NIMS Machining Level I Preparation Guide

Measurement, Materials, and Safety

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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 exam. However, this preparation guide is a useful tool for reviewing technical knowledge and identifying areas of strength and deficiency so that the student has what is needed to do well on the exam.

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 exam is tough, 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. Exam questions are designed to test 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 exam questions. Then, before the questions become part of the credentialing exam, qualified machinists 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 exam content and question format by utilizing the tools provided in this test preparation guide. The **Exam Specifications** portion of 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 test 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 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 exam you will attempt.

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

Step 3: Review the sample test 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 tool.

Areas of Knowledge Measured by the Exam

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

Exam Sections

The exam is divided into four sections. They are:

- **General Maintenance Tasks**
- **Industrial Safety & Environmental Protection Tasks**
- **Quality Control and Inspection Tasks**
- **Process Adjustment and Improvement Tasks**

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

- **Applying the *Machinery's Handbook*:** The machinist must be able to reference and apply information found in the handbook to solve application problems. Referencing thread percentage, finish symbols, and allowances are some of the skills required.
- **Basic Mathematics:** The exam will assess basic math knowledge of fraction/decimal conversion, addition and subtraction of decimals, and an understanding of percent.
- **Industrial Safety:** The machinist must become familiar with Hazmat, MSDS, basic personal protective equipment (PPE), and machine tool safety. Student assessment includes identification of a government body that regulates industrial safety – Occupational Safety and Health Administration (OSHA).
- **Maintenance:** Student assessment includes elementary knowledge of referencing and researching maintenance procedures, hand tool maintenance and safety, and simple tool maintenance.
- **Process Adjustment:** The exam presents basic problems of machining processes such as tapping, threading, drilling, milling, reaming, and grinding in which a process adjustment functions as the corrective action. Students must identify a basic goal of process improvement.
- **Quality Control Procedures:** The exam will evaluate knowledge of basic concepts of SPC and sampling plans. Basic knowledge of inspection plans includes rationale, criteria for choosing the correct measuring instrument, and organization. The evaluation includes basic knowledge of inspection setups and measuring instruments.

Before the Exam

Try to be well rested for the 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 test. 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 test 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 exam, reference materials that can be used and if a calculator is permissible.

Once the 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 to those you had difficulty with after 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.

Exam Content and Sample Question Summary

Exam Content and Sample Question Overview

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

The **Task List** describes competencies a machinist must have in order to receive a credential for Measurement, Materials, and Safety. The **Task List** has a two-fold purpose. The first purpose is to prepare the machinist for credentialing. The second is for 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 narrower 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 test question.

Sample questions follow the **Task List**. Although these same questions will not appear on the actual exam, they are in the same format as the actual 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 in the sample test questions. The sample test questions are developed to evaluate conceptual knowledge of machining rather than specific competencies.

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

Exam Specifications – Measurement, Materials, and Safety

Content Area	No. Of Questions	% of Test
Machine Maintenance	4	7.9
Finding Maintenance Procedures	2	3.9
Hand Tool Safety and Maintenance	2	3.9
Tooling Maintenance	3	6.0
Milling Process Adjustments	2	3.9
Grinding Process Adjustments	1	1.9
Tapping and Threading Process Adjustments	2	3.9
Drilling Process Adjustments	2	3.9
Gage Blocks	3	6.0
Surface Finish	2	3.9
Measuring Techniques and Tools	4	7.9
SPC	2	3.9
Inspection Plan and Sampling	6	11.8
MSDS Knowledge	3	6.0
Basic Shop Safety	8	15.7
PPE	2	3.9
Machine Safety	1	1.9
Fits and Allowances	1	1.9
Rationale – Process Improvement	1	1.9
	Total of 51	**100 %**

Task List

Measurement, Materials, and Safety

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 other resources are available to provide information.

Machine Maintenance

- Lubrication of machinery (procedure and checking oil level)
- Safe method of removing chips from machinery
- Maintenance procedure when mounting a chuck on the lathe
- Application of grease guns

Sample questions:

1) The safest way to remove chips from a lathe or milling machine is to use a:
   a) Air hose and high pressure nozzle
   b) Glove covering the operator's hand
   c) Shop rag soaked in solvent
   d) Brush

2) Small chips left on the spindle nose of the lathe should be cleaned to avoid:
   a) Run out on work holding devices
   b) Scratches on the workpiece
   c) Symmetry of shapes
   d) Faceplate alignment

3) Grease guns are used to insert grease into:
   a) Ways of a lathe bed
   b) Zerk fittings on machine tools
   c) The short taper of a cam lock spindle nose
   d) The T-slots of a vertical mill

4) To lubricate the ways of a lathe, the gibs of a mill, or the cross slide of a grinder:

   a) Use a grease gun with lithium grease

   b) Use inserts made of self lubricating metal

   c) Use lubricant found in central lubricating systems (“one shots”)

   d) Use chalk as a lubricant since it doesn’t attract dirt

5) If a vertical mill table is loose and has side play, the best solution to alleviate side play is to:

   a) Tighten the clamps that lock the table

   b) Tighten the taper gib adjustment

   c) Loosen the taper gib adjustment

   d) Use a parallel clamp and angle plate to eliminate any movement

Researching Maintenance Procedures

- Instructions for general maintenance
- Finding information for lubrication and maintenance of specific machinery

Sample questions:

6) A machinist wants to find the proper type of lubrication, schedule and recommended maintenance practices for the headstock of a lathe. The best source to find this information is:

   a) Piece part work instructions and inspection plan

   b) FMEA (Failure Mode Effects Analysis)

   c) Control Plan

   d) Preventative maintenance schedule and machine manual

   e) Tooling and Manufacturing Engineer's Handbook

7) General maintenance information for machine tools and machine work area can be found:

   a) On the inspection and sampling plan

   b) In a general maintenance manual

   c) On the capability report

   d) In the production work instructions

Hand Tool Safety and Maintenance

- Hand file safety
- Characteristics and causes of loading, pinning, scratching, etc.

Sample questions:

8) Pinning refers to:
   a) Back filing
   b) Cross filing
   c) Loading the file with metal chips
   d) Draw filing unloading

9) Files should be stored:
   a) With end mills, drills, and other cutting tools
   b) In a large wooden box close to the bench area
   c) One file 180º from the other file
   d) In a toolbox separated from each other

10) The best way to clean the chips out of a file is to use:
   a) An air gun
   b) Brush
   c) File card
   d) Chalk

11) What is the most common injury that may occur during a filing operation?
   a) Slivers from pinning
   b) Being stabbed with the tang (file without a handle)
   c) Scratches from holding the file
   d) Stiff fingers from filing too slow

Tooling Maintenance

- Process plan and tooling maintenance
- Use and application of sulphurized oil
- Description and cause of finish tears when reaming

Sample questions:

12) The best lubricant to prevent wear and increase cutting efficiency for tapping common steels is:

a) Mineral oil

b) Kerosene

c) Sulfur-based oil

d) Air jet

13) The process plan specifies tooling to be used by indicating:

a) Tolerances on dimensions

b) Machine maintenance procedures

c) Tooling diameters and sizes

d) Lubrication procedures

14) A reaming operation produces finish tears. The cause of the tears is:

a) Newly sharpened reamers

b) Insufficient stock allowance

c) Feeding too slow

d) A reamer with a worn tip

Gage Blocks

- Calculating gage block stacks
- Tools needed to use gage blocks to check heights on a surface plate
- Gage block stacks for creating angles on a given sine plate

Sample questions:

15) What is the gage block height for an angle of 9 degrees on a 10-inch sine plate?

a) 0.7822 inches

b) 1.5643 inches

c) 3.1287 inches

d) 0.4693 inches

16) Which of the following combinations of gage blocks (from an 81-block set) can be used to gage a length of 0.9528 inches?

a) 0.1008, 0.102, 0.750

b) 0.152, 0.1008, 0.600

c) 0.1008, 0.852

d) 0.1008, 0.352, 0.500

17) The process of displacing air between gage blocks for accurate measurements is called:

a) Smoothing

b) Honing

c) Lapping

d) Wringing

18) To check the height of multiple parts with gage blocks, a machinist would use a:

a) Digital height gage

b) Depth micrometer

c) Dial indicator and digital height gage

d) Vernier caliper and telescoping gage

Surface Finish

- Surface finish comparison charts
- Interpretation of surface finish symbols

19) Surface finish is checked with:

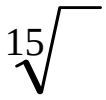
a) Comparison chart

b) Digital height gage and indicator

c) Optical comparator

d) Optivisor

20) A surface finish symbol is as follows:



a) The surface finish is 0.015 inches
b) The surface finish is finer than a callout of 10
c) The surface finish is 15 millimeters
d) The surface finish is rougher than a callout of 25
e) The surface finish is 15 micro inches

21) What is the most common type of surface finish callout?
a) Roughness
b) Waviness
c) Cut band length
d) Lay

Inspection Plan and Sampling Procedures

- Initial step for developing an inspection plan
- Main criteria for determining when a part is rejected
- Definition of a sampling
- Rationale for having inspection plans
- Main detail for determining the correct measuring tool to check a dimension
- The contribution of the sampling plan to quality control

22) A part is considered a reject when:
a) All the dimensions are in tolerance
b) Dimensions are out of tolerance
c) The daily production rate is not achieved
d) The part fails to be inspected in an 8-hour shift

23) A sampling is referred to as a:

a) Total population of parts
b) Number of defects in a shift
c) Samples taken from a machine over a period of time
d) The number of parts that meet all dimensions

24) Inspection plans are needed to:

a) Coordinate inspection procedures
b) Identify measuring tools
c) Check dimensions in a repeatable and reliable way
d) All of the above
e) Only a and c

25) The first thing to do when constructing an inspection plan is to:

a) Check the machine tool for accuracy
b) Select the critical and important dimensions to inspect
c) Select the measuring instruments
d) Construct SPC charts for all dimensions

26) The most important factor in selecting measuring tools for inspection is:

a) Access to measuring equipment
b) Process capability of the part in assembly
c) Tolerancing of dimensions to inspect
d) Verification of the sampling plan

27) Sampling plans contribute to a quality control process by:

a) Providing an acceptable representation of all the parts produced
b) Providing a list of acceptable measuring tools
c) Defining tolerances regardless of the print tolerances
d) Creating error margins in capability ratios

Measuring Techniques and Tools

- Application of a sine bar for checking angles
- Feature of a thread checked by a thread micrometer
- Application of gage pins for checking diameters
- Feature best suited for measuring with a dial bore gage

28) What feature of a thread is checked with a thread micrometer?

a) Major diameter

b) Minor diameter

c) Crest radius

d) Root radius

e) Pitch diameter

29) Dial bore gages are used to measure:

a) Tapered shafts

b) Internal threads

c) Holes

d) Bosses and pads

30) To indicate an angled surface and make that surface parallel to a surface plate, the machinist would use a _____.

a) Angle plate and plate protractor

b) Sine plate

c) Machinist vise

d) V-block and indicator

31) What sizes of gage pins would a machinist need for a dimension of 3/32 $\pm$ 1/64th inches for a go/no go gage setup (rounded to three places)?

a) 0.332/0.312

b) 0.110/0.094

c) 0.094/0.078

d) 0.110/0.078

SPC

- Definition of the range applied in SPC
- Chart used to measure variation between parts in a sampling

Sample questions:

32) A measure of dispersion that uses the largest and smallest measurements of a sampling is the:

a) Range
b) Mean
c) Median
d) Mode
e) Radian

33) What is the range of the following sampling: {0.345, 0.382, 0.353, 0.380, 0.377}:

a) 0.017
b) 0.025
c) 0.037
d) 0.005

34) Which of the following is not found on an X-bar and R control chart?

a) Mean
b) Upper control limit
c) Lower control limit
d) Capability ratio

MSDS Knowledge

- Acronym and definition of the Lower Explosive Limit
- MSDS indoctrination and safety meetings
- Acronym and definition of the Threshold Limit Value

Sample questions:

35) The acronym MSDS means:
   a) Manual Safety Data System
   b) Multiple System Diagnostic Sheet
   c) Machine Shop Disposal System
   d) Material Safety Data Sheet

36) Which of the following colors is not found on an HMIS label?
   a) Green
   b) Blue
   c) Red
   d) Yellow

37) The threshold limit value (TLV) is defined as:
   a) The point at which a chemical becomes flammable
   b) The greatest amount of a chemical liquid that can be stored in barrels
   c) The safe limit of unprotected exposure to a material
   d) The threshold temperature for explosion

38) MSDS information on new chemicals and materials found in the workplace can be reviewed and discussed at:
   a) Right to Know seminars and classes
   b) Safety meetings
   c) Performance reviews
   d) Exit interviews
   e) A and B are correct

39) The acronym HMIS stands for:
   a) Hazardous Methods Instructional Safety
   b) High Maintenance Inspection Survey
   c) Hazardous Materials Information System
   d) High Speed Machining Informational Status

Basic Shop Safety

- Rationale and proper disposal of rags and wipes
- Acronym for government agency which regulates safety and health requirements for industry
- First course of action if materials (solids) become lodged in the eye
- Safety hazards of long hair, loose clothes, and jewelry
- Proper technique for lifting

40) The acronym for the government agency that regulate safety is:

a) USFS

b) DECCA

c) OSHA

d) OCAW

41) Oily rags and wipes are stored in a red fireproof can with a lid to prevent:

a) Obnoxious smells

b) Oil from seeping on the floor

c) Fires through spontaneous combustion

d) Customers from thinking the plant is unclean

42) The first course of action to take if a material (solid) becomes lodged in the eye is to:

a) Pull the top lid over the bottom lid

b) Use a magnet to attract the object

c) Rub the eye in a circular motion

d) Use light air pressure to blow out the debris

43) The first action to take with a bleeding wound is to:

a) Stop the bleeding by applying cotton

b) Stop the bleeding by applying pressure to the wound

c) Apply pressure to the nearest artery

d) Apply a tourniquet

44) The best technique for lifting is to:

a) Keep the legs straight and use only the back

b) Keep feet as wide as possible

c) Keep arms straight

d) Lift with the legs and keep the back straight

e) Lift with the arms only

45) When operating a lathe, long hair, dangling jewelry or loose clothes can:

a) Have no effect on the operation

b) Obstruct the view of the operation

c) Become caught in the lathe pulling the operator toward the machine

d) Become dirty from oil and chips

Personal Protective Equipment (PPE)

- Equipment used when materials are stored overhead or hoists or cranes are utilized
- Basic PPE for common machine tools such as lathes, mills, and grinders

46) Government safety regulation state that a person must wear a _____ when working on material stored overhead using cranes or hoists.

a) Tarsal protector on the work shoes

b) Hard hat

c) Insulated gloves

d) Ear plugs or muffs

47) When working on machinery producing flying chips, the most important personal protection equipment a machinist must wear is:

a) Safety glasses

b) Ear plugs

c) Gloves

d) Steel-toed work boots

Machine Safety

- Safety practices for milling machines

48) Which one of the following procedures is a safe procedure for a milling operation?

a) Using an air gun to clean the chips off the mill table

b) Measure the part with the cutter rotating but away from the part

c) Adjusting the work only when the cutter is stopped

d) Extending the tool and quill to achieve a maximum length

49) The best technique for milling on a vertical mill that is not equipped with an automatic table is to:

a) Climb mill

b) Conventional mill

c) Peck mill

d) Spotface mill

Tapping and Threading – Process Adjustment and Improvement

- Causes of tapped holes being too tight or too loose
- Percentage of thread engagement

50) Tight threads produced by a tapping operation may be caused by:

a) Material springback

b) Tap wear

c) Large tap hole diameter

d) The tap cutting edges being too sharp

51) Thread percentage is dependent on the:

a) Major diameter of the thread

b) Number of threads per inch

c) Thread angle

d) Tap hole diameter

Grinding – Process Adjustment and Improvement

- Grinding long slender parts and flatness concerns

52) What is the root cause of warping when grinding long slender pieces?

a) Heat checking due to a hard wheel

b) The structure of the wheel is too open

c) Loose or cracked diamond used for wheel dressing

d) Vibration of the work piece during the grinding operation

53) When dressing the grinding wheel, the diamond dresser should be located on the:

a) Infeed side of the wheel rotation (right side)

b) Outfeed side of the wheel rotation (left side)

c) Bottom dead center of the wheel

d) Chuck at any convenient location

Milling – Process Adjustment and Improvement

- Machining tough material causing excessive tool wear
- Procedures for machining slots

54) Tough material causes accelerated tool wear. Machinists can _____ to reduce tool wear and possible tool breakage.

a) Switch tooling to non-coated high speed steel end mills

b) Increase the spindle speed

c) Increase the spindle speed and feed

d) Decrease the spindle speed

55) The print calls for a 0.375 ± 0.005 wide X 0.125 ± 0.005 deep slot to be milled. The best procedure is to:

a) Use a 0.375 diameter end mill with a single pass

b) Use a 0.250 diameter end mill to a depth of 0.100 and then use a 0.375 diameter end mill at a depth of 0.125 inches

c) Use a 0.375 diameter end mill at a depth of 0.125 inches and make two passes within .250 diameter end mill to obtain the 0.375-inch width

d) EDM the slots with an electrode since a mill cannot hold the specified tolerances

56) The most accurate method for aligning a vise mounted on a vertical mill table is to:

a) Use a dial indicator mounted on the quill or in a collet

b) Use a scale and measure distances

c) Use keys mounted on the bottom of the vise fitting the slots

d) Use calipers, perform triangulation and apply roll pins

Drilling – Process Adjustment and Improvement

- Drill breakage related to rpm and feed rate
- Corrective action for oversized reamed holes

57) Reamers cutting oversize due to built up edges may be caused by:

a) A slow feed rate

b) Excessive stock allowance

c) Sharp cutting edges

d) Flute lengths

58) The clearance for a counterbore pilot should be:

a) 0.000 to 0.0005 inches

b) 0.020 to 0.030 inches

c) 0.031 to 0.062 inches

d) 0.002 to 0.005 inches

Fits and Allowances

- Allowances for various fits (reference the *Machinery's Handbook)*

59) What is the allowance for a shaft measuring one inch in diameter with an RC6 sliding fit (in inches)?

a) + 0.001

b) + 0.004

c) - 0.004

d) - 0.001

e) - 0.003

60) What does the acronym FN represent?

a) Fast fit

b) Frontal fit

c) Force fit

d) Fundamental fit

Rationale for Process Adjustment and Improvement

- Reason to adjust and improve

61) Continuous improvement and teamwork:

a) Increase the work load

b) Increase production and profitability

c) Are used only in first piece inspections

d) Decrease production and increase rejects

62) Which of the following items is a tool for continuous improvement?

a) Inspection plan

b) Problem solving methodology

c) SPC charts

d) All of the above

e) Only a and c

Measurement, Materials, and Safety

Sample Test Answers

1) D

2) A

3) B

4) C

5) B

6) D

7) B

8) C

9) D

10) C

11) B

12) C

13) C

14) D

15) B

16) A

17) D

18) C

19) A

20) E

21) A

22) B

23) C

24) D

25) B

26) C

27) A

28) E

29) C

30) B

31) D

32) A

33) C

34) D

35) D

36) A

37) C

38) E

39) C

40) C

41) C

42) A

43) B

44) D

45) C

46) B

47) A

48) C

49) B

50) B

51) D

52) A

53) B

54) D

55) B

56) A

57) B

58) D

59) E

60) C

61) B

62) D