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CTE Standards Unpacking
Mechanical Drafting and Design

Course: Mechanical Drafting and Design
Course Description: People with careers in design and pre-construction create our future. They turn a concept into a set of plans whether it's a component, a system, or a building. Their plans guide other construction or manufacturing professionals as they continue the building process. Mechanical Drafting and Design will expose students to the American Design Drafting Association (ADDA) Apprentice standards in mechanical drafting and then the students will be given the option to take the ADDA Apprentice drafting test.
Career Cluster: Manufacturing
Prerequisites: Introduction to Drafting and Design course 21102
Program of Study Application: This is the second pathway course in the Manufacturing cluster, Design and Engineering pathway. Introduction to Drafting and Design Course number 21102 is a prerequisite for this course. The course would be followed by a capstone experience.

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<tr><td colspan="3">SUB-INDICATOR 1.2 (Webb Level: 3 Strategic Thinking): Demonstrate basic geometric dimensioning and tolerancing (GD&T).</td></tr>
<tr><td>Knowledge (Factual):
-Appropriate Mechanical Drafting Vocabulary

-American Society of Mechanical Engineers Y14.5M 1994 (ASME Y14.5M 1994)

-Feature control frames for (1. Reading 2. Decoding)

-Geometric symbols and terms related to geometric dimension and tolerancing (GD&T)</td><td>Understand (Conceptual):
-Geometric construction techniques (tangencies, circles, arc, lines, polygons, ellipses, lines to quadrants, & irregular curves)</td><td>Do (Application):
-Study Mechanical Drafting Vocabulary

-Demonstrate accuracy when producing a geometric drawing

-Draw elements that are accurate and to scale

-Use geometric construction techniques

-Describe the nominal size, tolerance, limits and allowance
of two mating parts
-Create limit dimensions</td></tr>
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		-Identify a clearance fit, interference fit, and transition fit -Describe basic hole and shaft systems -Dimension two mating parts using limit dimension, unilateral tolerances and bilateral tolerances -Draw geometric tolerancing symbols -Specify position and geometric tolerances -Draw and place feature control symbols and datum references on a drawing

Benchmarks:
Students will be assessed on their ability to:

- Understand Mechanical drafting vocabulary
- Utilizing the correct geometric shapes and lettering, properly illustrating drawings in a professional manner.
- Utilizing proper dimensioning techniques to make drawings understandable.
- ADDA Apprentice Drafting Competency met: Mechanical #6
- ADDA Apprentice Drafting Competency met: Mechanical #12

Academic Connections

ELA Literacy and/or Math Standard (if applicable, Science and/or Social Studies Standard):	**Sample Performance Task Aligned to the Academic Standard(s):**
G-Co. 12 Make formal geometric constructions with a variety of tools and methods G-MG.1 Modeling with Geometry Use geometric shapes, their measures, and	-Students will use geometric principals to construct designs -Students will create a blue print using

their properties to describe objects	geometric shapes

INDICATOR #MDD 2: **Prepare mechanical drawings.**		
SUB-INDICATOR 2.1 (Webb Level: 3 Strategic Thinking): Create a multi-view drawing.		
SUB-INDICATOR 2.2 (Webb Level: 3 Strategic Thinking): Create sectional views of a mechanical drawing.		
SUB-INDICATOR 2.3 (Webb Level: 3 Strategic Thinking): Develop auxiliary views of mechanical drawings.		
SUB-INDICATOR 2.4 (Webb Level: 3 Strategic Thinking): Generate pictorial drawings.		
SUB-INDICATOR 2.5 (Webb Level: 2 Skill/Concept): Examine drawing identification and management techniques used in mechanical drafting.		
Knowledge (Factual): -Line precedence -Views required for a drawing -Proper front view -Application of section lines -Features which are not sectioned -Cutting plane line -Line precedence -Section lines are dark and very thin -Cutting plane lines are drawn according to the alphabet of lines -Auxiliary view names (Height, Width, Depth) ANSI Y 14.5 standards	**Understand (Conceptual):** -Position and layout of views -Appropriate lines and surfaces for each view -Function of section view -Function of cutting plane line -Section drawings are completed according to ANSI standards -Section lines are drawn at a 45 degree angle unless a more appropriate angle is justified -Reference line/plane construction method -Fold line construction method -Plot circles and arcs so they are drawn to conform to the intersection of projection	**Do (Application):** -Draw an orthographic projection with the proper top, front and side views -Properly align views -Complete a technical drawing using standard sectional views such as full, half, offset, broken-out, removed, & revolved -Identify plane surfaces on isometric boxes -Construct angles on an isometric view -Construct isometric circle and arcs -Construct an isometric view in the center of a drawing space -Construct an oblique drawing in the center of a drawing space

	lines and transferred lines -Appropriate tolerances	-Construct an angle on an oblique drawing -Construct oblique circles -Construct a cavalier oblique drawing of a given object -Construct a cabinet oblique drawing of a given object -Identify the views of perspectives -Construct a drawing to the appropriate size and scale -Construct a one- & two point perspective -Apply necessary notes, material specifications, symbols, and other data to a drawing -Complete a parts list including, parts number, manufacturer's name, manufacturer's stock number, material specs, quantity of each part, and notes for assembly -Complete an assembly drawing showing the relationship the parts have to each other
Benchmarks: *Students will be assessed on their ability to:* • Orthographic projections and multi view drawings are critical to assure		

properly designed and manufactured products.
- Sectional views are important in an engineering drawing to show the imaginary plane cut through an object.
- Sectional views are often used to show voids in an object.
- A pictorial drawing displays a view as it would be seen by an observer who looks at the object from a selected point of view.
- Properly laid out drawing with accurate information are important to the design of products.
- ADDA Apprentice Drafting Competency met: Mechanical #7
- ADDA Apprentice Drafting Competency met: Mechanical #8
- ADDA Apprentice Drafting Competency met: Mechanical #10
- ADDA Apprentice Drafting Competency met: Mechanical #14

Academic Connections	
ELA Literacy and/or Math Standard (if applicable, Science and/or Social Studies Standard):	**Sample Performance Task Aligned to the Academic Standard(s):**
G-Co. 12 Make formal geometric constructions with a variety of tools and methods	-Students will use geometric principals to construct designs
G-MG.1 Modeling with Geometry Use geometric shapes, their measures, and their properties to describe objects	-Students will create a blue print using geometric shapes

INDICATOR #MMD 3: **Understand the design for manufacturing and assembly.**		
SUB-INDICATOR 3.1 (Webb Level: 1: Recall): Analyze different manufacturing processes.		
SUB-INDICATOR 3.2 (Webb Level: 1: Recall): Identify basic welding symbols used in manufacturing design process.		
Knowledge (Factual):	**Understand (Conceptual):**	**Do (Application):**
-Process of pattern making	-Casting and foundry processes	-Identify various types of machined holes
-Contemporary manufacturing processes	-Purpose of tooling, jigs, and fixtures	-Draw basic weld symbols
-Location and meaning of weld symbols	-Compare the difference between good and poor design	-Create detail drawings for a welded part
-Weld symbology (fillet,		-Indicate welding

groove, plug/slot, spot/seam, resistance welds)	-Importance of the design process in quality control -Weld size on drawings -Finish & contour welds -Field welds on drawing -Basic welding processes	process on a drawing

Benchmarks:
Students will be assessed on their ability to:

- Understanding the various manufacturing processes is important in selecting the proper design for a product
- Welding is one of the more common manufacturing processes so it is important to understand the various symbols and details that go into manufacturing a welded part.
- ADDA Apprentice Drafting Competency met: Mechanical #11

Academic Connections

ELA Literacy and/or Math Standard (if applicable, Science and/or Social Studies Standard):	**Sample Performance Task Aligned to the Academic Standard(s):**
G-MG.1 Modeling with Geometry Use geometric shapes, their measures, and their properties to describe objects	-Students will analyze blue prints to determine weld size
G-mG.3 Apply geometric methods to solve design problems	-Students will create sketches using geometric methods

INDICATOR #MMD 4: **Explore careers in drafting fields.**

SUB-INDICATOR 4.1 (Webb Level: 2 Skills/Concept): Define/compare career pathways in drafting

Knowledge (Factual):	**Understand (Conceptual):**	**Do (Application):**
-Career opportunities and Mechanical Drafting.	-Education needs for specific careers	-Research potential career interests

-Appropriate apprenticeships	-Importance of Industry certification -Potential job outlook based on location	-Interview potential employers or post secondary program specialists -Create Personal Learning Plan: www.sdmylife.com

Benchmarks:
Students will be assessed on their ability to:

- Create a list of career opportunities that are linked to career match maker section of www.sdmylife.com
- Presentation on career choice

Academic Connections

ELA Literacy and/or Math Standard (if applicable, Science and/or Social Studies Standard):	**Sample Performance Task Aligned to the Academic Standard(s):**
RI1. Cite strong and thorough textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text, including determining where the text leaves matters uncertain.	-Students will utilize career exploration software, research and write a report for comparison of chosen career paths.
RI4.Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings; analyze how an author uses and refines the meaning of a key term or terms over the course of a text	-Students will utilize career exploration software to research educational requirements for comparison of chosen career paths.

Additional Resources
Vocabulary:

MDD1.1 Apply geometric design and descriptive geometry to the design process.

1. **Bisecting an angle**- to divide an angle into two equal parts
2. **Cylinders**-
   Surface or solid bounded by two parallel planes and generated by a straight line moving
   parallel to the given planes and tracing a curve bounded by the planes and lying i n a plane perpendicular or oblique to the given planes.
3. **Dihedral angle** - the true angel between two planes**.**
4. **Eccentric circle**- a circle within a circle not having the same center
5. **Ellipseplane** curve such that the sums of the distances of each point in its periph ery from two fixed points, thefoci, are equal. It is a conic section formed by the in tersection of a right circular cone by a plane that cuts
   the axis and the surface of the cone. Circle seen at an angle. Oval shape that contains two centers of equal radius.
6. **Helix**- A point spiral moving around the circumference of a cylinder at a uniform rate and parallel to the axis of the cylinder.
7. **Hyperbola** - A geometric shape formed when a plane cuts two right circular cones that are joined at their vertices.
8. **Oblique plane**- A plane that is not perpendicular to any of the principal projection planes.
9. **Parabola**- A geometric shape formed when a plane cuts a right circular cone at the same angle as the elements.
10. **Point of intersection**- The point where two lines intersect or the point where a line and a plane intersect.
11. **Prism**- a solid having bases or ends that are parallel
    and congruent polygons and whose sides are parallelograms.
12. **Quadrilatera**l - A plane figure bounded by four straight lines.-
13. Rectified length- Determination of the length of a curve; Finding a straight line equal in length to a given curve.
14. **Regular polygon**- a polygon with equal sides and equal internal angles.
15. **Skewed**- to give an oblique direction to; shape, form, or cut obliquely.
16. **Tangent**- A line or curve that intersects a circle or arc at one point only and is always 90° relative to the center.
17. **True angle between planes**-The angle measured in a view where both planes appear as lines.

MDD1.2 Demonstrate the basics of Geometric Dimensioning and Tolerancing (GD&T).

1. **Actual local size**- The measured value of any cross section of any individual feature of size.
2. **Allowance**-Minimum clearance between two mating parts. Usually considered the tightest possible fit between two mating parts.
3. **Basic size**- the size from which the limits of size are derived by the application of allowances and tolerance.

4. **Circularity (Roundness**)- is a condition of a surface where (a) for a feature other that a sphere, all points of the surface intersected by a plane perpendicular to the axis are equidistant from that axis (b) for a sphere, all points of the surface intersected by a plane passing through a common center are equidistant from that center. A circularity tolerance specifies a tolerance zone bounded by two concentric circles within which each circular element of the surface must lie.
5. **Clearance**- The amount of clear space between two mating parts at assembly.
6. **Concentricity**- The condition where the median points of all diametrically opposed elements of a surface of revolution are congruent with a datum axis (or center point).
7. **Datum** - A theoretically exact point, axis, line, plane, or combination thereof derived from a theoretical datum feature simulator.
8. **Datum targets**- designated points, lines, or areas that are used in establishing a datum reference frame.
9. **Datum reference frame** - Three mutually perpendicular intersecting datum planes. This exists in theory and not on a part.
10. **Decimal metric dimensions** - When using metric units the following should be applied: The decimal point and zero are omitted when the metric dimension is a whole number. A zero precedes a decimal millimeter that is less than 1 millimeter. When a metric dimension is greater than a whole number by a fraction of a millimeter, the last digit to the right of the decimal point is not followed by a zero.
11. **Feature**- a physical portion of a part such as a surface, pin, hole, or slot or its representation on drawings, models, or digital data files**.** .
12. **Flatness**- the condition of a surface or derived median plane having all elements in one plane. A flatness tolerance specifies a tolerance zone defined by two parallel planes within which the surface or derived median plane must lie.
13. **Form tolerance**- A group of geometric tolerances that control straightness, flatness, circularity, and cylindricity.
14. **Least Material Condition (LMC)** – the condition in which a feature of size contains the least amount of material within the stated limits of size (e.g., maximum hole diameter, minimum shaft diameter.
15. **Limits** – the maximum and minimum sizes.
16. **Maximum Material Condition (MMC) –** the condition in which a feature of size contains the maximum amount of material within the stated limits of size (e.g., minimum hole diameter, maximum shaft diameter.
17. **Orientation tolerance zone**- a group of geometric control.
18. **Parallelism**- The condition of a surface or feature's center plane, equidistant at all points from a datum plane; or a feature's axis, equidistant along its length from one or more datum planes or datum axis.
19. **Positional tolerance** - is the location of one or more features of size relative to one another or to one or more datums. Positional tolerance defines a zone within which the center, axis, or center plane of a feature of size is permitted to vary from a true (theoretically exact) position.

20. **Profile tolerance** - define a tolerance zone to control form or combinations of size, form, orientation, and location of a feature(s) relative to a true profile.
21. **Reference dimension** - usually without a tolerance, that is used for informational purposes only.
22. **Runout tolerance** - is used to control the functional relationship of one or more features to a datum axis established from a datum feature specified at RMB (regardless of material boundary).
23. **Straightness- .** A straightness tolerance specifies a tolerance zone within which the considered element of a surface or derived median line must lie.
24. **Symmetry**- the condition where median points of all opposed or correspondingly located elements of two or more feature surfaces are congruent with a datum axis or center plane.
25. **Tolerance-.** The tolerance is the difference between the maximum and minimum limits**.**
26. **True position**- The theoretically exact location of a feature of size, as established by basic dimensions.

MDD2.1 Create multi view drawing.

1. **Break corner** Slight relief on a sharp corner. Usually noted in general title block notes. Can be done by machining, sanding or filing during manufacturing process.
2. **Chamfer**- Angular relief at the last thread of a thread screw that allows the thread to more easily engage with mating part or a surface angle to relieve a sharp corner.
3. **Feature**- a physical portion of a part such as a surface, pin, hole, or slot or its representation on drawings, models, or digital data files.
4. **Fillet** - Curve formed at the interior intersection between two or more surfaces.
5. **Front view**- the view in an orthographic projection drawing that represents the front of an object.
6. **Line precedence** – The order of lines that have precedence over each other. Example: Visible object line has precedence over hidden lines, hidden lines has precedence over centerlines.
7. **Perpendicular**- the condition of a surface, feature's center plane, or feature's axis at right angle to a datum plane or datum axis.
8. **Round**- Two or more exterior surfaces at their intersection. Can also be used to describe a circular piece of material**.**
9. **Runout**- is used to control the functional relationship of one or more features to a datum axis established from a datum feature specified at RMB (regardless of material boundary).
10. **Visible (object) line**- consists of solid lines and shall be used for representing visible edges or contours of objects

MDD2.2 Create sectional views of mechanical drawing.

1. **Aligned section** – where features lend themselves to an angular change in direction of the cutting plane (less than 90°), the sectional view is drawn as if the

bent cutting plane and features were rotated to a plane perpendicular to the line of sight of the sectional view.

2. **Auxiliary sections** A section view appearing in other than a principal view. Rules for cutting planes and sectioning are the same as for other sectional views.
3. **Broken out section** – where it is necessary to show only a portion of the object in section, the sectional area is limited by a break line. No cutting plane is indicated. .
4. **Conventional breaks** – used to shorten long features.
5. **Cutting plane line** – used to indicate the location of cutting planes for sectional views. Cutting plane lines shall be drawn to stand out clearly on the drawing. The ends of the lines are at 90° and terminated by arrowheads to indicate the direction of sight for viewing. There are three forms of cutting plane lines. (a) evenly spaced dashes; (b) alternating long dashes and pairds of short dashes; (c) the same as a and b except the dashes between the end lines are omitted. To relate the cutting plane line to its sectional view, capital letters such as A, B, C, etc., are placed near each arrowhead.
6. **Full section** – where the cutting plane line extends straight through the object, usually on the centerline of symmetry, a full section is obtained.
7. **Offset section** – in order to include features not located in a straight line, the cutting plane may be stepped or offset (generally at right angles) to pass through these features.
8. **Outline sectioning** A form of sectioning for large parts in section that does not completely use section lines for entire part, normally shown around the internal periphery of the part.
9. **Removed section** – a section that is not a direct projection from the view containing the cutting plane line, but displaced from its normal position .
10. **Revolved section**– If a cutting plane is passed perpendicular to the axis of an elongated feature, such as a spoke, beam, or arm, and then revolved in place through 90 degrees into the plane of the drawing, a revolved section is obtained. Visible lines on each side of the revolved section may be removed and break lines used. No cutting plane line is indicated.
11. **Section lines** – a pattern of straight, equally spaced, parallel lines used to indicate the cut surfaces of an object in section views.

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MDD2.3 Develop auxiliary views of mechanical drawing.

1. **ANSI Y14.3** - This Standard establishes the requirements for creating orthographic views for item description. The topics include the multiview system of drawing, selection, and arrangement of orthographic views, auxiliary views, sectional views, details, and conventional drawing practices.
2. **Parallel plane** -Two planes (surfaces) that do not intersect .
3. **Auxiliary plane** - A plane on which an auxiliary view is projected at 90° to the inclined plane not shown in true size.
4. **Auxiliary view (use & function)** Views that are used to show the true shape and relationship of features that are not parallel to any of the principal planes of projection.
5. **Ellipse**-
   Curve such that the sums of the distances of each point in its periphery from two fixed points, thefoci, are equal. It is a conic section formed by the intersection of a right circular cone by a plane that cuts the axis and the surface of the cone. Circle seen at an angle. Oval shape that contains two centers of equal radius.
6. **Foreshortened**- A line that appears shorter than its actual length because it is at an angle to the line of sight.
7. **Needed feature** A feature or view of a part that is required to accurately manufacture.
8. **Primary auxiliary view** views that are adjacent to and aligned with a principal view.
9. **Secondary auxiliary view** . A view that is adjacent to and aligned with a primary auxiliary view or with another secondary auxiliary view.
10. **True length** - true length is any distance between points that is not foreshortened by the view type and when the line of sight is perpendicular to a line.
11. **True size & shape** when the line of sight is perpendicular to a surface or feature.

MDD2.4 Generate pictorial drawing.

1. **Assembly drawing** defines the configuration and contents of the assembly or assemblies depicted thereon. It establishes item identification for each assembly. Where an assembly drawing contains detailed requirements for one or more parts used in the assembly, it is a detail assembly drawing.
2. **Axis lines**- A straight **line** about which a body or geometric object rotates or may be conceived to rotate
3. **Axonometric**- Axonometric projection is a type of parallel projection used to create a pictorial drawing of an object, where the object is rotated along one or more of its axes relative to the plane of projection. There are three main types of axonometric projection: isometric, dimetric, and trimetric projection
4. **Blocking**- A method of shading a curved surface to produce a highlight effect.
5. **Front view**- One of the 6 principal orthographic views and generally relates to the front of the part
6. **Horizon line**- horizontal line that is the vanishing point of lines perpendicular to the picture. The eye level of the observer established in the front view in relation to a determined station point. Used in perspective drawings
7. **Isometric angles**- Used in pictorial drawing in which all three axes (X, Y and Z) form equal angles totally 120° with the plane of projection.
8. **Isometric axis lines**- The three principal axes of an isometric drawing and any line on or parallel to them. These lines can be measured.
9. **Line of sight**- unobstructed line-of-sight between a subject and object
10. **Oblique**- neither perpendicular nor parallel to a given line or surface, slanting, sloping.
11. **Perspective drawing**- an approximate representation, on a flat surface (such as paper), of an image as it is seen by the eye.
12. **Pictorial**- Any of many types of drawing projection that gives depth and distortion that the human eye perceives. Isometric, perspective, diametric, trimetric exploded pictorial or oblique drawings are common types.
13. **Principle face** One of the 6 principal views in orthographic projection, usually the front face which all other views are based on.
14. **Sight direction** Can be perpendicular or in a pictorial projection at a different angle other than perpendicular
15. **Vanishing points**- a point in the picture plane that is the intersection of the projections (or drawings) of a set of parallel lines in space on to the picture plane

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MDD2.5 Examine drawing identification and management techniques used in mechanical drafting.

1. **Assembly drawing**- defines the configuration and contents of the assembly or assemblies depicted thereon. It establishes item identification for each assembly. Where an assembly drawing contains detailed requirements for one or more parts used in the assembly, it is a detail assembly drawing.
2. **Bill of materials**- a list of the raw materials, sub-assemblies, intermediate assemblies, sub-components, parts and the quantities of each needed to manufacture an end product
3. **Detail drawing**- provides the complete end product definition of the part or parts depicted on the drawing. A detail drawing establishes item identification for each part shown.
4. **General assembly drawing** Depicts how a assembled component and it's different parts relate to each other, identify those components by part number, material, quantity and parts list or bill of materials. Includes any additional specifications or notes for that assembled component.
5. **Layout- Drawing**- depicts design development requirements. It is similar to a detail, assembly, or installation drawing, except that it presents pictorial, notational, or dimensional data to the extent necessary to convey design solution used in preparing other engineering drawings.
6. **Materials block** Used on detail drawings to show the material that the detailed part is manufactured from. Located generally in the Title Block.
7. **Parts list** - a tabulation of all parts and bulk materials, except those materials that support a process and are not retained, such as cleaning solvents and masking materials, used in the item.
8. **Patent drawing**- - specific type of drawing submitted to the United States Patent and Trademark Office, following the guides of the USPTO, for patent or trademark approval of new products.
9. **Revision**- changes made to an original drawing or associated document after authorized release which requires the revision level to be advanced.
10. **Size as measured** - See actual local size definition. This should probably be removed.
11. **Title block** - A portion of a drawing that contains information such as the company name, part name, part number, designer, scale, and material.
12. **Working drawing** are a set of drawings that supply all the information required to manufacture any given product including, detail, assembly and parts list.

MDD3.1 Analyze different manufacturing processes.

1. **Casting**-A process called founding in which liquid material is poured into a hollow mold to produce a non-finished part.
2. **Drill press**- A machine that machine drills holes and can perform other functions such as reaming, boring, countersinking, counter boring and tapping of threads. Can have single or multiple spindles.
3. **Engine lathe** - A machine used to cut material for cylindrical objects.
4. **Foundry**- an establishment for producing castings in molten metal.
5. **Grinder**- A machine that uses an abrasive wheel to remove excess material or provide a desired finish.
6. **Jigs**- a plate, box, or open frame for holding work and for guiding a machine toll to the work, used especially for locating and spacing drilled holes; fixture.
7. **Mill**- Uses a rotary cutting tool to remove material from a part. Can be a horizontal or vertical mill**.**
8. **Punch press**- a power driven machine used to cut, draw, or otherwise shape material, especially metal sheets, with dies, under pressure or by heavy blows.
9. **Shaper**- A machine used primarily to produce horizontal, vertical or angular flat surfaces. Often replaced by a milling machine.

MDD3.2 Identify basic welding symbols used in the manufacturing design process.

1. **Arc welding**- welding by means of heat of an electric arc.
2. **Automatic welding** - A welding operation utilizing a machine to make a continuous, unbroken weld.
3. **MIG welding**- Also known as GMAW (Gas Metal Arc Welding) for thin material to very thick plate. Originally used for aluminum with a process called MIG (Metal Inert Gas). Electrical current by wire that forms the weld and can be used in automatic or robotic welding.
4. **Shielded metal arc welding (SMAW)** - also known as manual metal arc welding (MMA or MMAW), flux shielded arc welding or informally as stick welding, is a manual arc welding process that uses a consumable electrode coated in flux to lay the weld.
5. **TIG welding**- A method of welding in which the arc is maintained by a tungsten electrode and shielded from the access of air by an inert gas. Also known as GTAW (Gas Tungsten Arc Welding) and generally limited to thin materials, high integrity joints or small parts.
6. **Types of welds**

a. **Tensile** A weld (joint) that will realize tension stresses.
b. **Compression** A weld (joint) that will realize compression stresses.
c. **Bending** A weld (joint) that will realize bending stresses
d. **Torsion** A weld (joint) that will realize torsion stresses.
e. **Shear** A weld (joint) that will realize shear stresses
f. **Weld angles** denotes the angle of a fillet weld, usually 45° or a weld joint preparation.