Code No.: 9A03603/R09

B.Tech. III Year II Semester Regular and Supplementary Examinations Set-2

Solutions

April/May - 2013

METROLOGY

(Mechanical Engineering)

Time: 3 Hours Max. Marks: 70

*Answer any **FIVE** Questions*

***All** Questions carry **equal** marks*

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1. Define a fit. What are the different types of fits? Explain each in detail. Quote examples of each type of fit. **(Unit-I, Topic No. 1.2)**

2. Discuss in detail the procedure in manufacture and generation of slip gauges. **(Unit-II, Topic No. 2.1.2)**

3. (a) Define flatness error. What are the methods of measuring flatness error? **(Unit-III, Topic No. 3.2.1)**

   (b) Describe briefly the accuracy requirements for flatness of a cast iron surface plate. How do those requirements limit the use of CI surface plates for precision measurements? **(Unit-III, Topic No. 3.2.1)**

4. (a) Describe briefly the flow velocity type pneumatic comparators. Mention any speciality of these comparators. **(Unit-IV, Topic No. 4.2.4)**

   (b) List out the advantages and applications of pneumatic comparators. **(Unit-IV, Topic No. 4.2.4)**

5. (a) What is mean by drunken thread? How it is caused? What difficulties does it present in finding the pitch of the thread? **(Unit-V, Topic No. 5.2)**

   (b) Name the important dimensions of V-thread which control the fitting of threads. **(Unit-V, Topic No. 5.1)**

6. (a) Explain the set of alignment tests is to be carried out on a pillar type drilling machine. **(Unit-VI, Topic No. 6.3)**

   (b) List the equipments required and describe the procedure which should be followed. **(Unit-VI, Topic No. 6.1)**

7. (a) Explain with aid of a diagram a typical 'Rolling' gear tester. Describe four different tests which can be carried out on this equipment and information expecting from each test. **(Unit-VII, Topic No. 7.1.1)**

   (b) A 40 teeth grear of module 2.5 mm is to be checked by measuring the distance over two pins inserted in the tooth spaces at opposite sides of the wheel. Calculate the diameter of the pin which will rest with its centre at the point and determine the measurement over the pins. **(Unit-VII, Topic No. 7.1.2)**

8. (a) Explain the thermal spraying. **(Unit-VIII, Topic No. 8.2)**

   (b) Explain the materials used in thermal spraying. Explain their applications. **(Unit-VIII, Topic No. 8.2)**

SOLUTIONS TO APRIL/MAY-2013, SET-2,QP

Q1. Define a fit. What are the different types of fits? Explain each in detail. Quote examples of each type of fit.

Answer : **April/May-13, Set-2, Q1**

For answer refer Unit-I, Q11.

Q2. Discuss in detail the procedure in manufacture and generation of slip gauges.

Answer : **April/May-13, Set-2, Q2**

Manufacture of Slip Gauges

For answer refer Unit-II, Q8, Topic: Manufacture of Slip Gauges.

Generation of Slip Gauges

A set of gauges is generated by lapping process. It is performed by arranging a number of pieces of same size simultaneously, beginning from the longest member. A number of about eight 100 mm gauges are lapped at the same time. During certain intervals, the process is stopped and out of all any three gauges are wrung together and compared with 300 mm standard slip gauge. Lapping is carried out in stages until uniformity of gauges is achieved. On completion, each of the 100 mm gauge is accurately adjusted to size and out of all from the set any one is used as a standard gauge which is further used to generate the next complete set of lower series.

Q3. (a) Define flatness error. What are the methods of measuring flatness error?

Answer : **April/May-13, Set-2, Q3(a)**

For answer refer April/May-12, Set-1, Q3.

(b) Describe briefly the accuracy requirements for flatness of a cast iron surface plate. How do those requirements limit the use of CI surface plates for precision measurements?

Answer : **April/May-13, Set-2, Q3(b)**

Accuracy Measurements

A cost iron surface plate requires the following for accuracy in measurements,

1. The surface plate should be handled with care.
2. It should be kept dry and slightly lubricated.
3. In order to prevent the surface plate from damage and inaccuracy, it should always be kept covered when not in use.
4. Surface plate should not be used for hammering purposes as it will permanently impair the working surface.
5. To acquire maximum reliability and accuracy in measurements, surface plates should be kept clean.
6. Heavy workpieces should be placed gently with proper care on the CI surface plates.

The cast iron surface plates when exposed to environmental conditions are prone to rust and the use of rust inhibitor to clean the rust from the surface plate scrapes the surface. In order to limit the use of cast iron surface plates for precision measurements, granite is selected as the construction material for surface plates.

Advantages

Some of the advantages of granite for precision measurement are,

1. It gives high degree of surface flatness.
2. High stability.
3. No warpage and hence the surface flatness is maintained.
4. Ability to maintain the flatness when dipped unlike cast iron which develops tiny crack on the surface.
5. The surface is rust proof and requires easy maintenance.

Q4. (a) Describe briefly the flow velocity type pneumatic comparators. Mention any speciality of these comparators.

Answer : April/May-13, Set-2, Q4(a)

Free Flow Air Gauges (or Velocity or Flow Type Pneumatic Gauges)

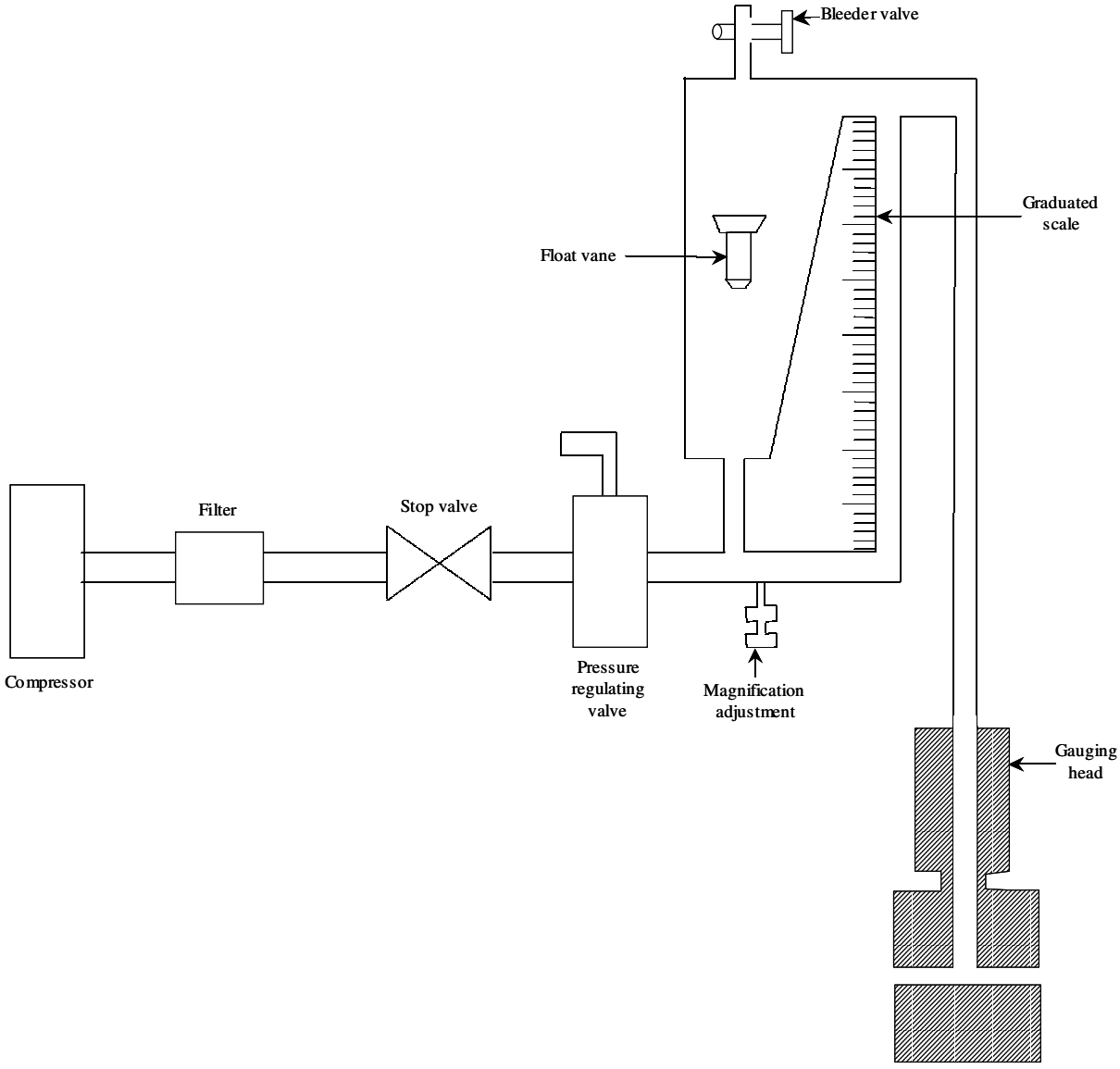

Figure: Free Flow Air Gauge

Construction

Free flow air gauge system consists of compressor, air filter, pressure regulating valve, tapered glass tube, float vane, graduated scale, etc. The pressure regulation valve is connected between stop valve and the glass tube to regulate the pressure of filtered air. A magnification adjustment is provided at the bottom tube. Magnification can be changed as required by using screw at the inlet to the tapered glass tube. A bleeder valve is fixed at the top of the tube for zero adjustment of the float vane. Variations in the float vane due to rate of flow of air can be noticed on the graduated scale which is provided on the tube. The outlet of tube is connected to gauging head through plastic tubing.

Working

It works by sensing and indicating the rate of flow of air on the graduated scale by varying float vane. The flow is sensed by the glass tube which has a tapered bore.

The compressed air from the compressor is subjected to filtration process. The filtered air is supplied to pressure regulating valve through a stop valve for any kind of repairs or maintenance. The air is passed to the tube through the bottom end of the tube. The float fluctuates due to the flow velocity of air. This air is then passed to gauging head by means of plastic tubing. The gauging head is provided with two diametrically opposite orifices for releasing the air into atmosphere. Various sizes can be measured by the velocity of air in the tapered glass tube from the height of float in the tube.

Advantages

Some of the advantages of using flow-velocity types pneumatic comparators are,

1. The comparator can be read accurately upto micros depending on the scale length.
2. Magnification of the order of 500 to 5000 times can be achieved.
3. As the tube, float and scale is changed the amplification of the system can also be changed.
4. The system is based on less air consumption.
5. They are simple and have quick response despite the length of the circuit.
6. The use of large clearance between nozzle and object surface results in reduced wear of the gauging members.
7. It is used in all applications where back pressure system is suitable.

(b) List out the advantages and applications of pneumatic comparators.

Answer : **April/May-13, Set-2, Q4(b)**

Advantages

For answer refer Unit-IV, Q34, Topic: Advantages of Pneumatic Comparators.

Applications

Pneumatic comparators are widely used for the following applications,

1. For automatic control of size of components like plug gauges.
2. For the measurement of very small holes of upto 0.0005 mm diameter.
3. For checking the ovality and taperness of circular bores.
4. For analyzing the true measurements of the following,
   (a) Components which are not perfectly round
   (b) Bell mouthing
   (c) Parallelism
   (d) Flatness
   (e) Camber and
   (f) Concentricity.

Q5. (a) What is mean by drunken thread? How it is caused? What difficulties does it present in finding the pitch of the thread?

Answer : **April/May-13, Set-2, Q5(a)**

For answer refer April/May-12, Set-1, Q5(a).

(b) Name the important dimensions of V-thread which control the fitting of threads.

Answer : **April/May-13, Set-2, Q5(b)**

For answer refer April/May-13, Set-1, Q5(a).

Q6. (a) Explain the set of alignment tests is to be carried out on a pillar type drilling machine.

Answer : **April/May-13, Set-2, Q6(a)**

For answer refer Unit-VI, Q15.

(b) List the equipments required and describe the procedure which should be followed.

Answer : **April/May-13, Set-2, Q6(b)**

For answer refer Unit-VI, Q2.

Q7. (a) Explain with aid of a diagram a typical 'Rolling' gear tester. Describe four different tests which can be carried out on this equipment and information expecting from each test.

Answer : **April/May-13, Set-2, Q7(a)**

Rolling Gear Tester

Parkinson gear tester machine is one of the rolling gear tester type that is widely used for calibration of production gears with master gears.

For remaining answer refer Unit-VII, Q12.

Different Tests

The different tests which can be carried on rolling gear tester by simple modification are as follows,

(i) Test for Checking Involute Shape of Gear

For answer refer Unit-VII, Q4.

(ii) Test for Tooth to Tooth Pitch Measurement

For answer refer Unit-VII, Q6, Topic: Step by Step Method or Tooth to Tooth Pitch Measurement.

(iii) Test for Measuring Centre Distance

The centre distance of the gears can be measured by Parkinson's gear testing machine just by simple modification. The test can be carried by locking the movable carriage and fixing the master gears during running of the machine.

(iv) Test for Backslash

The backslash in gears is determined by placing a dial gauge at the pitch line of the gear to be measured. At this modification, it is also possible for checking the smooth running of gears. Thus, rolling gear tester can be used for various tests of gear by simple modification of machine.

(b) A 40 teeth gear of module 2.5 mm is to be checked by measuring the distance over two pins inserted in the tooth spaces at opposite sides of the wheel. Calculate the diameter of the pin which will rest with its centre at the point and determine the measurement over the pins.

Answer : **April/May-13, Set-2, Q7(b)**

For answer refer April/May-12, Set-1, Q7(b).

Q8. (a) Explain the thermal spraying.

Answer : **April/May-13, Set-2, Q8(a)**

Thermal Spraying

Thermal spraying is a coating process in which the material is heated and sprayed onto a surface. In this process, material to be deposited is in wire or powder form. The material is heated to a molten state and sprayed onto the base metal surface with the help of a spray gun to form a metal coating.

Classification

Thermal spraying is classified into two types,

1. Wire metallizing
2. Powder metallizing.

1. Wire Metallizing

In wire metallizing, the metallic gun uses a metal in the form of wire. Initially, the surfaces, to be coated are cleaned and roughened to improve bond strength. The coating material is sprayed on the metal surface by using a spray gun (metallic gun), which comprises of,

(i) A gas torch with a hole at the centre of the tip for the wire.

(ii) A gear and a small air turbine in order to feed in the wire through the tip into the flame as fast as it melts.

(iii) An air cap around the torch tip, and

(iv) A nozzle to supply a blast of air to atomize the molten metal and deposit it on the prepared surface.

In this process the wire is fed into the metallic gun at a specific rate, melted by an oxyacetylene flame and then it is blown on to the surface, being coated by compressed air. However, wire metallizing is most commonly used because of the following reasons,

(a) The metal used is less expensive.

(b) It can be handled very easily and

(c) Easy availability.

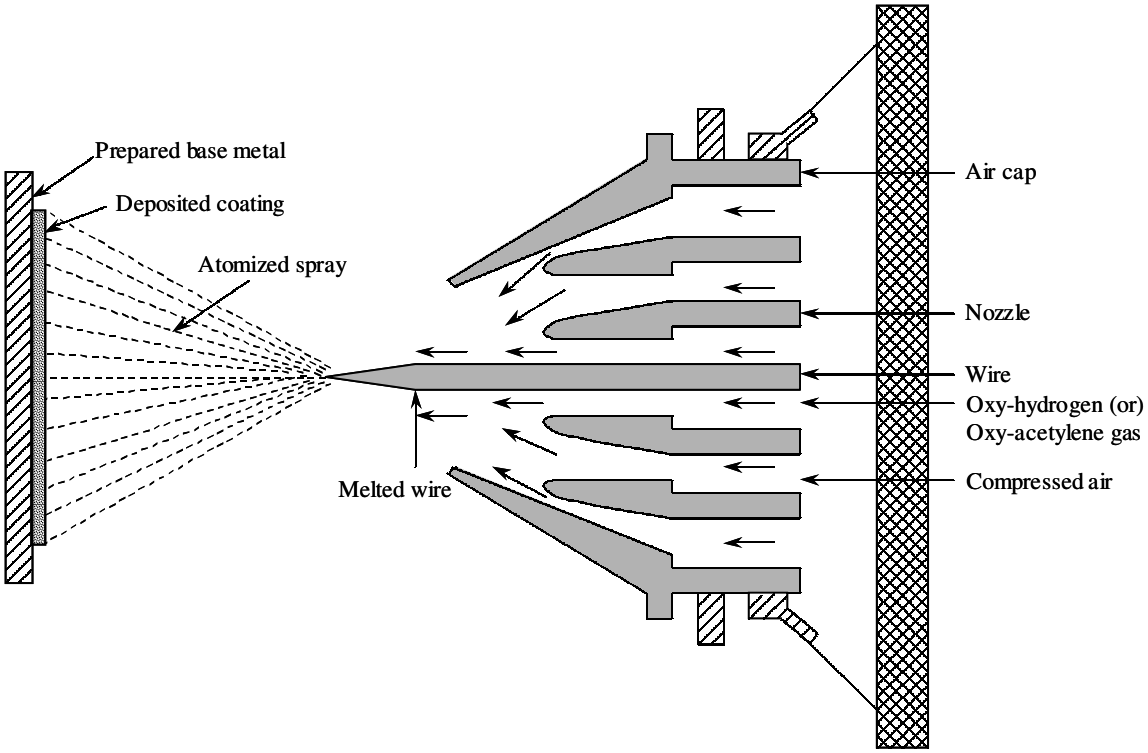

Figure: Wire Metallizing

2. Powder Metallizing

In this method, coating material is in the form of powder. The powdered metal is fed through rubber hose to spray gun from a container and out through the centre of the flame.

In this case, a small amount of air is sufficient to deposit the molten metal on the surface being coated, since the metal is already in the atomized form. The powder-gun has no gears or turbine, costs less and is lighter to handle.

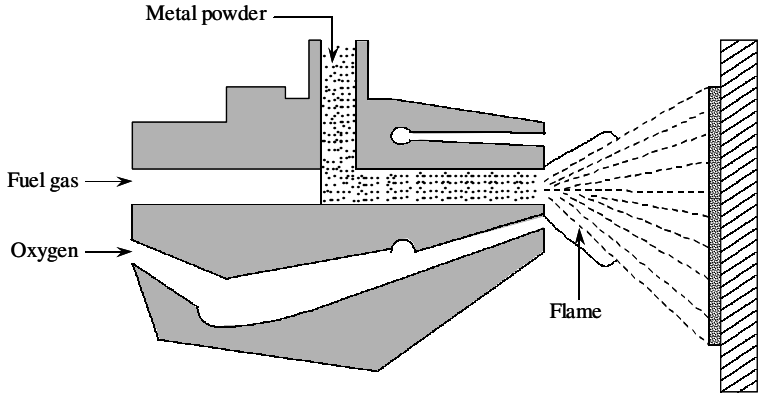

Figure: Powder Metallizing

Applications

The metallizing is used,

1. In corrosion protection.
2. To obtain hard and noble surfaces.
3. In soldering the surfaces.
4. To increase the electrical conductivity of poor conductors.
5. To increase thermal conductivity of the conductors.
6. The metallizing is also employed in reflecting surfaces, decorative films and special metal forms.

(b) Explain the materials used in thermal spraying. Explain their applications.

Answer : April/May-13, Set-2, Q8(b)

Types of Materials

The different types of materials used in thermal spraying are,

1. Single phase materials
2. Composite materials
3. Layered or graded materials.

1. Single Phase Materials

Some of the single phase materials are,

(i) Metals

(ii) Ceramics

(iii) Intermetallics

(iv) Polymers.

(i) Metals

Pure metals and metal alloys like tungsten, molybdenum, zinc, aluminium, mild and stainless steels, stellites, etc. are used in thermal spraying processes.

Applications

1. Automotive or diesel engine cylinder coatings.
2. Piston rings or value stems.
3. Turbine engine blades, vanes and combustors.
4. Mining and agricultural equipments etc.

(ii) Ceramics

The different forms of ceramics like Al_2O_3, stabilized ZrO_2, TiO_2, CrO_3, MgO, carbides like Cr_3C_2, SiC, nitrides like TiN and Si_3N_4, Spinels like mullite and 1-2-3 type super conducting oxides, etc. are used as thermal spraying materials.

Applications

1. Aircrafts and rockets
2. Satellites
3. Gas turbines
4. Steel industries
5. Chemical industries, etc.

(iii) Intermetallics

These include TiAl, Ti_3Al, Ni_3Al, MiAl, MoSi etc as thermal spraying materials.

Applications

1. Heat treating furnaces
2. Steel making purposes
3. Various manufacturing processes.

(iv) Polymers

Polymers like urethanes, ethylene vinyl alcohols (EVA's) nylon 11, polytetrafluro ethylene etc., are widely used in thermal spraying methods.

Applications

1. In chemical industries for acid tank stands and pickling tanks.
2. Paper and pulp industry for piping, tanks and mixer paddles.
3. Marine environment for the steel exposed above the water line.

2. Composite Materials

Composite materials include cermets, reinforced metals, reinforced polymers, particulate, fiber and whisker reinforced composite etc.

Applications

1. Automotive industry
2. Aircraft and military
3. Space industry
4. Marine applications.

3. Layered or Graded Materials

These are also known as functionally gradient materials. These materials are combination of one metal with other metals or non-metals. The combination of metals in molten state is known as alloying.

Example : Bronze which is an alloy of copper and tin.

Applications

1. Aerospace
2. Medicine
3. Defence
4. Optoelectronics.