regal
PLASTIC

PLASTICS REFERENCE HANDBOOK

REGAL PLASTIC SUPPLY COMPANY

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INTRODUCTION

Established in 1954, Regal Plastic Supply Company is considered one of the foremost pioneers in the plastic distribution industry. Throughout the years, the innovative "customer-oriented plan for success" thinking has become a credible trademark our customers rely on. Fortifying that philosophy, Regal introduced its Plastic Materials Reference Guide in 1984. As products and industries continue to evolve, so does this compilation of technical data. We view providing our customers with tools for effective planning and purchasing as important as meeting product "supply and demand". You will find this guide an invaluable reference source for researching or finding the answer pertaining to your plastic application. The product information contained herein covers the most commonly used materials; it does not reflect our total capacity.

True customer service is a thought process not developed overnight. Our experience and stability in the industry gives Regal the opportunity to assist you in your plastics endeavors as you utilize staff who are accessible, knowledgeable and resourceful with regard to all inquiries.

We invite you to visit the Regal Plastic Supply Company location in your vicinity. All locations maintain generous inventories of plastic sheet, rod, tube, film, and numerous finished products.

Regal Plastic Supply Company thanks all of our customers for their patronage over the years. We will continue in our efforts to provide the best in JIT inventory and personal service. Plastic is in your future and Regal Plastic Supply Company is your best source.

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National Association

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816-221-5822 FAX

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800-444-1211
316-263-4641 FAX

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800-867-8347
515-223-8062 FAX

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800-444-1420
417-782-8924 FAX

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800-444-7755
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800-373-8757
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800-444-3110
417-831-1386 FAX

TULSA, OK 74145
11612 E. 58th St. South
918-249-0775
800-444-2925
918-249-9708 FAX

NASHVILLE, TN 37210
1055 Elm Hill Pike
615-242-4800
888-615-6155
615-256-5600 FAX

ST. LOUIS, MO 63132
1456 Ashby Road
314-427-7722
800-666-0084
314-427-7717 FAX

OMAHA, NE 68108
2324 Vinton
402-344-4446
800-333-4446
402-344-4451 FAX

LA CROSSE, WI 54603
3160 Airport Road
608-784-2337
608-784-2336 FAX

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REGAL GRAPHICS - FILM DIVISION

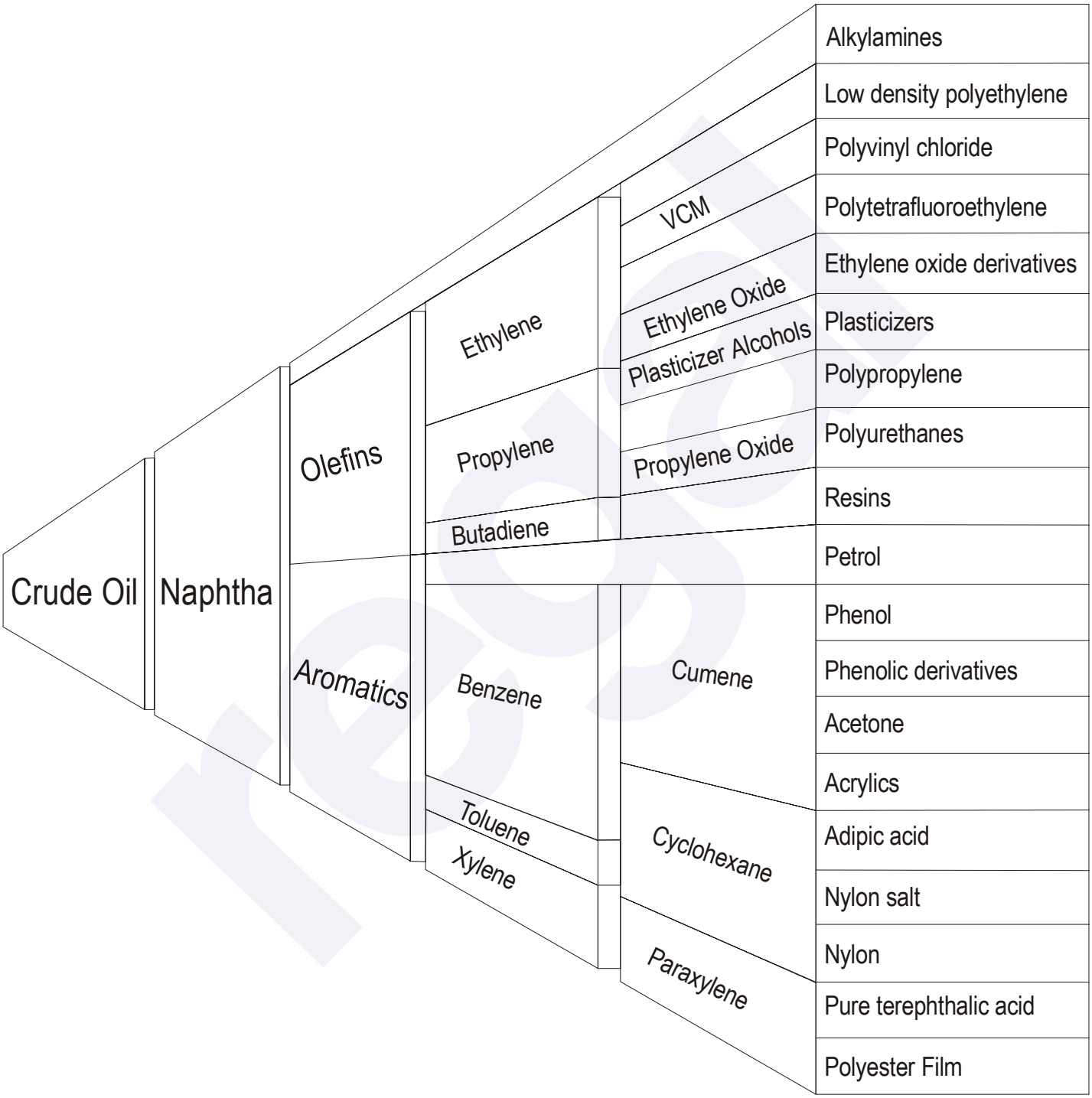
NORTH KANSAS CITY, MO 64116
111 E. 10th Avenue
816-842-1090
800-627-3425
FAX 816-421-0445

NASHVILLE, TN 37210
1055 Elm Hill Pike
615-242-8200
888-615-6155
FAX 615-256-5600

LA CROSSE, WI 54603
3160 Airport Road
608-784-2337
608-784-2336 FAX

SHERWOOD, OR 97140
13565 S.W.
Tualatin-Sherwood Rd.
Building 200
503-625-2262
800-627-3425
503-625-4568 FAX

The Origins of Plastic Materials



INTRODUCTION

Preface

Introduction

PLASTIC-(per Webster)- “Any numerous organic, synthetic, or processed materials that are high molecular weight polymers.”

Polymers are a tribute to man’s creativity and inventiveness. They are truly man-made materials. Like any other material, they have their origins in nature, in such basic chemical elements as carbon, oxygen, hydrogen, nitrogen, chlorine, and sulfur. These elements in turn are extracted from the air, water, gas, oil, coal, or even plant life.

It was man’s inspiration to take these elements and combine them, via various chemical reactions, in an almost unending series of combinations, to produce the rich variety of materials we know today as plastics.

The possibilities of combining chemical elements to create plastics with different properties are almost endless. It is this diversity that has made plastics so applicable to such a broad range of end uses and products today.

In the Beginning

Given this kind of versatility and the role that plastics play in modern living, it’s surprising to realize that a little over a century ago there was no such thing as commercial plastic in the United States. During the 1850's and 60's, developmental work was going on with hard rubbers and cellulose materials, but the U.S. plastics industry officially dates its beginnings back to 1868, when a product called Celluloid was created as the first commercial plastic in the U.S. The development was in response to a competition sponsored by a manufacturer of billiard balls. It came about when a shortage developed in ivory from which the billiard balls were made, and the manufacturer sought another production method. Celluloid was one of the materials considered, and the U.S. plastics industry was born.

As has been typical of new plastic materials ever since, Celluloid quickly moved into other markets. The first photographic film used by Eastman was made of celluloid: producing the first motion picture film in 1882. The material is still in use today under its chemical name Cellulose nitrate, for making products like eyeglass frames.

Forty years were to pass before the plastics industry took its second major step forward. In 1909, Dr. Leo Hendrik Baekeland introduced Phenol formaldehyde plastics (or Phenolics as they are more popularly known), the first plastic to achieve world wide acceptance.

The third big thrust in plastics development took place in the 1920's with the introduction of Cellulose acetate, ureaformaldehyde, polyvinyl chloride, or Vinyl, and Nylon.

Evolution

In the World War II years of the 1940’s, the demand for plastics accelerated, as did research into new plastics that could aid in the defense effort.

Preface

By the start of the 1950's plastics were on their way to being accepted by designers and engineers as basic materials, along with the more conventional ones.

Nylon, Teflon, Acetal, and Polycarbonate became the nucleus of a group in the plastics family known as the engineering thermoplastics. Their outstanding impact strength and thermal and dimensional stability enabled them to compete directly with metals. This group has grown since then to include a number of new plastics, as well as improved variations of older plastics that could similarly qualify for inclusion.

The Monomers & Polymers

Many plastics are derived from fractions of petroleum or gases that are recovered during the refining process. For example: ethylene monomer, one of the more important feedstocks, or starting materials for plastics, is derived in a gaseous form from petroleum refinery gas, liquefied petroleum gases, or liquid hydrocarbons. Although petroleum gas derivatives are not the only basic source used in making feedstocks for plastics, they are among the most popular and economical in use today. Coal is another excellent source in the manufacturing of feedstocks for plastics.

From these basic sources come the feedstocks we call monomers. The monomer is subjected to a chemical reaction known as polymerization; it causes the small molecules to link together into ever increasingly long molecules. Chemically, the polymerization reaction gas turns the monomer into a polymer, and thus a given type of plastic resin.

The Product as We See It

The polymer or plastic resin must next be prepared for use by the processor, who will turn it into a finished product. In some instances, it is possible to use the plastic resin as it comes out of the polymerization reaction. More often, however, it goes through other steps which turn it into a form that can be more easily handled by the processor and processing equipment. The more popular forms of resin for processing are pellet, granule, flake, and powder.

In the hands of the processor, these solids are generally subjected to heat and pressure. They are melted, forced into the desired shape (sheets, rods, and tubes) and then allowed to cure into a finished product. Resins are most readily available in their natural color, but by adding coloring agents, most any color can be achieved during the processing.

Plastics are a family of materials, not a single material. Each has its own distinct and special advantages.

Each day brings new plastic compounds, and new uses for the old compounds.

Chronology of Plastic

DATE	MATERIAL	ORIGINAL TYPICAL USE
1868	Cellulose Nitrate	Eye Glass Frames
1909	Phenol-Formaldehyde	Telephone Handsets
1926	Alkyd	Electrical Bases
1926	Analine-Formaldehyde	Terminal Boards
1927	Cellulose Acetate	Tooth Brushes, Packaging
1927	Polyvinyl Chloride	Raincoats
1929	Urea-Formaldehyde	Lighting Fixtures
1935	Ethyl Cellulose	Flashlight Cases
1936	Acrylic	Brush Backs, Displays
1936	Polyvinyl Acetate	Flash Bulb Lining
1938	Cellulose Acetate Butyrate	Irrigation Pipe
1938	Polystyrene or Styrene	Kitchen Housewares
1938	Nylon (Polyamide)	Gears
1938	Polyvinyl Acetal	Safety Glass Interlayer
1939	Polyvinylidene Chloride	Auto Seat Covers
1939	Melamine-Formaldehyde	Tableware
1942	Polyester	Boat Hulls
1942	Polyethylene	Squeezable Bottles
1943	Fluorocarbon	Industrial Gaskets
1943	Silicone	Motor Insulation
1945	Cellulose Propionate	Automatic Pens and Pencils
1947	Epoxy	Tools and Jigs
1948	Acrylonitrile-Butadiene-Styrene	Luggage
1949	Allylic	Electrical Connectors
1954	Polyurethane or Urethane	Foam Cushions
1956	Acetal	Automotive Parts
1957	Polypropylene	Safety Helmets
1957	Polycarbonate	Appliance Parts
1959	Chlorinated Polyether	Valves and Fittings
1962	Phenoxy	Bottles
1962	Polyallomer	Typewriter Cases
1964	Ionomer	Skin Packages
1964	Polyphenylene Oxide	Battery Cases
1964	Polymide	Bearings
1964	Ethylene-Vinyl Acetate	Heavy Gauge Flexible Sheeting
1965	Parylene	Insulating Coatings
1965	Polysulfone	Electrical/Electronic Parts
1970	Thermoplastic Polyester	Electrical/Electronic Parts
1973	Polybutylene	Piping
1975	Nitrile Barrier Resins	Containers

DISCLAIMER

The information contained herein provides product data, suggestions, and guidelines we believe to be reliable. They are offered in good faith but without any guarantee, as conditions, type of product, and methods of product use are beyond our control.

Regal Plastic Supply Company makes no warranties either expressed or implied and expressly disclaims any implied warranty of fitness for a particular purpose or procedure.

Sufficient verification and testing to determine the suitability for their own particular purpose of any information or products referred to herein, is strongly recommended.

FLEXIBLE TUBING

Basic Information

Plastic tubing is available to meet almost any application requirement. With varying formulations manufactured out of PVC, polyethylene (PE), polypropylene (PP), polyurethane (PUR), and polyvinylidene fluoride (PVDF), and Teflon® FEP and PFA, tubing is widely used in industry:

- Food and Beverage
- Chemical Processing
- Environmental
- Industrial
- Laboratory
- Medical
- Peristaltic Pump
- Pharmaceutical / Biotech
- Semiconductor Processing

PVC tubing exhibits excellent elongation and drape. It is typically used for lower pressure applications and for OEM designs with complex tubing pathways. Several grades are available for vacuum, fuel and high pressure applications.

PE tubing has chemical resistance, is semi-rigid, translucent and low in extractables.

PP tubing exhibits corrosion resistance to many acids and alkalies, is semi-rigid, offers higher operating temperatures and working pressures than PVC, PE, or PUR and is unaffected by most solvents at ambient temperature.

PUR tubing is resistant to abrasion, flex fatigue, aliphatic hydrocarbons, petroleum products, weak acids, and alkalies. It remains transparent and flexible at low temperatures. Pure polyurethane tubing contains no plasticizers and low levels of extractables which make it ideal for high-purity applications.

PVDF tubing is semi-rigid exhibiting corrosive, UV light, weathering, fungi, and abrasion resistance. Non-toxic, this tubing has a low level of extractables.

Teflon® FEP tubing is semi-rigid with low extractables and excellent for all concentrations of acids, aliphatic alcohols, aldehydes, bases, esters, hydrocarbons (aliphatic, aromatic and halgenated), ketones, and strong oxidizing agents.

Teflon® PFA tubing is semi-rigid with a very low water absorption and high chemical and corrosion resistance.

Tubing is available in braid-reinforced grades for increased pressure resistance and in black color for resistance to the ozone, UV light and weathering. Platinum-cured silicone tubing is produced without peroxide or plasticizers.

Working temperature range varies from a low of –400°F (-240°C) to as high as 500°F (287°C) with continuous use temperature as high as 400°F (204°C).

Vacuum tubing typically withstands up to 30" Hg at ambient temperature and 27" Hg at 140°F (60°C).

PRODUCT COMPLIANCE CODES

Standards found within the tubing industry include:

- FDA
- NSF
- USDA
- U.S.P. Class IV and 3A
- U.S.P. Class VI

PRODUCT AVAILABILITIES

Tubing comes is a wide range of inside diameters, outside diameters, and wall thicknesses. It is virtually impossible to list all the availabilities in one chart. Listed below are standard gauges available. Please consult with your nearest Regal Plastic Supply Distributor on current specific product availabilities and for customized formulations.

Inside Diameters: 1/32" to 4"
Outside Diameters: 3/32" to 5"
Wall Thicknesses: 1/32" to 1/2"

STERILIZATION GUIDELINES

Testing of product using the specific conditions of the application prior to specifying a particular tubing formulation is highly recommended.

- Autoclaving (250°F / 121°C, 15 psig for 20 - 30 minutes) - clean and rinse item with distilled water before autoclaving. Certian chemicals which have no appreciable effect on resins at room temperature may cause deterioration at autoclaving temperatures unless removed with distilled water beforehand.
- Gas - ethylene oxide formaldehyde
- Disinfectants - benzalkonium chloride, formalin, ethanol, etc.
- Dry Heat - 170°C (338°F)
- Radiation - gamma irradiation at 2.5 Mrad with unstabilized plastic.

Contact your nearest Regal Plastic Supply Representative for specific tubing properties and additional information.

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Click on trademark name to locate within document

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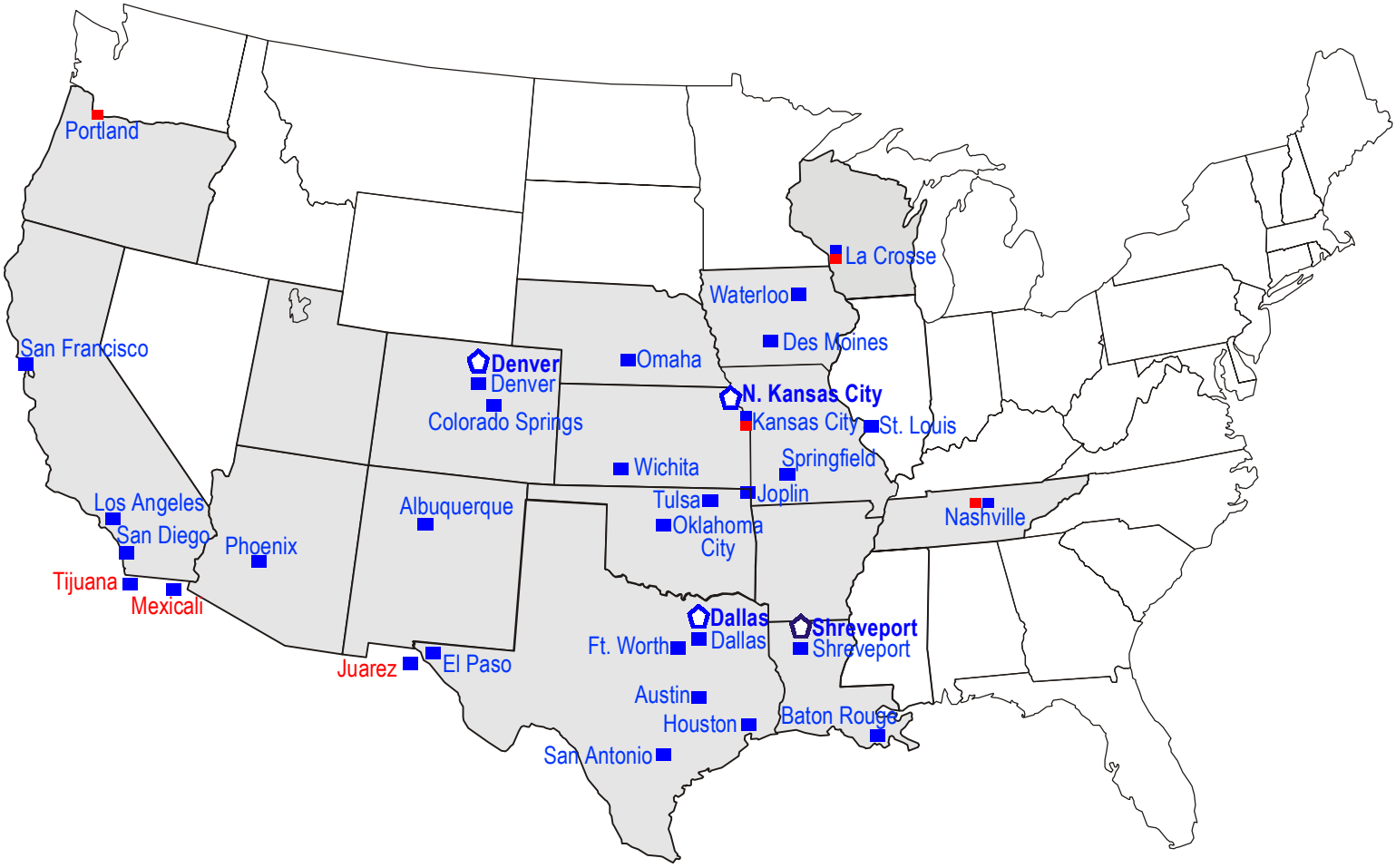

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