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1 Instrument usage

PH-4025 Φ 400mm horizontal digital measuring projector is a precise and excellent effective measuring instrument integrating optic, mechanic and electricity. Used broadly in the trade of mechanic, meter, electronics and light industry, as well as the laboratories, metric room and workshop of the academes, research institutions, measurement-inspecting department etc. This instrument can sufficiently inspect various kinds of surface and outline of complicated work-piece. Such as template, cam, tread and gear, perform milling cutter including machine tools and parts.

2 Instrument Specification:

2.1 Projective screen

2.1.1 Screen size (mm): Φ 412, used range $> \Phi$ 400 (carved with two crosshairs)

2.1.2 Screen rotary range: $0 \sim 360^\circ$

2.1.3 Resolution: $1'$ or 0.01°

2.2 Lens (Size unit: mm)

Magnification	5X(optional)	10X(standard)	20X(optional)	50X(optional)	100X(optional)
Object view	Φ 80	Φ 40	Φ 20	Φ 8	Φ 4
Working distance	93.66	103.91	95.07	65.74	34.96

2.2 Worktable (Size unit: mm)

2.3.1 X axis travel: 250 Resolution: 0.001

2.3.2 Z axis travel: 150 Resolution: 0.001

2.3.3 Worktable size: 450×200

2.3.4 Y axis travel (Focus) : 100

2.3.5 Worktable sway: $\pm 15^\circ$

2.4 Illumination

2.4.1 The illumination of transmission are 24V、150W halogen lamp

2.4.2 The illumination of reflection are 12V、150W halogen lamp

2.4.3 Refrigeration: Strong wind (transmission by 1 axial fans and reflection by 1 as well)

2.5 Power

110V/220V(AC), 50/60HZ, total power: 400W

2.6 Dimensions: (mm)

(L \times W \times H): $1200 \times 880 \times 1200$

2.7 Weight

Net weight: 240Kg,

Gross weight: 300Kg

3 Instrument working principle

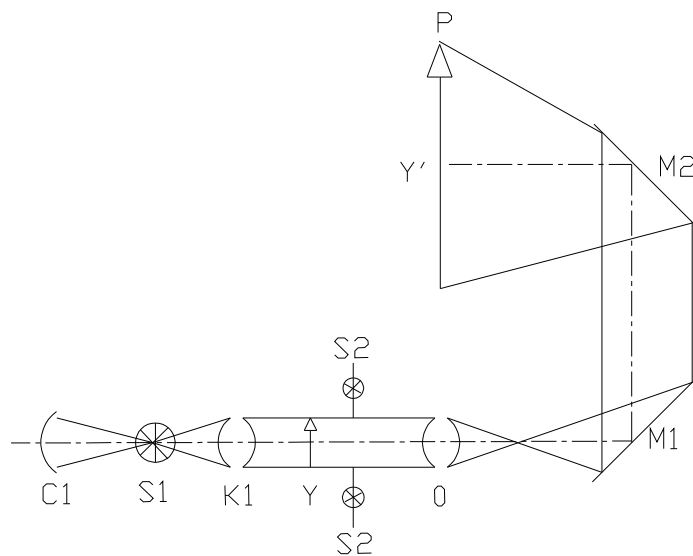


Fig.1 working principle

The working principle of the profile projector showed as Fig. 1. Work-piece for measuring **Y** is put on the worktable. Under the illumination of transmission or reflection, it is magnified by lens **O** and imaging **Y'** (up side down with **Y**) while reflects through **M₁** and **M₂** onto the granulate plane of the projective screen **P**. When the reflective mirror **M₁** is turned to the redirecting system, **Y'** will be up-side-up with **Y**. This would be more convenient for users to measure because the **Y'** is exactly the same position as the work-piece.

Y' can be measured by the standard glass ruler on the screen. And also can be measured comparably with a magnified standard pre-set picture. The measured data divided by the magnification is the size of the work-piece. Further more, you can use the table to measure **Y** by the digital measuring system. Or you can use the angle measuring system to measure the angle of the work-piece.

S1 is the transmission source , 2-S2 are two photoconductive fibers serving for reflective source (21V、150W illuminating source transmitted by the two photoconductive fibers for illumination) . And **K1** is transmission condenser , **C1** is the reflective condenser. They can be used both separately or simultaneity depends on the nature of the work piece.

4 Construction and function

4.1 The main construction of the instrument (Fig. 2)

It is mainly composed of the transmission illumination, main body, work table, projection box .

4.1.1 Main transmission illumination: Including the illumination source, various condenser, color filter, refrigerate fan.

4.1.2 Main body: Including reciprocally perpendicular linear scales, lift driving system, reflective illumination source, transformer, control circuit board, perpendicular track unit.

4.1.3 Work table: Including the upper, intermediate and lower worktable, X-direction friction-driving unit, X-direction linear scale, Y-direction friction-driving unit $\pm 15^\circ$ sway of the worktable.

4.1.4 Projection box: Including projection screen set, reflector, DC3000 multi-functional data processing box, lens, operating panel, reflector, power and other transition boards.

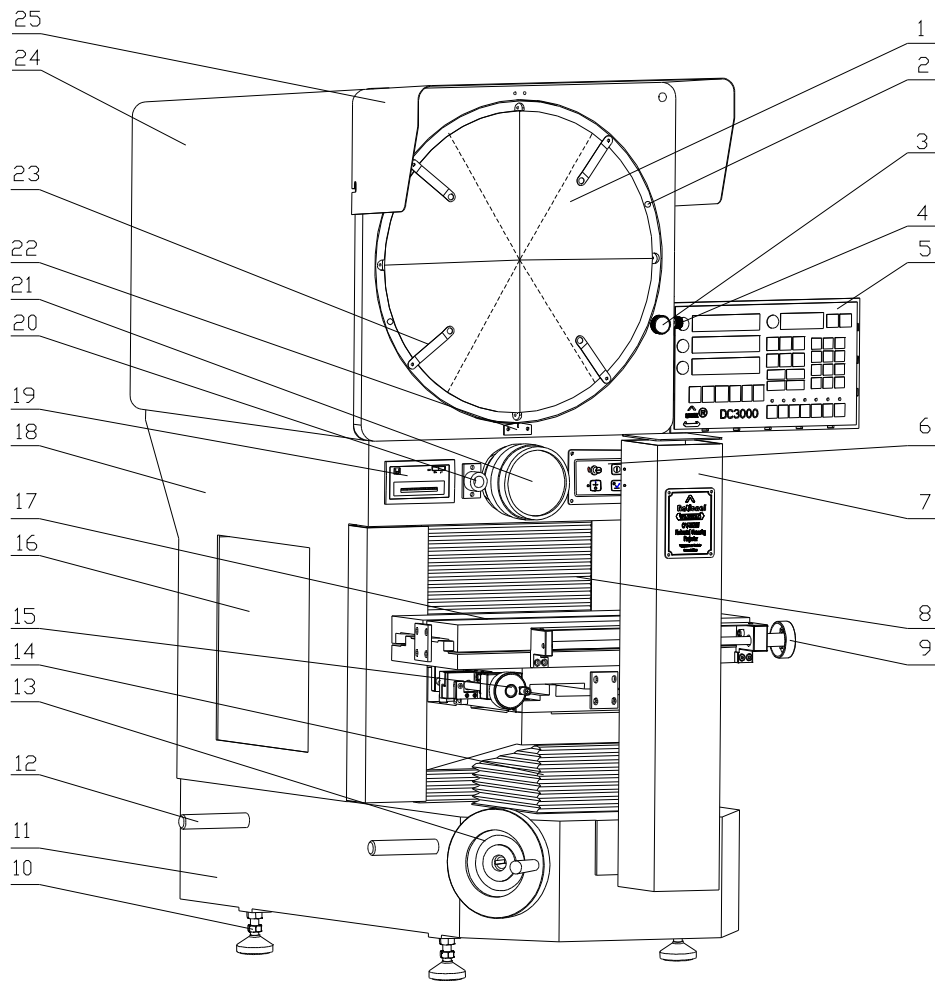
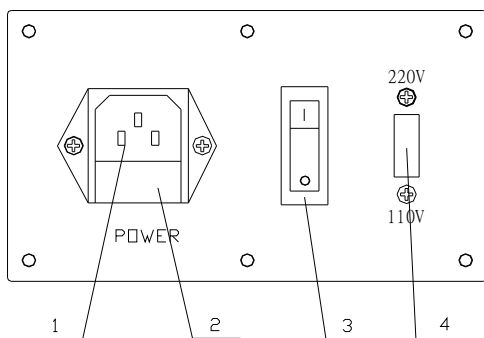


Fig. 2 The construction

1. Projection screen
2. Screen twirling handle
3. Micro-hand wheel
4. The screen-locking handle wheel
5. DC-3000 Multi-functional data processing system
6. Operating panel
7. Transmission illumination pusher
8. Dustproof cover(one)
9. X axis hand wheel
10. Horizontal adjusting bolt
11. Base
12. Convey hand wheel
13. Lift hand wheel
14. Dustproof cover(two)
15. Y axis hand wheel
16. Side board
17. Work table
18. Mid body
19. Mini-printer
20. Fiber of reflective condenser
21. Lens
22. Zero calibration board
23. Spring fixture
24. Projection box
25. Light cloak

4.2 The function of electronic control boards

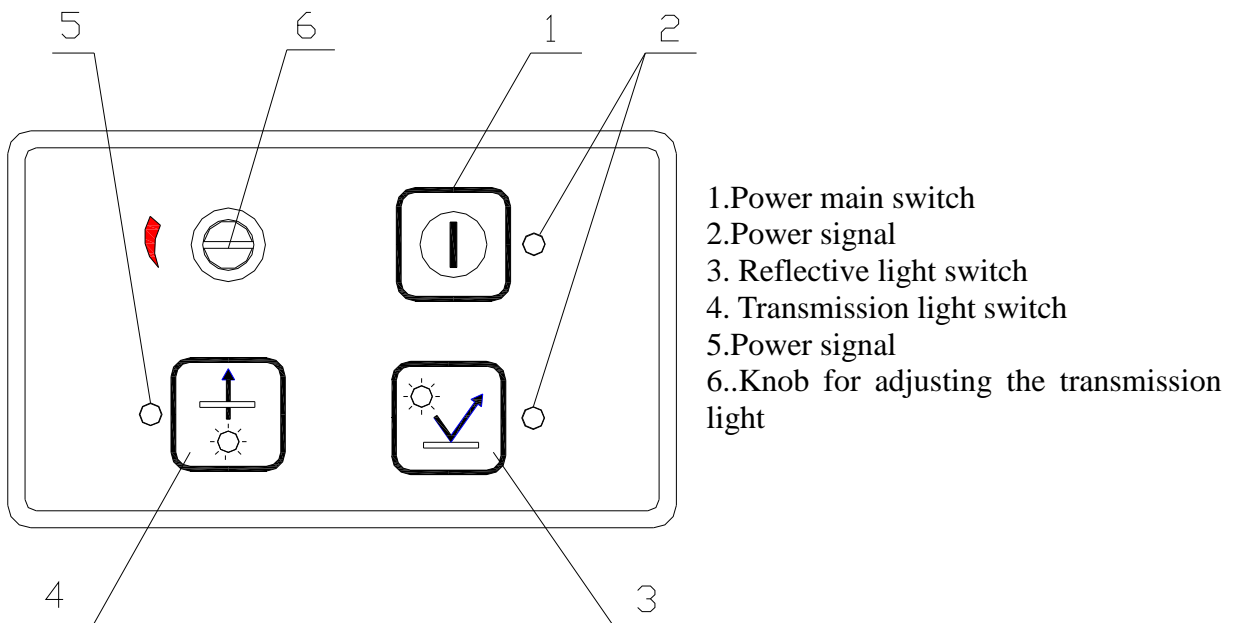
4.2.1 Power board.. (See Fig 3).



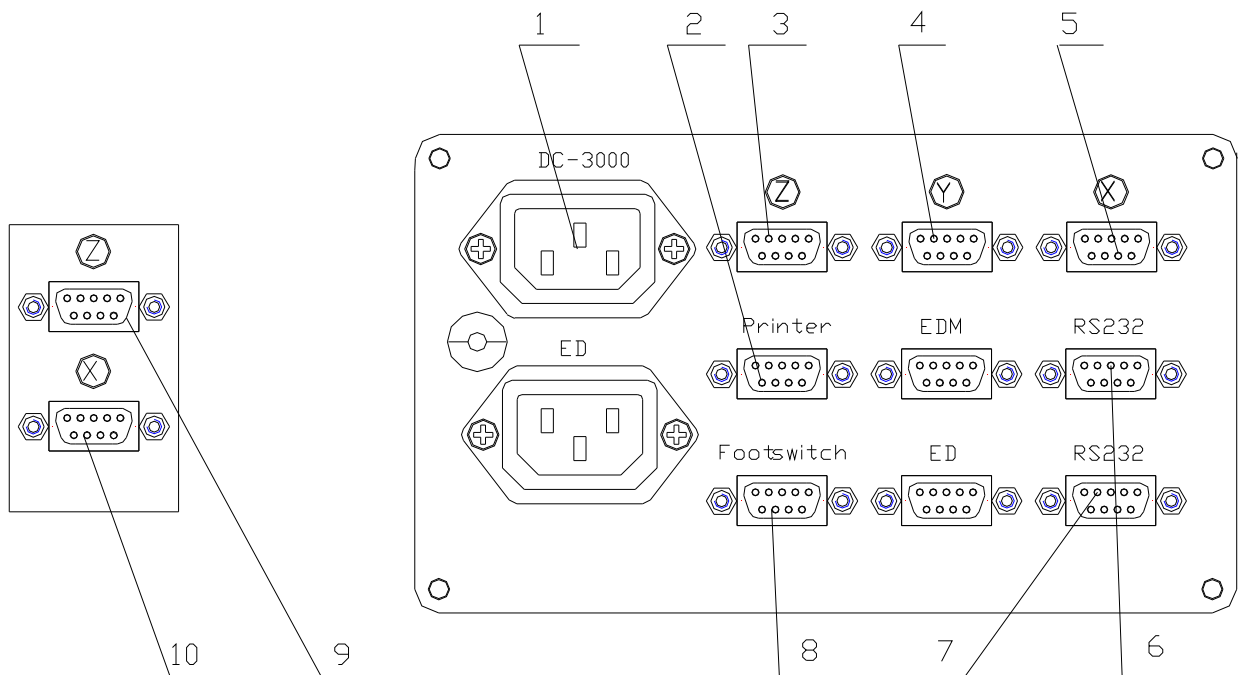
1. Main power plug
2. Fuse of power
3. Power switch
4. Voltage switch of 220V/110V

Fig.3 Power supply

4.2.2 Operating panel (6). (See Fig 4).



4.2.3 The transition board of the signaling wire as Fig. 5



- 1. DC-3000 power 2. Printer connector 3. Z Linear scale connector
- 4. Angle encoder connector 5. X Linear scale connector 6. Computer RS232 connector
- 7. RS232 connector 8. Footswitch connector
- 9. Z Linear scale connector 10. X Linear scale connector

Fig. 5 Signal exchange board

5 Uncover and fixing

- 5.1 Unclose all of the packages, take out the instruction of the instrument and read this chapter before operating.
- 5.2 Unscrew the four fixing bolts of the baseboard. Move the instrument to the pre-set work stage. The stage must be very sturdy for the instrument is as weight as 240kg or so.
- 5.3 Put on screw and adjust the four screws. Make sure that the instrument must be horizontal. All these can be tested level which is put on the work table.
- 5.4 The orientation of the instrument has to avoid windows or strong light source for fear decreasing the contrast of the screen.
- 5.5 Take out the connector board on the work table which is for fixing between the X axis and Y axis. So that the work table can be moved by both the hand wheel and the handgrip.
- 5.6 The power supply can be adjusted as 220V/110V depends on the local voltage. Adjust the voltage and chose the switch before connect the power supply. Otherwise the electricity system will be destroyed or the instrument can't work normally. As you obeying all the above mentioned. The instrument can be used subsequently.

6 Instrument operation

Instruction must be read before you operate the instrument. Especially the chapter of “The construction and function of the instrument”, for that can help you to further understand the instrument.

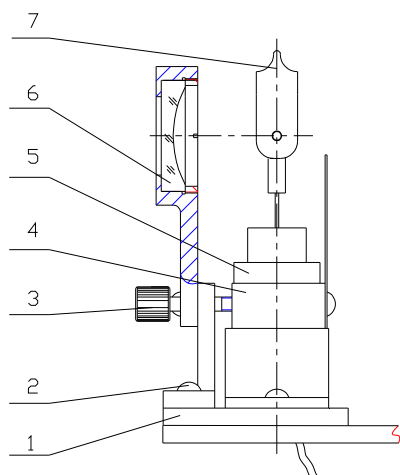
6.1 Replace and adjust the transmission condenser bulb

This can only work when replacing or adjusting the bulbs and checking the instrument regularly. The bulbs need to re-adjust because the original adjustment of the bulbs sometimes will change when delivering or moving. This is called re-adjust.

Caution: This can only be done after make sure that the illuminator is cold down. Otherwise it would be dangerous of hurting for the illuminator is of high temperature!

6.1.1 Re-adjusting (See Fig 6).

6.1.1.1 Take out the lens, turn on the transmission light. If the glower's image is illegibility or dose not concentrate on the screen center. Please do as:



- | | |
|---------------------|--------------------------------|
| 1.Light set | 2.Light set fixing bolt |
| 3.Light fixing bolt | 4.Light set adjusting pedestal |
| 5.Pottery light set | 6.Reflective mirror |
| 7.Bulb | |

Fig.6 Illumination group

6.1.1.2 Open the **Side board** of the instrument, Unscrew the bolts and move the relevant parts. Fasten the bolts when the image of the filament is clear (it needn't be too clear) and on

the center of the screen. Then install the lens and the instrument can be used again.

6.1.2 Method of replacing the bulb (See Fig.6)

6.1.2.1 Open the **Side board** of the instrument.

6.1.2.2 Take off the broken bulb after it is refrigerated..

6.1.2.3 Put on the new bulb (Please use the soft cloth to touch the bulb).

6.2 The adjustment of the reflective illumination .

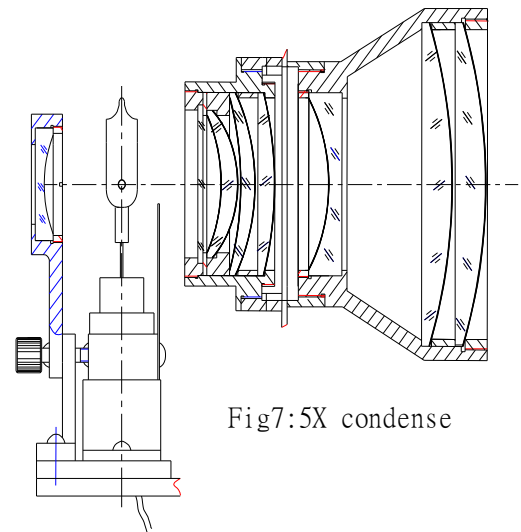
The two sides of the lens are respectively installed with two photoconductive fibers through which the 21V、150W-halogen tungsten lamp gives off light to illuminate the work piece. You have to only stretch out or draw back or bend the two photoconductive fibers (the work piece must be filled with the light spots).you needn't adjust the position of the bulb when replacing it.

6.3 Replacement of the lens and condenser

6.3.1 There is only one lens connector of the instrument. Different lens should be replaced separately.

6.3.2 The choose of lens' magnification must be based on the precision request and the size of the work piece. Usually speaking, the outline measurement will be more precise with the higher magnification of the lens. So dose the aim precision of the coordinate measurement.

6.3.3 the instrument is outfitted with condensers which serve the 10X and 20X lenses, meanwhile attached with 5X additional illumination mirror and 50X、100X additional condensers. If the user wants to use 5X lens, he has to only cover the 5X additional illumination mirror on the 10X、20X condensers. The same holds true for 50X、100X lens, the user only needs to cover the 50X、100X additional condensers on the 10X、20X condensers, but they cannot be used simultaneously.



The outfit of the condensers: 5X (Fig.7) 10X、20X (Fig.8) 50X、100X (Fig.9).

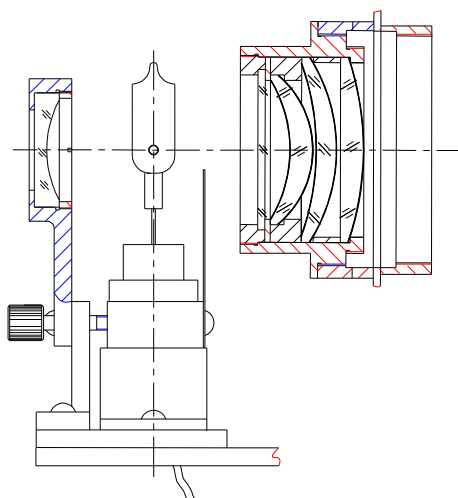


Fig.8 10X,20Xcondense

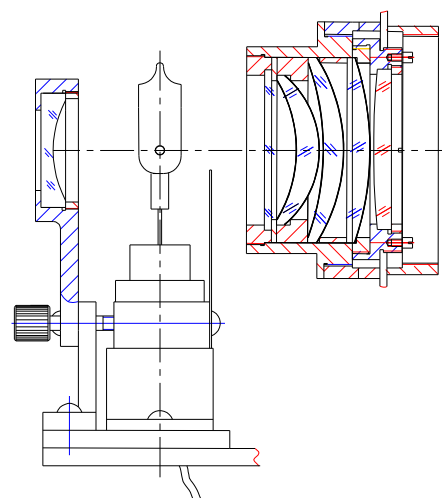


Fig.9 50X,100Xcondense

6.4 Work table operation

6.4.1 After turn on the main power. On the multi-functional data processing system DC-3000 , appears the value of coordinate of X axis and Z axis. The value changes when moving of the worktable.

6.4.2 The X axis can perform fast and slow driving for the coordinate measurement, the Y-orientation frictional driving is only used to adjust the focus, the Z-orientation coordinate driving is the lift and fall of the worktable, which is achieved by handle wheel, the Z-orientation driving is used for coordinate measurement.

6.4.3 When measuring with X、 Z coordinate, after the focus is perfectly adjusted, move worktable to and fro several times and let it into the measuring status from stationary status.

6.4.4 Please move the handle wheel when using the X and Z coordinates to measure. And please be sure to move it smoothly and softly.

6.4.5 The X,Y axes permits a sway of $\pm 15^\circ$. attached with a center stand, it can measure the finished screw tools.

6.5 Projector screen operation

6.5.1 After turn on the main power. The circling angle value of the screen will appear on the DC-3000 as well. You can pre-set the transition to angle value through the DC-3000 previously. For instance: $3^\circ 24' \Leftrightarrow 3.4^\circ$.

6.5.2 When the screen-locking handle wheel (See 4 of the Fig. 2). The screen can be move circle-wise quickly by the small handle (See 2 of Fig. 2). Or be moved slowly by the micro-hand wheel (See 3 of Fig. 2). And slowly movement should be used when measure angles.

6.5.3 The four spring fixtures on the projective screen (See the 23 of Fig. 2) can be used to nip the magnified standard picture or the glass ruler, which is for the outline comparison measurement.

6.5.4 When the white line on the stand of the screen aims at zero mark (See 22 of Fig.2). The level line on the screen is parallel with the X coordinate. Please adjust the work piece edge to parallel with the level line so that you can take the X coordinate measurement now.

6.5.5 There are 30° , 60° , 90° or 45° , 90° on the screen for standard graduation line. For that can be used to measure these special angles comparably. Therefore you can take the angle measuring system to measure the angles just by counting the deviation between them.

6.6 RS232 connector operation

RS232 connector showed as 2 of Fig.6. Communicating between the instrument and computer. It can process the data automatically and draw out the outline of parts through the special software. The report of measurement result and drawings can be printed out through the printer.

7 Measurement method

There are two measurement methods of the projector: Outline measurement and coordinate measurement

7.1 Outline measurement

7.1.1 Measure by comparing with the “magnified standard picture”.

This method is suitable for the large amount or complicated situation. Please take the following steps:

7.1.1.1 Choose the lens basing on the size of the work piece. Design a magnified picture as the same magnified-times as the lens. Please use the transparent plastic material with little contractibility. On the picture you can draw out the limit of tolerance. For instance, if the size of work piece is $\Phi 25$, you can choose the 10X lens and draw a picture with the proportion of 10:1. The following standard magnified pictures are available: circle-arcs, angles, gears, screws and grids.

7.1.1.2 Nip the standard magnified picture on the screen by the four spring fixtures.

7.1.1.3 Put the work piece onto the worktable. Then focus it. Move the X axes table and lifting the Z axes bracket to make sure that the work piece overlaps the standard magnified picture.

7.1.1.4 It is qualified if the deviation between the image and the picture is within the limit of tolerance. Otherwise it is unqualified. The deviation can be measured by the X –Z coordinate.

7.1.2 Use the glass ruler (optional) with the resolution of 0.5mm to measure the image of the work piece on the screen directly, the data which is smaller then 0.5mm can also be measured by the X-Z coordinate. Then divided by the magnified times of the lens. The last result is the size of the work piece.

7.2 Coordinate measurement

7.2.1 One-dimensional measuring

7.2.1.1 Put the work piece onto the work table or the vertical work table and focus it after chose the suitable lens.

7.2.1.2 Turn the projective screen to the zero mark, the white line of the screen holder aim at the zero mark.

7.2.1.3 Adjust the work piece parallel with the measuring axis. (See Fig.10) BC is parallel with X axis.

7.2.1.4 Move or **lifting** the work table, make the measuring edge AB aim at the vertical graduation line of the screen. The value of the X coordinate is set zero.

7.2.1.5 Move the X axis. Make the other edge of the work piece CD aim at the vertical graduation line of screen. What X axis shows is the size of AD edge.

7.2.2 Two-dimensional measuring

7.2.2.1 Aim the zero line of the projective screen at the zero mark.

7.2.2.2 Put the work piece onto the work table. Please choose a bigger times of the lens and adjust the focus.

7.2.2.3 Adjust the measuring edge to be parallel respectively with X axis and Z axis.
See $AE \parallel X$, $AB \parallel Y$ of the Fig. 11.

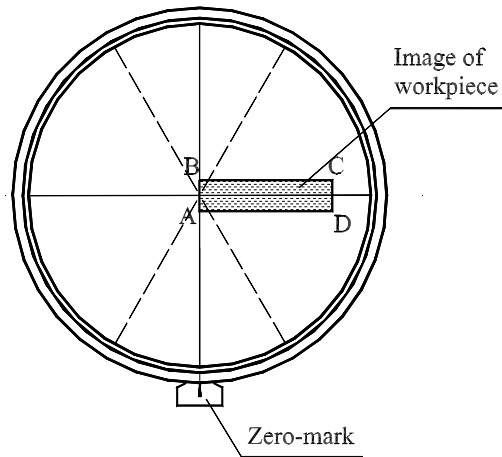


Fig.10 One-dimensional measuring

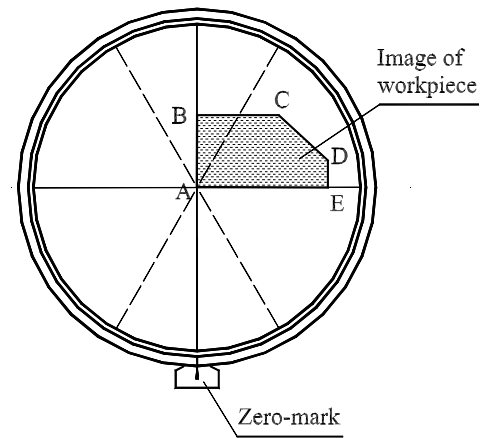


Fig.11 Two-dimensional measuring

7.2.2.4 Move the X axis and **lifting the Z axis**. Aim the image point A of work piece on the cross graduation point of the screen. The value of X axis and Y axis is set zero.

7.2.2.5 Move **and lifting** the work table again. Aim the image point C or D on the cross graduation points. Now the value of the X axis is the measurement value of BC or AE. while the value appears on the Z axis is the value of AB or DE.

7.2.2.6 Use the **SKEW** function of the multi-functional data processing system DC-3000. The position of the work piece can be put arbitrarily without any precise adjustment. Only need to move the worktable to aim the A, B, C or D on the cross graduation point respectively. You can measure out the length concerned. This operation is a time-saved and efficient way. The details can be seen in DC-3000 manual.

7.2.2.7 Connecting the RS232 port with computer. It can process the data automatically by the double coordinate measurement and draw out the outline of parts through the special software M2D (optional). The result of measurement report and drawings can be printed out through the printer. And the work piece can be put on the table arbitrarily without any precise adjustment. These can enhance the quality and upgrade the effect of the measurement.

7.2.3 Angle measurement

7.2.3.1 Put the work piece onto the worktable. choose the lens base on the size of the work piece then focus it.

7.2.3.2 Adjust the tip of the angle into the graduated center of the screen (See Fig. 12).

7.2.3.3 Turn the screen and aim at one edge of the measuring angle with a random line.

7.2.3.4 Turn the screen again. Aim the line at the other edge of the measuring angle. Now the value displayed is the value of the measured angle θ .

7.2.3.5 With the lines on the screen which show 30° , 60° , $90^\circ \dots$ (the precision is $1'$). You can take the measurement comparing with these special angle value.

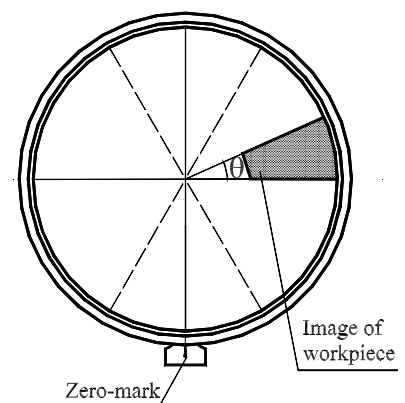


Fig.12 Angle measurement

8 Instrument maintenance

Horizontal digital measuring projector is a precise instrument integrating optic, mechanic, electricity and computing technical. It should be maintained properly and frequently. Well-maintained instrument can prolong the longevity by preserving the precision.

8.1 The instrument should be placed in the desiccative and clean room with the temperature of $20^{\circ}\text{C} \pm 5^{\circ}\text{C}$ and the moisture of 60%. For fear the precision of instrument and the optic system being unfavorably affected. Users should avoid the surface of the optic parts being moldy and obviate the metal parts being rusted. Nor the rail can be dusty.

8.2 The surface of optic parts should be keep clean and mustn't be touched by finger. Surface dust can be cleaned by soft brush. If there is too much dirtiness that affect the normal operation, please wipe it softly by the defatted cotton, or the lens-cleaning paper dip with some toluene or dip with the mixture of ethanol and ether.

8.3 Please don't touch the projective screen while operating because it is granulate panel. It would be unclear because the surface will be covered by dust and oil after long-time used. Users can wipe the whole screen by the clean wet gauze dip with some neutral detergent. Subsequently, you should wipe the screen with clean wet gauze for several times to get rid off the detergent. Be cautious please don't dip with too much water for fear that would drop down to the worktable which would cause rusted of the metal. Or you can cover a plastic pellicle on the worktable previously. The supplier should be called to manage the above work if it is much difficult for users to do.

8.4 Regarding the exposed metal of the instrument, it should be cloaked with the rust-proof grease and wiped by the aviation gasoline regularly or after used to avoid being rusted.

8.5 The lens, the work table and the other accessories of the instrument are of high fixing precision. Users can't unclose all the adjusting screw and tightening screw without supplier's permission. You can ask for inspection by the supplier if the instrument is out of order. The malfunction or the lose-precision of the instrument would not be considered as warranty if that is resulted from the users unclosing it without any permission.

8.6 Whether the cold fans work properly count for much to both the properly functioned and the longevity of bulbs. Users should pay closed attention to such a problem and contact the supplier at once when the instrument is out of order.

8.7 Regarding the work table precision, It has already been made the error compensation by the data processing system DC-3000 within the producing process. Users can't change the error compensation and other preset value without any permission. Otherwise that would cause the malfunction and incorrect precision of the instrument.

8.8 Please turn off the light power of the instrument after use. Except the reflection and transmission light, please don't turn on all the lights powers simultaneously if isn't necessary. Except saving the resource, all the mentioned above can also prolong the longevity of the lights and maintain the well state of the instrument.

9 Instrument electrical system

The power supply, illumination, refrigeration and the digitizer electro-circuit are as the Fig.13 shows. For instance:

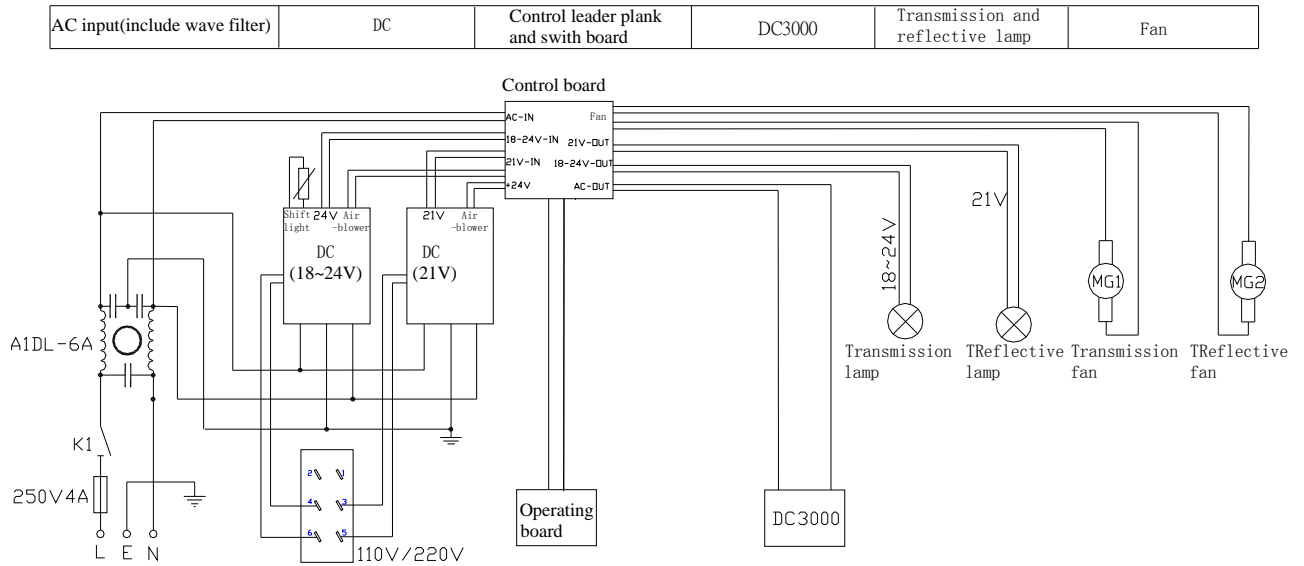


Fig.13 Electricity method

10 Instrument consistency

No.	Standard	Qua.	No	Option	Qua.
1	Main body	1Pcs	1	4A/ ϕ 5 \times 20 Fuse	5 Pcs
2	10 \times Lens	1Pcs	2	21V150 W Halogen bulb	1 Pcs
3	Spring Fixture of screen	4Pcs	3	24V150 W Halogen bulb	2 Pcs
4	2m Power wire	1Pcs			
5	Instruction	1Pcs			
6	QC pass certification	1Pcs			
7	Packing list	1Pcs			
No.	Option				
1	5 \times Lens		8	Rotary table	
2	20 \times Lens		9	Swivel center support	
3	50 \times Lens		10	Holder with clamp	
4	100 \times Lens		11	Over-layer chart (Φ 300mm)	
5	Vertical table		12	M2D-CPJ	
6	V-block with clamp		13	400mm measuring glass	
7	Work piece bearing board				