SHARP EDM
Model: SED301
(Also for SED401, 521, 551, 601, 1051)

Operations Manual & Parts List
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SAFETY DEVICES AND NORMAL OPERATION

Precaution:
As Electrical Discharge Machine is working with spark between electrode and workpiece, there should be safety devices with correct operation to prevent machine and workplace from getting fire. The correct way of operation is also illustrated in our Operation Manual. Please follow the instruction to avoid any possible accident.

A. 3 factors to cause combustion:
There are 3 factors to cause fire which are fire flame, oxygen and combustible materials. To avoid getting fire, you have to control these 3 factors. The following safety devices are equipped in our EDM to keep away from these factors.

a. Auto inspection device for abnormal machining:
During EDM working, bad cycling of the dielectric shall easily cause deposited carbon articles on the workpiece. The continuos carbon deposit shall force the electrode to move upward. In the long run, the electrode shall move above the dielectric level. This is one of the reason why it cause fire. To prevent such accident, we have equipped in our EDM the ARC Detection System as illustrated in the control panel in our Operation Manual. Please refer carefully to them.

b. Dielectric level monitor:
Normally, when the dielectric cannot cover the end of the electrode, it shall cause fire easily during machining. To avoid such trouble, we have equipped a dielectric level monitor system as illustrated in of the control panel in our Operation Manual. Please refer to it carefully.

c. Dielectric temperature monitor:
One of the reasons to cause fire is the high dielectric temperature. We have equipped a device to monitor this. Whenever the dielectric temperature is more than the set temperature, the power supply will shut off automatically to stop machining. For this, please refer to the control panel in Operation Manual for the details.

d. Flame monitor:
Another device to avoid getting fire is the flame monitor. As it gets spark when the machine is working, there might some occasions to have a flame when the dielectric cannot cover the end of the electrode. When there is a flame in this case, the lamp for the flame monitor will light and main power supply will shut off automatically to avoid any possible accident.

e. Fire Extinguisher:
The series machines need to fit fire extinguisher. Please refer to the local qualified supplier to install.

B. For the social security, the end user of the EDM machines are requested compulsory to buy the insurance especially for the fire accident in your country. The end user should take responsibility in case that he doesn't follow this regulation.
CHAPTER 1

THE BRIEF INTRODUCTION OF EDM
1.1 The outline of EDM

EDM is a machining of converting electricity energy into heat energy directly, and a little different from mechanical machining. The fundamental concepts show as below:
Single discharge process.

1. When the electrode is closest to the workpiece, on the nearest point the ARC occurs, between both electrode & workpiece spart generates, sparks become tiny ARC soon i.e. high density of electronic current strikes a point of workpiece.

2. This electronic currents produce heat of high temperature. The workpiece will be melted if touching this heat.

3. This heat vaporizes the dielectric fluid surrounding here, put pressure on melted workpiece and electrode.
The pressure is small to the all workpiece and electrode, but it is big to the unit area.

4. The melted metal was turned into particles and dispersed in the dielectric fluid. The residuals around the discharging point bulge, attached to electrode & workpiece. The bulge will become a successive discharging point.

5. The melted metal is removed and filtered with dielectric fluid soon. After cooling the discharging gap becomes insulated again.
Continuous discharge machining

While discharging thousands even tens thousand discharge in one second. Accumulative discharges proceed machining. The more the discharge works the faster the speed becomes. The gap is bigger, then machining roughness on top surface is coarser. The comparison among machining speed, current & pulse width. The machining speed is in compliance with current. While pulse width is fixed, the stronger the current the faster the machining speed. But the value of current is over 10A/cm², the speed will show down. Therefore fine finish & small surface had better employ small current to machine. When pulse width is extremely short or long, the machining speed has tendency to slow down even if the pulse on & pulse off are at the same ratio. The peak current has not reached the setting current, so the pulse width lengths, the density of current drops. The discharge current lower, it is hard to eliminate the melted metal. The residuals cease on the surface, the roughness of machining surface worsen, his machining surface with deformed layer thickens and machining efficiency worsens, so it is impractical.

Therefore the volume of current should match pulse width well. The theory of machining with low wear. There are some factors to affect the electrode wear. The theory of machining with low wear. There are some factors to affect the electrode wear.

The main two factors show as below:

1. Using the original characters of materials i.e. the outcome of melting point multiplexed by thermal conductivity to achieve the low wear. The more the outcome the lower it wears.

2. After machining the carbon attaching to the positive part will produce protection, and lower electrode wear. The deformed layer after machining. The processed material was treated by fast heating & cooling & the physical, chemical influence of high pressure, the deformed layer occurred. When pulse width is long, the existing time of heat energy will be long. The high temperature of ARC can conduct to the inner side of material the deformed layer will thicken. To thinning the deformed layer the machining condition should be under shorter pulse width. Besides, while steel is under machining in the dielectric fluid the fluid & decomposition of workpiece producing carbon will penetrate carbon under high pressure & temperature, and become highly rigid top surface containing high carbon.

1.2 The applications of EDM machining

1. EDM using heat energy to process is different from that of conventional mechanical method. Therefore, all the conductive material can be machined regardless of hardness & toughness. Especially for hardened steel & Tungsten Carbide hard alloy.

2. The force EDM machine produces is small, and machining surface shows no pile-up carbon therefore EDM is fit for thin slice and tiny workpiece machining.

3. When machining the electrode doesn't need rotate. Therefore it is favorable to machine complex and in the recent years the great progress has been made in the technological field. The EDM has been improving under the study of EDM experts. To the common steel, the electrode wear can be under 0.2%, the surface exactness reaches 0.3 μ m Ra. Consequently the EDM machine has been applied to high exactness and aero equipment.
CHAPTER 2

SYSTEM INSTRUCTIONS FOR AZ SERIES E.D.M.
2.1 COMPOSITION INSTRUCTION OF MACHINE FRAME AND POWER SUPPLY UNIT

2.1.1 MODELS OF POWER SUPPLY UNIT.
1. AZ50; MAX. MACHINING CURRENT 50A.
2. AZ75; MAX. MACHINING CURRENT 75A.
3. AZ100; MAX. MACHINING CURRENT 100A.
4. AZ125; MAX. MACHINING CURRENT 125A.
5. AZ150; MAX. MACHINING CURRENT 150A.

2.1.2 MODELS OF MACHINE FRAME.
1. SED301
2. SED401
3. SED501
4. SED551
5. SED601
6. SED1051

2.1.3 COMPOSITION INSTRUCTION.

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2.3 MACHINE UNIT AND ACCESSORIES

DETAIL 10

Diagram with labeled parts:
1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16

Legend:
- SLOW
- FAST
1. DEPTH SETTING:
   USING THIS DIAL GAUGE TO SET THE MACHINING DEPTH OF WORKPIECE. THE
   MACHINING DEPTH ALSO CAN BE SET BY D.R.O. " END " POINT. TO BE NOTED THAT
   ANY ONE OF THE SETTING DEPTH ( BY DIAL GAUGE OR D.R.O. " END " ) IS
   REACHED, THAT IS THE MACHINING DEPTH IS REACHED.

2. LUBRICATOR:
   FOR GUIDE WAY AND LEAD SCREW/ BALL SCREW, INCLUDING X, Y, Z, AND W AXES.

3. DIELECTRIC LEVEL CONTROL LEVER.

4. DRAIN CONTROL LEVER.

5. DIELECTRIC FLUID CONTROL VALVE:
   TO CONTROL FLUSHING AND FLUID SUPPLY SPEED.

6. SUCTION OR FLUSHING CONTROL VALVE.

7. Y AXIS HAND WHEEL:
   FOR TABLE MOVEMENT IN Y AXIS DIRECTION.

8. WORKHEAD CLAMP LEVER.

9. W AXIS HAND WHEEL FOR SED301.
   W AXIS MOVEMENT IS FEED BY MOTOR FOR SED401, SED501, SED551, SED601.

10. WORKHEAD SIDE CONTROL PANEL: (FOR SED301, SED401)
    FOR RAM MOVEMENT UP AND DOWN.

11. ELECTRIC HOLDER:
    WITH UNIVERSAL ADJUSTMENT (ANGULAR, PERPENDICULAR).

12. WORK TANK.

13. WORK TABLE.

14. X AXIS HAND WHEEL:
    FOR TABLE MOVEMENT IN X AXIS DIRECTION.

15. WORK TABLE BRAKE LEVER.

16. SADDLE BRAKE LEVER.
1. ANGULAR ADJUSTMENT SCREW.
2. HORIZONTAL ADJUSTMENT SCREW.
3. V- HOLDER.
4. INSULATOR.
5. SCREW FOR FIXING ELECTRODE.
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| 4. Timer | 52. Sparking gap increase key |
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| 6. A.O.S. key | 54. Servo sensitivity indicator |
| 7. D.R.O. counter | 55. Servo sensitivity increase key |
| 8. Single step machining key | 56. Servo sensitivity decrease key |
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| 10. Edit key | 58. Flushing height increase key |
| 11. Edge finder key | 59. Flushing height decrease key |
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| 16. Flame indicator | 64. Flushing 2-speed increase key |
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| 19. D.R.O. settings error indicator | 67. ARC sensitivity increase key |
| 20. Reset key | 68. ARC sensitivity decrease key |
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| 22. Dielectric level & temperature sensor key | 70. Low wear factor increase key |
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| 28. Key lock key | 76. Temporary condition key |
| 29. F1 key | 77. Stored condition key |
| 30. F2 key | 78. Machining material decrease key |
| 31. F3 key | 79. Machining material increase key |
| 32. F4 key | 80. Electrode real machining size decrease key |
| 33. Spark indicator | 81. Electrode real machining size increase key |
| 34. Spark on key | 82. Electrode wear decrease key |
| 35. Spark off key | 83. Electrode wear increase key |
| 36. Pump indicator | 84. Peak current decrease key |
| 37. Pump on key | 85. Peak current increase key |
| 38. Pump off key | 86. Machining material indicator |
| 39. Peak current indicator | 87. Electrode real machining size indicator |
| 40. Peak current increase key | 88. Electrode wear indicator |
| 41. Peak current decrease key | 89. Peak current indicator |
| 42. High voltage indicator | 90. Job No. decrease key |
| 43. High voltage increase key | 91. Job No. increase key |
| 44. High voltage decrease key | 92. Job No. indicator |
| 45. On time indicator | 93. Step No. decrease key |
| 46. On time increase key | 94. Step No. increase key |
| 47. On time decrease key |
95. Step No. indicator
96. Fuzzy key
THE INTRODUCTION TO JOEMARS NEW FUZZY LOGIC CONTROL SYSTEM CONTROL PANEL

1. VOLTAGE METER:
   Normally indicates at about 50V during sparking and 60V - 70V at fine finishing.

2. AMPERE METER:
   Indicates the machining average current output.

3. STABILITY DISPLAY:
   Indicates the machining stability. 20% - 40% means poor machining and parameters need to be adjusted. 80% - 100% indicates stable machining.

4. TIMER:
   To count on the machining time.

5. BUZZER:

6. A.O.S KEY:
   After start machining, put to "I" then when the depth is reached, machining stop and shut off the power. Put to "0", then the depth is reached, machining stop but power is still on.

7. D.R.O. CONTROL PANEL.
   To set the machining depth and machining steps: single steps or multi steps machining. Heidenhain counter (5 steps) & Fagor counter are selectable.

   * OPERATION MODES: (FROM 8. SINGLE STEP MACHINING TO 13. AUX2)

8. SINGLE STEP MACHINING: MANUAL MACHINING.
   Machining step by step and individually set the parameters for each step of depth.

9. MULTI STEP MACHINING: AUTO MACHINING FROM ROUGH TO FINE FINISHING.
   Set the different depth for each step machining from D.R.O. counter panel, and input the parameters from operation panel for each step of depth.

10. EDIT: Set & Edit the parameters for each step of machining.
11. EDGE FINDER: TO SET & ADJUST THE WORKPIECE SURFACE, CENTER. SET AT "ON", EXCEPT FOR (54. SERVO SENSITIVITY) IS STILL ON AND ALL OTHER MACHINING PARAMETERS WILL OFF. ADJUST NO. 54 (SERVO SENSITIVITY) TO CONTROL THE SERVO SPEED. SET AT "ON", PRESS Z SERVO "DOWN" BUTTON FROM THE WORKHEAD SIDE CONTROL PANEL THEN Z MOVES DOWN SLOWLY UNTIL TOUCH THE WORKPIECE THEN BUZZER ALARMS. THAT IS THE ZERO POINT OF WORKPIECE.

12. AUX1: TO CLEAR UP ALL (76. TEMPORARY CONDITIONS) INPUT BY USERS AND CALL OUT THE (77. THE STORED CONDITIONS) BY THE MAKER.

13. AUX2: SPECIAL MODE FOR EXPANSION IN FUTURE. NOTES: DURING SPARKING, TO AVOID WRONG SETTINGS AND DAMAGE THE WORKPIECE, THE (96. FUZZY LOGIC CONTROL SYSTEM) WILL AUTO LOCK (92. JOB NO.), (95. STEP NO.), (86. MACHINING MATERIALS) & (87. REAL ELECTRODE MACHINING SIZE).

*MESSAGES INDICATORS: (FROM 14. DEPTH ARRIVAL TO 19. D.R.O. SETTINGS ERROR)

14. DEPTH ARRIVAL INDICATOR:
WHEN SINGLE STEP MACHINING DEPTH OR THE FINAL STEP DEPTH OF MULTI STEPS MACHINING REACHED, "ON" AND MACHINING STOP.

15. DIELECTRIC LEVEL & TEMPERATURE INDICATOR:
SET (22. DIELECTRIC LEVEL & TEMPERATURE SENSOR) FUNCTION "ON", WHEN THE LEVEL IS LOWER THAN REQUIRED OR TEMPERATURE IS HIGHER THAN PRESET IN MANUFACTURER'S FACTORY, THE LED "ON" AND MACHINING STOP. FOR SAFETY, SET THE DIELECTRIC LEVEL AT LEAST 5CMS HIGHER THAN WORKPIECE AND DON'T ADJUST THE TEMPERATURE CONTROL. ENSURE THIS FUNCTION WORKS NORMALLY BEFORE OPERATION.

16. FLAME INDICATOR:
SET (23. FLAME SENSOR) FUNCTION "ON", WHEN FLAME HAPPENING, THE LED "ON" THEN MACHINING STOP. FOR SAFETY, DAILY CLEAN UP SENSOR & CHECK THE FLAME SENSOR FUNCTION WILL BE REQUIRED. ENSURE THIS FUNCTION WORKS NORMALLY BEFORE OPERATION.

17. ARCING INDICATOR:
SANTEC NEW FUZZY LOGIC CONTROL SYSTEM WILL AUTO MONITOR & ADJUST THE MACHINING PARAMETERS WHILE ARCING HAPPENING OR POOR MACHINING SITUATION. IF ARCHING STILL EXIST AND CAN NOT BE CLEARED BY ADJUSTING THE PARAMETERS, THEN LED "ON" AND MACHINING STOP. THE ARCING HAS TO BE CLEARED BY USER. NOTE: TAKE CARE OF THE ARCING HAPPENING TO AVOID WORKPIECE DAMAGE OR CAUSE FIRE HAZARD.
18. ELECTRODE-WORKPIECE COLLISION INDICATOR:
   AT (8. SINGLE STEP MACHINING MODE ), (9. MULTI STEP MACHINING
   MODE ) & (10. EDIT MODE ), WHEN ELECTRODE COLLIDE THE WORKPIECE
   BY OPERATOR'S NEGLIGENCE, THE LED " ON " THEN BUZZER ALARM AND
   MACHINE STOP.

19. D.R.O. SETTINGS ERROR INDICATOR:
   WRONG D.R.O. DEPTH SETTING, THE LED " ON ".

20. RESET KEY:

   * AUXILIARY FUNCTIONS: (FROM 21. AUTO RETRACT TO 32. F4)

21. AUTO RETRACT KEY:
   SET AT " ON ", WHEN THE DEPTH REACHED, THE SERVO HEAD WILL AUTO
   RETRACT TO THE TOP.

22. DIELECTRIC LEVEL & TEMPERATURE SENSOR KEY:
   SET AT " ON ", THE MACHINE WILL AUTO MONITOR THE DIELECTRIC LEVEL
   AND TEMPERATURE.
   FOR SAFETY, PLEASE SET IT AT " ON " AND ENSURE THIS FUNCTION WORKS.

23. FLAME SENSOR KEY:
   SET AT " ON ", THE MACHINE AUTO MONITOR THE FLAME.
   FOR SAFETY, TO CLEAN THE SENSOR DAILY AND BE SURE THAT THE FUNCTION
   WORKS DURING MACHINING. THE FIRE EXTINGUISHER IS RECOMMENDED TO
   BE FIXED ONTO MACHINE.

24. PUMP-SPARKING SYNCHRONOUS START KEY:
   SET AT " ON ", WHEN STARTING SPARKING, THE OIL PUMP WILL WORK
   SYNCHRONOUSLY. WHEN STOP SPARKING, THE OIL PUMP STOP.

25. ALIGNMENT ADJUSTING KEY:
   NORMALLY IS " OFF " AND ONLY USED TO ADJUST THE ALIGNMENT OF
   ELECTRODE & WORKPIECE. THE SERVO SPEED CAN BE DECIDED BY THE TOGGLE
   SWITCH ON THE WORKHEAD SIDE CONTROL PANEL.
   SET " ON ", WHEN ELECTRODE TOUCH THE WORKPIECE, IT STILL MOVES
   SLOWLY BUT NOT STOP AND ELECTRODE ALIGNMENT CAN BE ADJUSTED.

26. Z LOCK KEY:
   SET AT " ON ", THE ELECTRODE WILL STOP COMING DOWN. EQUIPPED WITH
   SANTEC ORBIT CUTTING SYSTEM, CAN MACHINING ORBITING FUNCTIONS.
27. UP CUTTINGS KEY:
( REVERSE SPARKING.) THIS FUNCTIONS CANNOT BE CHANGED DURING
MACHINING. WHEN USING UP CUTTING FUNCTION, THE MACHINING DIRECTION
WILL BE CHANGED AND THE MACHINING DEPTH & D.R.O. DEPTH SETTING MUST
BE CONSIDERED TO AVOID DAMAGE ELECTRODE OR WORKPIECE.

28. KEY LOCK KEY:
TO AVOID ANY ERROR ADJUSTING AFTER STARTING MACHINING, SET AT
" ON " AND ALL THE KEYS WILL BE LOCKED AUTOMATICALLY EXCEPT FOR
( 34. 35. SPARK ON & OFF ), (37. 38. PUMP ON & OFF ), ( 28. KEY LOCK ) & D.R.O.

29. F1 KEY : SYNCHRONOUS FLUSHING:
SET " ON " : DURING MACHINING, WHEN ELECTRODE MOVES UP THE IT FLUSHING
SYNCHRONOUSLY AND WHEN ELECTRODE MOVE DOWN, IT STOP FLUSHING.

30. F2 KEY:
SET AT " OFF ":
DURING DOWNWARD SPARKING, PRESS THE " UP " BUTTON ON THE
WORKHEAD, SPARKING & PUMP STOP.
DURING UP SPARKING, PRESS THE " DOWN " BUTTON ON THE WORKHEAD,
SPARKING & PUMP STOP.
SET AT " ON ":
DURING DOWNWARD SPARKING, PRESS THE " UP " BUTTON ON THE
WORKHEAD, SPARKING STOP AND PUMP STILL WORKS.
DURING UP SPARKING, PRESS THE " DOWN " BUTTON ON THE WORKHEAD,
SPARKING STOP AND PUMP STILL WORKS.

31. F3 KEY:
FOR SPECIAL FUNCTIONS EXPANDED.

32. F4 KEY:
FOR SPECIAL FUNCTIONS EXPANDED.

33. SPARK INDICATOR:

34. SPARK ON KEY:
35. SPARK OFF KEY:

36. PUMP INDICATOR:

37. PUMP ON KEY:

38. PUMP OFF KEY:

MACHINING PARAMETER: (FROM 39. PEAK CURRENT INDICATOR TO 74. ELECTRODE POLARITY DECREASE KEY).

WITH SANTEC FUZZY LOGIC CONTROL SYSTEM, 12 MACHINING PARAMETERS MAY BE SET AUTOMATICALLY BY INPUT 4 BASIC DATAS: (NO. 86 - NO. 89) PRESS OFF (96. FUZZY) KEY, THE MACHINING PARAMETERS CAN BE EDITED BY OPERATOR. DURING MACHINING, THE PARAMETER MAY BE ADJUSTED WITHOUT AFFECTING THE MACHINING BUT (96. FUZZY) KEY MUST BE PRESS OFF SO THAT IT CAN BE ADJUSTED.

39. PEAK CURRENT:
LOW VOLTAGE CURRENT. SAME AS (89. PEAK CURRENTS).
PEAK CURRENT & REAL MACHINING, PLEASE REFER TO CHART 1.

42. HIGH VOLTAGE CURRENT: 0 - 6 CODES.
DUAL VOLTAGE CURRENTS (LOW VOLTAGE CURRENTS & HIGH VOLTAGES CURRENTS) BEING SYNONYMISUALLY DISCHARGES ALLOWS FAST METAL REMOVAL RATE AND UNIFORM SURFACE FINISHING.
CODE 0: 0A
CODE 1: 0.5A  CODE 2: 1A  CODE 3: 1.5A
CODE 1, 2 & 3: THE HIGH VOLTAGE CURRENT OUTPUT APPEAR ONLY FOR A SHORT TIME (ABOUT 10μS) AT "ON TIME" PERIOD THEN DISAPPEAR.
CODE 4: 0.5A  CODE 5: 1A  CODE 6: 1.5A
CODE 4, 5 & 6: THE HIGH VOLTAGE CURRENT OUTPUT APPEAR FOR THE WHOLE "ON TIME." PERIOD.
HIGH VOLTAGE CURRENT & REAL MACHINING, PLEASE REFER TO TABLE 1.
NOTE: SET CODE AT 1, 2 OR 3: ONLY APPEAR ABOUT 10μS SO THAT THE ELECTRODE WEAR WILL BE LOWER BUT MACHINING SPEED WILL BE A LITTLE SLOW.
SET CODE AT 4, 5 OR 6: MACHINING SPEED WILL FASTER BUT ELECTRODE WEAR BE HIGHER.

45. ON TIME: 1 - 99 CODES.

48. OFF TIME: 1 - 99 CODES.
ON TIME, OFF TIME SETTING & REAL PULSE, PLEASE REFER TO TABLE 2.
ON TIME, OFF TIME & REAL MACHINING, PLEASE REFER TO CHART 2.
51. SPARKING GAP: 1 - 16 CODES.
   NOTE: LARGER SPARK GAP CODE, LARGER GAP VOLTAGE OUTPUT AND
   MACHINING WILL BE MORE STABLE BUT THE GAP BETWEEN ELECTRODE &
   WORKPIECE WILL INCREASE.

54. SERVO SENSIVITY: 0 - 15 CODES.

57. FLUSHING HEIGHT: 0 - 99 CODES.
   NOTE: LARGER FLUSHING HEIGHT CODE, HIGHER FLUSHING HEIGHT AND
   MACHINING WILL BE MORE STABLE BUT THE MACHINING SPEED WILL BE
   SLOW.

60. WORKING TIME: 1 - 99 CODES.
   DURING WORKING TIME, WHENEVER THERE IS ARCING HAPPENING, THE
   WORKING WILL AUTOMATICALLY PAUSE AND FLUSHING IMMEDIATELY THEN GO
   ON WORKING.
   NOTE: THE REAL WORKING TIME IS THE CODE X 0.1 SEC. FOR EXAMPLE, SET
   CODE AT 25 AND THE REAL WORKING TIME IS 25 X 0.1 SEC. = 2.5 SEC.
64. FLUSHING TWO SPEED: 0 - 3 CODES.

CODE: 0

CODE: 1

CODE: 2

CODE: 3 (USED AT BIG AREA MACHINING)

66. ARC SENSITIVITY: 0 - 9 CODES.
NOTE: LARGER ARC SENSITIVITY CODE, MORE SENSITIVE.

69. LOW WEAR FACTOR:
NOTE: LARGER LOW WEAR FACTOR CODE, LONGER SLANTWISE LINE AND LOWER ELECTRODE WEAR BUT SLOW MACHINING SPEED. SET THIS CODE BIGGER WHEN MACHINING A SHARP CORNER WORKPIECE OR REQUIRE A LOWER ELECTRODE WEAR. OPPOSITLY, SET THIS CODE SMALLER, SHORTER SLANTWISE LINE AND FASTER MACHINING SPEED BUT WEAR WILL BE HEAVY. WHEN SET AT 0, SAME AS NORMAL SPARKING CIRCUITS.
72. ELECTRODE POLARITY: CODES: +, +1, -, -1

CODE: + : ELECTRODE "+" AND WORKPIECE "-"

CODE: +1: ELECTRODE "+" AND WORKPIECE "-"
AND, DURING SPARKING, THE FUZZY LOGIC CONTROL SYSTEM
WILL AUTO SENSOR & AUTO ADJUST THE PARAMETERS.

CODE: -: ELECTRODE "-" AND WORKPIECE "+

CODE: -1: ELECTRODE "-" AND WORKPIECE "+
AND, DURING SPARKING, THE FUZZY LOGIC CONTROL SYSTEM
WILL AUTO SENSOR & AUTO ADJUST THE PARAMETERS.

75. SAVE KEY:
TO SAVE ALL MACHINING PARAMETERS AFTER EDITING, ADJUSTING UNDER SPECIFIC (92. JOB NO.) & (95. STEP NO.)

76. TEMPORARY CONDITION:
THE MACHINING PARAMETERS CAN BE ADJUSTED BY THE USERS DURING SPARKING.
IF IN THE FUZZY LOGIC CONTROL SYSTEM, THE (96. FUZZY KEY) MUST BE
NOTE: IF THE OPERATOR WANT TO ADJUST THE MACHINING PARAMETERS AND THE (96. FUZZY) KEY MUST BE PRESS OFF.
WHEN (96. FUZZY) KEY IS OFF THEN (76. TEMPORARY CONDITION) WILL ON AND OPERATOR MAY MODIFY THE PARAMETERS. AFTER ADJUSTING THE PARAMETERS, IF PRESS (75. SAVE) KEY THEN THE AFTER ADJUSTING PARAMETERS WILL REPLACE THE STORED PARAMETERS.
IF DON'T PRESS (75. SAVE) KEY AND PRESS (96. FUZZY) KEY OF (77. STORED CONDITION) KEY, IT WILL RETURN TO THE PREVIOUS (96. FUZZY) PARAMETERS AND THE TEMPORARY PARAMETERS DISAPPEAR.

NOTE: TO CLEAR UP ALL THE TEMPORARY PARAMETERS SET BY OPERATOR AND CALL OUT THE STORED FUZZY PARAMETERS, REFER TO THE BELOW STEPS:
(1) PRESS IN ORDER (12. AUX 1), THEN (40. PEAK CURRENT INCREASE KEY), THEN (77. STORED COND.) THEN (75. SAVE). (NO.5 BUZZER) SOUNDS FOR ABOUT 10 SECONDS.
(2) TURN OFF THE POWER.
(3) TURN ON THE POWER AND THEN PRESS (75. SAVE).

77. STORED CONDITION:
The specific condition / memory under (92. JOB NO.) & (95. STEP NO.) SAVED BY USERS.
86. MACHINING MATERIALS:
TOTAL 8 DIFFERENT MATERIALS MACHINING MODES: Cu-St, Cu-Al, Gr-St, Gr-Al, St-St, Cu-Wc, CuW-WC & OTHERS. THE OPERATOR CAN SELECT THE SUITABLE MODE.

87. ELECTRODE REAL MACHINING SIZE:
FROM DIA. 1.00 - DIA. 80MM TOTAL 8 SELECTABLE SIZE FOR MACHINING.

88. ELECTRODE WEAR:
5 SELECTABLE ELECTRODE WEAR RATIO. NORMALLY, ULTRA-LOW WEAR ONLY USED FOR ROUGH MACHINING AND ULTRA-HIGH WEAR ONLY USED AT SUPER FINE FINISHING.

89. PEAK CURRENT:
MAX. 30 SELECTABLE CURRENT STEPS.
POWER SUPPLY AZ50: 0 - 50A: TOTAL 14 CURRENT STEPS SELECTABLE.
POWER SUPPLY AZ75: 0 - 75A: TOTAL 18 CURRENT STEPS SELECTABLE.
POWER SUPPLY AZ100: 0 - 100A: TOTAL 22 CURRENT STEPS SELECTABLE.
POWER SUPPLY AZ150A: 0 - 150A: TOTAL 30 CURRENT STEPS SELECTABLE.

92. JOB NO.:
THE MEMORY CAN SAVE TOTAL 50 SETS OF JOBS FROM ROUGH TO FINAL FINISHING AUTOMATICALLY.

95. STEP NO.:
SINGLE STEP, 5 STEPS AND CAN EXPANDED TO 10 STEPS IN FUTURE (OPTION). FOR SINGLE STEP MACHINING, ONLY SET THE " END " POSITION FROM THE D.R.O. PANEL AND WHEN THE DEPTH REACHED, MACHINING STOP AND SET ANOTHER " END " POSITION TO CONTINUE THE MACHINING. FOR MULTI STEP MACHINING, SET DIFFERENT DEPTHS FROM THE D.R.O. PANEL AND EDIT MACHINING PARAMETERS FOR STEP. PRESS (9. MULTI STEP) THEN START SPARKING. THE MACHINE MAY AUTO MACHINING FROM ROUGH TO FINAL SURFACE FINISHING.

96. FUZZY KEY:
USING THE FUZZY KEY AND ONLY INPUT 4 DATAS: (NO. 86 - NO. 89), THE FUZZY SYSTEM WILL AUTOMATICALLY SET THE MOST EFFICIENT & SUITABLE PARAMETERS. PRESS THE FUZZY KEY OFF AND MAY MODIFY THE PARAMETERS.
1. PUT SWITCH ON "SLOW", THE RAM MOVEMENT WILL BE SLOW UP/DOWN.
   PUT SWITCH ON "FAST", THE RAM MOVEMENT WILL BE FAST UP/DOWN.

2. BUTTON SWITCH:
   PRESS THIS BUTTON, THE RAM WILL MOVE UP UNTIL RELEASE THIS BUTTON.

3. BUTTON SWITCH:
   PRESS THIS BUTTON, THE RAM WILL MOVE DOWN UNTIL RELEASE THIS BUTTON.
1. Z AXIS UP/ DOWN SPEED SWITCH: " I " SLOW & " O " FAST.
2. DIELECTRIC PUMP (THRU. FILTER): " I " ON & " O " OFF.
3. BY-PASS DIELECTRIC PUMP: " I " ON & " O " OFF.
4. SPARKING START: " I " ON & " O " OFF.
5. Z AXIS " UP/ DOWN ".

3-15
1. W AXIS "UP" SWITCH.
2. W AXIS "DOWN" SWITCH.
3.4 OPERATION EXAMPLES
3.4.1 AZ SERIES (HEIDENHAIN VRZ670E DRO)
1. FIRST DECIDE THE MACHINING DEPTH:

A. (1) SINGLE STEP MACHINING: INPUT END POINT FROM D.R.O. PANEL.

FOR EXAMPLE: SINGLE STEP DEPTH IS 4.3MM - PRESS END, INPUT -4.3MM, ENT. THE MACHINING DEPTH IS 4.3MM

NOTES: a. HOME MUST BE SET HIGHER THAN ZERO POINT. FOR EXAMPLE:
   10.00MM - PRESS HOME, INPUT 10.00MM, ENT.

b.  

B. MULTI STEPS MACHINING: (FOR EXAMPLES: 5 STEPS)

(1) FIRSTLY DECIDE THE TOTAL MACHINING DEPTH AND EACH STEP DEPTH.

FOR EXAMPLES, EACH STEP DEPTH ARE: P1: 4.30 MM  P2: 0.30MM
P3: 0.25MM  P4: 0.10MM &  P5: 0.05MM.

(2) KEY-IN: (FROM P5 TO P1)

PRESS END, INPUT -5.00MM, ENT: TOTAL DEPTH: 5.00MM
PRESS T2, INPUT 0.05MM, ENT: P5: 0.05MM
PRESS T1, INPUT 0.15MM, ENT: P4: 0.10MM

NOTES: 0.15MM IS THE DISTANCE FROM "END" TO P4 TOP. THAT IS INCLUDING P5: 0.05MM & P4: 0.10MM.

NEXT, INPUT HOME, P1 & P2:

PRESS HOME, INPUT 5.00MM, ENT: 5.00MM HIGHER ZERO.
PRESS 1, INPUT -4.30MM, ENT: P1: 4.30MM
PRESS 2, INPUT -4.60MM, ENT: P2: 0.30MM
NOTES: a. \[\text{VALUE MUST BE "-".}\]

b. \[\text{IS THE DISTANCE FROM ZERO TO P2 LOWEST POINT.}\]

THAT IS INCLUDING P1: 4.30MM & P2: 0.30MM.

c. P3: 0.25MM IS BETWEEN \[\text{THE D.R.O.}\]

COUNTER WILL AUTO CALCULATE AND NO NEED TO KEY IN.

(3) IF DOING 3 STEPS OR 4 STEPS MACHINING, JUST INPUT P2: 0

P3: 0 OR P4: 0.

NOTES: a. THE D.R.O. COUNTER ONLY SAVE THE LAST SET OF MACHINING DEPTH. SO, MACHINING DIFFERENT JOB MUST KEY IN EACH STEP OF DEPTH.

b. BEFORE START SPARKING, MUST MOVE THE Z SERVO HEAD HIGHER THAN THE HOME POINT.

2. EDIT MACHINING PARAMETERS FOR EACH STEP DEPTH:

A. SINGLE STEP MACHINING:

(1) PRESS "EDIT", DECIDE THE "JOB NO." & "STEP NO."

(2) WITH FUZZY LOGIC CONTROL SYSTEM TO SET MACHINING PARAMETERS:

INPUT (NO. 86 - NO. 89) DATAS THEN PRESS (75. SAVE) KEY.

THAT IS THE PARAMETERS UNDER THIS "JOB NO." & "STEP NO."

ON A NORMAL SUITATION, THE ELECTRODE-WORKPIECE MATERIALS & ELECTRODE SIZE DOESN'T CHANGE AND ELECTRODE WEAR IS SET SET AT 2. SO, ONLY CHANGE THE PEAK CURRENTS FOR EACH STEP OF DEPTH.
(3) UNDER FUZZY SYSTEM, THERE IS A PEAK CURRENT LIMIT AT A FIXED ELECTRODE SIZE. FOR EXAMPLES: (AZ50), SET (87. ELECTRODE REAL MACHINING SIZE) AT 1: PEAK CURRENT LIMIT: 1.5A,
SET AT 2: 2A, SET AT 3: 3A, SET AT 4: 6A, SET AT 5: 9A,
SET AT 6: 13A, SET AT 7: 28A & SET AT 8: 50A.

(4) OPERATOR SET MACHINING PARAMETERS:

PRESS (96. FUZZY) KEY OFF, INPUT 12 PARAMETERS THEN PRESS (75. SAVE) KEY. THAT IS THE PARAMETERS UNDER THIS "JOB NO." "STEP NO."

NORMALLY, WHEN PRESSING (96. FUZZY) KEY OFF, OPERATOR MAY JUST MODIFY SOME OF DATAS IN THE 12 PARAMETERS THEN PRESS (75. SAVE) KEY.

NOTES: WHATEVER THE PARAMETERS EDITED BY FUZZY SYSTEM OR BY OPERATOR, IT'LL BE SAVED AFTER PRESS (75. SAVE) KEY.

BUT, (92. JOB NO.) & (95. STEP NO.) & EACH STEP DEPTH MUST BE RECORDED BY OPERATOR SO THAT WHEN MACHINING THE SAME WORKPIECE, IT CALL BE CALL OUT TO MACHINING AND ONLY INPUT AGAIN THE DEPTHS.

B. MULTI STEPS MACHINING: (FOR EXAMPLES: 5 STEPS)

(1) ENSURE P1 - P5 EACH DEPTH ARE SET CORRECTLY.
(2) PRESS "EDIT", DECIDE "JOB NO." & "STEP NO."
(3) INPUT MACHINING PARAMETERS FOR P1 TO P5: SAME AS THE SINGLE STEP MACHINING.
THE FOLLOWINGS SHOWS THE PROCESS FOR 5 STEPS DEPTH MACHINING SETTING:
SET THE WORKPIECE SURFACE AT ZERO POINT BY (11. EDGE FINDER)
EXAMPLE TO SET THE DIFFERENT DEPTH FROM D.R.O. PANEL:

1. TOTAL MACHINING DEPTH : 5.00 MM : SET END -5.00 MM (END POINT)
2. P5 : FINAL FINISHING DEPTH : 0.05 MM : SET \( \frac{T_2}{2} \) 0.050MM
3. P4 : MEDIUM FINISHING DEPTH : 0.10 MM : SET \( \frac{1}{1} \) 0.15 MM
4. P3 : MEDIUM FINISHING DEPTH : 0.25 MM : AUTO CALCULATE BY COUNTER.
5. P2 : ROUGH MACHINING DEPTH : 0.30 MM : SET \( \frac{12}{2} \) -4.60 MM
6. P1 : ROUGH MACHINING DEPTH : 4.30 MM : SET \( \frac{1}{1} \) -4.30 MM

NOTICE:
1. P5 \( \frac{T_2}{2} \), P4 \( \frac{1}{1} \) VALUES, MUST BE POSITIVE (+)
2. P1 \( \frac{1}{1} \), P2 \( \frac{12}{2} \) VALUES, MUST BE NEGATIVE (-)
3. SET HOME HIGHER THAN ZERO POINT, FOR EXAMPLES, +5.000
3.4.2 AZR SERIES (FAGOR NV300CB DRO)

1. FIRSTLY DECIDE THE MACHINING DEPTH:

   a. SINGLE STEP MACHINING: ONLY INPUT END VALUE FROM THE DRO PANEL.

      FOR EXAMPLE:
      SINGLE STEP DEPTH IS 4.3 MM : PRESS END, INPUT -4.3 MM, ENTER THEN
      THIS MEANS THE MACHINING DEPTH 4.3 MM.

      NOTES: (1) HOME MUST BE SET HIGHER THAN ZERO. FOR EXAMPLE,
      SET 10.00 MM : PRESS HOME INPUT 10.0, ENTER

      (2) P1, P2, P3, P4 VALUE MUST SET AT 0.000 MM. FOR EXAMPLES:

         (a) P1 VALUE: PRESS Pn 1 INPUT 0.000 ENTER

         (b) P2 VALUE: PRESS Pn 2 INPUT 0.000 ENTER

         (c) P3 VALUE: PRESS Pn 3 INPUT 0.000 ENTER

         (d) P4 VALUE: PRESS Pn 4 INPUT 0.000 ENTER

      (3) SET THE WORKPIECE SURFACE VALUE AT Z= 0.000 MM.

   b. MULTI STEPS MACHINING (REFER TO PAGE 3 - 24 DESCRIPTIONS)

      (1) FIRSTLY DECIDE THE TOTAL MACHINING DEPTH & EACH STEP DEPTH.
      FOR EXAMPLE : TOTAL DEPTH IS 5.0 MM,
      P1 DEPTH : 4.3 MM,
      P2 DEPTH : 0.3 MM,
      P3 DEPTH : 0.25 MM,
      P4 DEPTH : 0.10 MM,
      P5 DEPTH : 0.05 MM

      (2) KEY IN:

         (a) SET HOME VALUE : PRESS HOME INPUT 10.000 ENTER

         (b) SET TOTAL DEPTH : PRESS END INPUT -5.000 ENTER

         (c) SET P1 VALUE : PRESS Pn 1 INPUT -4.300 ENTER

         (d) SET P2 VALUE : PRESS Pn 2 INPUT -4.600 ENTER

         (e) SET P3 VALUE : PRESS Pn 3 INPUT -4.850 ENTER

         (f) SET P4 VALUE : PRESS Pn 4 INPUT -4.950 ENTER
NOTE:
(1) THE DRO COUNTER ONLY SAVE THE LAST SET OF MACHINING DEPTH. SO, MACHINING DIFFERENT JOB, MUST KEY IN EACH STEP OF DEPTH.

(2) BEFORE START SPARKING, MUST MOVE THE Z SERVO HEAD HIGHER THAN THE VALUE.

(3) SET THE WORKPIECE SURFACE VALUE AT Z = 0.000 MM

2. EDIT MACHINING PARAMETERS FOR EACH STEP DEPTH:

A. SINGLE STEP MACHINING:

(1) PRESS "EDIT", DECIDE THE "JOB NO." & "STEP NO."

(2) WITH FUZZY LOGIC CONTROL SYSTEM TO SET MACHINING PARAMETERS:

INPUT (NO. 86 - NO. 89) DATAS THEN PRESS (75. SAVE) KEY.

THAT IS THE PARAMETERS UNDER THIS "JOB NO." & "STEP NO."

ON A NORMAL SUITATION, THE ELECTRODE-WORKPIECE MATERIALS & ELECTRODE SIZE DOESN'T CHANGE AND ELECTRODE WEAR IS SET SET AT 2. SO, ONLY CHANGE THE PEAK CURRENTS FOR EACH STEP OF DEPTH.

(3) UNDER FUZZY SYSTEM, THERE IS A PEAK CURRENT LIMIT AT A FIXED ELECTRODE SIZE. FOR EXAMPLES: (AZ50R), SET (87. ELECTRODE REAL MACHINING SIZE) AT 1: PEAK CURRENT LIMIT: 1.5A,

SET AT 2: 2A, SET AT 3: 3A, SET AT 4: 6A, SET AT 5: 9A,

SET AT 6: 13A, SET AT 7: 28A & SET AT 8: 50A.

(4) OPERATOR SET MACHINING PARAMETERS:

PRESS (96. FUZZY) KEY OFF, INPUT 12 PARAMETERS THEN PRESS (75. SAVE) KEY. THAT IS THE PARAMETERS UNDER THIS "JOB NO." "STEP NO."
NORMALLY, WHEN PRESSING (96. FUZZY) KEY OFF, OPERATOR MAY JUST MODIFY SOME OF DATAS IN THE 12 PARAMETERS THEN PRESS (75. SAVE) KEY.

NOTES: WHATEVER THE PARAMETERS EDITED BY FUZZY SYSTEM OR BY OPERATOR, IT'LL BE SAVED AFTER PRESS (75. SAVE) KEY. BUT, (92. JOB NO.) & (95. STEP NO.) & EACH STEP DEPTH MUST BE RECORDED BY OPERATOR SO THAT WHEN MACHINING THE SAME WORKPIECE, IT CALL BE CALL OUT TO MACHINING AND ONLY INPUT AGAIN THE DEPTHS.

B. MULTI STEPS MACHINING: (FOR EXAMPLES: 5 STEPS)

(1) ENSURE P1 - P5 EACH DEPTH ARE SET CORRECTLY.

(2) PRESS "EDIT", DECIDE "JOB NO." & "STEP NO."

(3) INPUT MACHINING PARAMETERS FOR P1 TO P5: SAME AS THE SINGLE STEP MACHINING.
THE FOLLOWINGS SHOWS THE PROCESS FOR 5 STEPS DEPTH MACHINING SETTING:
(SET THE WORKPIECE SURFACE AT ZERO POINT BY (11. EDGE FINDER))
EXAMPLE TO SET THE DIFFERENT DEPTH FROM D.R.O. PANEL:

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<th>DRO Z AXIS POSITION</th>
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<tr>
<th>DRO KEY</th>
<th>DRO INPUT VALUE</th>
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<tbody>
<tr>
<td>HOME</td>
<td>10,000</td>
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P1: 4,300  
P2: 0,300  
P3: 0,250  
P4: 0,100  
P5: 0,050  

P1: 4,300  
P2: 4,600  
P3: 4,850  
P4: 4,950  
P5: 5,000  

WORKPIECE

ELECTRODE
```
3. START MACHINING:

AFTER SETTING ALL THE MACHINING PARAMETERS, MOVE Z AXIS HIGHER THAN "HOME" POINT, ENSURE ALL SAFETY EQUIPMENTS (22. DIELECTRIC LEVEL & TEMPERATURE SENSOR), (23. FALME SENSOR), OR FIRE EXTINGUISHER WORKS NORMALLY. LOCK WORKTANK DOOR, DECIDE (8. SINGLE STEP) OR (9. MULTI STEP) MODES, TURN ON DIELECTRIC PUMP AND THEN START SPARKING.
CHART 1: PEAK CURRENT & REAL MACHINING:
A. LOW SPARKING CURRENT, SLOW MACHINING SPEED. HIGH SPARKING CURRENT, FASTER MACHINING SPEED.
B. USING COPPER AS ELECTRODE, THE WEAR WILL INCREASE ACCORDING TO MACHINING SPEED. BUT IF USING GRAPHITE AS ELECTRODE, THE WEAR IS NOT EXACTLY SAME AS COPPER. AT A CURRENT OUTPUT FIELD, THE WEAR IS NEARLY SAME.
C. THE SURFACE FINISHING & SPARKING GAP DEPENDS ON THE SPARKING CAPACITY.
CHART 2: ON TIME & REAL MACHINING:
A. ON TIME & SPARKING CURRENT DECIDE THE SURFACE FINISHING.
B. AT A FIXED SPARKING CURRENT, SHORTER ON TIME, FINER SURFACE FINISHING BUT BIGGER ELECTRODE WEAR. LONGER ON TIME, MORE ROUGH SURFACE FINISHING BUT LOWER WEAR.
C. REQUIRE LOW WEAR MACHINING, THE ON TIME MUST BE AT LEAST 100μS AND MEET WITH SUITABLE MACHINING CURRENTS. LONGER ON TIME THEN CAUSE SLOW MACHINING SPEED AND DAMAGE ELECTRODE EASILY.
CHART 3: OFF TIME & REAL MACHINING:
A. BETWEEN ON TIME & ON TIME, THERE IS A ISOLATING TIME WHICH
   WAS CALL "OFF TIME."
B. SHORTER OFF TIME, THE BIGGER AVERAGE CURRENT OUTPUT, FASTER
   MACHINING SPEED BUT POOR FLUSHING.
   LONGER OFF TIME, THE SMALLER AVERAGE CURRENT OUTPUT, SLOW
   MACHINING SPEED BUT GOOD FLUSHING.
C. THE EACH SPARKING CURRENT OUTPUT IS SAME SO THAT IT DOESN'T
   AFFECT THE SURFACE FINISHING BUT IT'S IMPORTANT TO THE
   MACHINING SPEED.

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<thead>
<tr>
<th>COPPER</th>
<th>GRAPHITE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MACHINING SLOWLY NOT EASY ARCING</td>
<td>MACHINING SPEED UP AND EASY ARCING</td>
</tr>
</tbody>
</table>

OFF-TIME PULSE
<table>
<thead>
<tr>
<th>HIGH VOLTAGE CURRENT SETTING VALUE</th>
<th>VOLTAGE OUTPUT</th>
<th>CURRENT OUTPUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>170V</td>
<td>0.5A</td>
</tr>
<tr>
<td>2</td>
<td>190V</td>
<td>1A</td>
</tr>
<tr>
<td>3</td>
<td>205V</td>
<td>1.5A</td>
</tr>
<tr>
<td>4</td>
<td>170V</td>
<td>0.5A</td>
</tr>
<tr>
<td>5</td>
<td>190V</td>
<td>1A</td>
</tr>
<tr>
<td>6</td>
<td>205V</td>
<td>1.5A</td>
</tr>
</tbody>
</table>