FUNDAMENTALS OF TOOL DESIGN

Rapid Tooling Design

SCENE 1.
RT35A, CGS: Direct Rapid Tooling Processes
white text, centered on background

SCENE 2.
RT36A, FTD65, 17:13:10:00-17:13:37:00
zoom in, dmls process

NARRATION (VO):

CONTRARY TO INDIRECT RAPID TOOLING PROCESSES THAT ARE WELL-ESTABLISHED AND WIDELY USED, DIRECT RAPID TOOLING PROCESSES ARE STILL EMERGING AND DEVELOPING AS THE TECHNOLOGIES, MATERIALS AND PROCESSES EVOLVE.

SCENE 3.
RT37A, zoom out, still, mold with dmls inserts
RT37B, FTD57, 08:06:22:00-08:06:33:00
injection mold process using dmls inserts, add vignette to image to mask edges
RT37C, FTD57, 08:17:42:00-08:17:58:00
injection mold process using dmls inserts

NARRATION (VO):

YET, RAPID TOOLING HAS BEEN SUCCESSFULLY DEPLOYED FOR PROTOTYPE, BRIDGE, SHORT-RUN AND HIGH VOLUME INJECTION MOLDING OPERATIONS USING MATERIALS RANGING FROM COMMODITY PLASTICS TO HIGHLY-ENGINEERED RESINS.

SCENE 4.
RT38A, FTD71, 05:20:45:00-05:21:07:00
mold insert being benched
RT38B, FTD71, 05:18:11:00-05:18:28:00
zoom out, mold base being assembled with dmls inserts

NARRATION (VO):

THE AIM OF DIRECT RAPID TOOLING IS TO DRAMATICALLY DECREASE THE TIME FOR MOLD CONSTRUCTION. WHEN APPLIED PROPERLY, MOLD MAKERS CITE LEAD TIMES OF THREE TO FOURTEEN DAYS FOR STANDARD TOOLS. IN CASES WHERE EXTENSIVE AMOUNTS OF EDM WORK ARE ELIMINATED, MOLD MAKERS REPORT

TIME, AND COST, SAVINGS UPWARDS OF SIXTY-SIX PERCENT.

SCENE 5.
RT39A, FTD58, 10:24:54:00-10:25:20:00
cad design of cavity
RT39B, zoom in, still, mold with complete dmls core and cavity
RT39C, zoom out, still, mold using dmls only for complex region
RT39D, FTD63, 15:18:50:00-15:19:09:00
zoom in, mold with dmls slides

NARRATION (VO):

TO ACHIEVE THESE IMPRESSIVE RESULTS, TOOL MAKERS ARE APPROACHING TOOL DESIGN AND CONSTRUCTION WITH AN EMPHASIS ON USING THE RIGHT PROCESS FOR DISCRETE ELEMENTS OF THE TOOL. THEY MAY APPLY RAPID TOOLING TO THE CONSTRUCTION OF COMPLETE CORES AND CAVITIES; A COMPLEX REGION OF A CORE OR CAVITY; OR INDIVIDUAL COMPONENTS SUCH AS GATES, SLIDES AND LIFTERS.

SCENE 6.
RT40A, FTD63, 15:49:23:00-15:50:28:00
injection mold process using dmls inserts

NARRATION (VO):

ALTHOUGH FEASIBLE, IT IS UNCOMMON FOR AN ENTIRE INJECTION MOLD TO BE RAPID TOOLED. THOSE THAT HAVE BEEN SUCCESSFUL WITH RAPID TOOLING TAKE A DIFFERENT APPROACH - THEY EVALUATE EACH ELEMENT OF THE TOOL TO DETERMINE WHAT WOULD BE THE FASTEST CONSTRUCTION PROCESS. THE RESULT IS A HYBRID TOOL THAT IS PIECED TOGETHER FROM COMPONENTS THAT ARE INVENTORIED, MACHINED OR RAPID TOOLED.

SCENE 7.
RT41A, FTD64, 16:19:36:00-16:20:01:00
zoom in, dmls process
RT41B, FTD65, 17:20:15:00-17:20:30:00
zoom out, mold with dmls inserts

NARRATION (VO):

IN THIS CONTEXT, RAPID TOOLING BECOMES AN ALTERNATIVE FOR EACH ELEMENT, OR

PIECE, OF THE INJECTION MOLD RATHER THAN A SUBSTITUTION FOR CONVENTIONAL MANUFACTURING METHODS. PIECES THAT ARE RAPID TOOLED ARE COMBINED WITH MACHINED METAL CAVITIES AND PURCHASED MOLD BASES.

SCENE 8.
RT42A, FTD65, 18:05:16:00-18:05:40:00
zoom out, powder cleaned from around dmls inserts

NARRATION (VO):

THE ADDITIVE FABRICATION TECHNOLOGIES THAT ARE USED GENERALLY PRODUCE NET SHAPE, FULLY DENSE METAL COMPONENTS WITH SURFACE FINISH AND ACCURACIES SUITABLE FOR MANY INJECTION MOLDING APPLICATIONS.

SCENE 9.
RT43A, FTD65, 17:07:56:00-17:08:36:00
zoom in, dmls process
RT43B, CGS: Stainless Steel
Cobalt Chromium
Maraging Steel
Titanium
Alloy Blends

NARRATION (VO):

WHILE THERE ARE SEVERAL TECHNOLOGIES THAT MEET THESE CRITERIA, THE MOST PREVALENT ARE DIRECT METAL LASER-SINTERING, OR 'DMLS', AND SELECTIVE LASER MELTING, OR 'SLM'. THESE ADDITIVE TECHNOLOGIES PRODUCE PARTS IN MATERIALS THAT INCLUDE STAINLESS STEEL, COBALT CHROMIUM, MARAGING STEEL, TITANIUM AND ALLOY BLENDS.

SCENE 10.
RT44A, FTD61, 13:45:31:00-13:46:07:00
zoom in, rapid prototyping with nanotool material
RT44B, CGS: Acrylonitrile Butadiene
Styrene
Acetal
Polycarbonate

NARRATION (VO):

ADDITIONALLY, USING RESINS, SUCH AS THE CERAMIC-FILLED 'NANOTOOL', THE STEREOLITHOGRAPHY PROCESS HAS BEEN APPLIED TO MOLD CONSTRUCTION FOR SMALL QUANTITIES OF PARTS INJECTION MOLDED IN

A WIDE RANGE OF THE THERMOPLASTICS, INCLUDING:
ACRYLONITRILE BUTADIENE STYRENE, OR ABS, ACETAL,
AND POLYCARBONATE.

SCENE 11.
RT45A, FTD63, 15:56:12:00-15:56:42:00
injection molded part removed
RT45B, FTD58, 10:17:26:00-10:17:42:00
dmls inserts in cad program
RT45C, FTD56, 07:53:35:00-07:53:50:00
zoom out, dmls process
RT45D, FTD66, 19:21:00:00-19:21:22:00
mold insert being ground
RT45E, FTD57, 08:12:00:00-08:12:13:00
zoom in, injection mold using dmls inserts

NARRATION (VO):

WHETHER USING METAL OR PLASTIC INSERTS, THE KEY TO SUCCESSFUL RAPID TOOLING DEPLOYMENT IS TO EVALUATE THE PROJECT THROUGH THE EYES OF THE PRODUCT DESIGNER, TOOL DESIGNER, MACHINIST, TOOL MAKER AND MOLDER. THIS COMPREHENSIVE VIEW PROVIDES AN APPRECIATION FOR THE CHALLENGES IN EACH STEP OF THE PROCESS, THE GOALS OF EACH OPERATION AND THE OPPORTUNITIES FOR IMPROVEMENT.

SCENE 12.
RT46A, FTD71, 05:28:59:00-05:29:12:00
zoom out, dmls inserts in cad program
RT46B, FTD64, 16:15:43:00-16:16:20:00
dmls process
RT46C, FTD66, 19:32:39:00-19:32:59:00
tilt, mold base being assembled with dmls inserts

NARRATION (VO):

IN THIS CONTEXT, THE INJECTION MOLD IS THEN ASSESSED COMPONENT-BY-COMPONENT AND ZONE-BY-ZONE WITH THE GOAL OF DETERMINING WHAT IS THE FASTEST METHOD TO MANUFACTURE EACH AREA OR ELEMENT OF THE MOLD WHILE MEETING THE PRODUCTION DEMANDS. WITH FEW EXCEPTIONS, THIS RESULTS IN A HYBRID TOOL CONSTRUCTED FROM BOTH ADDITIVE AND SUBTRACTIVE PROCESSES.

SCENE 13.
RT47A, FTD65, 18:10:05:00-18:10:20:00
zoom out, detailed dmls insert
RT47B, FMP253, 08:22:30:00-08:22:42:00
edming of mold
RT47C, FTD65, 17:05:16:00-17:05:34:00
dmls process

NARRATION (VO):

RAPID TOOLING IS MOST EFFECTIVE WHEN USED TO PRODUCE FINE, INTRICATE DETAILS. IF A TOOL'S DESIGN SHOWS AN AREA, OR COMPONENT, THAT REQUIRES EXTENSIVE EDM WORK OR FINE MACHINING, THIS SIGNALS AN OPPORTUNITY TO ACCELERATE THE MOLD MAKING PROCESS THROUGH RAPID TOOLING TECHNOLOGIES.

SCENE 14.
RT48A, FTD64, 16:20:15:00-16:20:49:00
dmls process
RT48B, FTD71, 05:13:49:00-05:14:21:00
zoom out, machining of mold base

NARRATION (VO):

IN ESSENCE, RAPID TOOLING REPLACES THE MACHINING OPERATIONS FOR ONLY THE AREAS, OR ELEMENTS, OF THE TOOL THAT WOULD BE TIME CONSUMING AND LABOR INTENSIVE. IT ALSO ENABLES A CONCURRENT, DUAL-PATH WORKFLOW THAT EXPEDITES DELIVERY AND IMPROVES PRODUCTIVITY.

SCENE 15.
RT49A, FTD60, 12:07:03:00-12:07:26:00
dmls operation
RT49B, CGS: Tool Design
RT49C, FTD71, 05:35:24:00-05:35:31:00
cad design of dmls inserts, dissolve to next image
RT49D, FTD71, 05:35:33:00-05:35:39:00
cad design of dmls inserts
RT49E, CGS: Component Building
RT49F, FTD64, 16:14:43:00-16:15:00:00
zoom in, dmls process
RT49G, CGS: Tool Assembly
RT49H, FTD66, 19:40:54:00-19:41:08:00
assembly of dmls tool
RT49I, CGS: Injection Molding
RT49J, FTD67, 21:10:23:00-21:10:37:00
injection molding using dmls inserts

NARRATION (VO):

THE BASIC, FOUR-STEP PROCESS FOR CONSTRUCTING INJECTION MOLDS WITH RAPID TOOLING TECHNIQUES IS THE SAME AS THAT WHEN MACHINING A MOLD:

TOOL DESIGN...,

COMPONENT BUILDING...,

TOOL ASSEMBLY...,

AND INJECTION MOLDING.

---TOUCH BLACK---

SCENE 16.
RT50A, CGS: Tool Design
RT50B, FTD71, 05:25:59:00-05:26:20:00
zoom out, dmls inserts in cad program

NARRATION (VO):

AFTER REVIEWING THE COMPONENTS OF THE TOOL AND IDENTIFYING WHAT IS TO BE RAPID TOOLED AND WHAT IS TO BE MACHINED, THE NEXT STEP IS TO DESIGN THE INSERTS.

SCENE 17.
continue previous shot
RT51A, FTD65, 17:02:24:00-17:03:02:00
zoom out, dmls process
RT51C, FMP908, 03:26:27:00-03:26:44:00
zoom in, machining process

NARRATION (VO):

THE INSERTS ARE DESIGNED SUCH THAT SIZE AND MASS ARE MINIMIZED. IT IS IMPORTANT TO RECOGNIZE THAT EFFICIENT RAPID TOOLING IS ACHIEVED WHEN THE VOLUME OF MATERIAL TO BE ADDITIVELY FABRICATED IS MINIMIZED, WHICH IS IN STARK CONTRAST TO EFFICIENT MACHINING THAT MINIMIZES THE VOLUME OF MATERIAL TO BE REMOVED AND NUMBER OF TOOL OR CLAMPING CHANGES.

SCENE 18.
RT52A, FTD65, 17:15:20:00-17:15:26:00
core with empty pocket, dissolve into next image
RT52B, FTD65, 17:15:30:00-17:15:36:00
insert placed into core pocket

NARRATION (VO):

HAVING DESIGNED THE INSERTS, CREATE A POCKET IN THE CORE, CAVITY OR MOLD BASE INTO WHICH EACH WILL SEAT.

SCENE 19.
RT53A, FTD66, 19:25:35:00-19:26:02:00
zoom out, inserts being machined for precision fit into mold base
RT53B, FTD57, 09:07:20:00-09:07:38:00
zoom out, dmls mold with flat parting surface

NARRATION (VO):

OPTIONALLY, THE INSERTS MAY BE ADJUSTED TO ALLOW MACHINING STOCK FOR A PRECISE FIT IN THE MACHINED POCKETS. A SMALL AMOUNT OF STOCK IS ADDED TO THE BACK FACE AND SIDE WALLS OF THE INSERT. WHEN THE PARTING SURFACE IS FLAT OR RELATIVELY SIMPLY, SOME STOCK MAY ALSO

BE ADDED TO THIS FACE.

SCENE 20.
RT54A, FTD57, 09:27:50:00-09:28:04:00
zoom out, through holes in dmls insert mold
RT54B, tilt, still dmls insert with multiple holes

NARRATION (VO):

ADDITIONALLY, STOCK MAY BE ADDED TO THROUGH HOLES, SUCH AS THOSE FOR THE EJECTOR PINS. TO MINIMIZE THE SECONDARY MACHINING, STOCK ALLOWANCES TYPICALLY RANGE FROM TEN THOUSANDTHS OF INCH TO TWENTY-FIVE THOUSANDTHS OF INCH.

SCENE 21.
RT55A, FTD57, 09:19:27:00-09:19:40:00
pan, cavity and core side of mold having dmls insert
RT55B, FTD57, 09:12:46:00-09:13:03:00
zoom out, gate of dmls insert

NARRATION (VO):

FOR DIRECT METAL INSERTS, IT IS ADVISABLE TO ADHERE TO RECOMMENDED ALLOWANCES FOR DRAFT ANGLES. WHEN PRACTICAL, GATES ARE ALSO DESIGNED INTO THE INSERT OR PRODUCED INDEPENDENTLY WITH THE DIRECT METAL TECHNOLOGY.

SCENE 22.
RT56A, FTD61, 13:41:01:00-13:41:17:00
stereolithography process using nanotool material
RT56B, FTD62, 14:02:55:00-14:03:14:00
part removed from mold using nanotool insert

NARRATION (VO):

WHEN USING STEREOLITHOGRAPHY INSERTS MADE FROM ‘NANOTOOL’, THERE ARE ADDITIONAL DESIGN REQUIREMENTS THAT ARISE BECAUSE OF THE MATERIAL’S PROPERTIES. SINCE THE INSERT IS A COMPOSITE PLASTIC, IT IS IMPORTANT TO DESIGN THE COMPONENTS TO AVOID DAMAGE THAT MAY RESULT DURING PLASTIC INJECTION AND PART EJECTION.

SCENE 23.
RT57A, FTD61, 13:08:53:00-13:09:04:00
small nanotool inserts draining
RT57B, zoom in, mold with small nanotool

NARRATION (VO):

‘NANOTOOL’ INSERTS ARE GENERALLY LESS

inserts

THAN FOUR INCHES FROM SIDE TO SIDE. ANYTHING LARGER REQUIRES AN INJECTION PRESSURE AND SHOT SIZE THAT WILL MOST LIKELY DAMAGE THE TOOL.

SCENE 24.
RT58A, still, nanotool insert in mold
RT58B, c.u., nanotool insert cavity
RT58C, c.u., gate of nanotool mold
RT58D, relocated gate of nanotool mold, dissolve into next shot
RT58E, relocated gate of nanotool mold
RT58F, c.u., nanotool mold with large standing ribs

NARRATION (VO):

ADDITIONAL DESIGN RULES FOR THE 'NANOTOOL' INSERTS INCLUDE:
DRAFT ANGLES OF TWO TO FOUR DEGREES OR MORE...,
OVERSIZED GATES THAT ARE TWO TO THREE TIMES THE STANDARD SIZE...,
RELOCATED GATES TO DECREASE INJECTION PRESSURES...,
STANDING RIBS GREATER THAN A SIXTEENTH OF AN INCH THICK WITH A HEIGHT TO WIDTH RATIO NO MORE THAN 3 TO 1.

SCENE 25.
RT59A, FTD61, 13:09:16:00-13:09:28:00
zoom out, nanotool insert draining
RT59B, FTD62, 14:20:23:00-14:20:44:00
injection molding operation using nanotool insert, parts manually pulled from mold

NARRATION (VO):

A FINAL DESIGN CONSIDERATION FOR A RAPID TOOL USING 'NANOTOOL' INSERTS IS TO SIMPLIFY THE TOOL'S OPERATION. SINCE THE TOOL WILL ONLY BE EXPECTED TO MOLD A SMALL NUMBER OF PARTS, TYPICALLY BETWEEN 20 AND 1,000, IT'S BEST TO DESIGN IT FOR MANUAL PART EJECTION THAT INCORPORATES HAND-LOADED INSERTS RATHER THAN SLIDES OR LIFTERS.

SCENE 26.
RT60A, CGS: Component Building
RT60B, FTD61, 13:39:42:00-13:40:08:00

NARRATION (VO):

zoom in, stereolithography process using nanotool material

ONCE THE TOOL DESIGN IS COMPLETE, THE RAPID PROTOTYPING BUILD CAN PROCEED.

SCENE 27.
continue previous shot
RT61A, FTD64, 16:06:51:00-16:07:41:00
zoom out, dmls process
RT61B, CGS: Layer Thickness
Build Orientation

NARRATION (VO):

THE RAPID PROTOTYPED INSERTS AND TOOLING COMPONENTS REQUIRE NO PROCESS MODIFICATION. HOWEVER, CONSIDERATION SHOULD BE GIVEN TO CONSTRUCTION CHARACTERISTICS THAT MAY CONTRIBUTE TO NET SHAPE PRODUCTION, WHICH ELIMINATES OR MINIMIZES SECONDARY MACHINING AND SIMPLIFIES POSTPROCESSING. THESE CONSIDERATIONS INCLUDE LAYER THICKNESS AND BUILD ORIENTATION.

SCENE 28.
RT62A, FMP908, 03:27:02:00-03:27:14:00
zoom out, machining of mold components
RT62B, FMP913, 08:21:31:00-08:21:45:00
grinding of pin

NARRATION (VO):

WHILE BUILDING THE RAPID TOOLED COMPONENTS, THE SIMULTANEOUS MACHINING OF ALL OTHER INJECTION MOLD ELEMENTS, SUCH AS CORES, CAVITIES, GATES, SLIDES, AND EJECTION SYSTEM CAN OCCUR.

SCENE 29.
RT63A, peter carey narration replacement
RT63B, FTD61, 13:18:40:00-13:18:50:00
nanotool being wiped
RT63C, FTD61, 13:27:05:00-13:27:29:00
nanotool going into uv oven
RT63D, CGS: Parts Washing
Support Removal
Ultraviolet Curing
RT63E, FTD66, 19:17:24:00-19:17:45:00
dmls inserts being post processed
RT63F, FTD66, 19:06:39:00-19:06:58:00
dmls inserts cut from platform
RT63G, FTD59, 11:49:50:00-11:50:02:00
dmls insert attached to build platform, pulled from machine

NARRATION (VO):

ONCE RAPID PROTOTYPING IS COMPLETE, THE INSERTS ARE POSTPROCESSED. FOR 'NANOTOOL' INSERTS, THIS INCLUDES PARTS WASHING, SUPPORT REMOVAL AND ULTRAVIOLET, OR UV CURING. FOR THE 'DMLS' AND 'SLM' PROCESSES, THIS INCLUDES REMOVAL OF SUPPORTS AND ANY

EXCESS METAL POWDER. WHILE THE BUILD PLATFORM MAY BE CUT AWAY FROM THE METAL INSERT, IT IS OFTEN INCLUDED AS AN INTEGRAL MOLD ELEMENT.

SCENE 30.
RT64A, FTD59, 11:51:51:00-11:52:11:00
zoom out, shot peening on dmls insert

NARRATION (VO):

SHOT PEENING IS OFTEN USED TO IMPROVE THE SURFACE FINISH AND COMPACT THE OUTER SKIN OF THE DIRECT METAL INSERT FOR ENHANCED DURABILITY.

SCENE 31.
RT65A, peter carey narration replacement
RT65B, FTD66, 19:28:24:00-19:28:42:00
zoom out, dmls insert being machined

NARRATION (VO):

IT IS CRITICAL TO AVOID EXCESSIVE SECONDARY OPERATIONS FOR THE PURPOSE OF HOLDING DESIRED TOLERANCES AND IMPROVING SURFACE FINISH.

SCENE 32.
RT66A, peter carey narration replacement
RT66B, FTD02, 02:42:15:00-02:42:48:00
zoom in, edming of injection mold
RT66C, CM47, 19:19:39:00-19:20:00:00
zoom out, edming of injection mold

NARRATION (VO):

IF A SIGNIFICANT AMOUNT OF MACHINING IS REQUIRED TO DELIVER THE SURFACE FINISH AND ACCURACY NEEDED FOR THE INJECTION MOLD, THE TIME FOR MACHINE SET UP AND OPERATION WILL NEGATE THE TIME ADVANTAGE THAT RAPID TOOLING OFFERS. THIS IS ESPECIALLY TRUE WHEN USING EDM AS A SECONDARY OPERATION.

SCENE 33.
RT67A, zoom in, still, gate with stair stepping
RT67B, pan, still, stair stepping on dmls insert

NARRATION (VO):

ADDITIONALLY, STAIR STEPPING, WHICH NATURALLY RESULTS FROM SOME RAPID PROTOTYPING LAYERING PROCESSES, OCCURS

ON INSERT SURFACES THAT ARE NOT VERTICAL OR HORIZONTAL. IF MACHINING OR POLISHING ISN'T A PRACTICAL SOLUTION TO REMOVE THESE STAIR STEPS, THEY MAY CAUSE SOME DIFFICULTY WHEN EJECTING THE MOLDED PART, OR AFFECT THE PARTS COSMETIC APPEAL.

SCENE 34.
RT68A, peter carey narration replacement
RT68B, **FTD66, 19:33:35:00-19:34:11:00**
zoom out, dmls insert being ground for placement in mold base
RT68C, **FTD66, 19:45:52:00-19:46:21:00**
dmls insert being ground for placement in mold base
RT68D, zoom out, still, dmls mold insert with holes

NARRATION (VO):

IF STOCK WAS ADDED TO AN INSERT'S DESIGN, THE SIDE WALLS, BACK FACE AND PARTING SURFACE MUST BE FINISHED TO SIZE BEFORE ASSEMBLY. DEPENDING ON THE TYPE OF INSERT AND THE MATERIAL FROM WHICH IT IS MADE, THE MATERIAL MAY BE REMOVED BY GRINDING, MILLING OR WIRE EDM. HOLES THAT WERE INTENTIONALLY UNDERSIZED ARE REAMED TO SIZE.

SCENE 35.
RT69A, CGS: Tool assembly
RT69B, **FTD66, 20:00:21:00-20:00:35:00**
zoom in, dmls inserts mounted into mold base
RT69C, **FTD66, 19:44:15:00-19:44:24:00**
insert placed into empty pocket
RT69D, **FTD66, 19:39:05:00-19:39:15:00**
insert placed into empty pocket

NARRATION (VO):

FINALLY, THE INSERTS ARE MOUNTED INTO THE POCKETS THAT HAVE BEEN MACHINED TO ACCEPT THEM, AND ALL OTHER COMPONENTS ARE ADDED TO COMPLETE THE INJECTION MOLD.

SCENE 36.
RT70A, CGS: Injection Molding
RT70B, **FTD67, 21:03:33:00-21:03:41:00**
dmls mold mounted to injection molding machine

NARRATION (VO):

THE MOLD IS THEN MOUNTED IN THE MACHINE FOR INJECTION MOLDING.

SCENE 37.
RT71A, still, zoom in, damaged nanotool

NARRATION (VO):

inserts
RT71B, FTD62, 14:23:18:00-14:23:38:00
injection molding using nanotool inserts

'NANOTOOL' INSERTS DO NOT HAVE THE MECHANICAL PROPERTIES OF A METAL TOOL, SO EXCESSIVE PRESSURE AND FORCEFUL PACKING OF THE CAVITY WILL RESULT IN INSERT DAMAGE. FOR THIS REASON, EASING INTO THE PRESSURE AND SHOT SIZE UNTIL THE CAVITY IS COMPLETELY FILLED AND GOOD PARTS ARE MOLDED IS ADVISABLE.

SCENE 38.
RT72A, FTD62, 14:28:48:00-14:29:00:00
zoom out, nanotool insert in mold
RT72B, FTD62, 14:09:44:00-14:10:00:00
injection molding using nanotool inserts
RT72C, still, deformed, failed nanotool insert and part

NARRATION (VO):

ADDITIONALLY, THE COMPOSITE PLASTIC 'NANOTOOL' MATERIAL ACTS AS AN INSULATOR. EVEN WITH OVERSIZED COOLING CHANNELS, THE TEMPERATURE OF THE INSERT WILL CONTINUE TO RISE WITH EACH INJECTION CYCLE. IF ALLOWED TO GET TOO HOT, THE PLASTIC PARTS MAY BEGIN TO STICK TO THE INSERT, THE INSERT MAY DEFORM OR THE INSERT MAY FAIL.

SCENE 39.
RT73A, FTD62, 14:25:57:00-14:26:16:00
wide, injection molding using nanotool inserts, parts removed manually

NARRATION (VO):

TO COUNTERACT ANY HEAT RETENTION, THE CYCLE TIME MUST BE INCREASED. FOR MOST THERMOPLASTICS, AN INCREASE OF 30 TO 60 SECONDS IS SUFFICIENT.

SCENE 40.
RT74A, FTD62, 14:13:52:00-14:14:08:00
zoom in, injection molding using nanotool inserts, parts removed manually

NARRATION (VO):

IF THE TOOL IS OPERATED MANUALLY THE DELAY BETWEEN INJECTION MOLDING SHOTS SHOULD BE SUFFICIENT TO ALLOW THE TOOL TO COOL.

SCENE 41.
RT75A, FTD62, 14:24:33:00-14:25:03:00
zoom in, injection molding using nanotool inserts, parts ejected

NARRATION (VO):

IN SOME CASES, THE THERMAL PROPERTIES OF THE 'NANOTOOL' INSERT ARE BENEFICIAL. THE ELEVATED TEMPERATURE OF THE TOOL MAY AVOID SHORT SHOTS BY PREVENTING FREEZING OFF OF THE PLASTIC IN THE CAVITY.

SCENE 42.
RT76A, FTD63, 15:43:33:00-15:44:13:00
zoom in, injection molding using dmls inserts

NARRATION (VO):

'DMLS' AND 'SLM' METAL INSERTS DON'T REQUIRE ANY SPECIAL CHANGES TO THE INJECTION MOLDING MACHINE. THE STRENGTH OF THE METAL INSERTS ELIMINATES THE NEED TO EASE INTO SHOT SIZE AND PRESSURE, AND ITS COOLING RATE IS SIMILAR TO THAT OF THE OTHER MOLD COMPONENTS, ALLOWING CONSISTENT COOLING.

SCENE 43.
RT77A, FTD57, 08:08:08:00-08:08:24:00
zoom in, injection molding using conformal cooling lines
RT77A, FTD57, 08:10:42:00-08:10:58:00
injection molding using conformal cooling lines

NARRATION (VO):

WHEN USED IN HIGH-VOLUME PRODUCTION MOLDS, RAPID TOOLING OFFERS A UNIQUE OPPORTUNITY FOR DECREASING CYCLE TIMES SIGNIFICANTLY BY USING CONFORMAL COOLING LINES.

SCENE 44.
RT78A, FTD59, 11:18:30:00-11:18:49:00
zoom out, dmls process
RT78B, FTD59, 11:34:59:00-11:35:08:00
cad image of insert cut away with conformal cooling lines
RT78C, FTD59, 11:35:33:00-11:35:42:00
cad image of insert with conformal cooling lines
RT78D, FTD57, 08:12:26:00-08:12:42:00
zoom in, injection molding using conformal cooling lines

NARRATION (VO):

SINCE COMPLEXITY IS NOT A CONCERN WHEN ADDITIVELY CONSTRUCTING A MOLD AND ITS INSERTS, RAPID TOOLING CAN ACCOMMODATE COOLING CHANNELS THAT TWIST, BEND AND CONTORT TO FOLLOW THE CONTOURS OF THE

MOLD'S CAVITY. THIS CIRCULATES COOLANT ACROSS THE ENTIRE MOLD CAVITY OR IN THE HOTTEST SPOTS OF THE MOLD.

SCENE 45.
RT79A, FTD59, 11:36:44:00-11:36:56:00
pan, cad image of conformal cooling lines
RT79B, FMP415, 10:25:49:00-10:26:02:00
mold with cooling lines, opening expelling part

NARRATION (VO):

THE CONFORMAL COOLING CHANNELS, WHEN DESIGNED EFFECTIVELY, HAVE BEEN REPORTED TO DECREASE CYCLE TIMES BY AS MUCH AS 40 PERCENT WHEN COMPARE TO THE STRAIGHT LINE, GUN DRILLED CHANNELS OF CONVENTIONALLY MADE INJECTION MOLDS.

--- TOUCH BLACK ---

SCENE 46.
RT80A, FTD61, 13:13:23:00-13:13:47:00
opening rtv mold
RT80B, FTD57, 08:10:44:00-08:10:57:00
dmls mold opening, dropping parts, closing

NARRATION (VO):

CONTRARY TO THE INDUSTRY PERCEPTIONS, RAPID TOOLING IS NOT LIMITED TO PROTOTYPING OR PRODUCTION OF SMALL PARTS IN SMALL QUANTITIES FROM A LIMITED NUMBER OF PLASTICS. WHEN COMBINED WITH MACHINED COMPONENTS, RAPID TOOLING CAN PRODUCE LARGE NUMBERS OF LARGE PARTS IN MOST, IF NOT ALL, THERMOPLASTICS.

SCENE 47.
RT81A, FTD56, 07:45:41:00-07:45:56:00
dmls process, dissolve to next image
RT81B, FTD56, 07:47:41:00-07:47:56:00
dmls process later
RT81C, FTD57, 09:08:40:00-09:08:56:00
zoom out, dmls mold
RT81D, FTD59, 11:11:59:00-11:12:23:00
dmls process
FTD CXM, credit music

NARRATION (VO):

THEY KEY TO SUCCESS IS TO APPLY RAPID TOOLING TO THE COMPONENTS OR REGIONS OF THE TOOL THAT CAN LEVERAGE ITS STRENGTHS IN RAPIDLY CONSTRUCTING COMPLEX, INTRICATE AND DETAILED MOLD FEATURES. WITH THIS HYBRID APPROACH, RAPID TOOLING

BECOMES AN ALTERNATIVE TO MACHINING CORES, CAVITIES AND COMPONENTS THAT WOULD PROVE TO BE DIFFICULT, TIME CONSUMING AND COSTLY TO MANUFACTURE USING CONVENTIONAL METHODS.

--- FADE TO BLACK ---