Unit 7: Dimensional accuracy
A. Precision and tolerance

- It is impossible to produce components with dimensions that are absolutely precise، مضبوط، with sizes exactly the same as those specified in a design. This is because all production processes are imprecise غير دقيق to a certain extent حد ما. Therefore, the sizes of several components produced from the same design will vary (differ). Although the variation may only be a few hundredths جزء من مئة of a millimetre, sizes will not be 100% accurate (exact) compared with the design.

- Because engineers know that accuracy cannot be perfect, in designs they often specify tolerances مسموح -that is, acceptable variations in precision. Instead of giving one precise size, a tolerance specifies a range of acceptable sizes- an allowed amount of variation. This is often given as a deviation (difference) from a precise size.
A. Precision and tolerance...

- The drawing on the side shows a shaft with a specified diameter of 88 mm, **plus or minus** (±) 0.05 mm. This means the diameter may **deviate** 0.05 mm either side of this size. Therefore, diameters of 87.95 mm and 88.05 mm, which are slightly **inaccurate**, are still **permissible** (allowed), as they are **within tolerance**. However, diameters of 87.94mm or 88.06mm are not permissible- they are **outside tolerance**.
A. Precision and tolerance…

- When the permissible deviation in size is very small, we say it is a **tight tolerance** (or a **close tolerance**). A large permissible deviation is a **loose tolerance**. For example:

  - Machining a metal component to a tolerance of \( \pm 0.1 \) mm is relatively easy to do, so this tolerance is loose. But a tolerance of just \( \pm 0.01 \) mm is a tight tolerance in metalworking.

  - In a concrete structure, \( \pm 10 \) mm is a loose tolerance. But \( \pm 1 \) mm is tight, because it is difficult to place wet concrete accurately.
When one component goes through another, such as a shaft or a bolt going through a hole, the two must fit together - their sizes and shapes must match. The key question is, how tightly (or loosely) should they fit together? There are two main types of fit:

- A clearance fit allows a component to slide or turn freely, by leaving clearance (a gap) between itself and the sides of the hole. This distance must be quite precise. If there is insufficient clearance - if the gap is too small - the component will fit too tightly. As a result, the component will bind - it will not be able to slide or turn freely. In other words, there will not be enough play. However, if there is too much clearance, there will be too much play and the component will be able to move too much.
B. Fit...

- An interference fit is a very tight fit which does not allow a component to move freely inside a hole. This type of fit can be achieved by forcing the component into the hole. Alternatively, the metal around the hole can be heated so that it expands (increases in size due to heat). After sufficient expansion, the component is placed in the hole. The metal then cools and contracts (decreases in size due to cooling). The contraction results in a tight fit. An example of an interference fit is a train wheel fitted on an axle محوور التماثل.
7.1 Find words and expressions with similar meanings to the words and expressions below. Sometimes there is more than one possible answer.

1. allowed permissible
2. Exact
3. Differ
4. Exactness
5. not exact
6. deviation between maximum and minimum
7. an acceptable deviation
8. an unacceptable deviation
9. little deviation allowed
10. large deviation allowed

1 permissible
2 accurate / precise
3 vary / deviate
4 precision / accuracy
5 imprecise / inaccurate
6 variation / range
7 within tolerance
8 outside tolerance
9 tight tolerance / close tolerance
10 loose tolerance
7.2 Match the related sentences.

1. It'll bind.  
   A. The bolt will have to turn in the hole.

2. It'll contract.  
   B. The bolt won't be able to turn freely enough in the hole.

3. It'll expand.  
   C. The bolt won't fit tightly enough in the hole.

4. There'll be too much play.  
   D. The wheel will have to fit very tightly on the axle.

5. It needs a clearance fit.  
   E. The hole will widen with the high temperature.

6. It needs an interference fit.  
   F. The shaft will shorten and narrow slightly as it cools.

1b, 2f, 3e, 4c, 5a, 6d
Blue Printing for performance

- The advantage of racing in a kart class سباق سيارات with a standard engine spec seems obvious – everyone has the same power, so it's driving talent موهبة that makes the difference. But things aren't quite فعلا، تمام that simple. No two standard engines are identical. There will always be a slight (1) ............... in the size of engine parts, since they are manufactured, not to perfectly (2) ............. dimensions, but to specified (3) ...............
Although these differences may only be (4) \ldots\ldots\ldots or (5) \ldots\ldots\ldots . a few hundredths of a millimetre, they will nevertheless ومع ذلك result in a slight performance gap between any two engines. One way round this problem (if you have the cash) is to have your engine blueprinted مخطط. The process is perfectly legal, as the sizes of all parts remain (6) \ldots\ldots\ldots the tolerances that are (7) \ldots\ldots\ldots for the standard engine specification. However, by carefully matching pairs or groups of parts that are all in either the lower or upper half of the tolerance (8) \ldots\ldots\ldots , a blueprinted engine is built to (9) \ldots\ldots\ldots . together very precisely, thanks to almost perfect (10) \ldots\ldots\ldots between moving parts.

1 variation  2 precise  3 tolerances  4 plus  5 minus  6 within  7 permissible  8 range  9 fit  10 clearances