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# **SHEET METAL FORMABILITY**

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## **DEFINITIONS OF SELECTED TERMS**

DRAWING  
STRETCHING  
COMPLEX FORMING OPERATIONS

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## **PHYSICAL PROPERTIES**

DUCTILITY  
PLANAR SHEAR  
TENSION TESTING

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## **SHEET METAL FORMING**

FORMING MODES  
FORMING LIMITS  
THE ROLE OF LUBRICATION  
SHEET STEEL MATERIALS  
NONFERROUS SHEET  
METAL FORMABILITY  
SIMULATIVE FORMABILITY TESTS  
SUPERPLASTIC METALFORMING

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## **ANALYTICAL METHODS**

CIRCULAR GRID SYSTEM  
FORMING LIMIT DIAGRAM  
COMPUTER SYSTEM  
SHAPE ANALYSIS  
COMPUTER-AIDED MODELING

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## **FORMABILITY PREDICTION AND EVALUATION**

SURFACE PATTERN FOR ANALYSES  
FORMING LIMIT DIAGRAM (FLD) CONCEPT  
SHAPE ANALYSIS (SA)  
COMPARING FLD AND SA RESULTS  
APPLICATION OF TECHNIQUES

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# **DIE AND MOLD MATERIALS**

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## **MATERIAL SELECTION**

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### **CARBON AND LOW-ALLOY STEELS**

HOT-ROLLED STEELS  
COLD-ROLLED STEELS

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### **CAST IRONS AND STEELS**

CAST IRONS FOR DIES  
STEEL CASTINGS FOR DIES

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### **STAINLESS AND MARAGING STEELS**

STAINLESS STEELS  
MARAGING STEELS

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### **TOOL STEELS**

CLASSIFICATION OF TOOL STEELS  
ALLOYING ELEMENTS  
PRODUCTION VARIABLES  
SELECTING TOOL STEELS  
HEAT TREATMENT OF TOOL STEELS

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### **STEEL-BONDED CARBIDES**

GRADES AVAILABLE  
ADVANTAGES  
APPLICATIONS  
DIE DESIGN AND CONSTRUCTION  
MACHINING AND  
GRINDING PROCEDURES  
HEAT TREATMENT

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### **CEMENTED TUNGSTEN CARBIDE**

APPLICATIONS  
PRODUCTION OF CEMENTED CARBIDES  
CEMENTED CARBIDE PROPERTIES  
GRADE CLASSIFICATIONS  
GRADE SELECTION  
DESIGN CONSIDERATIONS  
FINISHING OF CARBIDES  
TROUBLESHOOTING

## **NONFERROUS METALS**

ALUMINUM BRONZES  
BERYLLIUM COPPERS  
ZINC-BASED ALLOYS  
ANTIMONIAL LEAD  
BISMUTH ALLOYS

## **PLASTICS FOR DIES AND MOLDS**

ADVANTAGES OF USING PLASTICS  
LIMITATIONS OF PLASTICS  
TYPICAL APPLICATIONS  
PLASTICS USED  
POLYURETHANES  
DIE AND MOLD CONSTRUCTION

## **OTHER NONMETALLIC DIE MATERIALS**

HARDWOODS  
HARDBOARDS  
DENSIFIED WOOD  
RUBBER  
CORK

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# LUBRICANTS

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## PRINCIPLES OF LUBRICATION

FILM THEORY  
OPERATING PARAMETERS  
MATERIAL SURFACE PROPERTIES  
LUBRICANT SELECTION

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## TYPES OF LUBRICANTS

LUBRICANT PROPERTIES  
INGREDIENTS  
LUBRICANT FORMULATIONS

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## LUBRICANT APPLICATION METHODS

BENEFITS  
BASIC METHODS

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## WASTE TREATMENT AND DISPOSAL

WASTE TREATMENT  
BIODEGRADABILITY

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## CLEANING

TYPES OF CLEANERS  
CLEANER SELECTION FACTORS TYPES OF CLEANERS  
GENERAL GUIDELINES

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## LUBRICANT QUALITY CONTROL

STANDARDS  
TESTING  
STORAGE  
RECOVERY

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## TROUBLESHOOTING

VISCOSITY  
MIXTURE  
LUBRICITY AND EP AGENTS  
COMPLEX COMPOUNDS

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# **SHEET METAL BLANKING AND FORMING**

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## **STAMPING PRESS OPERATIONS**

MATERIALS USED  
FOR STAMPINGS  
BLANKING AND FORMING OVERVIEW  
NOMENCLATURE

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## **BLANKING**

TERMINOLOGY  
THE BLANKING/PUNCHING PROCESS  
ZONES OF A SHEARED PART  
FORCE CALCULATIONS  
BLANK DESIGN  
FINE BLANKING

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## **FORMING**

BENDING AND FLANGING  
DRAWING  
IRONING  
BULGING  
COMPRESSION OPERATIONS  
CREEP FORMING  
RUBBER PAD FORMING  
SUPERPLASTIC FORMING

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## **TOLERANCES FOR STAMPINGS**

PRACTICAL DATA  
FLAT STAMPINGS  
FORMED STAMPINGS  
HIGH-VOLUME PRODUCTION

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# PRESSES FOR SHEET METAL FORMING

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## PRESS NOMENCLATURE

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### TYPES OF PRESSES

SOURCE OF POWER  
NUMBER OF SLIDES

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### PRESS SELECTION

SIZE REQUIREMENTS  
PRESS SPEEDS  
MECHANICAL VS. HYDRAULIC PRESSES  
PRESS SYSTEMS  
FASTER DIE CHANGING

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### MECHANICAL PRESSES

TYPES OF FRAMES AND CONSTRUCTION  
MECHANICAL PRESS DRIVES  
FORCE, ENERGY AND TORQUE CONSIDERATIONS  
PRESS CLUTCHES AND BRAKES  
PRESS CONTROLS  
MECHANICAL PRESS SAFETY  
PRESS LUBRICATION AND MAINTENANCE

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### HYDRAULIC PRESSES

ADVANTAGES OF HYDRAULIC PRESSES  
PRESS LIMITATIONS  
FRAME CONSTRUCTION  
SELF-CONTAINED WORKHEADS  
TOOL-CASTING PRESSES  
AUTOMATIC TOOL CLAMPING  
LIMITING DOWNSTROKE  
REDUCING SHOCK LOADS  
PRESSURE SYSTEMS  
PRESS CONTROLS  
HYDRAULIC PRESS SAFETY

# **PNEUMATIC PRESSES**

ADVANTAGES OF PNEUMATIC PRESSES

POSSIBLE LIMITATIONS

APPLICATIONS OF PNEUMATIC PRESSES

TYPES OF PNEUMATIC PRESSES

# **SPECIAL-PURPOSE PRESSES**

DIE-SETTING PRESSES

DIEING MACHINES

LAMINATION PRESSES

FLEXIBLE-DIE FORMING PRESSES

FINE-BLANKING PRESSES

FOUR-SLIDE MACHINES

TRANSFER PRESSES

DIE-SET TRANSFER PRESSES

MULTISTATION-PLUNGER

TRANSFER PRESS

PORTAL PRESSES

# **DIE DESIGN FOR SHEET METAL FORMING**

## **DIE NOMENCLATURE**

### **DIE COMPONENTS**

DIE SETS  
STRIPPERS  
KNOCKOUTS  
STOPS  
KICKER (SHEDDER) PINS  
STOCK PUSHERS  
GUIDES  
HEEL AND WEAR PLATES  
STOP BLOCKS  
PERFORATORS (PUNCHES)  
PILOTS  
PILOT HOLDERS  
MISFEED DETECTORS  
DIE BUTTONS  
RETAINERS  
SPRING RETAINERS

## **LOCATION OF STAMPINGS IN DIES**

### **DESIGN CHECKLIST**

## **PLANNING DIE PROCESSING**

RULES FOR DESIGN

### **CUTTING DIES**

BLANKING AND PUNCHING  
CLEARANCE  
BLANKING OR PUNCHING FORCES  
DIE DESIGN

# **FORMING DIES**

BENDING AND FLANGING  
EMBOSSING AND BEADING  
DRAWING  
IRONING  
BULGING  
COMPRESSION OPERATIONS

# **MULTIPLE-OPERATION PROCESSES**

SINGLE-STATION OPERATIONS  
MULTIPLE-STATION OPERATIONS  
FOUR-SLIDE OPERATIONS

# **SAFETY CONSIDERATIONS AND TROUBLESHOOTING**

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# **EXPANDING, SHRINKING AND STRETCH FORMING**

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## **EXPANDING**

ADVANTAGES OF EXPANDING  
MATERIALS EXPANDED  
WORKPIECE SIZES  
EXPANDING APPLICATIONS  
EXPANDING MACHINES  
TOOLING FOR EXPANDING  
EXPANDING MULTIPLE PANELS

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## **FLUID EXPANDING**

CONVENTIONAL BLANK SLIPPAGE  
EXPANDING WITH 100% STRETCH  
COLUMN COMPRESSION  
AND FLUID EXPANSION

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## **SHRINKING**

MATERIALS AND SHAPES  
MACHINES USED  
SHRINKING APPLICATIONS  
COMBINED EXPANDING AND SHRINKING  
LOCALIZED EXPANDING AND SHRINKING

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## **STRETCH FORMING**

ADVANTAGES OF STRETCH FORMING  
PROCESS LIMITATIONS  
STRETCH FORMED MATERIALS  
APPLICATIONS OF STRETCH FORMING  
STRETCH FORMING MACHINES  
TOOLING FOR STRETCH FORMING  
OPERATING PARAMETERS  
TROUBLESHOOTING

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## **ANDROFORMING**

FORMING PRINCIPLE  
ANDROFORMING MACHINES  
TOOLING FOR ANDROFORMING

# **ROLL FORMING**

## **ROLL FORMING**

DESIGN CONSIDERATIONS  
ROLL FORMING METHODS  
ADVANTAGES AND LIMITATIONS  
MATERIALS ROLL FORMED  
TOLERANCES  
ROLL FORMING APPLICATIONS

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## **ROLL FORMING MACHINES**

TYPES OF ROLL FORMING MACHINES  
MACHINE SELECTION  
AUXILIARY EQUIPMENT

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## **ROLL FORMING TOOLING**

FORMING ROLLS  
FLYING CUTOFF DIES  
TUBE AND PIPE ROLLING

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## **OPERATING PARAMETERS**

POWER REQUIREMENT  
SPEED  
EQUIPMENT SETUP  
LUBRICATION

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## **TROUBLESHOOTING AND MAINTENANCE**

TROUBLESHOOTING  
MAINTENANCE

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## **SAFETY CONSIDERATIONS**

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# SPINNING

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## TYPES OF METAL SPINNING

MANUAL SPINNING  
POWER SPINNING  
SHEAR FORMING  
TUBE SPINNING  
ELEVATED TEMPERATURE SPINNING  
COMBINED AND  
SUPPLEMENTARY OPERATIONS

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## SPINNING CAPABILITIES

PROCESS ADVANTAGES  
LIMITATIONS OF SPINNING  
SHAPES PRODUCED  
MATERIALS SPUN  
APPLICATIONS OF SPINNING

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## SPINNING MACHINES

MANUAL SPINNING LATHES  
POWER-ASSISTED MACHINES  
SHEAR FORMING MACHINES  
MACHINE ACCESSORIES  
AND ATTACHMENTS  
MULTISPINDLE MACHINES

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## TOOLING FOR SPINNING

CHUCKS  
TOOLS FOR MANUAL SPINNING  
ROLLERS FOR SHEAR FORMING  
AND TUBE SPINNING  
TEMPLATE MATERIALS

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## OPERATING PARAMETERS FOR SPINNING

POWER AND PRESSURE REQUIREMENTS  
SPEEDS AND FEEDS  
LUBRICANTS AND COOLANTS

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# **BENDING AND STRAIGHTENING**

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## **SHEET AND PLATE BENDING**

BENDING NOMENCLATURE  
THEORY OF METAL FLOW  
BEND ALLOWANCE  
BENDING FORCE REQUIRED  
TYPES OF BENDING  
BENDING WITH PRESS BRAKES  
BENDING METHODS  
PRESS BRAKE DIES  
PRESS BRAKE GAGING  
PRESS BRAKE SAFETY  
ROLL BENDING  
PLATE BENDING

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## **TUBE, PIPE, AND BAR BENDING**

BENDING THEORY AND PROCESS  
TUBE AND BAR BENDING  
BENDING METHODS  
BENDING EQUIPMENT  
PIPE BENDING

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## **STRAIGHTENING**

INSPECTION METHODS  
PRINCIPLES OF STRAIGHTENING  
ADVANTAGES  
LIMITATIONS  
STOCK OR CONTINUOUS MATERIALS  
METAL PARTS AND COMPONENTS  
TOOLING

# **SHEARING**

## **GLOSSARY OF SHEARING TERMS**

## **SHEARING PRINCIPLES**

## **SHEARING CAPABILITIES AND ADVANTAGES**

## **SHEAR CONSTRUCTION**

OVERDRIVEN SHEARS  
UNDERDRIVEN SHEARS  
SWINGING BEAM SHEARS

## **TYPES OF SHEARS**

CROSSHEAD DRIVE  
SHEAR DESIGN  
SLITTING  
SHEAR ACCESSORIES

## **SHEAR KNIVES**

KNIFE SELECTION  
KNIFE SHARPNESS

## **OPERATING PARAMETERS**

POWER  
SHEARING FORCE  
RAKE  
KNIFE CLEARANCE  
SHEARING SPEED  
MAINTENANCE

## **TROUBLESHOOTING**

CAMBER  
BOW  
TWIST

## **SAFETY IN SHEARING OPERATIONS**

# **PUNCHING**

## **PUNCHING**

ADVANTAGES  
WORKPIECE SIZES  
APPLICATIONS

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### **PRESSES**

CONSTRUCTION  
TYPES OF PUNCH PRESSES  
PRESS CONTROL  
PUNCH PRESS SELECTION  
PUNCH PRESS ACCESSORIES

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### **NOTCHING MACHINES**

OPERATION  
TOOLING

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### **TOOLING FOR PUNCH PRESSES**

PUNCH SELECTION  
TOOL MOUNTING

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### **OPERATING PARAMETERS**

SPEED  
NIBBLED PATH EVALUATION  
FORMING ON A PUNCH PRESS  
LUBRICANTS  
MAINTENANCE  
SAFETY

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### **TROUBLESHOOTING**

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# **DRAWING, EXTRUDING AND UPSETTING**

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## **COLD DRAWING OF BAR, WIRE AND TUBE**

PURPOSES OF COLD DRAWING  
DRAFT, REDUCTION  
AND ELONGATION  
PREPARING FOR COLD DRAWING  
DRAWING ROD AND WIRE  
DRAWING BARS  
DRAWING TUBES  
OTHER DRAWING METHODS  
DIES FOR DRAWING  
LUBRICANTS FOR COLD DRAWING

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## **HOT EXTRUSION**

HISTORY OF HOT METAL EXTRUSION  
ADVANTAGES OF EXTRUSION  
POSSIBLE LIMITATIONS  
METHODS OF EXTRUDING  
MATERIALS EXTRUDED  
AND APPLICATIONS  
PRESSES FOR HOT EXTRUSION  
TOOLING FOR HOT EXTRUSION  
OPERATING PARAMETERS  
SAFETY CONSIDERATIONS

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## **COLD AND WARM EXTRUSION**

ADVANTAGES OF THE PROCESS  
LIMITATIONS OF COLD EXTRUSION  
SHAPES AND SIZES PRODUCED  
MATERIALS EXTRUDED  
APPLICATIONS  
METHODS OF EXTRUDING  
PRESSES FOR COLD AND  
WARM EXTRUSION  
TOOLING FOR COLD AND  
WARM EXTRUSION  
PRODUCING SLUGS FOR EXTRUDING  
PRESSURE REQUIREMENTS FOR  
COLD EXTRUSION  
EXTRUDING SPEEDS  
SAFETY CONSIDERATIONS

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## **COLD AND WARM UPSETTING (HEADING)**

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ADVANTAGES OF UPSETTING

LIMITATIONS OF UPSETTING

UPSET LENGTHS

UPSET VOLUMES

HEIGHT REDUCTION

MATERIALS UPSET

APPLICATIONS OF UPSETTING

METHODS OF UPSETTING

MACHINES FOR UPSETTING

TOOLING FOR UPSETTING

SAFETY CONSIDERATIONS

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## **AUTOMATIC COLD AND WARM FORMING**

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ADVANTAGES AND LIMITATIONS

PART SHAPES AND SIZES FORMED

MATERIALS FORMED

APPLICATIONS OF AUTOMATIC FORMING

MACHINES FOR AUTOMATIC FORMING

TOOLING AND OPERATING PARAMETERS

SAFETY CONSIDERATIONS

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# SWAGING

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## THE SWAGING PROCESS

METAL FLOW  
WORK ROTATION  
EFFECTS ON  
MATERIAL PROPERTIES  
DIMENSIONAL CHANGES

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## ADVANTAGES AND LIMITATIONS OF SWAGING

ECONOMY OF SWAGING  
VERSATILITY OF SWAGING  
IMPROVEMENTS IN QUALITY  
LIMITATIONS OF SWAGING

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## MATERIALS SWAGED

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## METHODS OF SWAGING

TUBE SWAGING  
MANDREL SWAGING  
HOT SWAGING  
INTERNAL SWAGING

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## SWAGING APPLICATIONS

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## SWAGING MACHINES

MACHINE CAPACITY  
NUMBER OF DIES  
ROTARY SWAGING MACHINES  
DIE-CLOSING SWAGERS  
STATIONARY-SPINDLE  
SWAGING MACHINES  
CREEPING-SPINDLE SWAGERS  
HOT SWAGING MACHINES  
SIMULTANEOUS-BLOW  
SWAGING MACHINES  
ALTERNATE-BLOW SWAGING MACHINES  
INTERNAL SWAGING MACHINES  
SWAGING SMALL PARTS ON PRESSES

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## **FEEDING SWAGERS**

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HAND FEEDING

POWER FEEDING

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## **SWAGING DIES**

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TYPES OF OPERATIONS

TYPES OF DIES

DIE MATERIALS

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## **SWAGING MANDRELS**

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## **OPERATING PARAMETERS**

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FEED RATES

CLEANLINESS AND LUBRICATION

TOOL MAINTENANCE

TROUBLESHOOTING

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# HOT FORGING

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## GLOSSARY OF FORGING TERMS

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### FORGING PROCESSES

OPEN-DIE FORGING  
IMPRESSION-DIE FORGING  
RELATED PROCESSES  
PREFORMING  
ADVANTAGES  
TOLERANCES  
APPLICATIONS

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### MATERIALS FOR FORGING

FORGEABILITY  
FERROUS MATERIALS  
NONFERROUS MATERIALS  
SUPERALLOYS  
REFRACTORY MATERIALS

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### FORGING EQUIPMENT

SELECTION CRITERIA  
FORGING HAMMERS  
HIGH ENERGY RATE FORMING MACHINES  
MECHANICAL PRESSES  
HYDRAULIC PRESSES  
SCREW PRESSES  
FORGING MACHINES  
HOT FORMERS  
FORGING ROLLS  
WEDGE ROLLING MACHINES  
RADIAL FORGING MACHINES  
RING ROLLING MACHINES  
AUXILIARY EQUIPMENT

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### OPERATING PARAMETERS

FORCE  
SPEED  
COST CONSIDERATIONS

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## **TOOLING**

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OPEN DIES

IMPRESSION DIES

FORGING MACHINE DIES

TRIMMING AND PUNCHING DIES

OTHER TOOLING

COMPUTER APPLICATIONS

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## **FORGING LUBRICANTS**

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LUBRICANT REQUIREMENTS

TYPES OF LUBRICANTS

LUBRICANT SELECTION

LUBRICANT APPLICATION

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## **TROUBLESHOOTING AND SAFETY**

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FORGING DEFECTS

DIE FAILURE

INSPECTION TECHNIQUES

SAFETY

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# CASTING

## CASTING

CASTING MOLD ELEMENTS  
GENERAL CHARACTERISTICS  
PROCESS SELECTION  
COMPUTERIZED OPERATIONS  
NOMENCLATURE

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## SAND-MOLD CASTING

DESIGN CONSIDERATIONS  
DIMENSIONAL VARIATIONS AND STOCK  
REQUIREMENTS  
DRY-SAND MOLDING  
GREEN-SAND MOLDING  
SHELL MOLDING  
THE FULL-MOLD PROCESS  
CEMENT MOLDING  
VACUUM MOLDING  
COREMAKING PROCESSES  
CORE AND COREBOX-MAKING METHODS  
MELTING AND POURING  
CLEANING AND FINISHING  
HEAT TREATMENT  
INSPECTION  
FINISHING

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## METAL-MOLD CASTING

HIGH-PRESSURE DIE CASTING  
PERMANENT-MOLD CASTING  
CENTRIFUGAL CASTING

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## PLASTER AND CERAMIC-MOLD CASTING

PLASTER MOLDING  
INVESTMENT CASTING  
SOLID-CERAMIC MOLDING  
CERAMIC CORES

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# **POWDER METALLURGY**

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## **GENERAL CONSIDERATIONS**

PROCESS FUNDAMENTALS  
SECONDARY OPERATIONS  
METAL POWDERS  
ADVANTAGES OF PM  
NOMENCLATURE

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## **METAL POWDERS**

POWDER PRODUCTION  
POWDER TYPES

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## **PM PRODUCT DESIGN**

GENERAL CONSIDERATIONS  
DESIGN FACTORS

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## **POWDER MIXING AND BLENDING**

MIXER VARIABLES  
LUBRICANT

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## **COMPACTING**

BEHAVIOR OF POWDERS<sup>10</sup>  
PRESSES

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## **SINTERING**

SINTERING METHODS  
FURNACES  
LUBRICANT PURGING  
ATMOSPHERES

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## **TOOLING FOR PM PARTS**

TOOLING DESIGN FACTORS  
DIE DESIGN  
PM TOOLING SYSTEMS  
PRACTICAL OPERATING TIPS

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# **COMPACTING PRESSES**

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MECHANICAL PRESSES

HYDRAULIC PRESSES

ANVIL PRESSES

ROTARY PRESSES

SINGLE LOWER PUNCH,  
OPPOSED-RAM PRESSES

SINGLE LOWER PUNCH  
WITHDRAWAL PRESS

MULTIPLE MOTION DIE SET PRESSES

MULTIPLE MOTION ADJUSTABLE  
STOP PRESSES

PM PRESS CONTROLS AND GUARDING

POWDER FEEDING SYSTEM

PRESS MAINTENANCE

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# **SECONDARY OPERATIONS**

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REPRESSING

FORGING

HEAT TREATMENT AND  
STEAM TREATMENT

IMPREGNATION AND INFILTRATION

MACHINING

FINISHING

JOINING

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# **SPECIAL PM PROCESSES**

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PRESSURE COMPACTION METHODS

ISOSTATIC COMPACTION

PRESSURELESS PM  
COMPACTION METHODS

WROUGHT PM PROCESSES

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# **NONFERROUS PM METALS**

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MAGNESIUM

BERYLLIUM

TITANIUM

COPPER

POWDER METALLURGY SUPERALLOYS

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# **QUALITY CONTROL**

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POWDER TESTS

QUALITY CONTROL PROGRAM<sup>13</sup>

NONDESTRUCTIVE EVALUATION

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# **SAFETY**

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EXPLOSION HAZARDS

FIRE FIGHTING

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# **PLASTICS FORMING**

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## **NOMENCLATURE**

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### **PLASTICS MATERIALS**

MOLECULAR STRUCTURE  
PRINCIPAL TYPES OF POLYMERS  
ADDITIVES  
PROPERTIES AND LIMITATIONS

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### **PART DESIGN AND PROCESSING**

DESIGN CONSIDERATIONS  
STANDARD TESTS  
PROCESSING METHODS  
DESIGN/MANUFACTURING  
INTERACTION

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### **THERMOSET PLASTICS MOLDING**

PRINCIPLES OF PLASTICS MOLDING  
COMPRESSION MOLDING  
TRANSFER MOLDING  
MOLDING PROCESS COMPARISON

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### **INJECTION MOLDING**

MOLDING PROCESS  
ADVANTAGES AND LIMITATIONS  
EQUIPMENT  
TROUBLESHOOTING

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### **EXTRUSION FORMING**

EXTRUSION PROCESS  
EXTRUSION EQUIPMENT

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### **REACTION INJECTION MOLDING**

RIM ADVANTAGES  
RIM LIMITATIONS  
RIM MATERIALS AND APPLICATIONS  
RIM PROCESS

## **REINFORCED THERMOSET PLASTICS**

HIGH-VOLUME PROCESSES

LOW-VOLUME PROCESSES

## **THERMOFORMING PLASTIC SHEET AND FILM**

MACHINERY REQUIREMENTS

TOOLING

THERMOFORMING TECHNIQUES

HIGH-PRESSURE LAMINATES

## **OTHER PROCESSING METHODS**

BLOW MOLDING

LIQUID INJECTION MOLDING

ROTATIONAL MOLDING

STRUCTURAL FOAM MOLDING

CASTING

FILM AND SHEET FORMING

## **MACHINING AND FINISHING**

GUIDELINES FOR MACHINING

TURNING

FILING

ROUTING AND SHAPING

GEAR CUTTING

SAWING

THREADING AND TAPPING

DRILLING

PUNCHING

EMBOSSING

BUFFING

POLISHING

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# **SPECIAL FORMING METHODS**

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## **DESCRIPTION OF SPECIAL FORMING METHODS**

ADVANTAGES AND LIMITATIONS  
MATERIAL FORMED  
WORKPIECE SIZES AND TOLERANCES

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## **SELECTION CRITERIA**

ECONOMIC CHARACTERISTICS  
PERFORMANCE CHARACTERISTICS

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## **FORMING METHODS**

EXPLOSIVE FORMING  
ELECTROHYDRAULIC FORMING  
ELECTROMAGNETIC FORMING  
HIGH-VELOCITY FORGING  
PEEN FORMING  
ULTRASONIC-ACTIVATED FORMING

# **SAFETY IN FORMING**

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## **SAFETY PROGRAM FUNDAMENTALS**

GENERAL CONSIDERATIONS  
HOW TO BEGIN

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## **SAFETY PROGRAM DEVELOPMENT**

EXAMPLES OF SAFETY DIRECTIVES  
SAFETY PROGRAM METHODOLOGY  
A SYSTEMATIC APPROACH  
TO METALFORMING SAFETY  
FIRE PROTECTION

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## **EFFECTIVE SAFETY PROGRAMS**

COMMON CHARACTERISTICS  
MODEL SAFETY PROGRAM

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## **STANDARDS AND INFORMATION SOURCES**

REQUIREMENTS OF THE OSHA LAW  
NOISE CONTROL  
INFORMATION SOURCES