FUNDAMENTAL MANUFACTURING PROCESSES

Workholding - WH

SCENE 1.
WH34A, CGS: Milling & Machining Center
Workholding
white text, centered on background
FMP BKG, motion background

SCENE 2.
WH35A, SME2638, 01:11:42:00-01:11:51:00
multiple clamping on machining center
WH35B, SME4303, 03:21:27:00-03:21:48:00
zoom out, milling large support
WH35C, SME4395, 05:10:25:00-05:10:52:00
zoom out, parts placed in fixtures, pneumatic clamping actuated, doors closed for machining
WH35D, SME4374, 04:38:33:00-04:38:47:00
dedicated fixture
WH35E, SME4305, 05:05:00:00-05:05:30:00
zoom out, milling with clamping of large stamping die base on machining center table

NARRATION (VO):

WORKHOLDING FOR MILLING SHOULD BE MATCHED TO THE PRODUCTION LEVEL. FOR SMALL-LOT PRODUCTION ON MILLING MACHINES, THE SIMPLEST MANUAL CLAMPS OR VISES ARE USED...,
FOR MEDIUM-LOT PRODUCTION ON MACHINING CENTERS, QUICK-ACTING SINGLE AND MULTIPLE CLAMPING DEVICES ARE USED. IF VOLUME WARRANTS IT, HYDRAULICALLY- OR PNEUMATICALLY-ACTUATED CLAMPS CAN BE USED FOR THE FASTEST CLAMPING...,
OR FOR MASS-PRODUCTION OF A UNIQUE PART, DEDICATED FIXTURING CAN BE BUILT.

--- TOUCH BLACK ---

SCENE 3.
WH36A, SME4367, 19:44:38:00-19:45:00:00
zoom out, clamps holding mold half during milling
WH36B, SME4367, 19:50:07:00-19:50:22:00
clamps holding work during milling

NARRATION (VO):

MANUALLY OPERATED CLAMPS ARE THE SIMPLEST WORKHOLDING DEVICE FOR MILLING. CLAMPING MUST BE STRONG SINCE THE CUTTING FORCES CHANGE DIRECTIONS AS THE MILLING CUTTER ENTERS AND EXITS THE

PART.

SCENE 4.
WH37A, SME2638, 01:15:17:00-01:15:32:00
loading/securing workpieces with clamps

NARRATION (VO):

CLAMPS MUST ALSO ACT QUICKLY FOR FAST LOADING AND UNLOADING, AND NOT DAMAGE THE WORKPIECE.

SCENE 5.
continue previous shot
WH38A, SME4363, 15:30:48:00-15:30:54:00
zoom out, strap clamp set up
WH38B, SME2645, 04:26:56:00-04:27:03:00
cam clamp

NARRATION (VO):

THERE ARE MANY BASIC CLAMP TYPES, SOME ARE:

THE STRAP CLAMP...,

AND THE CAM CLAMP.

SCENE 6.
WH39A, SME2645, 04:18:03:00-04:18:15:00
toggle clamp used in machining
WH39B, SME2639, 02:13:23:00-02:13:33:00
hold-down toggle clamp, clamping

NARRATION (VO):

TOGGLE-ACTION CLAMPS HAVE AN EXCELLENT RATIO OF HOLDING FORCE TO APPLICATION FORCE. THEY WORK QUICKLY, AND HAVE A POSITIVE LOCKING ACTION. THE MOST POPULAR TOGGLE CLAMP IS THE HOLD-DOWN DESIGN, WHICH HOLDS THE PART WITH A DOWNWARD CLAMPING ACTION.

SCENE 7.
continue previous shot
WH40A, still, push/pull clamp
WH40B, still, latch clamp

NARRATION (VO):

OTHER TYPES OF TOGGLE CLAMPS INCLUDE THE PUSH/PULL CLAMP...,

AND THE LATCH CLAMP.

SCENE 8.
WH41A, SME4024, 09:05:20:00-09:05:51:00
multiple vises being secured
WH41B, SME2645, 04:13:12:00-04:13:20:00
odd shaped part secured in vise
WH41C, SME2645, 04:09:53:00-04:10:02:00
alternate shot, odd shaped part secured in vise
WH41D, SME4394, 04:49:07:00-04:49:33:00
multiple three jaw vises with parts

NARRATION (VO):

VISES CLAMP MANUALLY OR AUTOMATICALLY, AND CAN BE CONSTRUCTED TO HOLD A GREAT MANY SHAPES IN MANY WAYS. ONE VARIATION HAS A FIXED CENTER JAW AND TWO MOVING

removed

OUTER JAWS--TO HOLD TWO OR MORE PARTS IN LESS SPACE THAN TWO SEPARATE VISES.

SCENE 9.
WH42A, SME4363, 15:41:55:00-15:42:11:00
swivel base vise being rotated

NARRATION (VO):

SWIVEL OR TILTING BASES ALLOW THE VISE AND WORK TO BE SET AT AN ACCURATE ANGULAR POSITION RELATIVE TO THE MACHINE AXES.

SCENE 10.
WH43A, SME4383, 14:32:11:00-14:32:32:00
zoom in, multiple vises holding long parts
WH43B, SME2645, 04:23:10:00-04:23:18:00
alternate shot, two vises holding long part

NARRATION (VO):

MULTIPLE VISES CAN BE USED TO EXTEND THE RANGE OF WHAT MAY BE HELD--SUCH AS LONG PARTS.

SCENE 11.
WH44A, SME4356, 09:43:11:00-09:43:24:00
setting up workholding on column
WH44B, SME4356, 09:44:38:00-09:44:56:00
alternate shot, zoom out, plate clamped to column
WH44C, SME2638, 01:10:50:00-01:10:58:00
workholding indexing in machining center

NARRATION (VO):

TO MINIMIZE SETUP TIME ON MACHINING CENTERS, WORKHOLDING MAY BE ARRANGED AROUND A CUBE OR COLUMN,
OR ON AN INDEXER OR ROTARY TABLE.

SCENE 12.
WH45A, SME4394, 04:05:50:00-04:06:10:00
zoom in, parts secured on tombstone, rotated, parts removed
WH45B, SME4394, 04:02:41:00-04:03:16:00
alternate shot, setting up parts on tombstone

NARRATION (VO):

PARTS MAY ALSO BE HELD ON TWO, THREE, OR FOUR SIDES OF A TOMBSTONE OR INDEXER, WITH IDENTICAL OR DIFFERENT WORKPIECES CLAMPED ON DIFFERENT SIDES.

SCENE 13.
WH46A, SME4394, 04:21:02:00-04:21:19:00
multiple parts clamped on tombstone being machined

NARRATION (VO):

MULTIPLE CLAMPS HOLD SMALL WORKPIECES IN POSITION AS THEY MACHINED ONE AFTER THE OTHER.

SCENE 14.
WH47A, SME2646, 01:01:39:00-01:01:51:00
tombstone with chucks

NARRATION (VO):

OR MULTIPLE CHUCKS CAN BE USED ON PALLETS AND TOMBSTONES TO HOLD ROUND PARTS.

SCENE 15.
WH48A, SME4030, 17:04:46:00-17:05:01:00
zoom out, part indexing to new side using rotary table
WH48B, SME4026, 11:35:41:00-11:35:48:00
rotary table moving
WH48C, SME4351, 03:15:43:00-03:16:04:00
alternate shot, rotary table indexing part

NARRATION (VO):

A ROTARY TABLE ALLOWS FOUR SIDES OF A WORKPIECE TO BE MACHINED IN ONE SETUP, AND ALLOWS THE MACHINING OF HOLES AND SURFACES AT ODD ANGLES. ROTARY TABLES ARE OF TWO TYPES:

SCENE 16.
WH49A, SME4386, 18:48:41:00-18:48:59:00
part machined, rotary table indexing to new position
WH49B, SME4018, 02:20:25:00-02:20:45:00
zoom out, cutter/work moving

NARRATION (VO):

THERE ARE INDEXING TABLES WHICH QUICKLY INDEX TO A FIXED POSITION OF ANGULAR ROTATION AND LOCK IN THAT POSITION FOR MACHINING...,
AND THERE ARE "FULL" ROTARY TABLES WHICH TRAVERSE DURING CUTTING TO GENERATE SHAPES.

--- TOUCH BLACK ---

SCENE 17.
WH50A, SME4315, 09:47:14:00-09:47:34:00
pan, modular fixturing post element

NARRATION (VO):

OFTEN FIXTURES MAY BE REQUIRED FOR ODD-SHAPED OR SPECIALIZED PARTS.
FORTUNATELY, MODULAR FIXTURING SYSTEMS CAN BE BUILT QUICKLY FROM A KIT OF VARIOUS COMPONENTS. THIS CUTS ASSEMBLY TIME WHILE MAXIMIZING FLEXIBILITY.

SCENE 18.
WH51A, SME4315, 09:03:14:00-09:04:07:00
cad screen build of modular fixturing elements, multiple cuts

NARRATION (VO):

STANDARD INTERCHANGEABLE FIXTURING

WH51B, CGS: Base Plates
Supports
Locators
Clamps

COMPONENTS INCLUDE:

BASE PLATES,

SUPPORTS,

LOCATORS,

AND CLAMPS.

SCENE 19.
WH52A, SME4315, 09:13:53:00-09:14:05:00
zoom out, locating holes on modular fixture
WH52B, still, zoom out, t-slot modular fixture with baseplate, clamps, angle plate, parts
WH52C, DV movie, zoom out, t-slot modular fixture with baseplate, clamps, angle plate, parts

NARRATION (VO):

MODULAR SYSTEMS START FROM A PATTERN OF LOCATING DOWEL HOLES AND TAPPED HOLES, OR FROM CONVENTIONAL T-SLOTS.

SCENE 20.
continue previous shot

NARRATION (VO):

A T-SLOT-BASED SYSTEM STARTS WITH T-SLOTTED BASEPLATES.

SCENE 21.
continue previous shot

NARRATION (VO):

FIXTURE ELEMENTS LIKE CLAMPS ARE ATTACHED TO THE BASE PLATE, ANGLE PLATE, AND SO ON, TO CREATE THE FIXTURE.

SCENE 22.
continue previous shot
WH55A, still, zoom in, t-slot modular fixture
WH55B, DV movie, zoom in, t-slot modular fixture

NARRATION (VO):

LIKE T-SLOTTED MACHINE TABLES, THE T-SLOT SYSTEM HAS ONE MAJOR DISADVANTAGE -- IT LACKS EXACT FIXED REFERENCES IN THE ‘X’ AND ‘Y’ AXES. TIME IS WASTED WHEN LOCATING AND RECONSTRUCTING PREVIOUS SETUPS.

SCENE 23.
WH56A, SME4315, 09:47:48:00-09:48:03:00
zoom out, modular fixture with clamp

NARRATION (VO):

PRECISION DOWEL-PIN-BASED MODULAR

FIXTURING SYSTEMS DO ASSURE THE EXACT POSITION OF EACH FIXTURE ELEMENT.

SCENE 24.
WH57A, SME4315, 09:14:59:00-09:15:09:00
pan fixture with part

NARRATION (VO):

ITS DISADVANTAGE IS THAT THE DOWEL PIN LAYOUT MAY RESTRICT THE LOCATION OF CLAMPING DEVICES.

--- TOUCH BLACK ---

SCENE 25.
WH58A, SME4356, 09:31:31:00-09:31:52:00
swapping tombstones
WH58B, SME4356, 09:34:48:00-09:35:16:00
part being milled
WH58C, SME4306, 06:31:39:00-06:31:51:00
part set up on tombstone
WH58D, SME4356, 09:45:38:00-09:45:49:00
alternate shot, zoom in, new part on tombstone

NARRATION (VO):

MANY HORIZONTAL MACHINING CENTERS ACCEPT WORKPIECES CLAMPED TO PALLETS AND CHANGE PALLETS AUTOMATICALLY IN SECONDS. FIXTURING IS BUILT ON THE PALLETS RATHER THAN ON THE MACHINE TABLE. WORKPIECES ARE UNLOADED AND LOADED ON THE PALLET OUTSIDE THE MACHINING ZONE.

SCENE 26.
WH59A, SME4304, 04:44:03:00-04:44:17:00
pallet of finished parts taken from mill
WH59B, SME4304, 04:41:15:00-04:41:50:00
wide, finished pallet pulled from mill, pallets rotated to new workpieces

NARRATION (VO):

FOR VERTICAL MACHINING CENTERS WITH PALLET AUTOMATION, SMALL WORKPIECES MAY BE SECURED ON PRE-FIXTURED MINI-PALLETS FOR PARTS THAT ARE RUN REPEATEDLY. KEEPING THE WORKHOLDING IN STORAGE MINIMIZES SETUP TIME.

SCENE 27.
WH60A, SME4304, 04:44:39:00-04:44:54:00
pallet of raw work stock placed in mill

NARRATION (VO):

THESE MINI-PALLETS TYPICALLY MATE WITH A FIXED PALLET RECEIVER OF KNOWN LOCATION ON THE MACHINE TABLE. THIS ENSURES PROPER PART LOCATION WITHIN THE MACHINE

TOOL'S WORKSPACE.

--- TOUCH BLACK ---

SCENE 28.
WH61A, SME4395, 05:05:04:00-05:05:53:00
wide, finished parts pulled from pneumatic fixtures, new parts placed and pneumatically actuated, doors closed for machining

NARRATION (VO):

SOME WORKHOLDING ALTERNATIVES ALLOW CLAMPING FOR HIGHER-VOLUME PRODUCTION. FOR EXAMPLE, HYDRAULIC OR PNEUMATIC CLAMPING IS COMMON IN APPLICATIONS WHERE THE SPEED GAINED IS WORTH THE WORKHOLDING INVESTMENT. HYDRAULICALLY- OR PNEUMATICALLY-ACTUATED CLAMPS CAN PERFORM THOUSANDS OF CLAMPING CYCLES, AND MANY CAN BE COMBINED AROUND A SINGLE WORKPIECE. WHEN THE OPERATOR PUSHES A BUTTON, MULTIPLE CLAMPS MOVE SIMULTANEOUSLY TO GRASP AND HOLD PARTS ON A FIXTURE.

SCENE 29.
WH62A, SME4379, 10:49:16:00-10:49:50:00
zoom out, machining of flat plastic parts using vacuum workholding

NARRATION (VO):

ANOTHER PUSH-BUTTON CLAMPING METHOD IS A VACUUM WORKHOLDING SYSTEM. THESE SYSTEMS SECURE TYPICALLY FLAT WORKPIECES QUICKLY BY THE APPLICATION OF NEGATIVE PRESSURE, FIXING THEM IN PLACE FOR MACHINING.

SCENE 30.
WH63A, SME4374, 04:50:56:00-04:52:12:00
wide, dedicated fixturing of parts, edit at multiple points

NARRATION (VO):

AT THE EXTREME END OF WORKHOLDING ARE APPLICATION-DEDICATED FIXTURES. DEDICATED FIXTURES ARE PRIMARILY USED FOR THE MASS PRODUCTION OF SPECIFIC

PARTS, ALLOWING HIGHLY ACCURATE PART LOCATION, FOOLPROOF PART LOADING, AND SIMPLE AUTOMATION. DEDICATED FIXTURES OFFER LITTLE FLEXIBILITY, BUT THEY DO OFFER SPEED, RELIABILITY, AND ACCURACY OVER A PRODUCT'S LIFETIME.

--- FADE TO BLACK ---