

# VISION INSPECTION & UV LASER PRINTING

for tablet / capsule



PENTAGON TABLET  
WHITE COLOR  
FILM COATED



2D & 3D IMAGE ANALYZATION  
LETTER ANALYZATION  
FRONT, BACK, SIDE, EDGE INSPECTION



UV LASER PRINTING  
PRINTING LETTER : 123, 健康, ENCLONY



PLANET Series



1999



2007



2012



2014

**ENCLONY** was founded in 2013 as Research and Development oriented organization that specializes in vision analyzation technology for tablet and capsule forms in pharmaceutical production process. However, our experience was started from 1999 by receiving a request from Suheung, a manufacturer of hard gelatin capsule, to develop a visual inspection machine for empty capsule. While developing this capsule inspection machine, the specialists, Kyungho Lee and Byungin Kim, found that the vision inspection technology has huge potential in the near future of pharmaceutical production process. So, Lee and Kim have developed the tablet inspection machine in 2007 and continued to develop a hybrid machine, which can inspect both tablet and capsule, in 2012.

On the year of 2014, we aligned the team by uniting the members only with full of R&D spirit, and have named it "ENCLONY". Enclony is defined as 'Avoid cloning and make new products only', and we call it the Enclony Spirit. After reorganization, we developed PLANET 4.8, which is more flexible than the previous model and continued to upgrade to PLANET 5G. In 2018, the current model of PLANET 6G was developed and to fulfill the demand of having higher outputs, have invented PLANET 6G/2X(double lane machine). In 2020, we invented the containment model for high toxic products, PLANET CI, which WIP(wash in place) is available and designed for OEB level 5.

For our vision inspection technology to be more applied on tablet and capsule production, we have developed PLANET LPI in 2018, two-in-one machine, which is able to perform UV laser printing and full vision inspection in one machine. This development of PLANET LPI becomes the starting point of new invention that combines our technology with the pharmaceutical industry. And, further developments are under planning for better productivity and quality improvement in pharmaceutical production.

Enclony has its own technologies required for vision inspection, such as mechanics, algorithms, programs, hardware, electric control, production, etc. and has its own ability to solve all related technical issues. By having these in house technical abilities, we are proud of that able to flexibly handling any type of demand from the customers. To keep the value of Enclony spirit (the spirit of continuous development of new technologies), we are continuing to focus on R&D day and night and willing to contribute these efforts to development of pharmaceutical industry.



# VISION INSPECTION MODELS



## PLANET 6GS Series

Customizable Model


- PLANET 6GS-T
- PLANET 6GS-C
- PLANET 6GS-TC



## PLANET 6GP Series

Standard Model

- PLANET 6GP-T
- PLANET 6GP-C
- PLANET 6GP-TC

 T : tablet only
  C : capsule only
  TC : tablet & capsule



## PLANET 6G 2X Series

Double Output Model

- PLANET 6G 2X-T
- PLANET 6G 2X-C
- PLANET 6G 2X-TC



## PLANET 6G CI Series

Containment Model, WIP equipped

- PLANET 6G CI-T
- PLANET 6G CI-C
- PLANET 6G CI-TC

# UV LASER PRINTING MODELS



## PLANET LPI Series

Laser Printing & Inspection

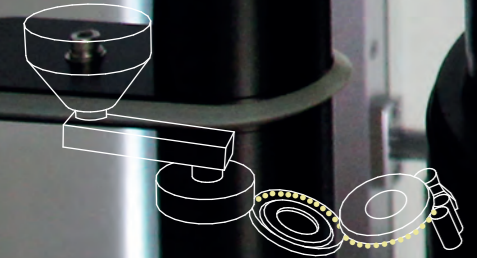
- PLANET LPI-T
- PLANET LPI-C
- PLANET LPI-TC



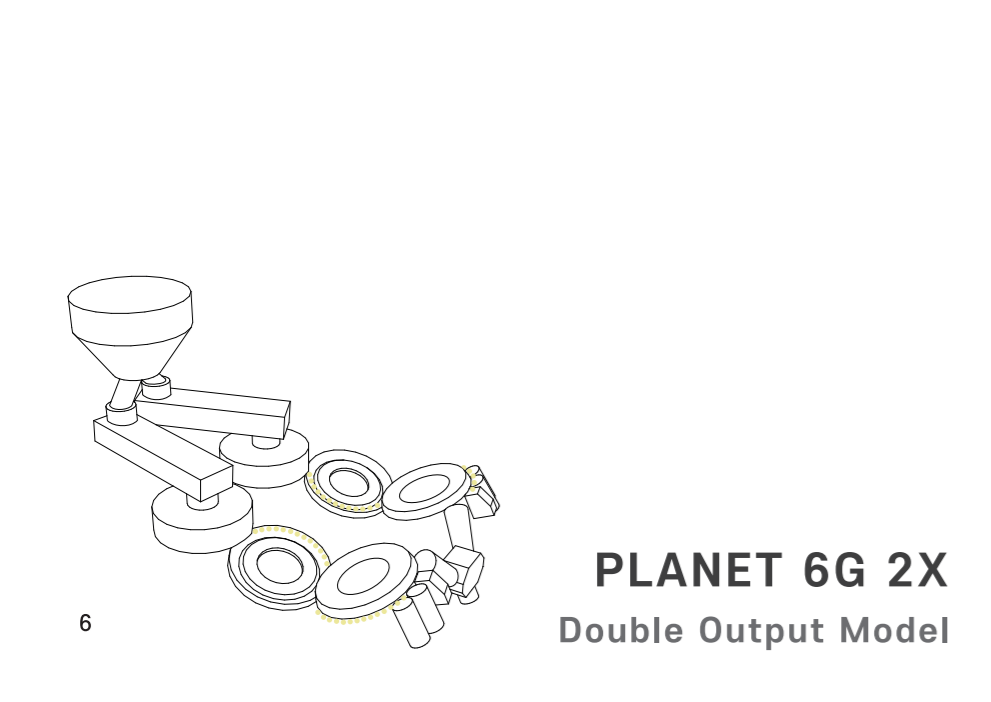
## PLANET LP Series

UV Laser Printing & Inspection on printed surface only

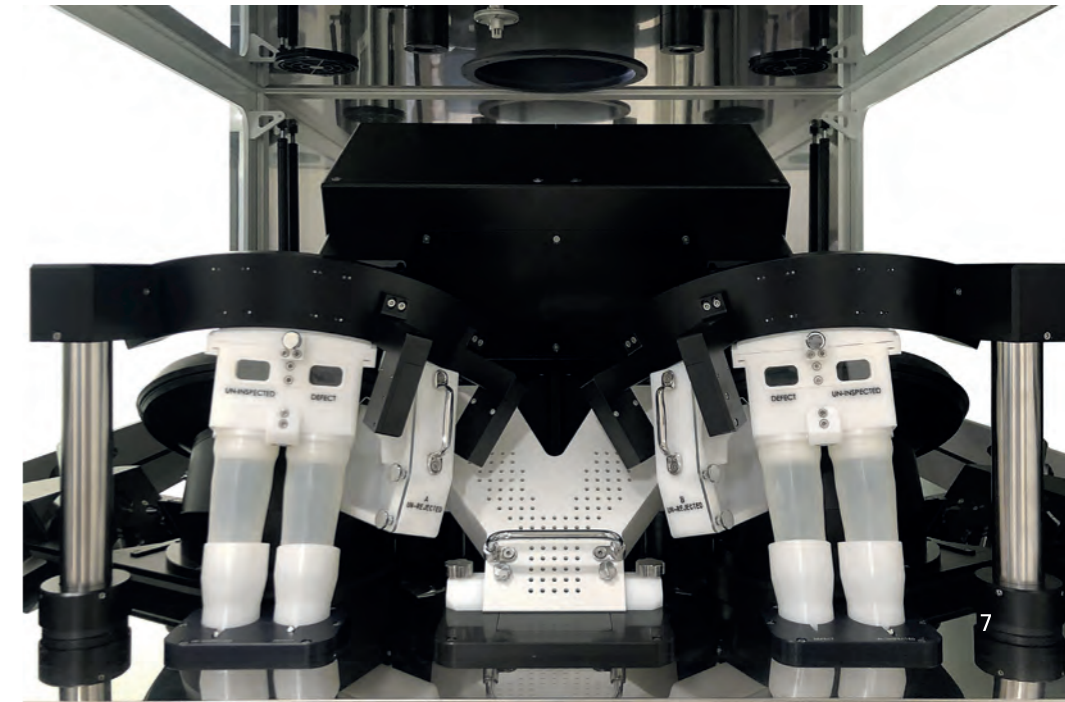
- PLANET LP-T
- PLANET LP-C
- PLANET LP-TC



Inspection Operation Chamber



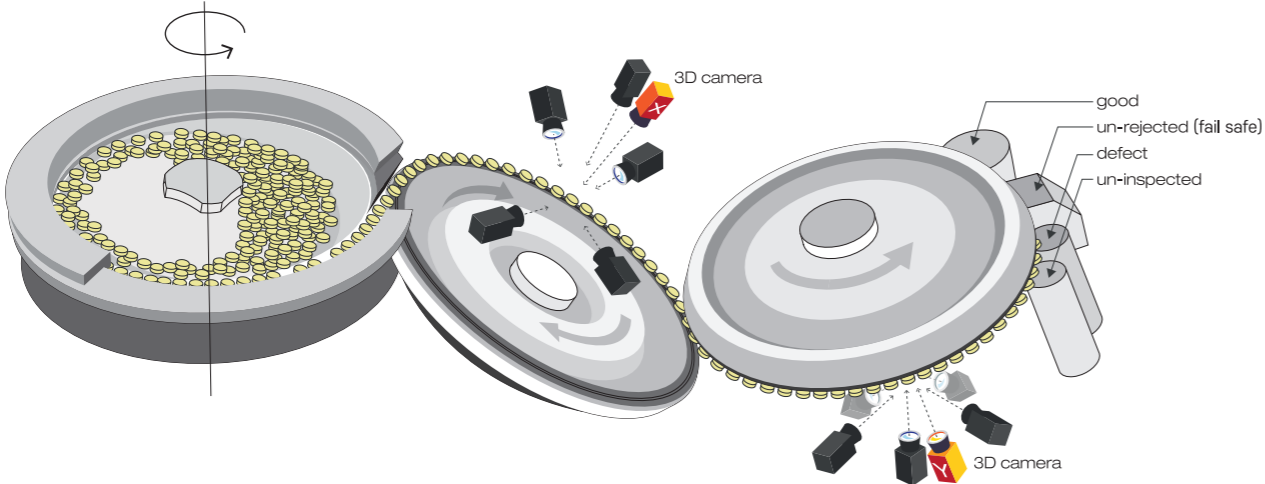
**PLANET 6G 2X**  
Double Output Model



# TABLET INSPECTION

Each tablet is inspected by ten 2D cameras capturing the complete surface areas (top, bottom, 360° sides with the shoulder, and edge corners of tablet) without any blind spot. In addition, two 3D cameras measure the height of tablet surface, both side of top and bottom, which allows to detect minimum 30µm defects including defects in engraved ID.

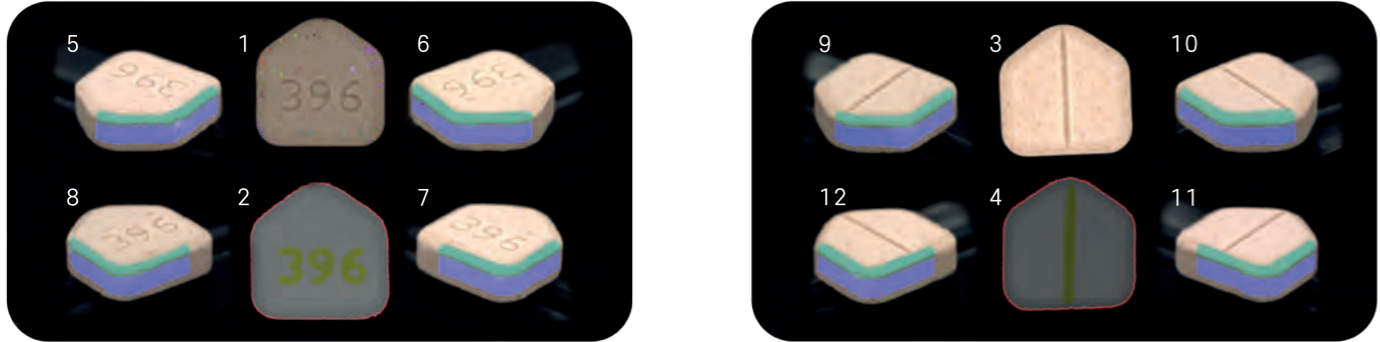
## Process



## Camera Views

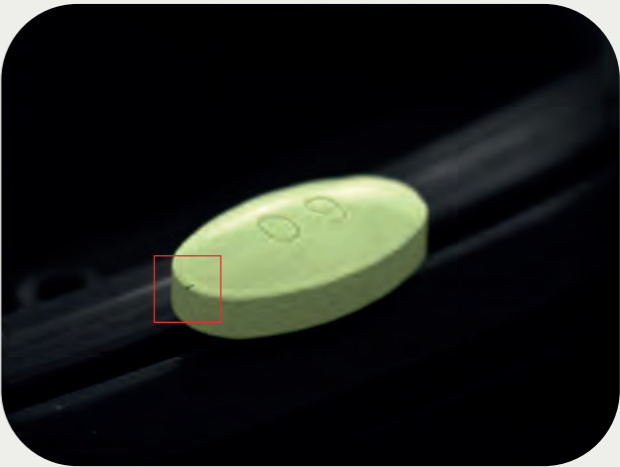


## Images & Inspection



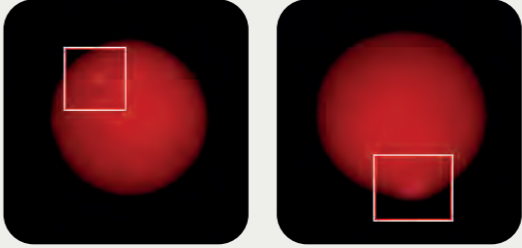
## Enhanced Edge Corner Inspection

The inspection performance of PLANET 6G series is enhanced to perfectly inspect without any blind spot. Especially, the size of defects located on the edge corner (as shown image on the right) is capable to control to be inspected same or similar as top and bottom.



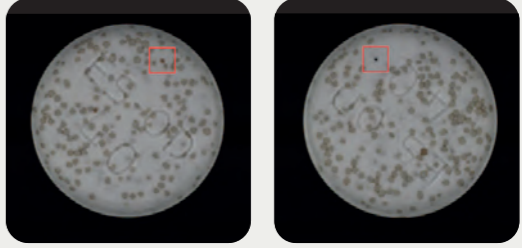
## Sugar Coated Tablet

Specific illumination system for sugar coated tablet performs efficient inspection on every edge.



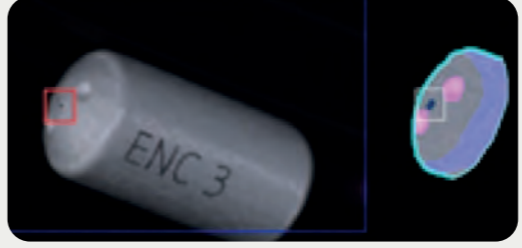
## Freckled Tablet

The program allows to select targeted color to be sorted out from various colored freckles.



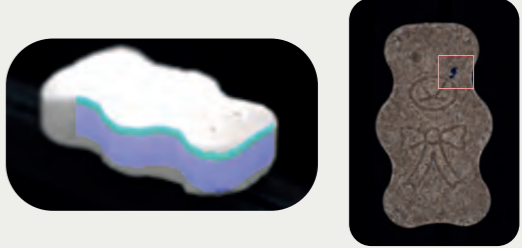
## Cylinder Type Tablet

Cylinder type tablet is capable to be inspected up to the end side, edge corner, etc. ID inspection is applied same as capsule inspection.



## Odd Shape Tablets

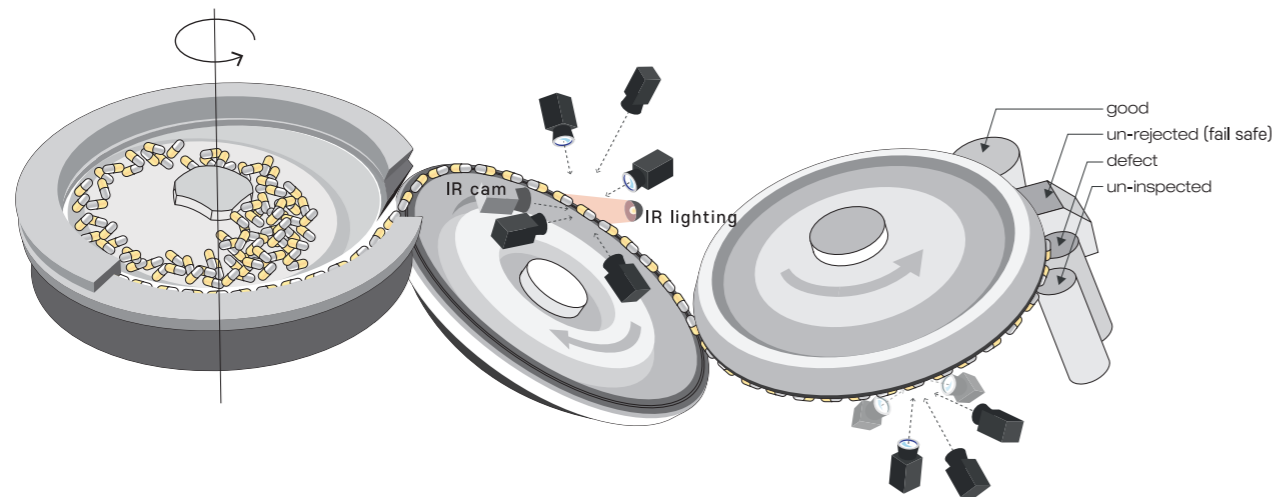
Various shapes of tablet are inspectable. The inspection on side and edge corner is proceeded as below.



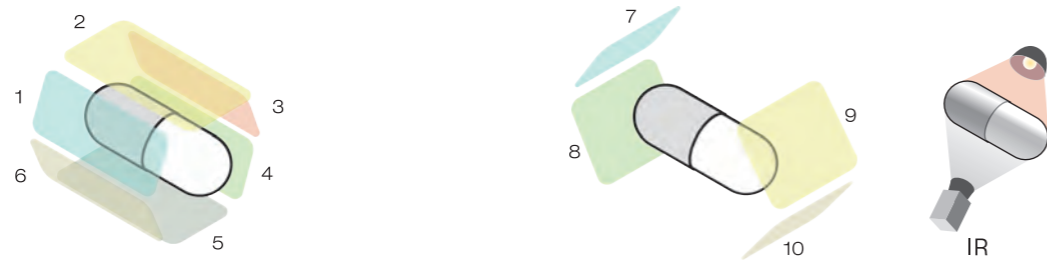
# CAPSULE INSPECTION

Each capsule is inspected by ten 2D cameras capturing the whole surface area (360° cylinder area and both hemispheres areas). An additional infrared camera detects the inside of capsule to check whether it is empty or lacking contents.

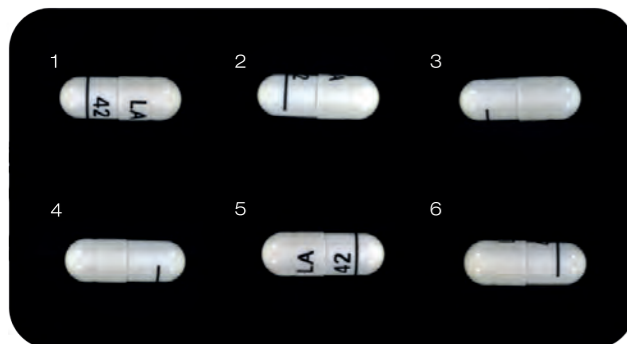
## Process



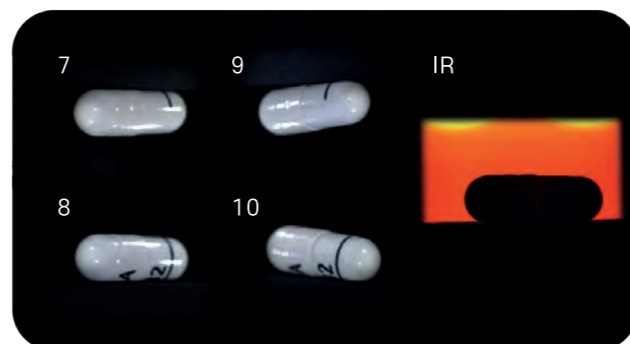
## Camera Views



## Images & Inspection



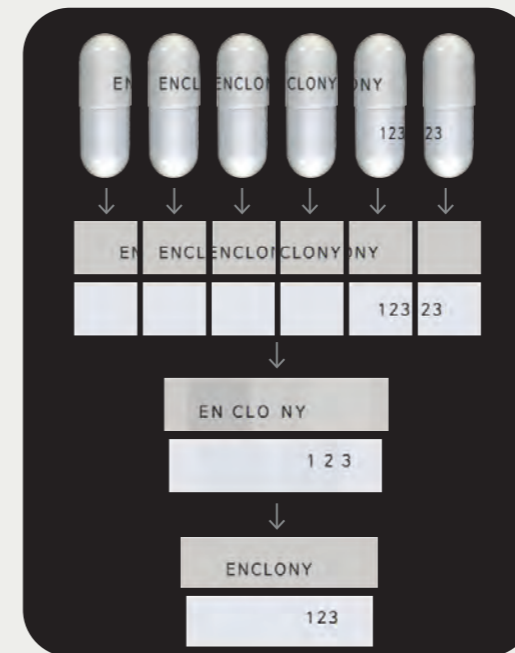
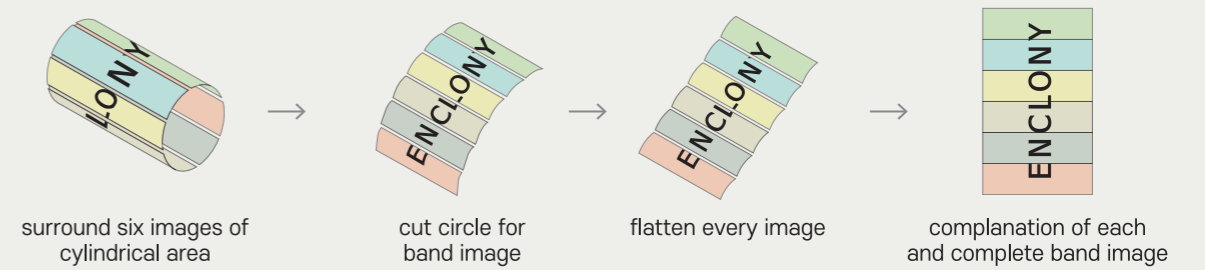
Cylinder area



Hemisphere area and IR image

## Cylinder Parts Reform to Band Image

6 images, which forming of 360° cylinder area, are combined and flattened after several steps of image reformation algorithm as shown below image. With this, we are able to perform detailed image analysis of cylinder area especially for printed ID 360° surrounded of capsule.



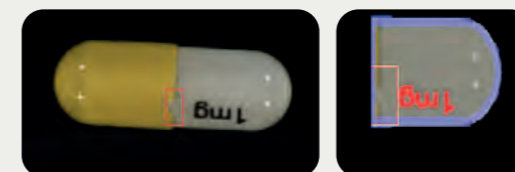
## 360° ID Analyzation

ID on the banded image in 360° is fully inspectable by geographical analysis, and it is even strong for complicated letters.



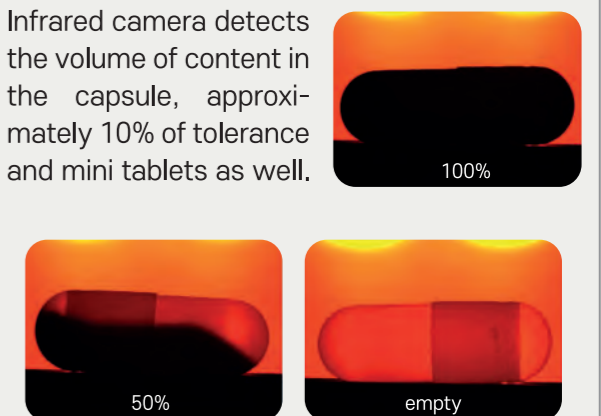
## Joint Line

Dedicated algorithm for the joint line inspects tears, piano, etc. even on the same color of cap and body.



## Checking Contents

Infrared camera detects the volume of content in the capsule, approximately 10% of tolerance and mini tablets as well.

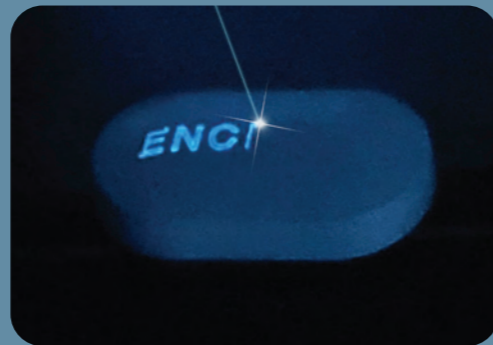


# UV LASER ID PRINTING

UV laser printing was developed based on our cumulated technologies to accurately print on the right point of tablet/capsule upon shape tracing process. This draws the innovated result and the elimination of lots of troubles caused from traditional ID marking on the tablet/capsule, engraving, and ink printing. In addition, Planet-LPI, which is combined of UV laser printing and vision inspection functions, provides numerous benefits in tablet production.

## Advantages of UV Laser Printing

- Non-contact printing on the tablet/capsule
- Precise positioning of ID on the tablet/capsule
- Maximum surface of tablet can be used for ID art work
- Distortion free of artwork on deep convex tablet
- High speed, approx. 6,500,000 characters/hour
- Immediate trial printing of ID artwork while designing
- Excellent fine and sharp design (line thickness min. 100µm)
- Simple and quick change over of ID
- Editable ID artwork on HMI (excellent feature for CMO)



## Compare to Ink-Printing

- No additives for printing
- Free from ink troubles (erased, blur, smudges, splatters, etc.)
- Mess free on the equipment and floor by ink
- Free from specific room condition (temperature and humidity)
- Free from ink quality control, procurement, storage, etc.

## Compare to Tablet Engraving

- Higher production speed than engraving production speed by proceeding with the flat tablet
- Reduction of defects such as sticking of ID, coating defects, etc.

## Advantages of 2-in-1, PLANET LPI

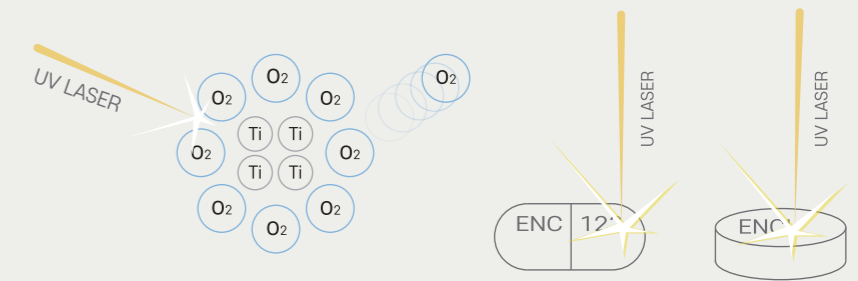
A combination of UV laser printing and vision inspection

- Minimizing of production process
- Cost saving of time, labor, spaces, etc.
- Immediate detection of defective ID
- Integrated control on single HMI of printing and inspection



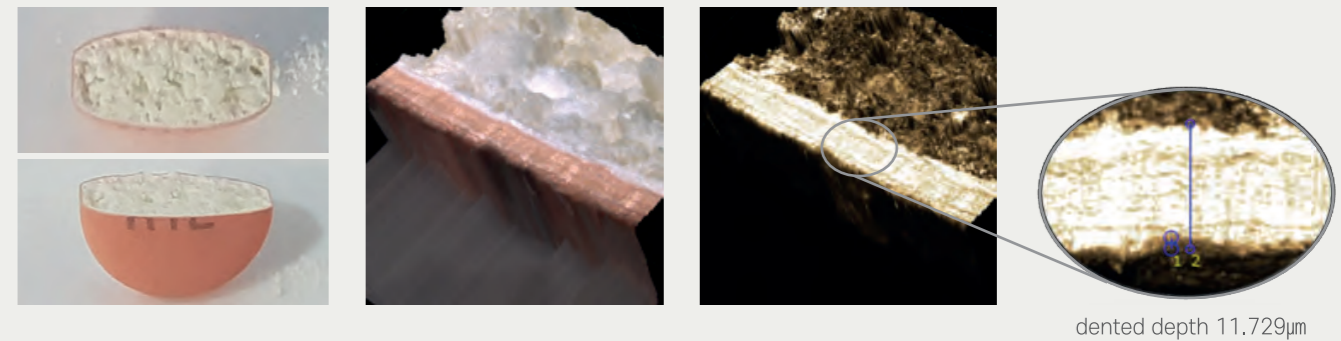
## Principles of UV Printing

The principles of UV laser printing, saying cold laser, are that applying the phenomenon of discoloration to be gray when Oxygen breaks away from TiO<sub>2</sub> (Titanium dioxide) by UV laser shooting.



## Coating Safety from UV Laser

UV laser shooting (cold laser) has very gentle and minor effects on the printed areas. And, UV laser power is adjustable to match the optimal condition, print quality, and its effects.



## Fine and Innovative Design

Fine printing technology is capable to do your ideal design as it is able to print the line with min. 100µm. And, the maximum surface of the tablet can be used for design like close to the edge and the corner of the tablet.



## ID Artwork on HMI

Capable ID design work on HMI and immediate trials of printings are available.

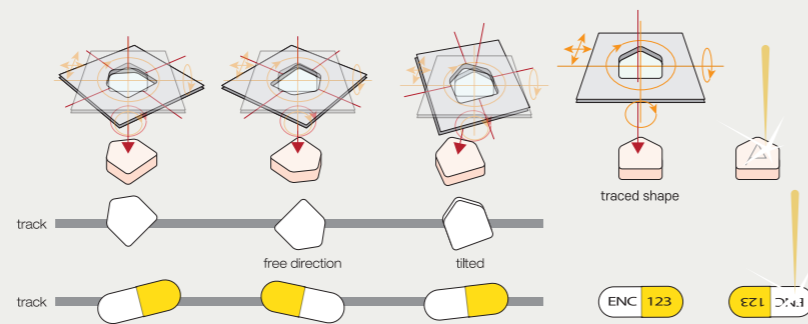


## Shape Tracing and Key Technologies

The precise shape tracing, complex technique of UV laser control, and precise motor movement control make accurate printing location in allowance  $\pm 100\mu\text{m}$  of XY axis and  $\pm 1^\circ$  in rotation direction. As able to read the convex surface of the tablet well, perform the fine printing even on the deep convex tablet without distortion.



- 1) Shape tracing
- 2) Laser Printing as per its shape



## Integrated Control

One HMI controls all functions of laser printing, inspection, and machine operation.

## Real Time Quality Control of Print

Real time quality control of every single tablet/capsule is possible. 1) Print posture check on the tablet/capsule, 2) Concentration check of print, 3) Inspection of tablet, etc.

## High Speed Printing Technology

The high speed printing technology, printing up to 6,500,000 characters/hr. for 1mm size characters (like A,B,C,1,2,3).

- Machine Control
- Inspection Control
- Print Quality Control
- Position Check
- Art Work
- Concentration Check

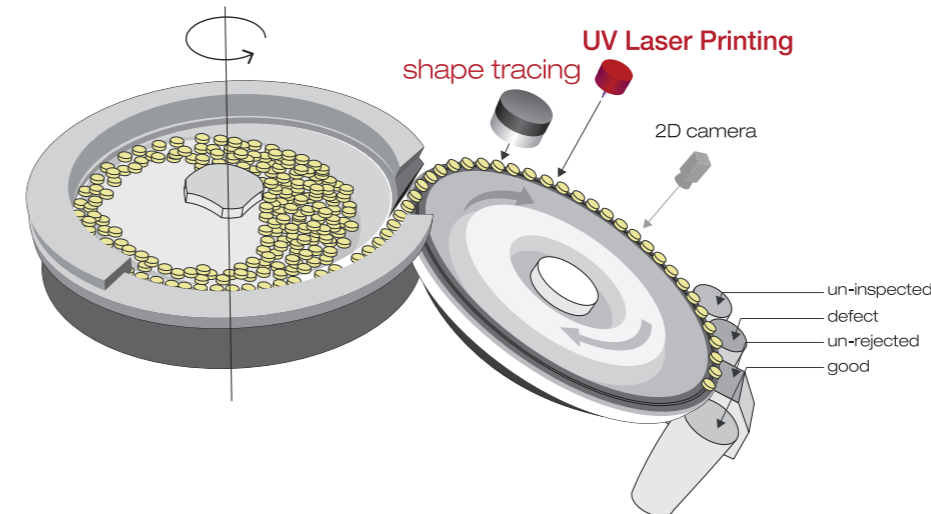
The interface shows parameters like Power (1.01 W), Laser setting, Print speed (0T/H), and Print quantity (0H 2M 32S). It also includes a 'Rank of occurrence of deviation in print position' table and a 'Print brightness' graph.

# PLANET LP

## UV LASER PRINTING ON THE TABLET/CAPSULE

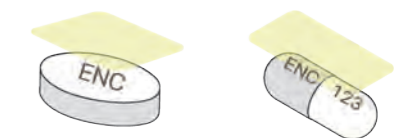
UV laser printing after shape tracing and inspection on printed surface by 2D camera.

Process



Inspection

Inspecting print area only

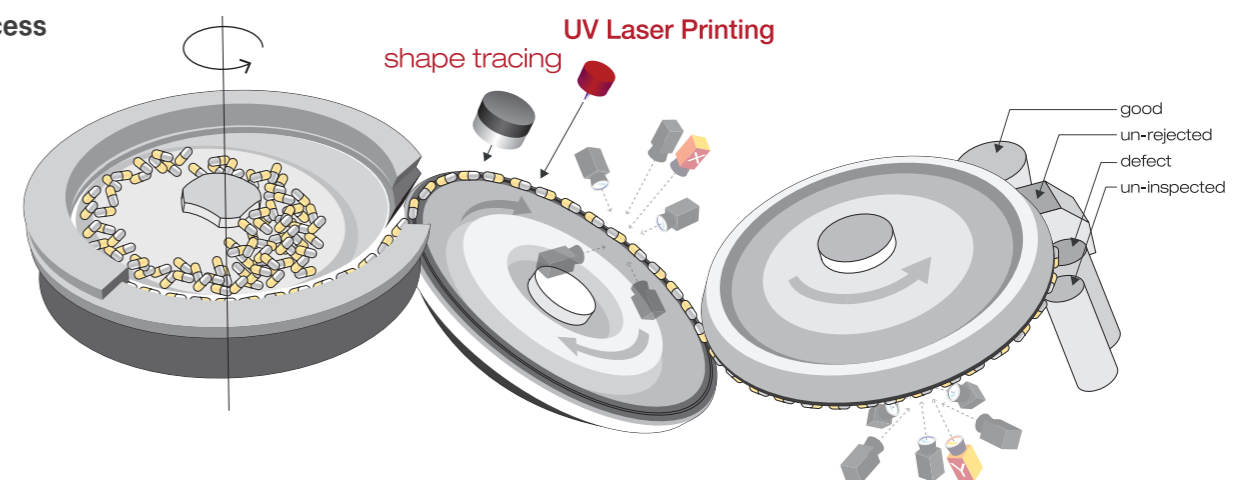


# PLANET LPI

## 2-IN-1 SYSTEM, UV LASER PRINTING WITH FULL VISION INSPECTION

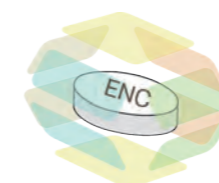
UV laser printing with shape tracing and full inspection for every single tablet/capsule.

Process



Inspection

Same inspection quality as PLANET 6G series like below images.



Full inspection of tablet



Full inspection of capsule



# PLANET CI

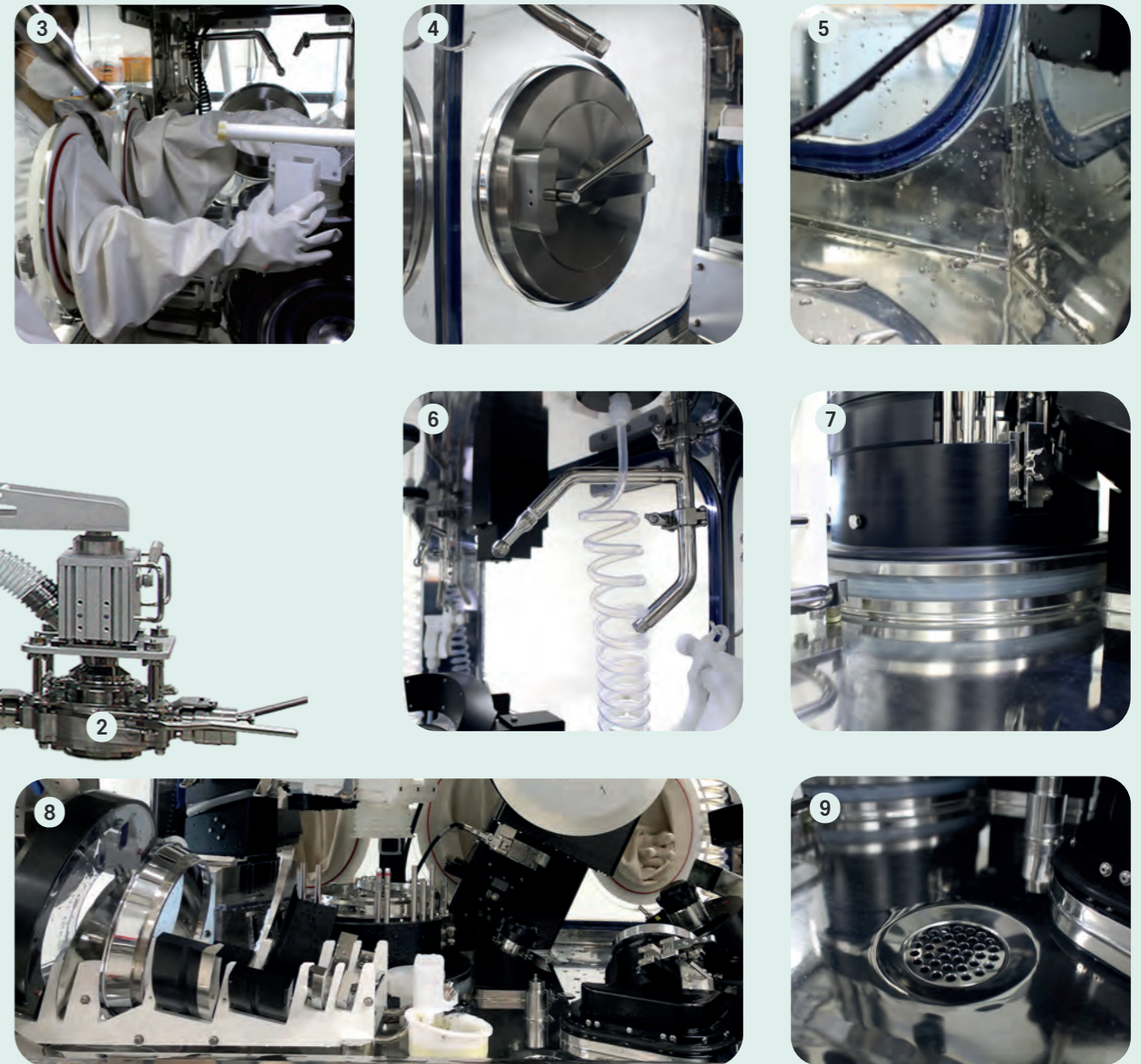
## Containment Model, WIP

PLANET CI is the containment model to protect the operator from highly toxic API production. Sealing construction is completed to apply WIP(wash-in-place), which is designed for OEB level 5. Commercial items, such as RTP(rapid transportation port), glove, valve, BIBO filtering system, etc. are adaptable as customer's specification.



## WIP System

For WIP application, the operation chamber is fully water proof sealed and washable. Applied of stainless steel welding construction, silicon water tight sealing for all moving parts, inflating tube seal for doors with the threshold, drain hole with the down sloped floor, water gun, air gun, ball spray, etc., which can be customized as a customer's specifications.

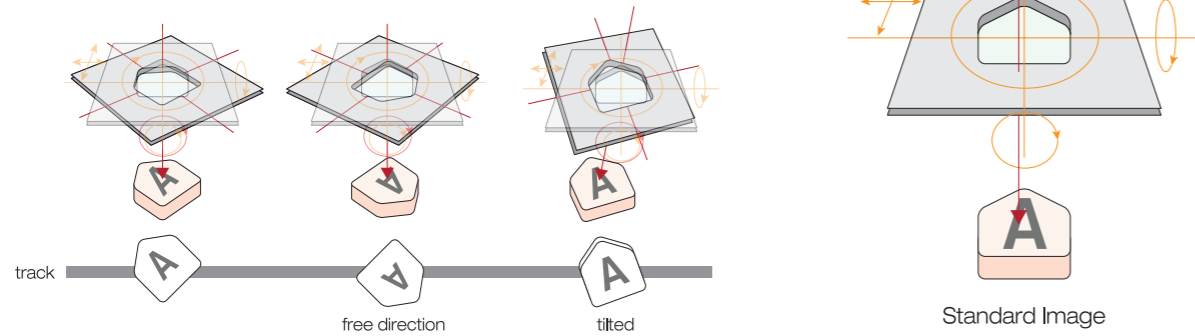


1. HMI, 2. split valve, 3. glove port, 4. RTP, 5. welded wall, threshold and inflating tube seal for doors, 6. ball sprays, water gun and air gun, 7. silicone seal for moving parts, 8. stand for detached parts, 9. drain and down sloped floor

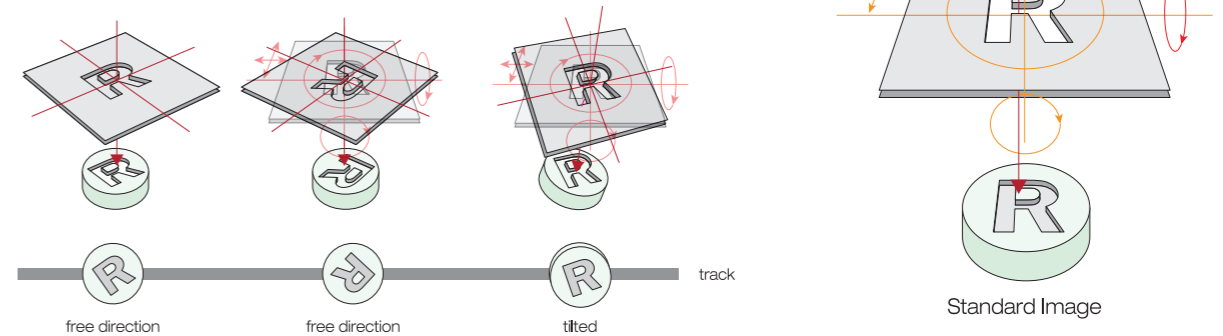
# ANALYZING ALGORITHM

## Applied for All PLANET Models

### Shape Tracing



### Letter Tracing



## Shape & Letter Tracing

Shape tracing is the first key process to the analysis algorithm of the inspection and the printing in PLANET series. It is essential issue of the vision inspection (reforming the original image to compare with the standard image) and the printing (adapting artwork on the traced shape). Shape tracing algorithm is capable by five-axis tracing technology.

Letter tracing for printed or engraved ID is the next important technological step for precise inspection of letters on the tablet or capsule.

## Geographical Analyzation

A sectionized image after shape and letter tracing is compared with the standard image pixel by pixel. This process clearly finds out the missing and unnecessary area as below case studies even though the pixel quantity of them are almost same.

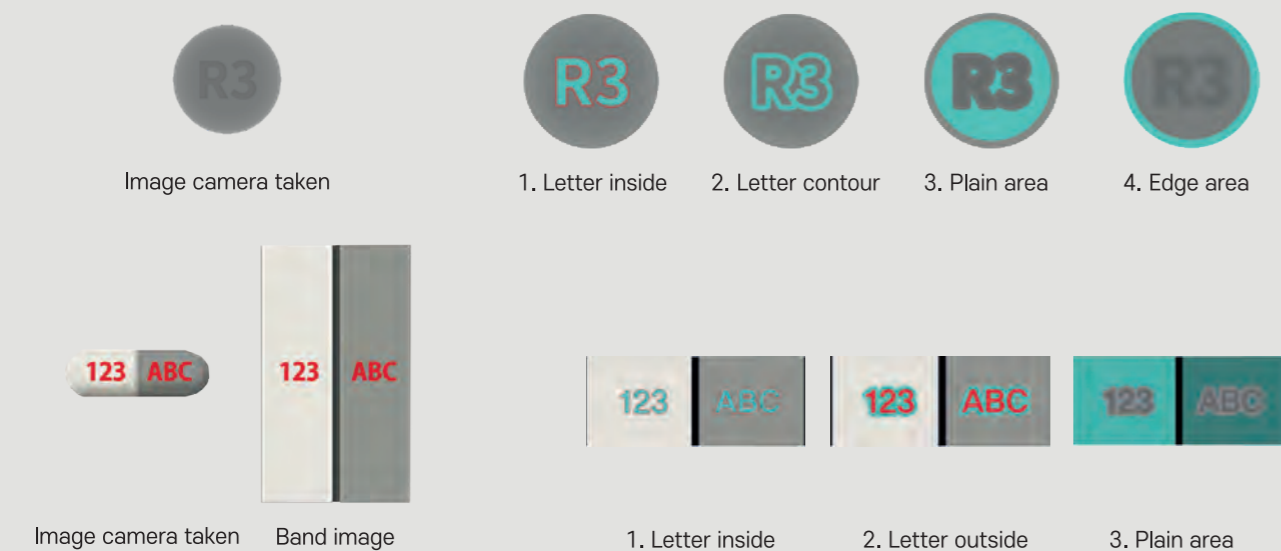
**Case of press punch mixed :** In the tablet production of engraving 'B', press punch of 'D' was mixed in by mistake, which was the real case.

**Case of wrong number mixed :** In the production of printing "50", "30" is mixed in. PLANET clearly distinguishes between missing area and unnecessary area from "30".

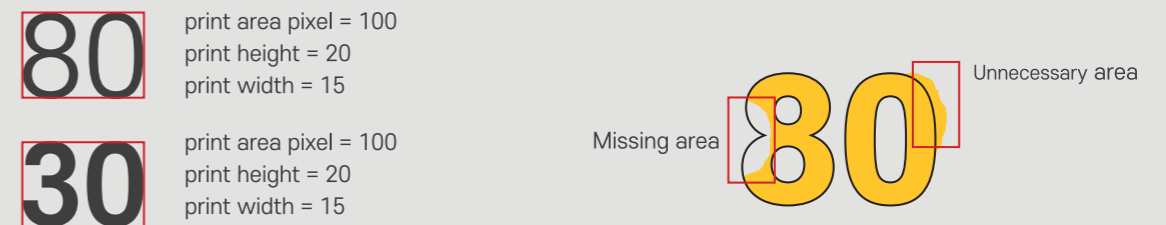


## Geographical Analyzation through Sectionization

All of top/bottom images of tablet/capsule are sectionized for detailed and precise inspection after shape and letter tracing.



A geographical analyzation clearly identifies missing and unnecessary areas by clearly distinguishing wrong letter made by ink (bold, blurred, erased, missing, splatter, etc.) and by wrong engraving (sticking, chipping, etc.)



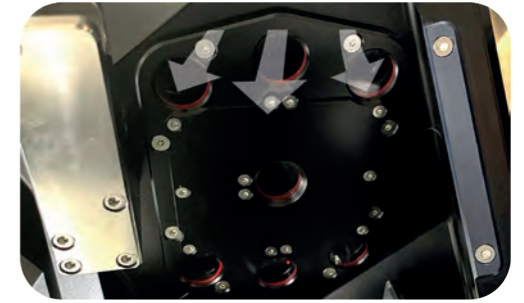
With the pixel counting, it is difficult to distinguish between of "80" and "30" as the number of pixels are same. However, PLANET is able to clearly distinguish between of them by precisely detecting the unnecessary area with the geographical algorithm.

# MACHINE FEATURE



## Dust Protection

All of cameras and sensors are located behind the glass cover and the protective air curtain is installed as well. Moreover, the program operates until a certain level of existing dust and, once it exceeds, the machine stops with the alarm.



## Discharge

Sorting after precise inspection:

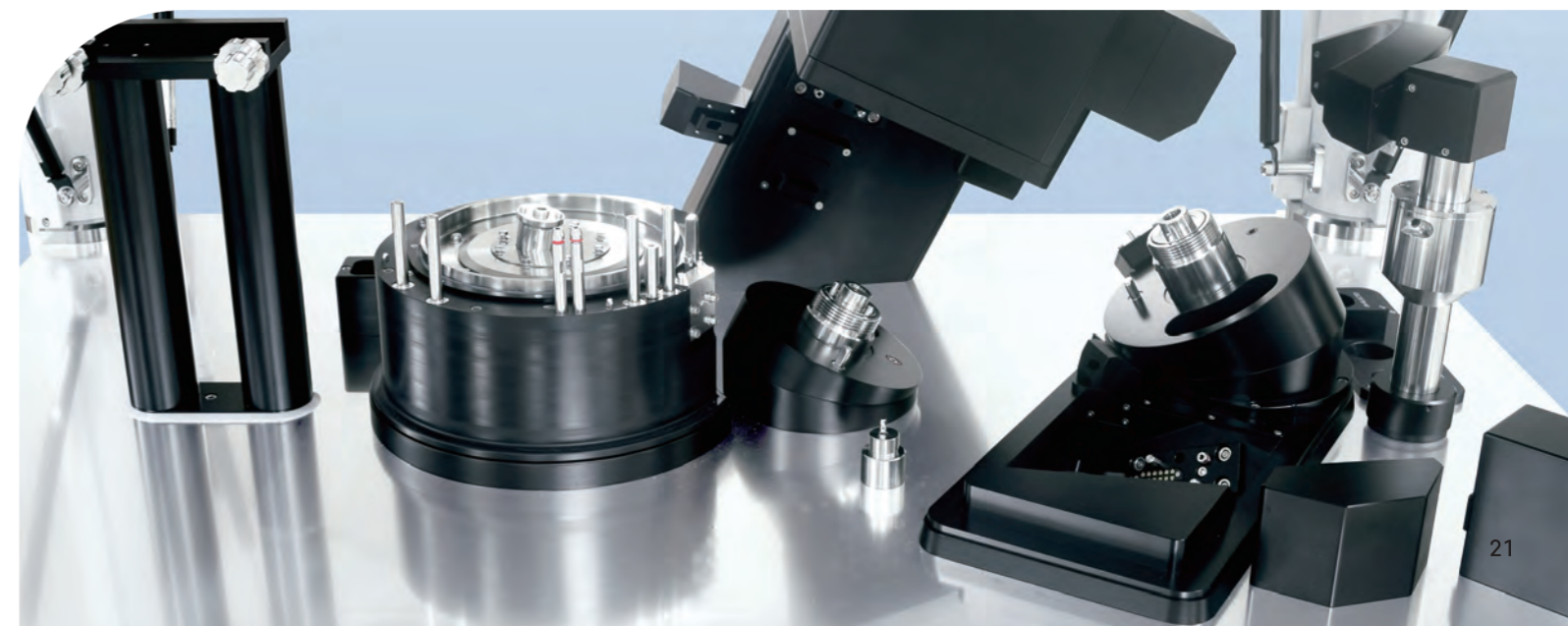
- ① un-inspected
- ② defect
- ③ fail-safe check sensor
- ④ fail-safe rejection
- ⑤ fail-safe double check to machine stop
- ⑥ good chute

A fail-safe rejection(④), box type, works as the wall to prevent rejected defect or un-inspected tablet/capsule to be jumped into good chute.



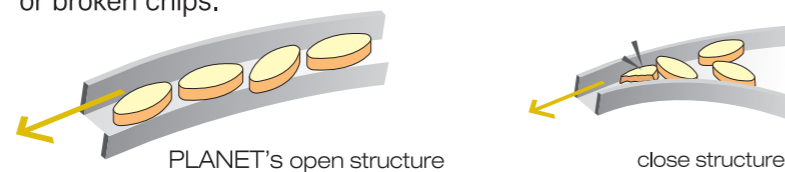
## Neat Operation Section for Easy Cleaning

PLANET is designed for simple job change-over by tool less dismantling (5min.) and reassembling (5min.). It is designed with no electric cords, sensor wires, and air hoses for easy cleaning. The following image shows the operation section after full disassembly.

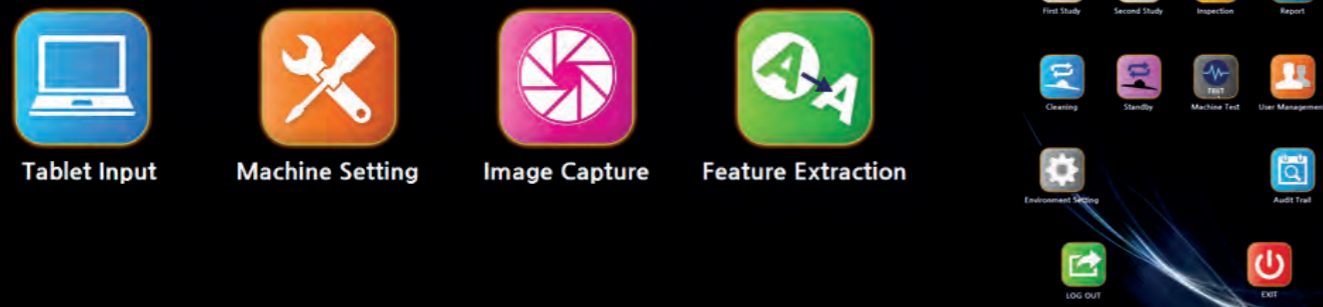


## Jam Free Feeding

A centrifugal feeding system with the open wall structure never makes tablet/capsule feeding to be jammed by sharp shaped tablet or broken chips.



# SMART HMI



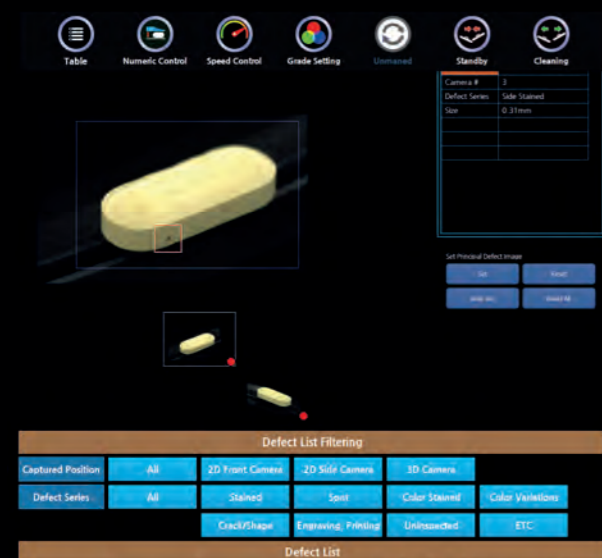
HMI designed with smart icon is easy approachable to all controls and adjustments in the machine operation such as inspection processing, electrical and mechanical control, operation, recipe setting, function test, various controls(brightness setting of light, illumination, shutter speed, etc.), production reports, audit trail record, user access management, log-in, log-out, etc. Any language available on Window is applicable.



Simple input of product information

Numerical machine setting and storing in the recipe

ID extraction by multi-touching



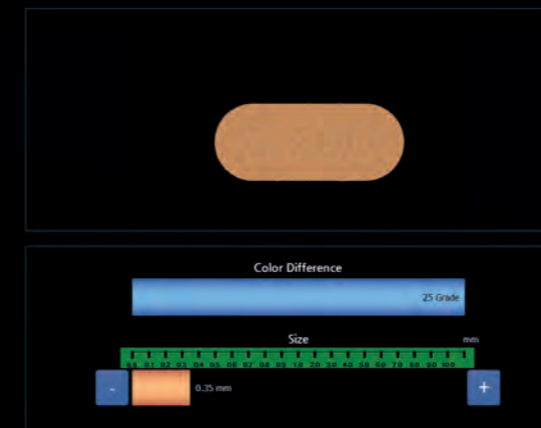
## Saving Defect Images and Running Simulation

Every single defect image and its related data(defect type, size, camera number of defect image, etc.) are saved in the memory and resulted in statistics. Based on this, able to set up desirable defects by running simulation in the program to find optimized defect criteria through adjusting its size, etc.

## Real-Time Operation Status

Ongoing inspection information is shown on HMI in real-time.

- 1) General information of product (product name, dimension, lot number, production speed, yield rate, elapsed time)
- 2) Production information (total number, good, defect, uninspected)
- 3) Production status (rates of good, defective and uninspected)
- 4) Defect information (type, size)
- 5) Defect image with square mark
- 6) Statistics as per types of defects
- 7) Former defects



## Easy Parameter Setting

The inspection parameters, the defect types and areas, are able to set easily by classified sectors and value settings. In addition, the simulation function is capable to check how the change in value setting affects the current detectability based on the saved defect data.

# FLEXIBILITY

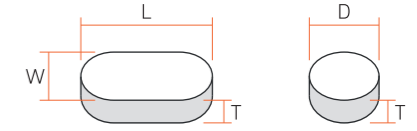
## New Product Recipe Setting in 30 Minutes

Your operator can set up the recipe of new product. Smart HMI guides your operator in 6 steps to get the initial parameters of the new product within 30 minutes, which can do setting as your own adjustment per your quality standard.



## Applicable Flexibility of Tablet/Capsule

- Round tablet : Diameter(D) 3.5mm – 14mm
- Oval/Oblong tablet : Width(W) 3.5mm – 14mm  
Length(L) 10mm – 22mm
- Thickness(T) : 2mm - 8mm \*Diameter (or Width) minus Thickness  $\geq 0.7$ mm
- Polygon tablet : triangle, square, diamond, pentagon, hexagon, octagon shapes, etc.
- Free shaped tablet : heart, kidney, bean, water drop, half round, almond, flower shapes, etc.
- Hard gelatin capsule : capsule No. 00, 0, 1, 2, 3, 4, 5



\* Inspection applicability of respective products is subject to actual product testing and confirmation by Enclony.



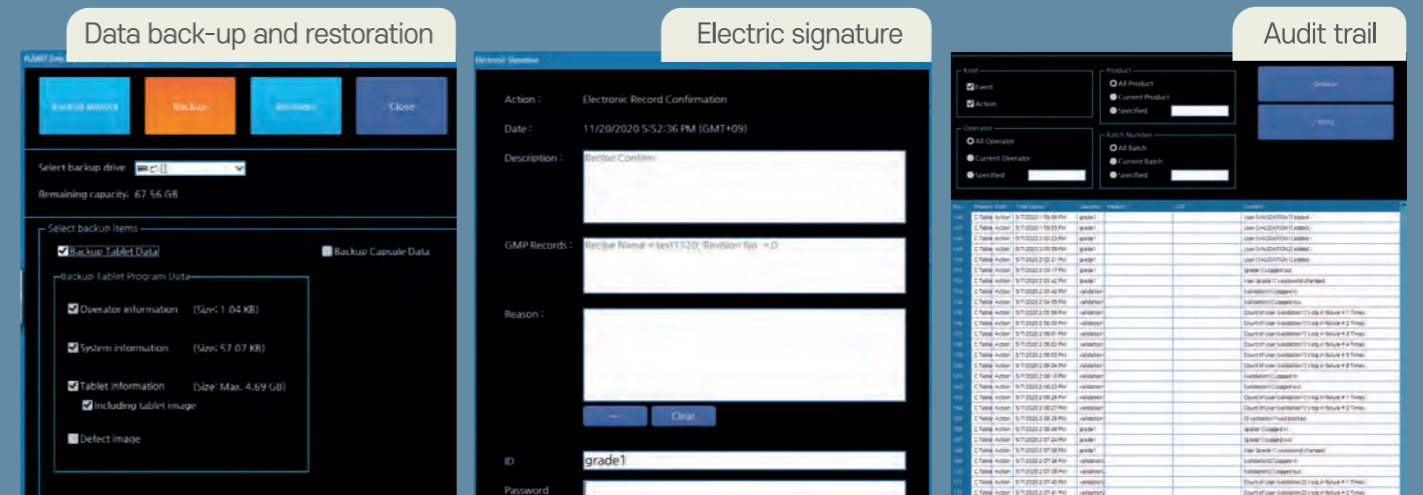
## Size Parts



The size parts, which are not product specific, are only composed of 3 pieces and are adjustable depending on the width/diameter of tablet/capsule. It is applicable to round, oblong, oval, polygon shaped tablets and various free shapes of tablets. Usually provide standard 6-8 sets of size parts and these are manageable almost all tablets and hard capsules.



# REGULATORY COMPLIANCE



FDA 21 CFR Part11, CE, EU GMP, GAMP, UL and other different global organizations' regulations are experienced and complied. A security support is provided with the installed functions such as data back-up and restoration, an electric record and signature, an audit trail, an access allowance in 3 classified levels, a control of password expiration, an automatic logout, etc.

# SPECIFICATION

Model Series	PLANET 6GP	PLANET 6GS	PLANET 6G2X	PLANET CI	PLANET LPI	PLANET LP
<b>Product Applicability</b>						
tablet applicable	uncoated tablet, film coated tablet, sugar coated tablet					
round tablet	dia. 3.5mm - 14mm					
oblong/oval tablet	width. 3.5mm - 14mm and length 10mm - 22mm					
capsule applicable	hard gelatin capsule size no.00, 0, 1, 2, 3, 4, 5					
<b>Inspectability</b>						
inspection area	top, bottom, 360° sides and all around edge corner without any blind spot					only print surface
2D cameras	over 40µm size of dark spot, stain, broken, coating peel, print break, print erased, print position, print brightness, etc.					
3D cameras	30µm depth of sticking, chipping, bump, etc.					n/a
twin tablets	completely reject-able					
broken chips	completely reject-able					
<b>Machine Specification</b>						
machine dimension, approx. (W:width, D:depth, H:height)	W/1,572mm D/1,064mm H/1,845mm	W/1,550mm D/1,030mm H/1,906mm	W/1,900mm D/1,340mm H/2,032mm	W/1,624mm D/1,074mm H/2,234mm	W/1,881mm D/1,131mm H/2,087mm	W/1,564mm D/1,118mm H/1,912mm
electric power	360V, 3phase, 50Hz(or 60 Hz), or custom power specification applicable					
electric consumption	7kW	7kW	13kW	19kW	12kW	8.3kW
compressed air	more than 0.5Mpa.					
machine weight (approx.)	934kg	1,350kg	2,200kg	1,400kg	2,000kg	1,055kg
installation environment	temperature: 20°C ~ 30°C, humidity: 30% ~ 60%					
<b>ID Printing Technology</b>						
printing method						UV laser source and galvanometer
accuracy of print position						XY axis direction : +- 100µm rotation direction : 1°
print speed approx.						6,500,000 characters/hr. for 1mm sized characters(ex.: A, B, C, 1, 2, 3, etc.)
<b>Effective Output</b>						
Model Series	PLANET 6GP	PLANET 6GS	PLANET 6G2X	PLANET CI	PLANET LPI	PLANET LP
round tablet	≤dia. 5mm	350,000	350,000	700,000	315,000	350,000
	dia. 7mm	240,000	240,000	480,000	215,000	240,000
	dia. 9mm	200,000	200,000	400,000	180,000	200,000
	dia. 10mm	180,000	180,000	360,000	160,000	180,000
	dia. 12mm	150,000	150,000	300,000	135,000	150,000
	dia. 14mm	120,000	120,000	240,000	110,000	120,000
oblong / oval tablet	length 10mm	200,000	200,000	400,000	180,000	200,000
	length 12mm	180,000	180,000	360,000	160,000	180,000
	length 14mm	160,000	160,000	320,000	145,000	160,000
	length 16mm	140,000	140,000	280,000	125,000	140,000
	length 18mm	120,000	120,000	240,000	110,000	120,000
	length 20mm	100,000	100,000	200,000	90,000	100,000
hard gelatin capsule	length 22mm	90,000	90,000	180,000	80,000	90,000
	no.5	150,000	150,000	300,000	135,000	150,000
	no.4	140,000	140,000	280,000	125,000	140,000
	no.3	130,000	130,000	260,000	120,000	130,000
	no.2	120,000	120,000	240,000	110,000	120,000
	no.1	110,000	110,000	220,000	100,000	110,000
note	no.0	100,000	100,000	200,000	90,000	100,000
	no.00	90,000	90,000	180,000	80,000	90,000
		The applicability and output of respective product's inspection can be affected by the specific characteristics such as dimension (diameter (or width) minus thickness ≥ 0.7mm, etc.), shape (extra deep convex, extraordinary, etc.), color (too dark, freckled, etc.), coating condition (sticky coating, etc.), surface roughness, and so on. A trial with real product is required to estimate the actual output and the result has to be confirmed by Enclony.			Above numbers listed in effective output represent the maximum feeding speed of the products. With the laser printing, the output speed will be varied upon printing speed.	

# DEFECT ANALYZATION

## Tablet

letter broken	chipping on engraving	chipping on split line	spot on engraving	spot on edge corner	spot	spot on multi-layer
chipping on edge corner	foreign color on freckles	color deviation	bump	hair	stained	sticking

## Capsule

letter broken	spot in letters	colored spot on the letter	letter missing	spot on hemisphere	joint area defect	bubble

long body	double cap	scratch	pin hole	dent	dent	empty



**ENCLONY**

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