FUNDAMENTAL MANUFACTURING PROCESSES

Die Casting

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

WARNING

federal law provides severe civil and criminal penalties for the unauthorized reproduction, distribution or exhibition of copyrighted videotapes.

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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 die casting equipment.
Make sure all machine guards are in place, and follow all safety procedures when working with or near die casting 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: Die Casting
white text centered on black

NARRATION (VO):

THIS PROGRAM IS AN INTRODUCTION TO DIE CASTING.

SCENE 6.
tape 450, 17:21:08-17:21:40
zoom out, casting process

NARRATION (VO):

DIE CASTING IS A HIGH PRECISION, RAPID PARTS-PRODUCTION PROCESS INVOLVING THE HIGH PRESSURE INJECTION OF MOLTEN METAL INTO A DIE HAVING A CAVITY OF THE DESIRED PART SHAPE.

SCENE 7.
continue previous shot

NARRATION (VO):

INSIDE THE DIE, THE HEAT OF THE MOLTEN METAL IS TRANSFERRED AWAY BY INTERNAL FLUID FLOW, COOLING THE METAL. WHEN THE METAL HAS SOLIDIFIED, CLAMPING PRESSURE IS RELEASED, THE DIE OPENS, AND THE PART IS REMOVED.

SCENE 8.
tape 442, 08:21:01-08:21:10
casting placed in quenching tank
tape 445, 12:13:31-12:13:39
trimming operation
tape 444, 11:20:23-11:20:31
machining operation

NARRATION (VO):

IF NECESSARY, THE PART IS THEN QUENCHED TO FURTHER COOL IT...,

TRIMMED OF THE EXCESS METAL...,

AND, IF REQUIRED, PROCESSED BY MACHINING, FINISHING OR OTHER METHODS TO COMPLETE THE PART.

SCENE 9.
tape 440, 06:09:18-06:09:24
single part removed from die
tape 443, 09:01:56-09:02:01
multiple parts removed from die

NARRATION (VO):

DIE CASTING IS AN EXTREMELY VERSATILE PROCESS, ALLOWING SINGLE PARTS TO BE CAST...,

OR MULTIPLE PARTS TO BE CAST SIMULTANEOUSLY.

SCENE 10.
tape 450, 17:17:38-17:17:43
part being trimmed
tape 467, 10:06:48-10:06:55
die cast part with intricate features
tape 467, 10:07:10-10:07:20
die cast part with intricate features
tape 467, 10:08:33-10:08:43
die cast part with holes ready for tapping
tape 467, 10:11:50-10:11:55
die cast part with smooth & textured finishes

NARRATION (VO):

DIE CASTING CAN PRODUCE PRECISE NET OR NEAR-NET SHAPES, HAVING INTRICATE EXTERNAL AND INTERNAL FEATURES, HOLES READY FOR TAPPING, AND SMOOTH OR TEXTURED FINISHES.

SCENE 11.
tape 472, 05:03:11-05:03:19
die cast part used in subsequent assembly operation
tape 472, 05:04:00-05:04:06
die cast part used in subsequent

NARRATION (VO):

IN ADDITION, EXTERNAL THREADS, STUDS AND BOSSES CAN BE CAST TO AID IN SUBSEQUENT ASSEMBLY

assembly operation
tape 467, 10:04:10-10:04:18
zoom out, copper die cast part with insert

OPERATIONS, AND INSERTS OF VARIOUS TYPES CAN BE INCLUDED FOR SPECIAL FEATURES.

SCENE 12.
tape 450, 17:11:53-17:12:09
die casting operation

NARRATION (VO):

DIE CASTING PRODUCTION RATES CAN RANGE FROM DOZENS TO THOUSANDS OF PARTS PER HOUR, DEPENDING ON PART CONFIGURATION AND THE METAL USED.

SCENE 13.
continue previous shot
tape 182, 02:03:56-02:04:02
pan of truck on bridge
tape 467, 10:16:22-10:16:28
appliance
tape 305, 02:02:22-02:02:27
person at computer
tape 466, 05:03:44-05:03:49
power tool
tape 331, 01:01:01-01:01:07
plumbing fixture
tape 466, 05:17:15:00
still, agricultural equipment
tape 467, 10:13:22-10:13:27
oxygen tank
tape 467, 10:10:30-10:10:35
camera
tape 467, 10:12:26-10:12:32
c.u. matchbox car
tape 467, 10:14:22-10:14:26
c.u. lock being unlocked

NARRATION (VO):

BECAUSE OF THIS VERSATILITY, DIE CASTINGS ARE USED IN MANY INDUSTRIAL AND CONSUMER PRODUCTS, INCLUDING TRUCKS AND CARS, APPLIANCES, COMPUTERS, POWER TOOLS, PLUMBING FIXTURES, AGRICULTURAL EQUIPMENT, MEDICAL DEVICES, CAMERAS, TOYS, LOCKS AND MANY OTHERS.

--- TOUCH BLACK ---

SCENE 14.
tape 443, 09:14:24-09:14:37
die-casting operation
CG, SUPER: Aluminum Alloys
Zinc Alloys
Magnesium Alloys
tape 467, 10:04:57-10:05:14
zoom out, copper die cast part

NARRATION (VO):

THE MOST COMMON DIE-CASTING METALS ARE ALUMINUM ALLOYS, ZINC ALLOYS, AND MAGNESIUM ALLOYS, ALTHOUGH OTHER METALS OR ALLOYS OF LOW MELTING TEMPERATURE CAN BE CAST. COPPER AND COPPER ALLOYS, SUCH AS THE BRASSES, ARE ALSO DIE CAST BUT LESS FREQUENTLY BECAUSE THEIR HIGH MELTING TEMPERATURE CAN MAKE CASTING MORE DIFFICULT.

SCENE 15.
tape 463, 07:16:25-07:16:45

NARRATION (VO):

die casting operation
CG, SUPER: Complexity Of Shape
Minimum Wall Thickness
Minimum Wall Draft/Taper
Precision To Which The Metal Can Be Cast

IN GENERAL, THE LOWER THE METAL'S MELTING TEMPERATURE, THE BETTER ITS CASTABILITY. CASTABILITY, A GENERAL QUALITATIVE TERM, REFERS TO THE COMPLEXITY OF SHAPE, MINIMUM WALL THICKNESS, MINIMUM WALL DRAFT OR TAPER, AND PRECISION TO WHICH THE METAL CAN BE CAST.

SCENE 16.
continue previous shot
tape 468, 00:09:00-00:10:00
blue background
CG: Zinc Alloys
Melt At 728° F/387° C
Aluminum Alloys
Melt At 1080° To 1170° F/582° To 630° C
Magnesium Alloy
Melting At 1105° F/596° C
The Brasses
Melting Temperatures Of 1650° To 1700° F/ 899° To 927° C

NARRATION (VO):

THE MOST COMMONLY USED ZINC ALLOYS MELT AT APPROXIMATELY 728 DEGREES FAHRENHEIT OR 387 DEGREES CELSIUS, AND ARE THE MOST CASTABLE. THEN COME THE ALUMINUM ALLOYS WHICH MELT AT 1,080 TO 1,170 DEGREES FAHRENHEIT OR 582 TO 630 DEGREES CELSIUS, THE PRINCIPLE MAGNESIUM ALLOY WHICH MELTS AT ABOUT 1,105 DEGREES FAHRENHEIT OR 596 DEGREES CELSIUS, AND THE BRASSES WITH MELTING TEMPERATURES OF 1,650 TO 1,700 DEGREES FAHRENHEIT OR 899 TO 927 DEGREES CELSIUS.

SCENE 17.
tape 445, 12:14:08-12:14:17
part being trimmed
tape 468, 00:09:00-00:10:00
blue background
CG: Maximum Part Weight
Aluminum And Zinc
75 Lbs./34 Kgs.
Magnesium
45 Lbs./20 Kgs.
The Brasses
10 Lbs./4.5 Kgs.

NARRATION (VO):

MAXIMUM PART SIZE ALSO VARIES WITH THE ALLOY. PART SIZE IS GENERALLY INDICATED BY WEIGHT, MAXIMUMS BEING ABOUT 75 POUNDS OR 34 KILOGRAMS FOR ALUMINUM AND ZINC, 45 POUNDS OR 20 KILOGRAMS FOR MAGNESIUM, AND 10 POUNDS OR 4.5 KILOGRAMS FOR THE BRASSES.

SCENE 18.
tape 443, 09:06:25-09:06:39
die casting operation
tape 468, 00:09:00-00:10:00
blue background
CG: Die-Cast Metal Densities
Magnesium
0.066 Pounds Per Cubic Inch/

NARRATION (VO):

WEIGHT, HOWEVER, IS A POOR MEASURE OF SIZE BECAUSE OF THE MARKED DIFFERENCE IN DENSITY, OR WEIGHT PER UNIT VOLUME, OF THE DIE-CAST METALS. THOSE

1.83 Grams Per Cubic Centimeter
Aluminum
0.095 Pounds Cubic Inch/
2.63 Grams Per Cubic Centimeter
Zinc
0.24 Pounds Per Cubic Inch/
6.64 Grams Per Cubic Centimeter
The Brasses
0.304 Pounds Per Cubic Inch/
8.41 Grams Per Cubic Centimeter

DENSITIES ARE: .066 POUNDS PER CUBIC INCH OR 1.83 GRAMS PER CUBIC CENTIMETER FOR MAGNESIUM, .095 POUNDS PER CUBIC INCH OR 2.63 GRAMS PER CUBIC CENTIMETER FOR ALUMINUM, .24 POUNDS PER CUBIC INCH OR 6.64 GRAMS PER CUBIC CENTIMETER FOR ZINC, AND .304 POUNDS PER CUBIC INCH OR 8.41 GRAMS PER CUBIC CENTIMETER FOR THE BRASSES.

SCENE 19.
tape 468, 00:01:50-00:01:58
GRAPHIC: large, magnesium part
CG, SUPER: Magnesium
tape 468, 00:02:20-00:02:28
GRAPHIC: medium sized, aluminum part
CG, SUPER: Aluminum
tape 468, 00:02:50-00:02:58
GRAPHIC: small sized, zinc part
CG, SUPER: Zinc
tape 468, 00:03:20-00:03:28
GRAPHIC: small sized, brass part
CG, SUPER: Brass

NARRATION (VO):

THUS, FOR A GIVEN WEIGHT, A PART CAST IN MAGNESIUM IS LARGER IN SIZE THAN A PART CAST IN ANY OF THE OTHER METALS.

SCENE 20.
tape 442, 08:04:10-08:04:18
die casting operation

NARRATION (VO):

MECHANICAL AND PHYSICAL PROPERTIES OF DIE CASTINGS ALSO VARY WIDELY DEPENDING ON THE ALLOY.

--- FADE TO BLACK ---

SCENE 21.
CG: Die Casting Machines
white text centered on black

SCENE 22.
tape 445, 12:06:10-12:06:19
zoom out, horizontal die casting machines
tape 443, 09:11:47-09:11:55
pan, horizontal die casting machine
tape 465, 01:20:57-01:20:20
vertical die casting machine

NARRATION (VO):

THERE ARE SEVERAL TYPES OF DIE CASTING MACHINES IN USE TODAY. MOST OF THESE MACHINES ARE HYDRAULICALLY ACTUATED AND OPERATE HORIZONTALLY, BUT VERTICALLY OPERATING MACHINES ARE ALSO UTILIZED.

SCENE 23.
continue previous shot
tape 445, 12:03:35-12:03:44
horizontal machine injecting metal

NARRATION (VO):

THE PRINCIPAL DIFFERENCE BETWEEN VERTICAL...,

AND HORIZONTAL DIE-CASTING MACHINES IS, AS THE

TERMS IMPLY, THE DIRECTION OF METAL INJECTION INTO

THE DIE.

SCENE 24.
tape 464, 09:13:55-09:14:02
c.u. injection system
CG, SUPER: Injection System
tape 445, 12:16:40-12:16:50
pan, clamping system
CG, SUPER: Clamping System

NARRATION (VO):

ALL DIE CASTING MACHINES INCLUDE A METAL-INJECTION

SYSTEM TO GET THE METAL IN THE DIE,

AND A CLAMPING SYSTEM TO KEEP THE DIE HALVES

CLOSED DURING INJECTION.

SCENE 25.
tape 442, 08:05:09-08:05:16
hot-chamber die casting machine
tape 468, 00:09:00-00:10:00
blue background
CG: Hot-Chamber Machine
Cold-Chamber Machine

NARRATION (VO):

THE TWO PRINCIPAL TYPES OF DIE CASTING MACHINES

ARE:

THE HOT-CHAMBER...,

AND COLD-CHAMBER TYPE.

SCENE 26.
CG, SUPER: Hot-Chamber Machine
tape 445, 12:04:22-12:04:36
hot-chamber die casting machine

NARRATION (VO):

THE HOT-CHAMBER MACHINE IS USED MAINLY FOR DIE-

CASTING ZINC AND OTHER METALS OF LOW MELTING

TEMPERATURE. HOWEVER, IT IS ALSO USED TO DIE-CAST

MAGNESIUM.

SCENE 27.
tape 462, 06:06:31-06:06:42
pan of holding pot
tape 442, 08:07:37-08:07:48
c.u. plunger
tape 473, 00:01:18-00:01:28
GRAPHIC: cutaway of hot-chamber machine, injection system highlighted

NARRATION (VO):

THE MACHINE'S SHOT OR CHARGE END HAS A HOLDING

POT, WHICH IS A RESERVOIR FOR THE MOLTEN METAL

SEATED IN A FURNACE, AND AN INJECTION SYSTEM FOR

TRANSFERRING THE METAL THROUGH A GOOSENECK-SHAPED

PIPE TO THE DIE.

SCENE 28.
tape 462, 06:05:57-06:06:14
pull back from plunger, injection system submerged in holding pot

NARRATION (VO):

THE PLUNGER END OF THE INJECTION SYSTEM AND THE LOWER PORTION OF THE TRANSFER PIPE ARE SUBMERGED IN THE MOLTEN METAL. FOR THIS REASON, ALUMINUM AND COPPER ALLOYS ARE UNSUITABLE FOR USE, SINCE THEY CHEMICALLY ATTACK OR ERODE THE SUBMERGED INJECTION SYSTEM.

SCENE 29.
tape 473, 00:02:16-00:02:23
ANI: cutaway of hot-chamber machine showing the injection system, plunger rising, charge of metal entering the pipe through a port, plunger stopping, add white burst
tape 473, 00:02:26-00:02:40
ANI: plunger then descending, closing the port and driving the charge through a nozzle at the end of the pipe and into the die

NARRATION (VO):

WHEN THE PLUNGER RISES, A CHARGE OF METAL ENTERS THE PIPE THROUGH A PORT. WHEN THE PLUNGER DESCENDS, IT CLOSES THE PORT AND DRIVES THE CHARGE THROUGH A NOZZLE AT THE END OF THE PIPE AND INTO THE DIE.

SCENE 30.
tape 442, 08:08:00-08:08:09
c.u. plunger descending, then rising

NARRATION (VO):

INJECTION PRESSURES MAY RANGE FROM 1,500 TO MORE THAN 4,500 POUNDS PER SQUARE INCH OR 10 TO 31 MEGA PASCALS.

--- TOUCH BLACK ---

SCENE 31.
CG, SUPER: Cold-Chamber Machine
tape 450, 17:02:12-17:02:22
cold-chamber die casting machine

NARRATION (VO):

THE COLD-CHAMBER MACHINE IS USED PRIMARILY TO DIE-CAST THE ALUMINUM, MAGNESIUM, AND COPPER ALLOYS.

SCENE 32.
tape 444, 11:14:35-11:15:08
zoom in from ladle system to pouring of shot

NARRATION (VO):

IN THE COLD-CHAMBER MACHINE, THE CHARGE IS SUPPLIED BY LADLE OR FEED SYSTEM FROM AN EXTERNAL FURNACE SOURCE TO A HOLDING POT AT THE SHOT END OF

THE MACHINE. THE FEED SYSTEM COMPONENTS ARE NOT SUBMERGED IN THE MOLTEN METAL.

SCENE 33.
continue previous shot

NARRATION (VO):

THE CHARGE IS POURED AHEAD OF THE PLUNGER TIP THROUGH A POUR HOLE IN THE SHOT SLEEVE. AS THE PLUNGER ADVANCES, IT CLOSES THE POUR HOLE AND DRIVES THE MOLTEN METAL INTO THE DIE.

SCENE 34.
tape 464, 09:15:00-09:15:18
c.u. cold-chamber plunger injecting metal

NARRATION (VO):

INJECTION PRESSURES MAY RANGE TO 10,000 POUNDS PER SQUARE INCH OR 69 MEGA PASCALS FOR ALUMINUM AND MAGNESIUM, ALTHOUGH SOME MACHINES CAN PROVIDE STILL GREATER PRESSURES.

SCENE 35.
tape 468, 00:07:45-00:08:09
ANI: plunger thrusting forward to release casting

NARRATION (VO):

AFTER THE METAL IN THE DIE SOLIDIFIES AND THE DIE HALVES ARE SEPARATING, THE PLUNGER THRUSTS FORWARD, EXTENDING THE PLUNGER TIP PAST THE COVER DIE. THIS PUSHES THE BISCUIT THAT SOLIDIFIES AT THE END OF THE SHOT SLEEVE, ASSISTING CASTING RELEASE.

--- TOUCH BLACK ---

SCENE 36.
tape 464, 09:01:20-09:01:26
static, accumulator, highlight accumulator
tape 441, 07:06:20-07:06:32
zoom in, plunger descending on hot chamber system

NARRATION (VO):

BOTH HOT-CHAMBER AND COLD-CHAMBER MACHINES OFTEN UTILIZE ONE OR MORE ACCUMULATORS TO BOOST INJECTION PRESSURE FOR DIE CASTING.

SCENE 37.
tape 464, 09:03:53-09:04:11
zoom in, pressure gauge on accumulator

NARRATION (VO):

AN ACCUMULATOR IS A CYLINDRICAL PRESSURE VESSEL

CHARGED WITH INERT GAS, USUALLY NITROGEN, WHICH STORES HYDRAULIC FLUID AT A PRESSURE REQUIRED FOR RAPID, HIGH-PRESSURE INJECTION.

SCENE 38.
tape 450, 17:15:08-17:15:18
pan from intensifiers to machine plunger being driven forward
tape 450, 17:15:31-17:15:44
zoom in, digital pressure readout increasing
tape 450, 17:07:17-17:07:25
wide, cold chamber plunger driven forward

NARRATION (VO):

PRESSURE INTENSIFIERS ALSO CAN BE USED TO INCREASE INJECTION PRESSURE. THESE GROUPS OF HYDRAULIC CYLINDERS CAN DOUBLE, EVEN QUADRUPLE, PRESSURE BY APPLYING HIGH FORCE THROUGH A SHORT DISTANCE AT THE END OF THE PLUNGER STROKE. THIS PACKS THE MOLTEN METAL MORE TIGHTLY INTO DIE-CAVITY DETAILS.

--- TOUCH BLACK ---

SCENE 39.
tape 464, 09:17:00-09:17:12
wide, clamping system releasing pressure, dies separating

NARRATION (VO):

THE CLAMPING SYSTEM OF THE DIE CASTING MACHINE CAN BE FULLY HYDRAULIC, MECHANICAL, PNEUMATIC OR A COMBINATION OF THESE SYSTEMS.

SCENE 40.
tape 445, 12:17:08-12:17:20
toggle system on die cast machine

NARRATION (VO):

THE MOST COMMON CLAMPING METHOD USES COMPOUND TOGGLES WITH A HYDRAULIC CYLINDER TO PROVIDE THE FULL CLAMPING FORCE.

SCENE 41.
CG, SUPER: Clamping-Force Capacity
tape 442, 08:23:41-08:23:55
casting removed, dies clamped shut
CG, SUPER: Shot-Weight Capacity
tape 464, 09:13:11-09:13:19
shot being poured into cold chamber system

NARRATION (VO):

DIE CASTING MACHINES ARE TYPICALLY RATED BY CLAMPING-FORCE CAPACITY. THIS IS THE AMOUNT OF FORCE THE MACHINE CAN PROVIDE TO RESIST THE PRESSURE GENERATED DURING METAL INJECTION. MACHINES ALSO MAY BE RATED BY THE SHOT-WEIGHT CAPACITY OF THE INJECTION SYSTEM.

SCENE 42.
tape 463, 07:10:37-07:10:54
static of dies on platens, highlight platens

NARRATION (VO):

THE DIE HALVES ARE ATTACHED TO PLATENS ON THE DIE CASTING MACHINE.

SCENE 43.
tape 442, 08:23:01-08:23:10
dies closing for injection of part
tape 468, 00:09:00-00:10:00
blue background
CG: Stationary Platen
Movable Platen

NARRATION (VO):

THESE PLATENS ARE LARGE THICK BLOCKS OF STEEL WHICH WILL NOT DEFLECT DURING INJECTION. THEY INCLUDE THE STATIONARY PLATEN, AND THE MOVABLE PLATEN.

SCENE 44.
tape 463, 07:09:11-07:09:22
zoom in, stationary platen holding the cover die half
tape 445, 12:09:00-12:09:12
zoom out, hole in stationary plate

NARRATION (VO):

THE STATIONARY PLATEN HOLDS THE DIE HALF THAT IS CALLED THE COVER HALF. THIS PLATEN HAS A HOLE DIRECTLY IN LINE WITH THE METAL INJECTION CYLINDER.

SCENE 45.
tape 463, 07:11:59-07:12:07
zoom in, movable platen holding the ejector die half
tape 463, 07:14:52-07:14:58
movable platen sliding closed on ways

NARRATION (VO):

THE MOVABLE PLATEN HOLDS THE OTHER DIE HALF, CALLED THE EJECTOR HALF. THIS MOVABLE PLATEN SLIDES BACK AND FORTH ON WAYS.

SCENE 46.
tape 442, 08:22:32-08:22:46
die halves separating, ejector pins releasing casting

NARRATION (VO):

WHEN THE METAL HAS SOLIDIFIED AND THE DIE HALVES SEPARATE, MECHANICALLY OR HYDRAULICALLY ACTUATED EJECTOR PINS RELEASE THE CASTING FROM THE EJECTOR HALF OF THE DIE.

SCENE 47.
tape 462, 06:02:20-06:02:30
die halves being lubricated before closing

NARRATION (VO):

BEFORE CLOSING, THE DIE HALVES ARE LUBRICATED BY EXTERNAL SPRAYS TO ASSIST IN COOLING, CASTING RELEASE AND TO MINIMIZE DIE WEAR.

SCENE 48.
tape 464, 09:08:47-09:08:55
zoom in, lubricant applied manually
tape 462, 06:04:45-06:04:53
lubricant applied automatically

NARRATION (VO):

LUBRICANTS, USUALLY WATER-SOLUBLE, CAN BE MANUALLY APPLIED...,
BUT ARE OFTEN SPRAYED AUTOMATICALLY USING CENTRAL DIE SPRAY SYSTEMS.

SCENE 49.
tape 450, 17:10:01-17:10:12
lubricant applied automatically, blast of air applied afterwards

NARRATION (VO):

THE APPLICATION OF DIE SPRAY IS USUALLY FOLLOWED BY AN AIR BLAST TO BLOW OFF RESIDUAL WATER, AND TO REMOVE ANY LOOSE METAL LEFT FROM THE PREVIOUS SHOT.

--- TOUCH BLACK ---

SCENE 50.
tape 464, 09:09:45-09:09:51
casting removed with tongs
tape 445, 12:15:27-12:15:37
casting dropped onto a conveyor
tape 440, 06:01:43-06:01:54
casting removed using automatic extractors, then spraying die

NARRATION (VO):

AFTER RELEASE FROM THE DIE, THE CASTING CAN BE REMOVED MANUALLY WITH TONGS...,
OR DROPPED ONTO A CONVEYOR OR DOWN A CHUTE FOR TRANSFER FROM THE MACHINE...,
OR REMOVED USING AUTOMATIC EXTRACTORS. THESE EXTRACTORS ARE COMMONLY USED AND OFTEN PROVIDE AUTOMATIC DIE SPRAY LUBRICATION.

SCENE 51.
tape 440, 06:08:48-06:09:12
robotic arm removing casting, spraying die, arm rotating, dropping casting into quenching tank, arm returning to its former position

NARRATION (VO):

IN ONE AUTOMATIC EXTRACTION SYSTEM, A ROBOTIC ARM REMOVES A CASTING, AND SPRAYS THE DIE HALVES...,
THE ARM THEN ROTATES, PRESENTS THE CASTING TO A CONVEYOR SYSTEM RUNNING THROUGH A QUENCHING TANK, AND RETURNS TO ITS FORMER POSITION FOR THE NEXT CASTING.

SCENE 52.
tape 440, 06:10:51-06:11:06
casting conveyed to trimming press

NARRATION (VO):

THE CASTING PASSES THROUGH THE QUENCHING TANK AND IS CONVEYED TO A TRIMMING PRESS WHERE AN OPERATOR TRIMS THE CASTING OF EXCESS METAL.

SCENE 53.
tape 462, 06:21:02-06:21:09
trimmings conveyed to furnace
tape 462, 06:21:30-06:21:36
trimming falling into furnace

NARRATION (VO):

THESE TRIMMINGS FALL ONTO A CONVEYOR THAT RETURNS THEM TO THE MELT FURNACE FOR REMELTING.

--- TOUCH BLACK ---

SCENE 54.
tape 445, 12:21:02-12:21:32
worker at computer screen

NARRATION (VO):

BOTH HOT- AND COLD-CHAMBER DIE CASTING SYSTEMS CAN BE FULLY AUTOMATED TO EXECUTE OPERATIONS BY PROGRAMMED COMMANDS, WHICH CAN BE STORED IN THE SYSTEM COMPUTER AND RECALLED AT ANY TIME.

SCENE 55.
continue previous shot
tape 444, 11:19:35-11:19:45
computer screen reading out material

NARRATION (VO):

MANY PROCESS PARAMETERS, SUCH AS INJECTION SPEED, DIE TEMPERATURE AND CLAMPING FORCE, CAN BE CONTINUALLY MONITORED DURING THE CASTING CYCLE TO ENSURE QUALITY DIE CASTINGS. PROCESS PARAMETERS CAN ALSO BE RECORDED FOR QUALITY ASSURANCE, AND USED FOR STATISTICAL PROCESS CONTROL.

--- FADE TO BLACK ---

SCENE 56.
CG: Die Cast Tooling
white text centered on black

SCENE 57.
tape 464, 08:01:10-08:01:20
static, die set

NARRATION (VO):

THE DIES FOR DIE CASTING IN HOT- OR COLD-CHAMBER

MACHINES ARE SIMILAR IN CONSTRUCTION.

SCENE 58.
tape 464, 09:15:35-09:15:55
c.u. die opening, releasing part
CG, SUPER: Determines The Shape Of The Part
Acts As A Heat Exchanger
Vents Trapped Air/Gas
Ejects The Solidified Part

NARRATION (VO):

THE DIES PROVIDE THE SHAPE OF THE DESIRED PART, AND ACT AS A HEAT EXCHANGER TO DRAW HEAT AWAY FROM THE CAST PART. IN ADDITION, THE DIES VENT TRAPPED AIR OR GAS, AND EJECT THE SOLIDIFIED PART.

SCENE 59.
tape 445, 12:18:34-12:18:47
c.u. die opening, ejecting parts, closing
CG, SUPER: Molten Metal Heat & Erosion
Thermal Shock From Repeated Heating & Cooling
Metal Injection & Clamping Pressures

NARRATION (VO):

THE DIES MUST WITHSTAND THE COMBINED EFFECTS OF MOLTEN METAL HEAT AND EROSION, THERMAL SHOCK FROM REPEATED HEATING AND COOLING, AND METAL INJECTION AND CLAMPING PRESSURES.

SCENE 60.
tape 463, 07:27:05-07:27:35
zoom in, die being milled
CG, SUPER: Hot-Work Tool Steels
Mold Steel
Maraging Steels
Refractory Metals
Tungsten Alloys
Molybdenum Alloys

NARRATION (VO):

DIES ARE USUALLY PRODUCED FROM HOT-WORK TOOL STEELS, MOLD STEEL, MARAGING STEELS, AND TO A LESSER EXTENT, REFRACTORY METALS SUCH AS TUNGSTEN AND MOLYBDENUM ALLOYS. ALL TOOLING MATERIALS ARE NOTED FOR HIGH HOT STRENGTH AND HIGH-TEMPERATURE WEAR RESISTANCE.

SCENE 61.
continue previous shot
tape 418, 14:01:47-14:01:55
casting operation

NARRATION (VO):

DIES ARE USUALLY MADE BY MACHINING FROM BLOCKS OF WROUGHT METAL, BUT THEY ALSO CAN BE CAST AND MACHINED.

SCENE 62.
tape 463, 07:23:08-07:23:25
zoom in, milling of runner system

NARRATION (VO):

BECAUSE OF THEIR MACHINED FEATURES, PRECISION AND MATERIALS USED, DIE-CASTING TOOLING IS EXPENSIVE.

BUT THE DIES ARE REUSABLE FOR THOUSANDS, OR EVEN HUNDREDS OF THOUSANDS OF PARTS.

SCENE 63.
tape 464, 08:05:52-08:06:00
zoom out, from port to wide of cover die

NARRATION (VO):

THE COVER DIE HALF CONTAINS A PORT FOR ENTRY OF THE MOLTEN METAL FROM THE METAL INJECTION SYSTEM.

SCENE 64.
tape 464, 08:06:45:08
still, ejector die half
tape 464, 08:04:46-08:04:59
zoom out, runners, gates, part cavity

NARRATION (VO):

THE EJECTOR DIE HALF USUALLY CONTAINS THE CHANNELS, CALLED RUNNERS, THROUGH WHICH THE MOLTEN METAL FLOWS TO REACH THE GATE OR GATES AT THE DIE CAVITY.

SCENE 65.
tape 462, 06:08:42-06:08:48
single-cavity die
tape 450, 17:27:08-17:27:16
multiple-cavity die

NARRATION (VO):

DIES ARE TYPICALLY SINGLE-CAVITY...,
OR MULTIPLE-CAVITY DIES.

SCENE 66.
continue previous shot
tape 463, 07:07:07-07:07:16
multiple-cavity parts on conveyor line

NARRATION (VO):

MULTIPLE-CAVITY DIES ARE USUALLY USED FOR MULTIPLE IDENTICAL PARTS. HOWEVER, THEY ALSO CAN BE USED TO PRODUCE PARTS OF DIFFERENT DESIGN AND, IF SO, THEY ARE COMMONLY CALLED COMBINATION DIES.

SCENE 67.
tape 463, 07:16:27-07:16:41
zoom out, multiple-cavity family castings pulled from machine

NARRATION (VO):

BECAUSE SUCH DIES ARE OFTEN USED TO CAST PARTS THAT WILL BE ASSEMBLED TOGETHER, THEY ARE ALSO CALLED FAMILY DIES, MEANING DIES FOR A FAMILY OF PARTS.

SCENE 68.
tape 462, 06:16:49-06:17:02
zoom in, fixed cores

NARRATION (VO):

CORES, FIXED OR MOVABLE IN EITHER DIE HALF, ARE USED TO CAST HOLES IN VARIOUS DIRECTIONS.

SCENE 69.
tape 464, 08:01:39-08:01:48
zoom in, fixed core
tape 462, 06:15:46-06:15:57
retractable core being moved back and forth manually

NARRATION (VO):

FIXED CORES ARE IN LINE WITH THE DIRECTION IN WHICH THE DIE HALVES OPEN. THOSE FOR HOLES IN OTHER DIRECTIONS ARE RETRACTABLE ON MOVING SLIDES, ALSO CALLED CORE PULLS, TO MOVE IN AND OUT WITH EACH SHOT.

SCENE 70.
tape 465, 01:27:34:00
still, insert
tape 465, 01:26:02-01:26:05
insert sliding into die casting machine
tape 465, 01:38:18-01:38:25
part with insert ejected from die cast machine

NARRATION (VO):

INSERTS, PLACED IN POSITION BEFORE EACH SHOT, ALSO CAN BE USED TO CAST COMPLEX FEATURES OR TO BE CAST IN PLACE AS AN INTEGRAL CASTING FEATURE.

SCENE 71.
tape 462, 06:19:45-06:19:55
zoom out, venting on die

NARRATION (VO):

TO MINIMIZE POROSITY IN THE CASTING, THE DIE HALVES HAVE VENTS TO RELEASE THE AIR THAT IS PUSHED AHEAD OF THE METAL SHOT.

SCENE 72.
tape 462, 06:11:12-06:11:26
zoom out, overflow on die

NARRATION (VO):

OVERFLOW CHANNELS IN THE DIE BLOCKS CATCH SURPLUS METAL. THEY ALSO ASSIST IN VENTING AND PROVIDE LOCATIONS OFF THE CASTING FOR ITS EJECTION.

SCENE 73.
tape 450, 17:25:51-17:26:12
zoom out, die block with a lot of cooling lines

NARRATION (VO):

BUILT INTO THE DIE BLOCKS ARE COOLING LINES CIRCULATING WATER OR OIL TO DISSIPATE THE HEAT OF THE MOLTEN METAL AT A PRECISE RATE.

SCENE 74.
continue previous shot

NARRATION (VO):

COOLING AT A CONTROLLABLE COOLANT FLOW RATE IS IMPORTANT BECAUSE IT CONTROLS THE METAL

SOLIDIFICATION RATE.

SCENE 75.
tape 463, 07:01:33-07:01:43
die opening, part ejected
tape 464, 08:07:03-08:07:08
side view, ejector die with side panel, dissolve to next image
tape 464, 08:08:13-08:08:22
side view, ejector die with side panel removed

NARRATION (VO):

AN EJECTOR SYSTEM IS REQUIRED TO RELEASE THE CASTING. IN THE SYSTEM, EJECTOR PINS ARE MOUNTED BETWEEN EJECTOR PLATES IN A POCKET ON THE EJECTOR SIDE OF THE DIE. IN MOST CASES, THEY ARE ACTIVATED BY PNEUMATIC OR HYDRAULIC CYLINDERS.

SCENE 76.
tape 469, 00:00:50-00:01:00
GRAPHIC: side angle, ejector die
tape 469, 00:01:18-00:01:28
GRAPHIC: side angle, ejector die, wipe on yellow lines left to right showing draft angle
tape 450, 17:10:16-17:10:26
parts being ejected from die
tape 443, 09:11:05-09:11:12
ejector pins ejecting part

NARRATION (VO):

TO FACILITATE CASTING EJECTION, DIES AND CORES INCORPORATE A SLIGHT DRAFT OR TAPER, THE AMOUNT DEPENDING ON THE METAL TO BE CAST. IN GENERAL, THE LOWER THE METAL'S MELTING TEMPERATURE, THE LESS THE DRAFT REQUIRED.

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SCENE 77.
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 78.
tape 450, 17:21:08-17:21:40
zoom out, casting process

NARRATION (VO):

DIE CASTING IS A HIGH PRECISION, RAPID PARTS-PRODUCTION PROCESS INVOLVING THE HIGH PRESSURE INJECTION OF MOLTEN METAL INTO A DIE HAVING A CAVITY OF THE DESIRED PART SHAPE.

SCENE 79.
tape 440, 06:09:18-06:09:24
single part removed from die
tape 443, 09:01:56-09:02:01
multiple parts removed from die

NARRATION (VO):

DIE CASTING IS AN EXTREMELY VERSATILE PROCESS, ALLOWING SINGLE PARTS TO BE CAST...,
OR MULTIPLE PARTS TO BE CAST SIMULTANEOUSLY.

SCENE 80.
tape 443, 09:14:24-09:14:37
die-casting operation
CG, SUPER: Aluminum Alloys
Zinc Alloys
Magnesium Alloys
tape 467, 10:04:57-10:05:14
zoom out, copper die cast part

NARRATION (VO):

THE MOST COMMON DIE-CASTING METALS ARE ALUMINUM ALLOYS, ZINC ALLOYS, AND MAGNESIUM ALLOYS, ALTHOUGH OTHER METALS OR ALLOYS OF LOW MELTING TEMPERATURE CAN BE CAST. COPPER AND COPPER ALLOYS, SUCH AS THE BRASSES, ARE ALSO DIE CAST BUT LESS FREQUENTLY.

SCENE 81.
tape 445, 12:03:35-12:03:44
horizontal machine injecting metal
tape 465, 01:20:57-01:20:20
vertical die casting machine

NARRATION (VO):

MOST DIE CASTING MACHINES ARE HYDRAULICALLY ACTUATED AND OPERATE HORIZONTALLY, BUT VERTICALLY OPERATING MACHINES ARE ALSO UTILIZED.

SCENE 82.
tape 442, 08:05:09-08:05:16
hot-chamber die casting machine
tape 468, 00:09:00-00:10:00
blue background
CG: Hot-Chamber Machine
Cold-Chamber Machine

NARRATION (VO):

THE TWO PRINCIPAL TYPES OF DIE CASTING MACHINES ARE:

THE HOT-CHAMBER...,

AND COLD-CHAMBER TYPE.

SCENE 83.
CG, SUPER: Hot-Chamber Machine
tape 445, 12:04:22-12:04:36
hot-chamber die casting machine

NARRATION (VO):

THE HOT-CHAMBER MACHINE IS USED MAINLY FOR DIE-CASTING ZINC AND OTHER METALS OF LOW MELTING TEMPERATURE. HOWEVER, IT IS ALSO USED TO DIE-CAST MAGNESIUM.

SCENE 84.
tape 462, 06:06:31-06:06:42
pan of holding pot
tape 473, 00:00:45-00:00:55
GRAPHIC: cutaway of hot-chamber machine
tape 473, 00:01:18-00:01:28
GRAPHIC: cutaway of hot-chamber machine, injection system highlighted

NARRATION (VO):

THE MACHINE'S SHOT OR CHARGE END HAS A HOLDING POT, WHICH IS A RESERVOIR FOR THE MOLTEN METAL SEATED IN A FURNACE, AND AN INJECTION SYSTEM FOR TRANSFERRING THE METAL THROUGH A GOOSENECK-SHAPED PIPE TO THE DIE.

SCENE 85.
tape 462, 06:05:57-06:06:14
pull back from plunger, injection system submerged in holding pot

NARRATION (VO):

THE PLUNGER END OF THE INJECTION SYSTEM AND THE LOWER PORTION OF THE TRANSFER PIPE ARE SUBMERGED IN THE MOLTEN METAL.

SCENE 86.
tape 473, 00:02:16-00:02:23
ANI: cutaway of hot-chamber machine showing the injection system, plunger rising, charge of metal entering the pipe through a port, plunger stopping, add white burst
tape 473, 00:02:26-00:02:40
ANI: plunger then descending, closing the port and driving the charge through a nozzle at the end of the pipe and into the die

NARRATION (VO):

WHEN THE PLUNGER RISES, A CHARGE OF METAL ENTERS THE PIPE THROUGH A PORT. WHEN THE PLUNGER DESCENDS, IT CLOSES THE PORT AND DRIVES THE CHARGE THROUGH A NOZZLE AT THE END OF THE PIPE AND INTO THE DIE.

SCENE 87.
CG, SUPER: Cold-Chamber Machine
tape 450, 17:02:12-17:02:22
cold-chamber die casting machine

NARRATION (VO):

THE COLD-CHAMBER MACHINE IS USED PRIMARILY TO DIE-CAST THE ALUMINUM, MAGNESIUM, AND COPPER ALLOYS.

SCENE 88.
tape 444, 11:14:35-11:15:08
zoom in from ladle system to pouring of shot

NARRATION (VO):

IN THE COLD-CHAMBER MACHINE, THE CHARGE IS SUPPLIED BY LADLE OR FEED SYSTEM FROM AN EXTERNAL FURNACE SOURCE TO A HOLDING POT AT THE SHOT END OF THE MACHINE. THE FEED SYSTEM COMPONENTS ARE NOT SUBMERGED IN THE MOLTEN METAL.

SCENE 89.
continue previous shot

NARRATION (VO):

THE CHARGE IS POURED AHEAD OF THE PLUNGER TIP THROUGH A POUR HOLE IN THE SHOT SLEEVE. AS THE PLUNGER ADVANCES, IT CLOSES THE POUR HOLE AND DRIVES THE MOLTEN METAL INTO THE DIE.

SCENE 90.
tape 468, 00:07:45-00:08:09
ANI: plunger thrusting forward

NARRATION (VO):

to release casting

AFTER THE METAL IN THE DIE SOLIDIFIES AND THE DIE HALVES ARE SEPARATING, THE PLUNGER THRUSTS FORWARD, EXTENDING THE PLUNGER TIP PAST THE COVER DIE. THIS PUSHES THE BISCUIT THAT SOLIDIFIES AT THE END OF THE SHOT SLEEVE, ASSISTING CASTING RELEASE.

SCENE 91.
tape 450, 17:10:01-17:10:12
die halves being lubricated before closing

NARRATION (VO):

BEFORE CLOSING, THE DIE HALVES ARE LUBRICATED BY EXTERNAL SPRAYS TO ASSIST IN COOLING, CASTING RELEASE AND TO MINIMIZE DIE WEAR.

SCENE 92.
tape 464, 09:08:47-09:08:55
zoom in, lubricant applied manually
tape 462, 06:04:45-06:04:53
lubricant applied automatically

NARRATION (VO):

LUBRICANTS, USUALLY WATER-SOLUBLE, CAN BE MANUALLY APPLIED...,

BUT ARE OFTEN SPRAYED AUTOMATICALLY USING CENTRAL DIE SPRAY SYSTEMS.

SCENE 93.
tape 464, 09:15:35-09:15:55
c.u. die opening, releasing part
CG, SUPER: Determines The Shape Of The Part/Parts
Acts As A Heat Exchanger
Vents Trapped Air/Gas
Ejects The Solidified Parts

NARRATION (VO):

THE DIES PROVIDE THE SHAPE OF THE DESIRED PART, AND ACT AS A HEAT EXCHANGER TO DRAW HEAT AWAY FROM THE CAST PART. IN ADDITION, THE DIES VENT TRAPPED AIR OR GAS, AND EJECT THE SOLIDIFIED PART.

SCENE 94.
tape 445, 12:18:34-12:18:47
c.u. die opening, ejecting parts, closing
CG, SUPER: Molten Metal Heat & Erosion
Thermal Shock From Repeated Heating & Cooling
Metal Injection & Clamping Pressures

NARRATION (VO):

THE DIES MUST WITHSTAND THE COMBINED EFFECTS OF MOLTEN METAL HEAT AND EROSION, THERMAL SHOCK FROM REPEATED HEATING AND COOLING, AND METAL INJECTION AND CLAMPING PRESSURES.

SCENE 95.
tape 464, 08:05:52-08:06:00
zoom out, from port to wide of cover die

NARRATION (VO):

THE COVER DIE HALF CONTAINS A PORT FOR ENTRY OF THE MOLTEN METAL FROM THE METAL INJECTION SYSTEM.

SCENE 96.
tape 464, 08:06:45:08
still, ejector die half
tape 464, 08:04:46-08:04:59
zoom out, runners, gates, part cavity

NARRATION (VO):

THE EJECTOR DIE HALF USUALLY CONTAINS THE CHANNELS, CALLED RUNNERS, THROUGH WHICH THE MOLTEN METAL FLOWS TO REACH THE GATE OR GATES AT THE DIE CAVITY.

SCENE 97.
tape 469, 00:00:50-00:01:00
GRAPHIC: side angle, ejector die
tape 469, 00:01:18-00:01:28
GRAPHIC: side angle, ejector die, wipe on yellow lines left to right showing draft angle
tape 450, 17:09:19-17:09:30
parts being ejected from die

NARRATION (VO):

TO FACILITATE CASTING EJECTION, DIES AND CORES INCORPORATE A SLIGHT DRAFT OR TAPER, THE AMOUNT DEPENDING ON THE METAL TO BE CAST.

--- FADE TO BLACK ---

SCENE 98.
CG: credit roll
white text on black, fade up mid screen

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SCENE 99.
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 machine operation.

SCENE 100.
tape 40, 01:00:00-01:00:12
SME logo