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FUNDAMENTAL MANUFACTURING PROCESSES

ELECTRICAL DISCHARGE MACHINING

SCENE 1.
CG: FBI warning

SCENE 2.
tape 40, 01:00:00-01:00:12
ANI: SME logo

SCENE 3.
tape 25, 01:01:06-01:01:20
series opening title:
FUNDAMENTAL MANUFACTURING
PROCESSES
tape 63, 12:06:32-12:09:06
opening music

MUSIC UP AND UNDER

NARRATION (VO):

THE FUNDAMENTAL MANUFACTURING PROCESSES VIDEO SERIES. EXAMINING THE TOOLS AND TECHNIQUES OF PRECISION METALWORKING.

SCENE 4.
program title,
CG: ELECTRICAL DISCHARGE
MACHINING
white text centered on black

NARRATION (VO):

THIS PROGRAM IS AN INTRODUCTION TO ELECTRICAL DISCHARGE MACHINING.

SCENE 5. 01:15:34 Wire
02:09:37 Ram

NARRATION (VO):

ELECTRICAL DISCHARGE MACHINING OR "EDM" IS A THERMAL EROSION PROCESS IN WHICH WORK MATERIAL IS REMOVED THROUGH A SERIES OF RAPIDLY REOCCURRING ELECTRICAL DISCHARGES BETWEEN AN ELECTRODE, OR CUTTING TOOL, AND A ELECTRICALLY CONDUCTIVE WORKPIECE IN THE PRESENCE OF A DIELECTRIC FLUID.

SCENE 6. Animation

NARRATION (VO):

THIS DISCHARGE OCCURS IN A VOLTAGE GAP BETWEEN THE ELECTRODE AND WORKPIECE. HEAT FROM THE SPARK VAPORIZES MINUTE PARTICLES OF WORKPIECE MATERIAL, WHICH IS THEN WASHED FROM THE GAP BY THE

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CONTINUOUSLY FLUSHING DIELECTRIC FLUID.

SCENE 7. Text over BG

NARRATION (VO):

THE TWO MAIN TYPES OF ELECTRICAL DISCHARGE MACHINES ARE RAM...,

AND WIRE-CUT.

SCENE 8. 03:11:03
02:11:04
03:16:20
05:27:30
03:18:16

NARRATION (VO):

EDM IS AN EXCEPTIONALLY DIVERSE PROCESS THAT PRODUCES PRODUCTS SUCH AS TINY ELECTRONIC CONNECTORS, HIGHLY ACCURATE MEDICAL PARTS, AUTOMOTIVE STAMPING DIES, AND AIRCRAFT BODY PANELS.

SCENE 9. 06:05:56

NARRATION (VO):

EDM HAS REPLACED MUCH OF THE MACHINING AND GRINDING STEPS FORMERLY NEEDED IN DIE MAKING, WHICH REPRESENTS THE LARGEST SINGLE USE OF THE EDM PROCESS.

SCENE 10. 02:10:33

NARRATION (VO):

DIE COMPONENTS CUT WITH EDM CAN OFTEN BE MADE IN A SINGLE PIECE NO MATTER HOW COMPLEX THEIR INTERNAL FORM. THE SINGLE-PIECE DIES ARE STRONGER THAN THOSE BUILT FROM SEGMENTS. DIES ARE CUT FROM HARDENED AND HEAT-TREATED STEELS, OR CARBIDE.

SCENE 11. Text over BG

NARRATION (VO):

OTHER MATERIALS THAT CAN BE EDM'D INCLUDE, POLYCRYSTALLINE DIAMOND, TITANIUM, HOT ROLLED AND COLD ROLL STEELS, COPPER, BRASS, AND HIGH-TEMPERATURE ALLOYS.

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SCENE 12. benefits of edm
Text Over:
01:17:04
05:27:30
05:09:55
00:02:28 3R Tape

NARRATION (VO):

THE PROCESS OF ELECTRICAL DISCHARGE MACHINING HAS MANY BENEFITS:

SINCE THE WORKPIECE AND ELECTRODE NEVER TOUCH, NO CUTTING FORCES ARE GENERATED. THIS MAKES EDM WELL-SUITED TO PRODUCING FRAIL OR FRAGILE PARTS THAT CANNOT TAKE THE STRESS OF CONVENTIONAL MACHINING.

BURR-FREE EDGES, INTRICATE DETAILS, AND SUPERIOR SURFACE FINISHES ARE POSSIBLE.

THE EDM PROCESS ELIMINATES THE RISK OF DAMAGING EXPENSIVE WORK PIECES BY ALLOWING HEAT TREATING BEFORE EDM MACHINING.

FINALLY, EDM MACHINE TOOLS WITH BUILT-IN PROCESS "KNOWLEDGE" HELPS REDUCE THE TRAINING WORKERS NEED TO PRODUCE COMPLEX PARTS.

SCENE 13. downsides to edm
Text over 01:15:34

NARRATION (VO):

THE EDM PROCESS ALSO HAS ITS LIMITATIONS:

THE METAL REMOVAL RATES ARE LOW COMPARED TO CONVENTIONAL METALCUTTING PROCESSES.

COMPLEX ELECTRODES REQUIRE LEAD TIMES FOR FABRICATION AND ARE CONSUMABLE WHILE CUTTING...

AND THE WORKPIECE MATERIAL MUST BE CONDUCTIVE.

SCENE 14. CG: THE EDM PROCESS
white text on black

SCENE 15. Graphic/04:08:23

NARRATION (VO):

THE BASIC COMPONENTS OF ELECTRICAL DISCHARGE MACHINING ARE RELATIVELY SIMPLE. THE ELECTRODE IS

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ATTACHED TO THE RAM WHICH IS CONNECTED TO ONE POLE OF A PULSED POWER SUPPLY. THE WORKPIECE CONNECTS TO THE OTHER POLE OF THE POWER SUPPLY.

SCENE 16. 04:09:14

NARRATION (VO):

THE WORKPIECE IS THEN POSITIONED SO THERE IS A SMALL GAP BETWEEN THE WORK AND THE ELECTRODE. THIS GAP IS FLOODED WITH A DIELECTRIC FLUID, WHICH ACTS AS AN INSULATOR UNTIL THE POWER IS TURNED ON.

SCENE 17. 05:27:30

NARRATION (VO):

ONCE ON, THE MACHINE CONTROL DELIVERS THOUSANDS OF "DC" ELECTRICAL PULSES PER SECOND TO THE GAP, AND EROSION BEGINS. THE SPARKS ARE GENERATED ONE AT A TIME-- BUT AT RATES FROM TENS OF THOUSANDS TO HUNDREDS OF THOUSANDS OF TIMES PER SECOND. EACH SPARK HAS A TEMPERATURE OF FROM 14,000 TO 21,000 DEGREES FAHRENHEIT.

SCENE 18. 05:27:30 cont.

NARRATION (VO):

AS EROSION CONTINUES, THE MACHINE CONTROL ADVANCES THE ELECTRODE THROUGH THE WORK, ALWAYS MAINTAINING A CONSTANT GAP DISTANCE.

SCENE 19. Graphic #1

NARRATION (VO):

TO UNDERSTAND HOW EDM REMOVES METAL LETS EXAMINE A SINGLE SPARK IN THE EROSION PROCESS. AS A PULSE OF "DC" ELECTRICITY REACHES THE ELECTRODE AND PART, AN INTENSE ELECTRICAL FIELD DEVELOPS IN THE GAP. MICROSCOPIC CONTAMINANTS SUSPENDED IN THE DIELECTRIC FLUID ARE ATTRACTED BY THE FIELD, AND

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CONCENTRATE AT THE FIELD'S STRONGEST POINT.

SCENE 20. Graphic #2

NARRATION (VO):

THESE CONTAMINANTS BUILD A HIGH-CONDUCTIVITY BRIDGE ACROSS THE GAP.

SCENE 21. Graphic #3

NARRATION (VO):

AS THE FIELD'S VOLTAGE INCREASES, THIS MATERIAL IN THE CONDUCTIVE BRIDGE HEATS UP. SOME PIECES IONIZE TO FORM A SPARK CHANNEL BETWEEN THE ELECTRODE AND THE WORKPIECE.

SCENE 22. Graphic #4

NARRATION (VO):

AT THIS POINT, BOTH THE TEMPERATURE AND PRESSURE IN THE CHANNEL RAPIDLY INCREASE, GENERATING A SPARK. A SMALL AMOUNT OF MATERIAL MELTS AND VAPORIZES FROM THE ELECTRODE AND WORKPIECE AT THE POINTS OF SPARK CONTACT.

SCENE 23. Graphic #5

NARRATION (VO):

A BUBBLE, COMPOSED OF GASEOUS BY-PRODUCTS OF VAPORIZATION, RAPIDLY EXPANDS OUTWARD FROM THE SPARK CHANNEL.

SCENE 24. Graphic #6

NARRATION (VO):

ONCE THE PULSE ENDS, THE SPARK AND HEATING ACTION STOP, COLLAPSING THE SPARK CHANNEL.

SCENE 25. Graphic #7

NARRATION (VO):

DIELECTRIC FLUID THEN RUSHES INTO THE GAP, FLUSHING MOLTEN MATERIAL FROM BOTH SURFACES. THIS EDM RESIDUE CONSISTS OF SMALL SOLIDIFIED BALLS OF

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MATERIAL AND GAS BUBBLES.

SCENE 26. Graphic #8 and Pic

NARRATION (VO):

THE RESULTING EDM'D PART CAN HAVE SEVERAL OBSERVABLE SURFACE LAYERS.

SCENE 27. Graphic #9 and Pic

NARRATION (VO):

THE TOP SURFACE LAYER IS CREATED WHEN EXPELLED MOLTEN METAL AND SMALL AMOUNTS OF ELECTRODE MATERIAL FORM SPHERES AND SPATTER THE SURFACE. THIS LAYER IS EASILY REMOVED.

SCENE 28. Graphic #10 and Pic

NARRATION (VO):

THE NEXT LAYER IS A "RECAST" OR "WHITE" LAYER, WHERE EDMING HAS ALTERED THE WORK PIECE METALLURGICAL STRUCTURE. THIS LAYER CAN BE REDUCED USING THE RIGHT CONTROL SETTINGS OR BY POLISHING THE PART.

SCENE 29. Graphic #11 and Pic

NARRATION (VO):

THE THIRD LAYER IS THE HEAT AFFECTED ZONE OR "ANNEALED" LAYER. IT HAS ONLY BEEN HEATED, NOT MELTED.

SCENE 30. The edm cycle animation

NARRATION (VO):

THE PART'S SURFACE CONDITION IS A FUNCTION OF THE EDM CYCLE, WHICH HAS AN ON-TIME AND OFF-TIME EXPRESSED IN MICROSECONDS. ALL WORK OCCURS DURING ON-TIME, SO PULSE DURATION AND THE NUMBER OF CYCLES PER SECOND—THE SUM OF ON AND OFF TIME--ARE IMPORTANT.

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SCENE 31. Animation cont.

NARRATION (VO):

METAL REMOVAL IS PROPORTIONAL TO THE AMOUNT OF ENERGY APPLIED DURING ON-TIME. THAT ENERGY IS CONTROLLED BY TWO VARIABLES; THE PEAK AMPERAGE, OR INTENSITY OF THE SPARK, AND THE LENGTH OF ON-TIME.

SCENE 32. Animation

NARRATION (VO):

THE LONGER THE ON-TIME, THE MORE THE METAL ERODES. THIS LONGER ON-TIME CREATES A BROADER, DEEPER CRATER AND A ROUGHER SURFACE FINISH THAN THAT PRODUCED BY A SHORT ON-TIME. A LARGER ON-TIME MAY ALSO PRODUCE A LARGER RECAST LAYER AND A DEEPER HEAT-AFFECTED ZONE.

SCENE 33. Animation cont.

NARRATION (VO):

OFF-TIME ALSO AFFECTS SPEED AND STABILITY OF THE EDM CUT. TOO SHORT AN OFF-TIME, AND THE EJECTED WORK MATERIAL WILL NOT BE SWEPT AWAY BY THE FLUSH OF DIELECTRIC. THE NEXT SPARK MAY THEN BE UNSTABLE.

SCENE 34. Animation cont./TEXT?

NARRATION (VO):

THE DUTY CYCLE IS THE PERCENTAGE OF ON-TIME RELATIVE TO TOTAL CYCLE TIME. THE HIGHER DUTY CYCLES MEAN INCREASED CUTTING EFFICIENCY.

SCENE 35. Animation and text

NARRATION (VO):

GAP DISTANCE BETWEEN WORKPIECE MATERIAL AND ELECTRODE ALSO IMPACTS METAL REMOVAL RATE. GENERALLY, THE SMALLER THE GAP, THE BETTER THE ACCURACY AND PART FINISH ARE, AND THE SLOWER THE

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METAL REMOVAL RATE IS.

SCENE 36. edm's kerf / Graphic

NARRATION (VO):

THE EDM'D CAVITY IS ALWAYS LARGER THAN THE ELECTRODE, WITH THE DIFFERENCE BEING CALLED THE OVERCUT, OR KERF.

SCENE 37. Graphic

NARRATION (VO):

AS AMPERAGE AND ON-TIMES INCREASE, THE OVERCUT ALSO INCREASES.

SCENE 38. Graphic

NARRATION (VO):

IT IS IMPORTANT TO KNOW THE EXPECTED OVERCUT DURING EDMING SO THAT THE ELECTRODE CAN BE PROPERLY UNDERSIZED.

--- FTB ---

SCENE 39. CG: RAM EDMING
white text on black

SCENE 40. 04:02:01
F/x 04:02:25
F/x 04:02:50
F/x 04:03:50

NARRATION (VO):

IN RAM EDM MACHINES, THE WORKPIECE MOUNTS INSIDE A TANK, AND IS COVERED WITH DIELECTRIC FLUID. AN ELECTRODE THEN LOWERS TO WITHIN A FEW THOUSANDTHS OF AN INCH OF THE WORKPIECE TO BEGIN EDMING.

SCENE 41. 02:25:25
F/x 02:26:10

NARRATION (VO):

RAM-TYPE EDMS HAVE THE ABILITY TO PRODUCE COMPLEX CAVITIES OUT OF A SOLID PIECE OF METAL.

SCENE 42. 02:09:37

NARRATION (VO):

RAM EDM MACHINES ARE ALSO REFERRED TO AS DIESINKERS OR VERTICAL EDMS, AND RANGE IN SIZE AND

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AUTOMATION FROM MANUALLY OPERATED TABLE TOP SYSTEMS TO LARGE-BED MANUAL OR COMPUTER NUMERICAL CONTROL SYSTEMS.

SCENE 43. ram edm subsystems
blue background
CG: RAM EDM SUBSYSTEMS
POWER SUPPLY
DIELECTRIC SYSTEM
ELECTRODE
SERVO SYSTEM

NARRATION (VO):

A RAM EDM HAS FOUR MAJOR SUBSYSTEMS: A POWER SUPPLY, A DIELECTRIC SYSTEM, AN ELECTRODE, AND A SERVO SYSTEM.

SCENE 44. CG, SUPER: RAM EDM POWER SUPPLY

Text per Narration

NARRATION (VO):

THE POWER SUPPLY PROVIDES THE SERIES OF "DC" CURRENT ELECTRICAL DISCHARGES BETWEEN THE ELECTRODE AND THE WORKPIECE. IT ALSO CONTROLS PULSE VOLTAGE, CURRENT, PULSE DURATION, DUTY CYCLE, PULSE FREQUENCY, AND ELECTRODE POLARITY.

SCENE 45. Animation

NARRATION (VO):

SINCE THERE IS A DIRECT RELATIONSHIP BETWEEN VOLTAGE AND THE GAP, THE POWER SUPPLY MUST SENSE THE VOLTAGE BETWEEN THE ELECTRODE AND WORKPIECE. THIS SIGNAL CONTROLS THE SERVO SYSTEM AND MAINTAINS A CONSTANT GAP DISTANCE THROUGHOUT THE EDM CYCLE.

SCENE 46. Animation W/text

NARRATION (VO):

MOST POWER SUPPLIES ALSO PROVIDE A CUTOFF OR FAULT PROTECTION CIRCUIT TO STOP POWER FLOW TO THE SYSTEM IF A SHORT CIRCUIT BETWEEN ELECTRODE AND WORKPIECE OCCURS.

SCENE 47. CG, SUPER: DIELECTRIC SYSTEM
01:10:22
Text per Narration

NARRATION (VO):

THE KEY TO SUCCESSFUL EDMING IS FLUSHING. THE EDM

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01:15:23 DIELECTRIC SYSTEM INTRODUCES CLEAN DIELECTRIC INTO THE CUTTING ZONE, FLUSHES AWAY THE EDM DEBRIS AND COOLS BOTH WORKPIECE AND ELECTRODE. POPULAR DIELECTRIC FLUIDS FOR RAM EDM ARE HYDROCARBON AND SILICON-BASED OIL.

SCENE 48. 02:22:18/02:03:33

NARRATION (VO):

THE DIELECTRIC FLUID IS PUMPED THROUGH NOZZLES, THROUGH THE ELECTRODE, OR THROUGH THE WORKPIECE... OR SOME COMBINATION OF THESE TO CONSTANTLY FLUSH THE WORK AREA.

SCENE 49. Animation

NARRATION (VO):

FLUSHING REQUIRES CAREFUL CONSIDERATION BECAUSE OF THE HIGH FORCES INVOLVED IN FORCING FLUIDS THROUGH SMALL PASSAGEWAYS. MANY LOW-PRESSURE FLUSHING HOLES ARE PREFERABLE TO A FEW HIGH-PRESSURE HOLES.

SCENE 50. CG, SUPER: THE CUTTING TOOL
04:06:36

NARRATION (VO):

THE SHAPE OF THE WORKING SURFACE OF THE ELECTRODE OR CUTTING TOOL IS A NEGATIVE OR REVERSE OF THE SHAPE OF THE CAVITY GENERATED ON THE WORKPIECE.

SCENE 51. 04:23:24/ANIMATION

NARRATION (VO):

THE RAM EDM ELECTRODE'S POLARITY USUALLY HAS A POSITIVE CHARGE, AND THE WORKPIECE'S POLARITY NEGATIVE. ALTHOUGH METAL REMOVAL IS SLOWER THAN IF POLARITY WERE REVERSED, A POSITIVE ELECTRODE POLARITY PROTECTS THE ELECTRODE FROM EXCESS WEAR AND PRESERVES ITS DIMENSIONAL ACCURACY.

SCENE 52. 04:16:19

NARRATION (VO):

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SOME EDMING REQUIRES MULTIPLE ELECTRODES THAT PERFORM ROUGHING, THEN FINISHING OPERATIONS.

SCENE 53. Text over 06:04:31

NARRATION (VO):

COPPER AND GRAPHITE ARE THE MOST COMMON ELECTRODE MATERIALS. THEY MACHINE EASILY INTO A VARIETY OF SHAPES AND ARE AVAILABLE IN SEVERAL GRADES.

SCENE 54. typical wear pattern of electrodes
06:05:13/06:05:32/06:05:56

NARRATION (VO):

WHATEVER ELECTRODE MATERIAL IS USED, IT SHOULD COMBINE HIGH STRENGTH WITH A HIGH MELTING POINT TO HELP THE ELECTRODE RESIST EROSION AT THE CORNERS, WHERE ELECTRICAL FIELDS CONCENTRATE.

SCENE 55. 05:06:00

NARRATION (VO):

MAKING THE ELECTRODES IS AN IMPORTANT STEP IN RAM EDM.

SCENE 56. 05:05:17

NARRATION (VO):

ELECTRODES ARE SHAPED ON ALL TYPES OF MACHINES. SINCE THE GRAPHITE MATERIAL TURNS TO DUST, THE MACHINE MUST BE EQUIPPED WITH A SYSTEM OF DUST CONTROL AND EVACUATION.

SCENE 57. CG, SUPER: THE SERVOSYSTEM
02:09:24

NARRATION (VO):

THE SERVO SYSTEM CONTROLS INFEED OF THE ELECTRODE TO PRECISELY DETERMINE THE RATE OF MATERIAL REMOVAL.

SCENE 58. 02:20:08

NARRATION (VO):

IF THE GAP VOLTAGE SENSOR DETERMINES THERE IS RESIDUE BRIDGING THE GAP BETWEEN ELECTRODE AND

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WORKPIECE, THE SERVO SYSTEM WILL REVERSE FEED UNTIL THE CONTAMINANT IS FLUSHED AWAY.

SCENE 59. TEXT/02:23:17

00:10:09 3R TAPE

NARRATION (VO):

THE GREATEST BENEFIT OF A CNC RAM EDM MACHINE COMES FROM THE CAPABILITY TO CHANGE TOOLS AUTOMATICALLY, BOOSTING UNATTENDED RUN-TIME.

SCENE 60. 04:16:19/06:10:56

NARRATION (VO):

THE TOOLCHANGER HOLDS MULTIPLE ELECTRODES, AND THE PARTS PROGRAM AUTOMATICALLY CHANGES THEM. THIS ALLOWS MULTIPLE CAVITIES OR A VARIETY OF WORKPIECES TO BE EDM'D.

SCENE 61. Animation

NARRATION (VO):

ORBITING IS A PATTERNED MOVEMENT BETWEEN ELECTRODE AND WORKPIECE THAT ADDS EDM'ING CAPABILITIES NOT ACHIEVED WITH STRAIGHT-DOWN SINKING.

SCENE 62. 00:10:27 3R TAPE

NARRATION (VO):

ORBITING THE ELECTRODE DISTRIBUTES WEAR EVENLY, SO THE CORNERS DO NOT WEAR AS FAST. LESS CUTTING IS DONE WITH THE BOTTOM... AND BOTTOM CORNERS OF THE ELECTRODE AND MORE WITH THE SIDES.

SCENE 63. 00:10:27 CONT.

NARRATION (VO):

ORBITING IS TYPICALLY ACCOMPLISHED ON A NON-CNC SINKER BY USING AN ORBITING DEVICE ON THE MACHINE'S QUILL. ON A CNC EDM, ORBITING IS FREQUENTLY DONE BY MOVING THE WORKTABLE RATHER THAN THE QUILL.

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SCENE 64. Animation

NARRATION (VO):

EMPLOYING A "CONTOURING" MOTION, A STANDARD OR SIMPLE ELECTRODE SHAPE MAY BE USED TO GENERATE A CAVITY WITHOUT HAVING TO MACHINE AN ELECTRODE TO THE EXACT FORM OF THE CAVITY.

--- FTB ---

SCENE 65. WIRE EDMING
white text on black

SCENE 66. 03:18:21

NARRATION (VO):

CNC WIRE-CUT EDM MACHINES USE A TRAVELLING WIRE ELECTRODE TO CUT COMPLEX OUTLINES AND FINE DETAILS IN STAMPING AND BLANKING DIES OF PREHARDENED TOOL STEEL.

SCENE 67. 03:04:34

NARRATION (VO):

THE WIRE DRIVE SYSTEM CONTINUOUSLY DELIVERS FRESH WIRE UNDER CONSTANT TENSION TO THE WORK AREA GUIDED BY A SET OF SAPPHIRE OR DIAMOND WIRE GUIDES. NEW WIRE IS ALWAYS EXPOSED TO THE PART, SO ELECTRODE WEAR ISN'T A PROBLEM LIKE IN RAM EDMING.

SCENE 68. 03:14:06

WIRE EDM MACHINES ARE ALSO EASIER TO LEARN THAN RAM EDM. THEY CAN RUN UNATTENDED FOR LONG PERIODS, INCLUDING OVERNIGHT AND WEEKENDS.

SCENE 70. Graphic/01:18:38

NARRATION (VO):

THERE ARE FOUR BASIC WIRE EDM SUBSYSTEMS, ALL OF WHICH ARE CNC CONTROLLED. THOSE SUBSYSTEMS INCLUDE: THE POWER SUPPLY, THE DIELECTRIC SYSTEM,

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THE WIRE FEEDING SYSTEM, AND THE POSITIONING SYSTEM.

SCENE 71. CG, SUPER: THE POWER SUPPLY & Text per Narration

NARRATION (VO):

THE WIRE EDM POWER SUPPLY PRINCIPLES ARE SIMILAR TO RAM EDM. IT PROVIDES THE SERIES OF "DC" CURRENT ELECTRICAL DISCHARGES BETWEEN THE WIRE ELECTRODE AND THE WORKPIECE.

SCENE 72. CG, SUPER: THE DIELECTRIC SYSTEM 01:23:45/05:09:12

NARRATION (VO):

AS WITH RAM EDM, FLUSHING IS CRITICAL. THE WIRE EDM DIELECTRIC SYSTEM USES DEIONIZED WATER WHICH CAN REMOVE HEAT MORE EFFICIENTLY THAN CONVENTIONAL DIELECTRIC OILS AND PRODUCE EXTREMELY THIN RECAST LAYERS.

SCENE 73. 05:12:45

NARRATION (VO):

FLUSHING IS DONE ALONG THE WIRE WITH FLUSHING NOZZLES. IN SOME CASES THE WORKPIECE AND WIRE ARE COMPLETELY SUBMERGED IN THE DIELECTRIC.

SCENE 74. 05:14:00/05:14:30

NARRATION (VO):

THE DOWNSIDE OF SUBMERGED CUTTING IS THAT ELECTROLYTIC CORROSION CAN HARM WORKPIECES. ADDITIONALLY, MACHINES WITH TANKS ARE MORE EXPENSIVE AND CYCLE TIMES ARE INCREASED BY FILL AND DRAIN TIMES.

SCENE 75. CG, SUPER: THE WIRE FEEDING SYSTEM 05:10:50 w/Text

NARRATION (VO):

THE WIRE FEEDING MECHANISM IS MADE UP OF SEVERAL ELEMENTS, INCLUDING:

A LARGE SPOOL OF WIRE,

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ROLLERS THAT DIRECT THE WIRE THROUGH THE MACHINE,
A METAL CONTACT TO CONDUCT POWER TO THE WIRE,
GUIDES TO KEEP THE WIRE STRAIGHT IN THE CUT,
PINCH ROLLS WHICH PROVIDE DRIVE AND WIRE TENSION
A SYSTEM TO THREAD THE WIRE FROM THE UPPER TO THE LOWER GUIDE,
A IDLE OR BALANCING ARM,
A SENSOR TO DETECT WHEN THE WIRE RUNS OUT OR BREAKS.
AND POSSIBLY, A TAKE UP SPOOL FOR THE SPENT WIRE OR A PLACE FOR THE WIRE TO COLLECT.

SCENE 76. AGEE Video Clip/NA

NARRATION (VO):

AN AUTOMATIC WIRE RETHREADING SYSTEM ALLOWS WIRE EDM TO RUN UNATTENDED. IT PROVIDES THE CAPABILITY OF RETHREADING THE WIRE AFTER IT HAS BROKEN.

SCENE 77. Text over 03:00:45
05:25:35

NARRATION (VO):

TYPICAL WIRE DIAMETER IS FROM TWO THOUSANDTHS TO THIRTEEN THOUSANDTHS OF AN INCH THICK. BECAUSE THE WIRE ELECTRODE IS THIN, POWER IS LIMITED AND METAL REMOVAL RATES ARE LOW. THOSE REMOVAL RATES ARE MEASURED IN INCHES TRAVERSED PER HOUR TIMES THE THICKNESS OF THE WORK IN INCHES, AND ARE CALLED "SQUARE INCHES PER HOUR". TOP SPEEDS FOR WIRE EDM ARE IN THE TWENTY TO TWENTY FIVE SQUARE INCHES PER HOUR RANGE.

SCENE 78. CG, SUPER: THE POSITIONING SYSTEM 01:17:04

NARRATION (VO):

THE POSITIONING SYSTEM CAN USE A CNC TWO-AXIS

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TABLE AND PROVIDE A VARIETY OF MULTI-AXIS WIRE POSITIONING CAPABILITIES, DEPENDING ON THE CUTS THAT MUST BE MADE.

SCENE 79. SHOW AXIS IN ABOVE W/ARROWS

NARRATION (VO):

A TWO-AXIS WIRE EDM MACHINE CAN MAKE ONLY RIGHT-ANGLE CUTS TO THE WORK TABLE.

SCENE 80. Pic?

NARRATION (VO):

AN INDEPENDENT FOUR-AXIS MACHINE CAN CREATE TAPERED ANGLES, EVEN WITH A TOP PROFILE THAT IS A DIFFERENT SHAPE THAN THE BOTTOM PROFILE. THIS IS NECESSARY FOR PRODUCING EXTRUSION DIES AND FLOW VALVES.

SCENE 82. Animation

NARRATION (VO):

AS IN RAM EDM, THE ELECTRODE NEVER TOUCHES THE WORKPIECE WHILE CUTTING. THE SERVO SYSTEM MAINTAINS AT LEAST A ONE THOUSANDTH OF AN INCH GAP BETWEEN WIRE AND WORKPIECE AS WORK ADVANCES.

SCENE 83. Animation/03:00:45

NARRATION (VO):

DURING SPARK EROSION, EACH WIRE PRODUCES A KERF OR OVERCUT IN THE WORK SURFACE THAT IS SLIGHTLY LARGER THAN THE WIRE'S DIAMETER. A TWELVE THOUSANDTHS OF AN INCH-DIAMETER WIRE, FOR EXAMPLE, CAN CREATE A FIFTEEN THOUSANDTHS OF AN INCH KERF.

SCENE 84. In the gap 03:13:34

NARRATION (VO):

THE WIRE CUTS ALONG A PROGRAMMED PATH. THE WIRE STARTS INTO THE CUT FROM THE SIDE OF THE WORKPIECE OR THROUGH DRILLED HOLES MADE WITH SMALL EDM

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HOLEMAKING MACHINES DESIGNED FOR THAT PURPOSE.

SCENE 85. Animation

NARRATION (VO):

WIRE EDM MACHINES CAN ALSO PROCESS PARTS THAT ARE STACKED, CUTTING PERHAPS FIFTY THIN PARTS AT A PASS. UNDER THESE CONDITIONS, HOWEVER, FLUSHING COULD BE PROBLEMATIC.

SCENE 86. small hole edm drilling,
00:07:55

NARRATION (VO):

A THIRD TYPE OF ELECTRICAL DISCHARGE MACHINING INVOLVES DRILLING SMALL, DEEP HOLES AND SLOTS OF ROUND, OR IRREGULAR SHAPES.

SCENE 87. 01:05:21
01:06:18

NARRATION (VO):

THESE MACHINES USE TUBULAR ELECTRODES UP TO A FOOT LONG, WITH DIAMETERS FROM ONE-HUNDREDTH TO ONE-EIGHTH OF AN INCH. THESE ROUND ELECTRODES ARE ROTATED AT MODERATE SPEEDS OF UP TO 100 REVOLUTIONS PER MINUTE DURING DRILLING. THIS ROTATION AIDS IN FLUSHING THE CUT, AND TENDS TO CREATE UNIFORM ELECTRODE WEAR.

SCENE 88. 01:13:13

NARRATION (VO):

THESE MACHINES CAN DRILL NUMEROUS SMALL HOLES OF ONE OR MULTIPLE DIAMETERS TO ACCURACIES NEAR PLUS OR MINUS ONE THOUSANDTHS OF AN INCH.

SCENE 89. 01:05:50

NARRATION (VO):

ADDITIONALLY, THIS PROCESS CAN OBTAIN LENGTH TO DIAMETER RATIOS OF 30 TO 1 OR BETTER.

SCENE 90. 01:22:40
02:12:20
04:07:50

NARRATION (VO):

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FIRE IS A RISK WITH RAM EDMING IF THE DIELECTRIC FALLS BELOW THE LEVEL AT WHICH SPARKING IS GOING ON. WHEN THIS HAPPENS, THE DIELECTRIC CAN BE HEATED ABOVE ITS FLASHPOINT AND SPARKS CAN IGNITE IT. THE MACHINE SHOULD TURN OFF AUTOMATICALLY WHEN THE DIELECTRIC DROPS BELOW A SAFE LEVEL.

SCENE 91. 02:07:10

NARRATION (VO):

SMOKE FROM THE PROCESS CAN BE AN IRRITANT. SMOKE SHOULD BE PROPERLY VENTED, OR SMOKE-CONSUMING UNITS CAN BE ATTACHED TO MACHINES.

SCENE 92.

NARRATION (VO):

FINALLY, EDM CAN PRODUCE HAND SKIN IRRITATION, WHICH IS REMEDIED WITH HAND CREAMS.

--- FTB ---

SCENE 93. CG: REVIEW
white text on black
tape 63, 12:00:15-12:03:49
review music

NARRATION (VO):

LET'S REEXAMINE THE MATERIAL CONTAINED IN THIS VIDEOTAPE.

SCENE 94. Animation from Scene 6
01:24:39

NARRATION (VO):

EDM IS A THERMAL EROSION PROCESS IN WHICH AN ELECTRICALLY GENERATED SPARK BURNS OR VAPORIZES THE ELECTRICALLY CONDUCTIVE WORK MATERIAL.

SCENE 95. 02:09:37 Ram
01:15:34 Wire

NARRATION (VO):

HIGH-FREQUENCY, PULSED DC CURRENT IS APPLIED TO THE WORKPIECE THROUGH EITHER A SHAPED ELECTRODE... OR A MOVING WIRE.

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SCENE 96. Animation from Sc 33

NARRATION (VO):

THE SPARKS JUMP ACROSS A SMALL GAP WITHIN A DIELECTRIC FLUID BETWEEN THE ELECTRODE AND THE WORKPIECE.

SCENE 97. Animation from Sc31/32

NARRATION (VO):

MACHINING TAKES PLACE DURING THE MICROSECONDS OF THE CURRENT OR SPARK'S "ON-TIME".

SCENE 98. Cont Animation above

NARRATION (VO):

THE LONGER THE SPARK IS "ON" THE DEEPER THE CAVITY CREATED AND THE FASTER THE RATE OF MACHINING OR BURNING. SHORTER ON-TIMES YIELD FINER FINISHES.

SCENE 99. TEXT PER NARRATION

NARRATION (VO):

ON AND OFF PULSES HAPPEN THOUSANDS OF TIMES A SECOND, WITH THEIR OPTIMAL LENGTHS DETERMINED BY SUCH PARAMETERS AS WORK MATERIAL, ELECTRODE MATERIAL, ROUGH OR FINISH CUTTING, DESIRED SURFACE FINISH, AND FLUSHING CONDITIONS.

SCENE 100. TEXT PER NARRATION

NARRATION (VO):

THE EDM PROCESS HAS MANY BENEFITS, INCLUDING:

EXCELLENT ACCURACY AND REPEATABILITY...

THE ABILITY TO CUT HARD MATERIALS SUCH AS DIE STEELS OR CARBIDE...

THE CAPABILITY TO PRODUCE SMALLER AND DEEPER HOLES THAN CHIP-CUTTING PROCESSES...

IT IS WELL-SUITED TO AUTOMATION AND LONG PERIODS OF UNATTENDED OPERATION...

SINCE THE EDM ELECTRODE OR WIRE NEVER TOUCHES THE

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PART, NO CUTTING FORCES BEING GENERATED.

SCENE 101. TEXT PER NARRATION

NARRATION (VO):

THE LIMITATIONS OF THE EDM PROCESS INCLUDE:

SLOW MACHINING RATES IN COMPARISON TO OTHER MATERIAL REMOVAL PROCESSES...

POSSIBLE DAMAGED SURFACE LAYERS ON THE WORKPIECE...

AND, WORKPIECES MUST BE ELECTRICALLY CONDUCTIVE.

SCENE 102. 02:12:20/01:24:39
01:05:21

NARRATION (VO):

EDM SYSTEMS ARE EITHER RAM, WIRE OR SPECIAL-PURPOSE HOLE-MAKING MACHINES.

SCENE 103. Animation w/Text

NARRATION (VO):

THE MAJOR EDM SUBSYSTEMS ARE: THE POWER SUPPLY, THE DIELECTRIC SYSTEM, THE ELECTRODE, AND THE SERVO SYSTEM.

SCENE 106. 05:25:27

NARRATION (VO):

THE MAIN DIFFERENCE BETWEEN RAM AND WIRE EDM IS THE ELECTRODE—RAM EDM ELECTRODES ARE COMMONLY MADE OF GRAPHITE AND COPPER. WIRE EDM USES A CONSTANTLY MOVING STRAND WIRE MATERIAL TO CUT CONTOURS.

SCENE 107.
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Some Machinery In This Program Had Safety Equipment Removed To Allow Better Recording Of Certain Processes.
Always Read The Safety Information Provided In The Manufacturers Manual Before Operating Any Machine

SCENE 108.
tape 40, 01:00:00-01:00:12
ANI: SME logo