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FUNDAMENTAL MANUFACTURING PROCESSES

PLASTIC INJECTION MOLDING

SCENE 1.
CG: FBI warning
white text centered on black to blue gradient

WARNING

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SCENE 2.
CG: disclaimer
white text centered on black to blue gradient

Always read the operating manual and safety information provided by the manufacturer before operating any injection molding equipment. Make sure all machine guards are in place, and follow all safety procedures when working with or near injection molding equipment.

SCENE 3.
tape 40, 01:00:00-01:00:12
SME logo

SCENE 4.
tape 25, 01:01:00-01:01:45
fundamental series open, with music

MUSIC UP AND UNDER

NARRATION (VO):

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

SCENE 5.
program title:
CG: PLASTIC INJECTION MOLDING
white text centered on black

NARRATION (VO):

THIS PROGRAM IS AN INTRODUCTION TO PLASTIC INJECTION MOLDING.

SCENE 6.
tape 421, 15:24:01-15:24:11
part falling out of injection mold, cycle beginning
tape 422, 16:06:17-16:06:47
zoom in, injection process
part falling out of injection mold, cycle beginning

NARRATION (VO):

INJECTION MOLDING IS THE MOST COMMON METHOD OF PRODUCING PARTS OUT OF PLASTIC MATERIAL. THE PROCESS INVOLVES INJECTING MOLTEN PLASTIC AT HIGH

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PRESSURE INTO A MOLD SHAPED IN THE FORM OF A PART.

ONCE THIS PLASTIC COOLS AND SOLIDIFIES, THE MOLD

OPENS, AND THE PART IS EJECTED.

SCENE 7.
tape 405, 10:02:22-10:02:28
2 shots, parts falling out of injection mold, cycle beginning
tape 416, 13:01:51-13:01:55
small part with many holes
tape 416, 13:02:29-13:02:33
small gray door with spring
tape 416, 13:04:45-13:04:49
glue stick with thread
tape 416, 13:11:32-13:11:39
cd-rom holder with hinge

NARRATION (VO):

INJECTION MOLDING IS AN EXTREMELY VERSATILE

PROCESS THAT CAN PRODUCE PARTS WITH HOLES,

SPRINGS,

THREADS,

HINGES,

AND UNDERCUTS IN A SINGLE OPERATION.

SCENE 8.
tape 416, 13:08:51-13:02:57
simple injection molded frisbee
tape 416, 13:13:42-13:13:47
complex, solid tan speaker cover threaded part
tape 416, 13:00:40-13:00:50
foamed part, styrofoam cup
tape 416, 12:02:40-12:02:50
still, reinforced injection molded electrical connectors
tape 416, 13:14:43-13:14:47
filled black threaded part
tape 416, 13:07:02-13:07:06
small injection molded model part
tape 416, 12:01:10-12:01:20
still, large injection molded dumpster
tape 416, 13:02:56-13:03:03
thick injection molded part
tape 416, 13:16:22-13:16:27
thin, flexible injection molded diaphragm
tape 416, 12:02:10-12:02:20
still, rigid injection molded medical item

NARRATION (VO):

INJECTION MOLDED PARTS CAN BE SIMPLE,

OR COMPLEX,

AND CAN BE SOLID,

FOAMED,

REINFORCED,

OR FILLED.

THEY CAN BE SMALL,

OR LARGE,

THICK,

OR THIN,

FLEXIBLE,

OR RIGID.

SCENE 9.
tape 424, 18:16:25-18:16:32
part falling out of injection mold
tape 416, 13:01:35-13:01:45
polished injection molded pearls
tape 416, 13:11:52-13:11:57

NARRATION (VO):

INJECTION MOLDED PARTS ALSO LEND THEMSELVES TO

ENDLESS DECORATIVE EFFECTS. THEY CAN BE POLISHED,

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leather textured injection molded car part
tape 427, 20:01:39-20:01:43
hot stamped injection molded wood grain car interior
tape 416, 13:09:00-13:09:06
plated injection molded make-up case
tape 416, 12:01:40-12:01:50
still, colored/clear injection molded camera
tape 416, 12:03:10-12:03:20
still, clear/colored injection molded turn signal casing
tape 415, 10:15:37-10:15:46
worker pulling part out of mold

TEXTURED,

HOT STAMPED,

PLATED,

COLORED,

OR CLEAR. NO OTHER MANUFACTURING PROCESS OFFERS THE RANGE OF CAPABILITIES INJECTION MOLDING PROVIDES.

--- FADE TO BLACK ---

SCENE 10.
tape 417, 12:05:34-12:05:46
zoom out, part falling out of injection mold
tape 390, 03:22:25-03:22:35
zoom out plastic pouring

NARRATION (VO):

TO BETTER UNDERSTAND THE INJECTION MOLDING PROCESS REQUIRES UNDERSTANDING SOME PROPERTIES INHERENT IN PLASTIC ITSELF. THE SIMPLEST DEFINITION OF A PLASTIC IS ANY NATURAL OR SYNTHETIC POLYMER THAT HAS A HIGH MOLECULAR WEIGHT.

SCENE 11.
tape 420, 03:07:55-03:08:00
shot of plastic
tape 427, 22:01:00-22:01:30
blue background
CG: Thermoplastic
Thermosets
build with red bullets

NARRATION (VO):

THERE ARE TWO TYPES OF PLASTICS:

THERMOPLASTIC,

AND THERMOSETS.

SCENE 12.
tape 392, 08:23:46-08:24:01
thermoplastic melted
tape 398, 02:09:32-02:09:40
thermoplastic being reground

NARRATION (VO):

THERMOPLASTICS UNDERGO A REVERSIBLE CHANGE FROM SOLID TO LIQUID WHEN HEATED, AND CAN BE COOLED, AND REGROUND FOR REUSE OVER AND OVER AGAIN.

SCENE 13.
tape 403, 01:30:25-01:30:39
2 shots, thermoset injection molding process

NARRATION (VO):

THERMOSETS UNDERGO A CHEMICAL REACTION BETWEEN TWO REAGENTS WHEN HEATED, AND ACHIEVE THEIR STRENGTH THROUGH THE INTERLOCKING CHEMICAL BONDS. ONCE

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MOLDED, THERMOSETS CANNOT BE RESOFTENED.

SCENE 14.
tape 403, 01:31:45-01:31:49
thermoset injection molding process
tape 421, 15:18:58-15:19:05
thermoplastic injection molding process

NARRATION (VO):

WHILE THERMOSETS ARE INJECTION MOLDABLE, MOST MATERIALS USED IN INJECTION MOLDING MACHINES ARE THERMOPLASTICS.

--- FADE TO BLACK ---

SCENE 15.
tape 400, 06:09:44-06:09:54
zoom in to injection molding process

NARRATION (VO):

INJECTION MOLDING PLASTICS IS EXTREMELY COMPLICATED BECAUSE OF THE INFINITELY CHANGING PRESSURE, TEMPERATURE AND VELOCITY INSIDE THE MOLD.

SCENE 16.
tape 421, 15:07:24-15:07:33
mold opening, part ejected, mold closing, injection cycle beginning

NARRATION (VO):

THESE MOLDING CONDITIONS DIRECTLY AFFECT THE PROPERTIES OF EACH MOLDED PART. A CHANGE IN ANY OF THE CONDITIONS WILL ALTER THE PARTS PRODUCED.

SCENE 17.
tape 421, 15:04:38-15:05:00
wide pan of injection molding process
CG, SUPER: Molder
Material
Injection Machine
Mold
build with red bullets
tape 421, 15:27:48-15:27:58
wide, injection molding machine
tape 421, 15:03:40-15:03:44
wide, injection mold

NARRATION (VO):

THERE ARE FOUR PRIMARY ELEMENTS THAT INFLUENCE THE PLASTIC INJECTION MOLDING PROCESS:

THE MOLDER,

THE MATERIAL,

THE INJECTION MACHINE,

AND THE MOLD.

THIS VIDEO FOCUSES ON THE LATTER TWO, THE

INJECTION MACHINE,

AND THE MOLD.

--- FADE TO BLACK ---

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SCENE 18.
CG: THE INJECTION MOLDING MACHINE
white text centered on black

SCENE 19.
tape 405, 10:13:57-10:14:00
injection molding machine
tape 420, 03:06:55-03:07:03
injection molding machine
tape 422, 16:04:51-16:04:54
injection molding machine
tape 420, 03:00:47-03:00:52
injection molding machine
tape 405, 10:21:03-10:21:09
injection molding machine
tape 421, 15:12:34-15:12:38
injection molding machine
tape 400, 05:07:47-05:07:51
injection molding machine
tape 405, 10:14:32-10:14:34
two platen injection molding machine
tape 405, 10:14:20-10:14:23
two platen injection molding machine
tape 420, 03:16:50-03:17:00
electric injection molding machine

NARRATION (VO):

THERE ARE A VARIETY OF INJECTION MOLDING MACHINES IN USE TODAY. THE VAST MAJORITY OF THESE MACHINES ARE HYDRAULICALLY ACTUATED AND HAVE THREE PLATENS, BUT NEWER STYLES SUCH AS TWO-PLATEN INJECTION MOLDING MACHINES,
AND ELECTRIC INJECTION MOLDING MACHINES ARE NOW GAINING MARKET ACCEPTANCE.

SCENE 20.
tape 420, 03:03:50-03:03:59
injection molding machine
tape 416, 13:17:35-13:17:39
tilt down, still of small injection molding machine
tape 416, 12:00:40-12:00:50
large injection molding machine
tape 400, 05:12:59-05:13:05
injection molding machine producing part
tape 398, 02:01:14-02:01:20
vertically oriented injection molding process
tape 398, 02:06:45-02:06:52
vertically oriented injection molding process, zoom in

NARRATION (VO):

INJECTION MOLDING MACHINES RANGE IN SIZE AND COMPLEXITY, FROM DESK-SIZED UNITS UP TO MACHINES THE SIZE OF A SMALL HOUSE. MOST INJECTION MOLDING MACHINES ARE HORIZONTALLY ORIENTED, BUT VERTICALLY ORIENTED MOLDING MACHINES ARE AVAILABLE. THESE VERTICAL MACHINES ARE PRIMARILY USED FOR INSERT MOLDING.

SCENE 21.
tape 422, 16:05:59-16:06:10
wide, injection molding machine
CG, SUPER: Injection System
Clamping System
build with red bullets

NARRATION (VO):

ALL INJECTION MOLDING MACHINES ARE A COMBINATION OF TWO SYSTEMS,

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AN INJECTION SYSTEM,

AND A CLAMPING SYSTEM.

SCENE 22.
tape 417, 12:05:16-12:05:25
machine heating plastic, dissolve to next shot
tape 417, 12:04:32-12:04:40
machine injecting melt into mold
CG, SUPER: Injection System

NARRATION (VO):

THE INJECTION SYSTEM HEATS THE THERMOPLASTIC MATERIAL TO ITS APPROPRIATE VISCOSITY OR FLOWABILITY AND THEN FORCEFULLY INJECTS IT INTO THE MOLD.

SCENE 23.
continue previous shot
tape 424, 18:08:02-18:08:11
reciprocating screw injection molding machine
tape 421, 15:14:09-15:14:14
two-stage screw injection molding machine

NARRATION (VO):

THERE ARE TWO TYPES OF INJECTION MECHANISMS:

THE RECIPROCATING SCREW, WHICH IS THE MOST COMMON,

AND THE TWO-STAGE SCREW.

SCENE 24.
tape 417, 12:16:26-12:16:36
wide, reciprocating screw inject system
tape 427, 21:12:15-21:12:25
shot of hopper
CG, SUPER: Hopper
tape 423, 17:08:04-17:08:12
reciprocal screw outside of machine
CG, SUPER: Reciprocating Screw
tape 427, 21:10:39-21:10:51
pan of injection barrel
CG, SUPER: Injection Barrel
tape 427, 21:12:32-21:12:38
shot of hydraulic motor
CG, SUPER: Hydraulic Motor
tape 427, 21:10:22-21:10:30
pan of injection cylinder
CG, SUPER: Injection Cylinder

NARRATION (VO):

THE MAIN PARTS OF THE RECIPROCATING SCREW INJECTION SYSTEM ARE:

THE HOPPER,

A RECIPROCATING SCREW,

INSIDE AN EXTERNALLY HEATED INJECTION BARREL,

A HYDRAULIC MOTOR,

AND AN INJECTION CYLINDER.

SCENE 25.
tape 398, 02:17:51-02:18:00
hopper

NARRATION (VO):

RESIN MATERIAL IS FED TO THE INJECTION BARREL FROM THE HOPPER.

SCENE 26.
tape 390, 03:21:41-03:21:44
hopper filled manually
tape 398, 02:18:03-02:18:15

NARRATION (VO):

THESE HOPPERS MAY BE FILLED MANUALLY, OR VACUUM

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pan, hopper filled automatically to dryer on top

FED AUTOMATICALLY, AND OFTEN HAVE DRYERS ATTACHED TO THE TOP TO REMOVE THE MOISTURE FROM THE MATERIAL.

SCENE 27.
tape 428, 00:00:48-00:01:20
ANI: resin entering the injection barrel from the hopper, driven forward by the rotation of the screw

NARRATION (VO):

AS THE RESIN ENTERS THE INJECTION BARREL IT IS DRIVEN FORWARD BY THE ROTATION OF THE SCREW, WHICH IS POWERED BY THE HYDRAULIC MOTOR.

SCENE 28.
continue animation

NARRATION (VO):

THE RESIN PLASTICIZES, OR MELTS, AS THE TURNING SCREW "DRAGS" IT TOWARDS THE NOZZLE END. THIS IS REFERRED TO AS DRAG FLOW. DRAG FLOW CAUSES THE POLYMER MOLECULES TO SLIDE OVER EACH OTHER CREATING FRICTIONAL HEAT WHICH MELTS THE MATERIAL.

SCENE 29.
tape 417, 12:12:19-12:12:35
pan, heating bands on injection barrel
tape 427, 21:02:32-21:02:42
zoom out from thermocouple in barrel
tape 427, 21:02:11-21:02:15
thermocouple in nozzle

NARRATION (VO):

EXTERNAL HEATING BANDS PROVIDE ADDITIONAL HEAT TO THE INJECTION BARREL. THE HEATING BANDS BRING THE MATERIAL TO ITS FINAL TEMPERATURE AND COMPENSATE FOR THE RADIATION HEAT LOSS. THE TEMPERATURE IS CONTROLLED BY THREE THERMOCOUPLES IN THE BARREL AND ONE IN THE NOZZLE.

SCENE 30.
tape 428, 00:02:40-00:02:50
GRAPHIC: wide of reciprocal screw
tape 428, 00:03:02-00:03:12
GRAPHIC: reciprocal screw's feed zone highlighted
CG, SUPER: Feed Zone
tape 428, 00:02:00-00:02:07
ANI: c.u. feed zone area, arrows indicating constant flight depth, screw begins to rotate, forcing plastic pellet material together

NARRATION (VO):

THE SCREW CONSISTS OF THREE ZONES. THE FIRST ZONE, WHICH IS ONE HALF OF THE SCREW, IS CALLED THE FEED ZONE. IT HAS A CONSTANT FLIGHT DEPTH, WHICH FORCES THE MATERIAL TOGETHER AND RIDS IT OF AIR.

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SCENE 31.
tape 428, 00:03:22-00:03:32
GRAPHIC: reciprocal screw's melt zone highlighted
CG, SUPER: Melt Zone
tape 428, 00:04:16-00:04:32
ANI: c.u. melt zone area, arrows indicating decreasing flight depth, screw rotating, plastic pellet material melting
tape 428, 00:03:43-00:03:53
GRAPHIC: reciprocal screw's metering zone, highlighted
CG, SUPER: Metering Zone

NARRATION (VO):

THE SECOND ZONE, CALLED THE MELT ZONE, HAS A DECREASING FLIGHT DEPTH WHICH REDUCES THE PLASTIC VOLUME. THIS CAUSES THE PLASTIC MOLECULES TO RUB HARDER AGAINST EACH OTHER, PLASTICIZING THE MATERIAL. THE MELT ZONE LEADS TO THE THIRD, OR, METERING ZONE.

SCENE 32.
tape 428, 00:05:12-00:05:48
ANI: c.u. metering zone area, arrows indicating decreased, constant flight depth, screw rotating, plastic pellet material melting

NARRATION (VO):

THE METERING ZONE HAS A CONSTANT FLIGHT DEPTH MUCH SMALLER THAN THAT OF THE FEED ZONE. THIS SECTION ACTS AS A PUMP.

SCENE 33.
continue animation

NARRATION (VO):

THE TIP OF THE SCREW HAS A ONE-WAY VALVE WHICH LETS THE MATERIAL FLOW ONLY TOWARDS THE NOZZLE END. THE FORCE OF THE PLASTICIZED MATERIAL PUSHES THE SCREW BACK AS IT TURNS. THIS BUILDS A CHAMBER OF PLASTIC IN FRONT OF THE SCREW. WHEN ENOUGH MATERIAL FOR THE INJECTION SHOT IS MELTED, THE SCREW STOPS AND PULLS BACK TO DECOMPRESS THE MATERIAL.

SCENE 34.
tape 428, 00:06:23-00:06:43
ANI: material injected into mold

NARRATION (VO):

FOR INJECTING THE MATERIAL, THE ONE-WAY VALVE CLOSES AS THE SCREW IS HYDRAULICALLY PUSHED FORWARD BY THE INJECTION CYLINDER. THIS SENDS THE MOLTEN MATERIAL THROUGH THE INJECTION UNIT'S NOZZLE, AND INTO THE INJECTION MOLD.

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SCENE 35.
tape 400, 05:13:31-05:13:52
zoom out, injection process

NARRATION (VO):

THE PRIMARY SPEED AND THE INJECTION PRESSURE, CALLED THE PACKING PRESSURE, IS HIGH, USUALLY AROUND 20,000 PSI, BUT SOMETIMES REACHING UP TO 30,000 PSI OR HIGHER. A SECONDARY LOWER PRESSURE IS APPLIED SHORTLY AFTER THE INITIAL INJECTION.

SCENE 36.
tape 398, 02:19:25-02:19:39
pan, injection process

NARRATION (VO):

AT THE TIME OF INJECTION, THE MATERIAL'S TEMPERATURE RANGES FROM APPROXIMATELY 320 TO 600 DEGREES FAHRENHEIT, OR 160 TO 320 DEGREES CELSIUS.

SCENE 37.
tape 428, 00:07:22-00:07:39
ANI: after injection, sprue bushing solidifying, reciprocating screw begins to rotate again, melting material for the next shot

NARRATION (VO):

ONCE THE PLASTIC SOLIDIFIES, NO MORE PRESSURE CAN BE EXERTED UPON IT IN THE MOLD. THE RECIPROCATING SCREW THEN BEGINS TO ROTATE AGAIN, MELTING MATERIAL FOR THE NEXT SHOT.

--- FADE TO BLACK ---

SCENE 38.
tape 421, 15:13:23-15:13:30
wide, two-stage screw machine
tape 421, 15:15:19-15:15:36
pan of screw and bore cylinder
tape 421, 15:15:49-15:16:06
two-stage screw injecting material into mold

NARRATION (VO):

THE TWO-STAGE SCREW TYPE MACHINE HAS A SCREW WHICH CONSTANTLY FORCES MELTED RESIN INTO A SECOND STRAIGHT BORE CYLINDER WITH ITS OWN PLUNGER. WHEN THE CORRECT AMOUNT OF MATERIAL HAS BEEN TRANSFERRED, THE SCREW STOPS TURNING, AND A VALVE CLOSES, SEPARATING THE CYLINDERS. THE PLUNGER PULLS BACK TO DECOMPRESS THE MATERIAL, WHICH IS THEN INJECTED INTO THE MOLD.

--- FADE TO BLACK ---

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SCENE 39.
tape 400, 06:05:09-06:05:28
tilt, clamping system as mold opens
CG, SUPER: Clamping System

NARRATION (VO):

THE FUNCTION OF AN INJECTION MOLDING MACHINE'S CLAMPING SYSTEM IS TO KEEP THE PLASTIC MATERIAL FROM LEAKING OUT, OR FLASHING, AT THE PARTING LINE OF THE MOLD'S CAVITY AND CORE.

SCENE 40.
tape 400, 05:11:44-05:12:00
pan, hydraulic clamping system of injection molding machine
tape 427, 21:04:33-21:04:46
clamping system as mold opens

NARRATION (VO):

THE CLAMPING SYSTEM OF THE INJECTION MOLDING MACHINE HAS TWO CONFIGURATIONS. ONE IS A FULLY HYDRAULIC SYSTEM WHERE THE TOTAL CLAMPING FORCE IS GENERATED BY THE HYDRAULIC CLAMPING CYLINDER.

SCENE 41.
tape 421, 15:10:22-15:10:34
toggle clamping system of injection molding machine

NARRATION (VO):

THE SECOND IS A TOGGLE SYSTEM WHERE A MUCH SMALLER HYDRAULIC CYLINDER IS USED IN CONJUNCTION WITH A SERIES OF TOGGLE LEVERS TO PROVIDE THE FULL CLAMPING FORCE.

SCENE 42.
tape 415, 10:28:06-10:28:26
pull back of injection molding machines

NARRATION (VO):

INJECTION MOLDING MACHINES ARE DESIGNATED BY THEIR CLAMP TONNAGE, WHICH IS THE AMOUNT OF SEALING FORCE A MACHINE CAN PRODUCE AGAINST THE HIGH PRESSURES GENERATED DURING THE INJECTION PROCESS.

SCENE 43.
tape 415, 10:23:12-10:23:25
med, pull back, platen holding mold, machine closes
tape 415, 10:08:10-10:08:30
static of injection molding machines, image grays down with each platen highlighted
CG, SUPER: Stationary Platen
Movable Platen
Rear Stationary Platen

NARRATION (VO):

PLATENS ARE LARGE THICK BLOCKS OF TOUGH STEEL WHICH WILL NOT DEFLECT ENOUGH TO AFFECT THE INJECTION PROCESS. THERE ARE THREE PLATENS ON MOST INJECTION MOLDING MACHINES:

A STATIONARY PLATEN...,

A MOVABLE PLATEN...,

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AND A REAR STATIONARY PLATEN.

SCENE 44.
tape 415, 10:11:11-10:11:19
zoom in, hole on stationary platen
wide,
tape 415, 10:01:16-10:01:33
zoom out, stationary platen with cavity side of the mold, anchoring the machines four tie bars

NARRATION (VO):

THE STATIONARY PLATEN HAS A HOLE DIRECTLY IN LINE WITH THE INJECTION CYLINDER'S NOZZLE. THE CAVITY SIDE OF THE MOLD, SOMETIMES CALLED THE "A" OR STATIONARY SIDE IS ATTACHED TO THE STATIONARY PLATEN. THE STATIONARY PLATEN ALSO ANCHORS ONE END OF THE MACHINES FOUR TIE BARS.

SCENE 45.
tape 415, 10:04:02-10:04:13
zoom in, movable platen holding the "b" half of the mold

NARRATION (VO):

THE MOVABLE PLATEN HOLDS THE CORE SIDE OF THE MOLD. THIS IS ALSO REFERRED TO AS THE EJECTION, KNOCKOUT, OR "B" SIDE OF THE MOLD.

SCENE 46.
tape 400, 06:09:00-06:09:18
movable platen moving back on the tie bars, mold opens, part expelled

NARRATION (VO):

THIS MOVABLE PLATEN MOVES BACK AND FORTH ON THE TIE BARS. AS THE MOLD OPENS, THE EJECTION SYSTEM EXPELS THE MOLDED PART.

SCENE 47.
continue previous shot

NARRATION (VO):

THE REAR STATIONARY PLATEN HOLDS THE OTHER END OF THE TIE BARS, ANCHORING THE ENTIRE CLAMPING SYSTEM.

SCENE 48.
tape 417, 12:19:41-12:19:58
zoom out injection molding machine with all the safety feature in place, running parts

NARRATION (VO):

INJECTION MOLDING MACHINES ARE DESIGNED NOT TO OPERATE UNLESS THE FRONT AND REAR SAFETY GATES ARE CLOSED. THIS LIMITS ACCESS TO THE PLATEN AREA WHILE THE MACHINE IS IN OPERATION.

SCENE 49.
tape 417, 12:28:51-12:29:04
zoom in, safety bar coming down

NARRATION (VO):

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as door to injection molding machine is opened, dissolve to later in same shot
tape 417, 12:29:09-12:29:13
injection molding operation, cut on action with previous shot

A SAFETY DROP BAR IS REQUIRED ON INJECTION MOLDING MACHINES. IT DROPS DOWN BETWEEN THE PLATENS WHEN THE SAFETY GATE IS OPEN, SO THAT THE MACHINE CANNOT CLOSE UPON A PERSON. THIS IS IN ADDITION TO OTHER HYDRAULIC AND ELECTRICAL SAFETY SYSTEMS.

SCENE 50.
tape 417, 12:15:20-12:15:31
machine run in a semi-automatic mode, the operator removes the part, then closes the gate, starting the next cycle
tape 398, 02:13:51-02:14:03
automatic operation, parts falling into a container
tape 399, 03:10:16-03:10:25
automatic operation, parts falling onto a moving belt
tape 398, 02:25:05-02:25:13
automatic operation, parts removed by robot

NARRATION (VO):

WHEN MACHINES ARE RUN IN A SEMI-AUTOMATIC MODE, THE OPERATOR REMOVES THE PART, THEN CLOSES THE GATE, STARTING THE NEXT CYCLE. IN AUTOMATIC OPERATION THERE IS NO OPERATOR INTERVENTION AND PARTS EITHER FALL DOWN INTO A CONTAINER, OR ONTO A MOVING BELT OR OTHER DEVICE, OR ARE REMOVED BY A ROBOT.

--- FADE TO BLACK ---

SCENE 51.
CG: THE PLASTIC INJECTION MOLD
white text centered on black

SCENE 52.
tape 421, 15:06:20-15:06:34
mold in injection molding machine

NARRATION (VO):

THE PLASTIC INJECTION MOLD IS A VITAL COMPONENT OF THE INJECTION MOLDING SYSTEM.

SCENE 53.
tape 417, 12:22:30-12:22:50
c.u. large mold as part is being removed
CG, SUPER: Determines Shape Of The Part
Acts As A Heat Exchanger
Vents Trapped Air/Gas
Ejects The Cooled Part
build with red bullets

NARRATION (VO):

THE INJECTION MOLD BOTH DETERMINES THE SHAPE OF THE DESIRED PART OR PARTS, AND ACTS AS A HEAT EXCHANGER TO DRAW HEAT AWAY FROM THESE PARTS. IN ADDITION, THE INJECTION MOLD VENTS TRAPPED AIR OR GAS, AND EJECTS THE COOLED PARTS.

SCENE 54.
tape 425, 19:03:34-19:03:57

NARRATION (VO):

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zoom in machining of mold
CG, SUPER: Special Mold Steels
Beryllium-Copper
Stainless Steel
Aluminum
Brass
Kirksite
Epoxy
build with red bullets

MOLDS ARE USUALLY PRODUCED FROM SPECIAL MOLD STEELS, BUT ARE ALSO MANUFACTURED FROM MATERIALS SUCH AS BERYLLIUM-COPPER, STAINLESS STEEL, ALUMINUM, BRASS, KIRKSITE AND EPOXY.

SCENE 55.
tape 418, 13:04:08-13:04:16
machining of mold
tape 253, 08:22:33-08:22:38
edm'ing of mold
tape 418, 14:01:47-14:01:55
casting of mold

NARRATION (VO):

MOLDS ARE MANUFACTURED USING A VARIETY OF METHODS INCLUDING:

MACHINING...,

EDM'ING...,

CASTING...,

AND OTHERS.

SCENE 56.
tape 422, 16:18:57-16:19:12
zoom out, coated surface of mold

NARRATION (VO):

ONCE MANUFACTURED, MOLD CAVITIES AND CORES ARE GENERALLY HEAT TREATED. IN ADDITION, THE CAVITY AND CORE SURFACES ARE OFTEN PLATED OR COATED TO HELP RESIST WEAR, CORROSION AND TO AID IN PART RELEASE.

--- FADE TO BLACK ---

SCENE 57.
tape 424, 18:22:43-18:22:51
zoom in, mold installed on machine, dissolve to
tape 424, 18:22:54-18:22:57
c.u. seating ring being positioned in stationary platen

NARRATION (VO):

AS THE INJECTION MOLD IS INSTALLED IN A MACHINE, A LOCATING RING WHICH SEATS IN A HOLE IN THE STATIONARY PLATEN SERVES TO LOCATE AND CENTER THE MOLD.

SCENE 58.
tape 424, 18:26:23-18:26:31
mold clamped to platen

NARRATION (VO):

THE MOLD SIDES ARE SECURED BY CLAMPS WHICH ARE SCREWED INTO TAPPED HOLES COVERING THE PLATENS.

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SCENE 59.
tape 415, 10:29:36-10:29:44
leader pin aligning mold sides

NARRATION (VO):

LEADER PINS AND BUSHINGS ALIGN THE MOLD. ONE PIN IS ASYMMETRICAL TO PREVENT IMPROPER ASSEMBLY.

SCENE 60.
tape 424, 18:23:43-18:23:52
c.u. nozzle entering sprue bushing

NARRATION (VO):

THE NOZZLE OF THE HEATING CYLINDER SEATS ON A SPRUE BUSHING WHICH IS CENTERED IN THE LOCATING RING.

SCENE 61.
tape 422, 16:26:12-16:26:22
zoom in to c.u. of sprue bushing
tape 422, 16:23:58-16:24:07
zoom in, mold half showing sprue bushing, runner system stopping at gate of mold

NARRATION (VO):

THE SPRUE BUSHING HAS A TAPERED HOLE IN ITS CENTER. THIS DIRECTS MOLTEN MATERIAL FROM THE INJECTION MACHINE'S NOZZLE INTO THE MOLD'S RUNNER SYSTEM, OR DIRECTLY INTO THE MOLD'S CAVITY.

SCENE 62.
tape 422, 16:17:21-16:17:39
c.u. pan of mold half showing runner system stopping at gate of mold

NARRATION (VO):

A MOLD'S RUNNER SYSTEM IS THE CHANNEL OR CHANNELS THROUGH WHICH THE MELTED THERMOPLASTIC FLOWS TO REACH THE GATE.

SCENE 63.
continue previous shot, add arrow to indicate gate
tape 422, 16:22:10-16:22:18
zoom out, sprue gate mold

NARRATION (VO):

THE GATE IS THE INTERFACE LINKING THE RUNNERS TO THE CAVITY WHICH FORMS THE PART. IF THE MOLTEN PLASTIC GOES DIRECTLY FROM THE SPRUE BUSHING INTO THE PART, IT IS CALLED A SPRUE GATE.

SCENE 64.
tape 388, 05:27:50-05:28:00
zoom out from mold gate
tape 428, 00:08:17-00:08:24
GRAPHIC: edge gate
CG, SUPER: Edge Gate
tape 428, 00:08:35-00:08:41
GRAPHIC: submarine gate
CG, SUPER: Submarine Gate
tape 428, 00:08:47-00:08:55
GRAPHIC: tab gate

NARRATION (VO):

SOME OTHER GATE TYPES THAT USE A RUNNER SYSTEM INCLUDE:

THE EDGE GATE, WHICH IS THE MOST COMMON,

THE SUBMARINE GATE,

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CG, SUPER: Tab Gate
tape 428, 00:09:03-00:09:08
GRAPHIC: ring gate
CG, SUPER: Ring Gate
tape 428, 00:09:19-00:09:24
GRAPHIC: fan Gate
CG, SUPER: Fan Gate

THE TAB GATE,

THE RING GATE,

AND THE FAN GATE.

SCENE 65.
tape 422, 16:20:45-16:21:04
c.u. pan of vents in mold

NARRATION (VO):

VENTS ARE GROUND ON THE PARTING LINE OF THE MOLD TO REMOVE THE AIR DISPLACED BY THE MATERIAL FLOWING INTO IT.

SCENE 66.
continue previous shot
tape 421, 15:20:41-15:20:57
pull back from vent to show whole mold

NARRATION (VO):

THE SIZE, NUMBER AND LOCATION OF THESE VENTS ARE DETERMINED BY THE MOLDER. THEY ARE PRIMARILY ESTABLISHED BY THE PART GEOMETRY, GATE LOCATION, TYPE OF INJECTION MATERIAL, VISCOSITY OF THE MATERIAL AND THE RATE OF INJECTION.

SCENE 67.
tape 421, 15:08:29-15:08:43
pull out, mold cooling lines
pan to cooling unit

NARRATION (VO):

BUILT INTO THE MOLD ARE CHANNELS FOR CIRCULATING WATER WHICH IS THE MOLD'S PRIMARY COOLING MEDIUM. THE WATER IS PUMPED CONTINUOUSLY THROUGH THE MOLD TO AND FROM A COOLING UNIT, REMOVING THE HEAT AND SOLIDIFY THE PART.

SCENE 68.
tape 415, 10:25:49-10:26:02
mold with cooling lines, opening expelling part

NARRATION (VO):

PROPER COOLING PROVIDES A CONSISTENT TEMPERATURE AND COOLANT FLOW RATE, WHICH CONTRIBUTES TO CONTROLLED SHRINKAGE, PART STRENGTH AND OTHER PROPERTIES.

SCENE 69.
tape 400, 06:12:19-06:12:35
mold with cooling lines, opening expelling part

NARRATION (VO):

THE SPEED OF THE INJECTION MOLDING PRODUCTION

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CYCLE IS CONTROLLED BY THE EFFICIENCY OF THIS COOLING SYSTEM. ASIDE FROM PRODUCING ACCEPTABLE PARTS, EFFICIENT COOLING IS THE MOST IMPORTANT FACTOR OF THE INJECTION MOLDING PROCESS.

SCENE 70.
tape 422, 16:08:45-16:08:58
mold with flat parting line closed, opening, expelling part
tape 400, 06:05:26-06:05:40
mold with irregular parting line closed, opening, expelling part

NARRATION (VO):

ONCE THE PART HAS HAD TIME TO COOL AND SOLIDIFY, THE MOLD OPENS AT THE PARTING LINE, WHICH MAY BE FLAT OR REGULAR...,

OR IRREGULAR.

SCENE 71.
continue previous shot
tape 400, 06:02:39-06:02:45
c.u. knockout system expelling part

NARRATION (VO):

SINCE THE FORCE OF THE MOLTEN PLASTIC AGAINST THE MOLD CREATES SIGNIFICANT FRICTION, A KNOCK OUT SYSTEM IS REQUIRED TO AID IN PART EJECTION. THIS IS USUALLY IN THE FORM OF KNOCKOUT PINS.

SCENE 72.
tape 421, 15:20:03-15:20:12
sprue puller used with eject system

NARRATION (VO):

IN SOME MOLDS, A SPRUE PULLER AIDS IN REMOVING THE MOLDED PLASTIC FROM THE SPRUE. THIS MATERIAL CAN THEN BE REGROUND FOR REUSE.

SCENE 73.
tape 421, 15:04:02-15:04:11
pull back, knockout system as mold opens and part is expelled
tape 424, 18:14:58-18:15:04
knockout system as mold opens and part is expelled
tape 421, 15:26:43-15:26:53
zoom in, following knockout system as mold opens and part is expelled

NARRATION (VO):

THE KNOCKOUT PINS AND OTHER MECHANISMS ARE MOUNTED BETWEEN KNOCKOUT PLATES WHICH RIDE ON THEIR OWN LEADER PINS AND BUSHINGS IN A POCKET ON THE EJECTION SIDE OF THE MOLD. IN MOST CASES, THEY ARE ACTIVATED BY PNEUMATIC OR HYDRAULIC CYLINDERS, ALTHOUGH OLDER MACHINES STILL USE MECHANICAL KNOCKOUTS.

SCENE 74.
tape 422, 16:01:30-16:01:36

NARRATION (VO):

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ejection system of molding machine
tape 427, 22:01:00-22:01:30
blue background
CG: Stripper Plate
Stripper Ring
Air Ejection
Jiggler Pins
Mechanical Cams
Cams Operated By A Hydraulic Cylinder
Cams Operated By A Pneumatic Cylinder
build with red bullets

SOME OTHER TYPES OF EJECTION METHODS INCLUDE:

USING A STRIPPER PLATE,

A STRIPPER RING,

AIR EJECTION,

JIGGLER PINS,

MECHANICAL CAMS,

CAMS OPERATED BY A HYDRAULIC CYLINDER,

OR BY A PNEUMATIC CYLINDER.

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SCENE 75.
tape 424, 18:01:30-18:01:43
pull out, mold producing, ejecting parts
tape 427, 22:01:00-22:01:30
blue background
CG: Cold-Runner Two-Plate Mold
Cold-Runner Three Plate Mold
Hot-Runner Mold
Insulated Runner Mold
build with red bullets

NARRATION (VO):

OVER TIME, MANY DIFFERENT MOLD DESIGNS HAVE BEEN DEVELOPED THAT MEET SPECIFIC INJECTION MOLDING REQUIREMENTS. THESE MOLD DESIGNS INCLUDE:

THE COLD-RUNNER TWO-PLATE MOLD,

THE COLD-RUNNER THREE PLATE MOLD,

THE HOT-RUNNER MOLD,

AND THE INSULATED RUNNER MOLD.

SCENE 76.
CG, SUPER: Cold-Runner Two-Plate Mold
tape 428, 00:10:00-00:10:20
ANI: the cold-runner two-plate mold, molding sprue, runners and gate along with the parts, ejected
tape 399, 03:11:45-03:11:55
parts separated from by-products which are reground

NARRATION (VO):

THE COLD-RUNNER TWO-PLATE MOLD CONSISTS OF TWO PLATES WITH THE MOLD CAVITY AND CORE MOUNTED ON THEM. THE COLD RUNNER SYSTEM MOLDS THE SPRUE, RUNNERS AND GATE ALONG WITH THE PARTS. AFTER EJECTION, THE PARTS ARE SEPARATED, AND THE REST REGROUND.

SCENE 77.
CG, SUPER: Cold-Runner Three Plate Mold
tape 424, 18:03:03-18:03:08
cold-runner three plate mold
tape 428, 00:12:25-00:12:32

NARRATION (VO):

THE COLD-RUNNER THREE PLATE MOLD USES THREE PLATES TO MOLD THE PART. THESE PLATES INCLUDE THE

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GRAPHIC: static, cold-runner three plate mold
tape 428, 00:11:18-00:11:28
GRAPHIC: stripper plate, highlighted
tape 428, 00:11:38-00:11:48
GRAPHIC: cavity plate, highlighted
tape 428, 00:11:58-00:12:08
GRAPHIC: movable plate, highlighted

STRIPPER PLATE, WHICH CONTAINS THE SPRUE, THE MIDDLE OR CAVITY PLATE, WHICH HOLDS THE CAVITY, RUNNER AND GATE, AND THE MOVABLE PLATE, WHICH HOLDS THE MOLDED PART.

SCENE 78.
tape 428, 00:12:44-00:12:58
ANI: cold-runner three plate mold opening up ejecting parts

NARRATION (VO):

THIS TYPE OF COLD RUNNER MOLD DESIGN AUTOMATICALLY SEPARATES THE RUNNER SYSTEM FROM THE PART AS THE MOLD OPENS, AND IS VERY EASY TO AUTOMATE.

SCENE 79.
CG, SUPER: Hot-Runner Mold
tape 428, 00:13:45-00:14:18
ANI: hot-runner mold with heated manifold keeping the molten thermoplastic in the runners at the same temperature as the heating cylinder, mold opens, parts ejected, mold closes

NARRATION (VO):

THE HOT-RUNNER MOLD USES AN ELECTRICALLY HEATED MANIFOLD THAT KEEPS THE MOLTEN THERMOPLASTIC IN THE RUNNERS AT THE SAME TEMPERATURE AS THE HEATING CYLINDER. THE HEATED RUNNER SYSTEM IS CONTAINED IN A PLATE OF ITS OWN AND DOES NOT OPEN DURING THE MOLDING CYCLE. BECAUSE OF THIS, HOT-RUNNER MOLDS GENERATE NO RUNNERS OR SPRUES. FOR THIS REASON HOT-RUNNER MOLDING, ALSO KNOWN AS "RUNNERLESS" MOLDING, IS FAST AND EFFICIENT.

SCENE 80.
CG, SUPER: Insulated Runner Mold
tape 428, 00:15:03-00:15:26
ANI: insulated runner mold with large diameter runner, during injection, the outer surface of the material freezes in runner, insulating the center material, keeping it at the molding temperature

NARRATION (VO):

THE INSULATED RUNNER MOLD IS MUCH LIKE THE HOT-RUNNER MOLD BUT IT USES A LARGE DIAMETER RUNNER. DURING INJECTION, THE OUTER SURFACE OF THE RUNNER FREEZES. THIS INSULATES THE CENTER MATERIAL, KEEPING IT AT THE MOLDING TEMPERATURE.

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SCENE 81.
CG: INJECTION MACHINE CONTROLS
white text centered on black

SCENE 82.
tape 400, 05:14:50-05:15:04
pull back of machine controls
tape 417, 12:07:55-12:08:02
swish pan from operator to machine controls
tape 420, 03:10:19-03:10:25
pull out machine controls

NARRATION (VO):

THE TYPE AND LOCATION OF MACHINE CONTROLS ARE DEPENDENT UPON THE INJECTION MOLDING MACHINE. THESE CONTROLS CAN VARY FROM ELECTROMAGNETIC RELAYS AND TIMERS,

TO COMPUTER DRIVEN SOLID-STATE DEVICES.

SCENE 83.
tape 424, 18:09:59-18:10:16
zoom out, machine controls
CG, SUPER: Quality Control
Real-Time Reject Recognition
Fault Analysis
Record Keeping
Instant/Accurate Set-Up
build with red bullets

NARRATION (VO):

THESE COMPUTERS NOT ONLY CONTROL THE PROCESS, BUT PERFORM OTHER FUNCTIONS SUCH AS QUALITY CONTROL, REAL-TIME REJECT RECOGNITION, FAULT ANALYSIS, RECORD KEEPING AND INSTANT, ACCURATE SET-UP.

SCENE 84.
tape 421, 15:29:16-15:29:31
operator setting parameters, starting injection cycle, walking away

NARRATION (VO):

AFTER THE MOLDING CONDITIONS ARE SET, THE MOLDING MACHINE USES THE COMPUTER TO CONTROL THE SEQUENCE OF OPERATIONS. THE CONTROLLER'S INSTANT FEEDBACK SYSTEM PROVIDES BETTER PROCESS STABILITY THAN CAN BE ACHIEVED BY HUMANS.

SCENE 85.
tape 426, 01:05:05-01:05:22
engineer monitoring entire plant from single location

NARRATION (VO):

COMPUTER CONTROLS CAN PROVIDE REAL TIME READOUTS OF SYSTEM CONDITIONS FROM MULTIPLE LOCATIONS SO THAT ONE ENGINEER CAN MONITOR AN ENTIRE PLANT.

SCENE 86.
tape 424, 18:09:24-18:09:41
controls keeping log of machine activity, producing analysis

NARRATION (VO):

CONTROLS CAN RECORD EVERY MOLDING CONDITION FOR

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EACH INJECTION CYCLE, AND KEEP A LOG OF MACHINE ACTIVITY. THIS DATA CAN BE USED TO ANALYZE DOWNTIME AND MACHINE EFFICIENCY.

SCENE 87.
tape 397, 01:13:56-10:14:02
computer in use with designing part for molding
tape 397, 01:06:45-01:06:49
computer in use with designing mold

NARRATION (VO):

ADDITIONALLY, COMPUTERS ARE USED FOR VARIOUS ACTIVITIES THROUGHOUT THE DESIGN AND CONSTRUCTION OF THE INJECTION MOLD.

SCENE 88.
tape 397, 01:09:37-01:09:48
simulation of injection process, cut on action with next shot
tape 397, 01:08:38-01:08:44
c.u. simulation

NARRATION (VO):

COMPUTER SOFTWARE PACKAGES CAN APPROXIMATE AND VISUALIZE VARIOUS CONDITIONS WITHIN THE INJECTION MOLD, PROVIDING VALUABLE FEEDBACK FOR THE PART AND MOLD DESIGN.

SCENE 89.
tape 425, 19:04:13-19:04:23
engineer looking at mold drawing machine of mold
tape 425, 19:01:56-19:02:04
machining of mold

NARRATION (VO):

THESE PACKAGES CAN ALSO CONVERT DESIGNS INTO MOLD DRAWINGS, AND PROVIDE PROGRAMMING DATA FOR AUTOMATIC MACHINING OF THE MOLD BASE, CAVITIES AND CORES.

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SCENE 90.
CG: REVIEW
white text on black
tape 63, 12:00:15-12:03:49
review music

NARRATION (VO):

LET'S REVIEW THE MATERIAL CONTAINED IN THIS VIDEOTAPE.

SCENE 91.
tape 421, 15:24:01-15:24:11
part falling out of injection mold, cycle beginning
tape 422, 16:06:17-16:06:47
zoom in, injection process
part falling out of injection mold, cycle beginning

NARRATION (VO):

INJECTION MOLDING IS THE MOST COMMON METHOD OF PRODUCING PARTS OUT OF PLASTIC MATERIAL. THE PROCESS INVOLVES INJECTING MOLTEN PLASTIC AT HIGH PRESSURE INTO A MOLD SHAPED IN THE FORM OF A PART.

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ONCE THIS PLASTIC COOLS AND SOLIDIFIES, THE MOLD OPENS, AND THE PART IS EJECTED.

SCENE 92.
tape 405, 10:02:22-10:02:28
2 shots, parts falling out of injection mold, cycle beginning
tape 424, 18:16:25-18:16:32
part falling out of injection mold

NARRATION (VO):

INJECTION MOLDING IS AN EXTREMELY VERSATILE PROCESS THAT CAN PRODUCE PARTS WITH A WIDE RANGE OF ATTRIBUTES.

SCENE 93.
tape 405, 10:13:57-10:14:00
injection molding machine
tape 420, 03:06:55-03:07:03
injection molding machine
tape 422, 16:04:51-16:04:54
injection molding machine
tape 420, 03:00:47-03:00:52
injection molding machine
tape 405, 10:21:03-10:21:09
injection molding machine
tape 421, 15:12:34-15:12:38
injection molding machine
tape 420, 03:16:50-03:17:00
electric injection molding machine

NARRATION (VO):

THERE ARE AN EXTENSIVE VARIETY OF INJECTION MOLDING MACHINES IN USE TODAY. THESE MACHINES ARE ALL A COMBINATION OF TWO SYSTEMS,
AN INJECTION SYSTEM,
AND A CLAMPING SYSTEM.

SCENE 94.
tape 417, 12:05:16-12:05:25
machine heating plastic, dissolve to next shot
tape 417, 12:04:32-12:04:40
machine injecting melt into mold
CG, SUPER: Injection System

NARRATION (VO):

THE INJECTION SYSTEM HEATS THE THERMOPLASTIC MATERIAL TO ITS APPROPRIATE VISCOSITY OR FLOWABILITY AND THEN FORCEFULLY INJECTS IT INTO THE MOLD.

SCENE 95.
continue previous shot
tape 424, 18:08:02-18:08:11
reciprocating screw injection molding machine
tape 421, 15:14:09-15:14:14
two-stage screw injection molding machine

NARRATION (VO):

THERE ARE TWO TYPES OF INJECTION MECHANISMS:
THE RECIPROCATING SCREW, WHICH IS THE MOST COMMON,
AND THE TWO-STAGE SCREW.

SCENE 96.
tape 400, 06:05:09-06:05:28
tilt, clamping system as mold opens
CG, SUPER: Clamping System

NARRATION (VO):

THE FUNCTION OF AN INJECTION MOLDING MACHINE'S CLAMPING SYSTEM IS TO KEEP THE PLASTIC MATERIAL

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FROM LEAKING OUT, OR FLASHING, AT THE PARTING LINE OF THE MOLD'S CAVITY AND CORE.

SCENE 97.
tape 400, 05:11:44-05:12:00
pan, hydraulic clamping system of injection molding machine
tape 421, 15:10:22-15:10:34
toggle clamping system of injection molding machine

NARRATION (VO):

THE CLAMPING SYSTEM OF THE INJECTION MOLDING MACHINE HAS TWO CONFIGURATIONS:

A FULLY HYDRAULIC SYSTEM...,

AND A TOGGLE SYSTEM.

SCENE 98.
tape 415, 10:28:06-10:28:26
pull back of injection molding machines

NARRATION (VO):

INJECTION MOLDING MACHINES ARE DESIGNATED BY THEIR CLAMP TONNAGE, WHICH IS THE AMOUNT OF SEALING FORCE A MACHINE CAN PRODUCE AGAINST THE HIGH PRESSURES GENERATED DURING THE INJECTION PROCESS.

SCENE 99.
tape 417, 12:22:30-12:22:50
c.u. large mold as part is being removed
CG, SUPER: Determines Shape Of The Part
Acts As A Heat Exchanger
Vents Trapped Air/Gas
Ejects The Cooled Part
build with red bullets

NARRATION (VO):

THE INJECTION MOLD BOTH DETERMINES THE SHAPE OF THE DESIRED PART OR PARTS, AND ACTS AS A HEAT EXCHANGER TO DRAW HEAT AWAY FROM THESE PARTS. IN ADDITION, THE INJECTION MOLD VENTS TRAPPED AIR OR GAS, AND EJECTS THE COOLED PARTS.

SCENE 100.
tape 421, 15:08:29-15:08:43
pull out, mold cooling lines pan to cooling unit
tape 415, 10:25:49-10:26:02
mold with cooling lines, opening expelling part

NARRATION (VO):

THE SPEED OF THE INJECTION MOLDING PRODUCTION CYCLE IS CONTROLLED BY THE EFFICIENCY OF THE MOLD'S COOLING SYSTEM. ASIDE FROM PRODUCING ACCEPTABLE PARTS, EFFICIENT COOLING IS THE MOST IMPORTANT FACTOR OF THE INJECTION MOLDING PROCESS.

SCENE 101.
tape 400, 05:14:50-05:15:04
pull back of machine controls
tape 417, 12:07:55-12:08:02
swish pan from operator to

NARRATION (VO):

THE TYPE AND LOCATION OF MACHINE CONTROLS ARE

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machine controls
tape 420, 03:10:19-03:10:25
pull out machine controls

DEPENDENT UPON THE INJECTION MOLDING MACHINE.

THESE CONTROLS CAN VARY FROM ELECTROMAGNETIC

RELAYS AND TIMERS,

TO COMPUTER DRIVEN SOLID-STATE DEVICES.

SCENE 102.
tape 424, 18:09:59-18:10:16
zoom out, machine controls

NARRATION (VO):

THESE COMPUTERS NOT ONLY CONTROL THE PROCESS, BUT

PERFORM SEVERAL OTHER FUNCTIONS.

SCENE 103.
tape 397, 01:09:37-01:09:48
simulation of injection process
tape 425, 19:01:56-19:02:04
machining of mold

NARRATION (VO):

ADDITIONALLY, COMPUTERS ARE ALSO USED FOR VARIOUS

ACTIVITIES THROUGHOUT THE DESIGN AND CONSTRUCTION

OF THE INJECTION MOLD.

--- FADE TO BLACK ---

SCENE 104.
CG: credit roll
white text on black, fade up mid screen

Produced By:

The Society Of Manufacturing Engineers

Executive Producer:

Steven Bollinger

Producer/Director/Cameraman:

Jerome T. Cook

Written By:

Irvin I. Rubin

Graphics By:

Jerome T. Cook
Dennis Summers

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SCENE 105.
CG: disclaimer
white text centered on black

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 106.
tape 40, 01:00:00-01:00:12
SME logo