NIMS Machining Level I Preparation Guide

Drill Press

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Overview

Introduction

This preparation guide or test advisor is intended to help machinists study and prepare for the National Institute for Metalworking Skills (NIMS) written credentialing exam. The sample test will help prepare machinists to take the actual credentialing exam. None of the questions are duplicates from the actual credentialing exam. However, this preparation guide is a useful tool for reviewing technical knowledge and identifying areas of strength and deficiency for adequate credential exam preparation.

Achieving a NIMS credential is a means through which machinists can prove their abilities to themselves, to their instructors or employers and to the customer. By passing the NIMS credentialing exam you will earn a valuable and portable credential. Because the credentialing exam is challenging, you will have the satisfaction of proving to yourself and others that you have reached a level of competency that is accepted nationally.

Who Wrote the Questions?

A panel of technical experts, from all areas of the metalworking industry, wrote the questions used on the actual credentialing exam. The panel of experts ranged from company presidents and owners, to engineers and quality personnel, to actual working machinists. Credentialing exam questions are designed to assess the knowledge skills needed for entry-level machinists. They are written to deal with practical problems, computations, and decisions machinists encounter in their day-to-day work.

The technical experts must first validate the credentialing exam questions. Then, before the questions become part of the credentialing exam, qualified machinist and industry personnel again validate them on a national level. Rejected questions are then rewritten or discarded altogether.

How to Prepare for the Credentialing Exam

Become familiar with the credentialing exam content and question format by utilizing the tools provided in this exam preparation guide. The **Exam Specifications** portion contained in this guide contains a summary description of the content covered by the actual credentialing exam. The **Task List** describes competencies for each particular area associated with the credentialing area.

Each question on the sample exam is linked to a particular task or set of tasks found in the **Task List**. Therefore, a review of the **Task List**, with an eye on judging whether you know how to perform each task listed, will provide you with valuable information as you prepare for the credentialing exam.

The questions are multiple-choice. Note instructions that may accompany some questions. Be sure to read each question carefully (twice, if necessary) so that you know exactly what is being asked. Check each answer and your work since an error in computation or understanding may make a wrong answer appear correct.

The following four steps are suggested for effective preparation:

Step 1: Study the content list for each credentialing exam you will attempt.

Step 2: Carefully read the **Task List** for each section.

Step 3: Review the sample exam to become familiar with subject matter and question type. This is a very important step.

Step 4: Repeat steps 1 through 3 and identify the area(s) where you need additional study. Use the preparation guide as a self-diagnostic assessment tool.

Areas of Knowledge Measured by the Exam

The knowledge and skills you will need to pass the credentialing exam are as follows:

Credentialing Exam Sections

The credentialing exam is divided into three major sections. Although not specifically designated on the credentialing exam, these sections constitute the majority of the questions. They are:

- **Basic Drilling Procedures**
- **Drilling Speeds, Feeds and Basic Math**
- **Reaming Procedures**

Following is a list of the basic knowledge areas assessed by the exam.

- **Drill Press Components:** Proper operation of a drill press depends on knowledge of drill press components and their functions. Identification of the spindle, base, table, column, variable speed control and feed handle are essential for safe and effective use of this machine tool. Other essential components are the table lock, column lock, motor and base.

- **Process Improvement:** An important part of any process improvement is an understanding of the symptoms and causes of some common problems associated with drilling operations. Understanding root causes of drill breakage, excessive wear, enlarged diameters and excessive RPM enable the machinist to analyze the process and make the correct improvement.

- **Twist Drill Nomenclature and Sizing:** Each twist drill is comprised of many separate features. Identifying the web and understanding web thickness enables machinist to recognize the effects of excessive web thickness. Knowing the purpose and location of the margin facilitates proper drill diameter measurement as well as the effect of worn margin near the point of the drill. All general-purpose drills have the same identical point angle. The included point angle of a drill will vary dependent on the application and the material being machined.

- **Safety Practices:** Proper safety procedures insure safe and productive machining. Safety includes safe lifting procedures, hair containment, jewelry removal and loose clothing containment. Drill press safety includes the proper location of the vise, storage of the chuck key and chip removal. Safety awareness should be apparent at all times evident through the correct application of speeds and feeds.

- **Countersinking, Counterboring, Spotfacing and Center Drilling:** Spotfacing, countersinking and counterboring are drilling procedures used to seat screws and bolts with special head configurations or to seat a fastener or washer evenly on a rough surface. Center drilling is an important procedure for accurate hole location as well as shaft preparation for turning between centers. The specific drilling operations have speeds and feeds that are proportionally slower than drilling with general-purpose twist drills.

- **Layout and Inspection:** Choosing the correct measuring instrument is primarily dependent on the tolerance range of the specific dimension. Proper setup and correct measuring procedures for each measuring device is imperative. The machinist must also know when and where to apply semi-precision and precision layout. Selection and application of proper layout tools and setups is essential in any machining operation.

- **Tapping:** The drill diameter used to create a hole for internal threading will dictate the thread percentage or amount of engagement between two mating threaded components. Most tap drill charts for conventional thread forms are based on 70% – 75% engagement. Pipe taps used for some pneumatic and fluid connects have tap drills based on other parameters. With the proper equipment, tapping can be performed under power if the drill press is capable of reversing the rotation.

- **Work Holding:** The work piece must be held securely to prevent part pullout from the work holding device. The equipment used for work holding parts is dependent upon the shape and size of the part being drilled. Proper location of the vise may prevent the vise from whipping around if the drill gets jammed in the part. Proper selection of work holding devices is imperative for safe and accurate application of a drill press.

Before the Exam

Try to be well rested for the credentialing exam. Being well rested will make you more alert and efficient when taking the credentialing exam. Review any course material from your instructor. Review the test advisor information and sample exam found in this preparation guide. Bring at least two sharpened (#2) soft leaded pencils and an eraser. In addition, bring a calculator and the *Machinery's Handbook.* Become familiar with the procedure for taking a Scantron test. If you wish to pace yourself, bring a watch, or be aware of the location of clocks at the test site. Make sure to bring some form of identification, any necessary paperwork from NIMS and arrive at the test site at least 10 to 15 minutes prior to the specified exam time.

At the Testing Site

When you arrive at the test center, wait in the assigned area until the proctor begins the exam orientation and administration. The proctor will instruct you in the proper procedure for filling out any information on the answer sheet and will tell you the amount of time allotted for the credentialing exam, reference materials that can be used and if a calculator is permissible.

Once the credentialing exam has begun, keep track of time. Avoid spending too much time on any one question. Answer the questions you know the answers to and then go back those you had difficulty with if time allows. Repeat this process for each section. Again, do not spend an excessive amount of time on any one question.

It is to your advantage to answer every question. Do not leave any answers blank. Answers that are left blank will be counted as incorrect. Your score will be based on the number of correct answers.

Credentialing Exam Content, Sample Question Summary

Credentialing Exam Content and Sample Question Overview

The following material is designed to help machinist prepare for and obtain a NIMS credential in the area of Drill Press Skills. This section begins with an **Exam Specifications** section. The **Exam Specifications** will list the main categories covered on the credentialing exam. This section will also list the name of the topic, the number of questions pertaining to that topic and the percentage of the credentialing exam devoted to that topic.

The **Task List** describes competencies a machinist must have in order to receive a credential for Drill Press Skills. The **Task List** has a two-fold purpose. The first purpose is to prepare the machinist for credentialing. The second is to encourage instructors to apply the **Task List** as a measurement of the effectiveness of their curricula.

The number of questions in each content area may not be equal to the number of tasks listed. Some of the tasks are more complex and broader in scope and may be covered by several questions. Other tasks are simple and narrow in scope, and one question may cover several tasks. The main objective in listing the tasks is to describe accurately what is done on the job, not to make each task correspond to a particular exam question.

Sample questions follow the **Task List**. Although these same questions will not appear on the actual credentialing exam, they are in the same format as the actual exam questions. All questions on the credentialing exam are in the multiple-choice format. Some concepts evaluated on the credentialing exam are assessed in greater depth with the sample exam questions. The sample exam questions are developed to evaluate conceptual knowledge of machining rather than specific competencies. The sample exam may be longer than the actual credentialing exam.

Answers to the sample questions are located at the end of the sample exam. Work with your instructor to identify weak areas and evaluate answers. Use the sample exam as a study guide and diagnostic tool.

Exam Specifications – Drill Press Skills

Content Area	No. of Questions	% of Test
Basic Drilling Procedures	7	14
Drilling Speeds, Feeds and Basic Math	6	12
Reaming Procedures	6	12
Drill Press Components	6	12
Process Improvement	5	10
Twist Drill Nomenclature and Sizing	5	10
Safety Practices	5	10
Countersinking, Counterboring, Spotfacing and Center Drilling	5	10
Layout and Inspection	2	4
Tapping	2	4
Work Holding	1	2
	Total of 50	**100 %**

Task List

Drill Press Skills

Reading this **Task List** will allow the machinist to focus preparation on those subject areas that need attention. The instructor can use the **Task List** to fine-tune the curricula to meet the standards. If you feel comfortable with your knowledge about a particular task, you are probably ready to answer the questions on that subject matter. If, on the other hand, you have any doubts, you and your instructor can work on these areas to build up proficiencies. Many texts and resources are available to provide information on subject areas.

Basic Drilling Procedures

- Proper method of controlling the twist drill during break through
- The type of drill press procedure that is involved in the majority of hole making operations
- Cutting lip edge preparation on a twist drill that will cut brass or hard bronze
- Major parameter that determine the drill point angle on a twist drill
- Material that does not require cutting fluids in a drilling or reaming operation
- Type of drill press utilized for drilling very large work pieces
- Typical size deviation when drilling a hole

1) The majority of material removal operations on a drill press involve:
   a) Turning
   b) Counterboring
   c) Drilling
   d) Spotfacing

2) To obtain a clean hole, reduce burring and prevent drill breakage when the drill starts breaking through the bottom of the work piece, the machinist must:

   a) Increase the RPM of the twist drill

   b) Increase the spindle feed pressure

   c) Decrease the spindle feed pressure

   d) Clamp the vise to the table and feed as fast as possible

3) Which following type of drill press is used to drill very large pieces?

   a) Sensitive drill press

   b) Magnetic based drilling machine

   c) Microdrill press

   d) Radial drill press

4) To drill brass or hard bronze, the machinist often grinds a small flat on the cutting lips of the drill. The flat on the cutting lip provides:

   a) A scraping action that prevents binding of the drill

   b) Positive rake to reduce tensile pressure on the cutting edge

   c) A method of having a new drill cut undersize

   d) Clearance to reduce the cutting pressure

5) Most drills will tend to produce a hole that is:

   a) The same size as the diameter of the drill

   b) A tapered hole that enlarges toward the opposite side

   c) Slightly oversize hole

   d) Slightly undersize hole

6) Changing the tip angle of a drill is in most cases dependent on:

   a) The web thickness\diameter ratio on the drill

   b) The material

   c) The material of the drill itself

   d) Cutting speed of the drill

   e) Lubrication used during the drilling operation

7) Which one of the following material can be drilled or reamed without any lubrication (reference the *Machinery's Handbook*)?

   a) Cast iron

   b) Aluminum

   c) Stainless steel

   d) A2 tool steel

   e) Copper

Drill Speeds, Feeds and Basic Math

- Basic mathematical functions (addition, subtraction, multiplication and division) for fractions
- How drill speed and feed are designated
- Calculating RPM for a given material and drill diameter with reference to the *Machinery's Handbook*

8) The feed rate for a twist drill is given in:

   a) Inches per minute (IPM)

   b) Inches per foot (IPF)

   c) Inches per revolution (IPR)

   d) Degrees per inch (DPI)

9) The speed of a twist drill is given in:

   a) Inches per minute (IPM)

   b) Revolutions per minute (RPM)

   c) Inches per revolution (IPR)

   d) Inches per degree (IPD)

10) Using the *Machinery's Handbook* for a reference, determine the RPM for a .375 inch high speed steel twist drill cutting through 1030 plain carbon steel with a Birnell hardness of 150 (use 3.82 as the constant):

   a) 603 RPM

   b) 215 RPM

   c) 1528 RPM

   d) 917 RPM

11) Calculate the RPM for a .500 inch high speed steel twist drill cutting through 4140 steel with a cutting speed of 55 SFPM (use 4 as the constant):

a) 440 RPM

b) 110 RPM

c) 220 RPM

d) 880 RPM

12) Using 3.82 as the constant in the RPM formula with a 250 SFPM cutting speed, a .750-inch high-speed steel twist drill will rotate at 1273 RPM. How fast will a .438-inch high-speed steel twist drill rotate applying the same cutting speed?

a) 849 RPM

b) 2180 RPM

c) 1453 RPM

d) 571 RPM

13) Five holes are equally spaced. The distance from the first hole to the fifth hole is 4 11/16 inches. What is the distance between each hole?

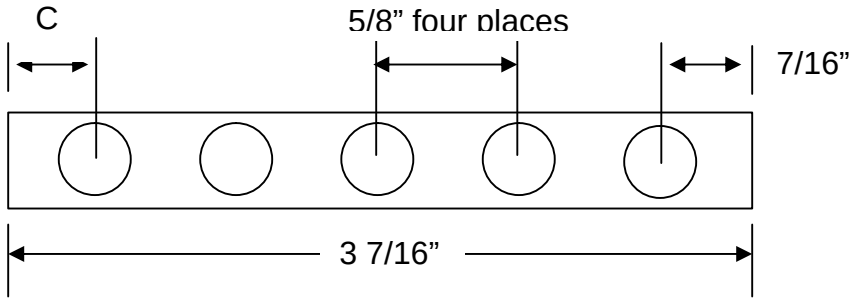
a) 1 13/32

b) 15/16

c) 1 9/16

d) 1 11/64

14) Determine the length of distance C as illustrated in the following diagram:



a) 1/2 inches

b) 7/16 inches

c) 27/64 inches

d) 31/64 inches

Reaming Procedures

- Comparing the RPM for drilling and reaming in cold rolled steel
- Root cause of an oversized hole for a reaming operation
- Comparing the cutting speed of a reaming operation and a drilling operation
- Root cause of a bellmouth reamed hole
- Common stock allowances left for reaming for various drilled hole diameters
- Reamer dimensions throughout the cutting portion of the reamer

15) What is the stock allowance for reaming a .3125-inch diameter?

a) .032 inches

b) .002 inches

c) .010 inches

d) .062 inches

16) To ream mild steel with a high-speed steel reamer, the cutting speed should be _____ that of drilling with the same size drill.

a) One eighth

b) One fifth

c) Twice

d) The same as

e) One half

17) A bellmouth condition at the top of a reamed hole may be caused by:

a) An undersized reamer

b) A misaligned reamer

c) Correct RPM with a slow feed

d) A reamer with a back taper (smaller away from the cutting edge)

18) The feed rate of a reaming operation is about _____ that of a drilling operation for the same tool diameter.

a) Four times

b) The same

c) Two times

d) One-half

19) When a reamer gradually starts to cut oversize, a root cause may be:

a) Chamfer and cutting edge runout

b) Excessive stock allowance causing material pickup or galling

c) Non-concentric shank

d) Misalignment of the spindles

e) All of the above

f) All except d and e

20) Which of the following RPM values would be appropriate for reaming a .375-inch diameter hole using a cutting speed of 100 SFPM for drilling (use 3.82 for the constant)?

a) 1019 RPM

b) 509 RPM

c) 907 RPM

d) 1529 RPM

21) Which of the following reamer(s) have a back taper (size reduction toward the shank)?

a) Hand reamer

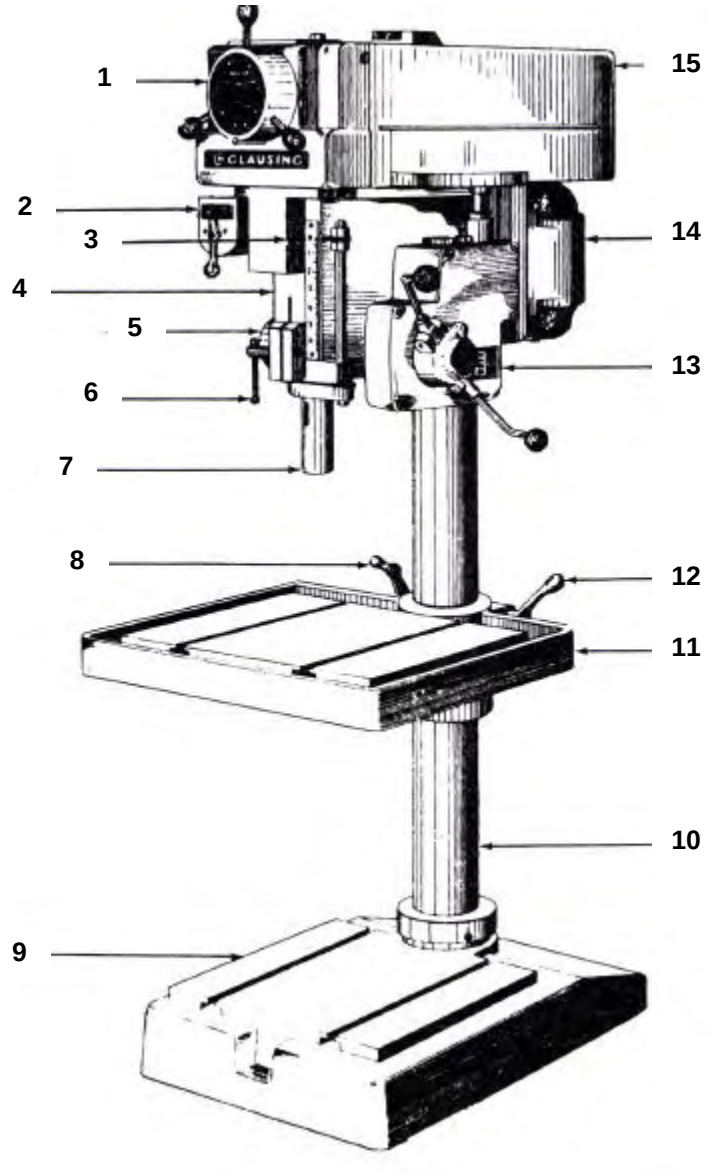
b) Straight flute chucking reamer

c) Carbide tipped chucking reamer

d) Helical taper pin reamer

Drill Press Components

- Spindle
- Base
- Feed Handle
- Table
- Variable Speed Control
- Table Locking Lever
- Column



22) Which of the following numbers represent the drill press spindle in the diagram?

a) 1

b) 4

c) 10

d) 7

23) Which of the following numbers represent the drill press table in the diagram?

a) 8

b) 11

c) 3

d) 14

24) Which of the following numbers represent the drill press on/off switch in the diagram?

a) 1

b) 14

c) 2

d) 9

25) Which of the following numbers represent the drill press base in the diagram?

a) 12

b) 9

c) 1

d) 6

26) Which of the following numbers represent the drill press column in the diagram?

a) 10

b) 5

c) 14

d) 2

27) Which of the following numbers represent the drill press table-locking lever in the diagram?

a) 12

b) 10

c) 14

d) 15

28) Which of the following numbers represent the drill press variable speed control in the diagram?

a) 15

b) 11

c) 7

d) 1

29) Which of the following numbers represent the drill press feed handle in the diagram?

a) 9

b) 4

c) 13

d) 8

Process Improvement

- The effect of excessive clearance on the cutting lips of a twist drill
- The proper chip color for drilling with high speed drills
- Parameters that determine the actual diameter of a drilled hole
- The effect of incorrect drill point angles, incorrect clearances and the effect of both at the same time
- Corrective action(s) for drilling operations that experiences frequent drill breakage

30) A high-speed steel twist drill is producing blue chips during a drill operation. This means that the:

a) Drill is rotating at the correct RPM

b) Drill must have a large lip relief angle

c) Drill is rotating at an excessive RPM

d) Spindle feed is too slow

e) Spindle feed is frozen and burning up

31) Incorrect drill point angles and clearances will generally produce drilled holes that are:

a) Undersize

b) Out of round

c) Oversize

d) Only a and b

e) Only b and c

32) What generally happens when the web thickness is excessive?

a) The drill will cut undersize

b) The feed pressure is excessive

c) The drill is very solid and feeding pressure is reduced

d) The drill will cut cooler since the cutting lip length is reduced

e) The drill will break as soon as it is fed into the workpiece

33) An excessive lip clearance angle may cause a twist drill to:

a) Cause excessive wear on the margin of the drill near the shank

b) Easier feeding due to chip clearance relief angles and an excessive web

c) Reduce feed pressure through increased rake

d) Chip or break out at the cutting edges

34) A drilling operation is experiencing frequent drill breakage. The twist drill has the proper point geometry include web thickness and lip clearance angles. A possible solution to the drill breakage problem could be:

a) Increasing the RPM 1.5 over the suggest RPM

b) Increase the feed rate by half

c) Decrease the feed rate

d) Decrease the RPM and increase the feed by the same proportion

35) Which of the following parameters affect the final diameter created by a twist drill?

a) Cutting speed

b) The lubrication applied

c) The type of material

d) The way the cutting lips and web are ground

e) All of the above

f) Only a and b

36) Which of the following may be a root cause of a twist drill that binds in the hole?

a) The clearance on the margin is worn

b) The set up is creating vibration

c) The chips are packed in the hole and flute of the twist drill

d) All of the above

e) Only a and c

Twist Drill Nomenclature and Sizing

- Characteristics of the web of a twist drill
- Basic sizing characteristics of number, letter and fractional twist drills
- Function of the flutes on a twist drill
- The definition and purpose of the drill margin
- Drill point angle for general purpose drilling

37) Which of the following sets of twist drills are arranged from the largest diameter to the smallest diameter?

a) 64, 36, D, A, 51/64

b) 7/16, K, C, 18, 78

c) 21, A, 1/16, 80, D

d) 1, 35, D, 51/64, J

e) 21/32, 53/64, 42, 1, A

38) Which of the following statements is **not** a fundamental characteristic of the web?

a) The web creates the “dead center” or chisel point of the twist drill

b) The web stays the same width throughout the whole length of the drill

c) The web is “thinned” to prevent excessive feed pressure

d) The web gets larger as the drill becomes shorter in length

39) Which of the following included point angles are found on general-purpose twist drills?

a) 118°

b) 59°

c) 130°

d) 65°

40) The flutes of a twist drill:

a) Are the cutting edges of a twist drill

b) Create the chisel point in the center of a twist drill

c) Facilitate chip removal

d) Are the parts of the twist drill inserted into the drill chuck

41) Which of the following statements define the margin of a twist drill?

a) The cylindrical portion of the land that is not cut away to provide clearance

b) The edge at the ends of the web that connects the cutting lips

c) The cutting edges extending from the chisel edge to the periphery of the twist drill

d) The reduced diameter between the body and the shank of a drill

Safety Practices

- Proper method to lift heavy objects
- Basic safe operating procedures for drill press operations
- Safe methods for handling and maintaining tools
- Safety precautions for long hair, jewelry and loose clothing

42) Which one of the following statements is **not** a safe drill press procedure:

a) Using a brush to remove stringy chips from the table

b) Having the vise on the right side of the operator

c) Plugging an existing hole to drill an intersecting hole

d) Center drilling a hole prior to drilling the hole

43) Which of the following statements does **not** address the proper lifting technique used to lift heavy objects?

a) Bend the knees and lift with the legs

b) The back should be kept as straight as possible

c) Bend the arms slightly, but do not lift with the arms

d) Hunch the back and lift with the arms, keep the legs locked

44) To safely handle tools and measuring instruments, they should be:

a) Laid on the drill press table or in clamping slots

b) Placed on a wooden tray or shop rag away from the drill press table or moving components

c) Lubricated with cutting oil and lithium grease

d) Stored in a drawer with tools and measuring instruments on top of each other

45) What is the danger of having loose clothing, long hair and dangling jewelry near a drill press with a rotating spindle?

a) They may get caught around the spindle causing the operator to get “pulled in” to the point of operation

b) Expensive jewelry can get scratched or damaged from cutting fluid

c) Loose clothing has a better chance of getting torn by a chip or stained with cutting fluid

d) The twist drill will wear out quicker causing oversize holes and the loose clothing may get burned from hot chips

Countersinking, Counterboring, Spotfacing and Center Drilling

- Purpose of spotfacing a surface
- Proper method of center drilling to reduce breakage
- The included angle on flat head type screws
- Type of drilling operations provided by utilizing a center drill
- Purpose of a counterbore

46) A counterbore is:

a) A conical enlargement at the end of a hole used to recess the head of a flat head screw

b) Internal threads with a conical axis used to seal the threads

c) An enlarge hole with a square bottom concentric to a smaller hole to accept the head of a socket head cap screw

d) Small hole with a large conical top to accept a lathe center

47) Most flat head screws used in metal fabrication and assembly (excluding the aircraft industry) use flat head screws with the included angle of the head measuring:

a) 41 degrees

b) 82 degrees

c) 100 degrees

d) 50 degrees

48) To reduce breakage of center drills:

a) Increase the feed rate 1.5 times

b) Back out the center drill frequently to remove chips

c) Increase the RPM 2 times for a similar diameter twist drill

d) Use a slow feed to protect the small drill end

e) Only a and c

f) Only b and d

49) Which one of the following drilling procedures is used to create an even surface for a socket head cap screw on a rough uneven surface?

a) Spotfacing

b) Countersinking

c) Center drilling

d) Reaming

e) Reverse drilling

50) A center drill is:

a) Used for spotting holes

b) A drill with a countersink at a 60° angle

c) A drill used to create a bearing surface for lathe centers

d) All of the above

e) Only a and c

Layout and Inspection

- The main item reviewed when selecting the correct type of measuring tool to inspect a part
- Tools used for precision layout

51) Which one of the following tools would be considered a **precision** layout tool?

a) Plate protractor

b) Machinist scale

c) Combination square and rule

d) Digital height gage with a scriber attachment

52) What is the first parameter to review when selecting a measuring instrument to measure a feature on a piece part?

a) Machine tool setup to manufacture the piece part

b) The tolerance of the feature to be inspected

c) The availability of measuring tools

d) The time and cost of measuring the feature

Tapping

- Tap drill sizes used for various NPT pipe threads
- The percentage of thread most tap drill charts are based upon

53) Most tap drill charts use a tap drill producing a _____ thread depth.

a) 50%

b) 75%

c) 100%

d) 85%

e) 45%

54) What is the tap drill diameter for a ½-14 NPT (pipe thread)?

a) 7/16

b) 1 1/2

c) 23/32

d) 3 1/4

55) Which type of tap will require the greatest amount of torque?

a) Taper pipe tap

b) Straight pipe tap

c) Spiral fluted tap

d) Straight hand tap

56) For most materials, what is the practical limit of thread percentage in relationship to the strength of the threads?

a) 55%

b) 65%

c) 75%

d) 90%

e) 100%

Work Holding

- Proper work holding technique to hold round stock

57) Which of the following methods are appropriate for holding round stock for a drilling operation?

a) V-blocks

b) Drill press vise

c) Angle plate and hand pressure to hold the piece part

d) Parallels and a strap clamp

e) Only a and b

f) Only b and d

58) Thin springy material is supported far away from the drill. What may happen on breakthrough?

a) The hole will be undersize due to the springy material “rebounding” inside the hole

b) The material will spring back creating a “fin” and causing drill breakage

c) The hole will be normal with expected dimensional changes

d) The drill will “burn” due to the non-cutting effect of the springy action

Drill Press
Sample Test Answers

1) C

2) C

3) D

4) A

5) C

6) B

7) A

8) C

9) B

10) D

11) A

12) B

13) D

14) A

15) C

16) E

17) B

18) C

19) E

20) B

21) A

22) D

23) B

24) C

25) B

26) A

27) A

28) D

29) C

30) C

31) E

32) B

33) D

34) C

35) E

36) E

37) B

38) B

39) A

40) C

41) A

42) B

43) D

44) B

45) A

46) C

47) B

48) F

49) A

50) D

51) D

52) B

53) B

54) C

55) A

56) C

57) E

58) B