

姓名 Name	李力博
学号 Student ID	0121628250417
专业班级 Class	车辆01604
学校 School	武汉理工大学

Test Paper of Wuhan University of Technology (A)

2018~2019 Academic Year 2nd Semester, Course: Manufacturing Technology of Automobile and Engine, Closed-book exam

Time: 120mins, class hours, credits, Total Points: 100, Percent in final evaluation

result: %, Date:

No.	I	II	III	IV	V	VI	VII	VIII	IX	X	Total
Full score	23	28	26	23							100
Score	9	20	5	5							39

Score

QUESTION I (23 Points)

1. What is the production process of automobiles? What is the manufacturing process of automobile production? (4 points)

答: 汽车生产过程是指材料或毛坯经过加工后成为汽车的过程, 分为材料生产过程、辅助生产过程、服务生产过程和准备生产过程。
工艺过程是指材料经过工艺加工后成为零件或产品的过程。

2. What are the three types of auto parts production? (3 points)

3. Briefly introduce the methods for obtaining workpiece dimension. (4 points)

工件尺寸的获得方法有: 试切法、静调整法、定尺寸刀具法
主动或自动调整控制法

4. What is operation? Describe the arrangement principles of machining operation (6 points)
答: 工序是指工人在一台设备上进行的一个或几个零件的连接部分的加工过程。

工序的安排原则有: 1. 工序尽量少
2. 走刀次数尽量少
3. 加工精度尽量高

5. What is machining allowance? What are the main factors influencing machining allowance? (6 points)

答: 加工余量是指在粗加工后, 为消除误差而与标准尺寸之间所留的余量。
影响加工余量的因素有: 系统误差、刀具误差、尺寸精度要求

Score

QUESTION II (28 Points)

6. Figure 1 shows the positioning condition of transmission case 1. The positioning element consists of two taper pins 2 both movable from top to bottom and from left to right, bearing plate 3 and bearing nail 4. Please analyze (12 points):

(1) What is the over-positioning?

(2) The degree to which the freedom is restricted by the positioning elements in the figure.

(3) Decide whether there exists over-positioning.

答: 1. 指定位元件过多, 导致有的定位元件并没有产生定位效果的情况

2. 由支承板3可以限制 $\bar{y}$ 、 $\bar{z}$ 、 $\bar{y}$
由活动圆锥2可以限制 $\bar{x}$ 、 $\bar{z}$
由支承钉4可以限制 $\bar{x}$

3. 没有过定位现象

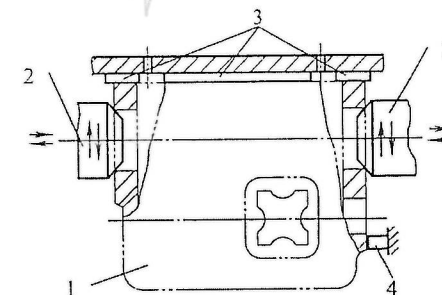


Figure 1

7. Figure 2 is a machining and positioning diagram of piston and pin hole. The piston has a full height of $106_{-0.1}^0$ mm, pin hole position of 56 ± 0.08 mm and symmetry requirement of 0.2mm. Please analyze (16 points):

- (1) What is positioning error? What are the main reasons for positioning error?
- (2) Please calculated the positioning error of process size 56 ± 0.08 mm.
- (3) Assuming that the coaxiality error between the seam allowance and the piston skirt is zero, please calculated the positioning error of the symmetry and determine whether it meets the processing requirement.

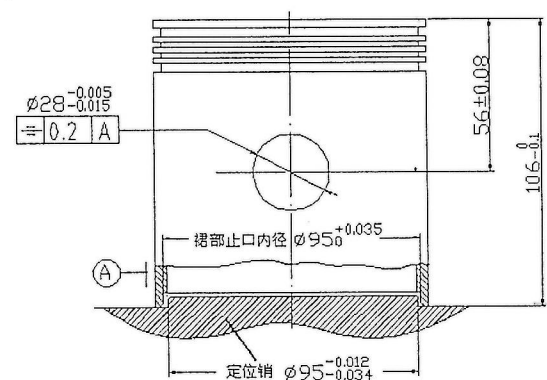


Figure 2

答解: (1) 定位误差是零件生产时的工序尺寸相对于定位基准之间的误差。
定位误差产生的原因有基准不重合误差、基准位移误差。

(2) $\Delta j = \Delta j_b + \Delta j_y = 0 + 0 = 0 \text{ mm}$

(3) $\Delta j = \Delta j_b + \Delta j_y = 0 + 0 = 0 \text{ mm}$

(3) $\Delta j = \Delta j_b + \Delta j_y = 0 + 0.035 + 0.034 = 0.069 \text{ mm}$

$\frac{1}{3} \times 0.2 = 0.067 < 0.069$

不满足加工要求

Score 5

QUESTION III (26 Points)

8. Figure 3 is the assembly diagram of the first principle axis journal of the crankshaft and the bearing pedestal. 1 is the crankshaft, 2 and 4 are thrust washers, 3 is the mainshaft bearing of the cylinder and 5 is the timing gear. Design requirements: the assembly gap between the journal and shoulder of the first principle axis and the thrust washer is $A_0 = 0.05 \sim 0.25\text{mm}$. Design requirements: $A_1 = 43.5\text{mm}$; $A_2 = A_4 = 2.5\text{mm}$; $A_3 = 38.5\text{mm}$. The assembly method of complete interchange is to be used, to ensure assembly precision. (20 points)

- (1) Please explain the principle of shortest dimension chain.
- (2) Set up assembly dimension chain and determine increasing and decreasing links with circuit method.
- (3) Solve and calculate the dimensional tolerances and limit deviations of the related parts.

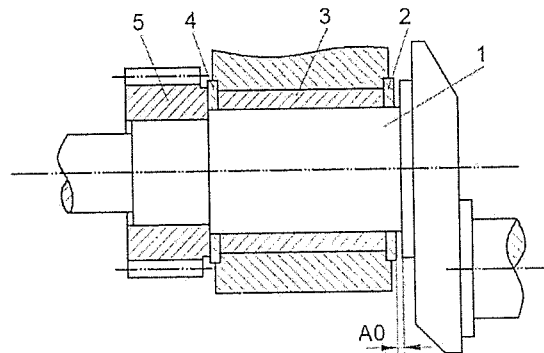


Figure 3

Standard tolerance (from GB/T 1800.3-1998)

Basic dimensions (mm)		≤ 3	$>3 \sim 6$	$>6 \sim 10$	$>10 \sim 18$	$>18 \sim 30$	$>30 \sim 50$
Tolerance grade (μm)	IT8	14	18	22	27	33	39
	IT9	25	30	36	43	52	62
	IT10	40	48	58	70	84	100

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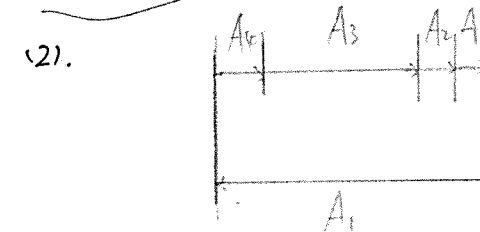
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试卷装订线

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解: (1) 由尺寸链上所装配的零件均为最少且最短的装配方法, 没有重复且可以去除的零件。



A_1 为增环, A_2, A_3, A_4 为减环。

$$\begin{aligned} (2) \quad & ES A_1 - EI A_2 - EI A_3 - EI A_4 = 0.25 \\ & EI A_1 - ES A_2 - ES A_3 - ES A_4 = 0.05 \end{aligned}$$

9. Describe the advantages and disadvantages of the assembly methods of complete interchange and incomplete interchange and the application occasions of such methods. (6 points)

Score 5

QUESTION IV (23 Points)

10. As shown in Figure 4, the slender axis workpiece (a and b in Figure 4) and thin-wall cylindric workpiece (c in Figure 4) are cut after being clamped with different fixtures on the machine tool. And different machining errors in dimension and shape occur in the machined parts. Please analyze reasons for the machining errors of the workpieces (6 points)

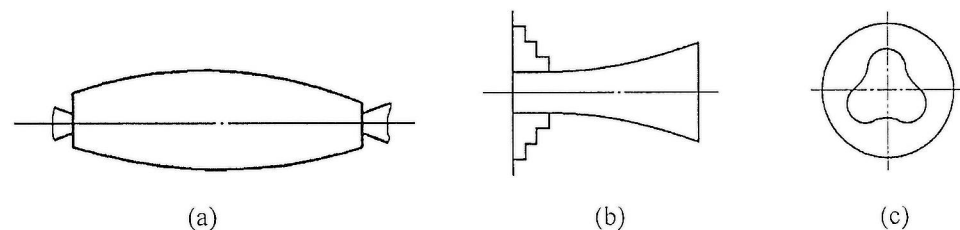


Figure 4

- 解: (a). 细长光轴工件在两端用圆锥夹紧的情况下, 在切削加工时, 产生了表压内拉的应力, 然而两端已被圈固定, 因而导致表面压力向外形成此形状。
- (b). b零件由于一端被卡盘夹紧固定, 导致其拉压应力只能向另一边释放因而形成此形状。
- (c).

11. Machine separately two batches of workpieces on the machine tool with static adjustment method. The dimension distribution curves obtained are shown as A and B in Figure 5. Δ is the dimension distribution range; ΔL is the deviation of the distribution center of the two batches of workpieces and T is the process tolerance of the workpiece. Please analyze: (11 points)

- (1) What is the 6σ principle? What does it mean in the manufacturing process?
- (2) Please determine the nature of the machining error leading to the change in the dimension distribution curves of the two batches of workpieces and describe how to eliminate the machining error.
- (3) Please provide the condition for ensuring that there is no rejected part in the two batches of workpieces.

解: (1). 6σ 原则是指理论上

在加工过程中, 生产出零件的尺寸偏差都分布在 3σ 内。其在生产制造中的意义是为了检验零件的合格率和合格标准, 判断尺寸的波动范围。

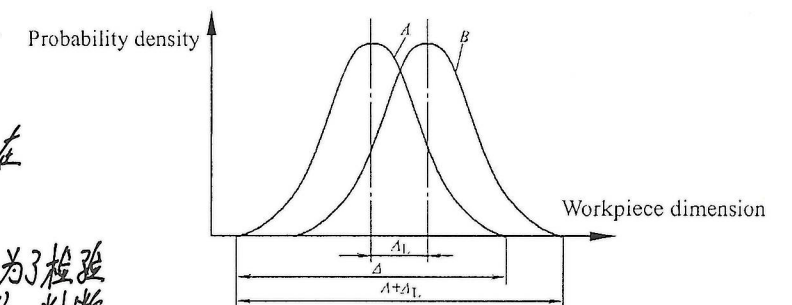


Figure 5

(2) 基准定位误差。

消除此类误差的方法是使用同一定位基准且保证工序尺寸的定位误差较小。

(3) 使合格零件的标准即工序公差 $T = \Delta + \Delta L$ 。

12. Analyze the influences of cutting heat on residual stress on the machined surface of the workpiece in the cutting process, at the end of cutting and when the workpiece is completely cooled in the machining process based on Figure 6. Here, t_H representing room temperature when the workpiece has high plasticity and t_p refers to the temperature; $+\sigma$ and $-\sigma$ represent tensile stress and compressive stress, respectively; 1, 2 and 3 represent three layers of metal at different distances from the workpiece surface, respectively. (6 points)

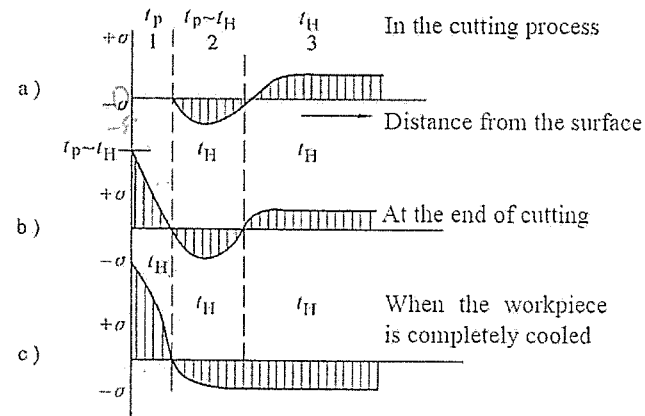


Figure 6

解: 切削过程中的切削热会在切削过程中对被加工表面产生淬火烧伤, 使其内部受到较大应力, 但在切削结束时产生回火烧伤, 使表面塑性高的部分温度降低后定形, 受到较大应力, 又在完全冷却后产生回火烧伤, 使工作内部热量向外扩散, 外表面受热膨胀受到较大应力。