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Gem & Jewellery Skill Council of India

Participant Handbook

Sector
Gems and Jewellery

Sub-Sector
Handmade Gold and Gems- Set Jewellery

Occupation
Gold Smithy (Basic)

Reference ID: **G&J/Q0611, Version 2.0**
NSQF Level 3

Jewellwery Frame and Component maker

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> Skilling is building a better India. If we have to move India towards development then Skill Development should be our mission.

Shri Narendra Modi
Prime Minister of India

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Certificate

COMPLIANCE TO
QUALIFICATION PACK – NATIONAL OCCUPATIONAL STANDARDS

is hereby issued by the

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for

SKILLING CONTENT : PARTICIPANT HANDBOOK

Complying to National Occupational Standards of

Job Role/ Qualification Pack: **'Jewellery Frame and Component Maker'**

QP No. **G&J/Q0611/NSQF Level 3'**

Date of Issuance: Nov 17th,2022
Valid up to*: Nov 17th,2025

*Valid up to the next review date of the Qualification Pack or the 'Valid up to' date mentioned above (whichever is earlier)

Authorised Signatory
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Sincerely,

Adil Kotwal
Chairman, GJSCI

About this book

1. This Participant Handbook is designed to enable training for the specific Qualificaication Pack (QP).
2. Each National Occupational (NOS) is covered across Unit/s.
3. Key Learning Objectives for the specific NOS mark the beginning of the Unit/s for that NOS.
4. The symbols used in this book are described below.
5. This book is about frame making by the goldsmith or artisan or bench worker.
6. It includes how to create the frame work of the jewellery as per required size, weight and quality by employing the appropriate techniques for the product, adding components, while minimising hazards and working independently.

Symbols Used


Key Learning Outcomes


Steps


Tips


Notes


Unit Objectives


Exercise

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Table of Content

It is recommended that all the trainings include the appropriate Employability Skills Module.

Content for the same is available here:
https://www.skillindiadigital.gov.in/content/list

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1. Introduction

Key Learning Outcomes

At the end of this module, you will be able to:

1. Discuss the Gem and jewellery sector in India, and its sub-sectors.
2. Define the role and responsibilities of Goldsmith - Frame Maker.

Unit 1.1: Gem and Jewellery Sector in India

Unit Objectives

At the end of this unit, you will be able to:

1. Understand the significance of the gem and jewellery sector in India.

1.1.1 Significance of Gem and Jewellery Sector in India

The Gems and jewellery sector plays a major role within the Indian economy, impacting approximately 6-7 % of the country's gross domestic product (GDP). Being one of the quickest growing sectors, it's particularly export directed and labour intensive.

Based on its potential for growth and worth addition, the government of India has declared the Gems and jewellery sector as focus industry for export promotion. The government has recently undertaken various measures to boost investments and to upgrade technology and skills to market 'Brand India' within the international market.

India's Gems and jewellery sector has been conducive in an exceedingly huge way to the country's foreign exchange earnings (FEEs). The government of India has viewed this industry as a robust area for export promotion.

- With a market size of just about INR 4,54,100 crores, the industry encompasses a massive share of the gross domestic product at approximately 5.9 %, apart from large-scale employment generation and foreign exchange earnings.
- Market research reveals that jewellery accounts for more than a fourth of the optional spending by consumers in India. This combined with rising earning levels in India may be a major growth driver.
- India has a calculable 229 crore women in the age group of 20 to 49. The number of working women in skilled sectors who are considered the amongst the key consumers for jewellery is rising rapidly.
- With over 300 crore individuals falling within the 25-29 age bracket in the period 2011-21, an estimated 150 crore weddings are expected to take place during this period.
- In Tier-3 zones, where landowners and moneylenders are the primary resource of monetary credit, jewellers have emerged as an alternate, providing investment choices through gold jewellery.

1.1.1 Significance of Gem and Jewellery Sector in India

Gem and Jewellery industry classification

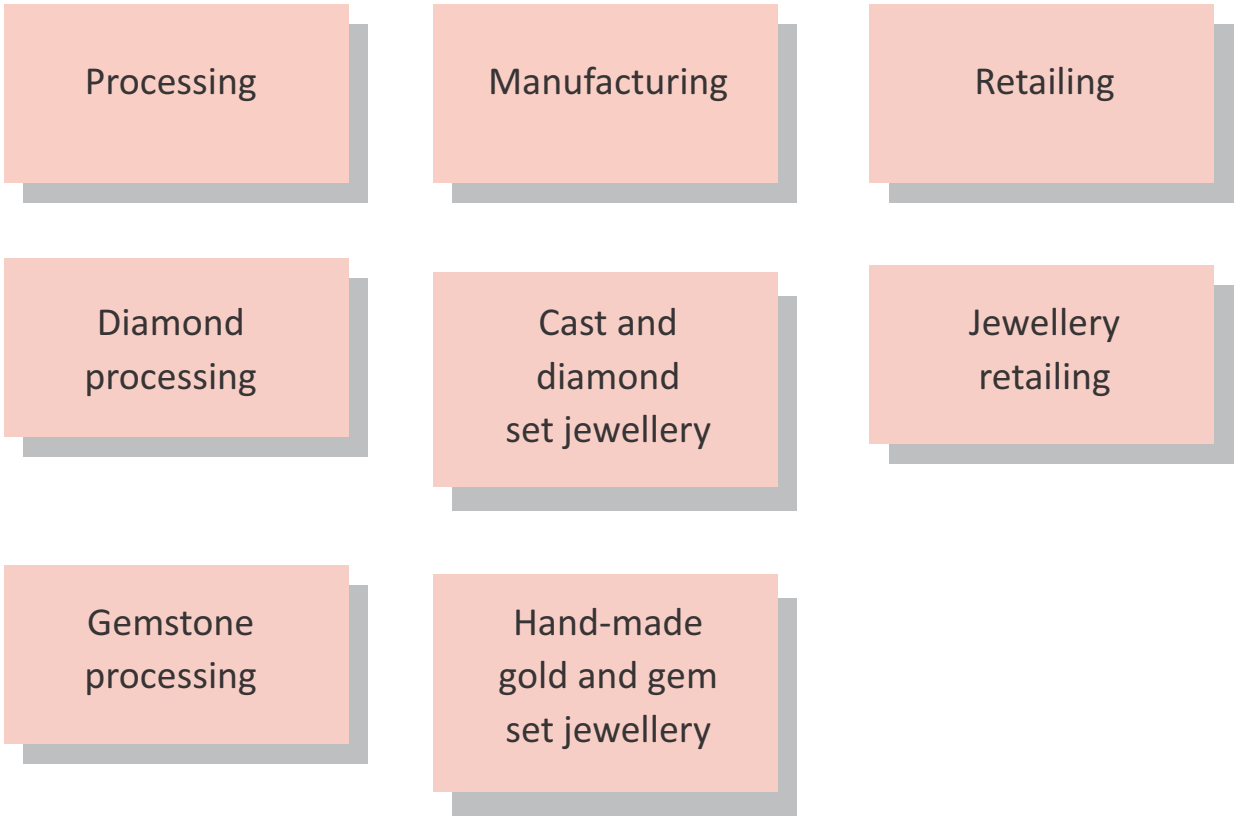

Fig 1.1.1.1

Based on economic activities from NIC-2008, key sub-sectors of the industry are: processing (diamond and gemstone), manufacturing (cast and diamond set, and handmade and gem set) and retailing.

1.1.1 Significance of Gem and Jewellery Sector in India

- With a market size of approximately INR 4,54,100 crores, the gem and jewellery segment has a sizeable share of the gross domestic product (GDP) at approximately 5.9%, apart from large-scale employment generation and foreign exchange earnings.
- The highly labor-intensive nature of the sector with large number of employees in the unorganised space, has led to job creation, employing more than 0.464 million people in the country in 2013. This is more than the population of Kolkata, the seventh highest populated city in India with a population of 4.5 crore; this indicates the high employment generation capacity of this sector.
- Indian markets for diamond processing — Surat, Ahmedabad; for gemstone processing — Bhavnagar and Jaipur; and for handmade gold jewellery — Kolkata, Thrissur and Coimbatore — are among other areas that are known world over for their products.
- Every region of the country has a different unique style of jewellery. Some examples of these traditional jewellery forms include Bikaneri, Dhokra, Minakari and Filigree.
- India is a source for manufacturing all varieties of products; and its presence in the global gems and jewellery sector is of much importance.

1.1.1 Significance of Gem and Jewellery Sector in India

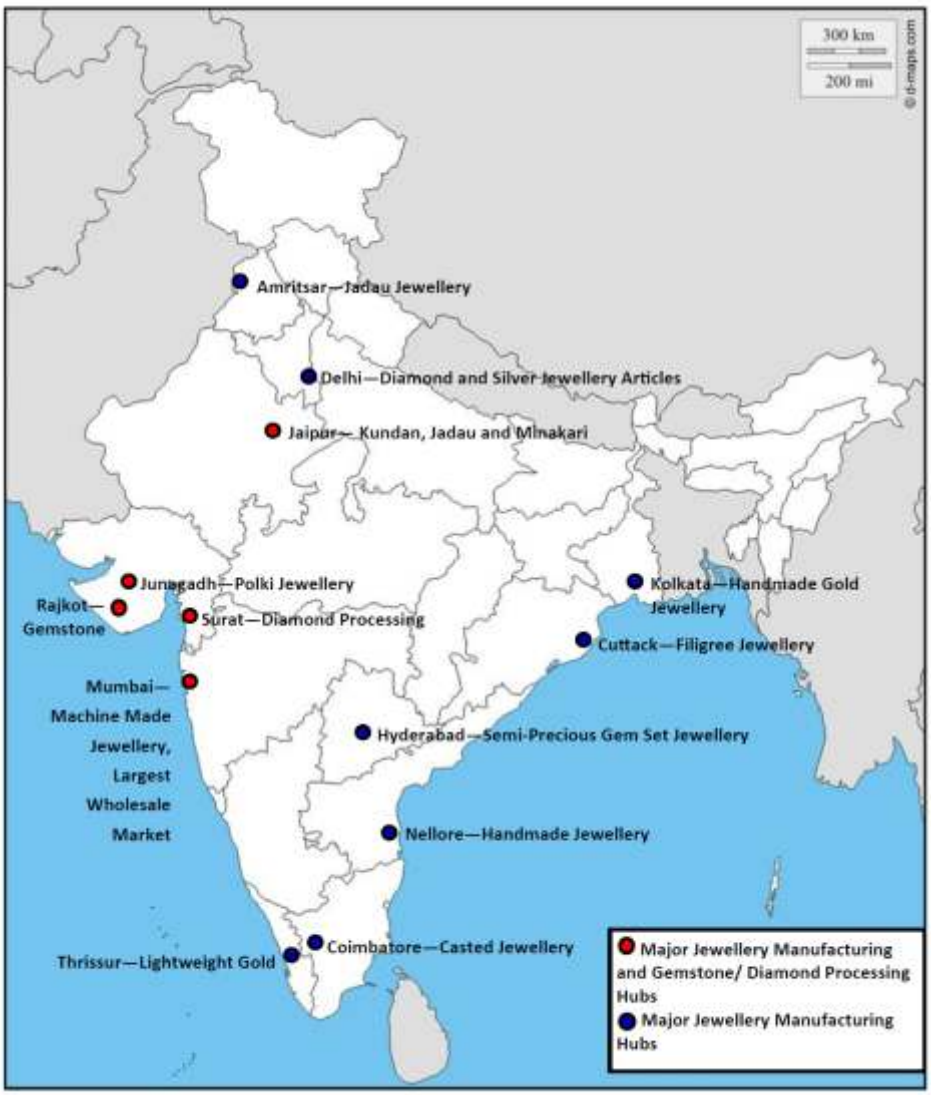

Fig 1.1.1.2 Geographical Markets: Employment Zones in India

- More than two-thirds of the sector work force in India are employed in the processing and manufacturing areas of the value chain.
- These workers are employed in certain zones, as indicated in the map above.
- The retailing work force is spread across the country from metros and Tier – 1 cities to villages in rural areas.

1.1.1 Significance of Gem and Jewellery Sector in India

Processing and Manufacturing Markets:

- Employment is concentrated in the states of Rajasthan, Gujarat, Maharashtra, West Bengal and the Southern states of Kerala and Tamil Nadu.
- Amritsar and Jaipur are well-known for Kundan and Jadau jewellery with Minakari work, while Delhi – NCR is well-known for silver jewellery. Further, Jaipur is also one of the largest coloured gemstone cutting and polishing centre in the world.
- Surat is the world's largest diamond processing centre and processes about 85 percent of the rough diamond imports of India. Surat has a large group of workforce and is also home to the world's leading diamond institute, the Indian Diamond Institute (IDI).
- Mumbai, besides being the largest trading hub and wholesale market in the country, is also a key centre for cast and diamond set jewellery.
- SEEPZ in Mumbai alone accounts for almost a quarter of the jewellery exports to USA, the world's largest jewellery consuming country.
- Thrissur is a hub for lightweight plain gold jewellery, a style traditional to Kerala, while Coimbatore is known for electroformed jewellery.
- Kolkata is renowned for handmade gold jewellery.
- Its importance also stems from the fact that a large share of the skilled artisans in the country are from this region. However, recent times have seen a decline of this supply due to a reduction in inherited skills.

1.1.1 Significance of Gem and Jewellery Sector in India

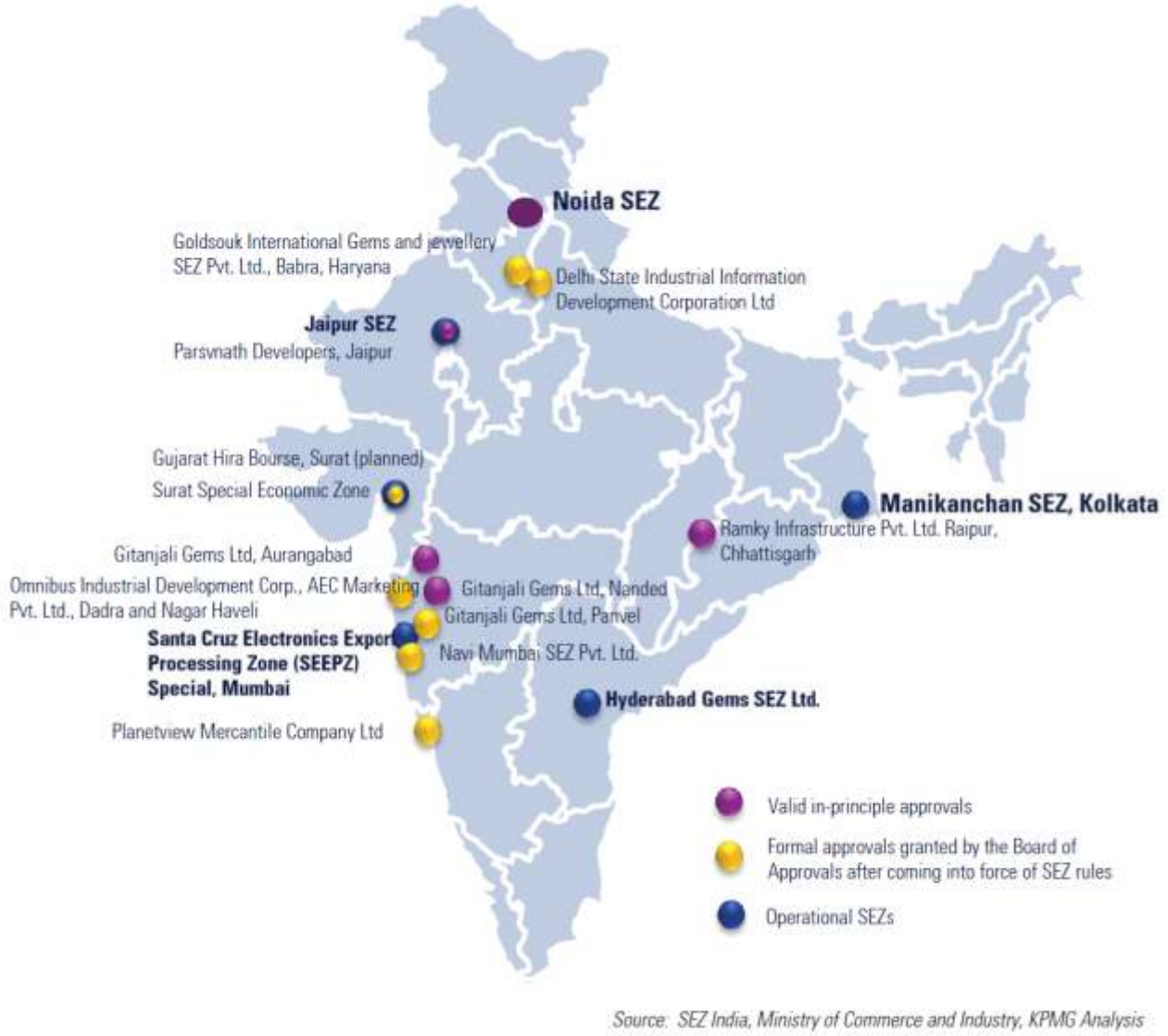

Fig 1.1.1.3 Geographical Markets

- India has multiple operational SEZs focused in the sector and many others expected to operationalise in the coming years.
- Currently, there are about 22 G&J SEZ's approved under the SEZ Act, 2005, throughout India.
- Out of these, 5 are operational, 4 have valid-in principle approvals and 12 are at the formal approval stage.
- The focus of investment is currently concentrated in Maharashtra, followed by Gujarat and Rajasthan.
- These areas will require skilled manpower and in line with current employment areas indicating that these areas will continue to be employment destinations for manpower supply.

1.1.1 Significance of Gem and Jewellery Sector in India

- **Incremental human resource requirement (2013-17, 2017-22) and skill gaps.**
- **Current workforce of 4.64 crore in 2013 is expected to increase to 8.22 crore by 2022.**

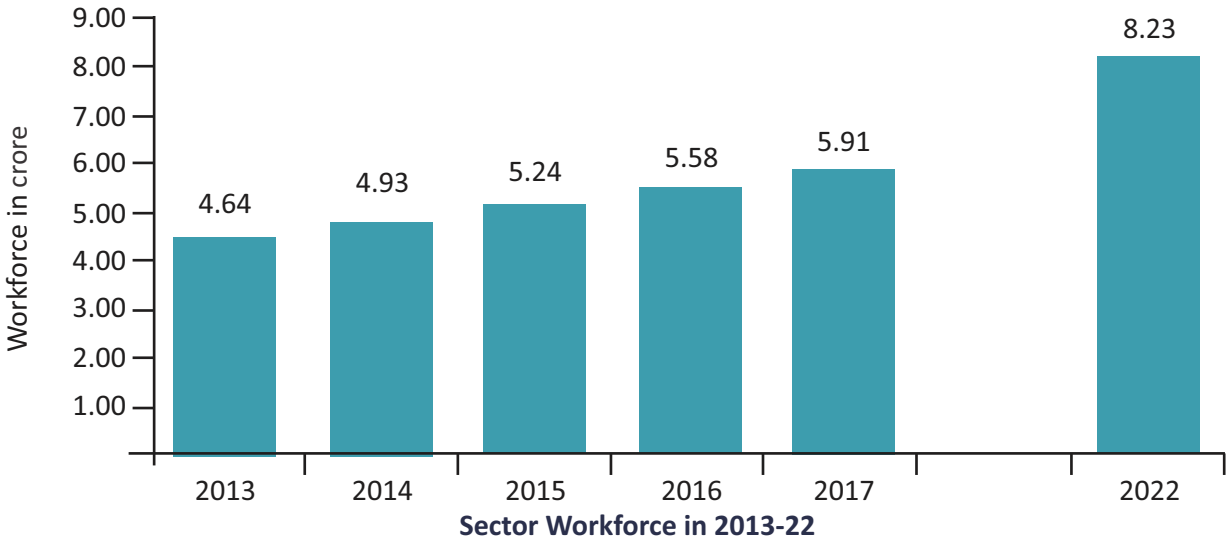

Fig 1.1.1.4

- The sector at present has more than 4.64 crore employees and is planning to hire approximately 8.23 crore employees by 2022.
- This suggests a further increase of ~3.59 crore jobs in the stated nine-year period.
- The period 2013 – 2018 will see slow progression in employment vis-à-vis 2017 – 2022 due to the effects of the worldwide recessions of 2008 – 2009.
- The industry will recuperate and will require more work-force in the later period viz. 2017 – 2022.

All facts and figures are based on research conducted by KPMG

Unit 1.2: Objectives of the Program

Unit Objectives

At the end of this unit, you will be able to:

1. Understand the importance of frame making.

1.2.1 Need for Frame Making of Jewellery

Fig 1.2.1.1

Unit 1.3: Where does Jewellery Frame & Component Maker Fall in the Jewellery Making Process

Unit Objectives

At the end of this unit, you will be able to:

1. Understand where a Jewellery frame & Component maker or component and frame making process fall.

1.3.1 Jewellery Making Process

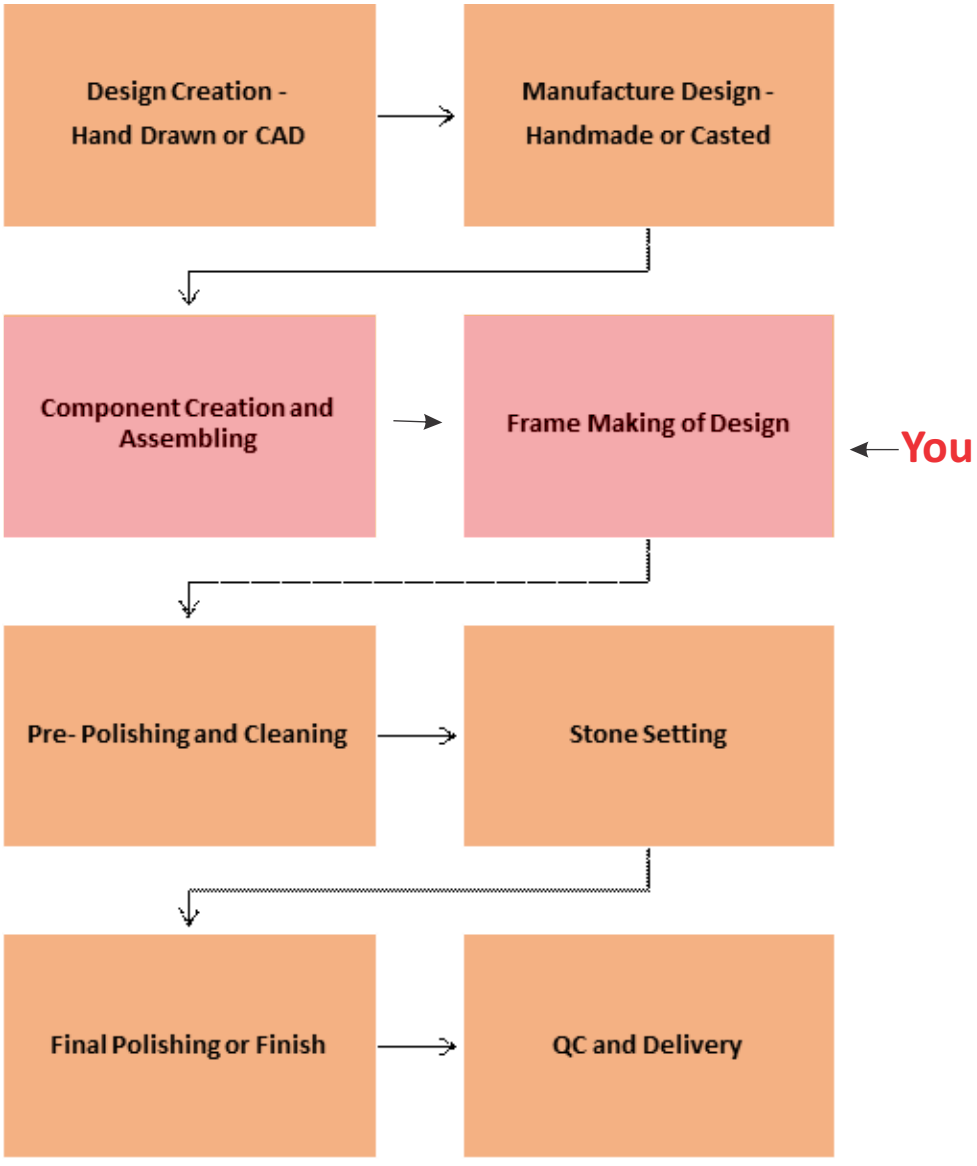

Fig 1.3.1.1

Unit 1.4: Job Opportunities for a Jewellery Frame & Component Maker

Unit Objectives

At the end of this unit, you will be able to:

1. Understand the job opportunities for a Jewellery Frame & Component Maker in the gem and jewellery industry.

1.4.1 Job Opportunities for a Jewellery Frame & Component Maker

1. Also known as 'Artisan' or 'Bench-worker'
2. Work as Freelancer
3. Own Business
4. Frame maker in small company/ firm/ shop
5. Frame maker in large company/ firm/ shop

Fig 1.4.1.1 Frame making

1.4.1 Job Opportunities for a Jewellery Frame & Component Maker

1. Freelancer

Fig 1.4.1.2 Freelancer

- A freelance frame maker works as self-employed on a contract basis in a single company, two or more companies.
- They have the freedom to pick and choose their project according to company rules and regulations.

1.4.1 Job Opportunities for a Jewellery Frame & Component Maker

2. Own Business

Fig 1.4.1.3 Own business

- The frame makers have their own small setup.
- Companies provide them their product which they have to create jewellery frame work independently with proper guidelines.

1.4.1 Job Opportunities for a Jewellery Frame & Component Maker

3. Frame Maker in Small Company/ Firm/ Shop

Fig 1.4.1.4 Frame maker in small company/ firm/ shop

- The Frame Maker works in smaller companies/ firms/ shops which has a small unit and few employees.

1.4.1 Job Opportunities for a Jewellery Frame & Component Maker

1. Frame Maker in Large Company/ Firm/ Shop

Fig 1.4.1.5 Frame maker in large company/ firm/ shop

- The Frame Maker works in larger companies/ firms/ shops which have a large unit and more employees.

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Click Here
Gem & Jewellery industry Orientation

1.4.2 Personal Qualities Required in a Jewellery Frame & Component Maker

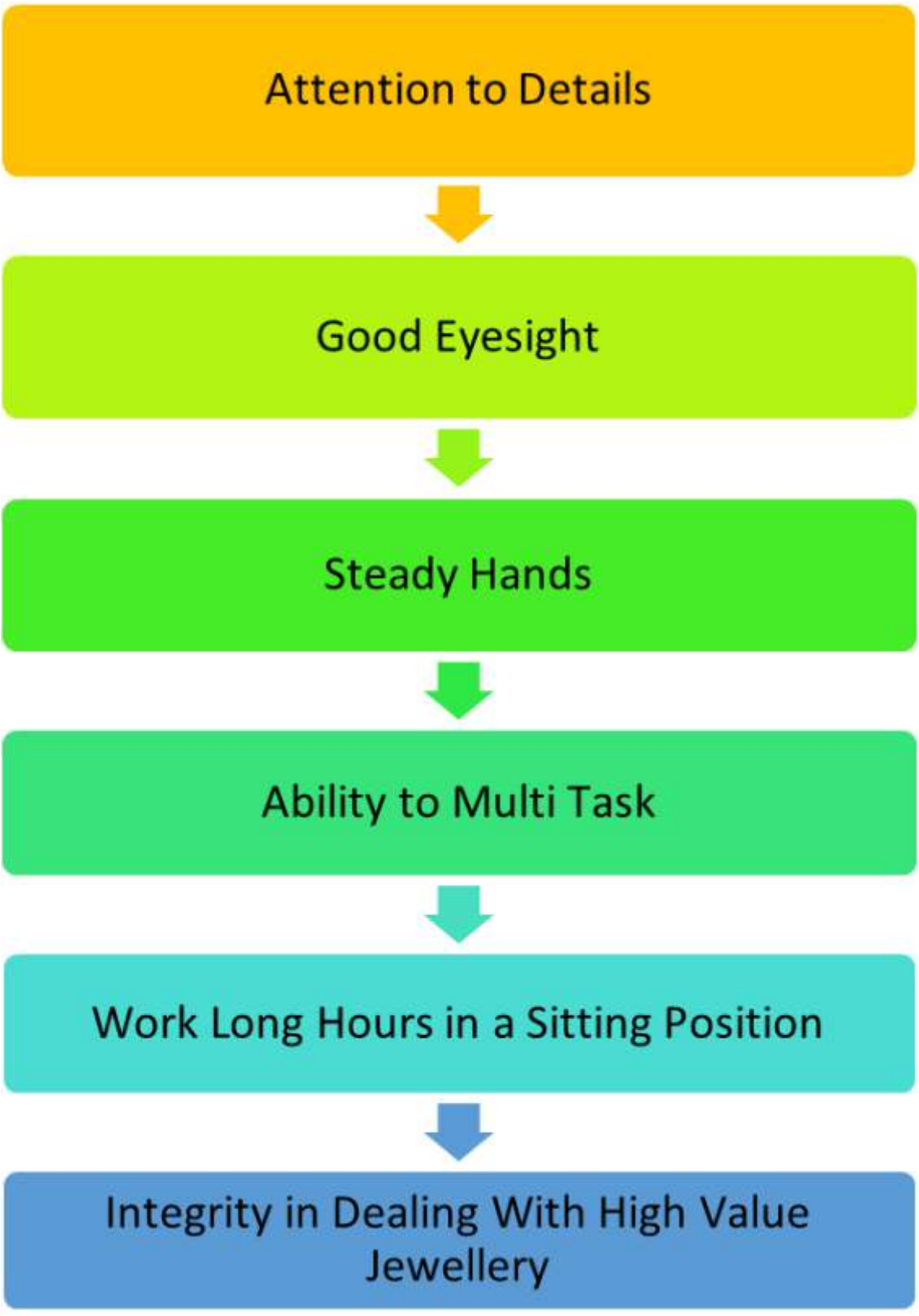

Fig 1.4.2.1

Notes

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2. Draw wire, roll sheet, and thick wire from precious metal

G&J/N0601

Key Learning Outcomes

At the end of this module, you will be able to:

1. Learn and understand the job work of a frame maker.
2. Learn to use the tools and equipment required for the job.
3. Understand the type of jewellery manufactured in India.
4. Learn about metals and their alloys.
5. Understand how to assemble components to complete a design frame.
6. Understand how to control gold loss.
7. Understand how to detect product defects.
8. Learn how to check quality.
9. Learn how to improve productivity.
10. Understand the jewellery making process.
11. Understand diamonds, gemstones, enamelling and plating.
12. Understand the work hazards in your department or work area.
13. Learn how to read a job sheet and design requirements.

Unit 2.1: Introduction to Jewellery Making Process

Unit Objective

At the end of this unit, you will be able to:

1. Understand the jewellery making process.

2.1.1 Jewellery Making Process – Part 1

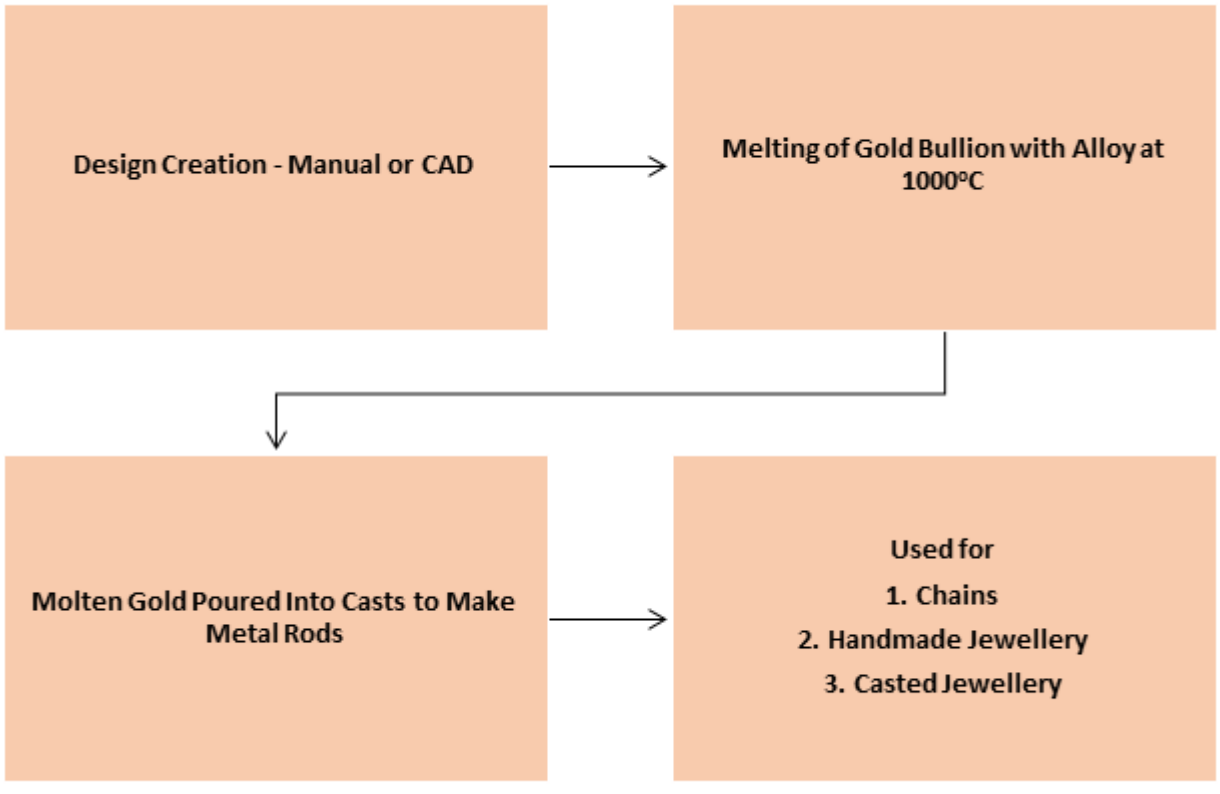

Fig 2.1.1.1

2.1.1 Jewellery Making Process – Part 2 – Handmade Jewellery

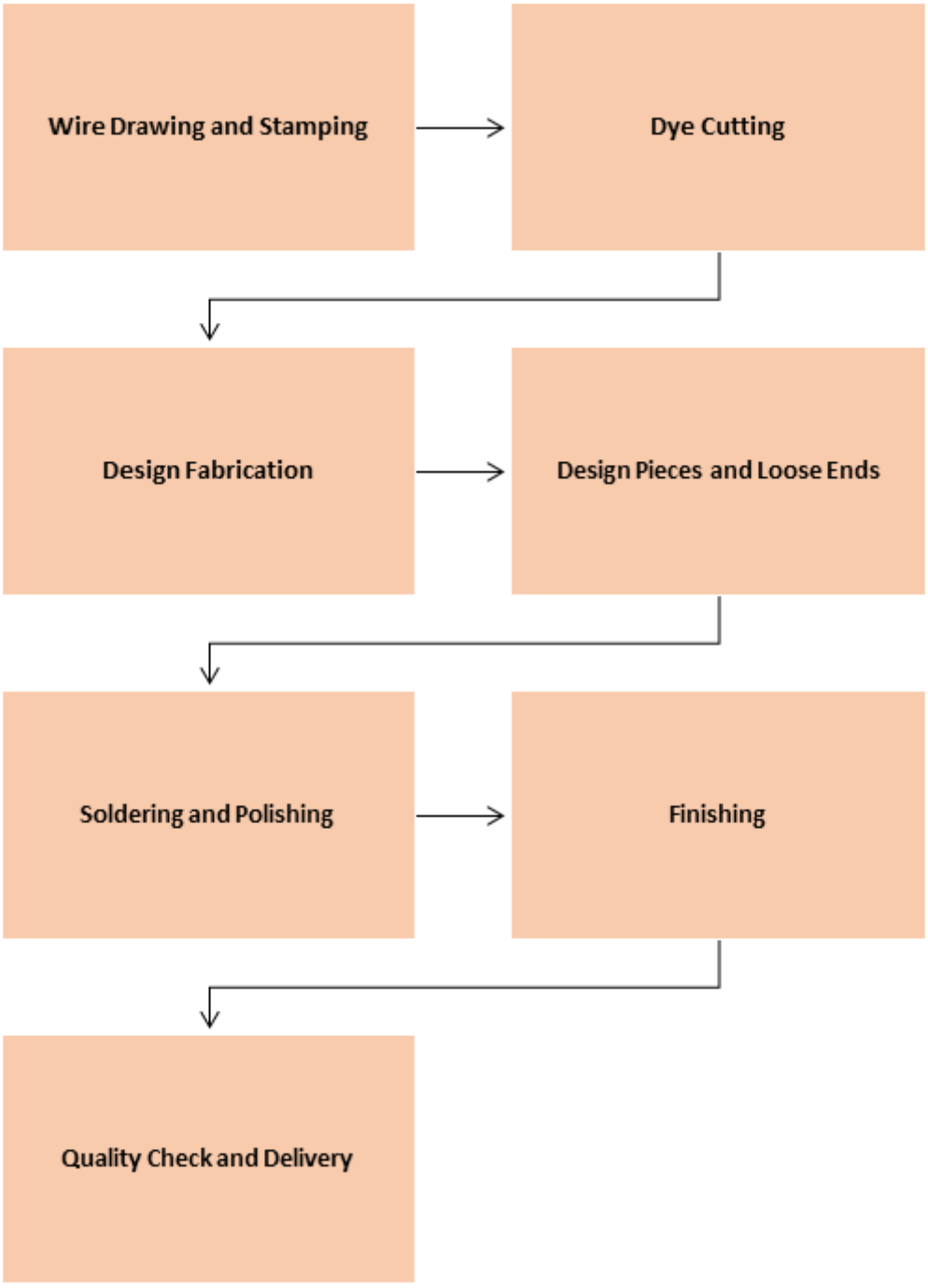

Fig 2.1.1.2

2.1.1 Jewellery Making Process – Part 3 – Casted Jewellery

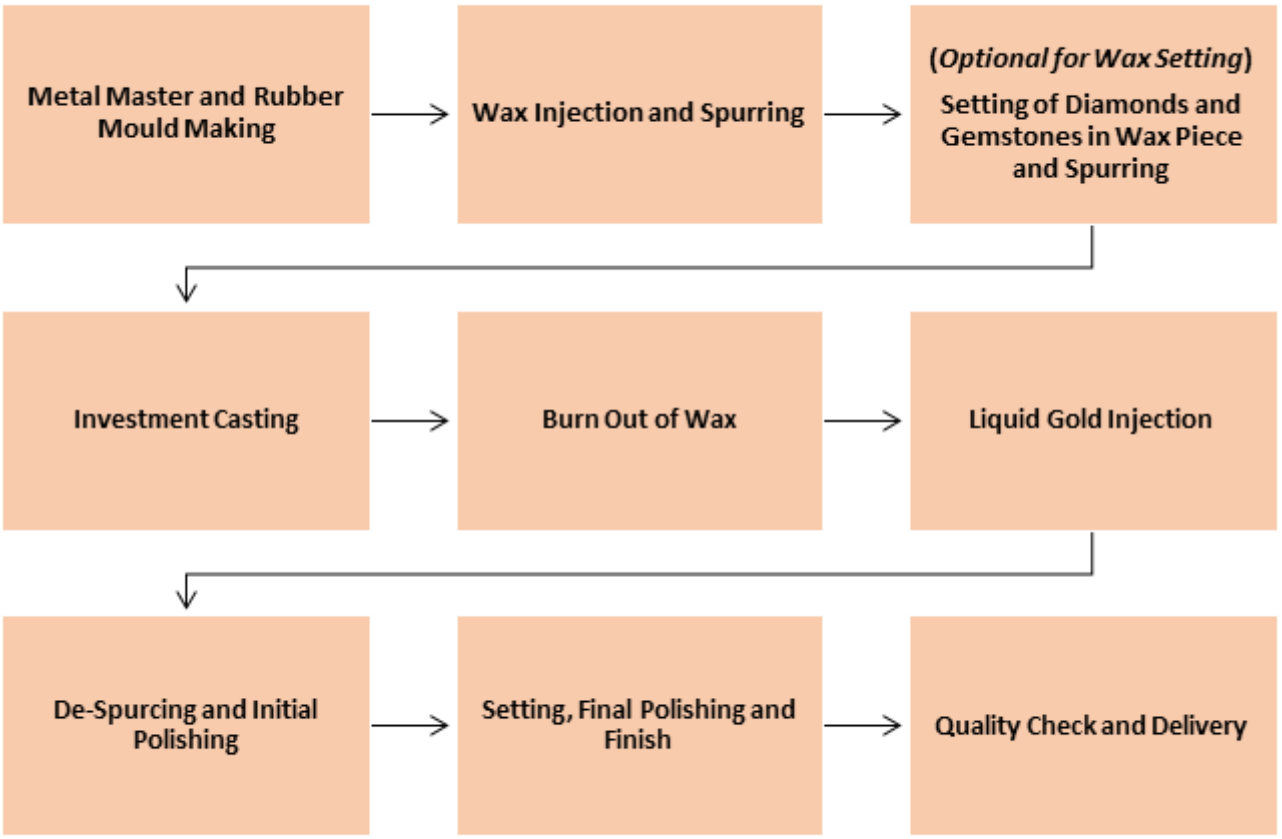

Fig 2.1.1.3

2.1.1 Jewellery Making Process – Part 4 – Machine Made Chains

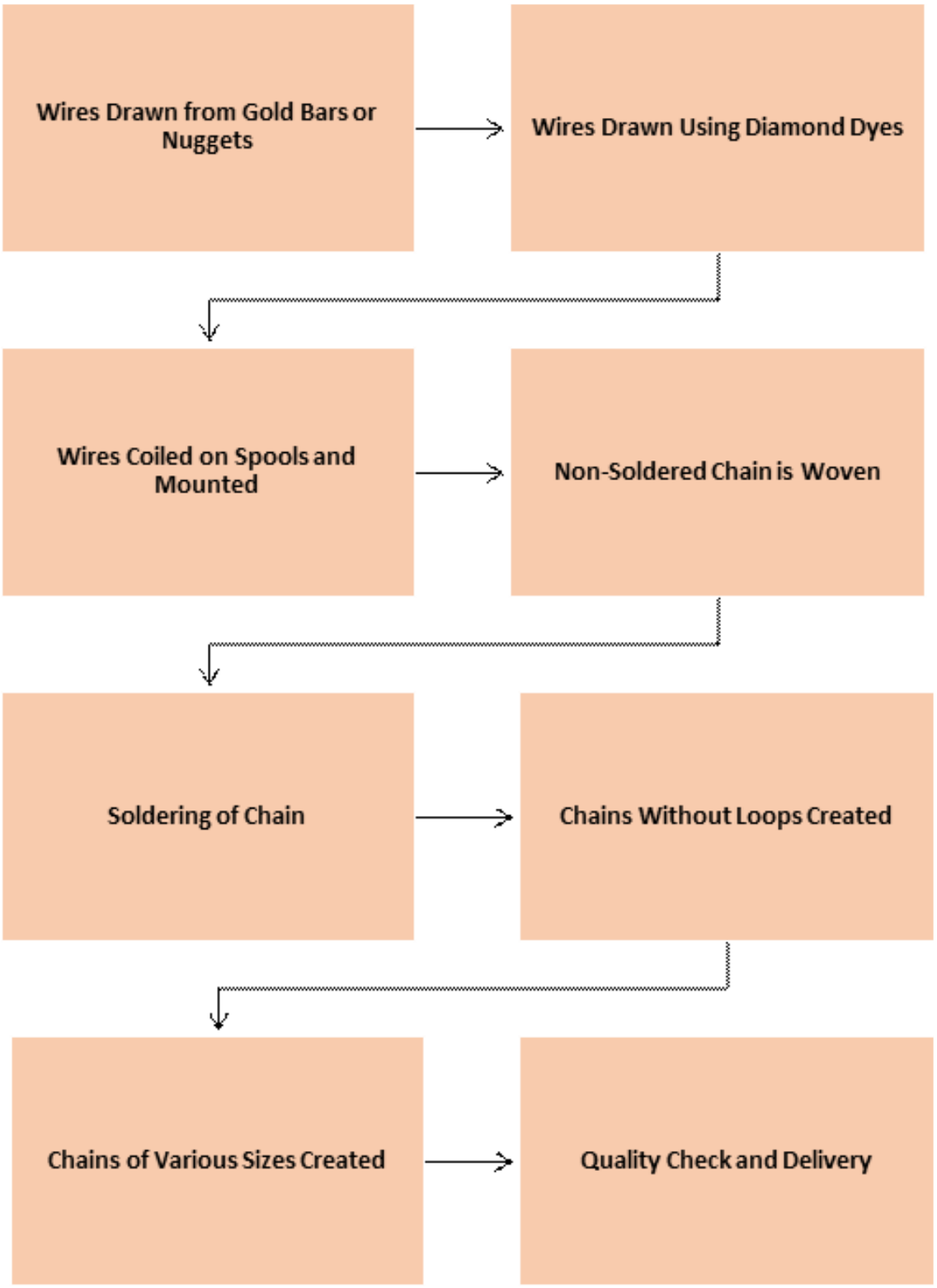

Fig 2.1.1.4

Tips

1. In the jewellery making process, there are 3 outcomes: machine made chains, handmade jewellery and casted jewellery.
2. The frame maker has a role to play in all 3 processes.
3. Without the frame maker, the jewellery will not be completed.

Scan the QR Code to watch the related video or click on link

Click Here
Wax Setting

Click Here
Wax Injection

Click Here
Tree Making

Click Here
Mould Making

Unit 2.2: Job Work of a Goldsmith - Frame Maker

Unit Objective

At the end of this unit, you will be able to:

1. Understand the job work of a frame maker including the tools and equipment that are used.

2.2.1 Introduction of Frame Maker

1. A Frame Maker is also known as “Artisan” or “Bench Worker”.
2. In India, a frame maker or goldsmith is also called as “Karigar”.
3. The frame maker works with machines and hand tools to create the base jewellery frame from gold as per design requirements.
4. The frame maker also creates the base of the jewellery for further working with components, gemstones, enamelling and plating.
5. The frame maker is also responsible for delivering quality gold jewellery with minimum gold or stone loss.
6. In the International market, frame making is also termed as “Jewellery Fabrication”.

Fig 2.2.1.1 Job of frame maker

2.2.2 Know the Machines and Tools Used in Frame Making of Jewellery

Fig 2.2.2.1 Frame making and soldering tools, machines and equipment

2.2.3 Preparing the Workplace

1. The workplace of a frame maker should be properly arranged, as well as neat and clean.
2. All the required tools to be used by the frame maker should be available and properly arranged on his/ her workplace.
3. Along with tools, safety measures like optivisor/ eye goggles, gloves, hair caps, face mask should also be kept.
4. All the required things for better working need to be in place so that there is less time wasting and more effective job can be done.

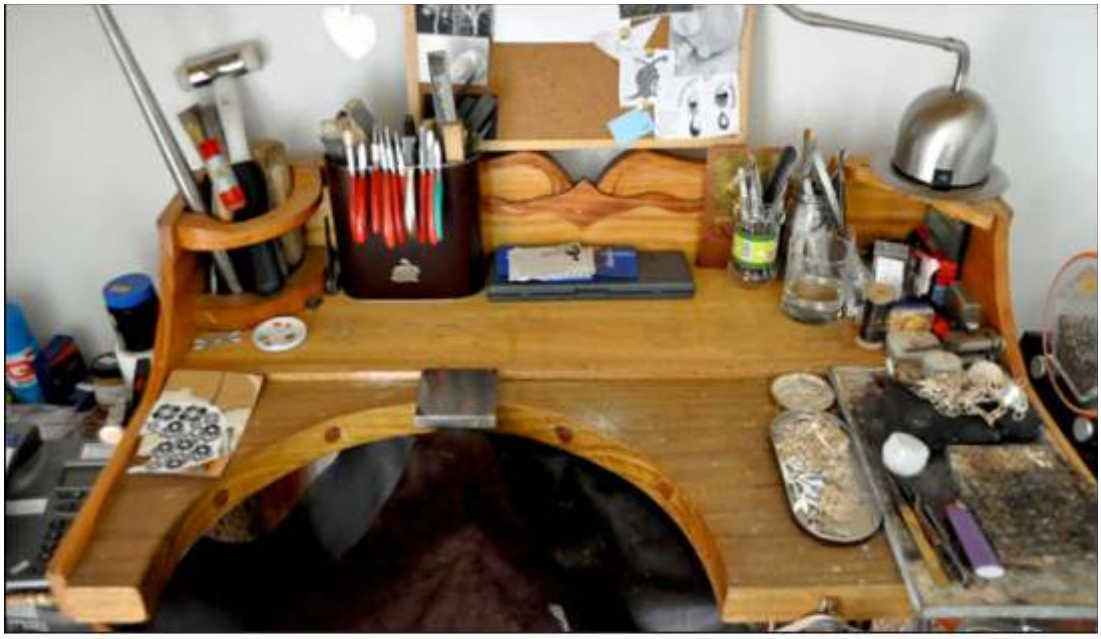

Fig 2.2.3.1 Preparing the workplace

2.2.3 Preparing the Workplace

Dust Collector

- Metal dust spreads in the air during the process of grinding, polishing, buffing and filing.
- To avoid inhaling them, which can be harmful, wear a mask that covers your nose and mouth.
- The simplest dust catching device is the dust collector.
- They are much more efficient in gathering dust as they work on suction fans which draw away dust, lint abrasives and metal particles through small holes behind the harbour shaft.
- Their effectiveness depends on the power of the fan.
- The dust is drawn through a flexible, large diameter hole which is attached to a dust collector or drum.

Fig 2.2.3.2 Preparing the workplace – Dust collector

Tips

1. Frame maker is a person who creates the base frame of jewellery which is handmade or casted.
2. The frame maker works with numerous hand tools and machines to ensure the frame outline is well developed as per design requirements.

Notes

Unit 2.3: Introduction to Metals

Unit Objectives

At the end of this unit, you will be able to:

1. Understand the properties of metals.
2. Understand the physical and chemical properties of gold.

2.3.1 Metal Properties

Physical Properties of Metals

- All metals show certain characteristic properties such as ductility, lustre, and malleability.
- Metals differ in terms of ductility and malleability with gold being the most ductile while lead and tin being least ductile and malleable.
- Metals differ widely in:
    - **Hardness**
        - Ability of a material to resist plastic deformation, usually by dent on metal, permanent change in shape, meaning that a metal that does not lose its shape or get scratched when worked on.
    - **Ductility**
        - Ability of being drawn into wire, meaning gold can be made into wires without breaking.
    - **Malleability**
        - A substance which can be beaten to make sheets, meaning gold can be beaten to a thin sheet without it breaking or tearing.
    - **Tensile Strength**
        - Ability of a material to resist tearing, meaning the metal can be beaten or drawn into a wire or sheet without tearing.
    - **Density**
        - Density is the mass of an object per unit of volume, meaning platinum is a heavier metal than silver, hence it has a higher density.
    - **Melting Point**
        - The temperature at which it changes state from solid to liquid at atmospheric pressure.

Fig 2.3.1.1 Metal properties

2.3.2 Physical Properties of Gold

- It is a soft, yellow, corrosion-resistant element, the most malleable and ductile metal.
- A good thermal and electrical conductor, gold is generally alloyed to increase its strength.
- 28 grams of gold can be beaten up to a 300 square feet sheet, due to its malleability.

- **Physical Properties of Gold** are as follows:
  - **Colour**:
    - Bright Yellow
  - **Lustre**:
    - It has a shine or glow.
  - **Ductility**:
    - It can be beaten into extremely thin sheets of gold leaf, most ductile amongst noble metals.
  - **Malleability**:
    - Capable of being shaped or bent, most malleable amongst noble metals.
  - **Conductivity**:
    - Good electrical conductor
  - **Solubility**:
    - Soluble (ability to be dissolved)
  - **Hardness**:
    - Relatively soft metal, gold is usually hardened by alloying with copper, silver, or other metals.
  - **Density**:
    - It is a dense metal.
  - **Melting point**:
    - Melts at 1065°C.
  - **Boiling point**:
    - Boils at 2000 °C

Fig 2.3.2.1 Gold sheet – Malleability property of gold

2.3.3 Chemical Properties of Gold

- Chemical properties determine how gold will react with other substances or change from one substance to another.
- Chemical properties are only observable during a chemical reaction.
- Reactions to substances such as alloys can be noticed if burning, rusting, heating, exploding, tarnishing etc. are observed on the jewellery piece.

- **Chemical Properties of Gold** are as follows.
    - **Chemical Formula:**
        - Au
    - **Activity:**
        - Pure gold is chemically inactive, it's extremely resistant to chemical action.
    - **Compounds:**
        - Auric chloride and chloro-auric acid are its most common compounds.
    - **Reactivity with acids:**
        - Aqua Regia, a mixture of nitric and hydrochloric acids, has the ability to dissolve gold.
    - **Reactivity with Non-metals:**
        - Gold does not react with the Non-metals, except for halogens, with which it forms halides.
    - **Alloys:**
        - Silver, platinum alloys, copper most commonly used.

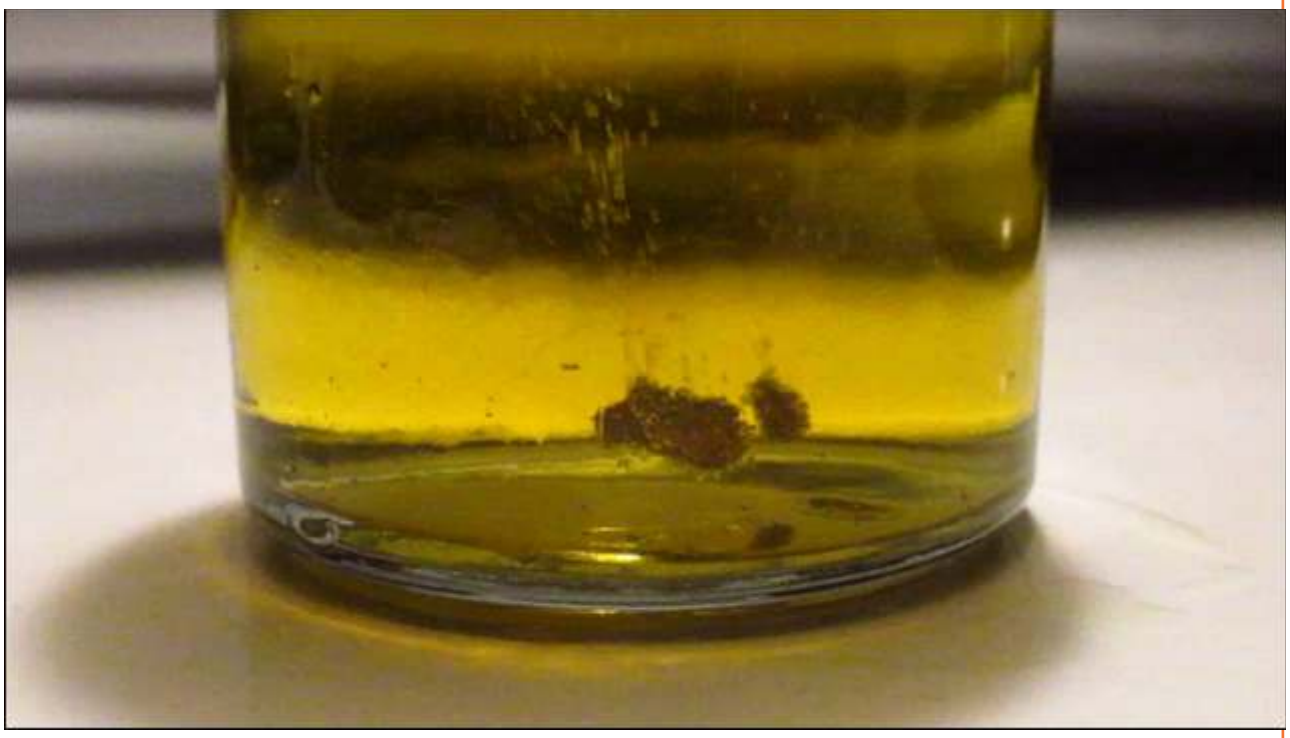

Fig 2.3.3.1 Gold dissolving in aqua regia

2.3.4 Silver

- Silver usually occurs in massive form as nuggets or grains, although it may also be found in wiry tree like aggregates.
- Silver is used in many types of Indian jewellery and is not an expensive metal compared to gold or platinum.

- **Silver Properties:**
    - When newly mined or recently polished, silver has a bright, silver white colour and metallic lustre making it ideal for jewellery.
    - Silver is the lightest in terms of density amongst the three precious metals.
    - Silver is easily fashioned into jewellery as it is medium heavy, ductile and malleable.
    - Melting point of silver is 960°C and specific gravity is 10.56.
    - On exposure to oxygen or sulphurous fumes in air, a black layer of silver oxide quickly forms on the silver surface, thus tarnishing it.
    - Silver in its pure or native form is too soft to be used in jewellery thus it is often alloyed with other metals or given a covering of gold.
    - To increase its hardness, silver is often alloyed with copper, zinc and cadmium.

Fig 2.3.4.1 Fine silver 999 purity

2.3.5 Platinum

- Platinum is a dense, expensive, and relatively rare, silvery-white metal.
- Unlike many elements, platinum can be found in its pure metallic form in nuggets, alloyed with other platinum metals, or as part of a mineral ore.

- **Platinum Properties:**
    - Heavy, soft, malleable (easy to work—only silver and gold are easier to shape), and ductile (easy to draw into wires).
    - Density: 21.5 g/cc
    - Melting point: 1768.3°C
    - Boiling point: 3825°C
    - Non-reactive to chemicals.
    - Does not react with oxygen in air so does not rust or tarnish.
    - Reasonably resistant to attack from acids.

Fig 2.3.5.1 Platinum in rough form

Tips

1. Every metal has a different physical and chemical property.
2. Before working with noble metals such as gold, silver and platinum (called noble metals as they resist tarnishing over the years in their purest forms), make sure that you know the alloys which you will use for soldering as many of them may react with the metal.

Scan the QR Code to watch the related video or click on link

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Introduction to Precious metal

Unit 2.4: Metal Alloys

Unit Objectives

At the end of this unit, you will be able to:

1. Understand what alloys are, uses and annealing of alloyed metal.

2.4.1 What is an Alloy?

1. Pure gold, also known as fine gold, is a soft gold often available in bullion form.
2. Alloy is a metal made by combining two or more metallic elements, especially to give greater strength or resistance to corrosion.
3. Gold alloy is gold mixed with other metals for making it harder and more durable, and this is used in jewellery.
4. The amount of gold in the mix determines the karat number, for example 18 karat gold contains only 18 parts of gold out of 24 parts.
5. The process of alloying that is mixing other metals with pure 24 karat gold makes gold more durable as well as aids in changing its colour.
6. Technically there is no such thing as 'White Gold.'
7. The colour of Gold can be made light by combining it with lighter metals however, most jewellery pieces are plated with Rhodium; a member of the platinum family and the whitest precious metal after silver.

Fig 2.4.1.1 Alloys, Mixing of alloys mixing and alloyed metal

2.4.2 Annealing and Cooling Alloyed Metal

- The further one reduces the metal thickness the harder it gets and less malleable it becomes.
- If not annealed properly, the metal will break or become too hard to work with.
- Before annealing gold (or silver), coat the piece with boric acid and alcohol.
- This flux coating will reduce oxidation and help minimize clean-up.
- The secret for having accurate annealing is to heat the metal up to a suitable temperature cause annealing.
- Many times, either the metal was not taken to a high enough temperature or the temperature was not held long enough.
- The accurate annealing can be done in a pre-heated furnace for approximately 15 minutes at the below suggested temperatures.
- For ideal malleability, karat gold alloys will require cooling in one of several different methods:
    - Reduce from red heat
    - Air cool
    - Reduce from black heat
    - Black heat is a description used for when the work part is no longer glowing red (840°F – 930°F)
    - Cool by any method
- There are several choices for cooling the medium.
- All 10K alloys and 14K white gold should be cooled in water, water plus de-saturated alcohol or a pickle solution based on sodium bisulphate.
- Cooling low karat and 14K white alloys into dilute acid solutions may result in stress corrosion.
- All other alloys may be cooled with the above or dilute acid solutions such as 10% sulfuric acid or 5% nitric acid.

Metal – Alloy	Annealing Temperature
10k Yellow, Green	648°C
10k White, Red	704°C
14k Yellow, Green	704°C
14k White, Red	760°C
18k Yellow	704°C
18k White	760°C

Fig 2.4.2.1 Cooling or quenching of metal

2.4.3 Alloyed Gold Types

1. White Gold

- Other than copper, all other gold alloying metals will whiten the colour hence it is possible to make white karat gold also.
- Additions of any white metal to gold could potentially bleach it's colour.
- Normally, nickel and platinum are strong 'bleachers' of gold; silver and zinc are moderate bleachers and all others are moderate to weak in effect.
- This has given rise to 2 basic classes of white gold - the Nickel whites and the Platinum white.
- At the 9 karat (37.5% gold) level, a gold-silver alloy is quite white, ductile although soft and is used for jewellery purposes.
- White gold is available up to 21 karat.

Fig 2.4.3.1 White gold vs other gold colour

2.4.3 Alloyed Gold Types

2. Nickel White Gold

- Nickel alloying additions form strong and hard white gold up to 18 karat.
- They are difficult to work and suffer from so-called 'fire cracking'.
- This copper addition affects colour, and white gold alloys are not a good white colour - more a slight yellow/ brown tint, particularly if nickel content is also low.
- As a result, white gold jewellery is normally electroplated with rhodium (a platinum metal) which is tarnish resistant and gives a nice white colour.
- Unfortunately, many people are allergic to nickel in when it comes in contact with the skin and this can give rise to skin rash or irritation.
- In Europe, nickel white gold is being replaced by palladium white gold
- The USA is taking a more relaxed approach, requiring jewellery to be labelled as nickel-containing, and much jewellery in the West is now marketed as 'non-allergenic' or 'nickel-free'.

Fig 2.4.3.2 White gold vs other gold colour

2.4.3 Alloyed Gold Types

3. Palladium White Gold

- Additions of about 10 -12% palladium to gold gives a good white colour.
- However, palladium is an expensive metal.
- Jewellery in palladium white gold will be more expensive compared to identical nickel whites for 2 reasons: firstly, due to the high cost factor of the palladium and secondly, due to the effect of density.
- Palladium white gold is much denser making the jewellery heavier as it contains more gold.
- It is also more difficult to process as the melting temperatures are substantially higher.
- Many commercial palladium white gold only contain about 6-8% palladium plus silver, zinc and copper.
- These may also have a lesser white colour and may require rhodium plating.
- Palladium white gold will normally be softer and more ductile compared to nickel whites hence it will not wear off as well.
- They are available in all karatages up to 21 karat.
- It is not possible to have a 22 karat white gold.

Fig 2.4.3.3 Palladium white gold vs standard white gold and platinum

2.4.3 Alloyed Gold Types

Metal (Symbol)	Function	Melting Point (°C)	Color
Palladium (Pd)	Reduces corrosion and tarnish Improves mechanical properties	1554	White
Platinum (Pt)	Raises melting temperature Improves hardness and elasticity	1772	Blue-white
Copper (Cu)	Hardens and strengthens the alloy Allows heat-treatment properties	1083.4	Reddish
Silver (Ag)	Hardens gold alloy Counters copper's redness	961.9	Silver
Zinc (Zn)	Acts as oxygen scavenger during casting process	419.6	Blue-white
Indium (In)	Used as a replacement for zinc	156.6	Gray-white
Nickel (Ni)	Seldom used. Increases hardness and strength	1453	White
Tin (Sn)	Acts with palladium and platinum to harden the alloy	232	White
Gallium (Ga)	Forms oxides for bonding ceramic to metal	29.8	Gray-white
Iridium (Ir)	Improves yield strength by creating smaller grains	2410	Silver-white
Ruthenium (Ru)	Improves yield strength by creating smaller grains	2310	White

KARAT	GOLD	PALLADIUM	SILVER	COPPER	ZINC	NICKEL
18K	75	20	5			
	75	15	10			
	75	10	15			
	75	10	10.5	3.5	0.1	0.9
	75	6.4	9.9	5.1	3.5	1.1
	75	15		3.0		7.0
14K	58.3	20	6	3	1	
	58.5	5	32.5	20.5	1.4	
10K	37.5		52	4.9	4.2	1.4

Fig 2.4.3.4 Gold alloy charts with colours

2.4.4 How to Make Gold Alloy

1. Weigh the metals carefully in the proportions as per the listing in the gold alloying tables (the larger the amount prepared, the more accurate the karat the resulting gold alloy will be).
2. Soak all the metals to make ensure they are all carefully cleaned.
3. Mix the metals, except the gold, in a crucible coated with borax.
4. Melt the metals with a reducing flame (starting with the highest melting point of metal).
5. Do not bring the metal to a boil.
6. Stir constantly with a carbon stirring rod.
7. Keep the metal molten and add the fine gold.
8. Pour the molten gold alloy into an ingot mould or dent made in a charcoal block.
9. If the resulting gold alloy is brittle when later worked, this will indicate impurities.
10. Streaks of colour will indicate that the alloy was not mixed properly and may have to be re-melted and remixed with a carbon stirring rod.

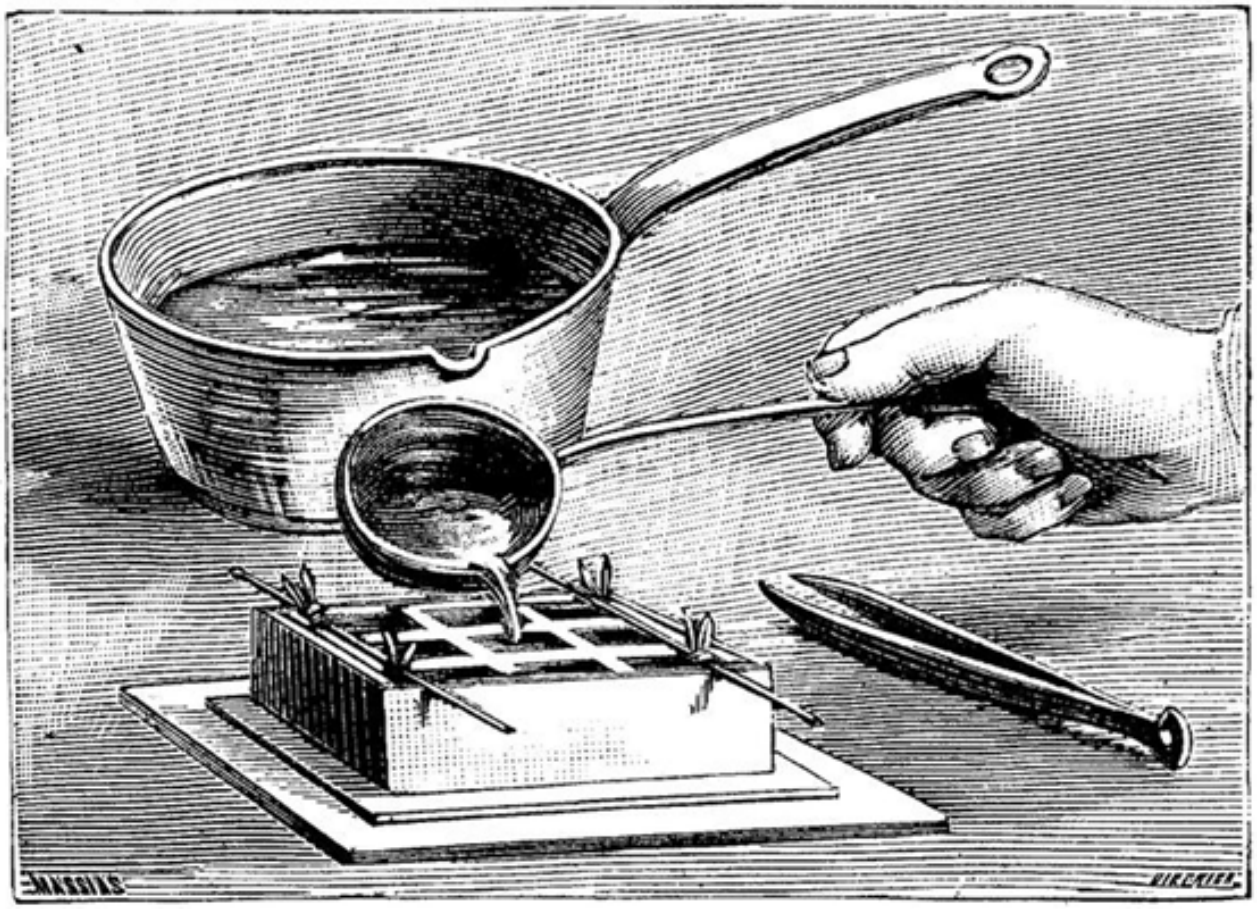

Fig 2.4.4.1 Making gold alloy

2.4.5 How to Increase or Decrease Gold Karat

A. Formula for Raising Karat

$$\frac{((K1 - K2) \times W)}{(24 - K1)} = \text{Amount of pure gold required to be added}$$

1. Weigh the gold you want to increase the karat for (W).
2. Subtract the starting karat (K2) from the desired karat (K1).
3. Multiply the result of step 2 by the starting weight, W.
4. Subtract the desired karat (K1) from 24 (for 24 karat).
5. Divide the result of step 3 by the result of step 4.
6. You now have the amount of 24K gold you need to add to your original karat gold to increase it.
7. For example:

· How much 24K gold do you need to add to 7 grams of 10K gold to increase its karatage to 14K?

· $\frac{((14 - 10) \times 7)}{(24 - 14)}$ = 2.8 grams of 24k

B. Formula for Lowering Karat

$$\frac{((W \times K1) - (W \times K2))}{K2} = \text{Amount of alloy you need to add to to lower the karatage of gold}$$

1. Weigh the gold whose karatage needs to be lowered (W).
2. Multiply this weight, W by its karat (K1).
3. Multiply the starting weight, W by the desired karat (K2).
4. Subtract the result of step 3 from the result of step 2.
5. Divide the result of step 4 by the desired karat (K2).
6. You now know how much alloy needs to be added to the gold to lower its karat.
7. For example:

· If you need to lower the karatage of a 6 grams 18k gold piece to 10k, how much alloy do you need to add?

· $\frac{((6 \times 18) - (6 \times 10))}{10}$ = 4.8 grams of alloy

2.4.6 Silver Alloy

1. Sterling silver contains 92.5% silver, and the rest is copper and zinc.
2. Britannica silver contains 95.8% silver, and the rest is copper and zinc.
3. Coin silver contains 90% silver and 10% copper.
4. Vermeil and German silver are some other silver alloys used in jewellery.
5. Vermeil is a combination having the inside core of pure sterling silver and the outside is a solid coating of finely crafted 14 karat gold.

Silver Purity or Fineness	Also Termed As:
999.9	Ultra Fine Silver
999	Fine Silver or Pure Silver
958	Britannia Silver
950	French 1st Standard, Mexican Silver
925	Sterling Silver
900	Coin Silver
830	Scandinavian Silver
800	German Silver, Egyptian Silver

Fig 2.4.6.1 Silver alloy

2.4.7 Platinum Alloy

1. To enhance its characteristics and durability, platinum is alloyed with copper and cobalt along with 'platinum group' metals, such as palladium, rhodium and iridium.
2. The main advantage of platinum as a metal for jewellery is its resistance to tarnish and its strength.
3. Pure platinum melts at 1769°C.
4. Ruthenium, rhodium, palladium, osmium, iridium, and platinum together make up the platinum group of metals.

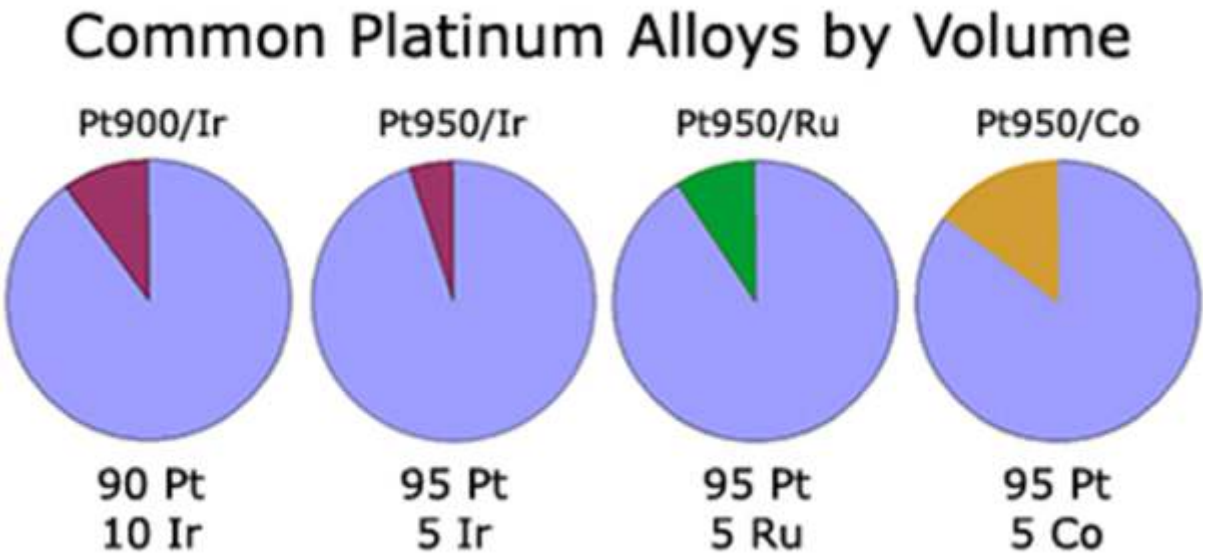

Fig 2.4.7.1 Platinum alloys

Tips

1. Always remember that pure 24 karat gold is very soft to work with and needs to be mixed with alloy to make it stronger and durable to be used in jewellery.
2. Different colours are achievable with different alloys.
3. Always cool the mixed metal before working on it as per the table above to avoid any metal defects.

Notes

Unit 2.5: Types of Jewellery

Unit Objectives

At the end of this unit, you will be able to:

1. Understand the different types of jewellery that are manufactured for Indian and International markets.

2.5.1 Types of Indian Jewellery

Antique Jewellery

- This kind of jewellery has a dull and rough look.
- Antique jewellery comes in numerous forms like meenakari, kundan work, jadau etc.

Fig 2.5.1.1 Antique Indian jewellery

2.5.1 Types of Indian Jewellery

Bead Jewellery

- During ancient times, people used to make beads out of gold, silver, copper, bone, clay, shells, ivory, wood and all other available materials.
- Beads made out of gold and silver are very popular in India.
- Beads of various sizes are used in plain gold, silver and studded jewellery.

Fig 2.5.1.2 Bead jewellery

2.5.1 Types of Indian Jewellery

Bridal Jewellery

- These days' silver and platinum jewellery are gaining popularity although gold jewellery is still the most popular metal among Indians.
- Bracelets, anklets, wedding necklaces, pendants, earrings, bangles, amulets, toe rings, finger rings, nose rings, hairpins, forehead tikka, waistband and other ornaments are part of the bridal jewellery.

Fig 2.5.1.3 Indian bridal jewellery

2.5.1 Types of Indian Jewellery

Custom or Customized Jewellery

- Custom or customized jewellery gives complete freedom of choice to the customer about the details for the jewellery.
- Like readymade jewellery, custom made jewellery too has a number of options, like gold jewellery, silver jewellery, diamond jewellery, kundan jewellery, gemstone jewellery, minakari jewellery, bead jewellery, pearl jewellery, etc.
- In readymade jewellery, the jeweller shows the customer catalogues and gives his or her personal suggestions, to help her choose what she desires.
- In custom made jewellery the customer and craftsman together decide what design has to be made.
- Often, the customer knows what he or she desires and takes this idea to the jeweller, in the form of a sketch or picture or sample.

Fig 2.5.1.4 Customized jewellery

2.5.1 Types of Indian Jewellery

Filigree Jewellery

- Filigree work involves accuracy and details, and requires great amount of patience and and a precise judgement for miniscule details.
- Pure gold or silver rods are made into extremely thin wires, by passing it through a wire drawing machine or by hammering.
- After this, the two thinnest wires are heated and twisted around a rotating wheel machine, known as “Charkha".
- They are then flattened again, to make it as a single wire.
- This wire is bent in different ways, to give it many different forms and shapes.

Fig 2.5.1.5 Filigree jewellery

2.5.1 Types of Indian Jewellery

Plain Gold Jewellery

- Some major gold jewellery of India includes necklaces, nose rings, earrings, hair clips, waistband or toe rings etc., all popular among Indian women

Fig 2.5.1.6 Plain Gold Jewellery

2.5.1 Types of Indian Jewellery

Jadau Jewellery

- In Jadau jewellery, precious and semi-precious gemstones, beads and other usable crystals are inserted in gold, which is initially slightly melted.
- When the gold becomes flexible, the stones are set on it with great precision and artistry.
- After that, the gold is cooled down slowly while the stones are fixed on it without using any glue or carvings.
- The chiterias create the initial design, while the ghaarias are in charge of making holes and engraving, Minakari or enamelling is completed by the enameller and the Karigar or goldsmith works on the kundan or the gold
- Uncut diamonds also locally termed as polki or vilandi are used as the central stone.
- Minakari or enameling which is executed at the backside of the jewellery piece is solely for beautifying purposes.
- The stone setters first set the stone in silver foil, then combine with a finishing of pure gold.

Fig 2.5.1.7 Jadau jewellery

2.5.1 Types of Indian Jewellery

Kundan Jewellery

- Traditional kundan jewellery has stones studded on one side and colourful minakari on the back side.
- The entire Kundankari technique is based on the skill of setting stones in gold, which is seldom solid.
- Holes are made for the stones to be set in them, after which the jewellery piece is engraved for the enameling process.
- The main part of the Kundan jewellery is consists of a natural resin locally known as lac.
- The natural resin or lac is inserted into the hollow areas of the jewellery piece making it noticeable through the holes cut for the gems from the front.
- The next step requires a sheet of highly refined karat gold (kundan) which covers the areas where the lac is visible, thus making it the base for the gems to be pushed into the metal.
- To increase the strength of the joints and to give it a smooth finish, more kundan is applied.

Fig 2.5.1.8 Kundan jewellery

2.5.1 Types of Indian Jewellery

Lac or Lacquer Jewellery

- The process of making lac or lacquer jewellery is complex.
- Various materials including varieties of beads, floral shaped mirrors and ornamental wire are also utilized for increasing the beauty of the jewellery piece.
- The inner part of a lac bangle consists of a thin layer of high quality lac.
- When lac is mixed with a similar material to white clay, it aids in strengthening the bangle.
- The heating, mixing, pressing, and hammering of the dried ingredients takes place repeatedly and soft dry paste is formed.
- Once the paste is heated, it is shaped further and the spreading of the lac creates the required thickness, resulting in thickening of the bangle.
- To adjust the overall thickness, a flat shaped tool is used for rolling the bangle on a flat surface.
- The shape of the bangle is achieved by controlling the lac into coloured grooves on all sides of the mold.
- The lac acquires the form of the groove into which it is pressed.
- This process, requires great precision.

Fig 2.5.1.9 Lac or Lacquer jewellery

2.5.1 Types of Indian Jewellery

Minakari or Meenakari Jewellery

- In Minakari or Meenakari jewellery also called as enameled jewellery, precious stones which are set in the jewellery are enameled with gold.
- Since it is usually done on the back side of kundan jewellery, the meenakar or enameller has to work with the Karigar or goldsmith, ghaaria or engraver, chiterias or designer and jadiya or stone setter
- The art requires high skill and its difficulty for application requires a technical mindset.
- For executing the meenakari or enameling work, the metal piece is fixed on a wooden stick having lac also known as lac stick.
- Various designs of flora, fauna and special designs are engraved on the metal.
- The engraving creates grooves or walls, which are serve the purpose of holding the colour.
- Enamel dust, of required colour, is then poured into the walls or grooves and each colour is individually placed under heat in a furnace.
- The heat of the furnace melts the colour dust to allow it to spread evenly into the walls or grooves of the design.
- To complete an entire design, each colour needs to undergo the colour melting process.
- To ensure that the colours do not get ruined due to the heat, colours having high heat resistant are initially applied and re-heated with every additional colour.
- Once the last colour has been heated, the material is cooled and polished with agate.
- The light return of the various colours depends on the depth of the walls or grooves.
- Gold and silver are the common metals used for making the base in Meenakari jewellery.
- The choice of colours varies as per the metal, for example, green, blue or yellow stick well to silver, hence they make the ideal choice of colours to be used with silver.
- In the case of gold, all colours stick to it, hence making it the preferred metal to be used in Meenakari jewellery.

Fig 2.5.1.10 Meenakari or Minakari jewellery

2.5.1 Types of Indian Jewellery

Dokra or Dhokra Jewellery

- Dokra is the art of crafts metal amongst some native tribes of eastern India.
- Basically, bronze melted with lac and resin is solidified into alloyed wires and rods, sometimes plates.
- Then the models are made with them and the designs created.
- They are handcrafted, therefore, the shapes are not precise, and the symmetries are not spitting images of each other unlike those produced in computer designing software's.
- The themes and subjects of Dokra or Dhokra jewellery are usually nature and animals.
- Dokra jewellery sets are heavy in weight especially if made with heavy metals such as copper or bronze.
- To create Dokra jewellery, the craftsman starts preparing the casting furnace and the wax image.
- The wax and the resin (dhuna) should be properly mixed with oil to make the required lump.
- The image to be made must be clearly visualized by the craftsman, until it is ready to be modelled in the prepared lump of wax.
- When the wax-image is completed it has to be cleansed with the five powdered pigments called pancha – varna.
- The links of the wax model components should be strengthened with copper rods or nails before being protected by the clay mould.
- These backings can be removed a??er the wax model melts due to the heat of furnace.
- The craftsman then pours molten metal into a hole in the mould, breaks away the clay, brings out the object and finally smoothens and polishes it.
- The most important rule, in this metal craft is created by non-metals like wax, resin and clay and the artistic work is done with them.

Fig 2.5.1.11 Dokra or Dhokra jewellery

2.5.1 Types of Indian Jewellery

Fusion Jewellery

- Fusion jewellery is a combination of modern and traditional designs.
- Fusion jewellery is designed keeping in mind the current fashion trends of the industry.

Fig 2.5.1.12 Fusion jewellery

2.5.1 Types of Indian Jewellery

Thewa Jewellery

- Thewa is an extraordinary jewellery making art involving the embossing of intricately designed sheet of gold on molten glass.
- Thewa literally means "setting".
- Thewa is the art of combining 22k Gold with multi-coloured glass.
- Each unit consists of a flat piece of transparent glass of different colours suggesting ruby (red), emerald (green) and sapphire (blue).
- The piece of glass is enclosed in a frame of gold plated silver wire.
- An extremely-thin gold sheet of gold, having the same size as the glass, is cut on which a free-hand drawing depicting flora, fauna or historical motifs is created with the aid of designing tools.
- The designed gold sheet is dipped in acid before washing it carefully with water.
- A mixture of cinnamon oil (dalchini tel) and another material known as 'Ratti' is brushed at the back, to prevent the metal from melting.
- The glass is then semi melted and the gold pattern is carefully slipped over the edge and pressed onto the surface of the glass.
- The piece is reheated, so that the glass and the gold sheet join firmly.
- To give the jewellery piece a uniform luster, a thin foil of silver is affixed on the opposite or back side.

Fig 2.5.1.13 Thewa jewellery

There are various categories of jewellery such as head ornaments, neck ornaments, hand ornaments, body ornaments, leg and feet ornaments.
Each of these are further divided as below:

Head Ornaments:
- Maang Tikka
- Sarpech (worn on turban by bridegroom)

Neck Ornaments:
- Necklace
- Choker
- Chains

Hand and Arm Ornaments:
- Bracelets
- Bangles
- Arm Band
- Ring
- Cufflinks

Body Ornaments:
- Tie Pins
- Brooch
- Waistband (Kamarpatta)

Leg and Feet Ornaments:
- Anklets (payal, jhanjhaar, paijab)
- Toe Rings

Fig 2.5.2.1 Categories of jewellery

Tips

1. A frame maker will come across different categories of jewellery while working, it is important that one remembers to follow the job sheet description for the right information
2. It is very important that a component maker should know the type of jewellery they are working on as each type of Indian jewellery requires a different look.
3. Other than the above mentioned jewellery types from India, there are some additional types of jewellery which include Navratna jewellery, Temple jewellery, Bikaneri jewellery (also called kundan), Pachchikam jewellery and silver iodized jewellery.

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Indian Heritage & Crafts in Global Market 1

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Unit 2.6: Introduction to Diamonds and Gemstones

Unit Objectives

At the end of this unit, you will be able to:

1. Understand the basics of diamonds and gemstones.

2.6.1 Introduction to Diamonds

- Diamonds are the hardest materials on earth.
- They are made of carbon (the lead of a pencil is also made of carbon).
- Diamonds are graded for 4Cs:
  - Clarity
  - Colour
  - Cut
  - Carat
- Although diamonds are the hardest, they can break if they are not handled carefully.
- If you drop a diamond jewellery, ask your supervisor to check for any damages.
- Diamonds can become milky when temperatures of 800°C and more touch them.
- If you are polishing and cleaning a wax set jewellery, check if any stones are missing or damaged.

Fig 2.6.1.1 Diamonds

2.6.1 Introduction to Diamonds

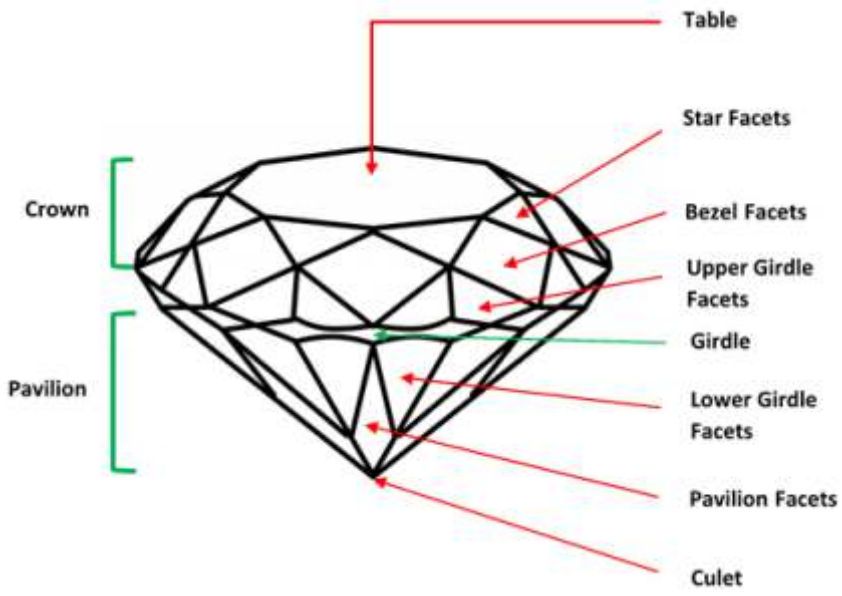


Fig 2.6.1.2 Parts of a cut diamond and gemstone

- The table is the biggest facet (face of the stone).
- The girdle is the main area where the metal setting secures the stones.
- The girdle of a diamond can break if not handled properly especially if it extremely thin in size.

4Cs of Diamonds

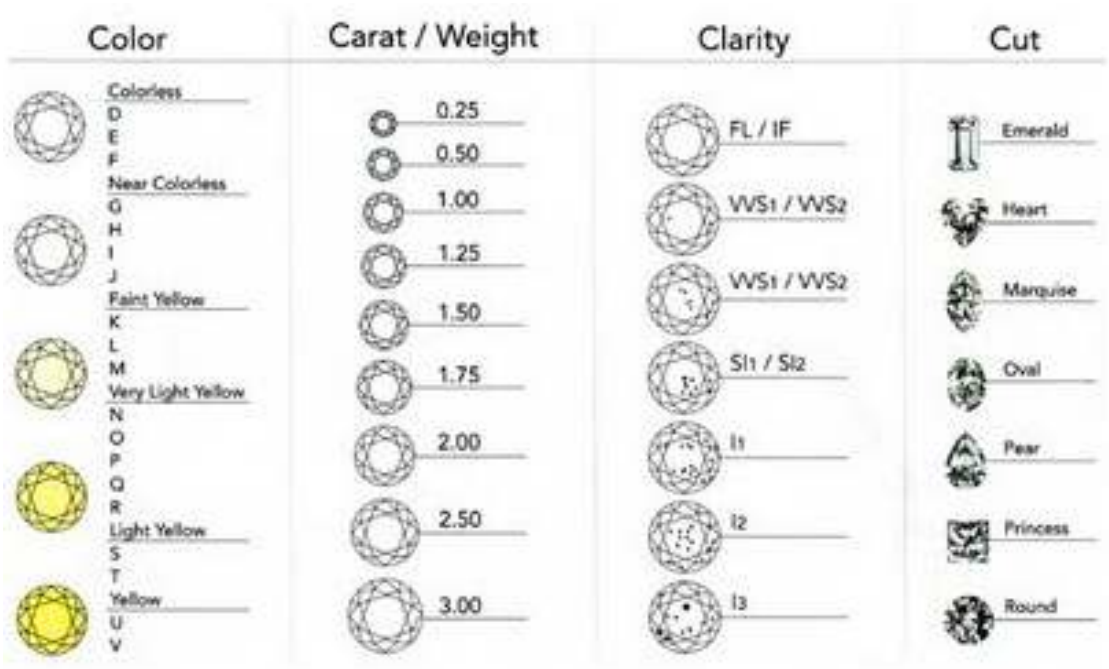


Fig 2.6.1.3 4Cs of diamond

2.6.1 Introduction to Diamonds

Cuts and Shapes for Diamonds

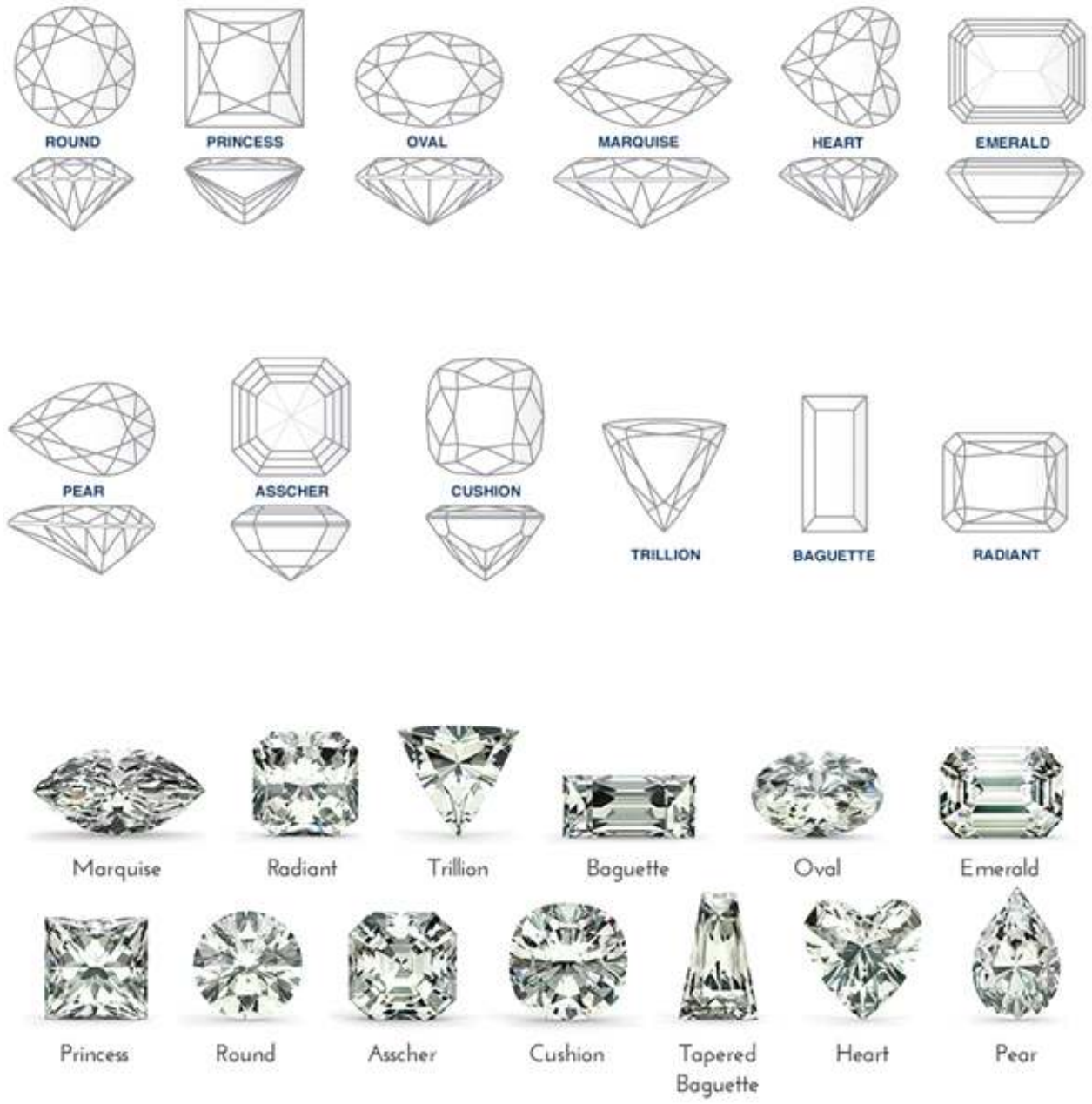


Fig 2.6.1.4 Cuts and shapes for diamonds

2.6.2 Introduction to Gemstones

- Gemstones are also called Coloured Stones.
- In the market, they are divided into Precious and Semi-Precious.
- Gemstones having hardness below 9 will get damaged.

Fig 2.6.2.1 Gemstones (Coloured stones)

2.6.2 Introduction to Gemstones

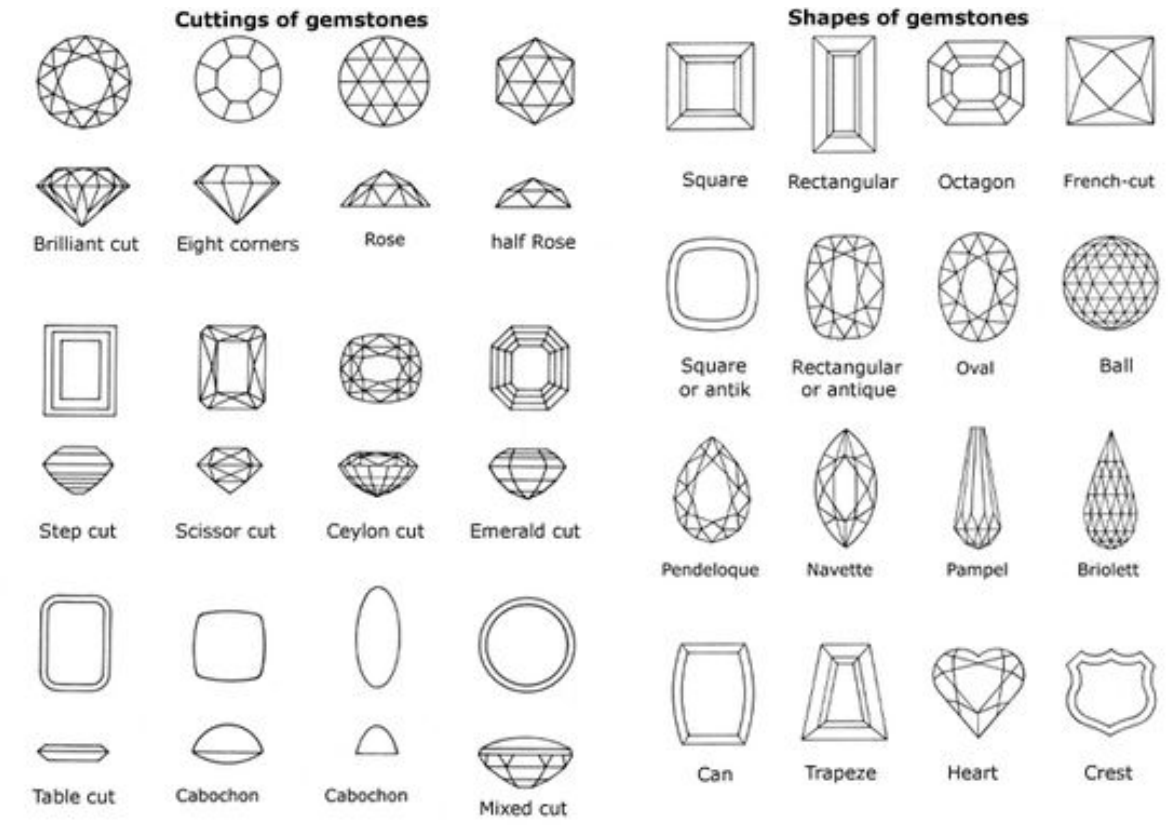


Fig 2.6.2.2 Cuts and shapes for gemstones

Tips

1. Diamonds are the hardest materials on earth.
2. Diamonds are graded for 4Cs:
   a. Clarity
   b. Colour
   c. Cut
   d. Carat
3. The table is the biggest facet (face of the stone).
4. The girdle of a diamond can break if not handled properly especially if it extremely thin in size.
5. Gemstones are also called Coloured Stones.
6. Gemstones having hardness below 9 will get damaged.
7. Check for any missing or damaged stones when assembling the frame work especially if the piece has been sent after wax setting, if you find any missing or damaged, inform your supervisor.

Scan the QR Code to watch the related video or click on link

Click Here
Common features & Diamond

Unit 2.7: Types of Settings

Unit Objectives

At the end of this unit, you will be able to:

1. Understand which are the different types of basic and advanced settings for diamonds and gemstones.

2.7.1 Types of Settings

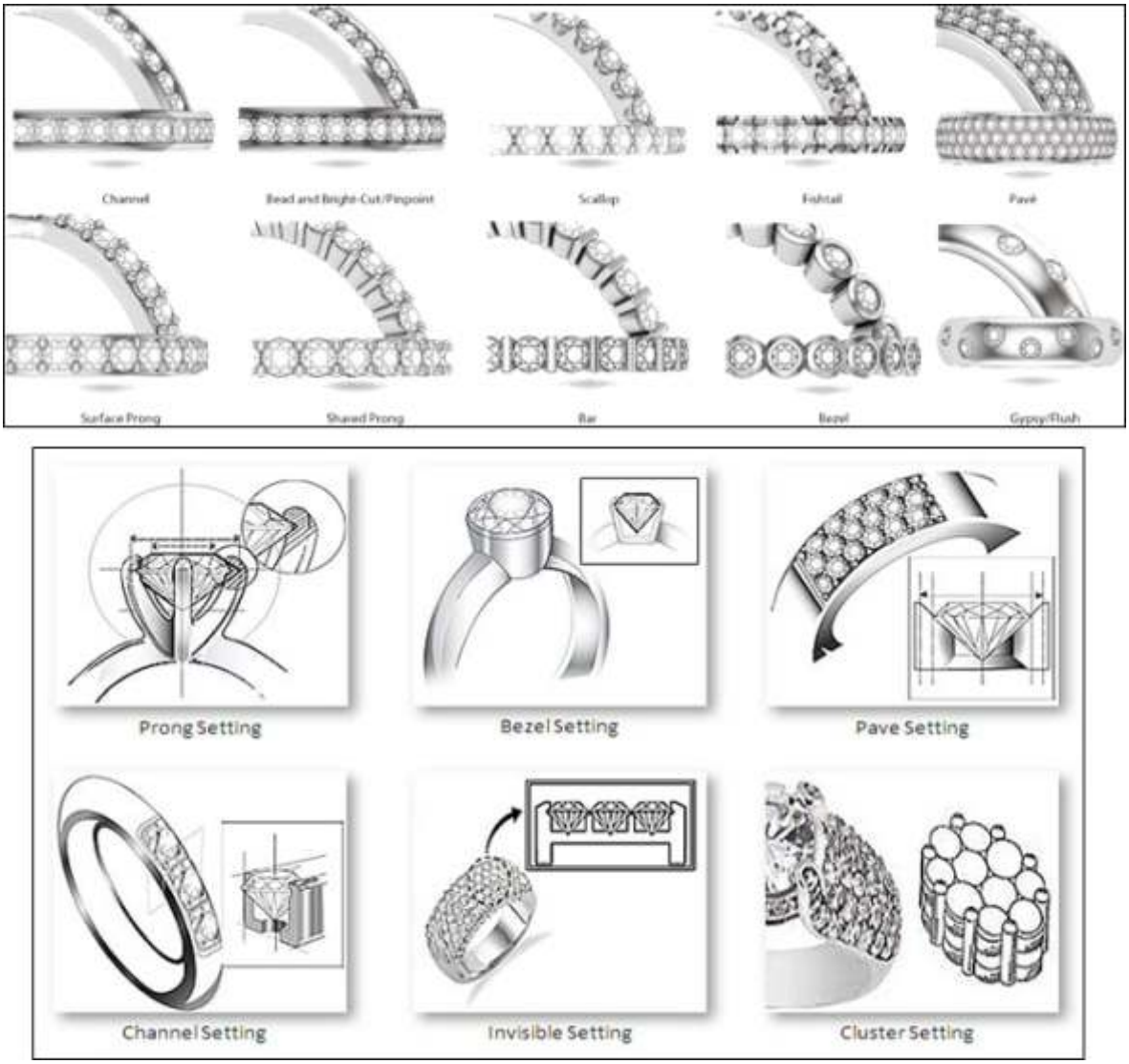


Fig 2.7.1.1 Different setting styles

2.7.1 Types of Settings

Prong Setting

- Prong or Claw setting is the most common setting.
- It is also known in India as "Nakun Setting", "Sutti Setting".
- There are some advance prong settings like Triple and Decorative Double.

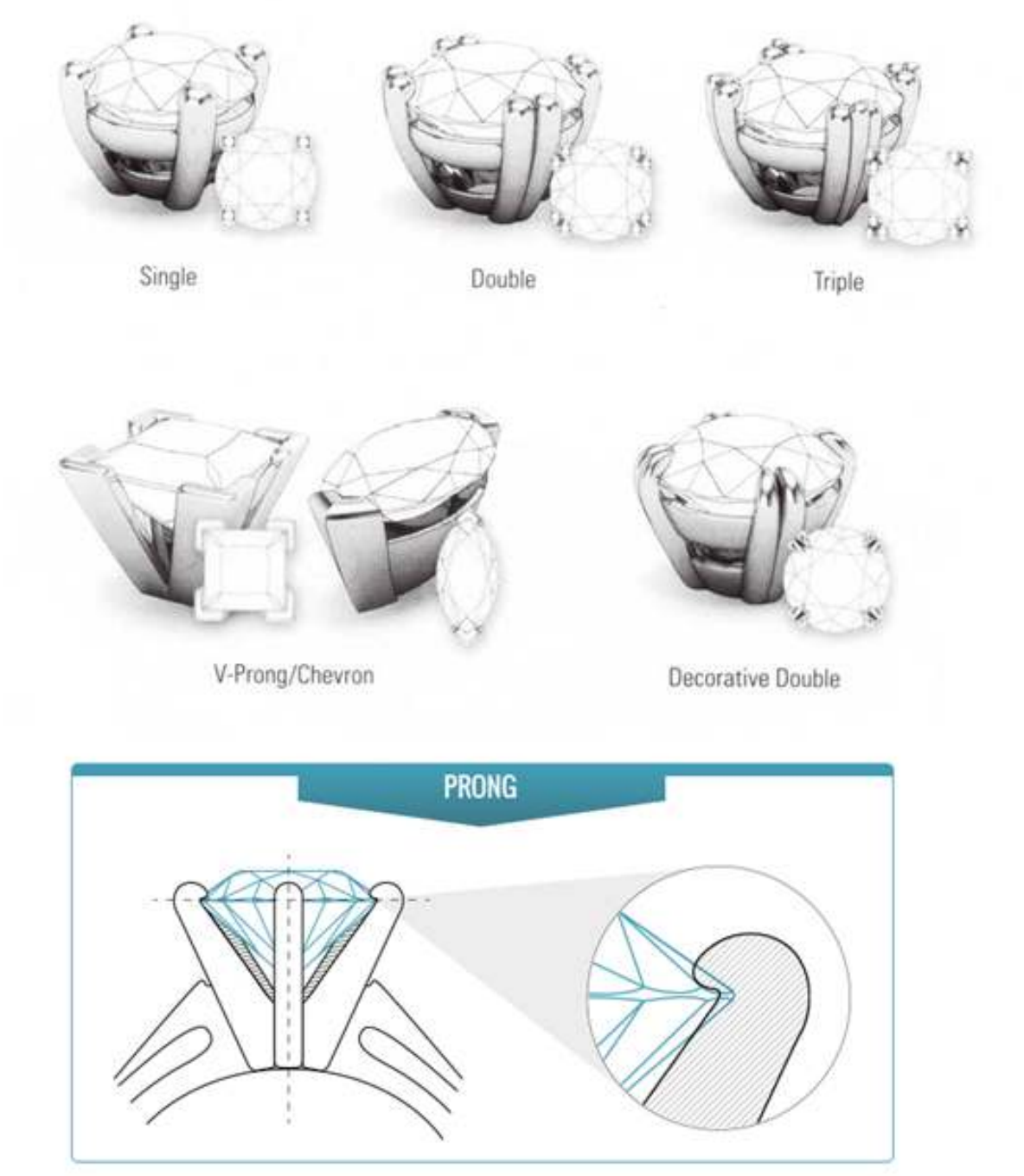


Fig 2.7.1.2 Prong setting

2.7.1 Types of Settings

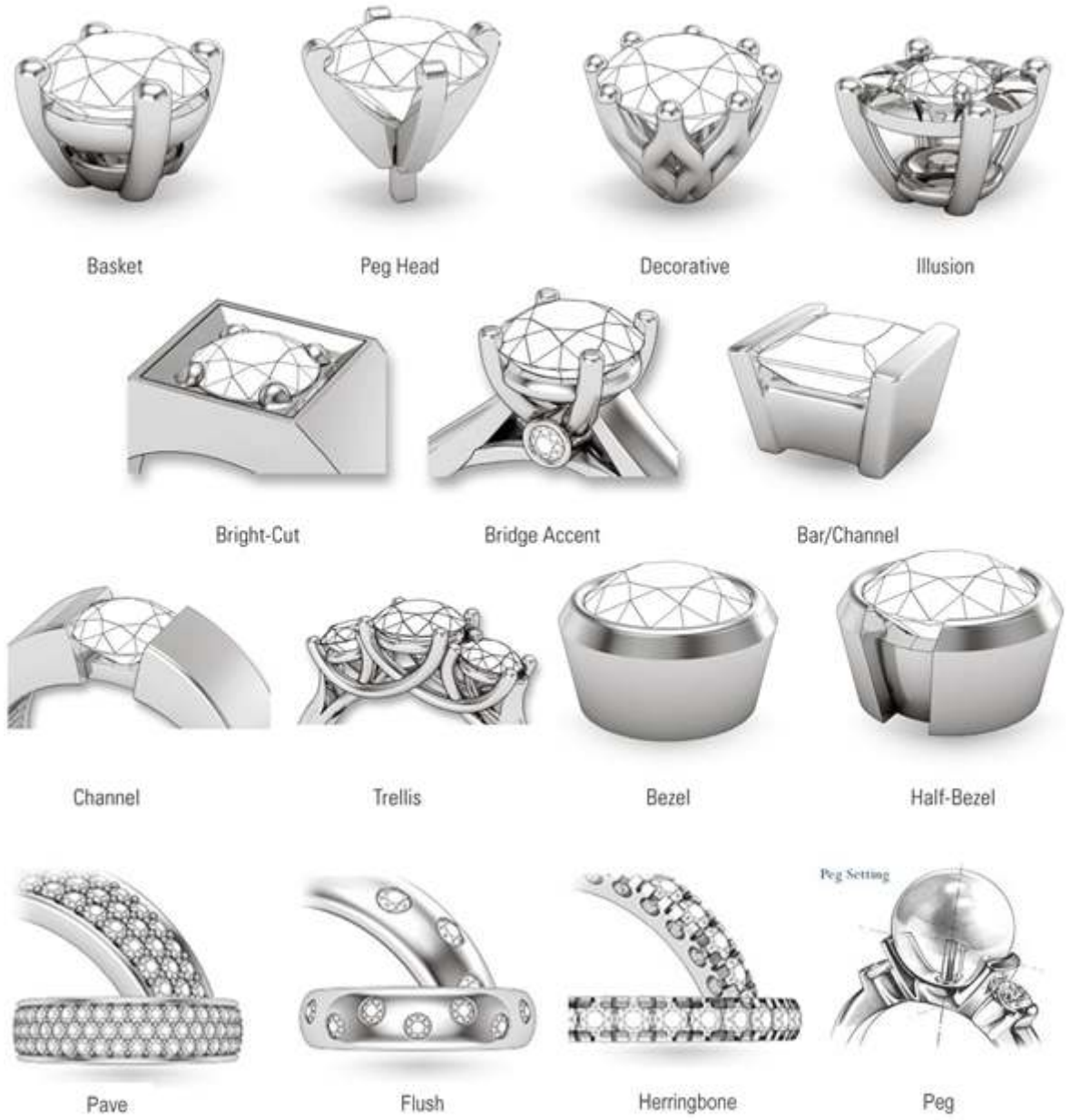


Fig 2.7.1.3 Other settings including prong setting

Tips

1. Check for any prongs missing especially for wax casted pieces, if there are missing prongs inform your supervisor.
2. Check that the stones are not tilted or missing especially if wax setting has been done.
3. Check that prongs are not bent.
4. Check for metal which will surround enamel and make sure it is not thin when filing.

Scan the QR Code to watch the related video or click on link

Click Here
Types of Gemstone Settings

Unit 2.8: Components or Findings Used in Jewellery Making

Unit Objectives

At the end of this unit, you will be able to:

1. Understand what are components or findings used in jewellery making.
2. Understand the different types of components or findings that are used in jewellery.

2.8.1 Introduction to Components or Findings

1. Jewellery is created by linking precious metal components or parts by soldering or welding them into position.
2. Components used in jewellery manufacturing range from heads, cages, or prongs needed for setting stones, to clasps, clutches, and earring posts that are important for the functioning of the jewellery piece.

Fig 2.8.1.1 Component being fitted - Hinge

2.8.2 Types of Components or Findings

Fig 2.8.2.1 Types of Components or Findings used in jewellery – 1

2.8.2 Types of Components or Findings

Fig 2.8.2.2 Types of components or findings used in jewellery – 2

Tips

1. Components or findings are usually manufactured separately in casting or die struck manufacturing methods.
2. These components or findings are available in gold, silver and platinum.
3. They are available in the different karatages or purity of gold, silver and platinum.
4. They are used for linking different frame parts together.
5. They play a very important role in jewellery manufacturing, if they are not proper then the functioning of the jewellery will get affected.
6. If a component or finding is not linked or soldered correctly, it may break and affect the jewellery piece.

Notes

Unit 2.9: Tools and Equipment Required for Frame Making

Unit Objectives

At the end of this unit, you will be able to:

1. Understand the different types of tools and equipment used to create wires, metal sheets and other tools required for frame making.

2.9.1 Rolling Mill

Rolling Mill

- This machine is used for making metal sheets and thick wires.
- The machine is used for two purposes: one part of the mill is used for sheets and the other for wires.
- It is also used to reduce the thickness of the sheet and wire.

Fig 2.9.1.1 Rolling mill

2.9.1 Rolling Mill

Working of the Rolling Mill

- There are two rollers attached on the inner side of the mill.
- The left picture indicates the roller for making metal sheets and the right picture indicates the roller for making wires.

Fig 2.9.1.2 Rolling mill - Rollers

- These are the adjusting wheels - one for sheet and other for wire.
- You can use these adjusting wheels to adjust for gaps in between the two rollers.

Fig 2.9.1.3 Rolling mill – Adjusting wheels

2.9.1 Rolling Mill

Working of the Rolling Mill

- Insert the metal sheet from one side in between both the rollers and adjust the tightening wheel on top of the machine to make the required size of metal sheet.
- The metal sheet will come out from the other side of the rolling mill.

Fig 2.9.1.4 Rolling mill – Metal sheet being adjusted for thickness

2.9.1 Rolling Mill

Working of the Rolling Mill

- We get only 22-24 gauge square wires from the rolling mill which can be used with the wire drawing machine to get different sizes and shapes of wire as per design requirement.

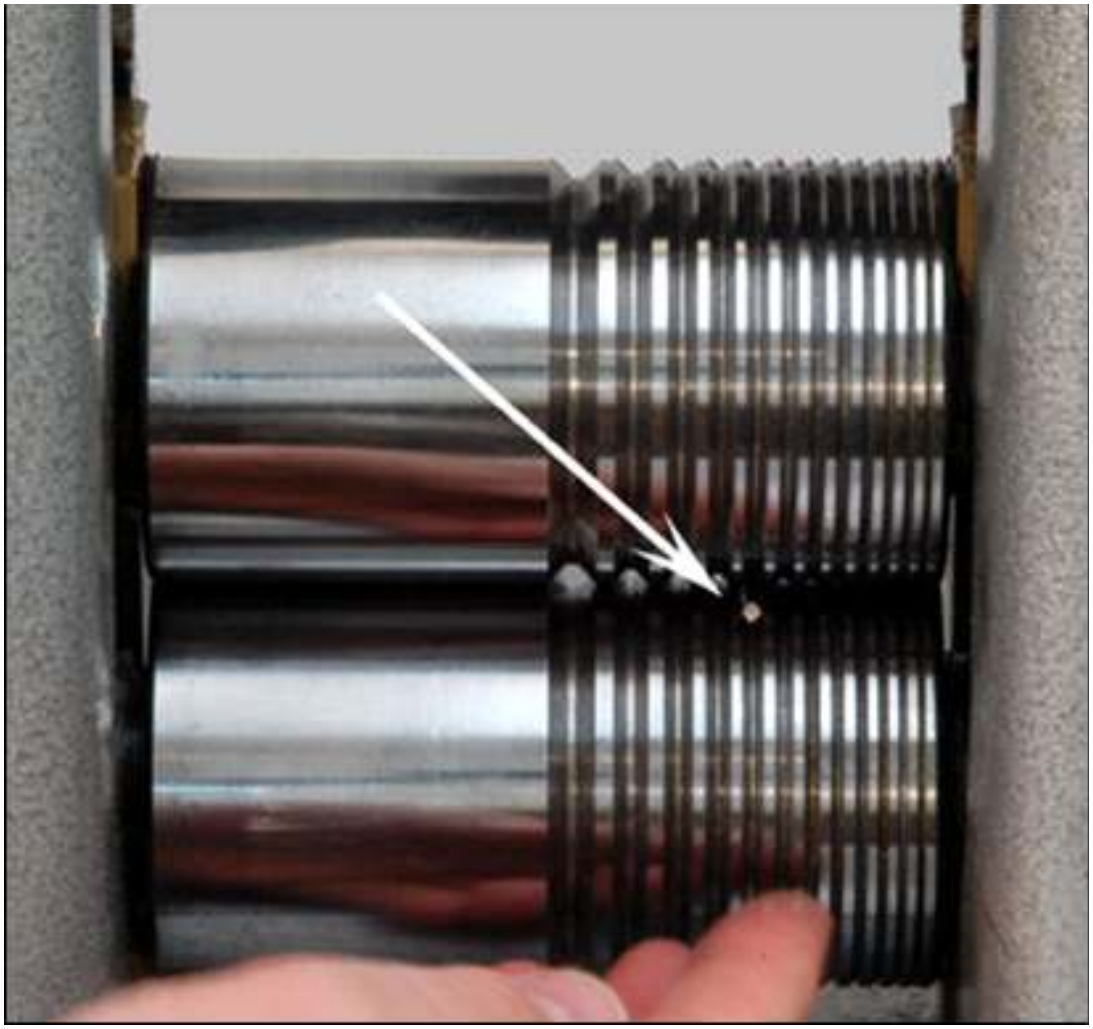


Fig 2.9.1.5 Rolling mill – 22 to 24 Gauge thickness square wire

2.9.2 Wire Drawing Machines and Tools

Working of the Wire Drawing Machines

- The wire drawing machine is used to make wire.
- To get different sizes of wire we use draw plates.
- To make the wire, first put the metal rod in the rolling mill to make a 10-gauge wire.
- Do not anneal the wire at the 1st stage, since it has already been heated before.

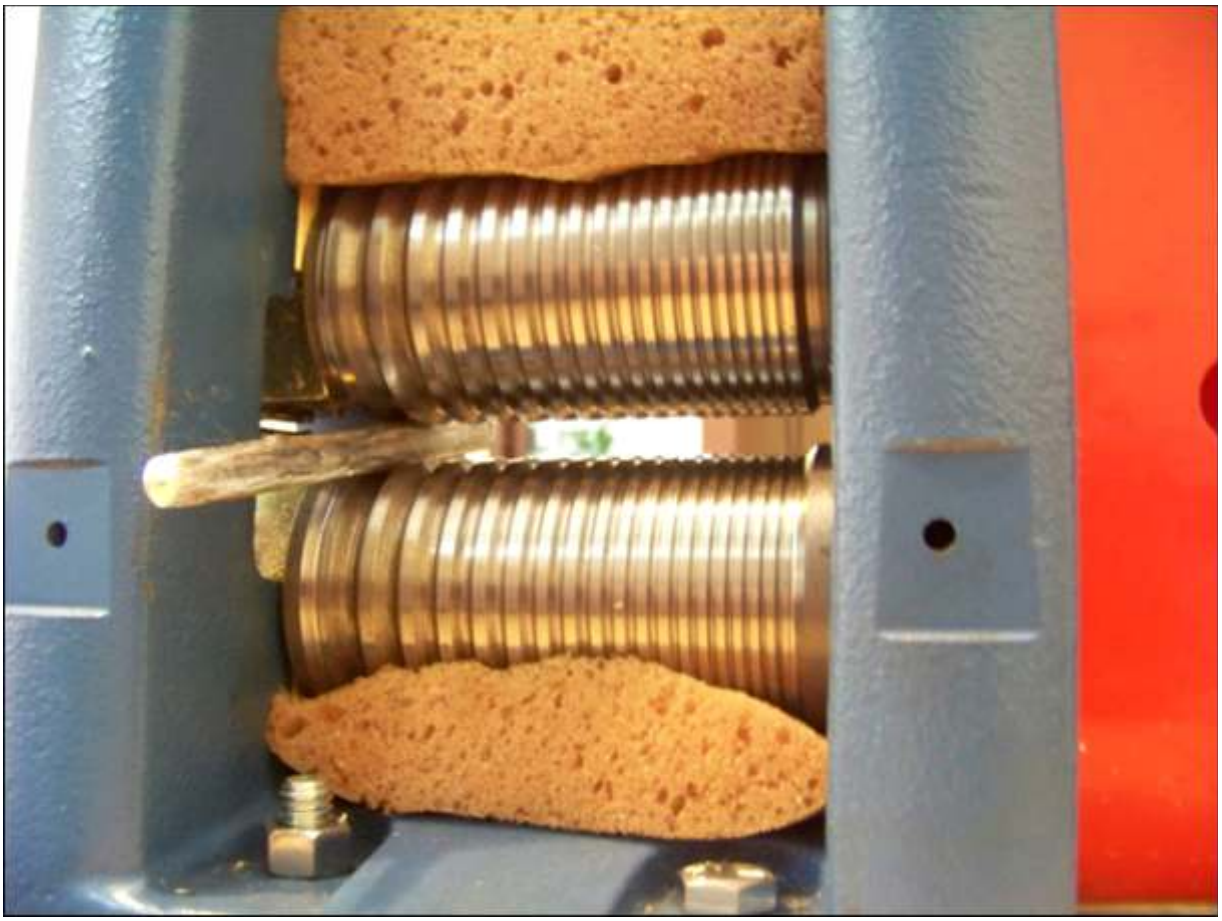


Fig 2.9.2.1 Wire drawing – Putting rod in rolling mill

2.9.2 Wire Drawing Machines and Tools

Working of the Wire Drawing Machines

- Anneal the wire when the wire is half the size of the original thickness.
- Then place the wire again in the rolling mill to make a 16-gauge wire.

Fig 2.9.2.2 Wire drawing – Anneal wire when it becomes half the thickness of original thickness

2.9.2 Wire Drawing Machines and Tools

Working of the Wire Drawing Machines

- After annealing put the wire again through the rollers to make it thinner.
- This is done by making the gaps between the rollers smaller.
- Once the required thickness is achieved then we need to use the draw plates.

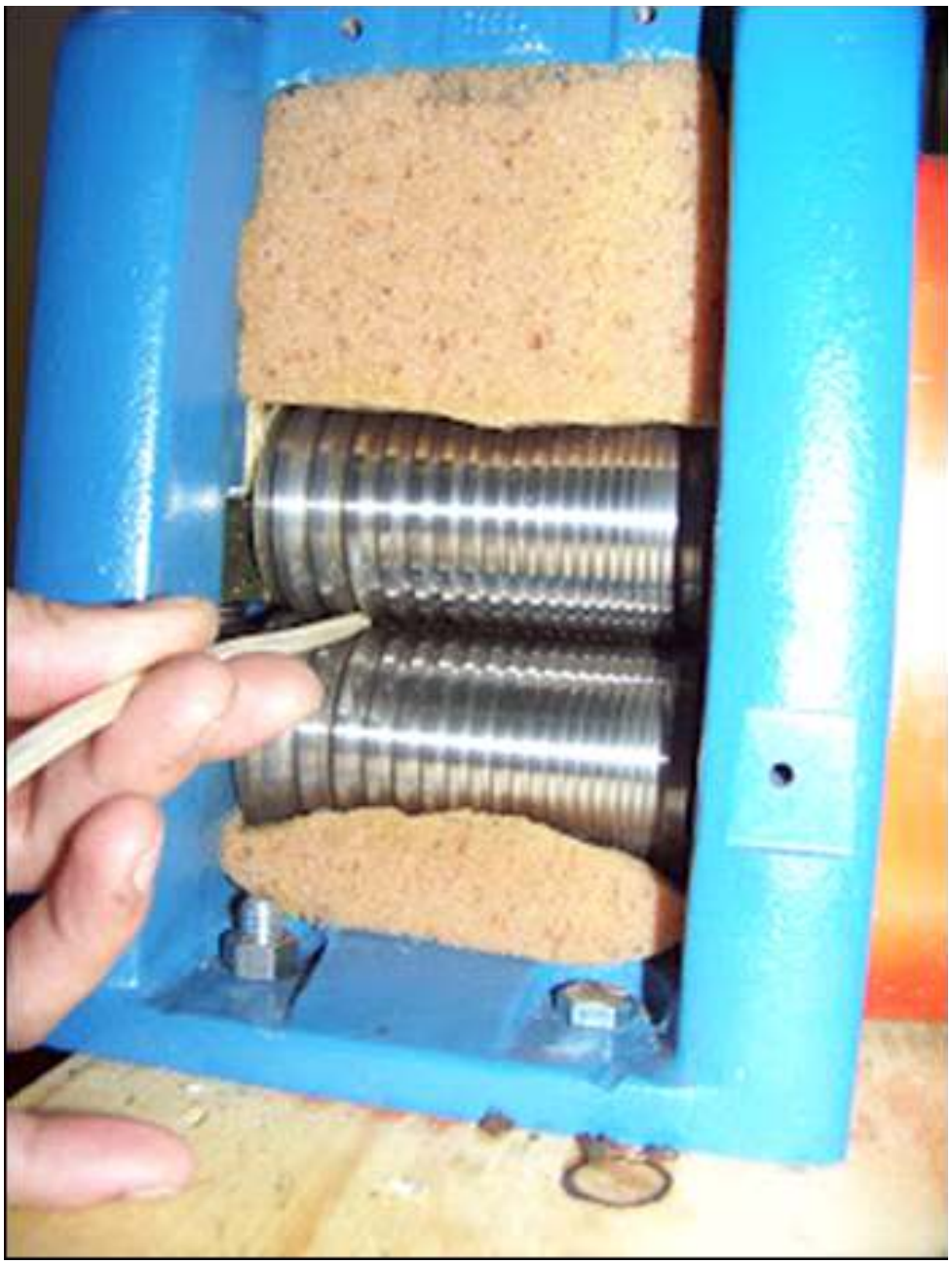


Fig 2.9.2.3 Wire drawing – After annealing put the wire again in the roll mill to make It thinner

2.9.2 Wire Drawing Machines and Tools

Working of the Draw Plates

- Once the wire has been made thin, it is then passed through a Draw Plate.
- A draw plate is a tool through which has different gauge sizes.
- When using a draw plate, start with the size that is the largest and then move to the thinnest size.
- You will need to place or keep the draw plate on something strong and use a wire tong or plier to pull the wire.
- The wire is inserted into the draw plate from the backside and then pulled from the front side.
- If the metal has an alloy problem, there will be cracks on the metal.
- Anneal the wire before using the draw plates and make it straight by hammering it.
- Form a tapered shape at one end of the wire by filing to form a grip.
- Filing makes it easier to draw the wire through the hole in the drawplates.

Fig 2.9.2.4 Wire drawing – Draw plate

2.9.2 Wire Drawing Machines and Tools

Working of the Draw Plates

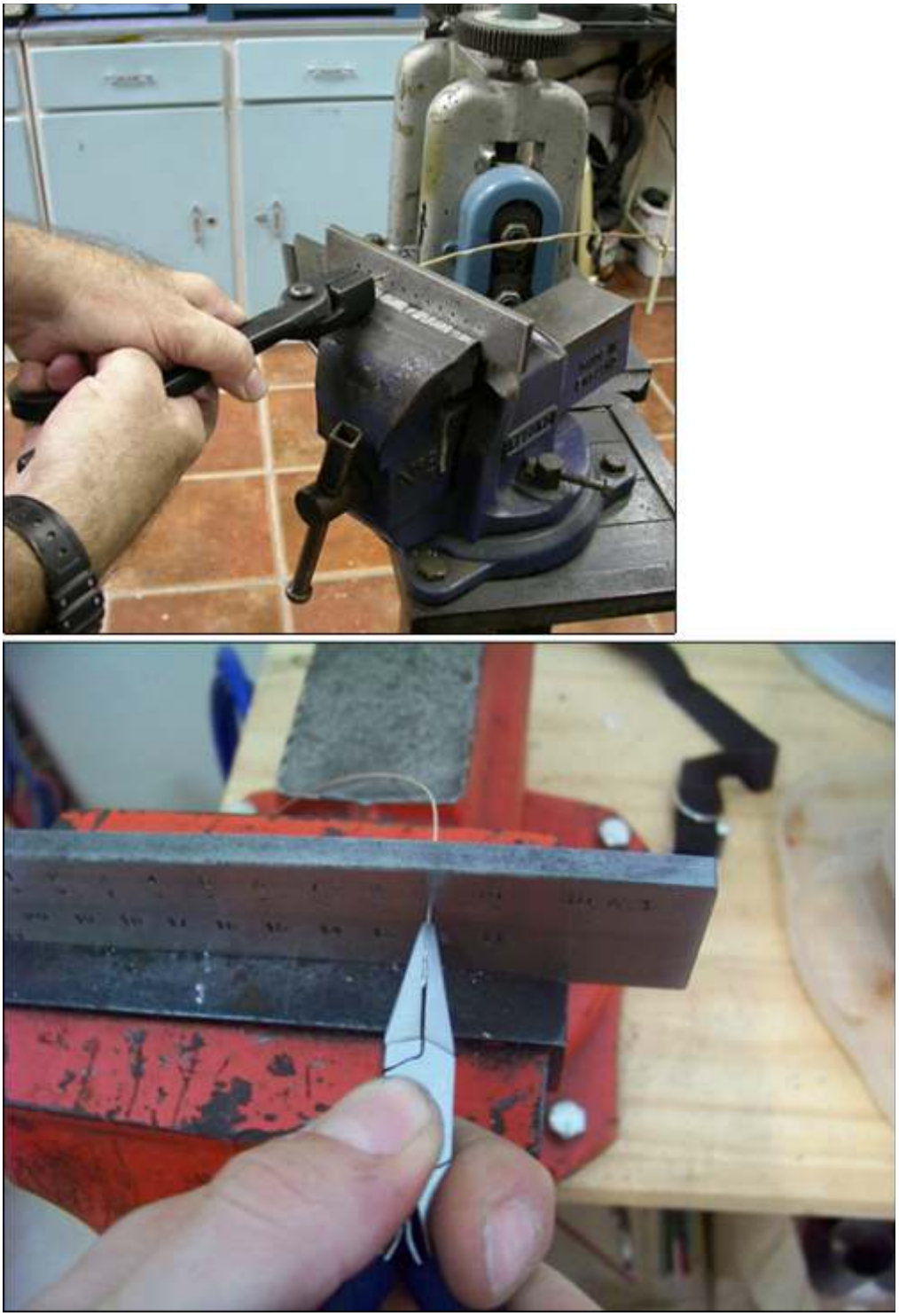
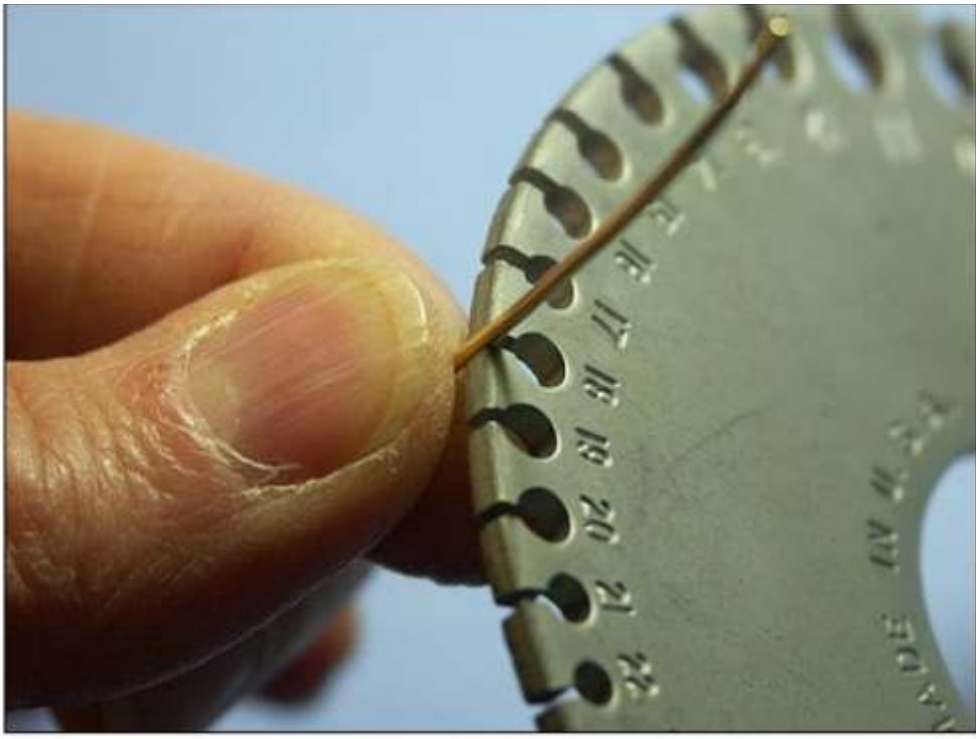


Fig 2.9.2.5 Wire Drawing – First use the large gauge and move to the thinnest gauge

2.9.2 Wire Drawing Machines and Tools

Working of the Draw Plates

- Keep checking the diameter of the wire with a wire gauge, so it does not become thin from the desired size.
- The required thickness of the wire is now ready to be used.



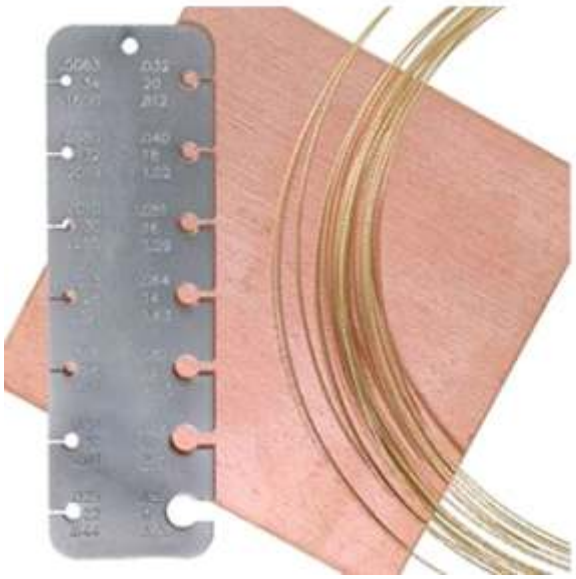


Fig 2.9.2.6 Wire drawing – Check the wire size with a wire gauge

2.9.3 Gauges

Different Types of Gauges Required When Working on a Frame

- Gauges are used for measuring the ring size and bangle or bracelet size.
- This helps when change of size is required before using the actual jewellery piece on a mandrel.

Fig 2.9.3.1 Gauges – Ring Gauge

Fig 2.9.3.2 Gauges – Bangle and Bracelet Gauge

2.9.4 Mandrels or Sticks

Different Types of Mandrels or Sticks Required When Working on a Frame

- Mandrels or sticks are used for measuring the ring size or bangle or bracelet size.
- These are used when a jewellery piece needs to be re-sized.
- The jewellery piece is placed on the mandrel, cut and adjusted as per size and soldered to the new size.

Fig 2.9.4.1 Mandrels or Sticks – Ring Stick

Fig 2.9.4.2 Mandrels or Sticks – Bangle or Bracelet Mandrel

2.9.5 Pliers

Different Types of Pliers Required When Working on a Frame

- Each plier has a different application.
- Use the appropriate plier while pulling wires, bending metal or cutting metal wires.

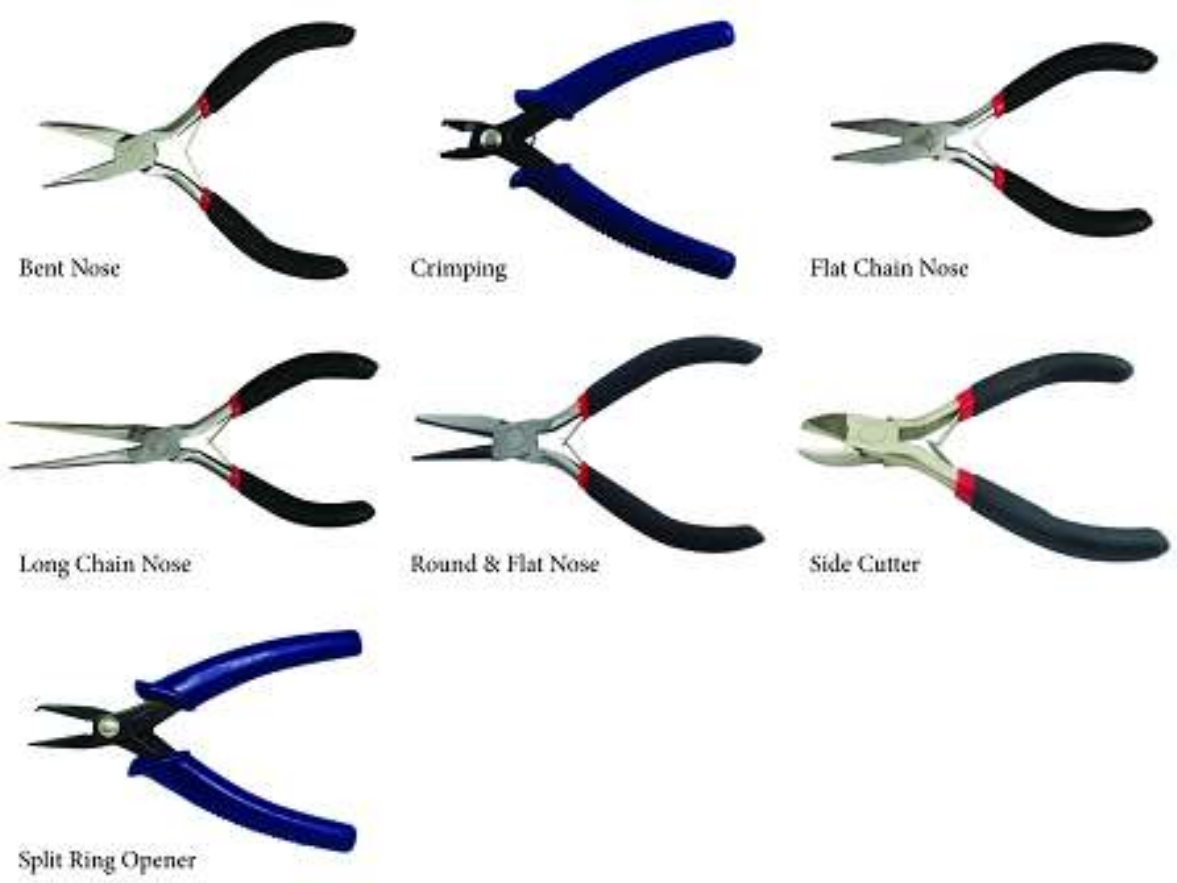


Fig 2.9.5.1 Pliers – Different Types of Pliers

2.9.6 Magnifying Lens

Different Types of Magnifying Lens Required When Working on a Frame

- These are available as head gears or as hand tools.
- The loupe is available in 10 times magnification (10x), 20x and 30x.
- Loupes are held with one hand and can be easy if you know how to use it.
- Loupes are held in front of one eye while checking the jewellery piece.
- Magnifying lens such as the head lens or the Optivisor are attached with the head band to your forehead.
- They come with additional lens for higher magnification.
- The head magnifying lens can help you work with both your hands while magnifying the jewellery piece.

Fig 2.9.6.1 Magnifying Lens – Different Types of Magnifying Lens

2.9.7 Tools for Setting Stones

Different Types of Tools for Setting Stones Required When Working on a Frame

- Tools for setting stones include prong pusher, burnisher, bezel roller and a lac stick.
- These are the basic setting tools, however, there are many new advanced setting tools also available in the market.
- Each tool set has beading tools also which are used for rounding the prongs in settings such as bead or grain setting and pave setting.

Fig 2.9.7.1 Stone Setting Tools – Prong Pusher, Burnisher, Bezel Roller, Lac Stick

2.9.8 Metal Stamping

Different Materials for Metal Stamping Required When Working on a Frame

- Metal stamping can mean stamping the logo of the company, karat or purity stamp, country of origin stamp or stamping messages.
- Metal stamping also means stamping of coins which is done with the help of the die struck method, where large machines stamp thick metal sheets.
- Metal stamping of jewellery does not need large machines.
- It can be done using hand tools and a mounting tape.

Fig 2.9.8.1 Metal stamping – complete metal stamping kit and how to stamp metal

2.9.9 Files

Different Types of Files Required When Working on a Frame

- Files are made of steel or iron or other metal.
- They are used to file a jewellery piece to give it a proper shape by removing or filing sharp edges or extra metal.
- It can also be used to make grooves for settings.

Fig 2.9.9.1 Files – 12 Piece Set of Metal Files for Filing

2.9.10 Saw Frame and Blades

Saw Frame and Blades Required When Working on a Frame

- Saw frames and blades are used for cutting a design.
- Be careful when using the blades as they can cut into your fingers.
- Use gloves whenever possible while using saw blades.
- The saw blade should be at 90 degrees to the metal sheet while cutting to ensure proper cutting.
- The saw blades come in different sizes, thickness and blade teeth.

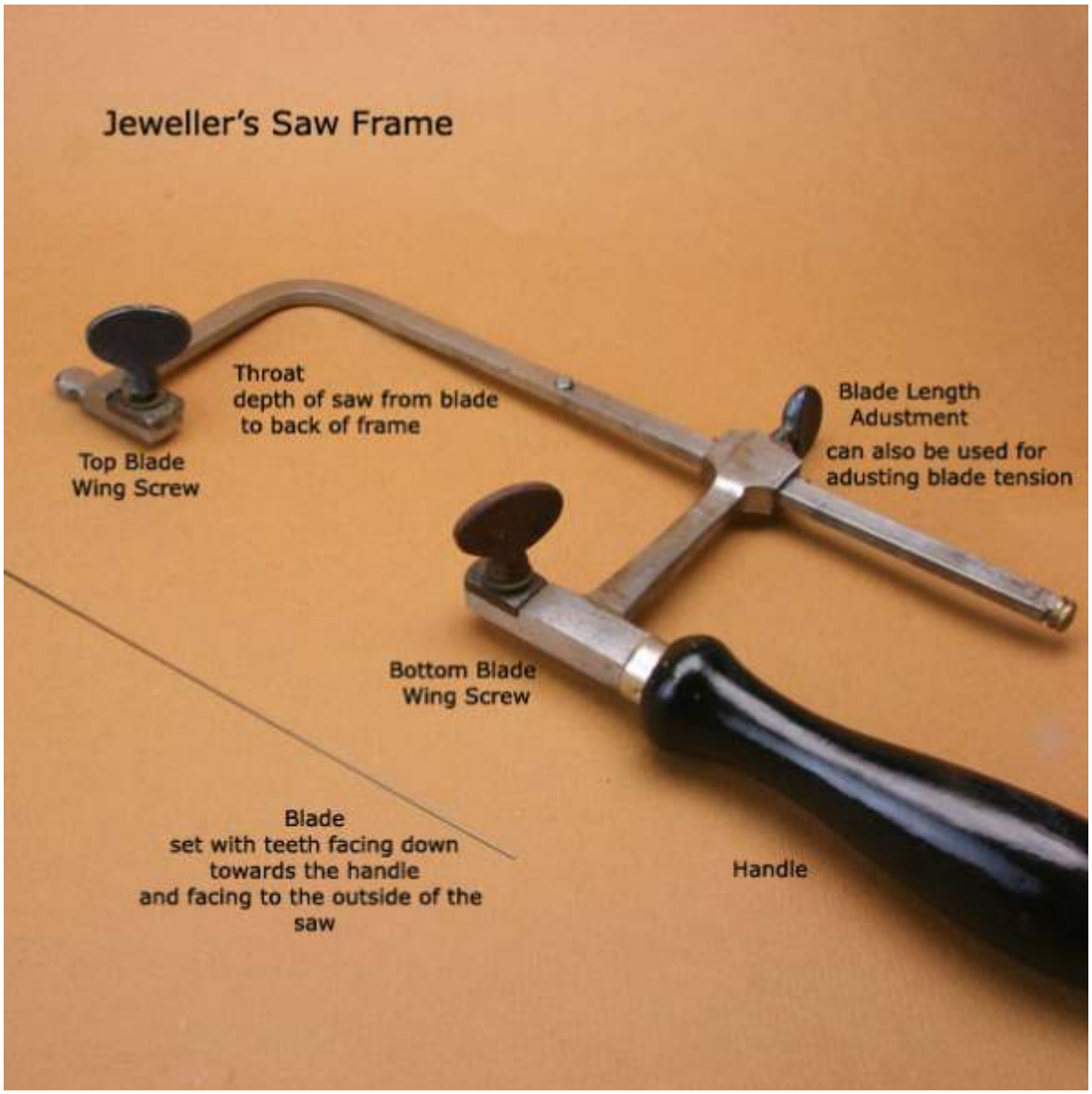


Fig 2.9.10.1 Saw Frame and Blade – Used for Cutting the Frame of Jewellery

2.9.10 Saw Frame and Blades

Saw Frame and Blades Required When Working on a Frame

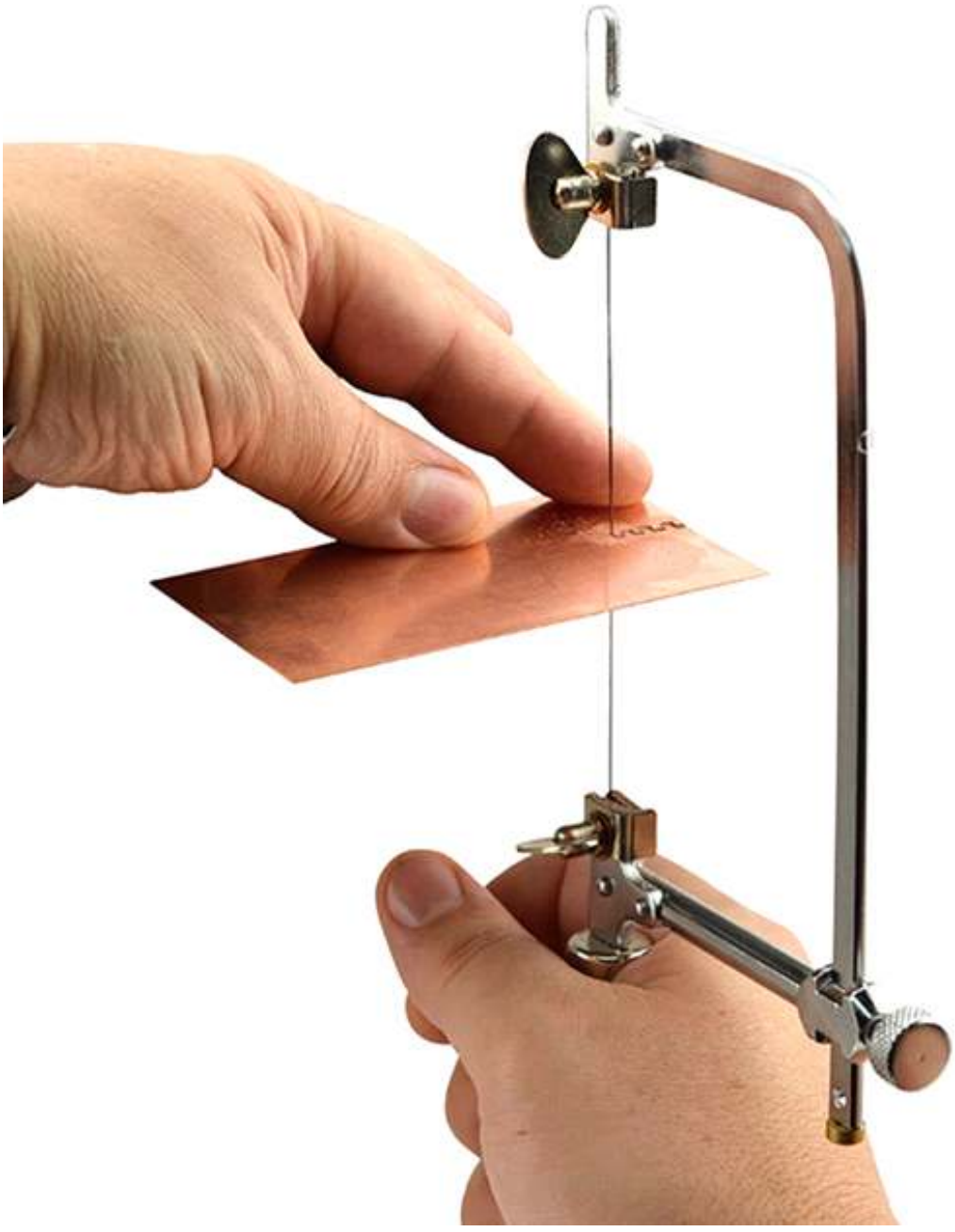


Fig 2.9.10.2 Saw Frame and Blade – Cutting Frame of Jewellery

2.9.10 Saw Frame and Blades

1. Saw Frame and Blades Required When Working on a Frame

- Use this saw blade size reference chart to help determine the correct size saw blade needed.
- Finer saw blades are great for use with small parts and cutting rings for sizing, heavier saw blades are better for larger and less delicate cutting jobs.
- All sizes are for mini 6 inch jewellery saw blades.

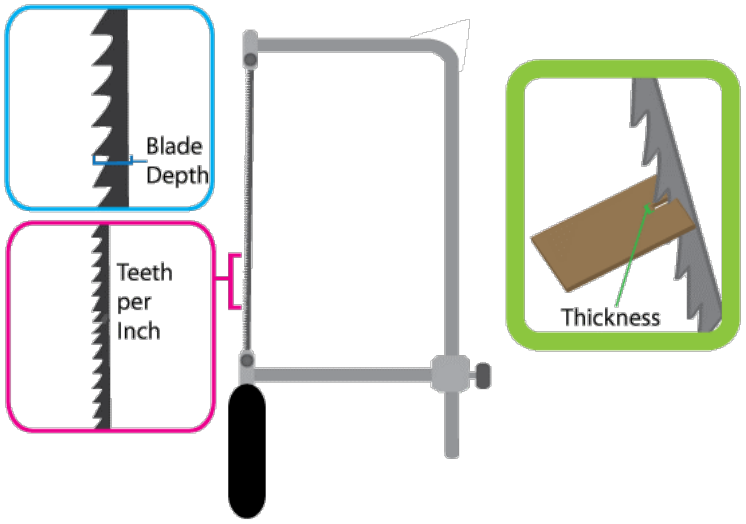


Fig 2.9.10.3 Saw Frame and Blade – Type of Blade Thickness Required

Saw Blade Reference Chart:

Size	Thickness	Blade Depth (inches/mm)	Teeth Per
8/0		.013" / 0.33mm	84 Per Inch / 33 Per cm
7/0	.007" / 0.18mm	.014" / 0.36mm	84 Per Inch / 33 Per cm
6/0	.007" / 0.18mm	.014" / 0.36mm	76 Per Inch / 30 Per cm
5/0	.008" / 0.20mm	.016" / 0.41mm	66 Per Inch / 26 Per cm
4/0	.009" / 0.23mm	.017" / 0.43mm	64 Per Inch / 25 Per cm
3/0	.010" / 0.25mm	.019" / 0.48mm	57 Per Inch / 22 Per cm
2/0	.010" / 0.25mm	.021" / 0.53mm	53 Per Inch / 21 Per cm
1/0	.011" / 0.28mm	.023" / 0.58mm	51 Per Inch / 20 Per cm
1	.012" / 0.30mm	.025" / 0.64mm	47 Per Inch / 19 Per cm
2	.013" / 0.33mm	.027" / 0.69mm	44 Per Inch / 17 Per cm
3	.014" / 0.36mm	.029" / 0.74mm	40 Per Inch / 16 Per cm
4	.015" / 0.38mm	.031" / 0.79mm	37 Per Inch / 15 Per cm
5	.016" / 0.41mm	.033" / 0.84mm	35 Per Inch / 14 Per cm
6	.017" / 0.43mm	.037" / 0.94mm	33 Per Inch / 13 Per cm
8	.020" / 0.51mm	.045" / 1.14mm	28 Per Inch / 11 Per cm
10	.024" / 0.61mm	.053" / 1.35mm	24 Per Inch / 10 Per cm
12	.024" / 0.61mm	.065" / 1.65mm	20 Per Inch / 8 Per cm
14	.024" / 0.61mm	.067" / 1.70mm	16 Per Inch / 6 Per cm

Fig 2.9.10.4

2.9.11 Hammers

Types of Different Hammers Required When Working on a Frame

- There are different types of hammers used for jewellery manufacturing.
- The heads of the hammer serve different purposes.
- There are some hammers which have separate finishing heads for textures.

Fig 2.9.11.1 Hammers – Types of Hammer Heads

2.9.11 Hammers

Types of Different Hammers Required When Working on a Frame

Fig 2.9.11.2 Hammers – Types of Hammers

2.9.11 Hammers

Types of Different Hammers Required When Working on a Frame

Fig 2.9.11.3 Hammers – Texture Hammers

2.9.12 Bench Pin

Types of Bench Pins Required When Working on a Frame

- A bench pin is a removable tool which is attached to the edge of the bench.
- Depending on the type of work, the bench pin can be changed.
- Bench pins are used for pre-polishing, setting, cutting and holding the ring clamp.

Fig 2.9.12.1 Bench Pin – Types of Bench Pin Available

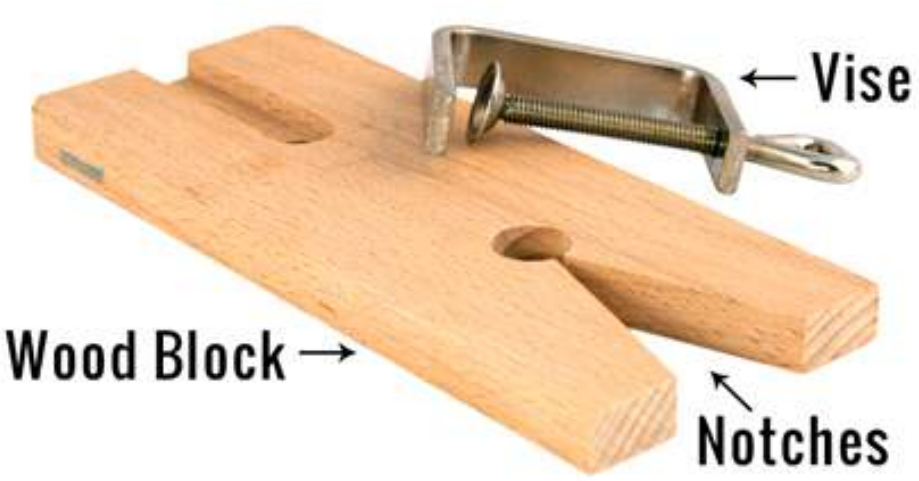


Fig 2.9.12.2 Bench Pin – Parts of a Bench Pin

2.9.13 Sandpaper or Polishing Paper and Sticks

Types of Sandpaper or Polishing Paper and Sticks Required When Working on a Frame

- Sandpapers or polishing papers are important tools while making jewellery.
- However, it can be confusing to understand the grit rating system and how to choose the right sandpaper for the job.

Fig 2.9.13.1 Sandpaper or polishing paper and sticks

- Understand the numbering system on the sandpaper and sandpaper sticks.
- 3M brand micron graded papers and standard grit rated papers are usually used.
- The chart below will help explain how the systems overlap.
- The larger the grit number, the finer the sandpaper.
- However, the micron rated papers are the opposite: the smaller the micron number, the finer the sandpaper.
- If you choose the wrong paper you can scratch the jewellery piece.

Reference Chart: Jewellery Finishing Sandpapers or Polishing Papers

Grades	Micron	Grit	3M Colour
Finest	1	10,000	White
Fine	2	6,000	Aqua
Medium	3	4,000	Pink
	9	1,200	Light Blue
Rough	15	800	Grey
Roughest	30	400	Green

Fig 2.9.13.2

2.9.13 Sandpaper or Polishing Paper and Sticks

Types of Sandpaper or Polishing Paper and Sticks Required When Working on a Frame

Reference Chart: Jewellery Finishing Sandpaper Sticks or Polishing Paper Sticks		
Stick Colour	**Grit**	**Sandpaper Mark Colour**
Grey	80	Silver
Red	120	Reddish Brown (Rust)
Orange	180	Brown
Blue	240	Purple

Fig 2.9.13.3

Fig 2.9.13.4 Sandpaper – Using Sandpaper Stick Before Sending Jewellery Piece to Polishing Department

2.9.14 Flex Shaft

Flex Shaft and Tools Required When Working on a Frame

- Flex shafts are very useful tools for manufacturing of jewellery.
- They come with different attachments which can be used for drilling setting seats, burnishing, polishing interior areas of closed frames.

Fig 2.9.14.1 Flex Shaft – Flex Shaft Kit Used for Various Purposes

2.9.14 Flex Shaft

Flex Shaft and Tools Required When Working on a Frame

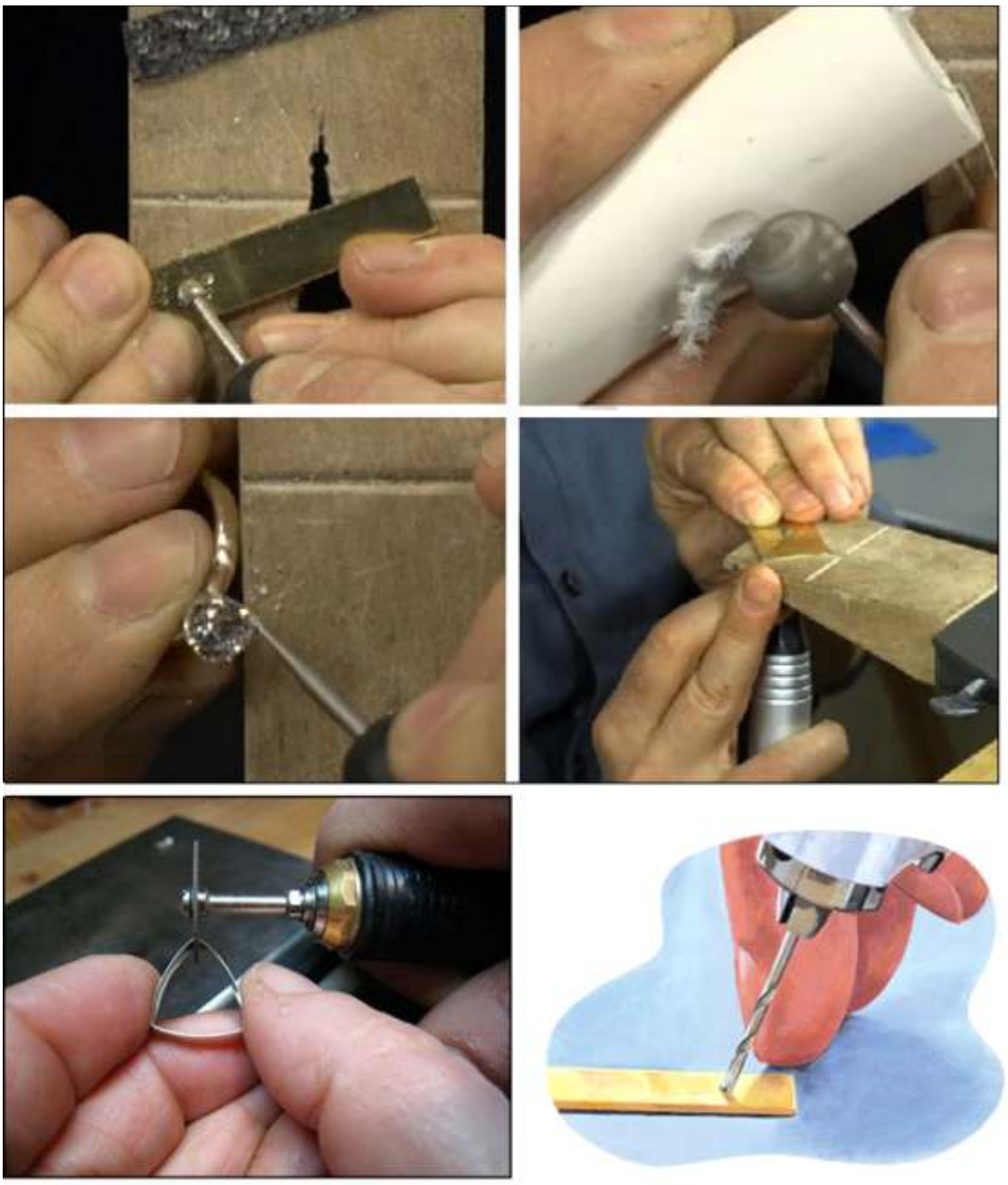


Fig 2.9.14.2 Flex Shaft – Flex Shaft is Used for Frames Polishing, Drilling Holes for Settings

2.9.14 Flex Shaft

Flex Shaft and Tools Required When Working on a Frame

Fig 2.9.14.3 Flex Shaft – Wrong Way of Holding Flex Shaft

Fig 2.9.14.4 Flex Shaft – Using the Right Tools of the Flex Shaft

2.9.15 Wire Cutter

Wire Cutter is Part of the Pliers Set Required When Working on a Frame

- Wire cutter is part of the set of pliers.
- The wire cutter has two sides: flat and bevelled (cut corner) side.
- Depending on the design requirement and work requirement, use the sides accordingly.

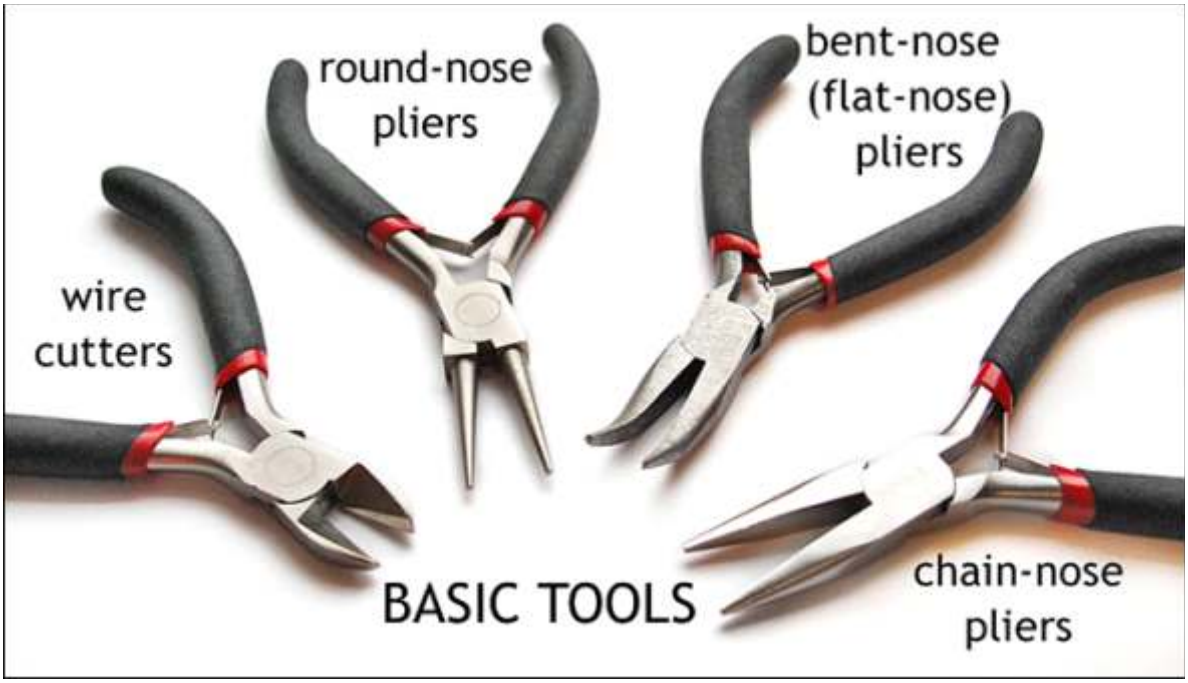


Fig 2.9.15.1 Wire Cutter – Wire Cutter is Part of the Pliers Set Used in Jewellery Manufacturing

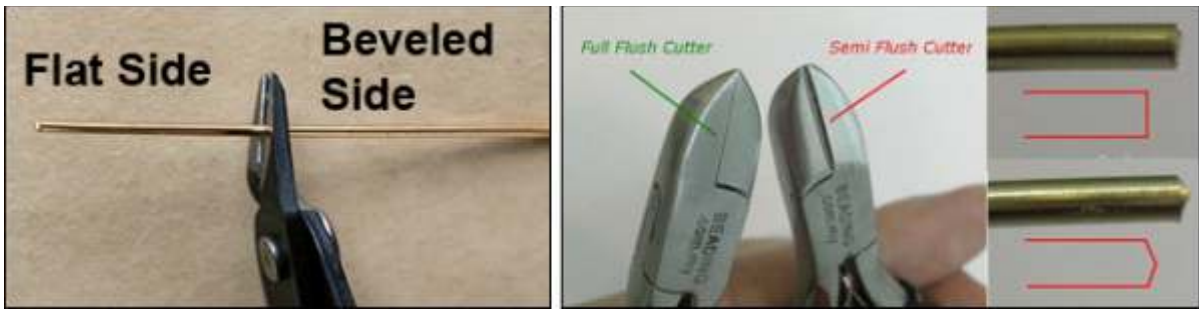


Fig 2.9.15.2 Wire Cutter – Method to Use Wire Cutter and Results

2.9.16 Callipers or Measuring Gauges

1. Callipers or Measuring Gauges Are Required When Working on a Frame

- Callipers or measuring gauges are used for measuring the length, width and thickness of metal.
- It is also used for measuring stones and the settings in which they are to be used.
- There are different types of callipers and measuring gauges available in the market, use the ones that you are comfortable with and which give you the accurate reading.

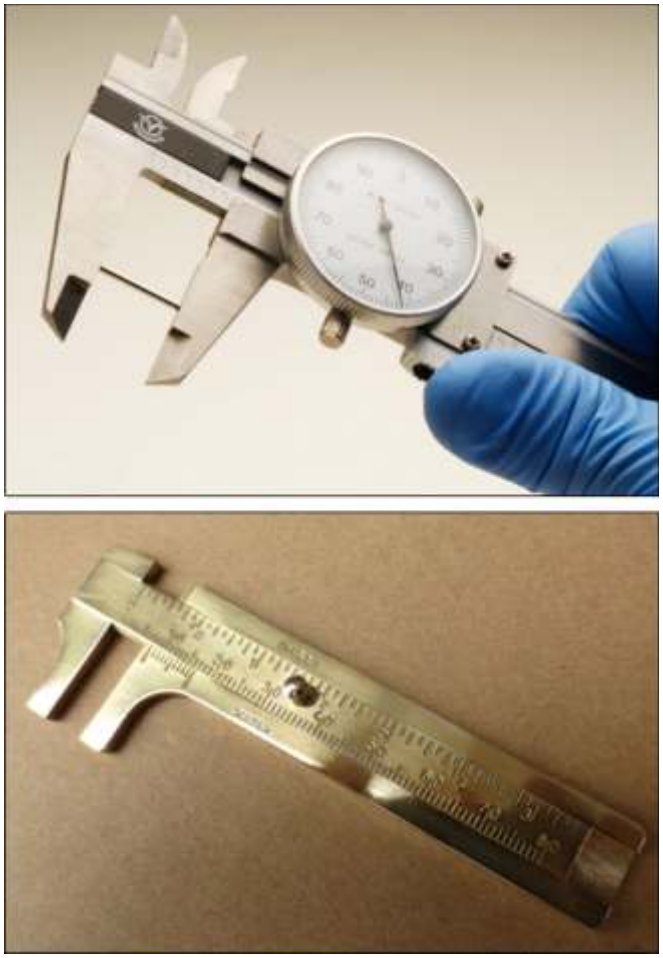


Fig 2.9.16.1 Callipers or Measuring Gauges – Used for Measuring Metal Thickness, Length and Stone Dimensions - 1

2.9.16 Callipers or Measuring Gauges

Callipers or Measuring Gauges Are Required When Working on a Frame

Fig 2.9.16.2 Callipers or Measuring Gauges – Used for Measuring Metal Thickness, Length and Stone Dimensions - 2

2.9.17 Ring Clamp

Ring Clamps Are Required When Working on a Frame

- A ring clamp is used to hold a ring or a wire frame during the filing and cutting process.
- The ring clamp can be attached to the bench or held with the hand while working.
- There are different types of ring clamps available in the market.

Fig 2.9.17.1 Ring Clamps – Used for Holding Rings and Wires

2.9.17 Ring Clamp

Ring Clamps Are Required When Working on a Frame

Fig 2.9.17.2 Ring Clamps – Hold the Jewellery Piece with Ring Clamp While Cutting or Using Flex Shaft

2.9.18 Tools for Layout of Design

Metal Rulers, Scribes, Compass and Dividers Are Required When Working on a Frame

- Metal rulers, scribes, compass and dividers are used during the layout process of the design on a metal sheet.
- The metal ruler is used for measuring the design along with the help of the compass.
- Scribes are used for etching the design on the metal.
- Dividers and compass have the same purpose.

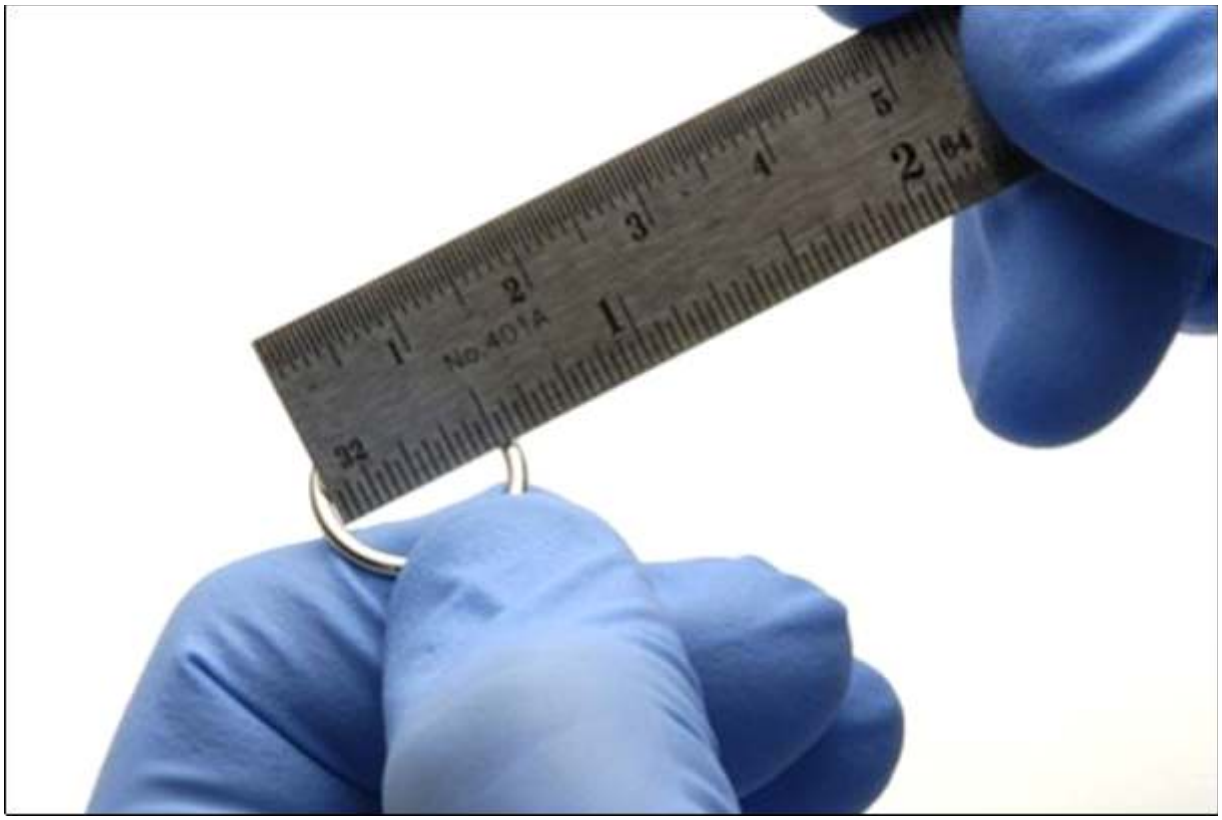


Fig 2.9.18.1 Tools for Layout of Design – Metal Ruler

2.9.18 Tools for Layout of Design

Metal Rulers, Scribes, Compass and Dividers Are Required When Working on a Frame

Fig 2.9.18.2 Tools for Layout of Design – Scribes and How to Use it to Etch the Design

2.9.18 Tools for Layout of Design

Metal Rulers, Scribes, Compass and Dividers Are Required When Working on a Frame

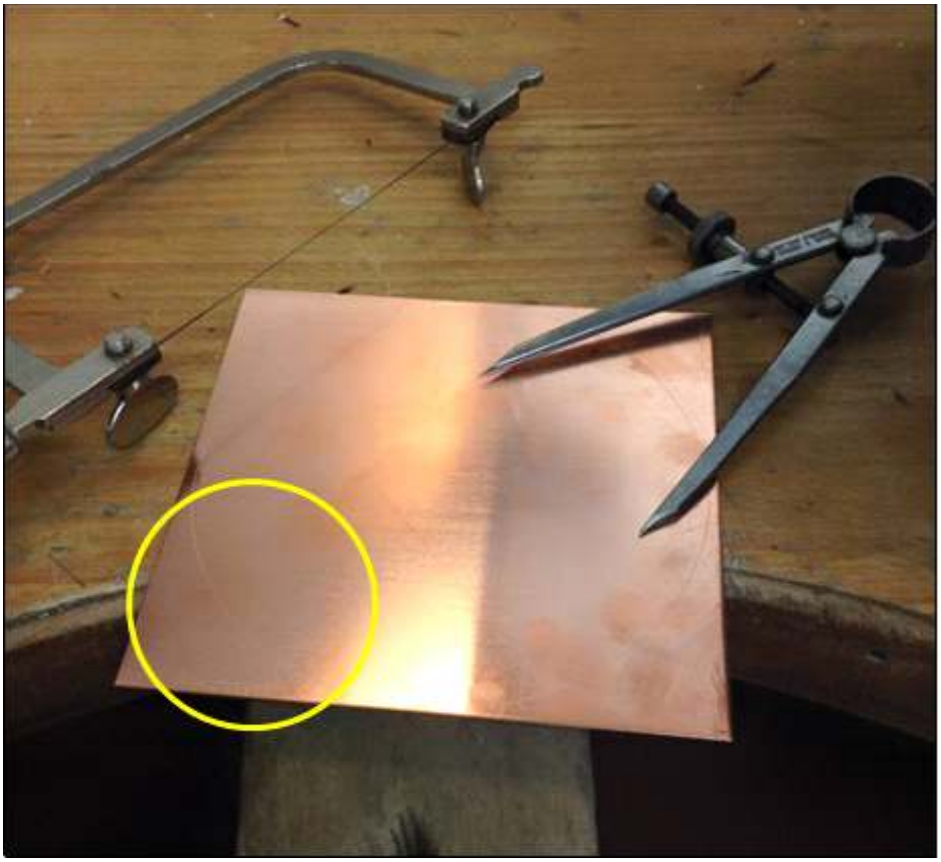


Fig 2.9.18.3 Tools for Layout of Design – Compass and Divider Used for Etching the Measurements of Design on Metal Sheet

2.9.19 Drilling Tools

Hand Drills and Small Drill Bits Are Required When Working on a Frame

- Hand drills and small drill bits are used for drilling holes in the metal manually.
- In India, we use the bow drill for the same purpose.
- However, the advanced flex shafts available today, can also drill holes.

Fig 2.9.19.1 Drilling Tools – Hand Drill and Small Drill Bits Are Used for Drilling Areas for Setting Stones or Links

Tips

1. Tools and equipment for creating a frame may be different from tools and equipment used for soldering.
2. One should always have all the required tools and equipment with them during the frame making process.
3. If there is any equipment or tool that is damaged, inform the supervisor.

Unit 2.10: Drawing Wire from Precious Metal

Unit Objectives

At the end of this unit, you will be able to:

1.Understand the process of drawing wire from precious metal.

2.10.1 Wire Drawing Machines and Tools

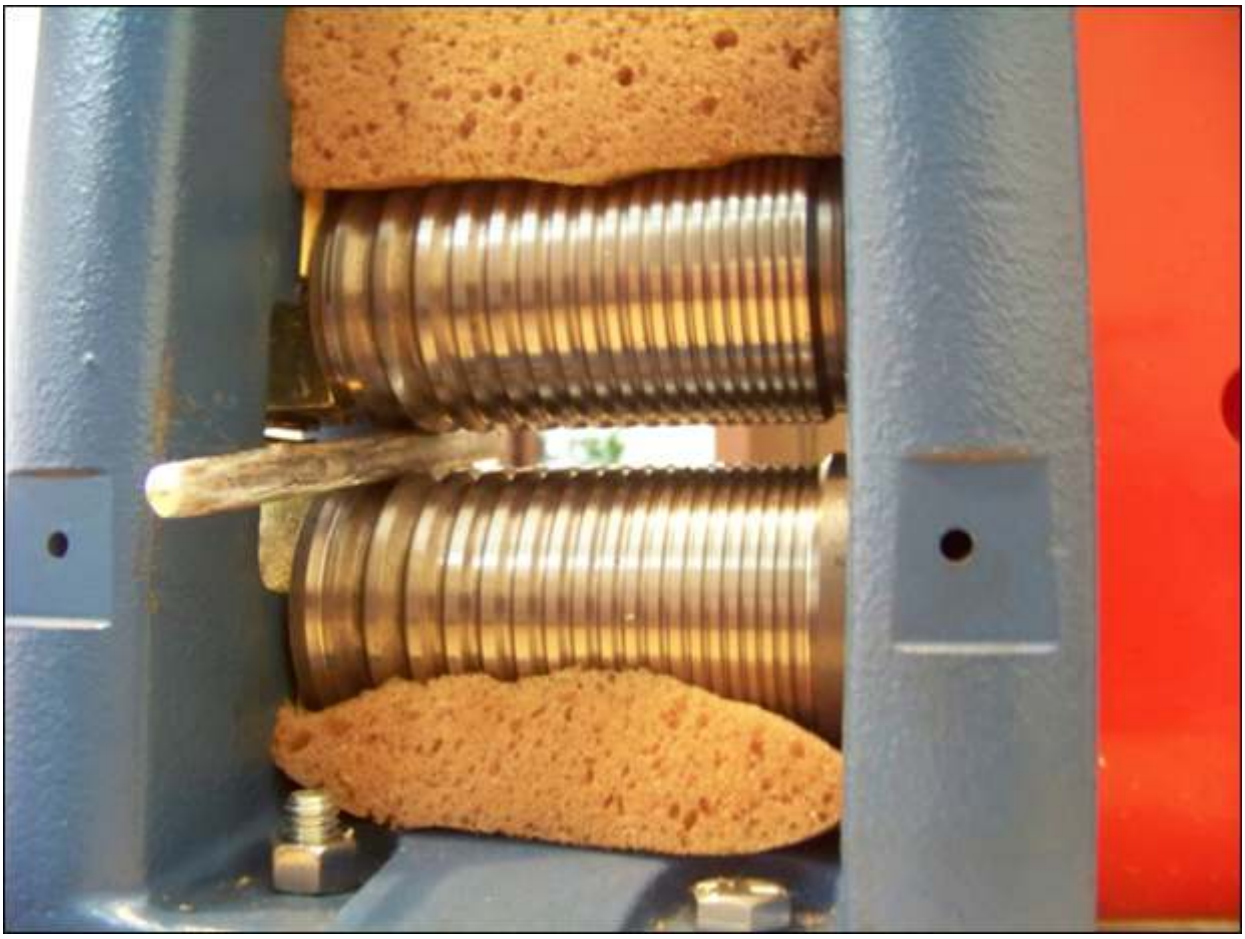


Fig 2.10.1.1 Wire Drawing – Putting Rod in Rolling Mill

2.10.2 Anneal the Metal Wire

- Anneal the wire when the wire is half the size of the original thickness.
- Then place the wire again in the rolling mill to make a 16-gauge wire.

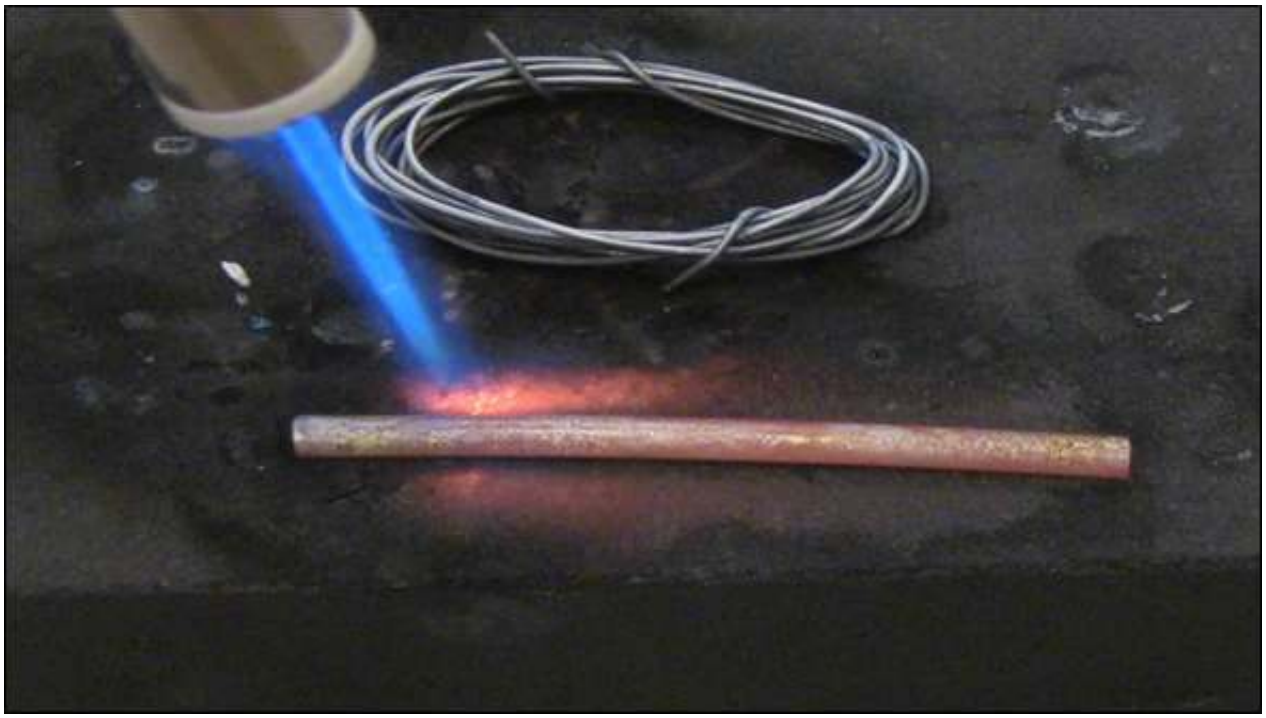


Fig 2.10.2.1 Wire Drawing – Anneal Wire When It Becomes Half the Thickness of Original Thickness

2.10.3 Post Annealing

- After annealing put the wire again through the rollers to make it thinner.
- This is done by making the gaps between the rollers smaller.
- Once the required thickness is achieved then we need to use the draw plates.

Fig 2.10.3.1 Wire Drawing – After Annealing Put the Wire Again in the Roll Mill to Make It Thinner

2.10.4 Using the Wire Draw Bench and Draw Plate

- Once the wire has been made thin, it is then passed through a Draw Plate.
- A draw plate is a tool through which has different gauge sizes.
- When using a draw plate, start with the size that is the largest and then move to the thinnest size.
- You will need to mount the draw plate on something sturdy and use a plier to pull the wire.
- The wire is inserted into the draw plate from the backside and then pulled from the front side.
- If the metal has an alloy problem, there will be cracks on the metal.
- Anneal the wire before using the draw plates and make it straight by hammering it.
- Form a tapered shape at one end of the wire by filing to form a grip.
- Filing makes it easier to draw the wire through the hole in the drawplates.
- Maintain the wire plate by using beeswax.

Fig 2.10.4.1 Wire Drawing – Draw Plate

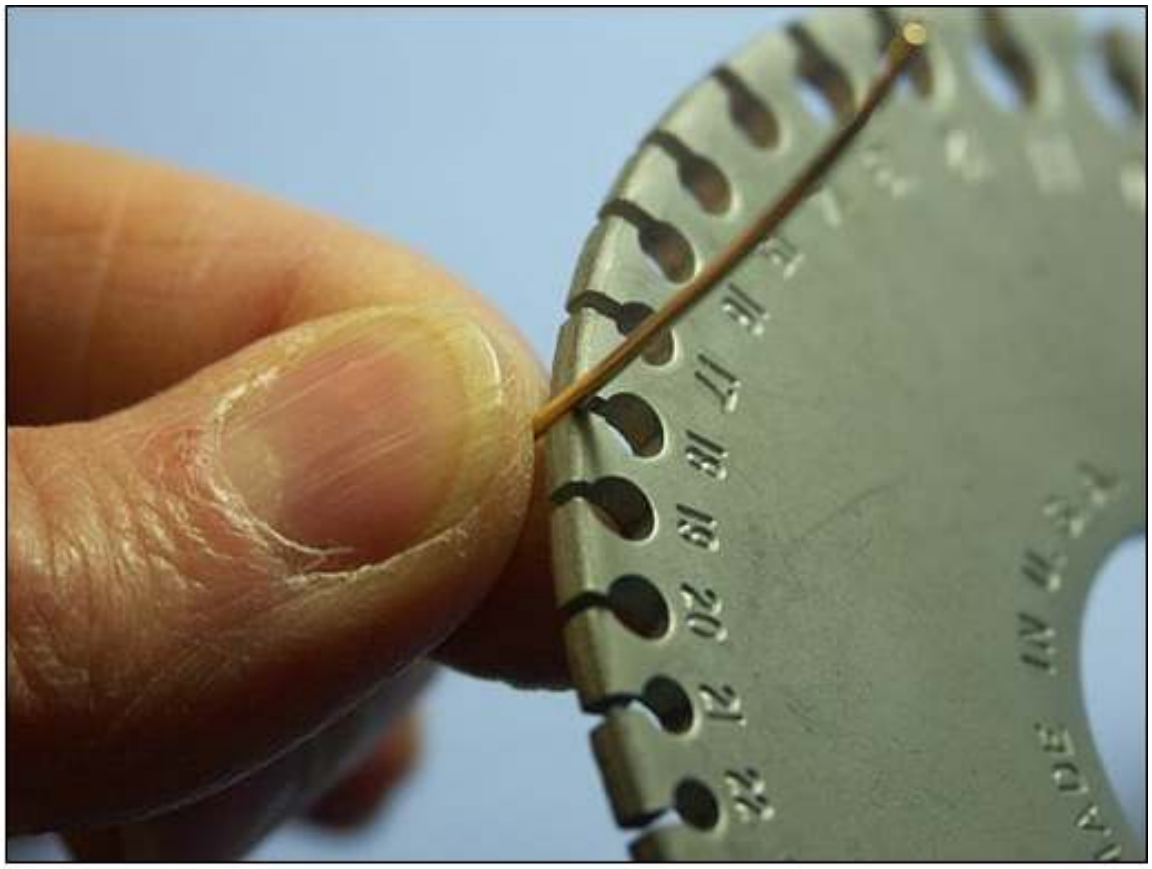
2.10.4 Using the Wire Draw Bench and Draw Plate

Fig 2.10.4.2 Wire Drawing – First Use the Large Gauge and Move to the Thinnest Gauge, Pull Using the Draw Tongs

2.10.4 Using the Wire Draw Bench and Draw Plate

Fig 2.10.4.3 Wire Drawing – Using the Draw Bench with the Draw Plate

2.10.5 Check the Thickness of the Wire



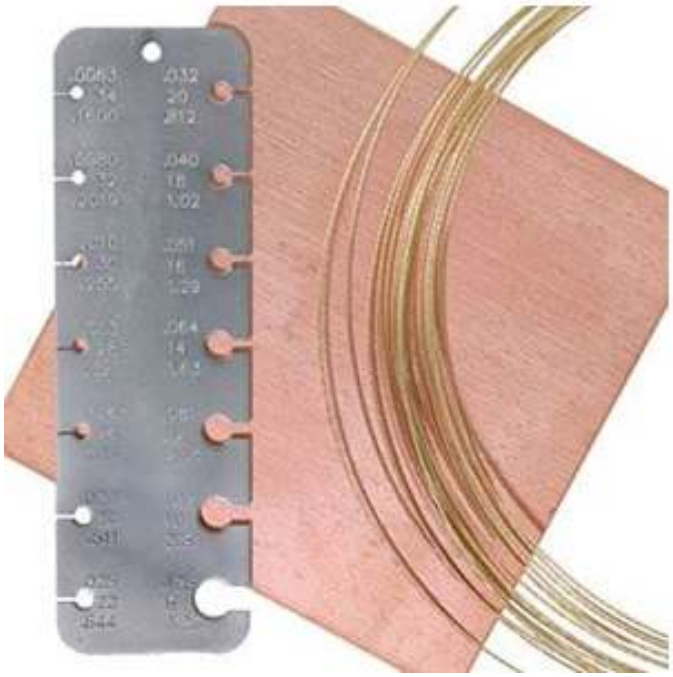


Fig 2.10.5.1 Wire Drawing – Check the Wire Size with a Wire

2.10.6 Filing the Wire

- After achieving the required thickness of wire, it should be filed and rounded with a cup bur tool.
- If rounding of edge of wire is not required, then there is no need to use the cup bur tool.
- Filing can be done using a file or sand paper.

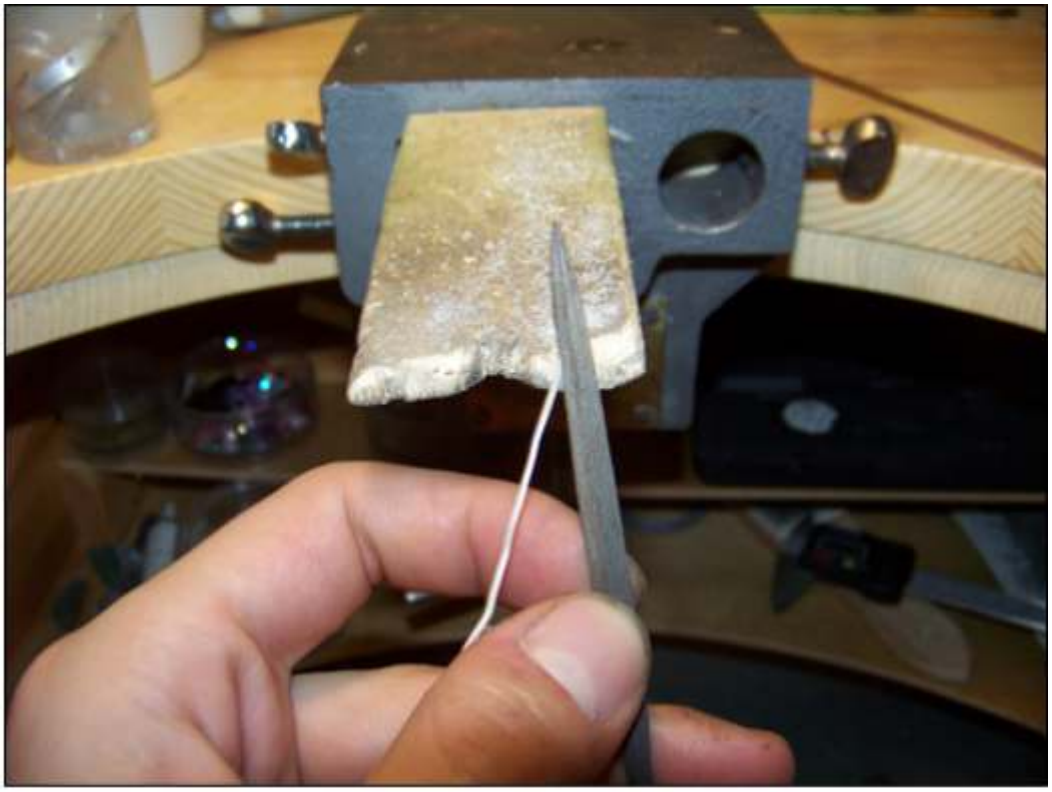


Fig 2.10.6.1 Filing and Cup Burring of Wire

2.10.7 Uses of Wire

- Wires are used for soldering purposes as well as for designs requiring wire work such as filigree.
- Wires are also coiled around to make various components including jump rings by cutting them.
- Make sure the wire is made straight by using a flat tweezer or plier.

Fig 2.10.7.1 Uses of Wire – Top Left (Coiled Wire); Top Right (Cutting Coiled Wire for Making Jump Ring); Bottom Left (Using Wire for Repairing Damaged Ring)

Tips

1. When working with wire, always remember the annealing process has to be done at regular intervals.
2. If the annealing and cooling is not done as per the metal properties, it will make the metal brittle.
3. Wires that are drawn through rusted draw plates can also create problem.
4. Make sure that the draw plates are regularly maintained by applying wax.
5. Also make sure that the draw bench is in working condition.
6. Use the right tweezer or plier for straightening the wire before coiling it.

Notes

Unit 2.11: Making Sheets from Precious Metal

Unit Objectives

At the end of this unit, you will be able to:

1. Understand the process of making sheets from precious metal.

2.11.1 Wire drawing machines and tools

- There are two rollers attached on the inner side of the mill.
- The left picture shows the roller for making metal sheets and the right picture shows the roller for making wires.

Fig 2.11.1.1 Rolling mill - Rollers

- These are the adjusting wheels - one for sheet and other for wire.
- You can use these adjusting wheels to adjust for gaps in between the two rollers.

Fig 2.11.1.2 Rolling mill – Adjusting wheels

2.11.1 Working of the Rolling Mill

- We get only 22-24 gauge square wires from the rolling mill which can be used with the wire drawing machine to get different sizes and shapes of wire as per design requirement.

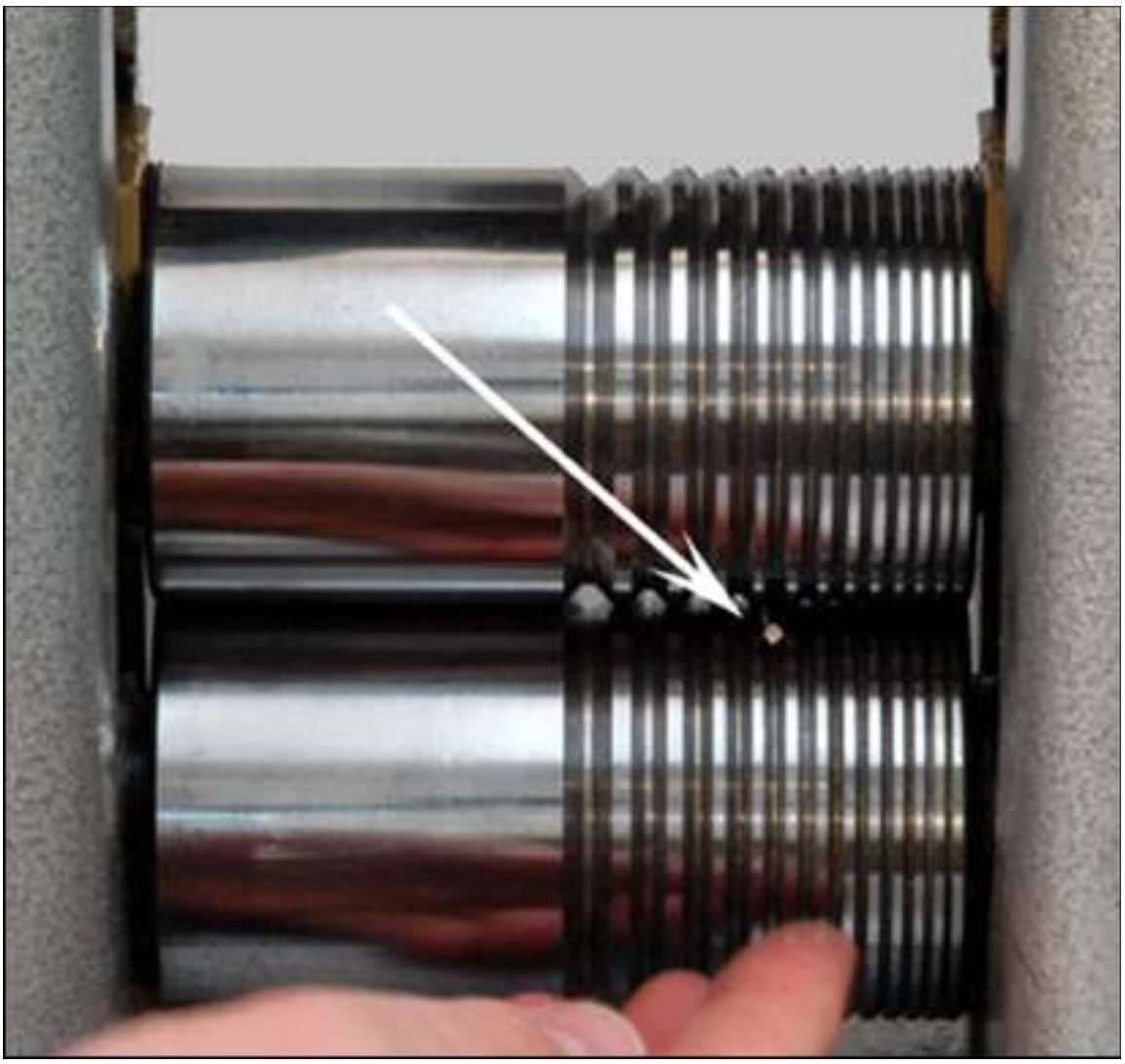


Fig 2.11.1.3 Rolling mill – 22 to 24 Gauge thickness square wire

2.11.2 Making Metal Sheet

- Insert the metal sheet from one side in between both the rollers and adjust the tightening wheel on top of the machine to make the required size of metal sheet.
- The metal sheet will come out from the other side of the rolling mill.

Fig 2.11.2.1 Rolling mill – Metal sheet being adjusted for thickness

2.11.3 Filing of metal sheet

- Metal sheets like metal wires also need to be filed and cleaned.
- Metal sheets are used for the main design etching of the jewellery.
- Filing can be done by using files or sandpaper.

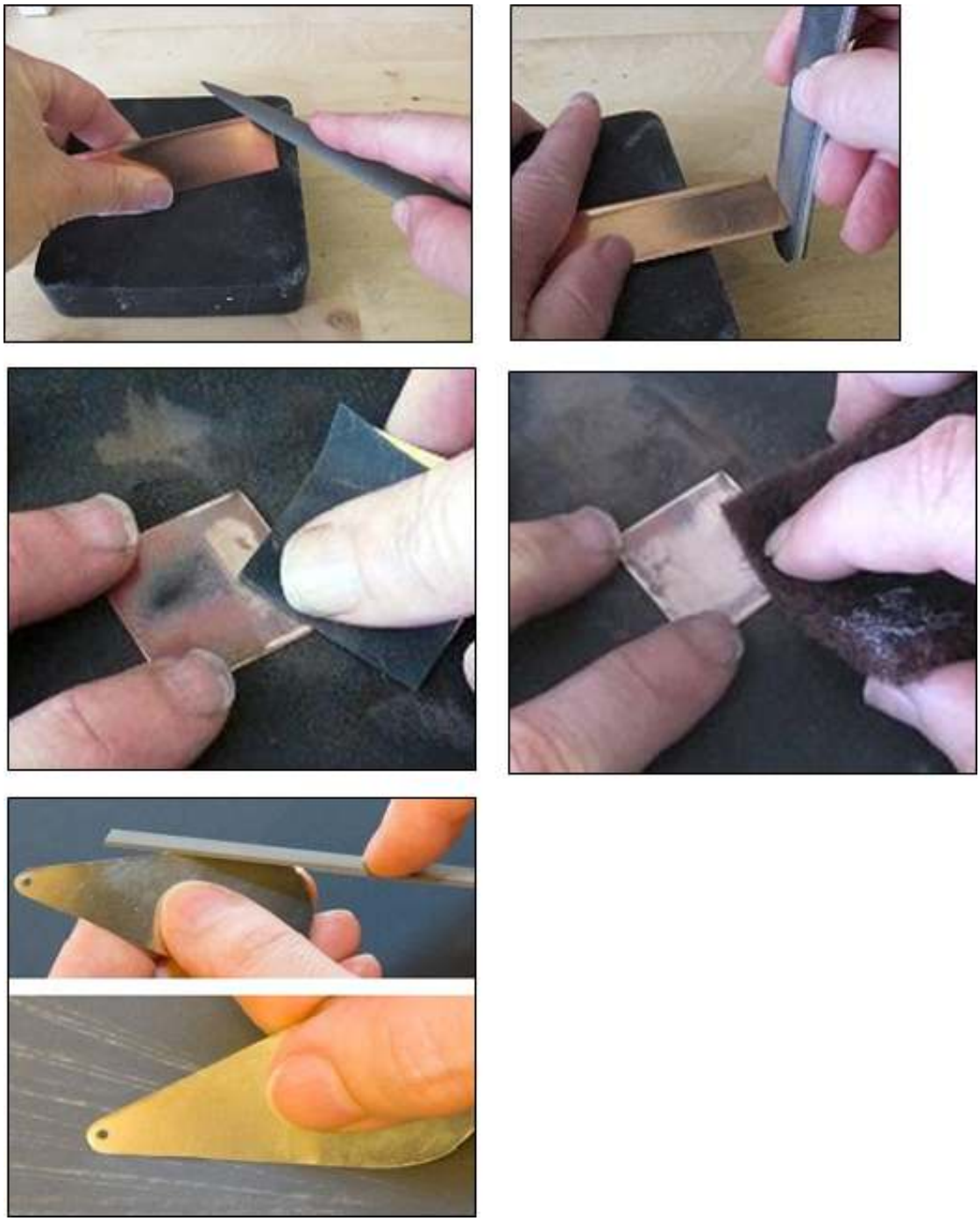


Fig 2.11.3.1 Filing and Cleaning of Metal Sheet

Tips

1. When working with metal sheets, always remember that the annealing process has to be done at regular intervals.
2. If the annealing and cooling is not done as per the metal properties, it will make the metal brittle.
3. File and clean the metal sheets thoroughly as it is the main element for making a design as well as a component.

Notes

Notes

Skill India
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Corporation
Transforming the skill landscape

GJSCi
Gem & Jewellery Skill Council of India

3. Make various jewellery components

Unit 3.1: Making a Round Tube
Unit 3.2: Make Balls from precious metal or alloy
Unit 3.3: Making grains or 'Rawa'
Unit 3.4: Making Collets
Unit 3.5: Making Box Claps
Unit 3.6: Stamp patterns on gold or its alloy
Unit 3.7: Make Chain from Gold Bar
Unit 3.8: Making the Filigree Wires

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Key Learning Outcomes

At the end of this unit, you will be able to:

1. Understand how to make precious metal balls and beads using the appropriate tools.
2. Understand how to solder and file the balls and beads.
3. Understand how metal stamping is done.
4. Understand how to file the stamped metals.
5. Understand how chains are made and importance of proper metal alloying.
6. Understand how to file chains.
7. Understand how to detect and repair product defects.
8. Learn to read a job sheet.
9. Learn how to control gold loss.
10. Understand standard quality of production and how to maintain it.
11. Understand how to know more about your organization.

Unit 3.1: Making a Round Tube

Unit Objectives

At the end of this unit, you will be able to:

1. Understand step by step process of making a seamless round table

3.1.1 Drawing a Seamed Tube

Drawing like rolling is a process involving plastic deformation. It is the process of the shaping and stretching of tubing and wire of highly malleable and ductile material by pulling it through a series of smaller-sized calibrated holes in a drawplate to reduce sectional area or diameter, increase length, change shape, and incidentally harden the metal.

Straight tubes with a lengthwise seam are made with a drawplate from a strip of sheet. The final outside diameter (OD) of a drawn tube is controlled by the size of the last hole in the drawplate through which it passes. Without the use of an interior core, the inside diameter (ID) cannot be controlled but is predictable to a degree by doubling the wall thickness and subtracting this figure from the OD. Tube wall thickness depends on the gauge of the sheet metal used. Choice of sheet metal gauge depends on the ultimate purpose of the tube. Take a tube made for a hinge as an example. As a general rule, hinge tubing has an ID equal to half the tube's OD. The sheet suitable for most jewelry hinges ranges from diameter, the thinner the gauge size used. The walls of hinges using short knuckles are thicker than those made with long knuckles.

The width of the sheet strip used to make a tube of a specific diameter is slightly more than three times the diameter of the drawplate opening aimed at for the tube's final size. This amount is based on the mathematical fact that the ratio of the circumference of a circle to its diameter is expressed by the Greek letter (pi), a symbol having the numerical value of 3.14159265+, or approximately 3%. As when drawing wire, the tube formed is lengthened as it is drawn through the progressively smaller holes of the drawplate, Even so, the strip length should be longer than the length of wire needed because allowance must be made for waste at the starting end Be sure the strip is cut accurately, is uniform in width, and has parallel edges throughout its length that are finished true (that is, perpendicular to the sheet) or they will not meet evenly along the seam length when curved. To assure a good butt joint, draw file the strip's long edges square. Remove any kerf that results from filing by running a scraper lightly down both sides of the edge length.

With hand shears or bench shears, cut one end of the strip to a flat-pointed taper for a distance of about one inch, be sure the flat point of the taper occurs in the center, or the tube will not shape evenly. When the tapered end is shaped to a cone it is drawing dog, and is passed through the drawplate first. A certain amount of preshaping of the strip I necessary, and different shaping methods are possible way is to place the strip into a half-round, depression in a swage block, or a similarly shaped semicircular, long groove in a hardwood shaping block. With any suitably shaped cross peen hammer, while the rest edgewise in the groove, beat it at a right angle to along its whole length, at the same time forcing it groove so that it is converted lengthwise by upsetting into a U shape.

3.1.1 Drawing a Seamed Tube

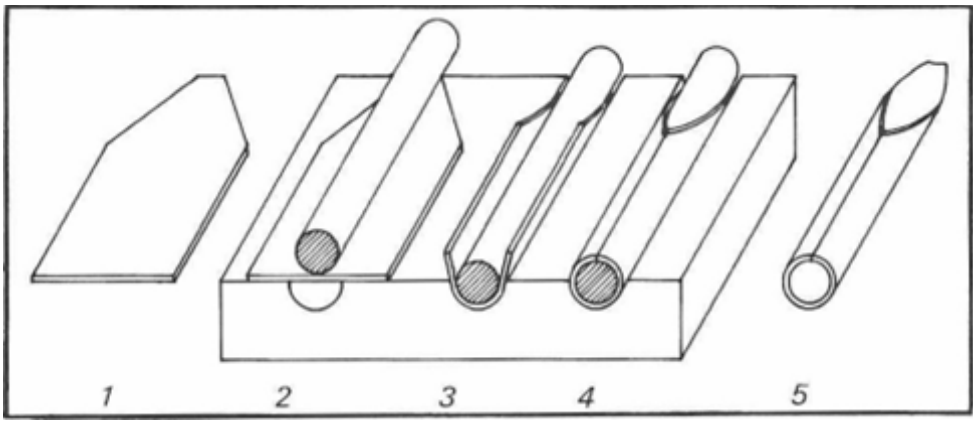


Fig 3.1.1.1 Preparing the metal sheet

- Cut the strip to a width is equal to the circumference of the mandrel that representation ID of the resulting the tube is to be drawn through the drawplate, cut one end to taper a to form a draw dog.
- Place the strip over grooved depression design block whose depth sufficient to accommodate the mandrel, and put the lubricated/ straight on top of the strip.
- Hammer the mandrel down on the strip to force it into the groove.
- Hammer the upright strip edges over the mandrel to close them and form the tube.
- Remove the mandrel from the tube with the hammer.

Unit 3.2: Make Balls from precious metal or alloy

Unit Objectives

At the end of this unit, you will be able to:

1. Understand step by step process of making spheres or balls from metal sheet.
2. Understand tools required for making balls.

3.2.1 Preparing the Metal Sheet

- To start work on making metal balls or beads, we need to first prepare the metal sheet.
- Take a metal sheet as per required thickness as mentioned in the job sheet.
- File and clean the metal sheet.
- Use a saw blade or shape cutter to make the required shape sheets of required size.

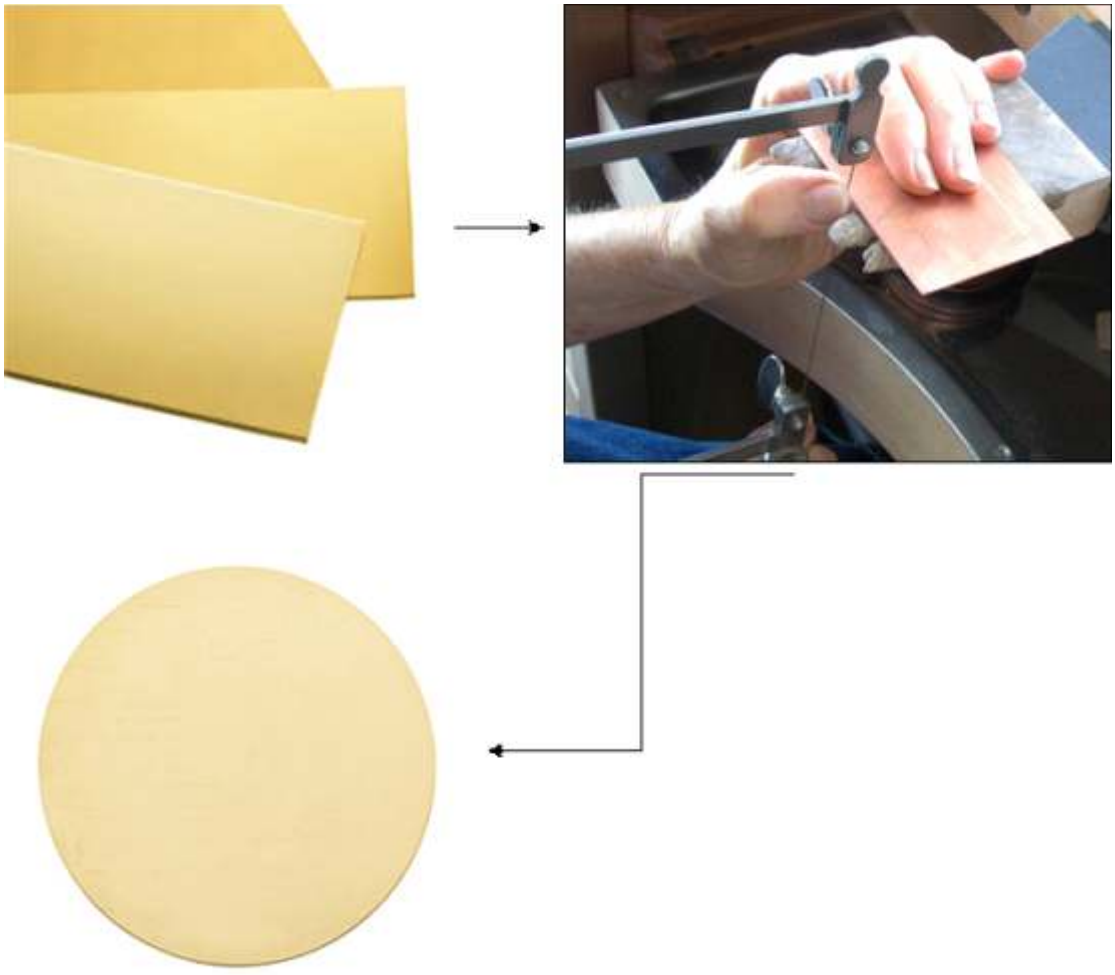


Fig 3.2.1.1 Preparing the metal sheet

3.2.2 Tools Required for Shaping

- For shaping the metal sheets, we need to use the Dapping Punch tool set.
- The tools are used to give the metal a rounded shape like a half bead.
- Shapes that are common in the market include round, oval, heart, square and other geometrical shapes.
- This shaping helps in creating hollow interiors while the exterior is made of metal, hence it is important to keep in mind the thickness of the metal.
- You will also require a hammer for the hammering.
- The square metal tool or the wooden square metal tool is called the Cube.
- The rounded tools are called Punches.
- The cube and punches have different sizes.
- When starting with a metal sheet, use the largest dent in the cube with a size smaller punch.
- The metal cube will make the metal surface dull whereas the wooden cube will make the metal surface smooth.
- Choose the type of cube depending on the metal softness.

Fig 3.2.2.1 Keeping tool set ready

3.2.3 Shaping the Metal

- After cutting the metal, we need to use the Dapping Punch Set.
- In the Cube, place the metal in the largest dent and hammer it lightly with a punch of a slightly smaller size than the dent size.
- Turn the metal sheet at different angles to get it rounded evenly from all sides.
- Remember, we are not making a complete ball here, we are only making a half sphere or half ball.
- Once the metal is rounded, put it in a smaller dent and follow the same steps of punching it.
- Keep putting in smaller dents till the diameter required is achieved.
- If you punch too hard, the metal thickness will become less, so keep checking the metal thickness.

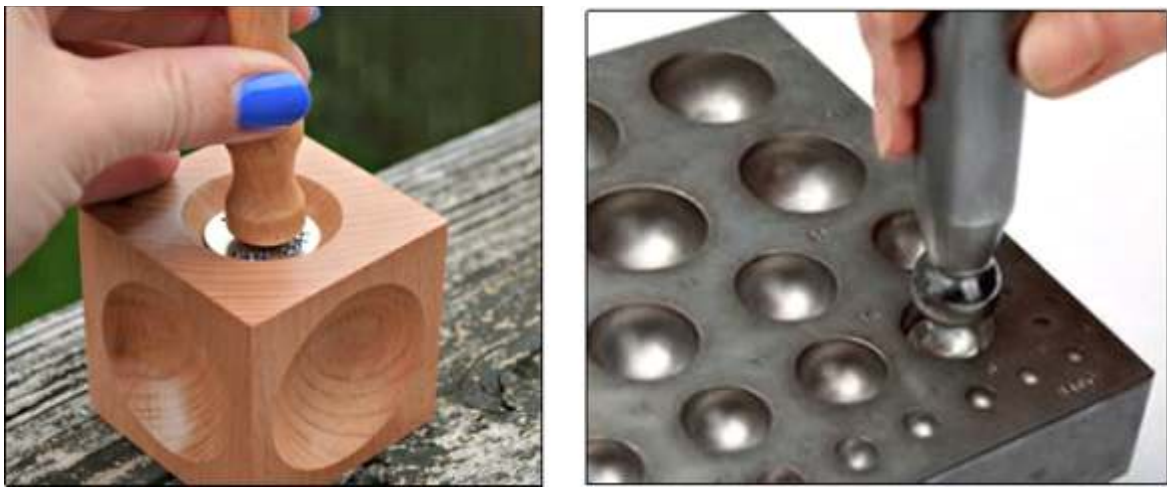


Fig 3.2.3.1 Shaping the metal

3.2.4 Half Sphere

- If you have chosen the right dent in the cube, you will get a perfect half sphere.
- If you have chosen the wrong dent in the cube, you will have extra metal around the half sphere.
- In the case of extra metal, you will need to saw the extra metal, which will lead to metal loss.
- If you see metal has cracked, then the metal impurities have not been removed while melting the metal.

Fig 3.2.4.1 Half sphere

3.2.5 Solder the Domes

- Before soldering the domes, file the edges to make sure the 2 half spheres meet together. without any gap.
- The next step is to solder the 2 half spheres together.

Fig 3.2.5.1 Solder the half spheres

3.2.6 Making Solid Beads

- The sphere beads will be hollow from inside, but if the design requirement is for solid beads, then we need to follow the following method.
- Keep a soldering table with holes in it.
- Place metal and alloy pieces together and heat it with a blow or heat torch.
- To make sure the metal does not stick to the table, lift it with a needle and drop it in the hole while removing the needle with the blow torch.
- Once melting is completed, remove the solid piece and put into water to cool down. Follow the filing, cleaning and finish process afterwards.

Steps

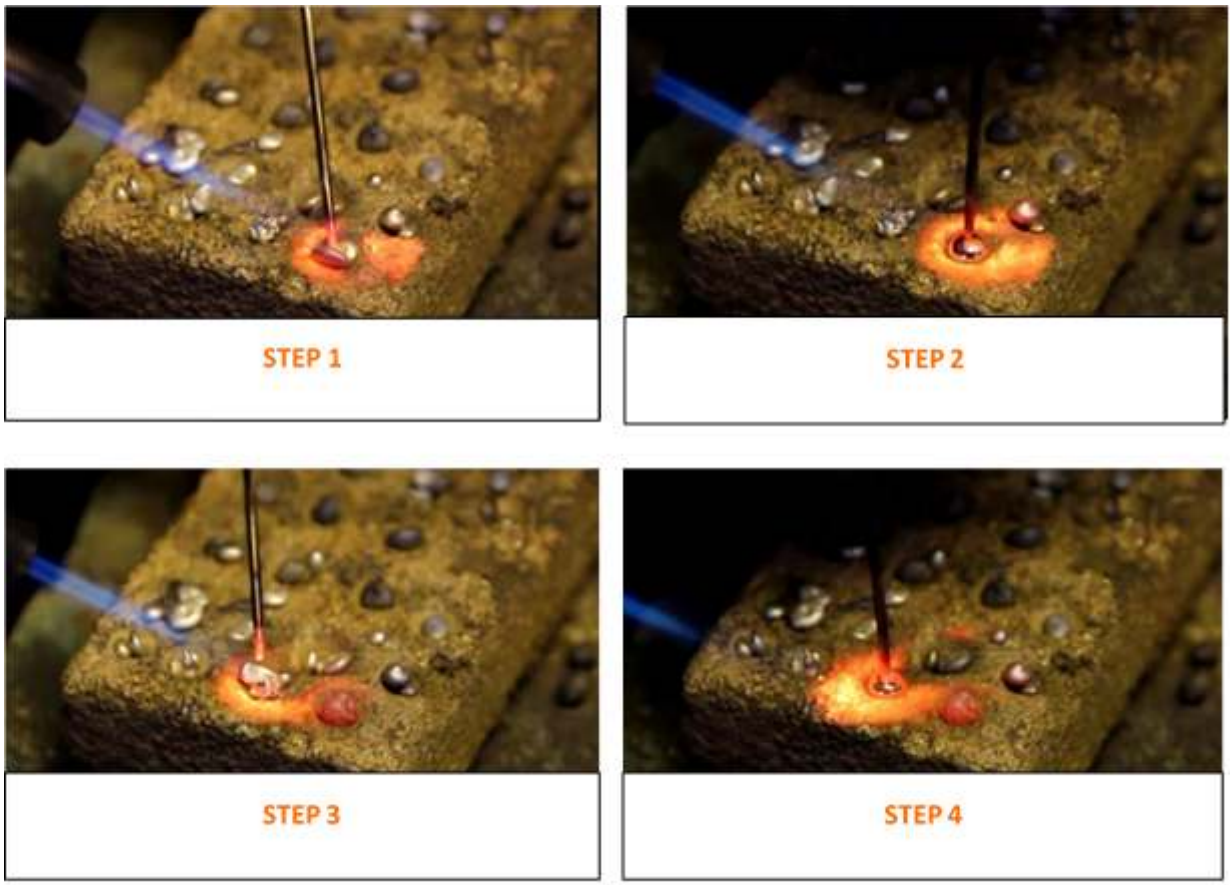


Fig 3.2.6.1 Making solid beads

Step 1: The metal is heated, lifting can help speed the process.
Step 2: When molten, the steel pin is pushed through the metal, then allow the metal to solidify and twist pin slightly to aid removal.
Step 3: The bead size can be adjusted by adding or removing metal.
Step 4: Allow the metal to solidify, give the pin a slight twist to enlarge the hole.

3.2.7 Fire the ball segments

Clean, Buff, Polish the Dome

- After soldering, cool the bead in cool water.
- Clean the metal in suggested cleaning acid or solution.
- Do a pre-polish on the bead, check for any extra metal and file it.
- Buff the bead and send for final polish.

Fig 3.2.7.1 Pre-Polish, file, clean, buff and final finish is the next process

3.2.8 Bead Making Machines

Hollow Bead and Ball Making Machines

- Hollow bead and ball making machines are available in the market, but are quite expensive.
- These machines follow the same process as handmade beads such as melting of metal, making metal sheet.
- The only difference here is that the metal wire is hollow from inside and not solid as the metal sheet is curved to make a hollow tube.
- The hollow tube is then shaped, buffed and separated into metal beads and balls.
- Since the metal is already hollow from inside, the bead hole is not required to be drilled again.
- Every machine has a different capacity; hence it is advisable to check with your company about the machine being used at your factory.

Fig 3.2.8.1 Hollow bead and ball making machine

Tips

1. If the half spheres do not meet together, there will be a gap in between and the piece will be defective.
2. Make sure to check that all extra metal has been filed off before sending it to the next department for polishing and cleaning.
3. Using the right alloys during the metal refining process will allow the metal to remain stable without cracks.
4. Any additional metal used which is later filed, will lead to metal loss.
5. Using the right alloys during the metal refining process will allow the metal to remain stable without cracks.

Exercise – Tick the Right Answer

1.What tool is this?

a. Buff Wheel
b. Flame Torch
c. Scribe
d. Ring Clamp

2.What process is this?

a. Polishing
b. Wire Drawing
c. Filing
d. Metal Sheet

3.What tool is this?

a. Rolling Mill
b. Steam Cleaner
c. Saw Blade
d. Setting Machine

4.What is the technique or term used for joining 2 half spheres?

a. Kundan
b. Soldering
c. Filing
d. Engraving

Exercise – Tick the Right Answer

5.What tool is this?

a. Buff Wheel
b. Tweezer
c. Dapping Cube
d. Hammer

6.What tool is this?

a. Soldering machine
b. Setting Machine
c. Dapping Punch
d. Polishing Wheel

Unit 3.3: Making grains or 'Rawa'

Unit Objectives

At the end of this unit, you will be able to:

1. Understand step by step process of making grains or ‘rawa’.
2. Understand technique to apply grain less to metal surface.

3.3.1 Granulation

Granulation (from "grain") is a type of decoration in which tiny balls or beads of gold called grains or granules ('small spheres') are applied to a surface of metal base using heat. The base is usually sheet metal, but the same process can be used to join granule to granule, granule to the wire, wire to wire, chip to sheet, wire to sheet, sheet to sheet, and any other combinations. This has been a popular way to decorate and texture jewelry items since ancient times.

Fig 3.3.1.1 Fine Granulation

The materials used for granulation are usually high-karat gold and/or silver alloys. Alloys below 18 kt. gold and sterling silver are not suitable for granulation.

3.3.2 Making Granules

The granules are made from the same alloy as the metal to which they will be applied. This process of making small spheres or small rounded balls is called 'Spherodizing'. In this process thin sheet of metal is rolled out of metal and scissoring very narrow fringes along the edge. The fringe is cut off and to get small squares or platelets of metal. Another technique for creating grains uses very thin wire coiled around a thin mandrel, like a needle. The coil is then cut into very small jump rings. These symmetrical jump rings or small platelets after heating, fusing, and cooling results ('Spherodizing') in evenly sized granules.

During 'Spherodizing' metal platelets or jump rings are coated in charcoal powder to prevent them from sticking together during firing and form a reducing atmosphere preventing oxidation. The bottom of a crucible is covered with a layer of charcoal and the gold or silver metal bits are evenly spaced as possible. Similarly, a new layer of charcoal powder and more metal pieces or chips are layered in the crucible. This crucible is fired in an oven. In the oven of the kiln these small metal bits are melted to a liquidus point, a cohering surface tension causes them to contract to a spherical shape. These newly created spheres are left to cool and then cleaned in water or pickled in acid. Sieves are used to sort the granules in order to confirm even-size granules.

It is also possible to set the metal bits pieces on a charcoal block and heat them with a torch, a method that is particularly useful when only a few granules are being made. A disadvantage of this method is that the spheres tend to have a small flat facet, especially in the larger granules.

Preparing the metal surface

Before the addition of granules, the surface on which granules will be fused is prepared by 'Depletion Gliding'. Depletion gilding is a method for producing a layer of nearly pure gold on an object made of gold alloy by removing the other metals from its surface. In this surface enrichment process, the object's surface is heated to a temperature, which causes the copper molecules in the outermost layers of the alloy to combine with oxygen, oxidize, and form a fire sale on its surface. Later the object is immersed in a hot picking solution (Nitric oxide), which dissolves the copper oxide i.e. the copper on the surface, and leaves precious metal-rich (gold or silver) molecules on the surface. After thoroughly rinsing the object with water the surface is scratched or brushed with soft brass brushed, which gives the effect of burnishing. The heating and pickling steps can be repeated to get a more enriched surface.

3.3.3 Main techniques for applying granules to a metal surface

There are two main techniques that can be used to apply granules to a metal surface, which are joining by fusion and other one is soldering either hard soldering or colloidal hard soldering.

Fusing

This fine granulation method 'Fusing' welds two metals of the same alloy together using only heat. A sheet of metal with approximately the same thickness as the diameter of the granules is necessary to get an even heat distribution. Once the granules are positioned using a diluted flux and a fine paintbrush, the whole thing is fired in an oven with a reducing atmosphere. At the point of reaching a liquidus temperature of the granules and sheet metal fuse together. At this point the surface of granules shines like a mirror. The great advantage of this method is that no flux or solder remains. This technique requires great skill and practice.

A more modern way to accomplish fusing is through the use of an electric current. This is referred to as fusion-welding. The electric current is applied to each granule, passing through the granule to the base, generating enough heat to fuse the granules to the object. The advantage of this method is that one can use it on finished jewelry items, even those already stone set. The disadvantage lies in the fact that the granules may not snuggle as tightly together as the design requires or that the current flow will be drawn to the neighboring granules, resulting in looser joins.

Hard soldering and Colloidal hard soldering

Soldering metal items together relies on the capillary action of a lower melting point solder flowing between the items to be bonded. Soldering is a commonly used technique for bench jewelers and has been practiced since ancient times. Soldering small metal grains, however, poses a problem. In order to solder granules, extremely small paillons of solder need to be cut and positioned near the point of contact between the granule and the metal. It would be very difficult to replicate this process repeatedly with the hundreds of granules that need to be attached to achieve a design. Additionally, solder requires the use of a binding agent called flux. When flux is heated it bubbles, this easily dislodges small items and would send granules jumping everywhere.

One way to avoid this problem is to file the solder to a coarse powder and mix it in with the flux. The area to which the granules will be attached is painted with tragacanth – which acts as a glue – and the granules are positioned using a very fine paintbrush. After drying, the granules are sprinkled with the flux-solder powder and heated to the point that the solder flows underneath the granules through capillary action. This process will leave solder remnants in the gaps between the granules which cannot be removed.

Colloidal or eutectic soldering, also known as chemical soldering is one of the ancient techniques. This technique makes use of a colloidal mixture of tragacanth gum and copper salts. This compound lowers the melting temperature of the two metals in contact (the granules and the base) after which the copper diffuses into both at the point of contact. This results in a strong metallic bond.

The surface of the metal is painted with colloidal solder. The granules are arranged on top of the solder with a fine paintbrush and left to dry slowly. The piece is fired in a reducing atmosphere and the tragacanth burns away releasing the copper salt from the compound. At the eutectic soldering temperature (the copper diffuses into the granules and the base linking them together. This requires good timing and a great deal of skill.

3.3.3 Main techniques for applying granules to a metal surface

Various arrangements of Granules or Granule patterning

Certain basic systems exist in which granules can be arranged. These patterns can be classified as follows: linear or serial systems; geometric massed systems; random systems; varied-sized or shaped granule systems; and three-dimensional systems.

Unit 3.4: Making Collets

Unit Objectives

At the end of this unit, you will be able to:

1. Understand step by step process of making round prong collets.

3.4.1. Making Collets

In case of basic bezel setting depending on the stone size the final diameter and height of collet is calculated and accordingly strip or tubing blank is cut. The height of the collet will be in proportion to the depth of the stone and the inner diameter of collet will be in proportion to the diameter of the stone.

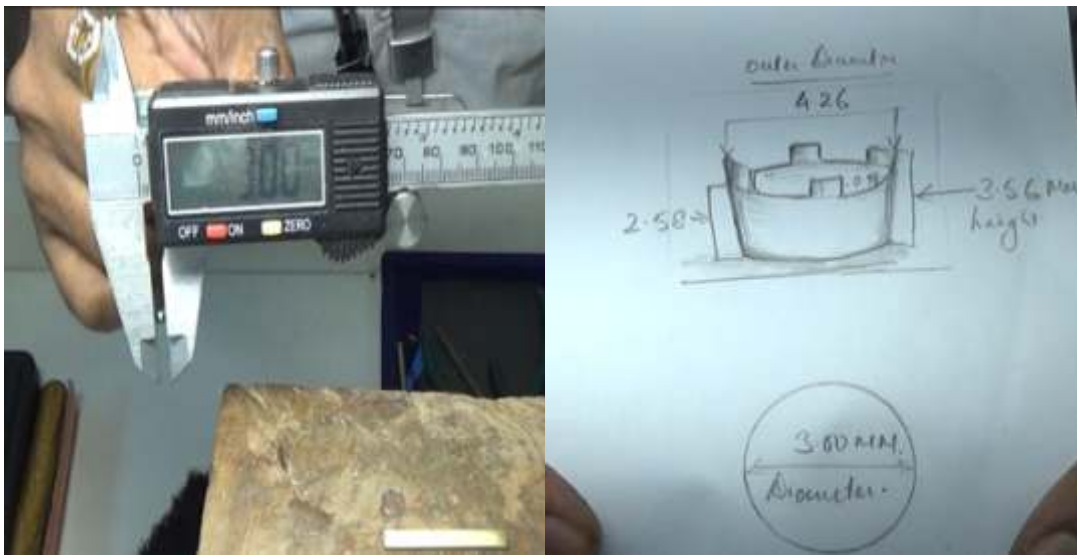


Fig 3.4.1.1 Sketch of Four prong collet for a round 3 mm stone

The strip is cut using jewelers saw and the annealed to soften the metal, which makes it easy to bent in circular shape.

Fig 3.4.1.2 Measured strip cut and annealed

3.4.1. Making Collets

After annealing and cooling the strip is bent using flat plier.

Fig 3.4.1.3 Bending strip using flat plier

Nose plier, iron block and hammer are also used to achieve final proper round shape.

Fig 3.4.1.4 Shaping collet to get round shape

3.4.1. Making Collets

After proper shaping of the round collet, the open seam needs to be soldered. For soldering the collet is placed on the soldering block and seam is soldered with suitable soldering compound. After quenching and cleaning the collet the extra solder is cleaned

Fig 3.4.1.5 Proper shaping of round collect & process

After the collet is finished properly after soldering using piercing saw mark out equal divisions by making a small cut. Then cross burr is used to follow the original saw cuts. Finally side slots are finished using small files like small square or round needle file to expand the slots.

Fig 3.4.1.6 Filing the cavities between the collet prongs

3.4.1. Making Collets

After cutting and finishing the four prongs of collet the inside is finished using round needle file and flat bottom side is finished using small flat file.

Fig 3.4.1.7 Using round needle file & flat bottom side

After finishing place the stone and check the final look of collet and Now the collet is ready to be fitted into the jewelry.

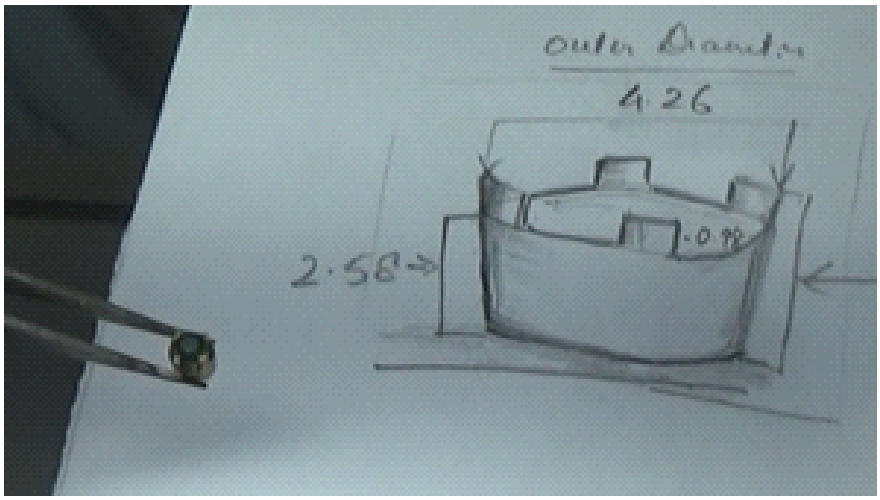


Fig 3.4.1.8 Check final look

Unit 3.5: Making Box Claps

Unit Objectives

At the end of this unit, you will be able to:

1. Understand step by step process of making a box claps.

3.5.1. Making Box Claps

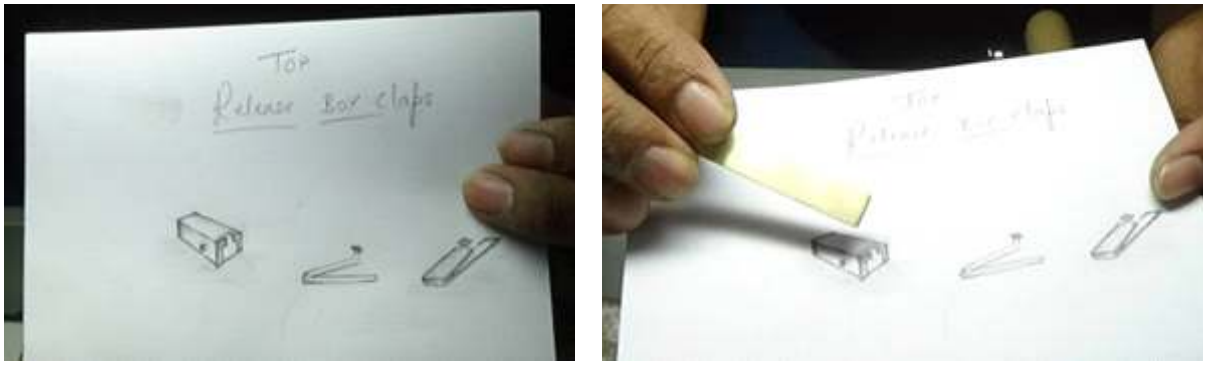


Fig 3.5.1.1

Box clasps have two parts a tongue and a box. The tongue or snap is squeezed and fits in the box and locks into place. So, after reviewing the drawing rectangular strip of measured size is cut for tongue or snap. Finish sides using emery paper.

Fig 3.5.1.2

Scribe small mark from one end of the strip using divider, T-Square which can be later filed and folded. Score using saw blade mark and triangle file. Later strip in annealed and cleaned. Then nose piler snap is bent.

Fig 3.5.1.3

3.5.1. Making Box Claps

Fig 3.5.1.4

After folding sheet solder the sheet crease is soldered and sheet is pickled, quenched, rinsed, and dried. After soldering using surgical blade used in rubber mould cutting and hammer the crease is corrected to ensure correct fold. Finally polishing is done using emery paper wheel.

Fig 3.5.1.5

Then ready-made Push or trigger is soldered to tongue and the snap is ready to fit in to the box.

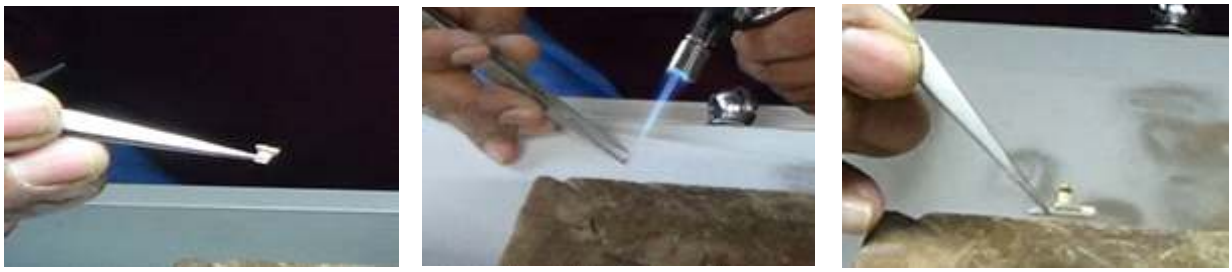


Fig 3.5.1.6

3.5.1. Making Box Claps

Now to make the GB box a brass strip is cut. On the strip creases are marked and cut using hack-saw at intervals of measured length using jewelers saw for the layers of the walls of the box. Then the folding at the crease is done to get rectangular shaped box Then edges are filed using triangular file to make burr free and now ready for soldering to form a closed box. After soldering and cleaning the box is filled and polished.

Fig 3.5.1.7

3.5.1. Making Box Claps

After filing and polishing of the soldered box, notch is pierce out to accommodate the trigger. The notch inside the box needs to be cut out and filed slowly, carefully to avoid excess removal of metal. The opening and the fitment should be checked frequently. The fit should be as tightly as possible and filing should be stopped after the assembly clicks into place.

Now stopper is be made using a thick brass wire and ball and is soldered to the box. Finally, the whole assembly is polished and checked for the final fitment.

Fig 3.5.1.8

Scan the QR Code to watch the related video or click on link

Click Here
Making Box Clasp

Unit 3.6: Stamp patterns on gold or its alloy

Unit Objectives

At the end of this unit, you will be able to:

1. Understand how to stamp a gold sheet.
2. Understand the importance of filing a stamped piece, especially die struck components.

3.6.1 Stamp the Gold Sheet

Introduction to Metal Stamping

- Refer to 3.1.1 for the metal sheet process.
- Metal stamping can mean either of the following:
  - Stamping company logo, name, hallmark, metal purity.
  - Having messages such as "Happy Birthday" stamped on the metal.
  - Have a die being used to create durable metal pieces for example coin die stamp.
- In the 1st two cases, a stamping tool set is required with stamps having the logo and an alphabet stamp kit and this is usually done manually.
- In the 3rd case, a die struck machine or tool is required with die stamps.

Fig 3.6.1.1 Stamping tools

3.6.1 Stamp the Gold Sheet

- In manual metal stamping with tool kit, we need to have metal sheets which have been cut to the size required as per job description.
- In case the shape is something that is used often, then multi-shape metal cutters are available for cutting the metal sheets as per required shape.
- In these cutters, the metal sheet is inserted into the opening below the designs (Look for arrow marked in picture).
- The required cutter size is chosen and the metal gets cut with clean edges.

Fig 3.6.1.2 Multi shape metal cutters

3.6.2 Manual Metal Stamping with Tool Kit

· Once the required shape and size of the metal is cut, the stamping of the metal is done.
· The tool kit will contain Metal Letter or Design Stamps, Hammer (for best results use 450 or 905 grams Brass Hammer), Steel Bench Block, Blank Metal Sheets for Stamping, Stamp Enamel™ (depending on kit manufacturer), Polishing Cloth (or a paper towel or clean rag) and a Straight Tape.

3.6.3 Manual Metal Stamping - Steps

Step 1

- Place a blank metal sheet on a steel bench block
- Stick a strip of Straight Tape across your blank.
- The upper side of the tape will act as a guide to help you stamp steadily and in a straight line.
- Mark the area on the tape with a pen where the letters will be stamped.
- This will ensure the stamped imprints are evenly spaced.

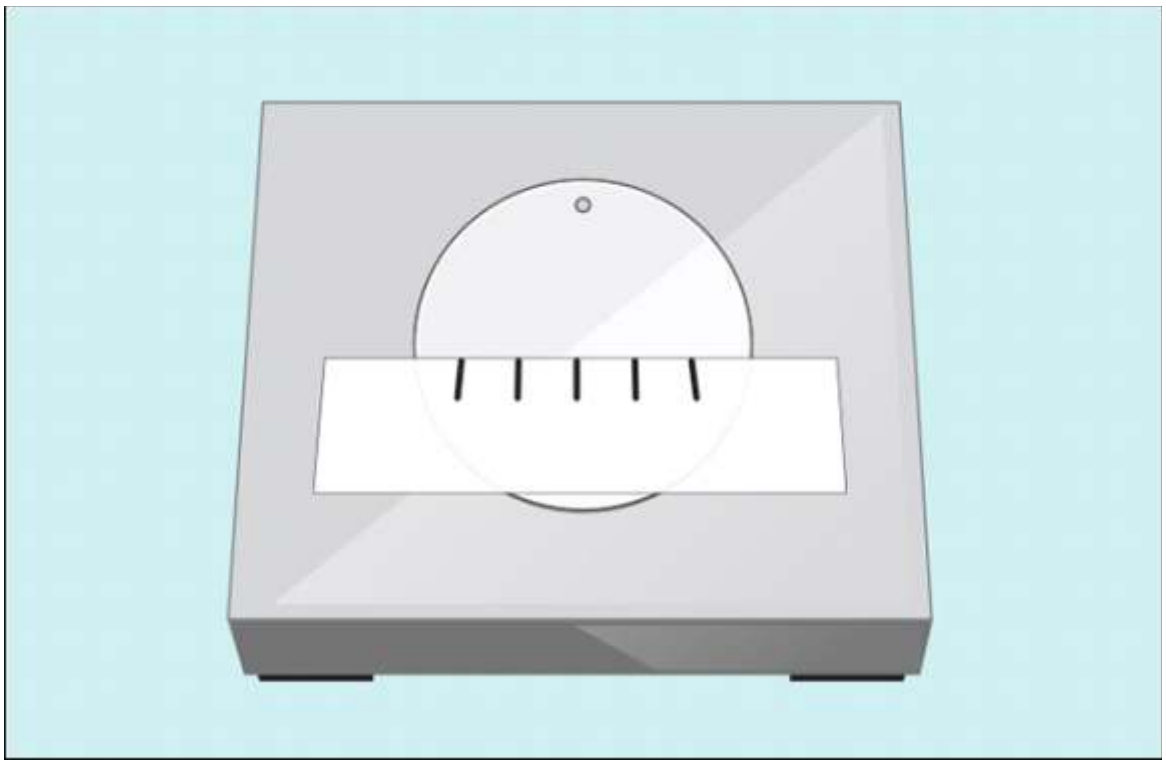


Fig 3.6.3.1 Tape the Metal Sheet

3.6.3 Manual Metal Stamping - Steps

Step 2

- Place your stamp on the disc and lightly drag the stamp towards the tape until you feel the stamp touch the top edge of the Straight Tape.
- Be careful not to scratch the stamping blank while dragging the stamp.

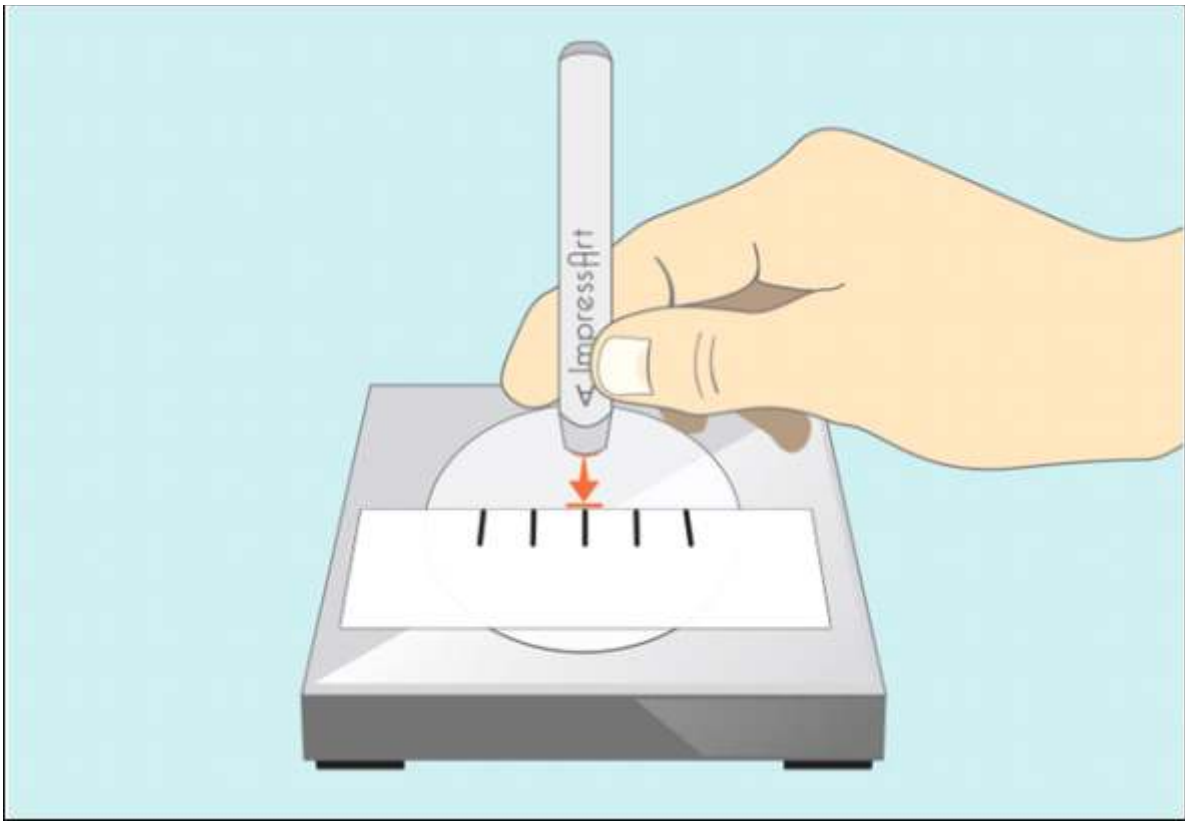


Fig 3.6.3.2 Lightly Drag the Stamp to the Edge of the Tape

3.6.3 Manual Metal Stamping - Steps

Step 3

- Hold your metal stamp so that the top part of the stamp is at level with the metal disc.
- With medium pressure, tap the top of the stamp with the hammer.
- If you tap the stamp too lightly you can tap it again as long as the stamp has not been moved.
- Larger as well as descriptive metal stamps require a harder tap compared to smaller and less descriptive stamps.

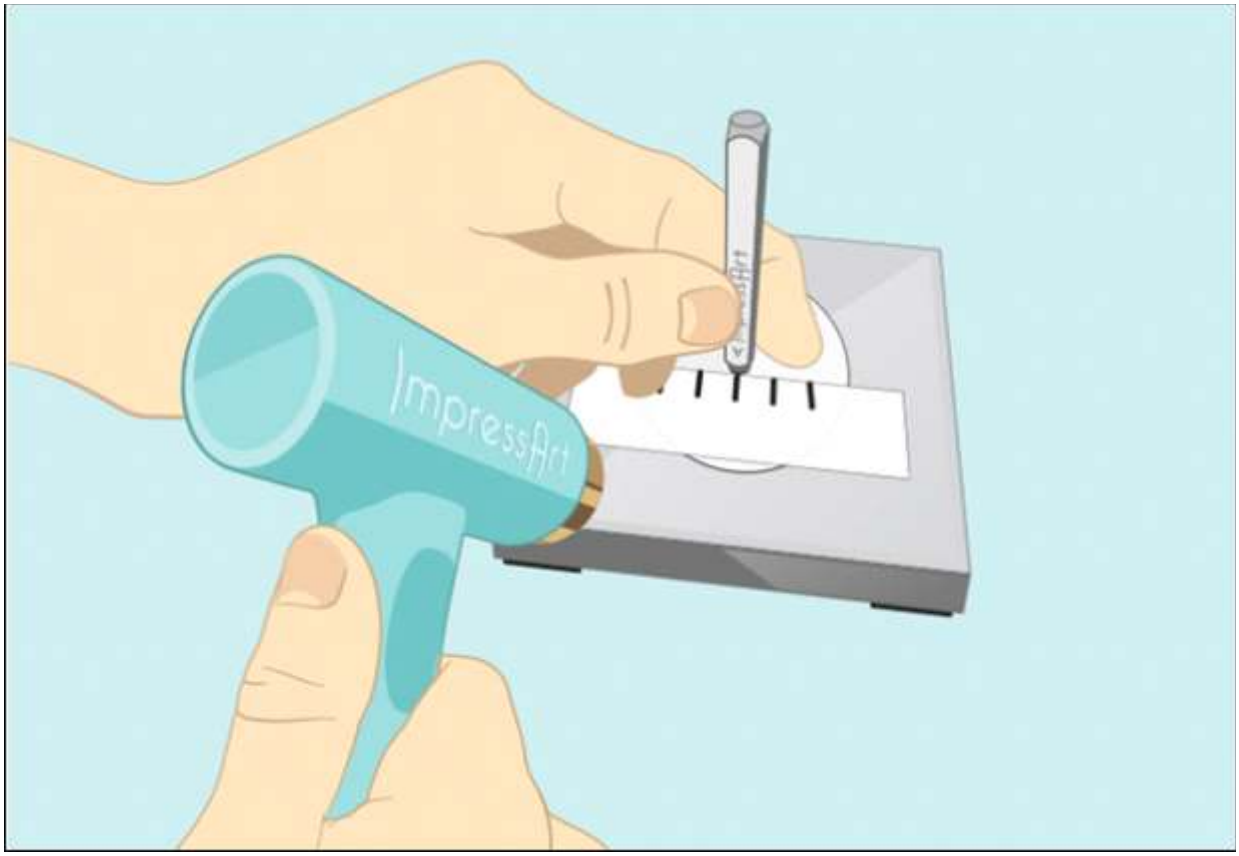


Fig 3.6.3.3 Striking the Metal Stamp with Hammer

3.6.3 Manual Metal Stamping - Steps

Step 4

- Repeat step 2 and 3 until all of your stamp impressions are made.
- Remove Straight Tape guide after you have finished stamping.
- To make the details more visible, colour the stamp imprints with ink.
- Quickly wipe off any surplus ink from the disk with a polishing cloth or clean rag.
- The enamel will fill the impression making it look beautiful.

Fig 3.6.3.4 Fill Stamp Imprints with ink

3.6.4 Stamping Machines – Die Striking

- In die cutting, the punch and matrix are flat, each component has a specific shape, one side with the preferred outline and the opposite side with the exact same hollow shape in the inside used to achieve the specific outline.
- In die moulding, the punch and the matrix have the same surface i.e. the punch has a high relief and the matrix has a low relief to achieve a desired texture in the precious metal sheet.

Fig 3.6.4.1 Die Striking Machines

3.6.4 Stamping Machines – Die Striking

Fig 3.6.4.2 Moulds for Die Striking Machines

3.6.5 File the Stamped Piece

Filing

- When filing metals, always file in one direction, do not move it back and forth.
- The purpose of filing is to:
  - Remove scratches on the metal surface
  - Shape the metal into different forms with the help of files
  - Remove extra metal and extra solder
  - Create different finishes or textures

Fig 3.6.5.1 File the Metal

Tips

1. Die struck components are very durable as long as the alloys used in the metal making is correct.
2. The wrong metal alloy can make the component crack.
3. When annealing the metal sheet for stamping make sure the sheet has been annealed properly and regularly to avoid any issues during stamping.
4. Stamping manually has to be done very carefully as the stamp may scratch the metal parts.
5. Always check the thickness of the metal when stamping, otherwise the stamping could break the metal.
6. In die struck jewellery, the incorrect proportion of alloy to metal during melting will make the metal brittle.

Exercise – Tick the Right Answer

1. The material that is being filed is a?

a. Saw
b. Component
c. Wood Piece
d. Ring

2. What is the craftsman doing?

a. Annealing the metal
b. Melting the metal
c. Filing the metal
d. Cooling the metal

3. For which jewellery are these components used?

a. Ring
b. Pendant
c. Bracelet
d. Earring

Unit 3.7: Make Chain from Gold Bar

Unit Objectives

At the end of this unit, you will be able to:

1. Understand the how chains are made from gold or alloy by machines as well as by hand
1. Understand how filing is important for chains.
1. Understand product defects that take place during component making.

3.7.1 Make Chain from Gold or Alloy

Introduction to Chains

- Gold, silver and platinum chains can be made either by chain making machines or then manually.
- The metal needs to be melted with the right alloy and drawn into wires of the required thickness.
- If the annealing and cooling of the wire is not done correctly, the chain will break.
- The type of solder used for joining the links is also important.
- Chains are available in different designs.
- Chains are also measured as per required lengths.
- When making a chain, refer to your job sheet for the design requirement and length of the chain.
- Chains are not only used for necks pieces but also can be used for bracelets as well as anklets.
- Machine made chains are less expensive compared to handmade chains.

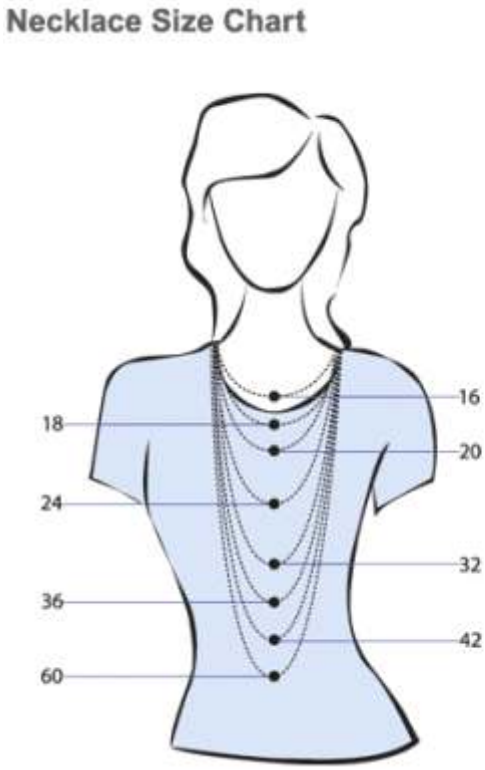


Fig 3.7.1.1 Chain Lengths and Metal Wire for Making Chains

3.7.2 Chain Designs

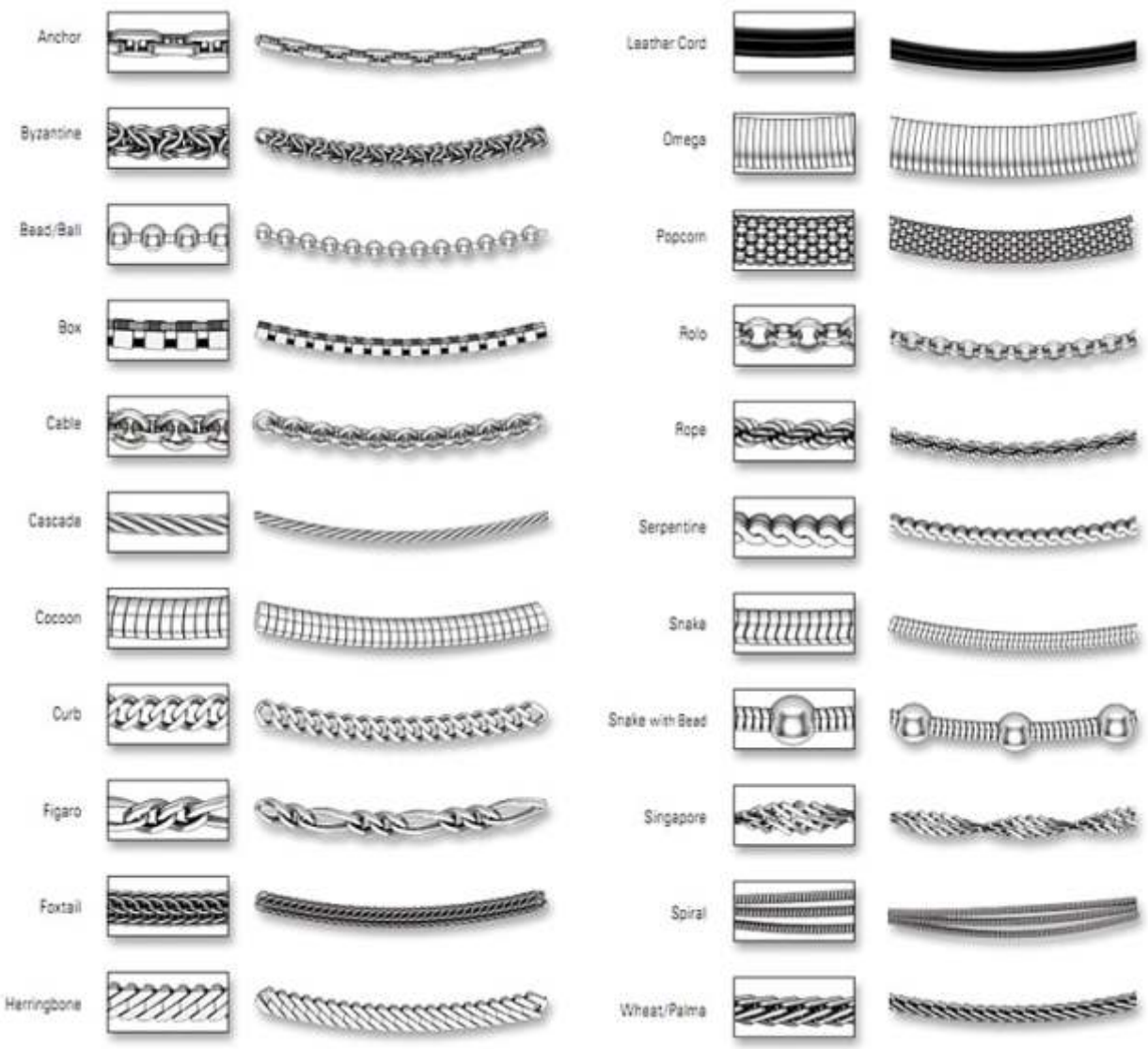


Fig 3.7.2.1 Types of chain designs

3.7.3 Clasps

- In addition to knowing the chain design and length, you should also know the types of clasps that will be used with the chain.
- Clasps are often available in lots manufactured by machines.
- You can also make a clasp manually.
- The clasp is an important element of the chain as it creates the locking system for the chain.
- If a clasp is defective, the chain will fall from the customer's neck.
- Clasps have to be soldered manually on both machine made chains as well as handmade chains.

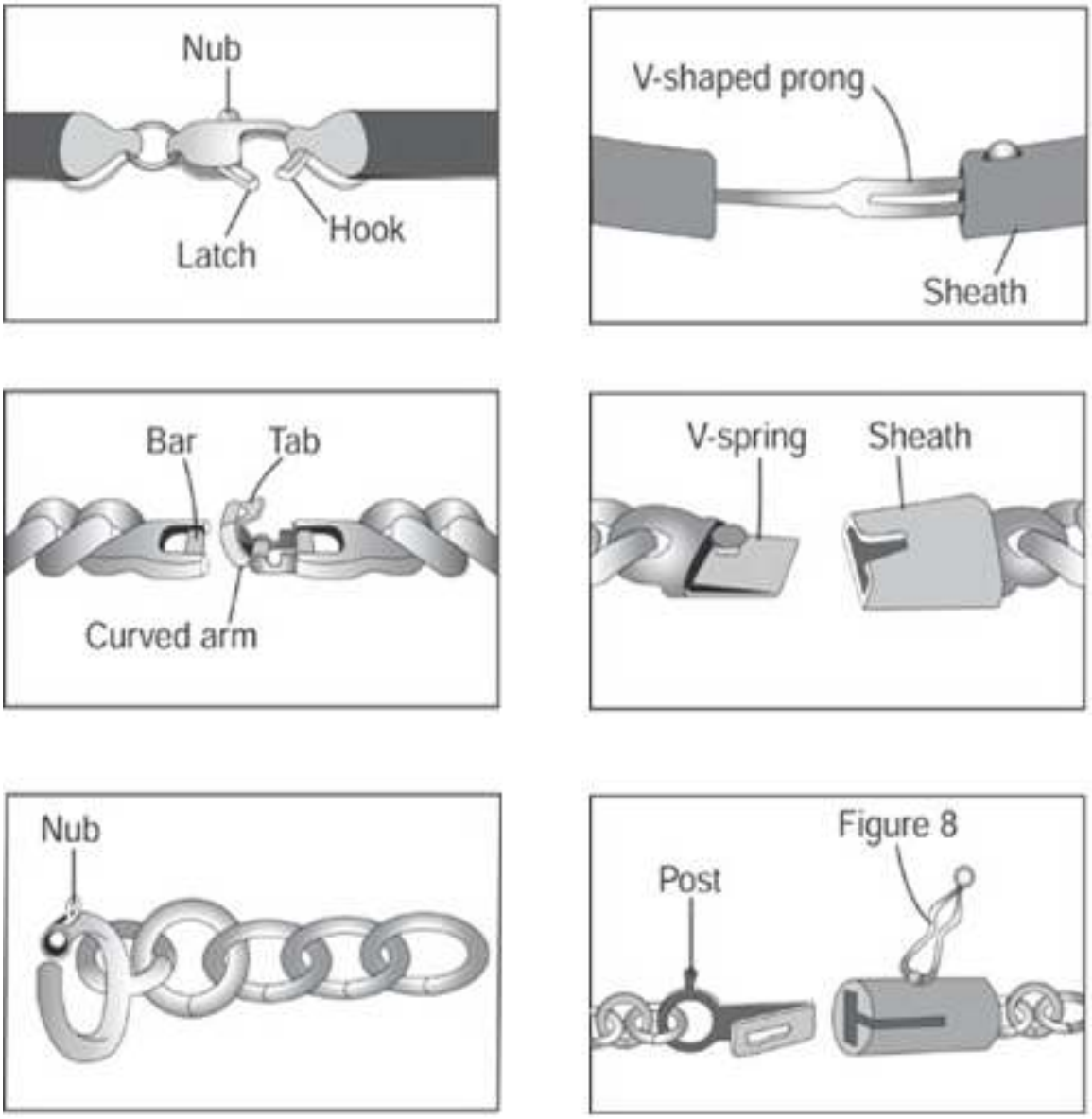


Fig 3.7.3.1 Types of clasps

3.7.4 Machine Made Chains

- Make the metal wire as per earlier instructions with the correct alloy before using it in the chain making machine.
- Chain making machines can make chains of higher karatage.
- They involve the entire process from making the required thickness to the type of chain design.
- Many machines also have in-built soldering, cleaning and finishing processes.
- Plating is done after the chain has been completely buffed and polished.
- Machine made chains have high production quantities and are also cost effective.

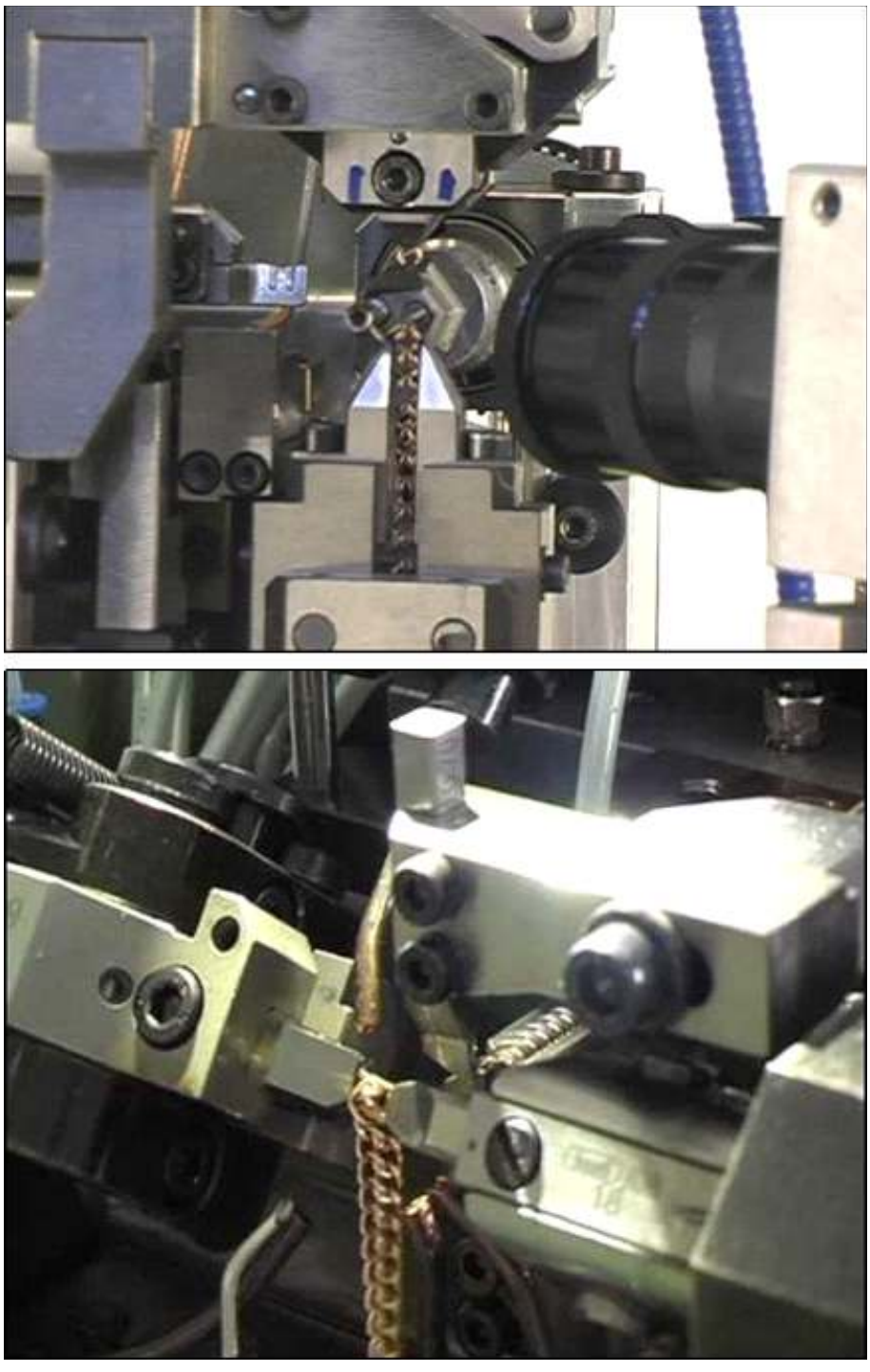


Fig 3.7.4.1 Machine made chains

3.7.4 Machine Made Chains

- When making, machine made chains, metal wire is made thin by re-heating and drawing so that it starts to coil.
- This coiled wire is then put on a spool.
- Once the wire is of the desired thickness is achieved, it is passed through shaping jaws of the machine.
- The shaping jaws of the machine shape and join the links together.
- Once the linking process is over, a worker takes the chains and puts them into a bowl of flux powder to make the chains ready for soldering.
- The chains are put under heat for completing soldering.
- They are then cleaned in a chemical bath.
- The final step is to plate the chains.
- The chains are then cut as per required size and a clasp is attached via soldering or pressing the metal loop tightly.

Fig 3.7.4.2 Machine made chains – Top left (coiled wire on spool), Top right (wire being pulled into machine for making wire), bottom (arrow shows the wire going into machine and getting shaped into chain)

3.7.5 Handmade Chains

- In handmade chains, the metal wire is drawn as per thickness specifications required for the design.
- The tools required for this job includes coiling set, pliers, wire cutter, solder alloy, flame torch or heat torch, solder pad, files, cleaning acid, water bowl, dry cloth, hammer, cup burs, cleaning tools, finishing tools and extra wire.
- This is a longer process since every part of the chain has to be made separately.
- Handmade chains are usually more expensive compared to machine made chains.
- In large factories, handmade chain steps are divided amongst the department such as soldering, making coil, making jump ring, twisting the jump ring, assembling and finishing.

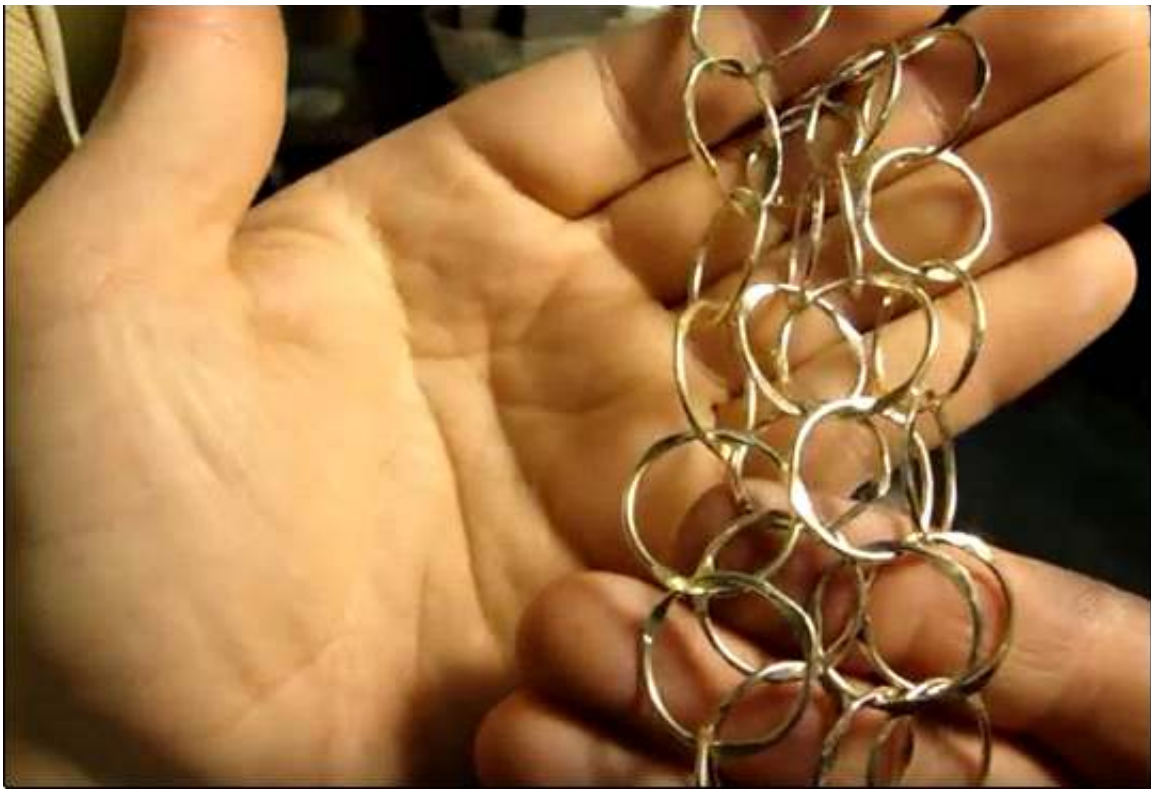


Fig 3.7.5.1 Handmade Chains

3.7.6 Handmade Chains - Steps


Step 1: Make spiral coil and cut single jump rings


Step 2: Join the ends of the jump rings and keep equal amount of open jump rings


Step 3: Solder the jump rings with solder

Fig 3.7.6.1 Handmade Chains – Steps Part 1

3.7.6 Handmade Chains - Steps

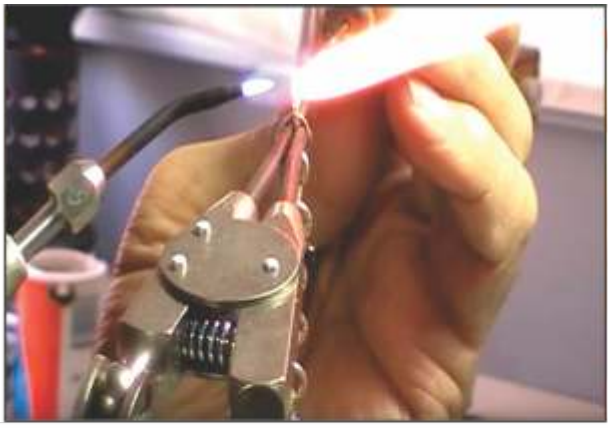

Step 4: Cool the soldered jump rings and take the balance open jump rings


Step 5: Join the solder jump rings and the open jump rings together – 2 closed jump rings in one open jump ring


Step 6: Place the attached jump rings on a holder for soldering the open jump rings

Fig 3.7.6.2 Handmade Chains – Steps Part 2

3.7.6 Handmade Chains - Steps

Step 7: Cut small bits of solder and solder the open jump rings with solder one by one – avoid flame torch touching the already soldered jump rings


Step 8: Cool the soldered chain and pickle it in acid


Step 9: To make the clasp, take a piece of metal wire, file it on the edge

Fig 3.7.6.3 Handmade Chains – Steps Part 3

3.7.6 Handmade Chains - Steps

Step 10: Bend the wire for making a clasp hook and send for cleaning, buffing and final polishing

Fig 3.7.6.4 Handmade Chains – Steps Part 4

3.7.7 File the Chain Components

File the Chain

- Filing process for any metal is the same as earlier discussed.
- Filing is an important aspect in chains as many chains may require additional filing to give it a specific finish or texture.
- Filing the clasp is also important if it has been handmade.

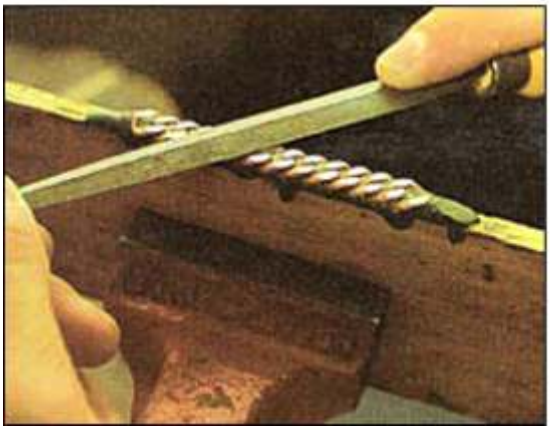
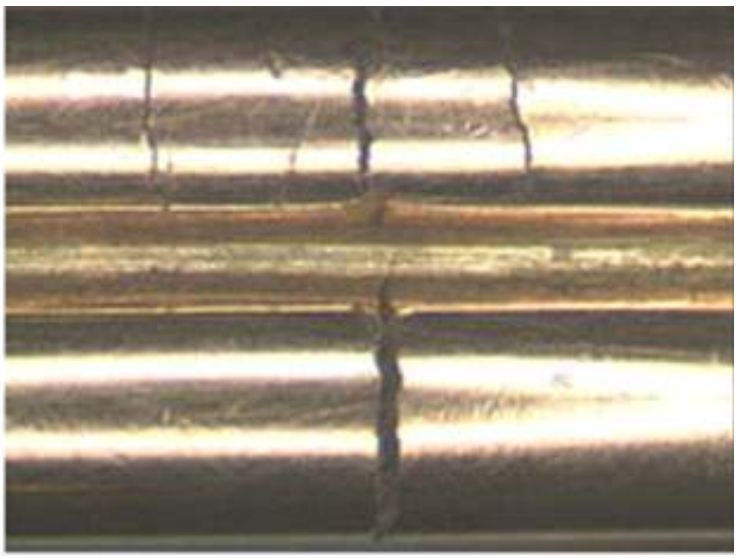


Fig 3.7.7.1 Filing of chains

3.7.8 Detecting Product Defects

Product Defects

- Jewellery components such as ring shanks which are made with metal sheets using the roll mill can have defects such as corrosion and stress (breakage) on it due to wrong alloy being used and due to irregular annealing of metal during the sheet making process.



The effect of corrosion and stress on a 10K yellow wedding band.

Fig 3.7.8.1 Product Defects – Corrosion and stress on a metal band

3.7.9 Product Defects

Fig 3.7.9.1 Product defects – damaged component or finding

3.7.9 Product Defects

Fig 3.7.9.2 Product defects – crack on ring shank due to annealing problem during wire drawing process

3.7.9 Product Defects

Figure 3 - Failed cup setting

Fig 3.7.9.3 Product defects – cracks on prong made in die struck machine due to annealing problem during metal sheet making

Figure 9 - Fractured ring blank

Fig 3.7.9.4 Product defects – fractured ring blank made in die struck machine due to annealing problem during metal sheet making

3.7.9 Product Defects

Fig 3.7.9.5 Product defects – metal chipped off during bead making process due to excess hammering

3.7.10 Repairing Product Defects

Fig 3.7.10.1 Product defect repairing – shank of ring is uneven and the 3rd ring requires re-cutting and re-soldering

Tips

1. When making chains, whether machine made or handmade, the most crucial part is the melting of the metal to make the wire along with the annealing and cooling of the metal.
2. If any part is done incorrectly during the melting or wire drawing process, the chain's strength and durability will get affected.
3. Too much filing before or after making component can affect the jewellery product.
4. Too much or too less of solder can make a jewellery piece defective.
5. If the component is damaged beyond repair, then inform your supervisor.
6. Once the damaged piece is repaired, send it to the next department with all repair details as well as weight loss details.

Notes

Unit 3.8: Making the Filigree Wires

Unit Objectives

At the end of this unit, you will be able to:

1. Understand step by step process of making the filigree wires.

3.8.1 Making the Filigree Wires

Filigree making is the process of curling, twisting, wrapping, and braiding fine pliable threads of precious metal wire (Gold/ Silver), and some other metals like copper and fastening them by soldering in some specific pattern or free-form design. This indigenous craft form is used in making complex and delicate jewellery as well as a decorative artefact in a minimal amount of precious metal.

The Silver and Gold wires or threads are interwoven into the complex lace-like decoration, which resembles a natural world of vines and twins and a type of artistic decoration 'Arabesque'. This surface decoration is based on rhythmic linear patterns of scrolling and interlacing foliage, tendrils or plain lines, often combined with other elements". Due to the delicacy, this art form can be only made by skilful hands and cannot be mass-produced by casting or by any metal fabricating process. The beauty of this artwork is enhanced by adding gemstones, crystals, enamelling, etc.

Fig 3.8.1.1 Filigree work

3.8.2 Types of filigree

In the process of making filigree jewellery many techniques such as nipping, plaiting, jointing, piling, filling, and knitting are used.

Types of Filigree can be grouped into four; the first and most common type is called Openwork filigree, in this, the filigree work is without any backing. This heavier frame holds soldered lighter-weight wire units inside. This filigree technique uses most minimal metal or wire, less than the actual surface of a form. In this lightest form labour cost is more due to the small-scale manipulatory skills, good vision and patience of the artisan. Tarakasi jewellery of Cuttack in India is the best example of the open type of filigree.

Fig 3.8.2.1 Filigree work

3.8.2 Types of filigree

Several forms of wire are used in filigree, which include: round, flat, square, textured, twisted, spiral, etc. the gauge of wire depends on the fineness and coarseness of the filigree design. Usually, in filigree jewellery, the frame wire of 20-26 gauge B&S and filer wire of 22-23 gauge B&S are used. The wire has to go through annealing, straightening, twisting and flattening to be ready to use for filigree.

Frame wire forms form the main structure or theme the shape that contains and supports the filler wires. A single piece of filigree jewellery or artefact may contain multiple subframe units joined to the main frame wire to give strength. Filler wire or patterns wire are the fine wires that fill the frame. The height of theses flattened filer wires are equal to but not more than the frame wire. These wires are shaped using tweezers and cut with nippers and cold chisels. High box setting and bezel setting are usually used to set the stone in this filigree work.

Fig 3.8.2.2 Filigree work

The second type of filigree is ground (base) support filigree, in which all the wires are ground-supported filigree. In this, all the wires are soldered to a ground of sheet metal or wire mesh. The base helps to construct and solder compared to open wire filigree soldering, in which the whole assembly needs to be flat and the fillers should be properly fixed leaving not too much of a gap, which can make the whole structure weaker. So, soldering needs to be done carefully.

Fig 3.8.2.3 Filigree Jewellery Making

After soldering the work is brushed with brass wire and then pickled. The base surface is usually matte, which is left as it is and the filer wires are burnished. The shining surface

The third type is the combination of openwork and ground support as well as combining any of the openwork filigree and ground support filigree with composite materials such as enamel or gemstone to enhance the design by filling in-between wires is the fourth type of filigree.

Fig 3.8.2.4 Filigree Work

For a filigree work to be made successfully and beautifully, one has to put in a lot of effort at the design stage.

Skill India
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Corporation
Transforming the skill landscape

GJSCi
Gem & Jewellery Skill Council of India

4. Make the Jewellery Frame

Unit 4.1 - Reading the Job Sheet
Unit 4.2 - Importance of Design Symmetry, Flexibility and Usefulness
Unit 4.3 - Creating Frame as per Design Requirements
Unit 4.4 - Filing and Linking Separate Frame Parts
Unit 4.5 - Detecting Product Defects
Unit 4.6 - Controlling Gold Loss
Unit 4.7 - Achieving Quality Standards
Unit 4.8 - Maintaining Quality of Production
Unit 4.9 - Know Your Organization and its Standards
Unit 4.10 - Work Hazards

G&J/N0610

Key Learning Outcomes

At the end of this module, you will be able to:

1. Learn and understand the job work of a frame maker.
2. Learn to use the tools and equipment required for the job.
3. Understand the type of jewellery manufactured in India.
4. Learn about metals and their alloys.
5. Understand how to assemble components to complete a design frame.
6. Understand how to control gold loss.
7. Understand how to detect product defects.
8. Learn how to check quality.
9. Learn how to improve productivity.
10. Understand the jewellery making process.
11. Understand diamonds, gemstones, enamelling and plating.
12. Understand the work hazards in your department or work area.
13. Learn how to read a job sheet and design requirements.

Unit 4.1: Reading the Job Sheet

Unit Objectives

At the end of this unit, you will be able to:

1. Understand how to read a job sheet and how a sample job sheet looks like.

4.1.1 Job Sheet Received from Supervisor

DESIGN SPECIFICATION SHEET				
Product Code				**Date of Creation:**
Product Name:				**Design Description:**
Design with Technical Information				-Measurements of Product: -Metal Used: -Stones: -Instruments to be Used: -Setting Style(s): -Finish: -Other Instructions:
Stone Details:				**Name and Signature:**
Stone	*Size*	*No. of Pieces*	*Setting Style(s)*	

Fig 4.1.1.1

4.1.2 Sample Job Sheet

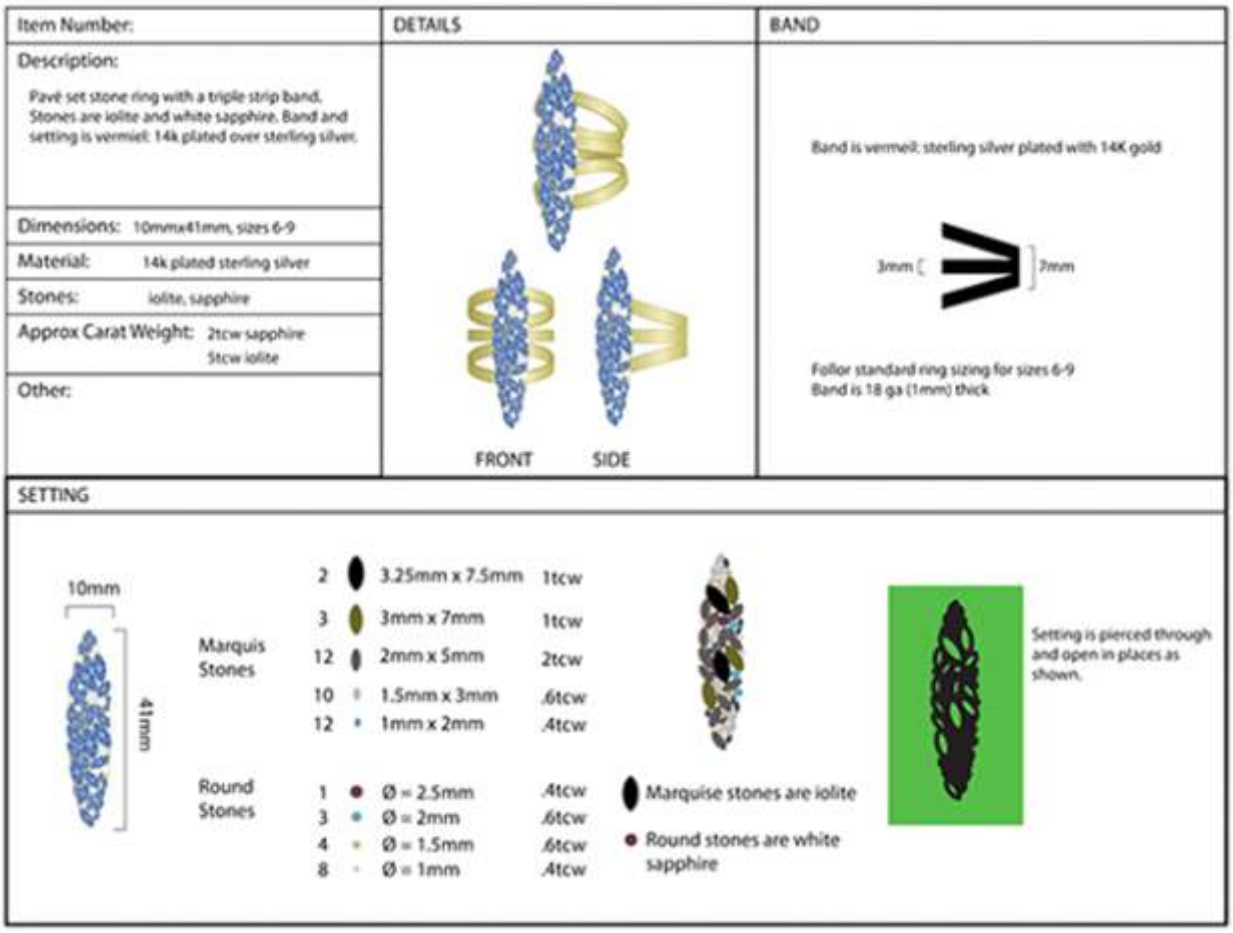

Fig 4.1.2.1 Sample Job Sheet

Tips

1. Always read the job sheet correctly before finishing and submitting the piece to the next department.

Notes

Unit 4.2: Importance of Design Symmetry, Flexibility and Usefulness

Unit Objectives

At the end of this unit, you will be able to:

1. Understand the importance of design symmetry, flexibility and usefulness through the design principles.

4.2.1 Design Principles

1. Design principles include balance, emphasis, movement, proportion, contrast, unity, and harmony of the design.
2. These principles of design are used to arrange the elements during jewellery manufacturing thus creating the visual appearance of the jewellery piece as per the design.

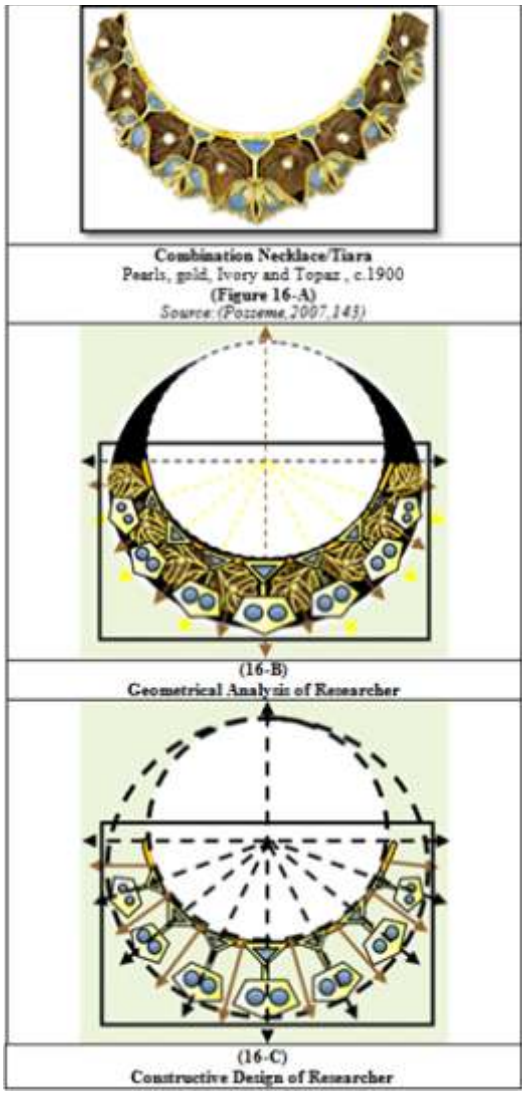

Fig 4.2.1.1 Design Principles

4.2.1 Design Principles

1. Balance

- Balance refers to the distribution of the graphical representation of colours, space, materials, and texture in jewellery designs.
- The weights should be similar on both sides to make a design feel balanced.
- For example, if there are numerous small elements on one side of a bangle they can be balanced by a larger element on the other side.
- In addition to physical weight, it's important to consider visual weight as well, such as colour, lightness or darkness and texture.
- When objects are equally distributed based on all aspects of weight, the jewellery design is considered balanced.
- Balance can be symmetrical (evenly balanced), asymmetrical (un-evenly balanced), radial balanced (arranged around a central point) or off balance (one side visual enhancement).

Fig 4.2.1.2 Balance Top Left (Symmetrical), Top Right (Asymmetrical), Bottom Left (Radial) and Bottom Right (Off Balance)

4.2.1 Design Principles

Emphasis

- Emphasis refers to the focal point of the jewellery design that catches the attention.
- A jewellery craftsman can make one area stand out by contrasting it with other areas in size, shape, colour or texture.
- Designers can also isolate the focal element, as an object placed away from a group of other objects or place it in the centre of the design to bring the most attention.

Fig 4.2.1.3 Emphasis

4.2.1 Design Principles

Movement

- Movement refers to the path our eyes follow in a particular piece of jewellery.
- A jewellery craftsman can manipulate the movement of the eye by the specific arrangement of elements in a jewellery piece.
- This movement is commonly accomplished through the use of repetition, regularity and action (movement of elements).
- For example, the observer's eye will view lines, graduation, edges, points, repeated shapes, lighter to darker elements and from colour to no colour.

Fig 4.2.1.4 Movement Top Left (Repetition), Top Right (Regularity) and Bottom (Action)

4.2.1 Design Principles

Proportion

- Proportion is all about the relationship of one part of the design to another or one area to the whole.
- Proportion is usually not noticed until something is out of proportion.
- When the relative size of two elements being matched looks incorrect or out of balance it is said to be "out of proportion".
- The clasp and focal piece should be proportionate to the components, beads, danglers in the jewellery design.
- Group similar elements together or things that share a common feature, such as texture, colour, materials, etc.

Fig 4.2.1.5 Proportion

4.2.1 Design Principles

Contrast

- Contrast is created by using elements that oppose one another, such as complementary colours, using different directions (horizontal and vertical lines) or extremely light and dark elements.

Fig 4.2.1.6 Contrast

4.2.1 Design Principles

Unity

- This refers to how the elements in a design work together.
- Unity can be created by grouping similar items together in a design and repeating a colour, texture or element throughout a design.

Fig 4.2.1.7 Unity

4.2.1 Design Principles

Harmony

- This refers to how the different elements in a piece of jewellery relate to and complement each other.

Fig 4.2.1.8 Harmony

Tips

1. The importance of design symmetry, flexibility and usefulness should be understood well by a craftsman.
2. The 7 principles of design are very important and should be taken into consideration when making the frame work of the design.
3. If the design is difficult to make, ask your supervisor for advice or suggestions on how to work on the design.
4. Do not change the design on your own unless advised by the company with proper instructions.

Notes

Notes

Unit 4.3: Creating Frame as per Design Requirements

Unit Objectives

At the end of this unit, you will be able to:

1. Understand how to create the frame as per design requirements.

4.3.1 Requirements for Creating Frame

- Jewellery creation requires parts, preparation, and bonding.
- Sometimes the parts to be assembled are created through jewellery casting.
- Although the cast items come from an accurate CAD jewellery design, the raw castings are crude until shaped and finished by a skilled artisan.
- An important element of jewellery manufacturing is the cleaning and deburring of cast items.
- Proper preparation ensures ensures cast components will join with the model during the assembling process.
- Sometimes, parts are manufactured from raw metal, which is rolled or drawn into sheet and wire.
- Wire and sheet can be soldered or welded together to create settings or details to be added to the design.
- Using files, gravers, and flex shafts, frame makers can shape raw metal to form the design elements as per design requirements.

Fig 4.3.1.1 Creating Frame Work

4.3.2 Etch Design on Metal Sheet

- Etch the design on the metal sheet using the appropriate tools.

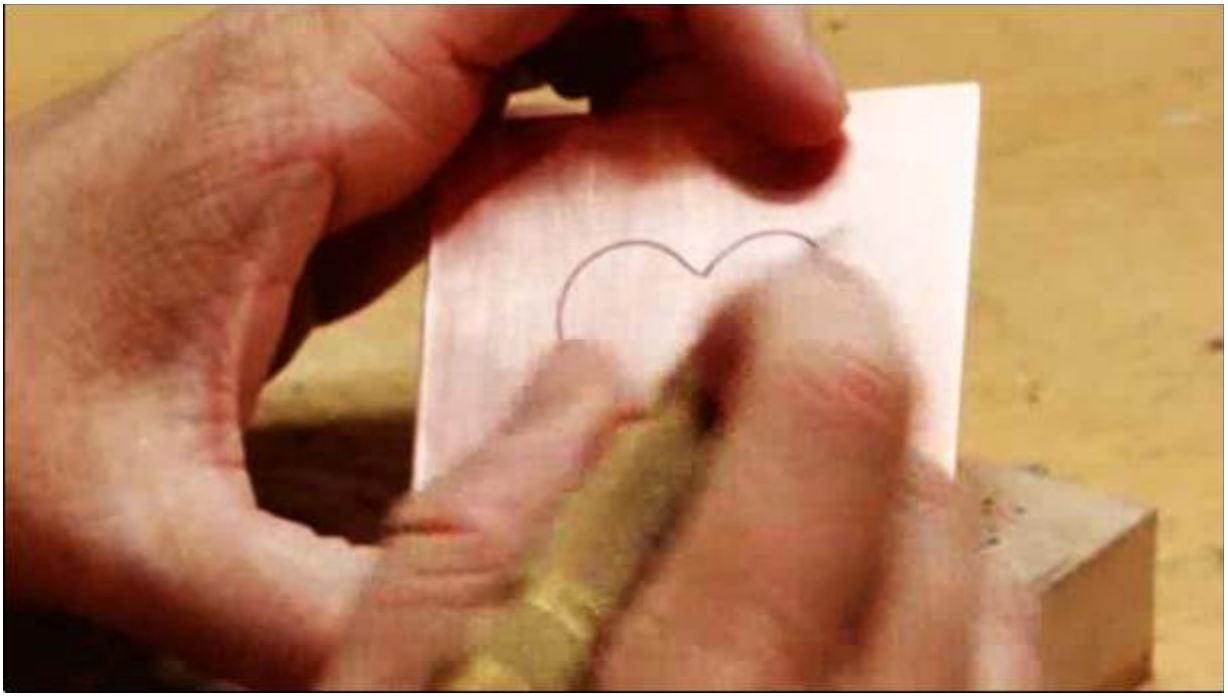

Fig 4.3.2.1 Etch Design on Metal Sheet

4.3.3 Cut Metal Sheet

- Cut metal sheet or wire as per design requirements.
- Use appropriate cutting tools for cutting the design.

Fig 4.3.3.1 Cut Metal Sheet with Appropriate Tool

4.3.4 File Each Part

- File each part that is going to be used for making the frame by using the appropriate tools and equipment.
- After filing, do a pre-polishing of the metal.

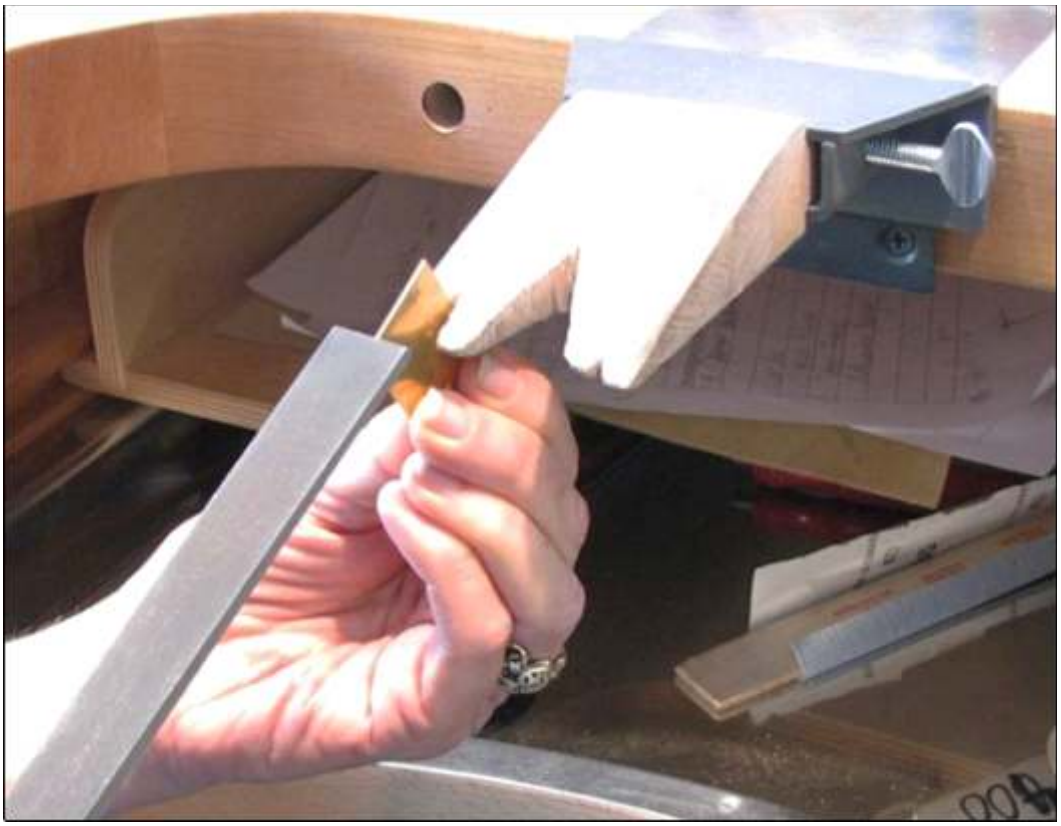

Fig 4.3.4.1 File the Metal

4.3.5 Create Frame Work on Lac or Clay

- Start creating the frame work on lac or clay by using tweezers.
- The clay is not hardened; it requires to be soft.
- This is the outer frame only.
- This will be not soldered so that in case of any changes required, the same can be made by removing the frame piece and re-arranging it.

Fig 4.3.5.1 Arrange Cut Metal Pieces as per Design on Lac or Clay

4.3.6 Check Stone Size with Frame Made

- Check the stone size with the frame made.
- You can place the stones on the metal to check if the setting frame is of the correct size or not.

Fig 4.3.6.1 Check the Stone Size with the Setting Frame for the Stones

Tips

1. Read the job sheet carefully before starting on the work.
2. Understand the design requirements including the thickness of the metal, type of metal required, setting style, type of jewellery and stones that will be used.
3. If you do not understand any part of the job sheet, ask your supervisor for additional information to help you with the job work.
4. Keep all required tools and equipment including findings ready before starting the job work.

Notes

Unit 4.4: Filing and Linking Separate Frame Parts

Unit Objectives

At the end of this unit, you will be able to:

1. Understand how to link the separate frame parts and make one jewellery piece.

4.4.1 Soldering

- Prepare the frame work for soldering i.e. linking or joining of all the frame parts.
- Start with 2 pieces, then increase the number of pieces gradually as they are linked together.
- Apply flux or solder alloy (found in the market) to the area to be joined with a thin file.
- Apply heat from a flame torch or solder machine to melt the solder alloy.
- Turn off heat once solder alloy melts.
- Cool soldered parts in water or coolant mix.
- Clean pieces after soldering is completed.

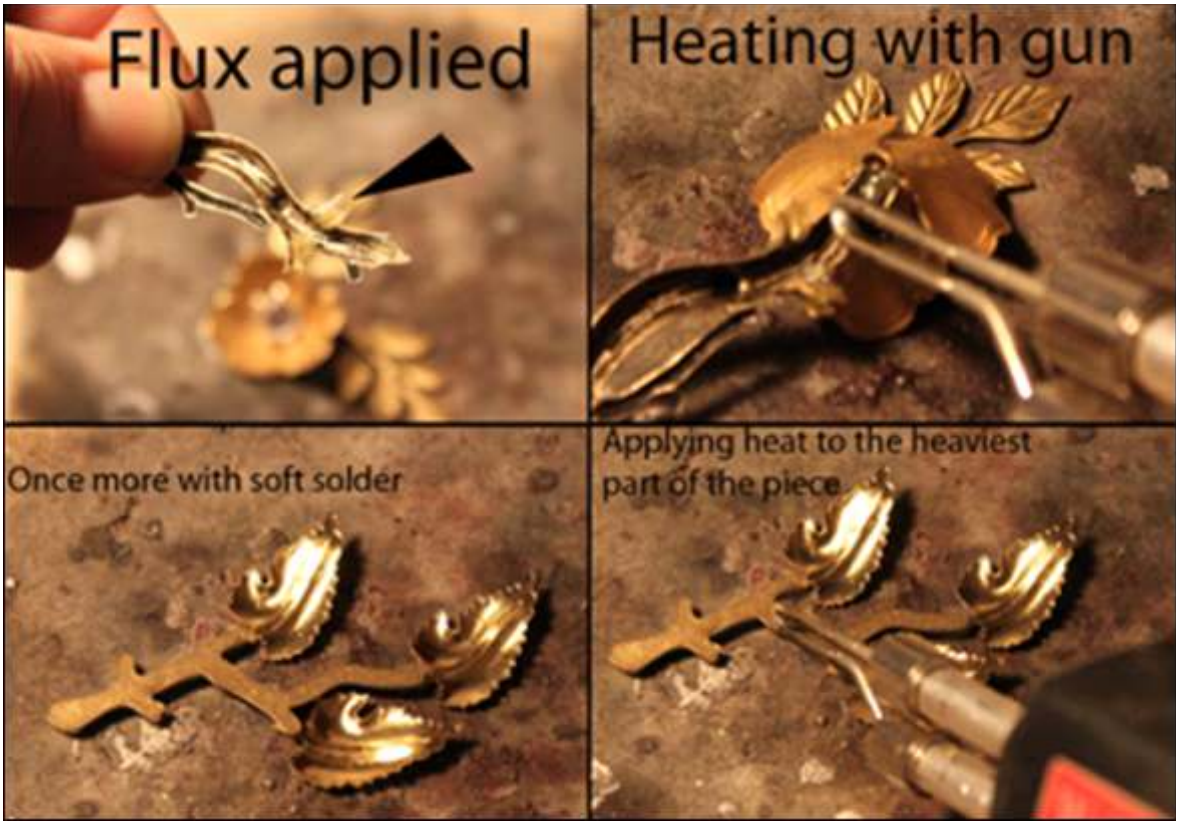

Fig 4.4.1.1 Soldering Frame Pieces

4.4.1 Soldering

- Prepare the frame work for soldering i.e. linking or joining of all the frame parts.

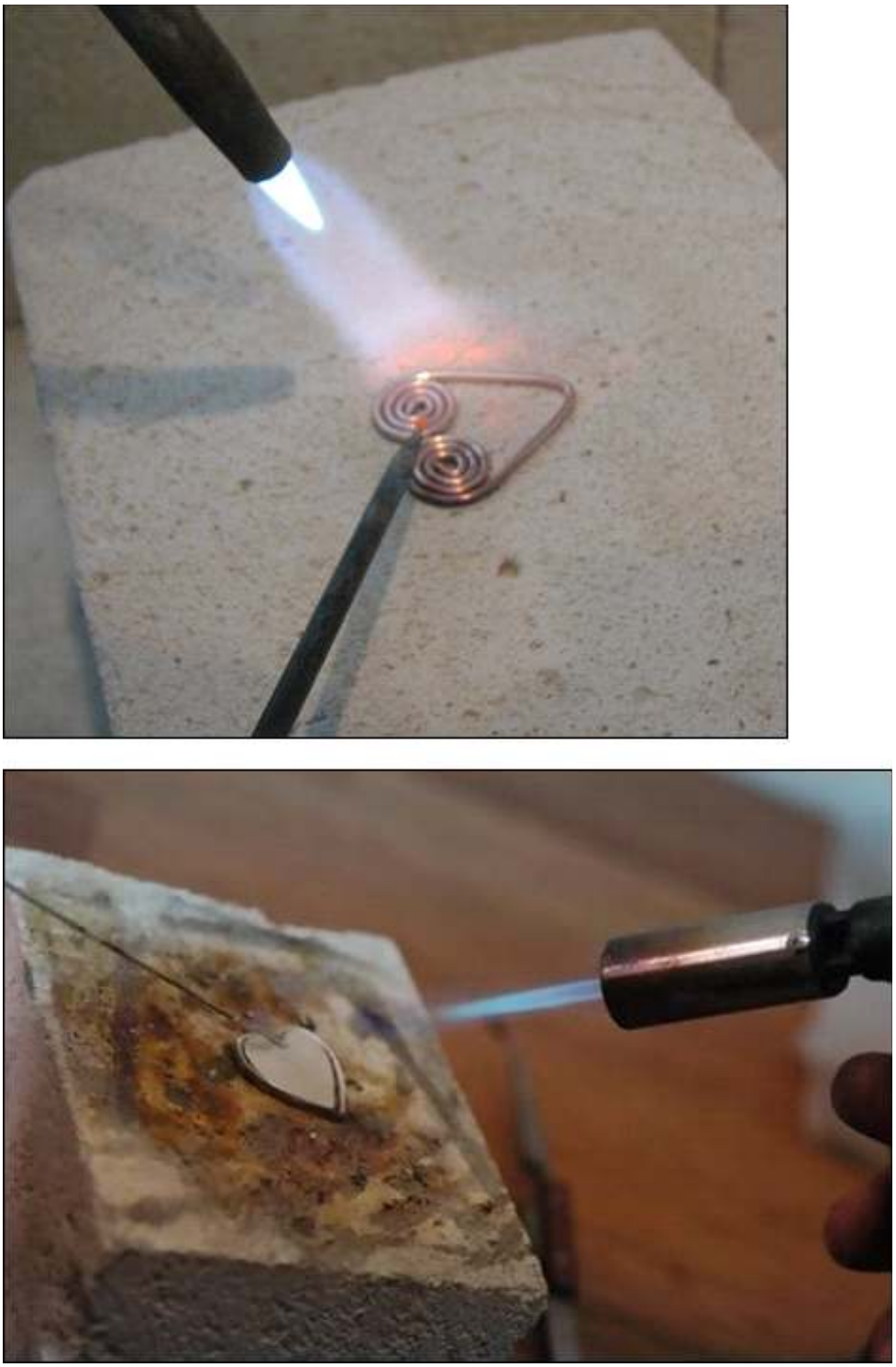

Fig 4.4.1.2 Soldering Wire and Sheet Frames

4.4.2 Using Plaster of Paris (POP)

- Another method of soldering large jewellery pieces such as necklaces, earrings or bracelets having many frames is by soldering them in plaster of Paris or POP.
- Create a paste by adding water to the POP powder.
- Mix the paste with a brush.
- The mixture should be free of air bubbles.
- Place the arranged frame work in a vessel so that it can turned over after the POP mixture is poured.
- Pour the prepared mixture on the arranged frame work.
- After pouring the mixture, turn the vessel so that the extra mixture falls out.
- Let the POP dry, carefully break around the POP to view the piece.
- Apply liquid flux on the areas to be joined and turn on heat torch.
- Cool the pieces after soldering and clean.

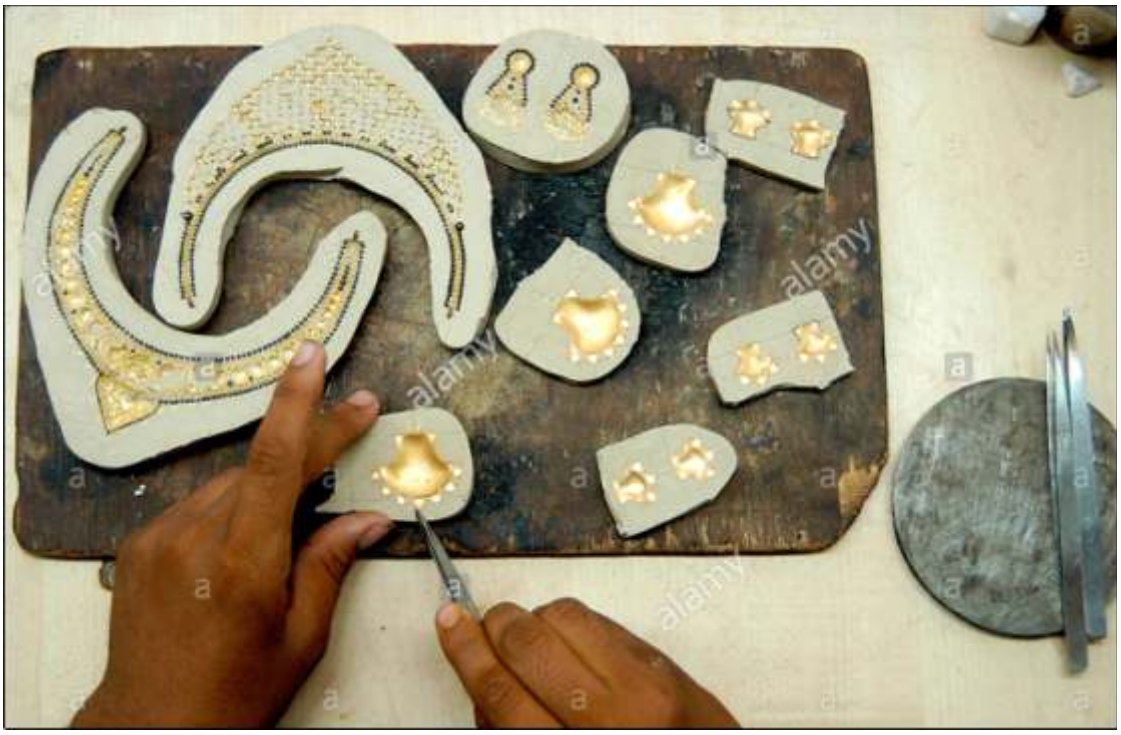

Fig 4.4.2.1 Frame Work Ready to be Soldered in POP

4.4.3 Linking Soldered Parts

- After soldering is completed, link the soldered parts with the components earlier mentioned either by tightly pressing the metal joints or soldering the components or fittings to the main jewellery piece.

Fig 4.4.3.1 Soldering Components or Fittings to Main Jewellery Piece - 1

4.4.3 Linking Soldered Parts

- After soldering is completed, link the soldered parts with the components earlier mentioned either by tightly pressing the metal joints or soldering the components or fittings to the main jewellery piece.

Fig 4.4.3.2 Soldering Components or Fittings to Main Jewellery Piece - 2

4.4.4 Filing and Pre-Polishing

- After the soldering process is completed for the entire piece, file the extra solder.
- Do a pre-polish of areas that have been filed before sending to the next department for either stone setting or final polishing.

Fig 4.4.4.1 Filing of Soldered Jewellery

Tips

1. Read the job sheet carefully before starting and completing the work.
2. Make sure all frames are in the right place before soldering or pouring POP.
3. Do not heat the metal till its melting point, read the usage instructions of the flux or solder alloy that is being used by your company.
4. Do not over file a soldered area as this might make the area weak.
5. Make sure you use enough solder to attach the pieces together.
6. If there is excess solder, file the soldered area till it has the same metal thickness as per the rest of the jewellery piece.
7. Keep aside pieces that are damaged and need to be repaired.
8. Pieces which are approved as per QC should be handed over to the next department with all the proper documentation regarding weight of metal before and after.

Notes

Unit 4.5: Detecting Product Defects

Unit Objectives

At the end of this unit, you will be able to:

1. Understand product defects that take place during frame making.

4.5.1 Product Defects

Fig 4.5.1.1 Product Defects – Excessive Filing

4.5.1 Product Defects

Fig 4.5.1.2 Product Defects – Damaged Component or Finding

4.5.1 Product Defects

Fig 4.5.1.3 Product Defects – Crack on Ring Shank Due to Annealing Problem During Wire Drawing Process

4.5.2 Product Defects Repairing

Fig 4.5.2.1Product Defect Repairing – Shank of Ring is Too Thin and Needs to be Repaired

Tips

1. Too much filing before or after frame making can affect the jewellery product.
2. Too much or too less of solder can make a jewellery piece defective.
3. The jewellery piece if damaged then inform your supervisor.
4. Once the damaged piece is repaired, send it to the next department with all repair details as well as weight loss details.

Notes

Unit 4.6: Controlling Gold Loss

Unit Objectives

At the end of this unit, you will be able to:

1. Understand how to control gold loss afer the frame making process.

4.6.1 Preventing Me tal Loss

- Points to prevent metal loss during the frame making processes are as follows:
  - Don't do extra filing.
  - Don't use extra force during the time of filing or pre-polishing.
  - Precious metal should match the allowed metal loss standards as per design requirement.
  - Tally accounts to check for metal weight matching before and afer frame making.
  - Conduct regular and controlled environment cleaning for collection of metal dust.
  - Minimise metal loss below the prescribed limits of the company.
  - Report any incidents of high precious metal loss to the supervisor.
  - Suggest improvements in order to reduce precious metal loss.
  - Collect metal scatered during the day (dust and fragments).

Fig 4.6.1.1 Collecting gold dust and fragments

4.6.2 Methods to Recover Metal Loss

Cleaning Hands

- Jeweller's as well as workers are required to clean their hands of gold dust even when leaving their workplace for a break.
- Although employees brush gold dust o fftheir hands, it sstillemains in their nails and hair.
- Afer all the work is done, wash your hands with detergent in hand-washing buckets, even when you take a break.
- Collect gold dust from this water once a week.
- Have a gold dust collector under the wash basin to collect gold dust when washing hands if working in a factory.
- Collect and process this gold dust once a week.
- Weigh the gold dust before processing.

Fig 4.6.2.1 Gold dust recovery

Tips

1. Wash your hands before taking a break and after finishing the work.
2. Brush your desk before taking a break and after finishing the work.
3. Always tally the accounts for the gold weight of the jewellery piece of before and after weight.

Notes

Unit 4.7 Achieving Quality Standards

Unit Objectives

At the end of this unit, you will be able to:

1. Understand how maintain the quality of production or the company.

4.7.1 Achieving Quality Standards as Per Company

Quality Control	Achieving a minimum standard for a product, service or production process which meets customer needs
Quality Assurance	Ensuring quality is delivered & maintained at each stage of the production process. This creates a *'culture of quality'.*
Quality Standards	Most products will have to meet strict standards laid down by independent organisations.

Fig 4.7.1.1 Achieve and maintain quality standards as per the company

- Check for the following quality control points to maintain the quality standard of your company
  - o Symmetry of design
  - o Design / Engraving or carving
  - o Setting / prongs
  - o Checking for defects such as porosity in casted metal, extra metal, missing prongs, missing stones, finish
  - o Check weight of individual jewellery pieces before handling over to next department

Tips

1. Quality of production will affect the reputation of the company.

2.If there are new ideas that you have to improve the quality of production, share the same with your supervisor.

Notes

Unit 4.8: Maintaining Quality of Production

Unit Objectives

At the end of this unit, you will be able to:

1. Understand how to maintain the quality of production for the company.

4.8.1 Maintaining Quality of Production

Fig 4.8.1.1

Tips

1. The lesser the defects in the frame made, lesser the defects in the finished product, hence faster the production.
2. If there is any particular component that you have seen with many defects over a period of time, inform your supervisor about it.

Notes

Unit 4.9: Know Your Organization and its Standards

Unit Objectives

At the end of this unit, you will be able to:

1. Understand your company better.

4.9.1 Know Your Organization and Its Standards

Fig 4.9.1.1

Tips

1. Identiy your skills and match them with the company's requirements.
2. If you know the product well, use your skills to make it productive for the company.

Notes

Unit 4.10: Work Hazards

Unit Objectives

At the end of this unit, you will be able to:

1. Understand what are the work hazards in your workplace.

4.10.1 Work Hazards

Fig 4.10.1.1

Tips

1. Understand and read your company's work hazard manual.
2. If you feel there is a work hazard which has not been accounted for, speak with your supervisor about it.

Notes

Exercise – Tick the Right Answer

1. **What machine is this?**
   a. Buff Wheel
   b. Flame Torch
   c. Scribe
   d. Ring Clamp

2. **What process is this?**
   a. Polishing
   b. Wire Drawing
   c. Ultrasonic Cleaning
   d. Metal Sheet

3. **What machine is this?**
   a. Rolling Mill
   b. Steam Cleaner
   c. Saw Blade
   d. Setting Machine

4. **What type of jewellery is this?**
   a. Kundan
   b. Dhokra
   c. Thewa
   d. Rani Haar

Exercise –
Tick the Right Answer

5. **What process is this?**
   a. Polishing
   b. Enamelling
   c. Metal Stamping
   d. Setting

6. **What process is this?**
   a. Soldering
   b. Setting
   c. Melting of Metal
   d. Polishing

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5. Follow material and energy conservation practices at workplace

Unit 5.1 : Energy Conservation
Unit 5.2: Conservation of Materials

G&J/N9949

Key Learning Outcomes

At the end of this module, the trainee will be able to,

- Telling about the importance of energy conservation.
- Explain the different types of energy.
- Following various methods of energy saving practices.
- Explain the importance of material conservation.
- Explain the commonly used materials in industrial establishments.
- Following various methods of material conservation practices.

Unit 5.1 : Energy Conservation

Unit Objective

At the end of this unit, the trainee will be able to,

- Telling about the importance of energy conservation.
- Explain the different types of energy.
- Following various methods of energy saving practices.

5.1.1 Definition of Energy

In fact, energy is a property of objects, which can be transferred to other objects or transformed into various forms. The ability of any object and human being to do work is called energy. Water falling from a height has energy because it can turn a wheel, which can generate electricity.

It is difficult to give a simple definition of energy. Energy is not a thing. We cannot see it, it occupies no space, and it casts no shadow. Energy exists in many forms, including electromagnetic radiation (such as light), gravitational potential energy, kinetic energy, thermal energy, nuclear energy, and chemical bonds.

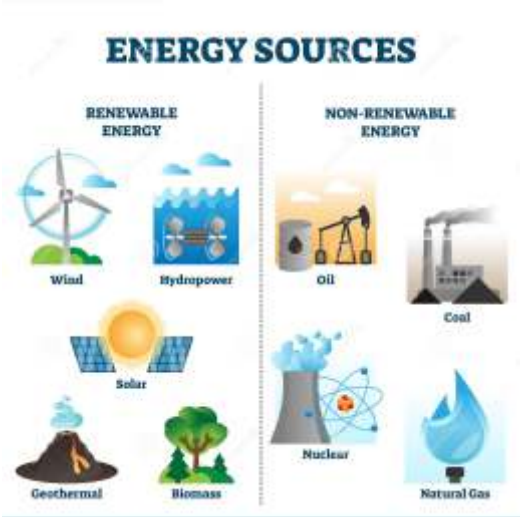
5.1.2 Importance Of Energy Conservation

Energy is an important means of meeting all the important needs of human life. Energy is the reason for movement in life, whether it is for our walking or for the operation of machines, energy is needed in every field of life. There are limited reserves of energy. That's why we have to go towards energy conservation so that our future generations do not face energy crisis. Energy conservation becomes a major issue in today's time considering the rapidly increasing population and consumption of energy.
Because energy is a precious gift given to us by nature, to be honest, life has no meaning without it. We are constantly making new inventions and making full use of energy and filling our future life with comforts. Yes – No it is not a wrong thing but when this energy is misused in useless things then it is completely wrong thing because by doing this we are harming ourselves and nature as well.

5.1.3 Different Types of Energy

Generally energy is of two types

- **Renewable Energy/Non-conventional**
- **Non-Renewable/Conventional Energy**



5.1.3.1 Renewable Energy & Non Renewable Energy

Renewable energy is pollution-free and never-ending energy, they can be used anytime, for example, solar energy, wind energy, tidal energy, etc. come in renewable energy.
Under non-renewable energy, those energies come which cannot be obtained again once they are exhausted, it may take millions of years to be formed, for example, coal, petroleum etc.

- **Conventional Sources of Energy:**
  - Coal
  - Petroleum/Mineral Oil
  - wood
  - Natural gas, etc.

Coal (coal):
This is the largest source of energy production in India, coal meets about 67% of the country's commercial energy demand, India has coal reserves in many states such as Jharkhand, Odisha, Chhattisgarh, Tamil Nadu And so on.

Biomass or dry organic matter:
Under this comes dry branches of trees, wood, dung, and oil obtained from living beings etc. It is also an important medium of energy, which fulfills about 14 percent of the world's energy. In developing countries, its amount is up to 43 percent, so there is continuous deforestation, the day is not far when we will destroy the environment completely. Will give and myself too.

Oil:
Petroleum and oil products contain more energy than coal. Many organic and inorganic substances are obtained from crude oil. Oil reserves are mostly found in porous rocks and 40% of the world's energy is obtained from oil energy. And out of that 55% only from Central Asian countrie.

Natural gas:
Natural gas is also found mainly near oil deposits, it also contains some amount of carbon dioxide and other flammable gases ethane and propane.

Nuclear energy:
92U235 is used for its production, energy is obtained from the disintegration of Uranium 235. It is disintegrated in a nuclear reactor.

Hydroelectric energy:
This energy is cheap and frequently used energy, the earth receives energy from the sun every year. It is absorbed by energy which becomes vapor then we get this energy again through rain.

- **Non-Conventional Sources:**

Solar energy

Solar energy is used for human welfare in direct and indirect form, direct solar energy is radiation energy while indirect solar energy is the energy that comes from the elements, in which solar energy radiation is first contained.

Solar energy is used directly in the form of heat energy and this energy is converted into electricity. Photovoltaic batteries directly convert solar energy into electricity.

When solar energy is used indirectly among many types of energy sources, biomass energy is the most prominent. Biomass is used here for all those substances which are made by the process of photosynthesis.

5.1.3.2 Solar Energy

Wind energy

The fan is rotated by using wind (air) and electricity is generated but there is also a problem in this, energy through wind cannot be obtained in every area, for this only islands, coastal, and mountainous areas are better.

5.1.3.3 Wind Energy

Tidal energy

Electricity is produced through high tides and low tides that rise in the ocean.

Geothermal energy

Electricity is generated by rotating the turbine from the springs and surface water flowing in the form of hot water.

Ocean wave energy

Electrical energy is also produced by running turbines in sea waves generated by wind.

5.1.4 Different ways of energy / Power saving practices

Most of the light is received from the sun, which is generally 1 lakh lux / Sq.meter, while office work generally requires 200 to 250 lux labeled light. Therefore, to make maximum use of the sunlight, keep the curtains of the windows open.

5.1.4.1 How to save electricity

General measure:

5.1.4.2 BEE star rating label

- The walls of the rooms should be painted with white/light colors and the ceilings should be painted with white paint, due to which the temperature inside the room decreases as compared to the outside.
- All electrical appliances used for cooling and heating should have a thermostat switch. A thermostat is such a device that controls the power supply by sensing the current temperature.
- Domestic wiring should not have joint or loose connection.
- All electrical equipment should be earthed.
- Solar energy should be used as far as possible.
- Use of fancy/decorative lights should be minimized. Neon/LED lamps should be used in night lamps.
- Use star rated appliances. BEE Using electrical appliances of higher star rating approved by the IAEA results in less energy consumption as well as carbon emissions. According to its power consumption "Star" rating is given like one / single star appliance consumes the most power and on the other hand five / five-star appliance consumes the least power.
- Unnecessarily more electricity is spent on switching off the equipment from the remote instead of turning it off directly from the switch. Therefore, as far as possible, the equipment should be switched off.

5.1.4.3 Turn off light

Arrangement / measures of lighting electrical equipment:

- Using LEDs instead of ordinary lamps saves up to 75 percent of electrical energy while providing the same amount of light.
- Use a task light (table lamp) to provide proper illumination at the work place.
- Light gets reduced by up to 50 percent when dust accumulates on the lights. So keep them clean.
- Automatic systems save a lot of electrical energy, such as infrared sensors, motion sensors, automatic timers, street lights and dimmers, etc. can be used to switch on / off like automatic switches.
- Keep the switches of electrical equipment closed when not required. It is the best way of saving electrical energy.

Coolers and fans:

- Five star rated fans should be used to save energy.
- Electronic regulator should be used in coolers and fans.
- Keep fans and coolers switched off when not required.
- Before the start of the season, overhauling of coolers and fans should be done, this increases their capacity.
- Automatic timer switch should be used to turn on/off the pump in coolers. This saves electrical energy as well as water.

Room air conditioner:

- An air conditioner of appropriate capacity should be installed according to the size of the room.
- AC Energy is saved by installing false ceiling in the room.
- AC room should be air sealed.
- Five star rated air conditioners should be used to save energy.
- Goods made of heat absorbent materials should not be kept in AC room.
- Turn off the AC half an hour before leaving the room.
- The air filter and air conditioner coil should be cleaned from time to time.
- The thermostat should be set at a minimum of 25 degrees centigrade, which provides comfortable coolness at low cost. About 03 percent electricity is saved for every 01 degree centigrade higher temperature set.
- Painting of white ceramic paint on the outer surface of the roof reduces the temperature of the room by 6 to 8 degrees. Due to which the load on AC will reduce and electricity will be saved.
- As far as possible do not install AC on the south and west walls, because these walls get more sun rays due to which the AC gets damaged and the load on AC will be more.

5.1.4.4 Soft Starter - For Industrial Motors

Electric motor :

- Energy efficient motor should be used.
- If the motor load is less than 50%, then it should be replaced with an energy efficient motor of lower capacity.
- Soft starter should be used in the motor.
- If the motor burns out, instead of rewinding the motor, the motor should be replaced with an energy efficient motor. On rewinding, there is a loss of 5 percent to 10 percent energy efficiency.
- Use of flat belt in place of V-belt reduces frictional loss, thereby saving energy.
- The motor should operate at optimum voltage, not at excess voltage.
- Motor should not be run without load.
- Variable frequency drives (VFDs) should be used for variable torque loads like blowers, pumps etc.

5.1.4.5 Variable Frequency Drives - For Industrial Blowers & Pumps

Unit 5.2: Conservation of Materials

Unit Objective

At the end of this unit, the trainee will be able to,

- Explain the importance of material conservation.
- Explain the commonly used materials in industrial establishments.
- Following various methods of material protection practices.

5.2.1 Conservation of materials and resources

Different types of materials and resources are used in industrial establishments for different purposes or applications. The following types of materials are commonly used extensively in industry

- Water / Steam
- compressed air
- paper
- Oils and Lubricants
- Petrol/Diesel
- Industrial gases
- Chemicals
- Plastic Bags
- Wax
- Polishing Compound

It is important to use such materials/resources or minimum to reduce the effect of some of the bad consequences mentioned below, such as,

- Environmental pollution
- Depletion of valuable/non-renewable resources for future generations
- Monetary Expenditure
- Ozone depletion
- Health hazards to employees working in hazardous processes

5.2.2 Different Methods of Material Conservation

What can you do to conserve water?

5.2.2.1 How to save water

1. Check that there is no water leakage in your house.
2. Use only as much water as you need.
3. Keep the water taps closed after use.
4. Keep the tap closed while brushing and open it only when necessary.
5. Don't waste too much water for bathing.
6. Use such a washing machine which does not consume much water.
7. Do not leave taps open while washing food items and clothes.
8. Never pour water down the drain, but use it for other uses like watering plants or garden or cleaning. Etc.
9. The water used for washing vegetables and fruits is used to water the pots of flowers and ornamental plants.
10. Do not throw away the remaining water in the water bottle, but use it to irrigate the plants.
11. Do not leave the water tank open.
12. Don't throw garbage in ponds, rivers or sea.

Some water conservation measures in industrial establishments:

1. Reuse non-potable water for other purposes.
2. Re-install existing appliances and fixtures
3. Replace old appliances with energy-efficient alternatives.
4. Removal of water from cleaning processes when dry alternatives are possible.
5. Reduce the amount of water required for non-essential operational activities.
6. Install water saving taps at common points of consumption.

Suggestions to reduce the use of paper in office work:

1. Post in-house reminders near copy machines or on individual desktops.
2. Track the individual print footprint in your office.
3. Hold paperless meetings
4. Encourage the use of email extensively
5. Set the default on the computer for double sided printing, font size of 10, and lower margin setting for MS Word related documents.
6. Reuse the paper used on one side for photocopying purpose.

Some tips to save fuel for private vehicles:

- Do not press the accelerator or brake suddenly, it consumes more fuel.
- Avoid running the air conditioner if it is not needed.
- Do not drive in reverse gear excessively, it consumes unnecessary fuel. While parking the car in the parking lot, park it in reverse, so that when you want to go, you can get out of the car directly.
- Keep the air pressure in the wheels correct. Follow the specifications given by the vehicle manufacturer.
- Avoid carrying unnecessary items in the vehicle. Keep only essential items in the trunk.
- Avoid keeping luggage on the roof of the vehicle, it consumes more fuel.
- Get the vehicle serviced on time, getting the service done at the right time gives more mileage, because fuel is spent more due to dirty air filter, old spark plug and less fluid.
- Use public transportation.
- Plan well before you set out on a trip. Try to leave in the morning itself, the crowd is less. Car pooling can also be used.
- Before buying a new car, do know its mileage, don't buy a car just because of its looks.

Some tips for saving fuel in industrial establishments:
1. Take proper care of machines on time.
2. Follow the operating standards given by the machine manufacturer.
3. Take proper care of your generator. Maintaining your generator can significantly reduce fuel consumption.
4. Remove carbon deposits.
5. Minimize the use of generators.
6. Don't overload or underload.
7. Maintain proper coolant temperature.

Plastic bags, wax, polishing compound:
- Select the correct option by adopting the principle of Re-do, Re-use, Recycle

Notes

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6. Maintain Health and Safety at Workplace

Unit 6.1 - Potential Sources of Accidents
Unit 6.2 - Safety Signs and Appropriate Requirements to be Safe
Unit 6.3 - Ergonomics or Bad Posture of Body
Unit 6.4 - Fire Safety Rules
Unit 6.5 - How to Deal with Emergency Situations

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Key Learning Outcomes

At the end of this module, you will be able to:

1. Inspect safety procedures.
2. Inspect potential hazards.
3. Analyze what to do in an emergency situation.
4. Analyze how to use the fire extinguisher by identifying the appropriate fire.
5. Analyze how complying with company safety rules and regulations can be safe for you.

Unit 6.1: Potential Sources of Accidents

Unit Objective

At the end of this unit, you will be able to:

1. Analyze the potential sources of accidents in a workplace.

6.1.1 Potential Sources of Accidents

Accidents are unpleasant events that happen unexpectedly, causing damage, injury or sometimes even death. Working people spend most of the time in work, thus accidents at work can happen unexpectedly.

Accidents or hazards mean an incident involving loss of life inside or outside the workplace, suffering injuries internally and/or externally, or release of toxic chemical or explosion or fire, or spilling of hazardous chemical resulting in 'on-site' or 'off-site' emergencies or damage to equipment leading to stoppage of process or adverse effects to the environment.

- Accidents or hazards usually occur due to: Faulty equipment
- Improper working conditions
- Faulty inspection or repairing equipment or tool without the proper instructions
- Irregular maintenance of equipment and tools
- Repairing of faulty equipment by someone who is not qualified to repair
- Lack of concentration or bringing personal tensions to work
- Unsafe practices such as plugging wires directly into sockets without a plug
- Not reading voltage instructions for imported equipment
- Improper or insufficient safety training
- Smoking in non-smoking zones
- Storage of chemicals near heat emitting machines
- Improper storage of chemicals
- Improper work clothing or lack of protective gears
- Exposed wire or wires bitten by rats or other animals
- Wires with bad insulation
- Improper electric connections
- Using wrong tools and equipment in wrong place or plugging into wrong socket
- Using too many wires in one spike guard or electric socket
- Bad housekeeping which includes wet floors, sweeping not done, papers thrown on floor, dustbins not covered or emptied
- Tools and equipment not stored properly after work
- Not unplugging tools and equipment after work or during breaks
- Leaving main switch ON of tools and equipment after work
- Non reporting of hazards to supervisor or ignoring potential dangers

6.1.1 Potential Sources of Accidents

The below figure clearly shows an exposed wire that can be hazardous to anyone who accidently touches or comes in contact with it.

Fig 6.1.1.1 Exposed Wire

6.1.1 Potential Sources of Accidents

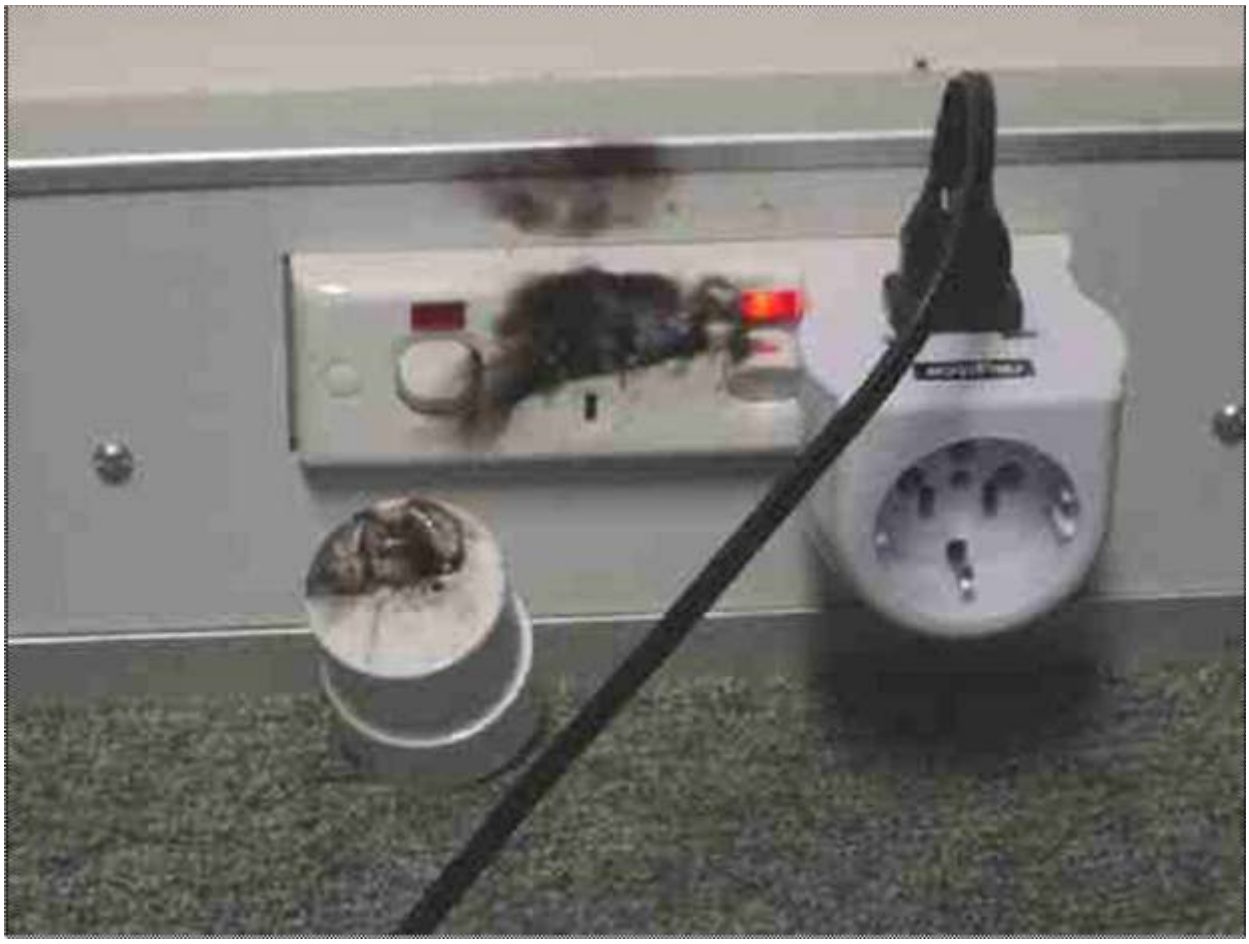

Fig 6.1.1.2 Burned Socket – Not advised to use the working plug

6.1.1 Potential Sources of Accidents

In the picture it is clear that the floor is wet with equipment lying on it. This can lead to serious accident and the workers should be very careful.

Fig 6.1.1.3 Liquid spilled on carpet floor with tools and equipment around

6.1.1 Potential Sources of Accidents

Fig 6.1.1.1 Causes of Accidents

Tips

1. Check your surrounding areas for any live wires, cables that are exposed or any chemical spill which may cause a fire.
2. Always check that equipment and tools are switched off before you leave for a break and after your work has ended.
3. It is better to be safe than sorry as it could cost you your life or put others in danger.
4. If there is a potential hazard waiting to happen inform your supervisor to have the same checked as soon as possible.
5. Do not delay in informing your senior about any hazardous thing you see around.

Notes

Unit 6.2: Safety Signs and Appropriate Requirements to be Safe

Unit Objective

At the end of this unit, you will be able to:

1. Analyze the safety signs and appropriate requirements to be safe and to make the workplace safe for yourself and others.

6.2.1 Safety Signs

Safety Signs are some very important tips that you see around when you need some help in any situation where safety is required. You are just required to keep your mind alert during work and to look for any safety sign for your use. These are signs that cannot be avoided and are especially useful when nobody else is around to help.

Fig 6.2.1.1 Safety Sign - 1

6.2.1 Safety Signs

Fig 6.2.1.2 Safety Sign - 2

6.2.1 Safety Signs

Fig 6.2.1.3 Safety Sign - 3

Fig 6.2.1.4 Safety Sign - 4

6.2.1 Safety Signs

Fig 6.2.1.5 Safety Sign - 5

Fig 6.2.1.6 Safety Sign – 6

6.2.1 Safety Signs

In the figure you can see various signs explaining physical hazards and health hazards that you need to check around yourself. These are majorly warning signs that alert you beforehand.

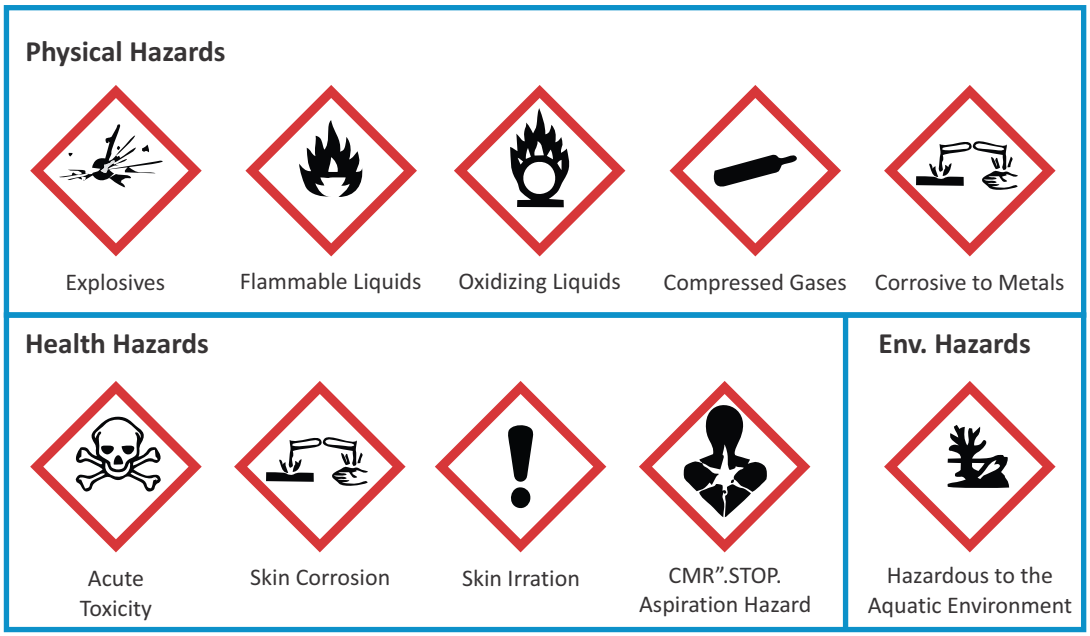

Fig 6.2.1.7 Safety Sign – 7

6.2.2 Safety First

Fig 6.2.2.1 Safety gears to be worn while working with tools and equipment

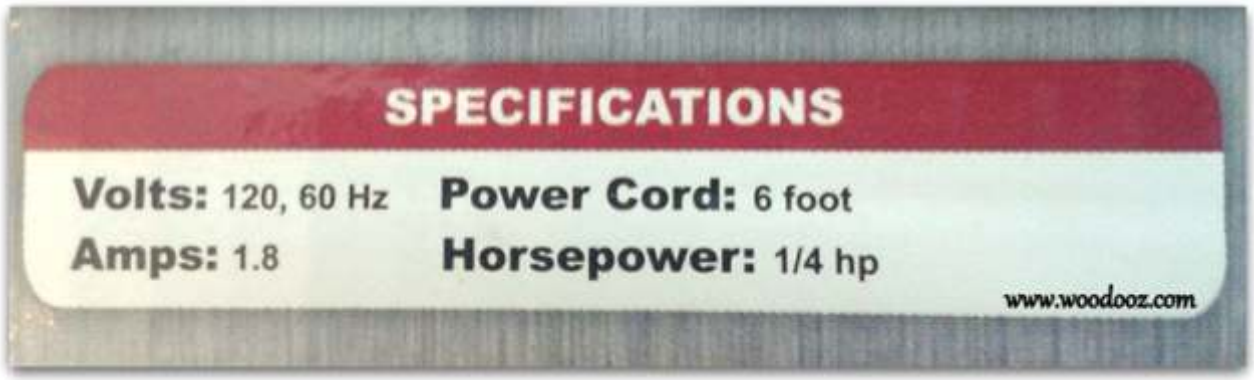

Fig. 6.2.2.2 Refer to voltage mentioned on equipment and machines before plugging in socket to avoid short circuit

6.2.2 Safety First

Fig 6.2.2.3 Housekeeping rules for every employee

6.2.2 Safety First

Just say no to electrical hazards.
Before you turn it on, make sure that you say no the following:

- Are outlets, motors, or circuits overloaded?
- Are the electric wires passing near water or heat sources?
- Are cords twisted or tangled?
- Do I see sparks or smoke?
- Are my hands wet?
- Am I wearing any metal jewellery?

Tips

1. If you follow proper housekeeping rules and the other mentioned rules, you can avoid accidents or hazards in your workplace.
2. Always work as a team when it comes to the workplace.

Notes

Unit 6.3: Ergonomics or Bad Posture of Body

Unit Objective

At the end of this unit, you will be able to:

1. Develop the right body posture required while carrying out any kind of work.
2. Analyze how to relax your body more and put less strain on your body.

6.3.1 Ergonomics or Bad Posture of Body

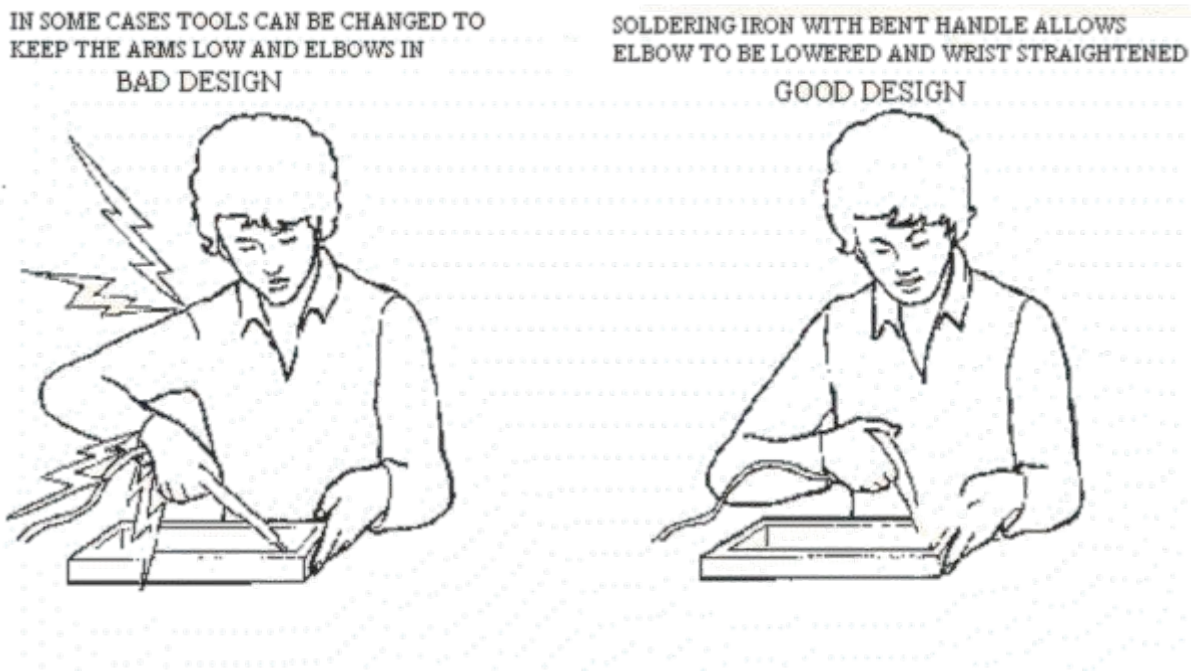

Fig 6.3.1.1 Straining elbows can strain the shoulder leading to body pain

6.3.1 Ergonomics or Bad Posture of Body

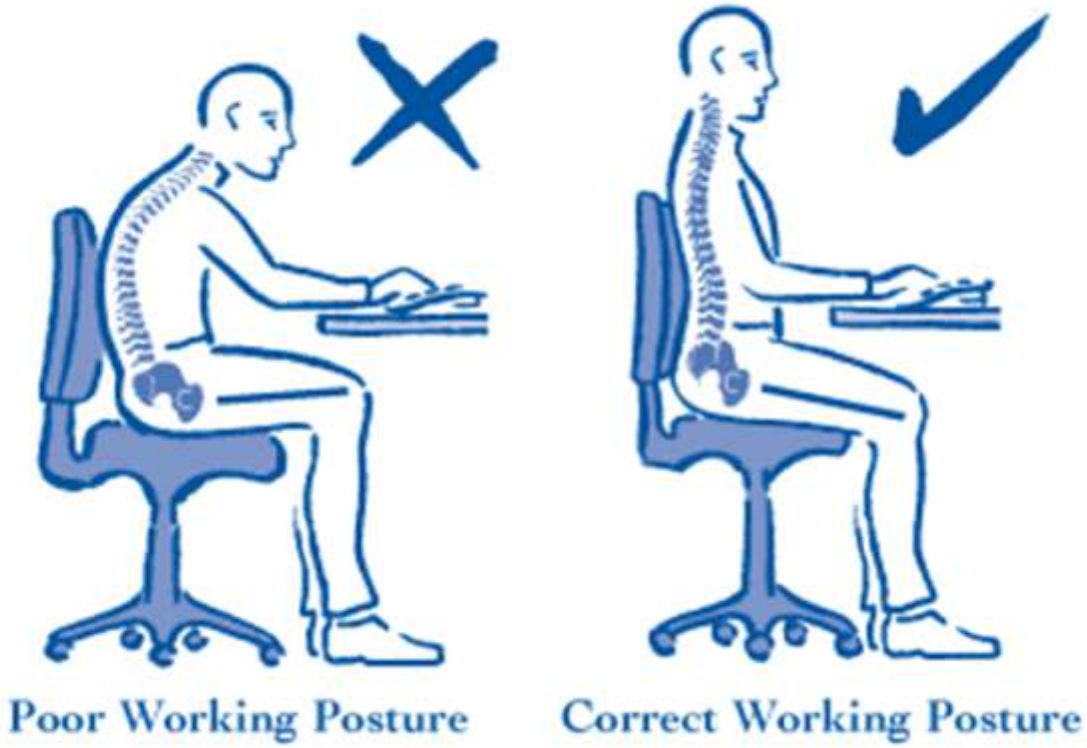

Fig 6.3.1.2 Wrong and right way to sit

Fig 6.3.1.3 Right way to work on computer

6.3.1 Ergonomics or Bad Posture of Body

Fig 6.3.1.4 Problems to avoid

Tips

1. The right body posture will benefit you in keeping many health problems away.
2. The wrong body posture can create health problems such as stiff neck, pain in the entire body, stiff shoulders, cervical spondylitis and many other problems.
3. Also drink a lot of water to keep yourself hydrated.

Notes

Unit 6.4: Fire Safety Rules

Unit Objectives

At the end of this unit, you will be able to:

1. Inspect the fire safety rules.
2. Develop the skills on how to use a fire extinguisher.

6.4.1 Fire Safety Rules

CLASSES OF FIRES	TYPES OF FIRES	PICTURE SYMBOL
A	Wood, paper, cloth, trash & other ordinary materials.	
B	Gasoline, oil, paint and other flammable liquids.	
C	May be used on fires involving live electrical equipment without danger to the operator.	
D	Combustible metals and combustible metal alloys.	
K	Cooking media (Vegetable or Animal Oils and Fats)	

Fig 6.4.1.1 Know the different types of fire with classification codes and symbols

6.4.1 Fire Safety Rules

Fig 3.4.1.2 Know your fire extinguisher code

Fig 6.4.1.3 Know the refill date on the fire extinguisher

6.4.1 Fire Safety Rules

Fig 6.4.1.4 Basic fire fighting steps

Fig 6.4.1.5 Do not use elevator or lift when there is a fire

6.4.2 Using the Fire Extinguisher

Fig 6.4.2.1 Steps to use the fire extinguisher – use the right extinguisher for the fire

Tips

1. Always recognize the type of fire before using the fire extinguisher.
2. The fire extinguisher has a code on it and that code will tell you for which fire that extinguisher can be used.
3. Do not use the lift or elevator when there is a fire.
4. Use wet blankets or napkins to cover your mouth so that you do not inhale the smoke.
5. Call the fire brigade and pull the fire alarm.

Notes

Unit 6.5: How to Deal with Emergency Situations

Unit Objective

At the end of this unit, you will be able to:

1. Analyze an emergency situation and how to deal with it.

6.5.1 Emergency Situations

Fig 6.5.1.1 Emergency situations

6.5.2 Dealing with Emergency Situations

Evaluate Situation

- Check the surroundings.
- Evaluate the situation.
- Are there things that may place you in danger or harm?
- Are you or the victim endangered by fire, harmful smoke or gasses, an unstable construction, live electrical wires or alternative dangerous scenario?
- Don't rush into a situation wherever you may find yourself as a victim?
- If approaching the victim will endanger your life, seek professional help immediately; they have higher levels of training and know how to handle these situations.
- First aid becomes useless if you can't safely perform it without hurting yourself.

Fig 6.5.2.1 Evaluate situation

6.5.2 Dealing with Emergency Situations

Call for Help

- Call for help.
- Call the appropriate authorities or emergency services immediately if you feel someone is seriously injured.
- If you are the only person on the scene, try to check if the person is breathing before calling for help.
- Do not leave the victim alone for an extensive amount of time.

Take Care of the Person

- Take care of the person.
- A person who has just gone through a serious trauma requires to be taken care of including providing emotional support and physical treatment such as first aid.
- Always remember to remain calm and try to be reassure the person about help arriving.

Check for Response

- Determine responsiveness.
- If a person is unconscious, try to wake them by gently tickling their bare hands and feet or by speaking to them.
- If they do not respond to activity, sound, touch or other stimulation, check if they are breathing.

6.5.2 Dealing with Emergency Situations

Conducting CPR OR First Aid

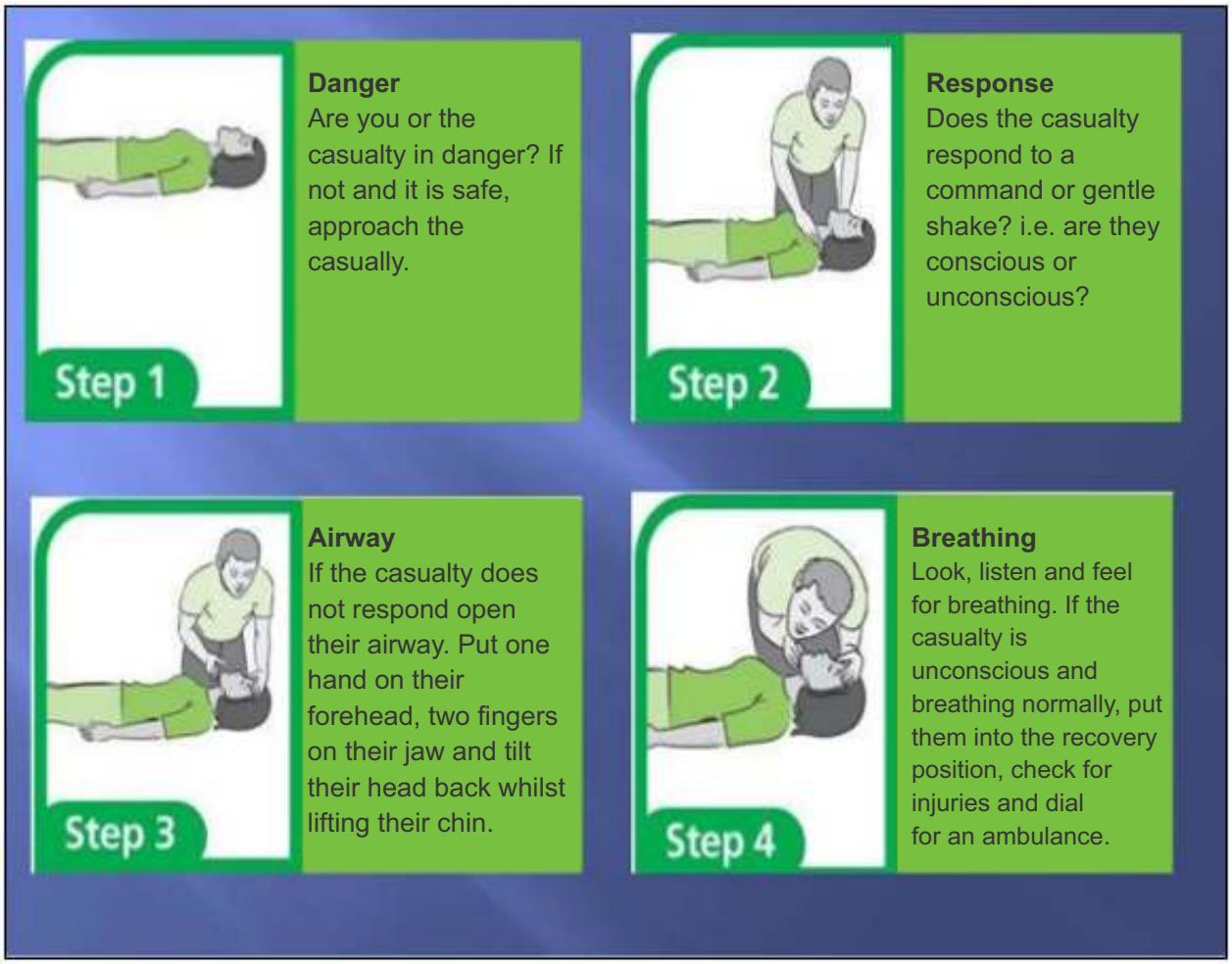

Fig 6.5.2.1 Conducting CPR or first aid

EMERGENCY NUMBERS IN INDIA

- 100 for Police
- 102 for Ambulance
- 101 for Fire
- 108 for Disaster management
- 181 for Women's helpline

6.5.3 Solving the Issue

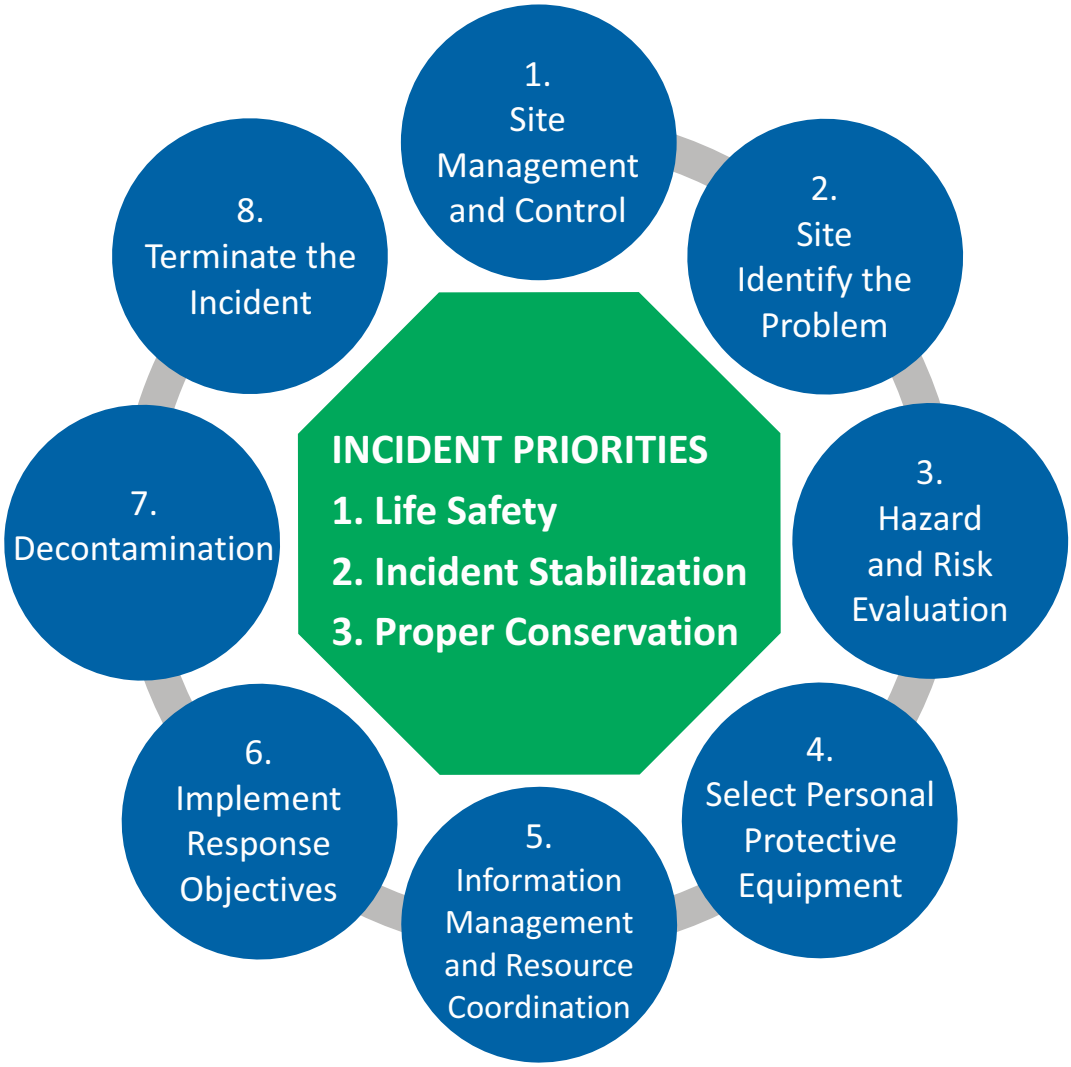

Fig. 6.5.3.1 Incident Priorities

Tips

1. Always participate in emergency drills organized by your company, you may never know when the knowledge will come in use.
2. Ask your company for a live demonstration of first aid administration.
3. Check with your company the contents of the first aid box and where it is kept.
4. Always report an incident to your supervisor or others, rather than hiding it.
5. Always care for others in an emergency situation.

Exercise

1. Write the full form of RACE.

2. Identify the meaning of the safety signs.

Safety Sign	Meaning of Safety Sign
	
	
	

3. Identify the following emergency numbers.

a. 100: _____

b. 101: _____

c. 102: _____

4. Accidents or hazards usually occur due to-

a) Faulty equipment

b) Smoking in non-smoking zones

c) Improper electric connections

d) All of these

5. If you find that someone is stuck in an emergency situation, how will you deal with it? Write in short.

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7. Annexure

Annexures 1 - QR codes - Video Link

G&J/N9949

Annexure: Chapter wise QR codes

Chapter No.	Unit No.	Topic Name	Page No.	Url	QR code (s)
1. Introduction	Unit 1.4: Job Opportunities for a Jewellery Frame & Component Maker	1.4.1 Job Opportunities for a Jewellery Frame & Component Maker	16	https://www.youtube.com/watch?v=nKY1AbPz668&t=1s	Gem & Jewellery industry Orientation
2. Draw wire, roll sheet, and thick wire from precious metal	Unit 2.1: Introduction to Jewellery Making Process	2.1.1 Jewellery Making Process – Part 4 – Machine Made Chains	25	https://youtu.be/tmoE_kago7o	Wax Setting
2. Draw wire, roll sheet, and thick wire from precious metal	Unit 2.1: Introduction to Jewellery Making Process	2.1.1 Jewellery Making Process – Part 4 – Machine Made Chains	25	https://youtu.be/JhmV_sDARvI	Wax Injection
2. Draw wire, roll sheet, and thick wire from precious metal	Unit 2.1: Introduction to Jewellery Making Process	2.1.1 Jewellery Making Process – Part 4 – Machine Made Chains	25	https://youtu.be/9MLjkyEmXTQ	Tree Making
2. Draw wire, roll sheet, and thick wire from precious metal	Unit 2.1: Introduction to Jewellery Making Process	2.1.1 Jewellery Making Process – Part 4 – Machine Made Chains	25	https://youtu.be/3K154_b5dy0	Mould Making
2. Draw wire, roll sheet, and thick wire from precious metal	Unit 2.3: Introduction to Metals	2.3.5 Platinum	36	https://drive.google.com/file/d/1eWzT-AO66CBSbpcdkpl6clY8qXMseP25/view?usp=sharing	Introduction to Precious metal

Chapter No.	Unit No.	Topic Name	Page No.	Url	QR code (s)
2. Draw wire, roll sheet, and thick wire from precious metal	Unit 2.5: Types of Jewellery	2.5.2 Categories of Jewellery	62	https://drive.google.com/file/d/1Reg-5FCnxLzJkTj9NFecrL8EYnNNv6nA/view?usp=sharing	Diversity in Indian Jewellery
2. Draw wire, roll sheet, and thick wire from precious metal	Unit 2.5: Types of Jewellery	2.5.2 Categories of Jewellery	62	https://drive.google.com/file/d/1szE3LWEmzgSt1xGopymE3shRhDCwpLqf/view?usp=sharing	Categaries of Indian Jewellery
2. Draw wire, roll sheet, and thick wire from precious metal	Unit 2.5: Types of Jewellery	2.5.2 Categories of Jewellery	62	https://youtu.be/XEn-Cq2pDLc	Indian Heritage & Crafts in Global Market 1
2. Draw wire, roll sheet, and thick wire from precious metal	Unit 2.5: Types of Jewellery	2.5.2 Categories of Jewellery	62	https://youtu.be/1NZ-1Gxpos4	Indian Heritage & Crafts in Global Market 2
2. Draw wire, roll sheet, and thick wire from precious metal	Unit 2.6: Introduction to Diamonds and Gemstones	2.6.2 Introduction to Gemstones	68	https://drive.google.com/file/d/1hu_XQdhI02jklckOyMfPuV2VweuUCIfX/view?usp=sharing	Common features & Diamond
2. Draw wire, roll sheet, and thick wire from precious metal	Unit 2.7: Types of Settings	2.7.1 Types of Settings	72	https://drive.google.com/file/d/1_2XPTcEapET9ICY4n0IJ_BaRTmWX1c3q/view?usp=sharing	Types of Gemstone Settings

Chapter No.	Unit No.	Topic Name	Page No.	Url	QR code (s)
3. Make various jewellery components	Unit 3.5: Making Box Claps	3.5.1 Making vox claps	157	https://youtu.be/MLWwFsQSuAg	Making Box Clasp
Employability Skills				https://www.skillindiadigital.gov.in/content/list	Employability Skills

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