

Certification Test

CT.Servo.03.eLM.Sizing.CertificationTest



Student Name: _____

Company Name: _____

Address: _____

Phone: _____

Email: _____

Test Date: _____

Answers:

1	_____	26	_____	_____	_____
2	_____	27	_____	_____	_____
3	_____	28	_____	_____	_____
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25	_____		_____	_____	_____

Taking the Test

- The purpose of this test is to validate the learning experience corresponding to the applicable eLearning Module. It is recommended to preview the questions before viewing the module and answer them as the module progresses.
- The test is open book. You may use any website, manuals, software, demo, etc. The test must be taken individually; you may not contact another person for help.
- Each question has only one correct answer unless otherwise noted. Please clearly record all answers on the answer sheet. All questions are equally weighted. A passing score is 90%.

Returning the Test

- Please return **only the first page** of the test (the answer sheet) with completed answers and contact information.

Option 1: Fax the answer sheet to **Yaskawa Technical Training Services** at **(847) 887-7185**.

Option 2: e-mail a scan, photo, or edited pdf of the answer sheet with all answers and contact information to training@yaskawa.com.

Receiving Your Score

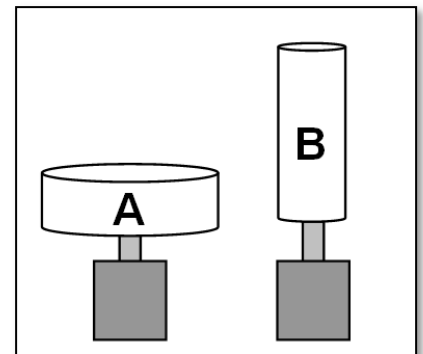
You may review your answers only if a passing score is received. You will receive a system-generated email with your score. Please allow up to 5 business days.

For questions 1-3, consider a motor with a gearbox of reduction ratio N (N revolutions in, produce 1 revolution out) and efficiency of 100%.

1. What is the effect of this gear reduction on torque?
 - A. Output torque is input torque times the gear ratio.
 - B. Output torque is input torque divided by the gear ratio.
 - C. Output torque is the same as the input torque.
 - D. Output torque is input torque times the square of the gear ratio
 - E. Output torque is input torque divided by the square of the gear ratio.
2. What is the effect of this gear reduction on speed?
 - A. Output speed is input speed times the gear ratio.
 - B. Output speed is input speed divided by the gear ratio
 - C. Output torque is the same as the input torque.
 - D. Output torque is input torque times the square of the gear ratio.
 - E. Output torque is input torque divided by the square of the gear ratio.
3. What is the effect of a gear reduction on inertia?
 - A. Reflected inertia is load inertia times the gear ratio.
 - B. Reflected inertia is load inertia divided by the gear ratio.
 - C. Reflected inertia is the same as the load inertia.
 - D. Reflected inertia is load inertia times the square of the gear ratio.
 - E. Reflected inertia is load inertia divided by the square of the gear ratio.
4. What possible problems may occur if a large inertia mismatch is used (assuming motor torque is sufficient)?
 - A. The motor shaft is likely to break, and the motor may create backlash.
 - B. External regeneration resistors may be needed, and the motor may be difficult to tune.
 - C. The motor may be difficult to tune, and the shaft is likely to break.
 - D. The motor may create backlash and may overheat.
5. How does duty cycle (ratio of move time to rest/dwell time) affect RMS torque?
 - A. Higher duty cycle percentage causes increased RMS torque.
 - B. Lower duty cycle percentage causes increased RMS torque.
 - C. Duty cycle has no effect on RMS torque.
6. A customer is replacing a motor with a 64 in-lbs continuous torque rating and 2500rpm max speed motor. The SGMG-13 motor has 74 in-lbs rated torque and 3000rpm max. Is this a valid replacement?
 - A. Yes, the replacement motor will work for the application.
 - B. No, the replacement motor will not work.
 - C. There is not enough information to make a good decision.

For questions 7-9, consider a servomotor that moves an unloaded, horizontally oriented ballscrew actuator according to a fixed trapezoidal velocity profile with equal acceleration and deceleration times.

7. During what part of the move profile will the maximum value of torque occur?
 - A. During acceleration
 - B. During deceleration
 - C. During traverse (constant speed)
 - D. During dwell
 - E. Depends on the direction of travel
8. What are the components of this maximum torque?
 - A. Friction torque and acceleration torque
 - B. Friction torque and rated torque
 - C. Acceleration torque and RMS torque
 - D. RMS torque and friction torque
9. Which of the following statements are TRUE?
 - A. A change in ballscrew pitch has no effect on the RMS torque that the motor must produce
 - B. A change in ballscrew pitch has no effect on the inertia reflected to the motor shaft
 - C. A change in ballscrew pitch has no effect on the speed at which the motor operates
 - D. None of the above statements are true
10. Two cylinders have equal mass. Cylinder "A" is fat and short. Cylinder "B" is skinny and long. What cylinder takes more torque to accelerate, assuming they accelerate at the same rate?
 - A. Cylinder A requires more torque to accelerate
 - B. Cylinder B requires more torque to accelerate
 - C. Both cylinders require the same torque for acceleration
11. Assuming a system has some level of backlash, how does backlash affect sizing?
 - A. Increases RMS torque
 - B. Increases Peak torque
 - C. Reduces Reflected inertia
 - D. None of the above.

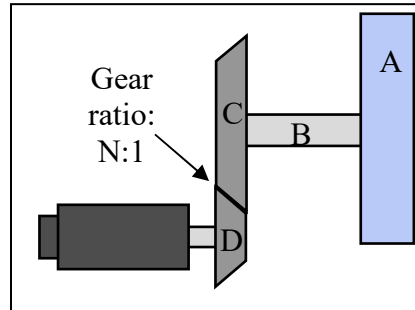


12. What factor(s) are important when sizing an application with quick moves and high precision?

- A. Torque
- B. Inertia ratio
- C. Torque and inertia ratio are both essential
- D. Neither torque nor inertia matter in most applications

13. In the diagram to the right, what is the load inertia reflected to the shaft of the motor?

- A. $J_{ref} = J_C + J_D + (J_A + J_B)/N$
- B. $J_{ref} = J_D + (J_C + J_A + J_B)/N$
- C. $J_{ref} = J_A + J_B + J_C + (\frac{J_D}{N})$
- D. $J_{ref} = (J_A + J_B + J_C + J_D)/N$
- E. $J_{ref} = J_A + J_B + (J_C + J_D)/N^2$
- F. $J_{ref} = J_C + J_D + (J_A + J_B)/N^2$
- G. $J_{ref} = J_D + (J_C + J_B + J_A)/N^2$
- H. $J_{ref} = (J_A + J_B + J_C + J_D)/N^2$
- I. $J_{ref} = J_A + J_B + J_C + (\frac{J_D}{N^2})$



14. Move A accelerates from 0 to N rpm in 2 seconds. Move B accelerates the same load to the same speed in 1 second. How does the acceleration torque of Move A compare with Move B?

- A. Move A requires twice as much torque as move B
- B. Move A requires four times more torque than move B
- C. Move A requires eight times more torque than move B
- D. Move B requires twice as much torque as move A
- E. Move B requires four times more torque than move A
- F. Move B requires eight times more torque than move A.

15. How does friction affect the calculated inertia of a system?

- A. The reflected inertia is divided by the coefficient of friction μ
- B. The reflected inertia is multiplied by the coefficient of friction μ
- C. The reflected inertia is divided by the coefficient of friction μ times the downward force F_N
- D. The reflected inertia is multiplied the coefficient of friction μ times the downward force F_N
- E. Friction has no effect on inertia

16. How can RMS torque required by a motor be reduced?

- A. Reduce load inertia and increase dwell time
- B. Increase load inertia and increase dwell time
- C. Increase load inertia and reduce acceleration rate
- D. Choose a larger motor with higher rotor inertia

17. How can peak torque required by a motor be reduced?
- A. Reduce load inertia and reduce acceleration rate
 - B. Increase load inertia and reduce acceleration rate
 - C. Choose a larger motor with higher rotor inertia
 - D. Increase friction
18. How can the speed required by a motor be reduced without increasing the move time?
- A. Reduce the load inertia
 - B. Remove or decrease the gear reduction ratio
 - C. Increase the acceleration time
 - D. Add a holding brake
 - E. A,C
 - F. B,C
 - G. B,D

Use Sigma Select to answer the following questions

19. Which of the following can be used to create the sizing motion profile?
- A. CSV file
 - B. Cam Editor
 - C. MotionWorksIEC
 - D. SigmaSelect (Profile Editor)
 - E. A,D
 - F. B,C
 - G. A,C,D
 - H. A,B,D
20. Which profile types are available in the Profile Editor?
- A. Accel/Decel
 - B. Square
 - C. Trapezoidal
 - D. Dwell/Traverse
 - E. Circular
 - F. Triangle
 - G. A, C, D
 - H. C, D, F
 - I. B, C, E, F
 - J. A, C, D, F

21. Which SigmaSelect tab is used to define the Mechanism?

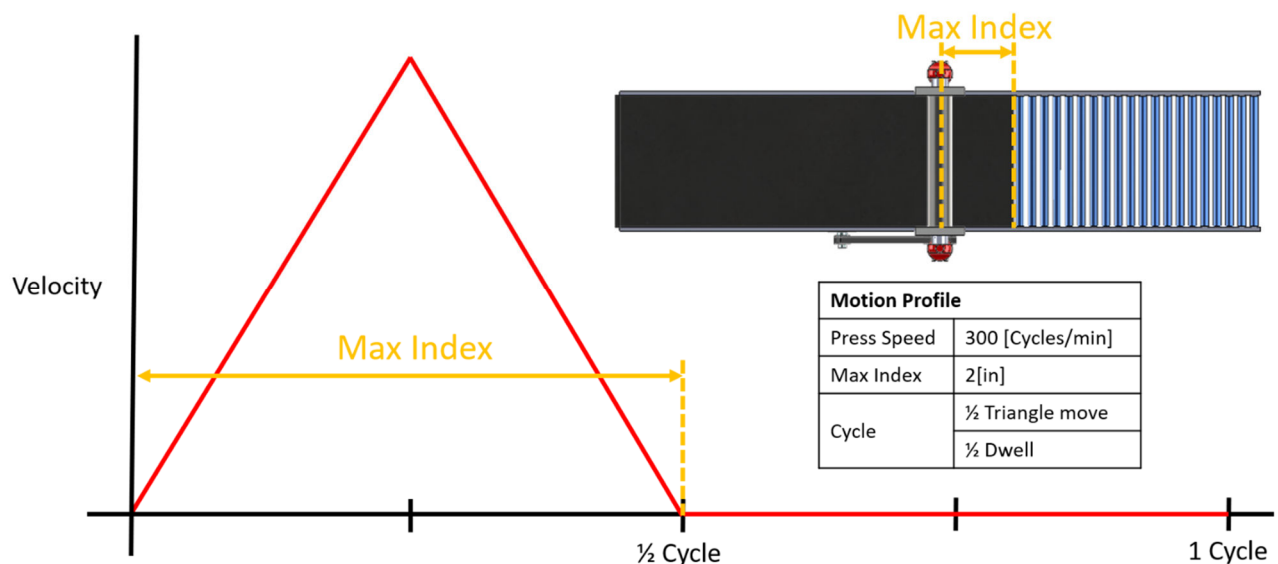
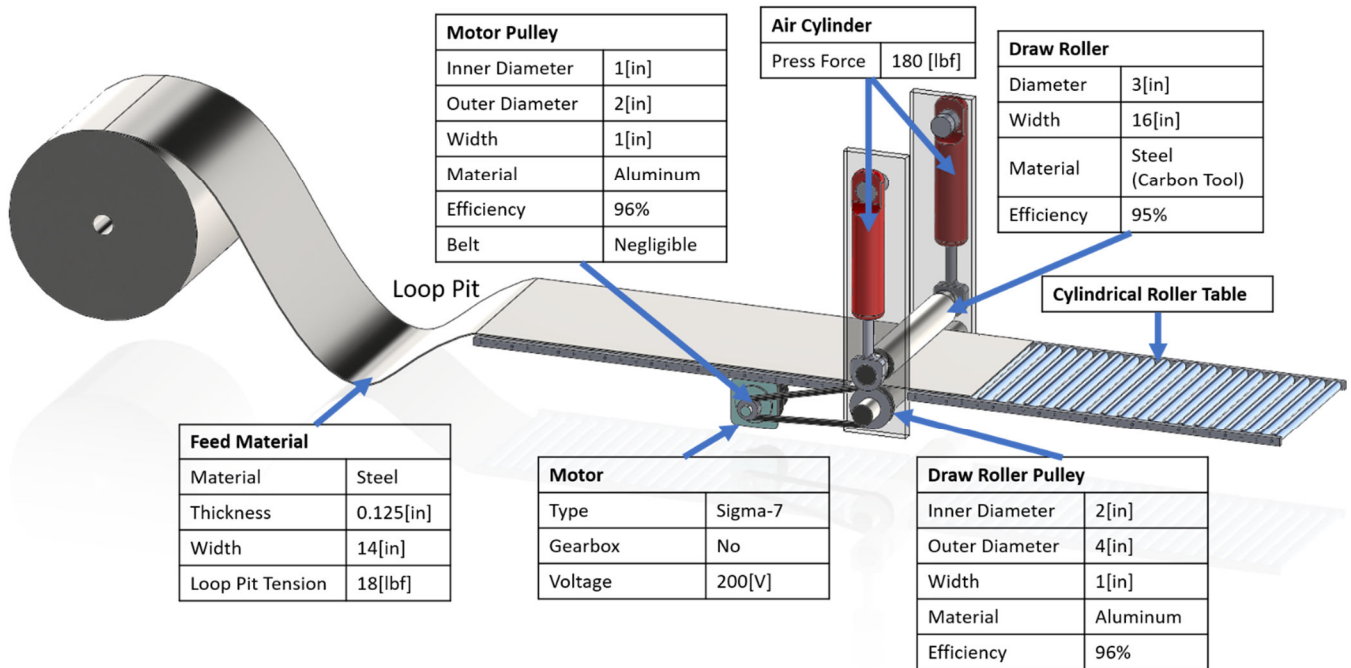
- A. User Info
- B. Load Editor
- C. Profile Editor
- D. Motor Results
- E. Motor Details
- F. Regeneration

22. Which SigmaSelect tab is used to view the Speed/Torque graph of the motor?

- A. User Info
- B. Load Editor
- C. Profile Editor
- D. Motor Results
- E. Motor Details
- F. Regeneration

Exercise 1: Press Feed Roll

The Draw Rollers pull up to 2[in] of material across the Cylindrical Roller Table for half the cycle and waits for a stamping process to run for the other half of the cycle. This machine runs at 300 [cycles/min]. The bottom draw roller is connected to the motor through a 2:1 pulley reduction ratio. Two Air Cylinders provide a total of 180[lbf] pressure down onto the top Draw Roller. Two Air Cylinders provide a total of 180[lbf] pressure down onto the top Draw Roller.



23. What is the most cost-effective motor for this application?

% of Allowable Inertia Ratio < 100%, Safety Factor for Torque: 1.25 or greater

- A. SGM7A-20
- B. SGM7G-09
- C. SGM7G-13
- D. SGM7G-20
- E. SGMGH-13

24. What factor excludes the same series motor with the next lowest cost?

- A. Speed
- B. RMS Torque
- C. Peak Torque
- D. Inertia Mismatch

25. If the press speed is changed from 300 to 600 and the max index is reduced to 1in, which is the best motor?

% of Allowable Inertia Ratio < 100%, Safety Factor for Torque: 1.25 or greater

- A. SGM7A-30
- B. SGM7A-50
- C. SGM7G-13
- D. SGM7G-20
- E. SGM7G-30
- F. SGM7G-44

26. Set the Cycle rate back to 300 [cycles/min] and max index of 2 [in]. A smooth s-curve motion profile more accurately represents the command to the roll feeder. Adjust the Jerk factor to 50%. What motor is now the most cost effective?

% of Allowable Inertia Ratio < 100%, Safety Factor for Torque: 1.25 or greater

- A. SGM7A-20
- B. SGM7A-25
- C. SGM7G-09
- D. SGM7G-13
- E. SGM7G-20
- F. SGM7G-30

27. What factor excludes the same series motor with the next lowest cost?

- A. Speed
- B. RMS Torque
- C. Peak Torque
- D. Inertia Mismatch

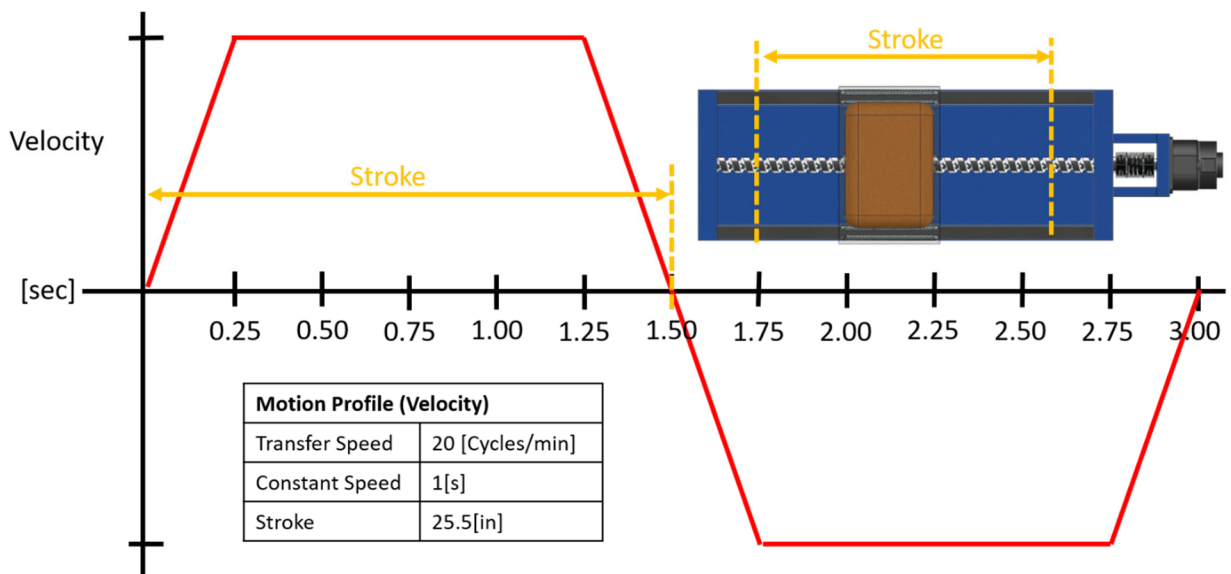
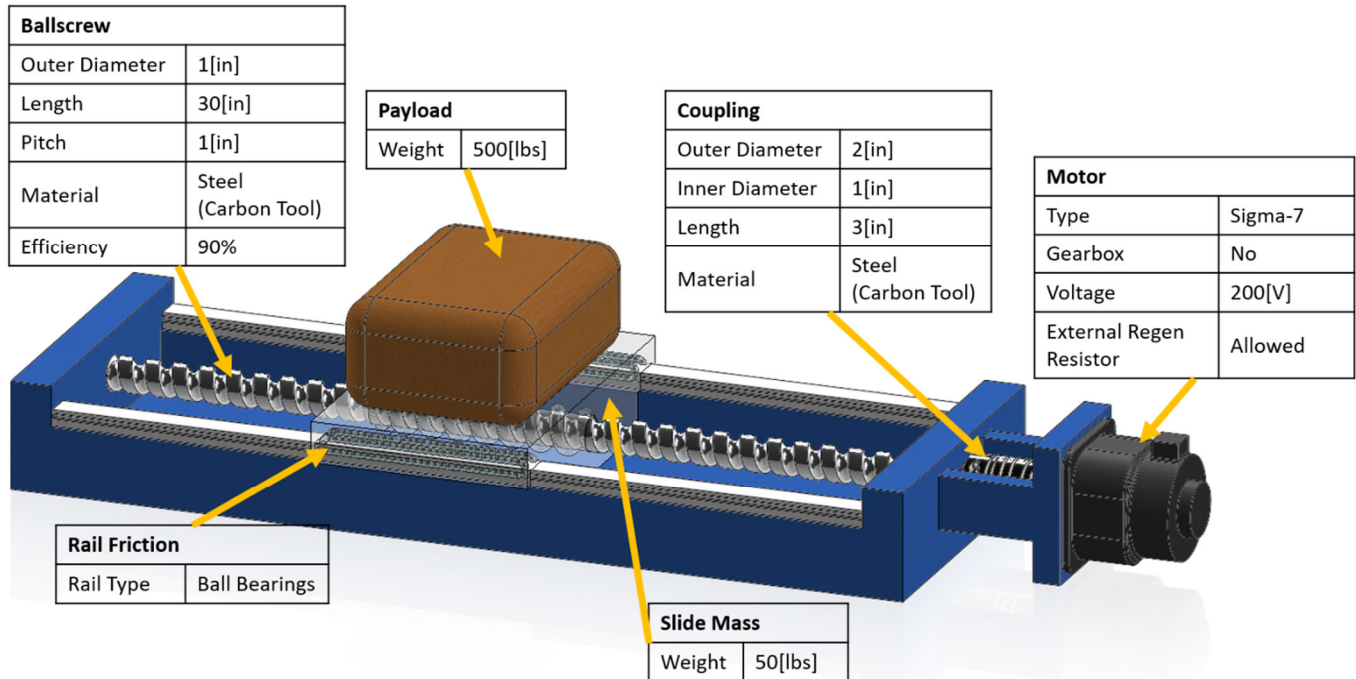
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Exercise 2: Linear Transport Ballscrew

This ballscrew receives a Payload and moves it one 25.5[in] Stroke to a separate station where the Payload is removed. The unloaded ballscrew immediately moves back to the original position to repeat the process without dwell time. This machine runs at 20 [cycles/min] with 1[s] of constant speed.



28. What is the most cost effective motor for this application?

% of Allowable Inertia Ratio < 100%, Safety Factor for Torque: 1.25 or greater

- A. SGM7J-06
- B. SGM7P-15
- C. SGM7A-10
- D. SGM7G-05
- E. SGM7G-09
- F. SGM7G-13

29. What factor excludes the same series motor with the next lowest cost?

- A. Speed
- B. RMS Torque
- C. Peak Torque
- D. Inertia Mismatch

30. If the payload is doubled(1000[lbs]), which motor is the most cost effective?

% of Allowable Inertia Ratio < 100%, Safety Factor for Torque: 1.25 or greater

- A. SGM7A-10
- B. SGM7G-09
- C. SGM7G-13
- D. SGM7G-20
- E. SGM7J-06
- F. SGM7P-15

31. Leave the payload doubled and make the application vertical. What motor is now the most cost effective?

- A. SGM7A-50
- B. SGM7A-40
- C. SGM7A-70
- D. SGM7G-09
- E. SGM7G-44
- F. SGM7G-55



32. What factor excludes the same series motor with the next lowest cost?

- A. Speed
- B. RMS Torque
- C. Peak Torque
- D. Inertia Mismatch

33. For this vertical application, if a 1.5 second dwell (with motor torque used to hold position) is added to the motion profile after each move, what motor is the best choice?

- A. SGM7A-40
- B. SGM7A-50
- C. SGM7A-70
- D. SGM7G-09
- E. SGM7G-30
- F. SGM7G-44

