

**FUNDAMENTAL MANUFACTURING PROCESSES**

Milling & Machining Centers

SCENE 1.

**FMP RVW**, CGS: Review  
white text, centered on background

SCENE 2.

**ML06A, SME3454, 22:17:28:00-22:17:41:00**  
zoom out, milling of flat plastic surface  
**ML06B, SME2973, 13:06:29:00-13:06:47:00**  
zoom out, milling contoured surface

**NARRATION (VO) :**

MILLING IS A HIGHLY VERSATILE MACHINING  
PROCESS THAT USES ROTATING, MULTI-EDGE  
CUTTERS TO GENERATE FLAT...,  
OR CONTOURED SURFACES ON A VARIETY OF  
WORKPIECE MATERIALS.

SCENE 3.

**ML12A, SME2667, 05:01:49:00-05:02:25:00**  
milling using cutter with multiple inserts  
**ML12B, SME3339, 00:04:09:00-00:04:30:00**  
zoom out, end milling operation with a lot  
of chips

**NARRATION (VO) :**

WORKPIECE MATERIAL IS REMOVED IN THE  
FORM OF A DISCONTINUOUS, TAPERED CHIP.  
THIS PROCESS IS A FORM OF INTERRUPTED  
CUTTING.

SCENE 4.

**ML15B, FMP015, 15:35:17:00-15:35:39:00**  
zoom out, knee mill in operation  
**ML16A, FMP015, 15:11:03:00-15:11:21:00**  
med, knee & column  
**ML16B**, CGS: Column  
**ML16C**, CGS: Knee  
**ML16D, FMP015, 15:11:32:00-15:11:48:00**  
med, table & saddle  
**ML16E**, CGS: Table  
**ML16F**, CGS: Saddle  
**ML17A, FMP015, 15:14:40:00-15:15:00:00**  
zoom out, ram, head moving in  
**ML17B**, CGS: Ram  
**ML17C, FMP015, 15:19:08:00-15:19:23:00**  
tilt, milling head  
**ML17D**, CGS: Head  
**ML18A, FMP015, 15:21:09:00-15:21:23:00**  
zoom out, quill/spindle, tool rotating  
**ML18C**, CGS: Spindle  
**ML22A, FMP015, 15:33:55:00-15:34:20:00**  
zoom out, c.u. knee mill with powered feed

**NARRATION (VO) :**

THE BASIC ELEMENTS OF MILLING MACHINES  
ARE ILLUSTRATED BY THE MANUAL KNEE MILL,  
WHOSE MAIN COMPONENTS INCLUDE:  
THE COLUMN...,  
KNEE...,  
TABLE...,  
SADDLE...,  
RAM...,  
HEAD...,  
SPINDLE...,

**ML22B, FMP015, 15:34:46:00-15:35:02:00**  
zoom out, c.u. knee mill with powered  
feed, alternate take  
**ML22C, FMP015, 15:37:12:00-15:37:38:00**  
zoom out, digital readout

AND VARIOUS CONTROLS, POWERED FEEDS, AND  
DIGITAL READOUTS.

SCENE 5.

**ML25A, SME4018, 02:09:10:00-02:09:36:00**  
zoom in, cnc control running machining  
operation  
**ML30A, FTD99, 09:30:27:00-09:30:48:00**  
zoom out, vertical machining center  
**ML30B, SME3353, 10:10:42:00-10:10:57:00**  
zoom out, horizontal machining center

**NARRATION (VO) :**

PRODUCTION MACHINING CENTERS USE  
COMPUTER NUMERICAL CONTROL, OR 'CNC', IN  
WHICH INSTRUCTIONS FOR MACHINING ARE IN  
THE FORM OF A CODED PART PROGRAM. THE  
TWO PRIMARY 'CNC' MACHINING CENTERS  
INCLUDE THE VERTICAL MACHINING  
CENTER...,  
AND THE HORIZONTAL MACHINING CENTER.

SCENE 6.

**ML38B, SME4026, 11:26:05:00-11:26:12:00**  
tool change  
**ML39A, SME4026, 11:58:14:00-11:58:25:00**  
tool storage, tools indexing

**NARRATION (VO) :**

TOOLCHANGING IS AUTOMATED ON MACHINING  
CENTERS, WHERE TOOL STORAGE CAPACITY MAY  
RANGE FROM 20 TO 200 OR MORE CUTTING  
TOOLS.

SCENE 7.

**ML40C, FMP006, 06:36:18:00-06:36:34:00**  
face milling  
**ML40D, FMP001, 01:42:41:00-01:42:55:00**  
end milling  
**ML42B, FMP006, 06:30:09:00-06:30:49:00**  
face milling operation  
**ML46H, FMP015, 15:40:25:00-15:40:38:00**  
edging operation  
**ML46D, FTD07, 06:46:02:00-06:46:12:00**  
shoulder operation  
**ML46F, FTD19, 20:11:25:00-20:11:36:00**  
zoom out, grooving operation

**NARRATION (VO) :**

THERE ARE MANY CUTTERS AND TYPES OF  
MILLING OPERATIONS, WITH TWO OF THE MOST  
COMMON TOOLS BEING FACE MILLS,  
AND END MILLS.  
MILLING CUTTERS CAN CREATE FLAT

**ML53B, FMP006, 06:09:05:00-06:10:11:00**  
pocket milling operation  
**ML54B, SME3339, 00:19:05:00-00:19:26:00**  
contour milling operation  
**ML55A, FTD23, 03:16:48:00-03:17:14:00**  
zoom in, milling using carbide inserts  
**ML55B, SME4022, 07:11:24:00-07:11:37:00**  
high speed machining emphasizing tooling

SURFACES...,  
EDGES...,  
SHOULDERS...,  
GROOVES...,  
POCKETS...,  
CONTOURS...,  
AND OTHER FEATURES. BOTH TOOL SHAPE AND  
MATERIAL, AS WELL AS THE CHOICE OF  
TOOLHOLDER, ARE IMPORTANT PERFORMANCE  
FACTORS.

SCENE 8.

**ML33B, FMP003, 03:09:43:00-03:10:10:00**  
indexer on vmc  
**ML21B, FMP015, 15:29:40:00-15:29:50:00**  
zoom out, part held by vise to table  
**ML21A, FMP015, 15:31:35:00-15:31:52:00**  
zoom out, part bolted directly to table  
with clamps  
**ML59C, FTD90, 06:28:02:00-06:28:15:00**  
zoom in, machining of part on tombstone

**NARRATION (VO) :**

WORKHOLDING DEVICES SECURE THE WORK AND  
ORIENT IT IN DIFFERENT WAYS TO THE  
CUTTING TOOL. WORKHOLDING DEVICES  
INCLUDE THE VARIOUS VISES...,  
CLAMPS...,  
TOMBSTONES,  
AND OTHER FIXTURES.

SCENE 9.

**ML61A, FTD88, 04:44:03:00-04:44:17:00**  
pallet of finished parts taken from mill  
**ML61B, FTD88, 04:41:15:00-04:41:41:00**  
wide, finished pallet pulled from mill,  
pallets rotated to new workpieces  
**ML61C, FTD88, 04:44:39:00-04:44:54:00**  
pallet of raw work stock placed in mill  
**ML61D, FTD90, 06:31:39:00-06:31:51:00**  
part set up on tombstone  
**ML61E, FTD90, 06:27:26:00-06:27:41:00**  
zoom in, milling operation on part

**NARRATION (VO) :**

WORKCHANGING METHODS ALLOW UNPROCESSED  
WORKPIECES TO BE SET UP WHILE THE  
SPINDLE IS CUTTING OTHER WORKPIECES.

SCENE 10.

**ML66A, FMP012, 12:39:04:00-12:39:41:00**  
touch trigger probe used on workpiece in  
mill

**NARRATION (VO) :**

OF THE MANY ACCESSORIES THAT MAY BE USED

**ML67A, FTD08, 07:25:13:00-07:25:39:00**  
tap placed in tool presetting machine

WITH MACHINING CENTERS, TWO ARE  
PARTICULARLY SIGNIFICANT:  
THE TOUCH-TRIGGER PROBE...,  
AND THE TOOL-PRESETTING MACHINE.

SCENE 11.

**ML72A, FMP001, 01:12:43:00-01:13:16:00**  
zoom out, milling operation  
**ML73A, CGS: Cutting Speed**  
**ML73B, FTD99, 09:36:42:00-09:37:03:00**  
horizontal face milling operation  
**ML74A, CGS: Feed Rate**  
**ML74B, SME2667, 05:09:49:00-05:10:18:00**  
zoom in, milling operation  
**ML76C, SME2666, 04:20:03:00-04:20:25:00**  
zoom in, small face milling operation  
**ML76D, CGS: Axial Depth of Cut**  
**ML76E, CGS: Radial Depth of Cut**  
**ML76F, SME6667, 05:08:56:00-05:09:19:00**  
zoom in, pocket milling operation

**NARRATION (VO) :**

CUTTING TOOLS, MACHINE POWER, WORKPIECE  
MATERIAL, AND OTHER FACTORS DETERMINE  
THE MAJOR OPERATING PARAMETERS IN  
MILLING, WHICH INCLUDE:  
THE CUTTING SPEED, WHICH IS THE SPEED AT  
WHICH THE TOOL EDGE ENTERS THE CUT...,  
THE FEED RATE, WHICH IS BASED ON THE  
DISTANCE THE TOOL EDGE TRAVELS INTO THE  
WORKPIECE IN ONE CUTTER REVOLUTION...,  
THE AXIAL DEPTH OF CUT, WHICH IS THE  
DISTANCE THE TOOL IS SET BELOW THE UN-  
MACHINED SURFACE....,  
AND THE RADIAL DEPTH OF CUT, WHICH IS  
THE DISTANCE OF WORK SURFACE ENGAGED BY  
THE TOOL.

--- FADE TO BLACK ---