WORKSHEET 04 · CAD & ENGINEERING GRAPHICS

TOLERANCES, SURFACE TEXTURE & DATUMS

Read and calculate limits, tolerances and fits, interpret surface texture symbols and explain why datums and datum targets are used.

04

COURSE NOTES **CH 04** TIME **50 MIN** TOTAL **29 MARKS** EDITION **TYPE-IN**

NAME _____ CLASS _____ DATE _____

LEARN IT THE ESSENTIALS

LIMITS, TOLERANCE, FITS

- **Limits**: largest and smallest sizes allowed. **Tolerance** = upper limit − lower limit (always positive).
- **Common** (limits stacked), **asymmetrical** (two different deviations) or **symmetrical** (±). **NF** sizes take the general tolerance.
- Max clearance = largest hole − smallest shaft. Min clearance = smallest hole − largest shaft. Max interference = largest shaft − smallest hole.
- Clearance (g6), transition (k6) or interference (s6) fit.

SURFACE TEXTURE AND DATUMS

- **Ra** (µm) is a maximum. Bar: material must be removed. Circle inside: must not be removed. Circle at the corner: all round the outline.
- Finer Ra and tighter tolerances cost more.
- **Datum**: where measurement starts. Triangle clear of a dimension line: the surface. In line with one: the axis or centre plane.
- **Datum targets** (A1, A2, A3): only these points touch the fixture.

GENERAL TOLERANCE ±0,1 · Ra 3,2 UNLESS OTHERWISE STATED · DIMENSIONS IN mm

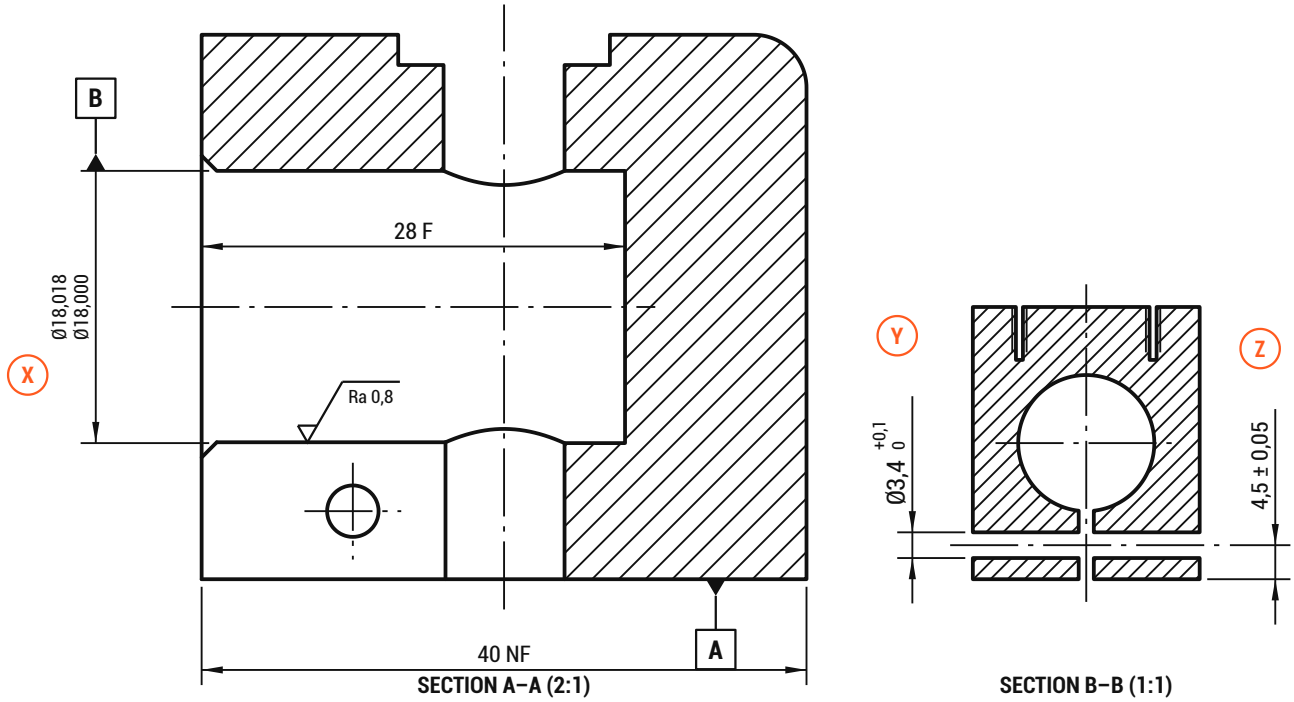


Fig 1 Motor mount, proposed revision C (extract). SECTION A–A at 2:1; SECTION B–B, through the pinch-bolt hole, at 1:1.

MISSION BRIEF The HSRDU wants the pinch-bolt hole of the motor mount toleranced so that every clamp grips the arm the same way. Fig 1 shows the proposed revision C of drawing SX-02-003. Three toleranced sizes are labelled X, Y and Z.

1 Refer to Fig 1.

(a) Name the method used to show the tolerance at X, at Y and at Z.

X

Y

Z **3**

(b) Calculate the tolerance at X, at Y and at Z. Show your working.

3

(c) The 28 depth of the bore is marked F and the 40 length is marked NF. Explain why the two sizes are treated differently, and state the limits of the 40 length.

3

2 The pinch-bolt hole leaves a thin wall of metal under it (SECTION B–B). Calculate the **smallest** and the **largest** thickness this wall can be when the sizes at Y and Z are within their limits. Show your working.

3

3 The arm end is made to Ø18 g6 (17,994 / 17,983) by Supplier A. Supplier B offers cheaper arms with a diameter of 18,010 / 17,998.

(a) Calculate the maximum clearance and the maximum interference between a Supplier B arm and the Ø18 H7 bore. State the type of fit.

3

(b) Explain why Supplier B's arms are not suitable for SUMMIT-X. Refer to how the drone is maintained.

2

4 Fig 2 shows four surface texture symbols, A to D.

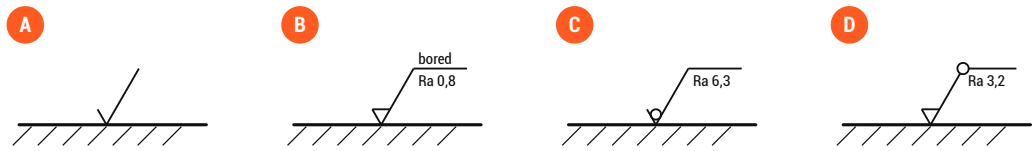


Fig 2 Surface texture symbols A–D.

(a) Describe what symbols B, C and D tell the manufacturer.

3

(b) The bore of the mount is Ra 0,8 but the rest of the part is Ra 3,2. Explain why the designer has not specified Ra 0,8 for every surface.

2

5 Datums A and B are shown in SECTION A–A (Fig 1).

(a) The triangle for datum B is drawn in line with the Ø18 dimension line. Explain what this tells the machinist.

1

(b) Explain why the CAM programmer and the inspector should both work from datums A and B.

2

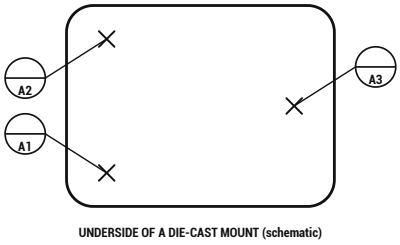


Fig 3 A future die-cast version of the mount, underside.

(c) A future version of the mount may be die cast. Fig 3 shows datum targets A1, A2 and A3 on its underside. Explain why datum targets are used on this part rather than the whole face.

2

6 A trainee suggests changing the general tolerance on the mount drawing from ±0,1 to ±0,02 "so every part is better". Explain **two** reasons why this is a poor decision.

2

EXAM INTEL **SHOW WORKING FOR EVERY MARK**

Write the rule, the numbers and the answer with units: "max clearance = largest hole - smallest shaft = 18,018 - 17,983 = 0,035 mm". Keep three decimal places. A fit question usually asks you to **state the type of fit** as well — do not forget that mark.

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TOTAL 29 MARKS