LEARN DIE MAKING

DIE CUTTING AND DIE MAKING GUIDE

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INTRODUCTION

DIECUTTING

This e-book has been prepared to give all of the necessary information on packaging paperboard die cutting. In current circumstances, functioning of almost all industries would be unimaginable without the process of die cutting, but a packaging paperboard die cutting is also inevitable to satisfy the needs of both these industries, including tertiary sector, and individuals as well. It is varying in needs of either transport or commercial packaging paperboard. It stands behind a successful business operating of the biggest companies.

The design of new packaging papers and paperboards requires new up-to-date die cutting tools to be made that can satisfy needs of high precision, high speed and low cost. The important elements of a die cutting tool are materials that they are made of, that also follow the die making and die cutting development techniques.

Die cutting is an invisible process infiltrated in many segments of diverse industries. Experts in one of the many segments of the die cutting process are often unfamiliar with other areas of die cutting process. A company die-cutting individual component part of clothing or footwear does not know much about paperboard die cutting and creasing on high volume automatic platen presses and dealing with steel rule die making and die cutting techniques in the folding carton industry.

Die cutting in its most basic form is sometimes compared to a woman making cookies. She could roll out cookie dough on a kitchen counter and cut out shapes of figures using a tin cookie cutter. She is in effect die cutting her cookie dough into cookie shapes. This very concept has been used for decades to cut duplicate items out of many soft to semi hard materials like, leather, paper, fabrics, plastics and other materials, only it is done by big manufacturers with big automated and semi-automated presses in hundreds of pieces at a moment.

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Die cutting developed with the outset of Industrial Revolution in manufacturing process. Manufacturers started to standardize the component parts of their products. In the beginning, the best examples were manufacturing of shoes and clothing, as well as a paper processing.

Leather shoes are manufactured from a number of component parts, including vamps, quarters, outer soles, inner soles etc. It was done manually for each pair of shoes before the Industrial Revolution, when and hand craft a pair of shoes or boots feet was hand crafted to fit each customer's feet. Fitting of their produces depended upon the skill of the craftsmen. Since the outset of use of the die cutting processes, standardized footwear was made available to customers. Shoe manufacturers developed patterns in size ranges and started to cut out the parts using a pattern with a hand held knife and eventually cutting dies. Mallet handle dies were the beginning of the die cutting process as hand held die usually in the shape of a sole of a shoe that was used to cut the sole design out of heavy leather. The leather would be placed on top of an end grained maple wood block and the die would cut throughout the leather slightly penetrating the surface of the wood block. The sharp edge of the die cut through the leather and produced a

perfectly die cut part of the shoe. Later, die-cutting machines or basic belt driven die presses were used to cut out shoe parts and eventually, with the development of the swing-arm clicker press it was enabled for heat-treated 9/16" and 3/4" single and double edge clicker dies to cut out the various right and left component parts of shoes.

Paper production has undergone strong development in the course of last two centuries. The first great improvement in its beginning was the use of papyrus by the Egyptians in the third millennium B.C., when the sheets of beaten papyrus stems were stuck together into scrolls. Papyrus was followed by parchment paper, made in the city of Pergamum in Asia Minor, in the second century B.C. Greeks and Romans had used animal skins to write on them, but durable and smooth parchment, which could be used for writing on both sides, was an improvement. After that, for centuries, paper was produced by hand from rag pulp. It was long before wood fibers began to be used for paper production and subsequently fibrous pulp and those were papers of a low quality, because not only the fibers were used, but also all parts of the wood. The method of papermaking developed in China was based on producing paper pulp from husks of cotton fibers; it was brought over Asia first to Spain and after that, it spread throughout Europe. In the first paper mill in America, sheets of paper were produced one at a time until a continuous process was developed. This process was patented in England under the name Fourdrinier and was followed by the invention of the cylinder-type papermaking machine that can produce a better quality paper in a continuous process.

These two papermaking processes are still used, although technologically improved. In paper industry, the first to come to the idea of die cutting paper was a printer in New York City who was setting up his printing press to crease some paper stock and applied too much pressure to the creasing rule in the press, so that the creasing rule cut into the paper. The printer had an idea to take the crease blade and ground a sharp edge onto the crease rule. He then put the rule back into the press and the rule cut through the paper. The process of paper and paperboard die cutting of was started, whereas in England, the first die cutting tools, i.e. steel rule cutting blades were produced.

From the early developments in the shoe and printing industries, companies producing other goods discovered that they could die cut thousands of identical parts to be assembled into products. The die cutting operation was always an integral part of the total manufacturing operation, which enabled manufacturers to be more competitive with increased speed of work, effectiveness and efficiency of production, with die cutting many different types of materials.

Die cutting is present all around us, starting from clothing with sleeves, pockets, collars, underlining and other components, leather gloves and bags to components of footwear. Many plastic components in home ware and components of devices and machines are

die cut. The component parts of vehicles are die cut, including the upholstery and floor coverings and component parts in personal computer as well. The parts are all visible, wherever we turn around us, with a die cutting process behind them, a part of manufacturing that we cannot see.

Spongy insert for headlight's bulb

Engine Head Gasket

Die Cutting and Die Making Guide

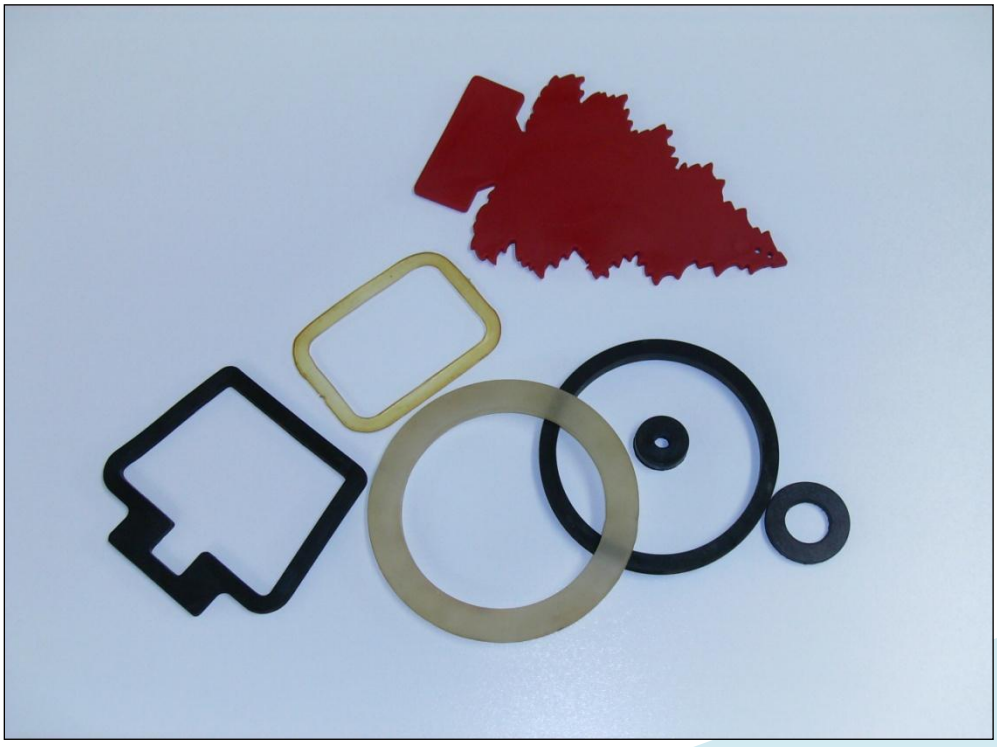
Foil with imprinted watch

A variety of stickers

Die Cutting and Die Making Guide

Coasters

And a variety of rubber or plastic elements



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We can see a great application for die cutting in the area of packaging of products. Every day some type of paperboard or corrugated packaging is used by everyone. Those packages are all die cut and many of them are thermoformed or blister packed. The parts of them are cut or trimmed by use of cutting dies.

Tray with holder for windscreen ice removers with zipper opening

Tube style carton packages cutout with the same die but can be used for different products

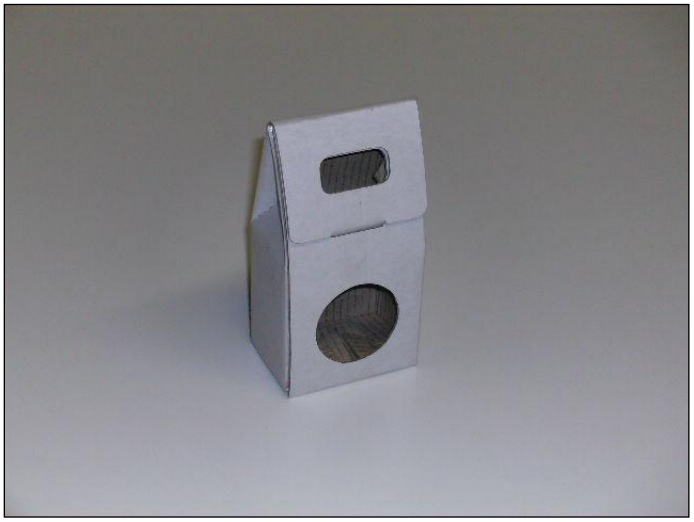
Die Cutting and Die Making Guide

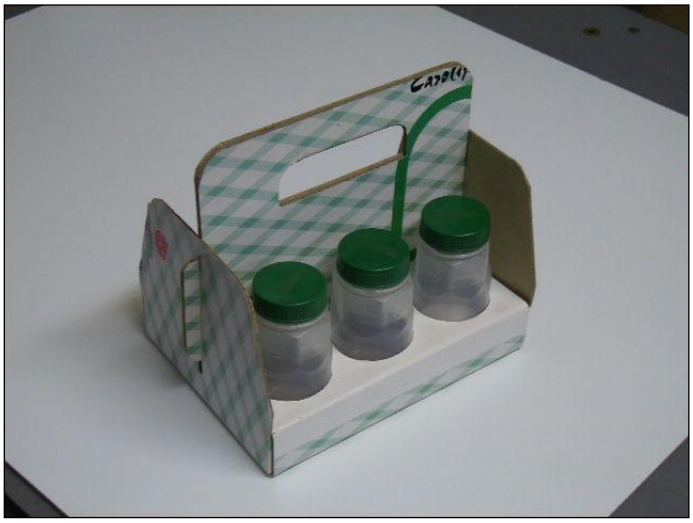
One-piece display easel with holder for pharmaceutical product

Triangle package for wine bottles

Die Cutting and Die Making Guide

Small gable top package with open window and handle for packing a small glass for brandy





Six count spice carrier

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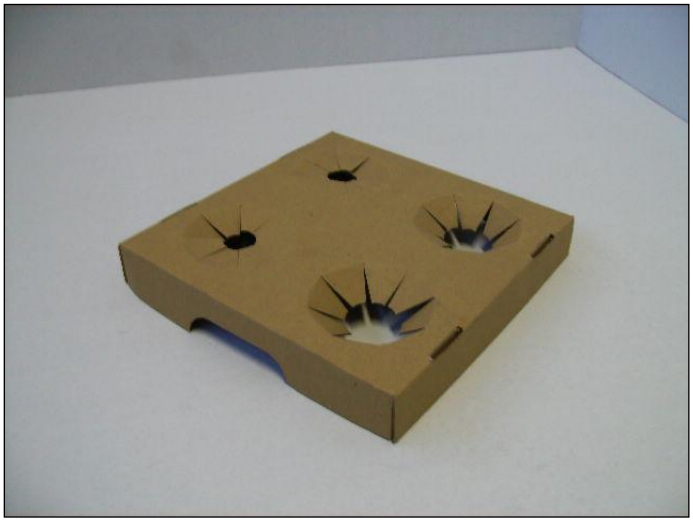
Four-count tray insert



Ten-count tray insert

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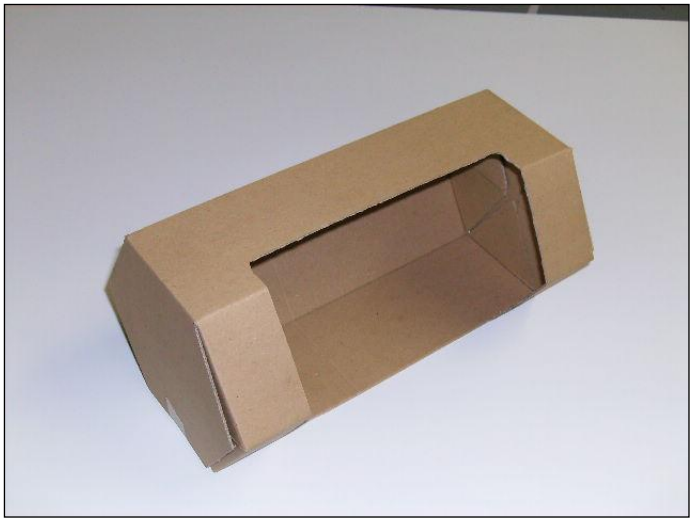
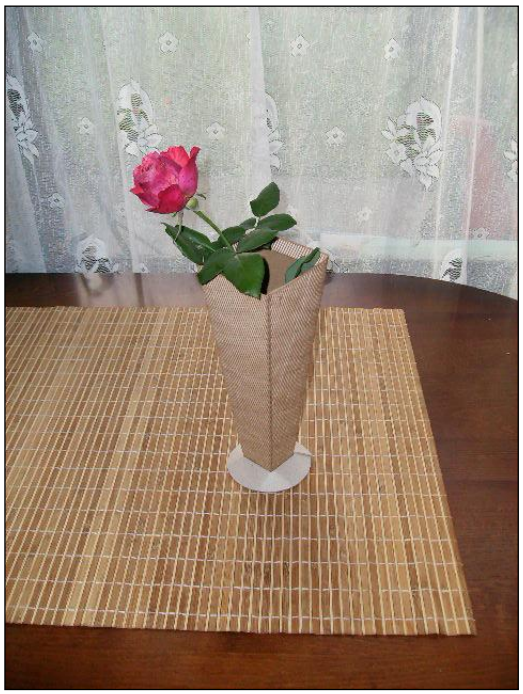
Hexagon box with open window





Flower vase

Corrugated two partition wine bottle carrier

Octagonal box with
lock and handles

Six count bottle carrier

A perfume bottle frame view tray

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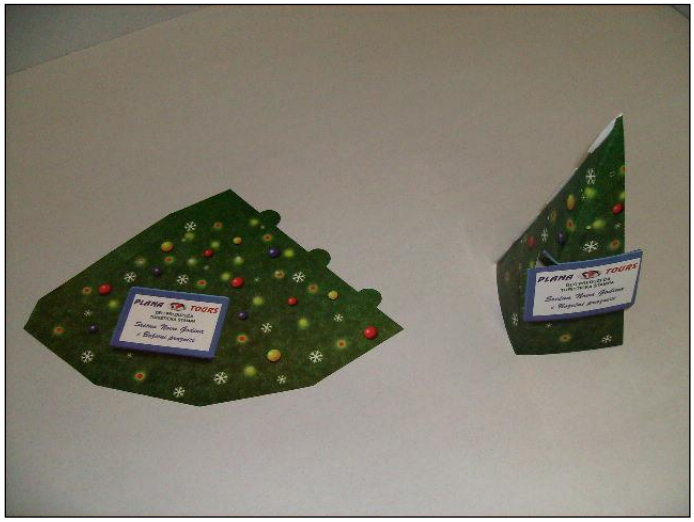
Gable top containers
With holders

Corrugated produce
shipper/display

Die Cutting and Die Making Guide



Advertise pyramid

Gable top container
with handle for
Wine bottles

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Corrugated promo-package
with closed window
for coffee bag and two cups

Triangle self-locking tray

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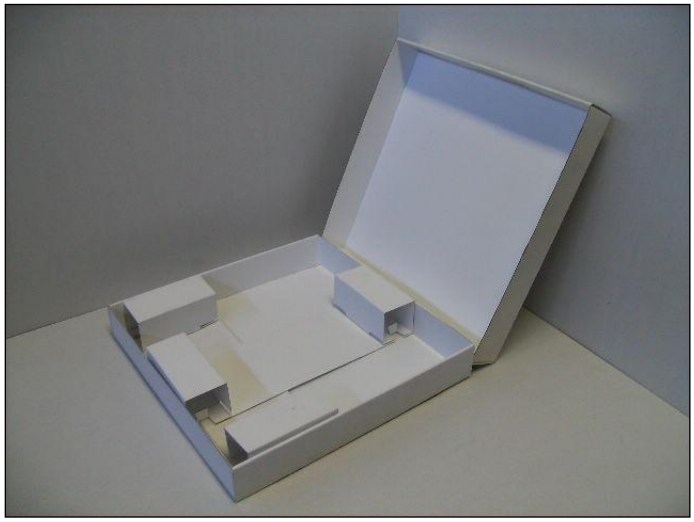
Small corrugated box made of two glued two-layer corrugated papers giving the surface of the box a wavy texture

Corrugated cardboard doughnut shipper/display

Die Cutting and Die Making Guide



Two piece tray with scored sheets for product holding and protection

Tapered top with center handle tray package for pastry shops

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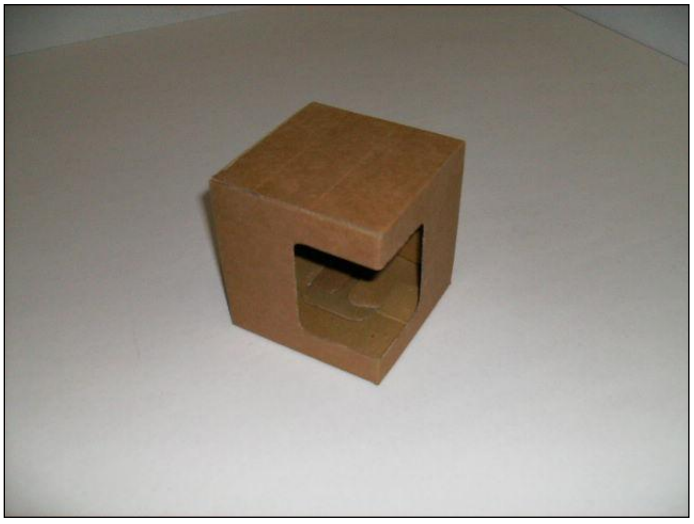
Container with
separate tray lid



Box with corner
open window

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Bag with glued sides and carrying handle

Folder for shallow products

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One-piece display stand

Gravity-fed dispenser for cigar packs

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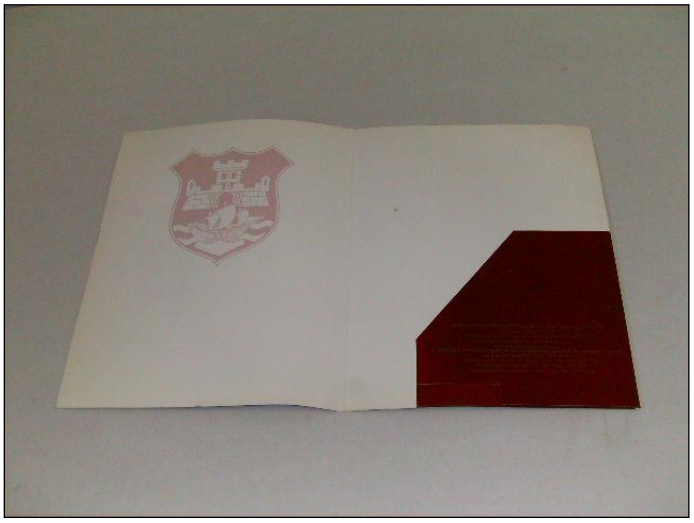
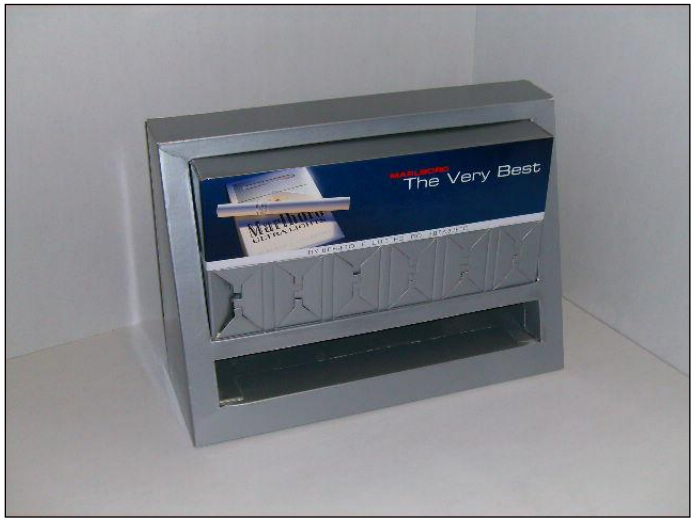
Two piece display easel with sample holder

Folder





Display with cigar pack holders

Container display with product dividers

Die Cutting and Die Making Guide

Triangle display stand with product holders

Plastic see-thru package for another coffee package

There is a wide range of the applications of die cutting techniques. All kinds of plastic elements for installation in diverse devices in machines, including cars and vehicles,

printed circuit boards in electronic devices, formatted products of paper industry are die cut. Food products, medical products, sanitary items and many other products are die cut, as well.

In last decade, die cutting process was recognized as an incentive to the transforming and growing economies of the Far East countries, which resulted, combined with a cheap labor, in boosting of those economies. Die cutting process helped their production, together with a cheap labor, to be competitive in prices on the world market. It is also manifested lately in the boosting economies of emerging markets, such as China, with a high growth of the Gross National Product followed by high rate of export, in numerous fields as electronics, clothing industry and production of machines and devices.

There is a wide range of types of cutting dies and die cutting press systems to cut and trim different materials. Which type of cutting die or cutting press will be used, depends on several basic elements of the material to be die cut:

- ✓ Thickness of materials
- ✓ Firmness of material
- ✓ Compression of material
- ✓ Surface coatings of material
- ✓ Single-ply or multiple-ply die cutting
- ✓ Stretch or distortion of the material while die cutting
- ✓ Effects of temperature and humidity

The best solutions to cut different materials or products depend upon the understanding of the basic elements of having a sharp knife blade penetrate through a particular layer of material to produce a good clean cut, while maintaining the integrity of the material. To obtain good die cutting, following elements in the die cutting process must be considered:

- ✓ Material to be die cut
- ✓ Cutting die used to cut a material
- ✓ Shape of a die cut product
- ✓ Hardened cutting surface that is either cut against or cut into it
- ✓ Cutting press adequate for purpose

The correct type of cutting die is an essential element in the success of the die cutting process both for big manufactures and for small businesses. There are different types of cutting dies that are best suited to cut different types of materials. There are certain techniques that are more appropriate to use for cutting one type of material over another. Die making and die cutting techniques are still in process. Die making and die

cutting still incorporate many craftsmen techniques and the expert understanding of how to cut or trim one material over another material.

That information on the best techniques or methods cannot be easily found. Experts are actively trying to improve the level of die making and die cutting excellence. It has been only 150 years since the steel has come into a mass production. There is a variety of types, many of which serve for cutting dies to be produced

Numerous types of cutting dies are designed for the production of sheet-metal work on power presses and experts are striving to make new designs. However, generally they are classified in two types. Dies that just cut or punch flat blanks belong to the first type and dies changing the form from the original flat condition by drawing, forming or bending it belong to the second type. Nevertheless, the second type often includes features common with the first one, as a combination of cutting and shaping dies, firstly cutting out the required outline and then shaping it to the desired form. Dies of blanking type are mainly used to cut blanks from flat sheets or strips of a material. It cannot be drawn, formed or bent, but if the drawing process were following the blanking, then it would be considered a drawing die. A great number of such dies in use vary widely and range from simple and inexpensive blanking dies to complex and costly ones. The difference between die and punch should be explained here. The term die is mainly applied to entire press tool with component parts, whereas the terms punch and die are applied to parts of a complete die, a punch being usually the upper part but not necessarily. The form is generally distinguishing feature between the punch and the die. As mentioned before, there is a variety of dies with diverse applications, to start with plain blanking dies to multi-purpose dies, blanking and piercing dies, follow or progressive dies, piercing and perforating dies, shaping dies, multi-purpose dies for laminations, sub-press or self-guiding dies, drawing dies with many sub-types such as dies for drawing shallow shells, dies for drawing deep shells, dies for drawing shells having wide flanges and drawing dies for conical and tapering forms, drawing dies for spherical and oval shapes; then bending and forming dies, notching dies, expanding dies of rubber and hydraulic types and dies for special operations.

The aim of this e-book is providing information on metals used to make die cutting tools, the packaging paper and paperboard die cutting process. Therefore, the first chapter of this course deals with metals used in die cutting process and their composition and characteristics, which are important for this process. It will include in the first place classification of cutting dies with their basic features and references regarding their relevant applications, then the most important facts concerning metals and alloys used to make cutting dies, including an action of metal shearing and wear of cutting edges, an effect of clearance between punch and die, condition of sheared edge, where to apply clearance, dullness of cutting edges and heat-treatment of die steels explaining

elements, which increase harden ability of steel, how the heating changes the structure of tool steel, grain size and toughness and cooling tool and die steels, as well as tempering tool steels covering the effect of double tempering and effect of hardening temperature on hardness after tempering and size changes during heat treatment.

The second chapter deals with packaging paper and paperboard, starting from basic data on paper and paperboard composition; paper and paperboard production; paper and paperboard characteristics; paper formats since it is produced in standardized formats; types and application in packaging paper and paperboard depending on the type of the product to be packed and material to be die cut; construction and types of corrugated paper and paperboard with elements and characteristics; cross-corrugated paperboard used for special purposes in transport packaging, often combined with wood packaging; types of corrugated paper used for transport packaging and types of corrugated paper used for commercial packaging, as well as types of special packaging paperboards and inner protection of paperboard packaging, refined paper and paperboard and other special papers, mostly used for printing, labeling and decorative purposes in commercial packaging.

The third chapter deals with the principals of practical die making in the packaging die making area, starting with the process of making a prototype for a package which is later to become a die; meeting with the elements from which dies are made of; showing you the basic operations in processing the die elements and how they after: board cutting, rule processing (cutting, mitering, bending, broaching, placing nicks), rule placing, rule pulling, rubber placing, counter form making, become a complete die ready to be put in a press and start die cutting packages. In short, the first two chapters are about the theory that die makers need to know before making a die which the third chapter shows. After chapter three you should be acquainted with die making skills as an average die maker.

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