FUNDAMENTAL MANUFACTURING PROCESSES

Milling & Machining Centers

SCENE 1.
ML71A, CGS: Operating Parameters
white text, centered on background

SCENE 2.
ML72A, FMP001, 01:12:43:00-01:13:16:00
zoom out, milling operation
ML72B, CGS: Cutting Speed
Feed Rate
Axial Depth of Cut
Radial Depth of Cut

NARRATION (VO):

THE SELECTION OF OPERATING PARAMETERS IN MILLING INVOLVES MANY FACTORS. WITH THE MOST IMPORTANT INCLUDING:

CUTTING SPEED,

FEED RATE,

AXIAL DEPTH OF CUT,

AND RADIAL DEPTH OF CUT.

SCENE 3.
ML73A, CGS: Cutting Speed
ML73B, FTD99, 09:36:42:00-09:37:03:00
horizontal face milling operation
ML73C, FTD101, 11:17:18:00-11:18:14:00
face milling operation

NARRATION (VO):

IN MILLING, CUTTING SPEED IS MEASURED IN TERMS OF SURFACE INCHES OR METERS PER MINUTE. THIS IS HOW FAST THE EDGE OF THE TOOTH AT THE PERIPHERY OF THE CUTTER ENTERS THE WORK. IT IS A FUNCTION OF CUTTER DIAMETER AND SPINDLE ROTATIONS PER MINUTE. TYPICAL VALUES FOR COMMON MATERIALS MAY RANGE FROM APPROXIMATELY 40 TO 1,000 SURFACE FEET, OR 10 TO 300 METERS, PER MINUTE.

SCENE 4.
ML74A, CGS: Feed Rate
ML74B, SME2667, 05:09:49:00-05:10:18:00
zoom in, milling operation
ML74C, FTD87, 03:20:14:00-03:20:41:00

NARRATION (VO):

THE FEED RATE IN MILLING IS EXPRESSED IN

zoom out, milling operation

INCHES OR MILLIMETERS PER CUTTER EDGE OR TOOTH. IT IS BASED ON THE LINEAR DISTANCE A TOOL EDGE TRAVELS INTO THE WORKPIECE DURING ONE CUTTER REVOLUTION. IT COMBINES THE VARIABLES OF TABLE MOTION, CUTTER DIAMETER, AND NUMBER OF TEETH ON THE CUTTER. A COMMON FEED RATE IS TEN THOUSANDTHS OF AN INCH, OR A QUARTER OF A MILLIMETER, PER TOOTH.

SCENE 5.
ML75A, FTD99, 09:19:40:00-09:19:57:00
zoom out, milling operation

NARRATION (VO):

IN MILLING, THE TABLE TRAVEL SPEED IS NOT EQUIVALENT TO FEED RATE; RATHER IT MUST BE SELECTED TO ACHIEVE THE DESIRED FEED RATE.

SCENE 6.
ML76A, SME2667, 05:12:44:00-05:12:59:00
zoom out, milling operation
ML76B, CGS: Axial
Radial
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, SME2667, 05:08:56:00-05:09:19:00
zoom in, pocket milling operation

NARRATION (VO):

THERE ARE TWO TYPES OF DEPTH OF CUT:
AXIAL,
AND RADIAL.
IN FACE MILLING, THE AXIAL DEPTH OF CUT IS THE DISTANCE THE TOOL IS SET BELOW THE UN-MACHINED SURFACE. ORDINARILY, AN AXIAL DEPTH OF CUT IS SELECTED TO MINIMIZE THE NUMBER OF PASSES REQUIRED TO REMOVE A GIVEN AMOUNT OF MATERIAL. THE RADIAL DEPTH OF CUT IS THE WIDTH OR DISTANCE OF WORK SURFACE ENGAGED BY THE TOOL.

SCENE 7.
ML77A, FTD01, 01:15:42:00-01:16:21:00
zoom out, milling operation
ML77B, CGS: Amount of Material Removed
Average Chip Thickness
Cutter Geometry
Speed
Workpiece Material

NARRATION (VO):

EFFICIENT MILLING ALSO REQUIRES SPINDLE POWER CONSIDERATIONS, SO THAT THE MILLING CUTTER MAKES THE BEST USE OF AVAILABLE MACHINE HORSEPOWER. THE POWER REQUIRED FOR AN OPERATION VARIES WITH THE AMOUNT OF MATERIAL REMOVED, AVERAGE CHIP THICKNESS, CUTTER GEOMETRY, DESIRED SPEED, AND THE WORKPIECE MATERIAL.

SCENE 8.
ML78A, SME4021, 05:52:47:00-05:53:10:00
high speed machining operation using flood coolant
ML78B, SME4031, 18:02:00:00-18:02:18:00
zoom out, high speed milling using flood coolant

NARRATION (VO):

COMMON MACHINING OF TYPICAL WORKPIECE METALS USUALLY REQUIRES FLOODING THE PROCESS WITH WATER-BASED COOLANT TO COOL THE CUTTING INTERFACE AND TRANSPORT CHIPS AWAY FROM THE PROCESS. WATER-BASED COOLANT MUST HAVE THE RIGHT CHEMISTRY AND CLEANLINESS FOR EFFICIENT MACHINING.

SCENE 9.
ML79A, SME4087, 01:36:06:00-01:36:36:00
drilling, tapping, spot drilling on mill using mql
ML79B, SME4089, 03:12:47:00-03:13:06:00
zoom in, end milling using mql
ML79C, SME4091, 07:13:20:00-07:13:30:00
chips produced from mql operation

NARRATION (VO):

HOWEVER, SOME MATERIALS, SUCH AS ALUMINUM, CAN BE MACHINED WITH NEAR-DRY MACHINING, ALSO CALLED ‘MINIMUM QUANTITY LUBRICATION, OR ‘MQL’. WITH ‘MQL’, ONLY A THIN MIST OF LUBRICANT, SUCH AS VEGETABLE OIL, IS APPLIED TO THE CUTTING

SURFACE THROUGH SPECIALIZED TOOLING OR APPLICATORS. THUS, 'MQL' SAVES COOLANT HANDLING AND DISPOSAL COSTS AND PRODUCES CLEANER CHIPS.

SCENE 10.
ML80A, SME4030, 17:13:32:00-17:13:56:00
zoom out, high speed machining operation
ML80B, SME4026, 11:29:35:00-11:29:49:00
zoom in, high speed machining operation
ML80C, SME4018, 02:08:03:00-02:08:23:00
zoom out, high speed machining steel

NARRATION (VO):

VARIOUS WORK MATERIALS CAN ALSO BE MACHINED USING VERY HIGH SPINDLE SPEEDS. THIS IS COMMONLY REFERRED TO AS HIGH-SPEED MACHINING, OR 'HSM'. 'HSM' IS LOOSELY DEFINED AS MACHINING WITH ENHANCED SPINDLES THAT SUPPLY ROTATIONAL SPEEDS ABOVE 10,000 ROTATIONS PER MINUTE, OR 'RPM'. THESE SPINDLE SPEEDS ARE COUPLED WITH RAPID AXIS MOVEMENTS, TRANSVERSE RATES, ACCELERATIONS, AND DECELERATIONS TO MAXIMIZE MATERIAL REMOVAL.

SCENE 11.
ML81A, SME4026, 11:32:39:00-11:33:00:00
fast high speed machining
ML81B, SME4026, 11:42:00:00-11:42:20:00
zoom out, high speed machining operation

NARRATION (VO):

GENERALLY, HIGH SPEED MACHINING IS PERFORMED USING A SHALLOW AXIAL DEPTH OF CUT THAT HELPS TO REDUCE CUTTING FORCES AND FRICTIONAL HEAT WHILE INCREASING METAL REMOVAL RATES. THUS, 'HSM' REDUCES DISTORTION IN THE WORKPIECE DURING CUTTING AND ALLOWS HIGHER THROUGHPUT THAN WITH CONVENTIONAL MACHINING, WHILE PRODUCING A GOOD SURFACE FINISH.

--- FADE TO BLACK ---

Copyright © 2010 Society of Manufacturing Engineers