FUNDAMENTAL MANUFACTURING PROCESSES

Threading

SCENE 1.
TH57A, CGS: Internal Threads
white text, centered on background
FMP BKG, motion background

SCENE 2.
TH58A, SME2575, 01:26:04:00-01:26:18:00
zoom out finished internal thread rolled parts

NARRATION (VO):

TO CREATE INTERNAL THREADS, IT IS POSSIBLE TO INTERNALLY THREAD ROLL A WORKPIECE. HOWEVER, THE METAL MUST BE FAIRLY SOFT AND THE WORKPIECE'S WALL MUST BE THICK ENOUGH TO RECEIVE THE THREAD.

SCENE 3.
TH59A, SME4391, 23:20:06:00-23:20:32:00
thread turning operation
TH59B, SME4384, 15:36:34:00-15:37:20:00
thread turning operation
TH59C, SME4351, 03:44:23:00-03:44:41:00
thread turning operation, alternate shot

NARRATION (VO):

INTERNAL THREADS CAN ALSO BE GENERATED BY TURNING, USING A THREADING INSERT HELD IN A BORING BAR. BECAUSE THE CUTTING TOOL IS LONG, STABILITY AND TOOL DEFLECTION ARE IMPORTANT ISSUES TO ADDRESS.

SCENE 4.
TH60A, SME4384, 15:29:37:00-15:30:01:00
zoom in, large tapping operation
TH60B, CGS: Tapping

NARRATION (VO):

BUT BY FAR THE MOST TYPICAL PROCESS FOR GENERATING INTERNAL THREADS IS TO CUT THEM WITH A TAP. A TAP HAS A PROGRESSION OF SHARP THREAD-CUTTING SECTIONS ON ITS PERIPHERY.

SCENE 5.
TH61A, SME4367, 19:18:36:00-19:18:45:00
zoom out, tapping operation

NARRATION (VO):

TH61B, SME4389, 21:24:48:00-21:24:59:00
drilling hole
TH61C, SME4389, 21:26:49:00-21:27:10:00
zoom out, manually tapping hole

THE TAPPING OPERATION IS USUALLY A PROCESS OF TWO OR MORE STEPS. FIRST, A HOLE IS DRILLED INTO THE WORKPIECE WITH SLIGHTLY SMALLER DIAMETER THAN THE FINAL THREADED HOLE. THEN A ROTATING TAP IS DRIVEN INTO THE HOLE TO CUT A THREAD SHAPE INTO THE HOLE'S WALL AS THE TAP MOVES AXIALLY.

SCENE 6.
TH62A, SME4389, 21:28:29:00-21:28:41:00
tilt, square base of tap

NARRATION (VO):

BECAUSE TAPPING REQUIRES HIGH TORQUE, TAPS USUALLY HAVE A SQUARE BASE THAT CAN BE SECURELY GRIPPED.

SCENE 7.
TH63A, SME2631, 01:21:53:00-01:22:00:00
tap entering hole
TH63B, SME4389, 21:14:54:00-21:15:02:00
zoom out, split sleeve driver, compressing tap tightly
TH63C, SME2577, 01:20:15:00-01:20:20:00
tap inserted into collet
TH63D, SME2631, 01:27:26:00-01:27:36:00
collet holder, holding tap

NARRATION (VO):

THERE ARE THREE GENERAL TYPES OF TAP HOLDERS. THE MOST COMMON IS THE SPLIT-SLEEVE DRIVER, WHICH COMPRESSES TO HOLD THE TAP TIGHTLY. THERE ARE ALSO CONVENTIONAL COLLETS...,
AND COLLET HOLDERS WHICH ARE USED WITH THE COLLET, AND SPECIALLY SIZED TO THE TAP.

SCENE 8.
TH64A, SME4384, 15:26:29:00-15:27:12:00
zoom out, solid tap operation

NARRATION (VO):

SOLID TAPS ARE THE MOST COMMONLY USED TAPS. THEY CAN RANGE IN DIAMETER FROM ABOUT FIFTY THOUSANDTHS OF AN INCH OR ONE MILLIMETER, TO ABOUT TWO INCHES OR FIFTY MILLIMETERS.

SCENE 9.
TH65A, SME4388, 20:05:11:00-20:05:20:00
small tap, tapping multiple holes
TH65B, SME2577, 01:22:07:00-01:22:12:00
tap with steep chamfer, freeze last frame
TH65C, SME2577, 01:22:53:00-01:23:03:00
tap with no chamfer

NARRATION (VO):

THE MAIN DIFFERENCE AMONG TAPS IS THE AMOUNT OF CHAMFER AT THE CUTTING END. THE STEEPER THE CHAMFER, THE MORE GRADUAL THE CUTTING ACTION. THE LESS CHAMFER, THE GREATER THE CUTTING POWER.

SCENE 10.
TH66A, SME4388, 20:26:33:00-20:26:54:00
tapping on multiple holes

NARRATION (VO):

AS A RULE, THE LONGEST POSSIBLE CHAMFER ALLOWS THE BEST CUTTING EFFICIENCY, TAP LIFE, AND SIZE CONTROL.

SCENE 11.
TH67A, SME4393, 02:04:32:00-02:05:00:00
tapping operation on multiple holes
TH67B, CGS: Taper Tap
Plug Tap
Bottoming Tap

NARRATION (VO):

THREE COMMONLY USED SOLID TAP FORMS ARE:
THE TAPER TAP,
THE PLUG TAP,
AND THE BOTTOMING TAP.

SCENE 12.
TH68A, CGS: Taper Tap
TH68B, SME2652, 00:03:08:00-00:03:21:00
taper tap starting thread

NARRATION (VO):

THE TAPER TAP HAS THE GREATEST CHAMFER AND DOES THE LEAST CUTTING OF THE THREE. IT IS USED TO START THE THREADING.

SCENE 13.
TH69A, CGS: Plug Tap
TH69B, SME2577, 01:19:51:00-01:20:01:00
plug tap, tapping hole

NARRATION (VO):

THE PLUG TAP HAS AN INTERMEDIATE CHAMFER AND IS A GENERAL PURPOSE TAP.

SCENE 14.
TH70A, CGS: Bottoming Tap
TH70B, SME2577, 01:23:16:00-01:23:26:00
bottoming tap finishing hole

NARRATION (VO):

THE BOTTOMING TAP HAS THE LEAST CHAMFER AND IS USED FOR FINISHING OPERATIONS.

SCENE 15.
TH71A, SME2632, 02:06:54:00-02:07:06:00
tapping operation
TH71B, SME2632, 02:13:12:00-02:13:32:00
zoom out, tapping operation, alternate shot
TH71C, SME2652, 00:01:52:00-00:02:00:00
two flute tap
TH71D, SME2652, 00:01:30:00-00:01:38:00
four flute tap

NARRATION (VO):

TAPS HAVE FLUTES OR CHANNELS THAT CREATE CUTTING EDGES. THESE FLUTES ALLOW CHIPS OUT OF THE HOLE AND CUTTING FLUID IN.

TAPS USUALLY HAVE TWO...,

THREE...,

OR FOUR FLUTES.

SCENE 16.
TH72A, SME2652, 00:03:53:00-00:04:06:00
four flute tap threading
TH72B, SME2652, 00:03:25:00-00:03:40:00
two flute tap threading

NARRATION (VO):

A FOUR-FLUTE TAP CUTS BETTER AND SMOOTHER BECAUSE IT HAS MORE CUTTING EDGES. TWO- AND THREE-FLUTE TAPS HAVE MORE SPACE FOR CHIPS, AND ARE STRONGER.

SCENE 17.
TH73A, still, straight flute tap
TH73B, still, spiral flute tap

NARRATION (VO):

TAPS MAY HAVE STRAIGHT...,

OR SPIRAL FLUTES.

SCENE 18.
TH74A, SME4389, 21:22:08:00-21:22:28:00
zoom out, straight tap producing chips

NARRATION (VO):

STANDARD STRAIGHT-FLUTE TAPS TEND TO PRODUCE SMALL CHIPS. ORDINARILY THIS IS NOT A PROBLEM, BUT IN A BLIND HOLE THESE CHIPS TEND TO COLLECT AT THE BOTTOM OF THE HOLE, OR CLOG THE FLUTES.

SCENE 19.
TH75A, SME2577, 01:03:48:00-01:04:00:00
manual spiral tapping operation

NARRATION (VO):

SPIRAL-FLUTE TAPS PULL LONGER CHIPS UP AND OUT OF THE HOLE, MAKING THEM PARTICULARLY USEFUL IN TAPPING BLIND HOLES.

SCENE 20.
TH76A, SME4393, 02:06:10:00-02:06:58:00
zoom out, tapping operation on multiple holes

NARRATION (VO):

MOST TAPS ARE MADE FROM HIGH-SPEED STEEL, BUT CARBIDE OR CARBON STEEL IS SOMETIMES USED. SOLID CARBIDE TAPS CUT FASTER AND CLEANER, AND LAST LONGER.

SCENE 21.
TH77A, SME4091, 07:26:28:00-07:26:46:00
tapping operation on multiple holes

NARRATION (VO):

TAPS ARE DESIGNED CHIEFLY TO CUT STEEL, BUT THERE ARE SPECIAL TAPS FOR WORKING WITH ALUMINUM, NICKEL ALLOYS, AND CAST IRON.

--- TOUCH BLACK ---

SCENE 22.
TH78A, SME4372, 02:15:14:00-02:15:26:00
tapping operation

NARRATION (VO):

HOW MUCH A TAP CUTS PER REVOLUTION DEPENDS ON THE ANGLE AT WHICH THE CUTTING TOOTH ON THE DIE CONTACTS THE WORKPIECE.

SCENE 23.
TH79A, CGS: Rake/Hook Angle
TH79B, ANI: tap
TH79C, ANI: tap, rake angle
TH79D, ANI: tap, rake angle, center line
TH79E, CGS: Negative Rake
TH79F, ANI: negative tap
TH79G, ANI: negative tap, rake lines
TH79H, CGS: Zero Rake
TH79I, ANI: zero tap
TH79J, ANI: zero tap, rake lines
TH79K, CGS: Positive Rake
TH79L, ANI: positive tap
TH79M, ANI: positive tap, rake lines

NARRATION (VO):

THIS ANGLE IS CALLED THE RAKE OR HOOK ANGLE, AND IS DEFINED AS THE ANGLE BETWEEN A LINE THROUGH THE CUTTING FACE AND A RADIAL LINE FROM THE TOOL CENTER TO THE TOOTH TIP. GENERALLY, THE MORE DUCTILE THE MATERIALS, THE GREATER THE RAKE ANGLE, BECAUSE THE DIE TOOTH CAN TAKE A BIGGER BITE OUT OF SOFTER MATERIALS.

SCENE 24.
TH80A, SME4372, 02:35:44:00-02:36:02:00
tapping operation on two holes
TH80B, SME2577, 01:23:59:00-01:24:08:00
tapping too fast, tool breakage
TH80C, SME2632, 02:09:32:00-02:09:44:00
tapping with lubrication
TH80D, SME4111, 02:33:16:00-02:33:34:00
tapping multiple holes with lubrication, alternate shot

NARRATION (VO):

TAPPING SPEED IS CRITICAL IN DETERMINING HOW A TAP CUTS, BECAUSE IT AFFECTS THREAD QUALITY AND TAP LIFE. TOO MUCH SPEED CAUSES THE TAP TO BECOME DULL OR BREAK, OR TEARS UP THE METAL. HIGH-SPEED TAPPING ALSO MAKES IT DIFFICULT TO ACHIEVE GOOD LUBRICATION AND CHIP REMOVAL.

SCENE 25.
TH81A, SME4388, 20:04:15:00-20:04:38:00
forming tap used on multiple holes
TH81B, zoom out, still, thread forming tap
TH81C, SME4388, 20:01:58:00-20:02:09:00
zoom out, forming tap used on multiple holes
TH81D, SME2632, 02:14:28:00-02:14:44:00
thread forming tap operation, alternate shot

NARRATION (VO):

FOR SOFTER METALS, OR WHERE IT IS IMPORTANT NOT TO MAKE CHIPS, THREAD FORMING TAPS OR ROLL TAPS MAY BE USED. ROLL TAPS HAVE NO CUTTING EDGES OR FLUTES. THEY GENERATE MORE FRICTIONAL HEAT THAN STANDARD TAPS, BECAUSE THEY FORM RATHER THAN CUT THE THREAD.

--- TOUCH BLACK ---

SCENE 26.
TH82A, SME4389, 21:22:30:00-21:22:40:00
manual tapping
TH82B, SME4389, 21:20:13:00-21:20:28:00
hole being drilled
TH82C, SME4389, 21:30:53:00-21:31:03:00
zoom out, placing tap in tap wrench
TH82D, SME4389, 21:21:50:00-21:22:14:00
tapping operation on hole

NARRATION (VO):

TAPPING IS DONE MANUALLY FOR LOW-VOLUME PRODUCTION. MANUAL TAPPING INVOLVES DRILLING A HOLE...,
PUTTING A TAP IN A TAP WRENCH...,
AND MANUALLY THREADING THE HOLE.

SCENE 27.
TH83A, SME4386, 19:02:27:00-19:02:45:00
zoom out, flexible arm used to tap part

NARRATION (VO):

IN AN OPERATION WHERE PRECISION TAP

POSITIONING IS NOT CRITICAL, IT MAY BE PRACTICAL TO MANUALLY PLACE THE TAPPING TOOL IN THE HOLE. IN THESE CASES, FLEXIBLE ARMS CAN BE USED.

SCENE 28.
TH84A, SME2632, 02:01:38:00-02:01:47:00
dedicated machine tool tapping
TH84B, SME4387, 19:12:28:00-19:12:34:00
tapping on lathe
TH84C, SME4308, 08:10:12:00-08:10:27:00
zoom in, tapping on mill
TH84D, SME4388, 20:03:28:00-20:03:36:00
zoom in, tapping on machining center
TH84E, still, drill & tap machine
TH84F, tapping with drill & tap machine
TH84G, SME4393, 03:21:42:00-03:22:11:00
zoom out, multi-spindle tapping operation

NARRATION (VO):

FOR HIGHER VOLUMES, TAPPING IS MOST COMMONLY ACCOMPLISHED USING DEDICATED TAPPING MACHINE TOOLS...,
LATHES...,
MILLS...,
MACHINING CENTERS...,
DRILL AND TAP MACHINES...,
OR SPECIALIZED MULTI-SPINDLE TAPPING MACHINES.

--- TOUCH BLACK ---

SCENE 29.
TH85A, SME4372, 02:16:27:00-02:16:39:00
tapping operation

NARRATION (VO):

FOR ACCURATELY POSITIONING AND PROPERLY DRIVING TAPS, THREE TECHNIQUES ARE USED IN TAPPING OPERATIONS.

SCENE 30.
TH86A, SME2632, 02:02:28:00-02:02:48:00
floating head tap, tapping

NARRATION (VO):

THE FIRST TECHNIQUE USES A TAP HOLDER THAT CAN ACCOMMODATE BOTH MISALIGNMENT AND DIFFERENCES IN TENSION AND COMPRESSION BETWEEN THE TAP AND SPINDLE. THIS IS CALLED A FLOATING HEAD.

SCENE 31.
TH87A, SME2632, 02:06:29:00-02:06:45:00

NARRATION (VO):

rigid/synchronous tap driving operation
TH87B, SME4352, 04:40:09:00-04:40:49:00
zoom out, rigid/synchronous tap driving operation on multiple holes, alternate shot

THE SECOND REQUIRES THE ABILITY TO PROGRAM THE SPINDLE DRIVE SO THAT THE TORQUE DELIVERED TO THE TAP IS EXACTLY WHAT IS NEEDED. THIS IS CALLED RIGID OR SYNCHRONOUS TAP DRIVING.

SCENE 32.
TH88A, SME4387, 19:09:56:00-19:10:18:00
zoom in, tapping head operation

NARRATION (VO):

THE THIRD TECHNIQUE INVOLVES ADDING A TAPPING HEAD TO AN EXISTING MACHINE TOOL. THIS TAPPING HEAD ADAPTS THE MACHINE TOOL'S SPINDLE TORQUE TO THE TAPPING OPERATION, MAINTAINING THE BEST TAP CUTTING SPEED AND REVERSING DIRECTION AT THE END OF THE TAPPING STROKE. THESE SELF-REVERSING TAPPING HEADS ARE OFTEN PROGRAMMABLE.

SCENE 33.
TH89A, SME4387, 19:08:34:00-19:09:02:00
tapping operation
TH89B, CGS: Accuracy Required
Production Volume
Tap Size
TH89C, SME4372, 02:37:15:00-02:37:24:00
rigid tapping operation
TH89D, SME4388, 20:01:31:00-20:01:40:00
zoom out, tapping using self-reversing head

NARRATION (VO):

DETERMINING WHICH OF THESE THREE TECHNIQUES IS BEST SUITED FOR A SPECIFIC TAPPING OPERATION DEPENDS ON THE ACCURACY REQUIRED, PRODUCTION VOLUME, AND TAP SIZE. RIGID TAPPING CAN CONTROL THE TENSION AND COMPRESSION ON THE TAP, BUT PROCESSES AT A SLOWER RATE THAN SELF-REVERSING HEADS.

--- FADE TO BLACK ---