# DECORATIVE PRECIOUS METALS

Product Selection Guide

**MacDermid Enthone Decorative Plating and Electroforming Processes for Fashion and Luxury Applications**

MacDermid Enthone
INDUSTRIAL SOLUTIONS

# INTRODUCTION

## Decorative Precious Metals Product Selection Guide

MacDermid Enthone manufactures **SEL-REX®** processes specially formulated to meet the most stringent requirements of the luxury industry.Our best-in-class processes are trusted and production-proven as high performance, cost-effective technologies. But what truly distinguishes MacDermid Enthone is our commitment to customers' needs.We partner with our customers to deliver them colors, precise karat gold alloys and new alloys for precious and non precious metal processes. MacDermid Enthone's environmentally friendly electrolytes improve efficiency and productivity while delivering the lowest cost of ownership.

As fashion is constantly changing, MacDermid Enthone's full range of SEL-REX processes become more and more popular. From clothing fasteners,watches, spectacle frames, high fashion accessories, costume jewelry, to plain gold jewelry manufacturing, SEL-REX decorative plating and electroforming processes make them look and perform to their optimum! For further information on any of the processes contained within this comprehensive guide, please contact your local MacDermid Enthone sales representative.

**Contents**

# GOLD ELECTROFORMING

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**Gold Electroforming** **Features/Benefits**

**ARTFORM®**
**ECOFORM®**

ARTFORM and ECOFORM are cost-effective systems for manufacturing fine gold (14K to 24K) hollow jewelry by using advanced electroforming process chemistry and computer controlled equipment. Conventional techniques such as stamping or pressing, require expensive tools and a significant metal thickness for successful fabrication. ARTFORM and ECOFORM require no such tooling while reducing the metal thickness normally required by conventional methods. They provide the flexibility to manufacture more complex and intricate designs than difficult casting techniques. Since the pieces are hollow, the jewelry is lightweight and gold usage is reduced, while maintaining main casting characteristics. Thicknesses ranging from 90 up to 400microns can easily be obtained using ECOFORM EASY computer controlled system.

The last generation of gold electroforming process ECOFORM PLUS is totally free of cadmium and complies with the latest regulations about cadmium restriction in jewelry and watch articles.

| Process | Color | Alloying Metal | Purity | Metal Content [g/L] | | | T [°C] | Plating Speed (Time for 1µm Deposit) | Observation |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Gold | Copper | Cadmium | | | |
| **ARTFORM** | Rose to Yellow | Copper Cadmium | 14 - 21K | 4 - 9 | 51 - 70 | 0.6 - 1.6 | 65 - 70 | 2 to 4 min | Bright, excellent solderability |
| **ECOFORM PLUS** | Pink to Yellow | Copper | 14 - 21K | 6 - 10 | 55 - 90 | - | 65 - 75 | 3 to 7 min | Bright, cadmium free |

# GOLD STRIKE AND FLASH

Decorative Precious Metals Product Selection Guide

**Gold Strike** **Features/Benefits**

**AUROBOND®**

AUROBOND applied under a KARATCLAD® or ECOLOY gold deposit is the lowest cost assurance of perfect adhesion. AUROBOND also minimizes drag-in of contaminants into the gold plating bath and reduces the effect of porosity in the base metal. It can also be used as adhesion promoter on bronze and palladium deposits.

| Process | Alloying Metal | pH | Gold Content [g/L] | Gold Complex | Current Density [A/dm²] | Plating Speed for 0.1µm | T [°C] | Observation |
|---|---|---|---|---|---|---|---|---|
| **AUROBOND TN** | - | 3.5 | 1 - 3 | GPC* | 0.2 - 1.2 | 0.5 min | 20 - 50 | Universal strike |
| **AUROBOND XDA** | Cobalt | 0.5 | 1 - 3 | Special XPH Gold Complex | 1 - 3 | 1 - 2 min | 25 - 40 | For stainless steel |
| **AUROBOND XPH** | Cobalt | 0.5 | 1 - 3 | Special XPH Gold Complex | 2 - 6 | 1 - 2 min | 25 - 40 | For stainless steel |

**Gold Flash** **Features/Benefits**

**AUROFLASH®**
**PTS®**

AUROFLASH and PTS processes produce flash gold deposits with a broad range of colors from white gold to pink-red gold deposits. Low gold thicknesses make the processes extremely cost-effective. The processes are capable of producing 1N to 5N colors (NIHS standard) and many others.

| Process | Alloying Metal | pH | Gold Content [g/L] | Gold Complex | Plating Speed for 0.1µm | T [°C] | Observation |
|---|---|---|---|---|---|---|---|
| **AUROFLASH 100 SERIES** | Silver, Copper Ruthenium | 7.3 | 0.3 - 0.5 | GPC* | 0.5 - 1 min | 55 | Tolerance to Nickel contamination<br>Up to 0.2 µm thickness |
| **AUROFLASH 100 WHITE** | Silver | 12 | 0.25 | GPC* | 40 sec | 30 | Very white deposit, close to silver color<br>7 - 10k |
| **PTS SERIES** | Silver, Nickel, Copper | 11 - 12 | 0.8 | PTS Gold Complex | 20 sec | 65 | Work with voltage<br>Very bright deposit<br>Up to 0.3µm thickness |

**Gold Potassium Cyanide*

# LOW KARAT GOLD

Decorative Precious Metals Product Selection Guide

## Low Karat Gold

### ECOLOY™

### Features/Benefits

ECOLOY mildly alkaline, cyanide gold electroplating processes produce cadmium-free karat gold alloys from 14 to 18K. The uniform, pink to yellow color deposits are hard, fully bright up to 20µm, and exhibit excellent ductility, distribution and wear resistance.

ECOLOY processes are very stable and simple to control. The processes are primarily used as cost-effective undercoats in duplex systems where a very high quality finish is required. ECOLOY deposits are totally free of cadmium and comply with the latest regulations about cadmium restriction in jewelry and watch articles. ECOLOY processes are ideally suited for jewelry and watch applications, as well as for writing instruments, optical goods and high fashion accessories.

| Process | Color | Alloying Metal | Purity | Gold Content [g/L] | T [°C] | Observation |
|---|---|---|---|---|---|---|
| **ECOLOY AMBER** | Yellow to Pink | Copper, Indium Zinc | 14 -18 K | 5 | 65 - 70 | Stable color<br>Good throwing power<br>Suitable for chains Rack & Barrel |
| **ECOLOY GC LT** | Pink to Red | Copper | 14 -18 K | 6 | 70 | Attractive Pink color |

# HIGH KARAT GOLD

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**Acid Hard Gold** **Features/Benefits**

**KARATCLAD®**

KARATCLAD processes are acid-based and produce 22K to 24K deposits. They can plate a wide spectrum of consistent colors. The deposits will not tarnish or discolor and offer excellent corrosion and wear resistance. The processes are able to plate bright deposits up to 3µm or more, without color change. KARATCLAD gold processes are easy to maintain and control in rack and barrel operations, and are ideally suited as a topcoat, either in duplex or single systems for jewelry and bathroom fittings, high fashion accessories and writing instrument applications.

| Process | Alloying Metal | Purity [%] | Deposit Hardness [Hv 0 0.20] | Deposit Density [g/cm³] | Plating Speed for 1µm | T [°C] | Color* | | | Observation |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | L | a | b | |
| **KARATCLAD 1N14** | Nickel Indium | 95.8 | 200 - 240 | 17.5 | 6.5 | 32 | 84 - 86 | 4 -5.5 | 28 -29 | NIHS standard colors |
| **KARATCLAD 2N18** | Nickel Indium | 95.8 | 200 - 240 | 17.5 | 7 | 32 | 84 - 86 | 5 -5.5 | 29 -30 | NIHS standard colors |
| **KARATCLAD 3N** | Nickel Cobalt | 97.9 | 160 - 200 | 17.8 | 6.5 | 55 | 84 - 86 | 6.5 -7.5 | 30 -32 | NIHS standard colors |
| **KARATCLAD 100** | Nickel | 91.7 | 250 - 300 | 17.0 | 7.5 | 55 | 83 - 85 | 2.5 -4 | 13 -17 | Very pale color |
| **KARATCLAD 264iS** | Nickel | 93.8 | 250 - 300 | 17.0 | 12 | 32 | 81 - 84 | 4 -5.5 | 18 -20 | Pale color |
| **KARATCLAD 265S** | Cobalt | 97.9 | 230 - 250 | 17.7 | 6 | 32 | 85 - 87 | 7 - 9 | 32 -36 | Warm Yellow |
| **KARATCLAD 2001** | Cobalt | 99.6 | 120 - 190 | 17.0 | 4 | 35 | 85 - 87 | 8.5 - 10 | 34 -36 | High speed process |
| **KARATCLAD 2NF** | Iron | 98.1 | 180 - 220 | 17.8 | 3 - 4 | 40 | 48 - 86 | 4.5 - 7 | 26 -32 | Nickel & Cobalt free |
| **KARATCLAD 1N14 NF** | Iron Indium | 98.5 | 200 - 240 | 17.0 | 9 | 40 | 84 - 86 | 4.5 - 6 | 26 -30 | Nickel & Cobalt free |

**(CIE D65 10°)*

# HIGH KARAT GOLD

Decorative Precious Metals Product Selection Guide

| Sulfite Hard Gold | Features/Benefits |
|---|---|
| **ULTRACLAD® 920** | ULTRACLAD 920 is a non-cyanide, sulfite-based process .The process yields deposits that will not tarnish or discolor. It offers excellent resistance to corrosion and can plate 5µm or more at a plating rate of 1µm in 3 to 4 minutes, without color or deposit structure change. This process maintains an excellent deposit distribution enabling uniform thicknesses even on complex shapes. ULTRACLAD 920 process is suitable for all decorative applications and is ideal for the spectacle frame industry. |

| Process | Color | Alloying Metal | Purity | Hardness [Hv 0 0.20] | Gold Content [g/L] | T [°C] | Observation |
|---|---|---|---|---|---|---|---|
| **ULTRACLAD 920** | Champagne Pink | Copper Palladium | 22.5K | 280 - 300 | 8 | 57 | Ammonium based, high levelling power |

# WHITE & BLACK PRECIOUS METALS

## Decorative Precious Metals Product Selection Guide

| Palladium/Palladium Alloys | Features/Benefits |
|---|---|
| **DECOREX® NF** | DECOREX NF process produces a white pure palladium deposit that offers a barrier layer to prevent metal migration to the surface. It complies with ISO1811 regulation about nickel release and is ideally suited for nickel free applications. |
| **PALLADEX®** | PALLADEX processes produce bright white Palladium Nickel deposits for decorative purposes. Deposits obtained from palladium nickel processes can be used as diffusion barrier layer, underlayer or as topcoat, from low to high thickness. |

| Process | Alloying Metal | Purity | Precious Metal Content [g/L] | T [°C] | pH | Plating Speed | Observation |
|---|---|---|---|---|---|---|---|
| **PALLADEX 9010** | Nickel | 90% | 6 | 35 | 8.0 | 2.5 min/µm | Bright up to 10µm |
| **PALLADEX 8020** | Nickel | 80% | 10 | 35 | 8.6 | 2.5 min/µm | Bright up to 10µm Levelling effect |
| **PALLADEX SB** | Nickel | 86% | 2 - 4 | 35 | 8.0 | 4.5 min/µm | Bright up to 4µm |
| **DECOREX NF** | - | 99.9% | 2 - 4 | 50 | 7 | 45 sec/0.1µm | Max 0.3µm |

# WHITE & BLACK PRECIOUS METALS

Decorative Precious Metals Product Selection Guide

**Ruthenium** **Features/Benefits**

**RUTHENEX®**

RUTHENEX processes produce thicknesses up to 0.3µm. The deposits are bright, hard, wear and corrosion resistant with a uniform grey to gun metal color. Ideally suited for decorative applications such as watch cases, spectacle frames, bathroom fittings, writing instruments and all nickel-free jewelry applications.

| Process | Purity | Precious Metal Content [g/L] | T [°C] | pH | Plating Speed | Color* | | | Observation |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | L | a | b | |
| **RUTHENEX GR3** | 99% | 5 | 65 | 1.5 | 3 min/0.1µm | 53 - 72 | 0.5 - 0 | 1.5 - 25 | Color adjustable with blackening additive |

**Rhodium** **Features/Benefits**

**RHODIUM SB**

RHODIUM SB plating process produces a brilliant white deposit that combines extreme hardness, high reflectivity and excellent tarnish resistance. The process yields a durable white color that is 99.99% pure with excellent wear characteristics.

| Process | Purity | Precious Metal Content [g/L] | T [°C] | pH | Plating Speed | Color* | | | Observation |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | L | a | b | |
| **RHODIUM SB** | 99.99% | 2 | 45 | <1 | 15 min/µm | 89 | 0.5 - 1 | 2.5 - 3 | High hardness |

# WHITE & BLACK PRECIOUS METALS

## Decorative Precious Metals Product Selection Guide

**Silver** **Features/Benefits**

**SILVREX®**

SILVREX silver processes yield mirror bright,white, silver deposits. SILVREX deposits are extremely ductile and have excellent solderability. As some of the processes do not contain a metallic brightener, they may be used for electrical and electronic, as well as decorative applications. Other processes contain metallic brightener that provides silver metallic color and a harder deposit. Deposits obtained with SILVREX processes can be protected with EVABRITE™ immersion process, in order to improve tarnish resistance.

| Process | Alloying Metal | Purity | Hardness [Hv 0 0.20] | Observation |
|---|---|---|---|---|
| **SILVREX S** | - | 99.9% | 90 - 100 | Organic Brighteners analyzable by HPLC<br>New cyanide-free,more stable brightener CF |
| **SILVREX R107** | Antimony | 99 - 99.9% | 150 - 220 | Metallic hardener and brightener<br>Bluer color |
| **SILVREX GMS** | - | 99.9% | 70 - 90 | Cyanide-free<br>2 versions :mat or bright (max 5µm) |

**Evabrite** **Features/Benefits**

**EVABRITE™**

EVABRITE WS is a solvent-free, water-based anti-tarnish emulsion that yields a thin, transparent protective film which prevents sulphide formation. It is easy- to-use and can be applied on jewelry, flatware and hollow components, as well as on electronic parts.

| Process | Suitable On | T [°C] | pH | Immersion Time | Observation |
|---|---|---|---|---|---|
| **EVABRITE WS** | Silver and Gold | 45 | 4.5 | 0.5 - 10min | Solvent free |

# NON PRECIOUS METALS

## Decorative Precious Metals Product Selection Guide

| Bronze | Features/Benefits |
|---|---|
| **BRONZEX®** | BRONZEX, electrolytic bronze processes, offer yellow or white deposits. They are often used as precious metal undercoats for nickel-free, non allergenic coatings. BRONZEX white deposits can also be used as topcoat thanks to their good corrosion and tarnish resistance. Our lead-free processes fully comply with RoHS (Restriction of Hazardous Substances Directive) and Oko Tex Standard (Environmentally Friendly Textile Specification). |

| Corrosion Resistant White Process | Features/Benefits |
|---|---|
| **SEL-REX® QUATRO™** | SEL-REX QUATRO is a cyanide, organically brightened process that produces bright,white, non-allergenic and corrosion resistant deposits,with improved levelling effect in rack and barrel applications.The easy-to-use, robust process is extremly stable and features a wide current density range. |

| Process | Alloy | | | | | T [°C] | Rack | Barrel | Plating Speed for 1µm | | Observation |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Copper | Tin | Zinc | Lead | Indium | | | | Rack | Barrel | |
| **BRONZEX MV** | 82 - 90 | 10 - 18 | | | | 60 | | • | | 6′ | For coins applications |
| **BRONZEX AF** | 75 | 10 - 15 | 2 - 4 | 2 - 4 | - | 45 | • | | 2′30″ | | High levelling |
| **BRONZEX YLF** | 75 | 10 - 15 | 10 - 15 | - | - | 45 | • | • | 2′30″ | 9′ | No levelling |
| **BRONZEX SW/WJ** | 50 - 55 | 28 - 32 | 15 - 20 | - | - | 62 | • | • | 3′30″ | 17′ | Potassium version, High speed |
| **BRONZEX NA** | 50 - 55 | 25 - 30 | 15 - 20 | - | - | 62 | • | • | 7′ | 27′ | Sodium version, decarbonatation possible |
| **SEL REX QUATRO** | 50 - 55 | 25 - 30 | 5 - 10 | - | 10 | 62 | • | • | 3′ | 30′ | High corrosion resistance |

# STRIPPERS

## Decorative Precious Metals Product Selection Guide

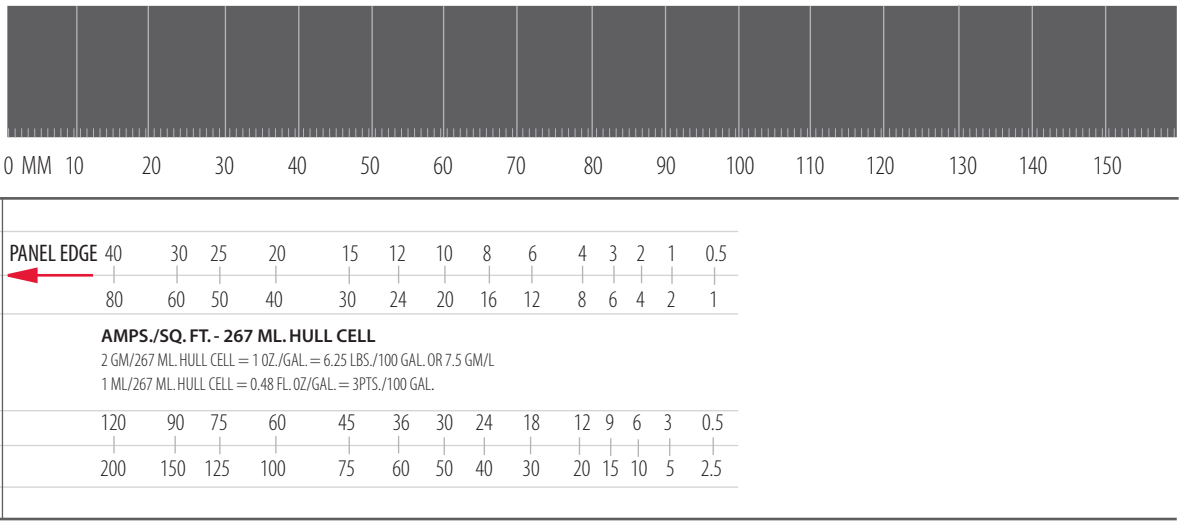
| Strippers | Features/Benefits |
|---|---|
| ENSTRIP® | Several ENSTRIP stripper processes have been designed to remove the various precious metals on different substrates or underlayers. Electrolytic and immersion processes, cyanide or cyanide-free formulations are available. |

| Process | Suitable For | T [°C] | Type | Observation |
|---|---|---|---|---|
| ENSTRIP NX | Gold | 27 | Cyanide | Cyanide containing; stripping rate: 1.2µm/minute |
| ENSTRIP PM | Palladium, Palladium alloys, Silver, Nickel phosphorus | 28 | acidic | Stop on brass, copper alloys |
| ENSTRIP AU ELJAS | Gold | 35 | alkaline | Electrolytic – cyanide-free; for flash deposit on copper alloys or nickel. |

# PLATERS INFO

Decorative Precious Metals Product Selection Guide

## Hull Cell Ruler




## Conversion Factors

**Grams per liters**
(g/l) multiplied by 0.134 = avoirdupois ounces per gallon (oz/gal)

**Avoirdupois ounces per gallon**
(oz/gal) multiplied by 7.5 = grams per liter (g/l)

**Grams per liters**
(g/l) multiplied by 0.122 = troy ounces per gallon (troy oz/gal)

**Troy ounces per gallon**
(troy oz/gal) multiplied by 8.2 = grams per liter (g/l)

**Grams per liters**
(g/l) multiplied by 2.44 = pennyweight per gallon (dwt/gal)

**Pennyweight per gallon**
(dwt/gal) multiplied by 0.41 = grams per liter (g/l)

**Amperes per square decimeter**
(amp/dm2) multiplied by 9.29 = amperes per sq.ft (amp/ft2)

**Amperes per square foot**
(amp/ft2) multiplied by 0.108 = amperes per square decimeter (amp/dm2)

**Fluid ounces per gallon**
(fl oz/gal) multiplied by 7.7 = cubic Centimeters per liter (cc/l)

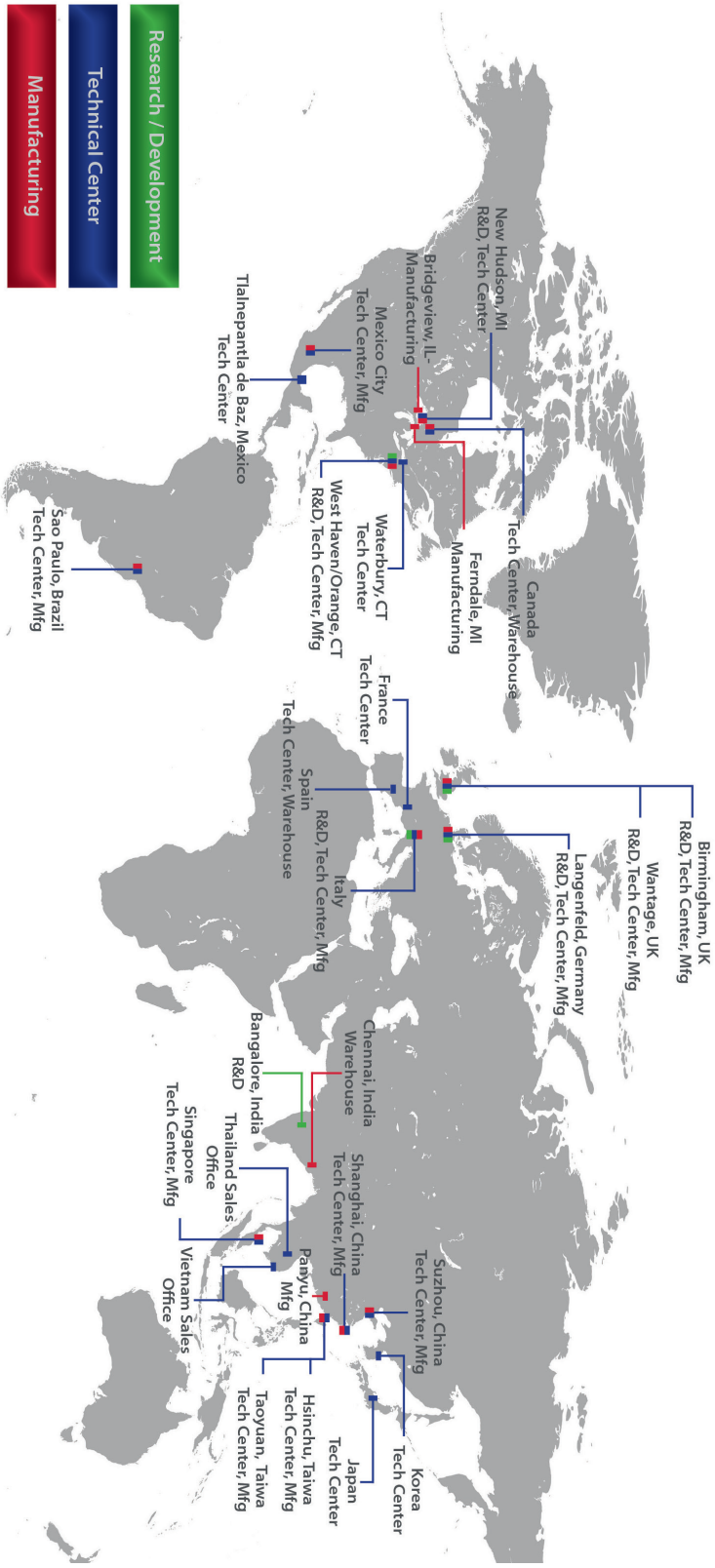
### Conversion Tables

To convert from a unit in the column at the left to a related unit, multiply by the factor in the appropriate right hand column. For example, to convert inches to meters multiply by 0.0254.

| Length | | | | | |
|---|---|---|---|---|---|
| Units | Centimeters | Meters | Kilometers | Inches | Feet |
| Centimeters | 1 | 0.01 | 0.00001 | 0.3937 | 0.03281 |
| Meters | 100 | 1 | 0.001 | 39.37 | 3.281 |
| Kilometers | 100,000 | 1000 | 1 | 39400 | 3281 |
| Inches | 2.54 | 0.0254 | $2.54 \times 10^{-5}$ | 1 | 0.08333 |
| Feet | 30.48 | 0.3048 | 0.000305 | 12 | 1 |

1 angstrom = 1 x 10-4 microns = 1 x 10-8 cm = 3.937 x 10-9 inches
1 mile = 1.609 km = 1760 yd = 1.151 nautical mile
1 meter = 1.094 yd

| Mass & Weight | | | | | |
|---|---|---|---|---|---|
| Units | Grams | Kilograms | Grain (Avoir.) | Ounce (Avoir.) | Lb (Avoir.) |
| Grams | 1 | 0.001 | 15.43 | 0.03527 | 0.0022 |
| Kilograms | 1000 | 1 | 15432 | 35.27 | 2.205 |
| Grain (Avoir.) | 0.06480 | $6.48 \times 10^{-5}$ | 1 | 0.00229 | 0.000143 |
| Ounce (Avoir.) | 28.35 | 0.02835 | 437.5 | 1 | 0.0625 |
| Lb (Avoir.) | 453.6 | 0.4536 | 7000 | 16 | 1 |

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