260326	22	55
193	M	Glass	Merged	3	3	Y	86282	14	54
194	O	Glass	Cyano	2	3	N	N/A	N/A	N/A
194	O	Glass	Cyano + Rhodamine 6G	1	4	Y	34012	11	27
194	O	Glass	Cyano + Rhodamine 6G	3	4	Y	46530	10	28
194	O	Glass	Cyano + Rhodamine 6G	4	4	Y	52056	12	30
194	M	Glass	Merged	1	3	N	N/A	N/A	N/A
195	O	Glass	Cyano	3	3	N	N/A	N/A	N/A
195	O	Glass	Cyano + Rhodamine 6G	2	3	N	14016	6	26
195	O	Glass	Cyano + Rhodamine 6G	1	3	N	N/A	N/A	N/A
195	O	Glass	Cyano + Rhodamine 6G	1	4	N	N/A	N/A	N/A
195	M	Glass	Merged	1	4	N	25208	8	37
196	O	Glass	Cyano	4	4	N	22020	10	24
196	O	Glass	Cyano + Rhodamine 6G	5	3	Y	267789	23	35
196	O	Glass	Cyano + Rhodamine 6G	1	4	Y	131145	15	33
196	O	Glass	Cyano + Rhodamine 6G	5	3	Y	267060	20	37
196	M	Glass	Merged	2	3	Y	327348	18	38

197	O	Glass	Cyano	2	4	N	18276	12	25
197	O	Glass	Cyano + Rhodamine 6G	3	4	Y	53131	13	25
197	O	Glass	Cyano + Rhodamine 6G	2	3	Y	78160	16	28
197	O	Glass	Cyano + Rhodamine 6G	5	4	N	N/A	N/A	N/A
197	M	Glass	Merged	4	3	N	N/A	N/A	N/A
198	O	Glass	Cyano	1	4	Y	321678	23	45
198	O	Glass	Cyano + Rhodamine 6G	1	3	Y	94934	14	49
198	O	Glass	Cyano + Rhodamine 6G	5	4	Y	188850	25	54
198	O	Glass	Cyano + Rhodamine 6G	2	4	Y	187304	15	53
198	M	Glass	Merged	5	4	Y	311809	19	49
199	O	Glass	Cyano	4	4	Y	1093965	27	40
199	O	Glass	Cyano + Rhodamine 6G	5	2	Y	447746	17	29
199	O	Glass	Cyano + Rhodamine 6G	1	3	Y	667359	21	34
199	O	Glass	Cyano + Rhodamine 6G	4	3	Y	1659987	27	40
199	M	Glass	Merged	3	4	Y	795674	22	41
200	O	Glass	Cyano	1	3	N	N/A	N/A	N/A
200	O	Glass	Cyano + Rhodamine 6G	5	3	N	N/A	N/A	N/A
200	O	Glass	Cyano + Rhodamine 6G	4	4	N	N/A	N/A	N/A
200	O	Glass	Cyano + Rhodamine 6G	1	4	N	38943	9	44
200	M	Glass	Merged	5	3	N	N/A	N/A	N/A
201	O	Glass	Cyano	1	2	Y	1887080	38	65
201	O	Glass	Cyano + Rhodamine 6G	3	3	Y	1581255	39	65
201	O	Glass	Cyano + Rhodamine 6G	4	2	Y	199650	22	52
201	O	Glass	Cyano + Rhodamine 6G	4	3	Y	307832	28	57
201	M	Glass	Merged	1	3	Y	586385	23	61
202	O	Glass	Cyano	4	3	Y	89610	15	49
202	O	Glass	Cyano + Basic Yellow 40	1	4	Y	323610	23	51
202	O	Glass	Cyano + Basic Yellow 40	4	3	N	41119	13	43
202	O	Glass	Cyano + Basic Yellow 40	5	4	Y	92412	18	52
202	M	Glass	Merged	5	4	Y	219300	17	52
203	O	Glass	Cyano	5	3	Y	98804	17	40
203	O	Glass	Cyano + Basic Yellow 40	2	4	N	75950	14	45
203	O	Glass	Cyano + Basic Yellow 40	2	4	N	N/A	N/A	N/A
203	O	Glass	Cyano + Basic Yellow 40	1	3	Y	169760	16	41
203	M	Glass	Merged	5	3	Y	117844	17	34
204	O	Glass	Cyano	1	4	Y	438560	20	52
204	O	Glass	Cyano + Basic Yellow 40	3	3	Y	316954	22	56
204	O	Glass	Cyano + Basic Yellow 40	1	2	Y	94945	17	54
204	O	Glass	Cyano + Basic Yellow 40	1	4	Y	130543	17	55
204	M	Glass	Merged	1	3	Y	304656	22	56
205	O	Glass	Cyano	1	4	Y	164646	18	50
205	O	Glass	Cyano + Basic Yellow 40	1	4	N	N/A	N/A	N/A
205	O	Glass	Cyano + Basic Yellow 40	4	4	Y	158382	14	37
205	O	Glass	Cyano + Basic Yellow 40	1	3	N	188976	16	47
205	M	Glass	Merged	4	4	Y	82030	13	45
206	O	Glass	Cyano + Basic Yellow 40	4	3	Y	79563	11	41
206	O	Glass	Cyano + Basic Yellow 40	5	4	Y	62582	13	34
206	O	Glass	Cyano + Basic Yellow 40	5	3	Y	153792	18	43
206	M	Glass	Merged	5	4	Y	76496	14	46
207	O	Glass	Cyano	1	4	Y	272160	20	44
207	O	Glass	Cyano + Basic Yellow 40	3	4	Y	173700	20	47
207	O	Glass	Cyano + Basic Yellow 40	5	4	Y	61677	9	26

207	O	Glass	Cyano + Basic Yellow 40	2	4	N	63664	17	40
207	M	Glass	Merged	1	2	Y	238464	27	44
208	O	Glass	Cyano	5	4	Y	373934	23	44
208	O	Glass	Cyano + Basic Yellow 40	3	4	Y	258082	22	46
208	O	Glass	Cyano + Basic Yellow 40	2	4	Y	204426	18	42
208	O	Glass	Cyano + Basic Yellow 40	5	3	Y	214874	22	47
208	M	Glass	Merged	5	4	Y	139587	17	44
209	O	Glass	Cyano	4	4	Y	130663	19	43
209	O	Glass	Cyano + Basic Yellow 40	1	3	Y	158834	13	32
209	O	Glass	Cyano + Basic Yellow 40	3	4	N	45089	11	32
209	O	Glass	Cyano + Basic Yellow 40	1	3	Y	267546	17	40
209	M	Glass	Merged	4	3	Y	119275	13	39
210	O	Glass	Cyano	2	4	Y	646625	25	49
210	O	Glass	Cyano + Basic Yellow 40	1	4	Y	1028720	38	57
210	O	Glass	Cyano + Basic Yellow 40	1	4	Y	395451	21	43
210	O	Glass	Cyano + Basic Yellow 40	4	4	Y	181920	20	49
210	M	Glass	Merged	5	4	Y	413977	23	45
211	O	Glass	Cyano	5	4	N	N/A	N/A	N/A
211	O	Glass	Cyano + Basic Yellow 40	3	3	N	52116	12	39
211	O	Glass	Cyano + Basic Yellow 40	1	4	Y	30297	4	30
211	O	Glass	Cyano + Basic Yellow 40	5	4	N	N/A	N/A	N/A
211	M	Glass	Merged	5	4	N	N/A	N/A	N/A
212	O	Glass	Cyano	1	3	Y	432033	21	56
212	O	Glass	Cyano + Basic Yellow 40	2	4	Y	818697	33	55
212	O	Glass	Cyano + Basic Yellow 40	4	3	Y	806288	28	47
212	O	Glass	Cyano + Basic Yellow 40	1	3	Y	368832	17	51
212	M	Glass	Merged	2	3	Y	538524	21	55
213	O	Glass	Cyano	1	4	Y	273196	22	50
213	O	Glass	Cyano + Basic Yellow 40	1	4	Y	132800	16	47
213	O	Glass	Cyano + Basic Yellow 40	5	3	Y	102697	17	42
213	O	Glass	Cyano + Basic Yellow 40	5	4	Y	82384	16	46
213	M	Glass	Merged	3	4	Y	216220	19	44
214	O	Glass	Cyano	5	3	Y	576531	27	57
214	O	Glass	Cyano + Basic Yellow 40	5	3	Y	376763	23	52
214	O	Glass	Cyano + Basic Yellow 40	1	3	Y	289660	20	57
214	O	Glass	Cyano + Basic Yellow 40	5	3	Y	1443629	37	59
214	M	Glass	Merged	1	3	Y	1046675	25	57
215	O	Glass	Cyano	1	4	Y	236265	19	48
215	O	Glass	Cyano + Basic Yellow 40	5	4	N	N/A	N/A	N/A
215	O	Glass	Cyano + Basic Yellow 40	4	4	N	N/A	N/A	N/A
215	O	Glass	Cyano + Basic Yellow 40	1	2	Y	36584	6	30
215	M	Glass	Merged	5	4	N	N/A	N/A	N/A
216	O	Glass	Cyano	5	3	Y	1161690	30	46
216	O	Glass	Cyano + Basic Yellow 40	4	4	N	N/A	N/A	N/A
216	O	Glass	Cyano + Basic Yellow 40	4	4	N	N/A	N/A	N/A
216	O	Glass	Cyano + Basic Yellow 40	5	2	N	N/A	N/A	N/A
216	M	Glass	Merged	4	4	Y	742716	23	37
217	O	Glass	Cyano	2	4	Y	142672	16	47
217	O	Glass	Cyano + Basic Yellow 40	3	4	Y	139536	17	46
217	O	Glass	Cyano + Basic Yellow 40	4	4	N	34940	10	44
217	O	Glass	Cyano + Basic Yellow 40	1	3	Y	59584	14	37
217	M	Glass	Merged	4	3	Y	81887	13	49

218	O	Glass	Cyano	4	4	Y	179400	15	42
218	O	Glass	Cyano + Basic Yellow 40	5	4	Y	129523	17	39
218	O	Glass	Cyano + Basic Yellow 40	4	4	Y	259146	17	42
218	O	Glass	Cyano + Basic Yellow 40	2	2	Y	495462	22	41
218	M	Glass	Merged	1	2	N	45988	13	41
219	O	Glass	Cyano	4	3	Y	80388	14	45
219	O	Glass	Cyano + Basic Yellow 40	4	4	Y	109226	13	42
219	O	Glass	Cyano + Basic Yellow 40	5	2	N	N/A	N/A	N/A
219	O	Glass	Cyano + Basic Yellow 40	3	4	N	N/A	N/A	N/A
219	M	Glass	Merged	3	4	Y	98424	9	47
220	O	Glass	Cyano	1	3	N	N/A	N/A	N/A
220	O	Glass	Cyano + MBD	5	3	N	N/A	N/A	N/A
220	M	Glass	Merged	1	3	N	N/A	N/A	N/A
221	O	Glass	Cyano	5	4	N	37026	11	37
221	O	Glass	Cyano + MBD	1	3	N	N/A	N/A	N/A
221	M	Glass	Merged	5	3	N	N/A	N/A	N/A
222	O	Glass	Cyano	5	3	Y	88980	12	29
222	O	Glass	Cyano + MBD	5	3	Y	18641	7	21
222	M	Glass	Merged	5	4	N	13870	4	23
223	O	Glass	Cyano	4	4	Y	515168	34	49
223	O	Glass	Cyano + MBD	5	4	Y	271570	26	47
223	M	Glass	Merged	2	4	Y	535600	26	52
224	O	Glass	Cyano	3	4	Y	414575	25	58
224	O	Glass	Cyano + MBD	1	3	Y	1044414	27	56
224	M	Glass	Merged	5	3	Y	732660	30	57
225	O	Glass	Cyano	1	4	Y	533675	25	56
225	O	Glass	Cyano + MBD	5	4	Y	313704	12	51
225	M	Glass	Merged	5	3	Y	185264	16	54
226	O	Glass	Cyano	2	4	Y	95936	15	42
226	O	Glass	Cyano + MBD	2	4	N	N/A	N/A	N/A
226	M	Glass	Merged	3	3	Y	96694	13	31
227	O	Glass	Cyano	2	3	Y	433419	21	53
227	O	Glass	Cyano + MBD	1	4	Y	185263	13	51
227	M	Glass	Merged	5	4	Y	446992	14	48
228	O	Glass	Cyano	1	4	Y	491986	19	44
228	O	Glass	Cyano + MBD	5	2	Y	295584	24	44
228	M	Glass	Merged	2	4	Y	521576	22	43
229	O	Glass	Cyano	3	3	Y	227430	18	44
229	O	Glass	Cyano + MBD	4	4	Y	298809	21	45
229	M	Glass	Merged	3	4	N	90720	18	47
230	O	Glass	Cyano	1	2	Y	79662	17	42
230	O	Glass	Cyano + MBD	4	4	Y	335925	25	38
230	M	Glass	Merged	4	2	Y	329916	19	42
231	O	Glass	Cyano	5	4	Y	2001320	40	55
231	O	Glass	Cyano + MBD	3	2	Y	523962	31	51
231	M	Glass	Merged	1	2	Y	752832	32	57
232	O	Glass	Cyano	3	3	N	N/A	N/A	N/A
232	O	Glass	Cyano + MBD	1	3	N	N/A	N/A	N/A
232	M	Glass	Merged	2	4	N	N/A	N/A	N/A
233	O	Glass	Cyano	1	2	Y	294528	26	48
233	O	Glass	Cyano + MBD	2	4	Y	1218624	32	46
233	M	Glass	Merged	4	4	Y	709590	21	50

234	O	Glass	Cyano	5	3	Y	98189	13	32
234	O	Glass	Cyano + MBD	2	4	N	66671	11	30
234	M	Glass	Merged	2	3	Y	197205	15	36
235	O	Glass	Cyano	4	4	N	N/A	N/A	N/A
235	O	Glass	Cyano + MBD	4	4	N	N/A	N/A	N/A
235	M	Glass	Merged	3	4	N	N/A	N/A	N/A

APPENDIX C

NFIQ Scores

Bandey Score Frequency

Appendix D

NFIQ script

```
>for file in *.jpg
>do
>part_1=$file
>part_2="$($a ${file} -d)"
>echo "$part_1 $part_2">>> a.txt
>done
```