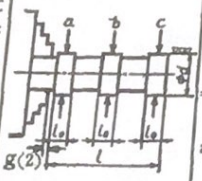
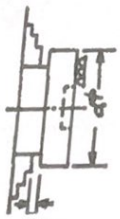
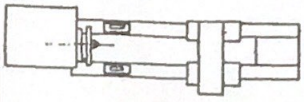
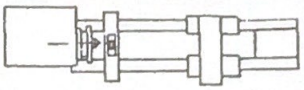
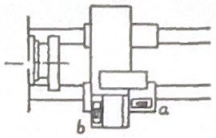
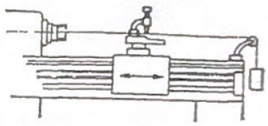
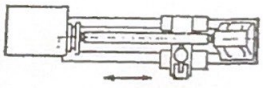
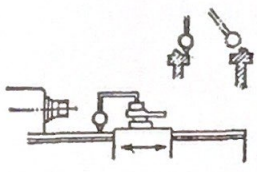
Ⅳ. ACCURACY TEST OF WORK (PRACTICAL TEST)

Unit : mm

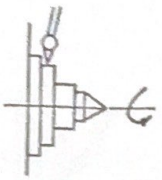
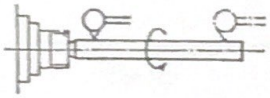
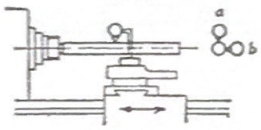
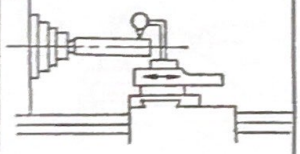
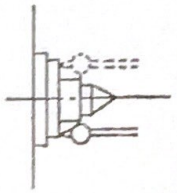
No.	Inspection item		Measuring method	Diagram of measuring method	Dimension of work (approx.) Swing over bed	d	ℓ	ℓ_o	Tolerance	Measured Value
1	Accuracy of outside turning	a. Roundness	Fix work on the chuck, and finish turn by traversing the carriage and measure the diameter at 3 points (1) at a, c and b on 4 planes 45. apart including the centre axis. Then the maximum difference of diameters shall be the value of out of roundness required. Also the maximum difference of 3 diameters in one plane shall be the value of out of cylindricity required.		300 and over and under 500	70	200	15	0.01	
					500 and over and under 750	90	300	20	0.015	
					750 and over and under 1000	120	300	20	0.015	0.015
		b. Cylindricity			300 and over and under 500	70	200	15	0.02	
					500 and over and under 750	90	300	20	0.03	
					750 and over and under 1000	120	300	20	0.03	0.005

No.	Inspection item	Measuring method	Diagram of measuring method	Dimension of work (approx.) Swing over bed	d	Tolerance(4) Flatness	Measured Value
2	Accuracy of face turning	Fix work on the chuck or face plate, and by means of transverse feed, make finish turning. on the finished surface find the largest deviation of surface with base plane (i. e., a straight edge) in 2 directions at right angle to each other, and taking the largest value of the two and converting it in terms of the value at the centre of the work (3), and let it be the value required.	 $d_0 \div \frac{d}{2}$	300 and over and under 500	250	For diameter 0.02	
				500 and over and under 750	300	For diameter 0.02	
				750 and over and under 1000	400	For diameter 0.02	-0.02

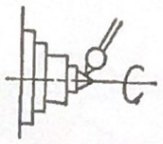
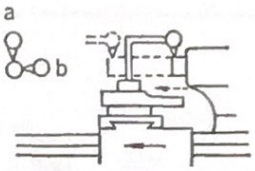
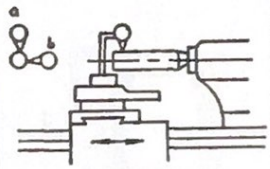
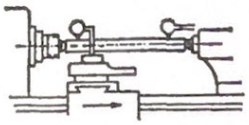
V. STATIC ACCURACY TEST (GEOMETRICAL TEST) Unit : mm

No.	Inspection item		Measuring method	Diagram of measuring method	Tolerance: Swing of engine lathe — Under 500	Tolerance: Swing of engine lathe — 500 and over and under 1000	Measured Value
1	Straightness of bed slideways	a. Longitudinal direction (5) (in vertical plane)	Place a precision level on the slideway of the bed or on the straightedge placed crosswise over the ways at not less than three positions, the centre and each end. The maximum difference in readings of the level shall be the measurement value required. when it is not possible to follow the above method, fix the precision level on the carriage and take the reading of the level as the carriage is put at least to 3 positions of centre and two extreme positions of the travel. The maximum difference in readings of the level shall be the measurement value required.	(a)  Bed must not be sagging at central part (6) (b)  	0.04/m	0.05/m	0.02/m
		b. Transverse direction(5) (in vertical plane)			0.04/m	0.05/m	0.02/m
		c. Longitudinal direction (in horizontal plane)	For the swing over bed in excess of 500, stretch a steel wire over the slideway of the bed, and attach a micrometer microscope to the carriage so that observation from the top is possible. Slide the carriage and obtain readings of microscope along the full length of the way. The maximum difference in reading shall be the measurement value required (7)(8). For the swing over bed under 500, slide a test indicator fixed to the carriage along the test bar held between two centres. The maximum difference in readings of the indicator obtained shall be the measurement value required (9).	 	when centre distance does not exceed 1000: 0.01	0.01	0.02
					Centre distance exceeding 1000 and under 2000: 0.02	0.02	
					Centre distance exceeding 2000: 0.04	0.04	
2	Parallelism of bed slideways		Apply a test indicator fixed to the carriage against the way of tailstock. Slide the carriage keeping in contact with slideway, and obtain reading of the indicator for the full length of the travelling of carriage. The maximum difference in reading shall be the measurement value required.		0.02	0.02	0.01

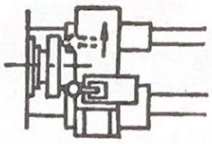
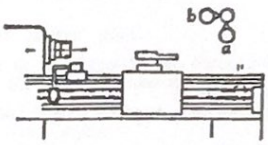
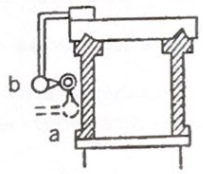
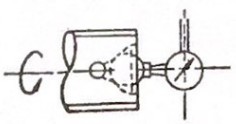
Unit : mm

No.	Inspection item	Measuring method	Diagram of measuring method	Tolerance: Swing of engine lathe — Under 500	Tolerance: Swing of engine lathe — 500 and over and under 1000	Measured Value
3	Spindle nose runout	Apply a test indicator against the spindle nose. Rotate the spindle and obtain reading of the indicator. The maximum difference in reading shall be the measurement value required.		0.01	0.02 Rear	0.01 0.035
4	Spindle taper hole runout	Fit a test bar to the main spindle and apply a test indicator against the fixed end and the free end. Rotate the spindle and obtain reading of the indicator. The maximum difference in reading shall be the measurement value required.		At fixed end of test bar: 0.01	At fixed end of test bar: 0.02	0.01
				At point of 300: 0.02	At point of 300: 0.03	0.01
5	Parallelism of centre line of main spindle to longitudinal motion of carriage — a. In vertical plane	Slide a test indicator fixed to the carriage along the test bar fitted to the main spindle. The maximum difference in reading of indicator obtained shall be the measurement value required (10)	Per 300 of test bar 	Test bar shall not be drooping at free end: 0.01	0.02	0.08
	b. In horizontal plane			Test bar shall not lean to further side: 0.01	0.02	0.01
6	Parallelism of centre line of main spindle to longitudinal motion of tool rest (in vertical plane)	Slide a test indicator fixed to the tool rest along the test bar fitted to the main spindle, The maximum difference in reading of the indicator obtained shall be the measurement value required (10)(11)	Per 150 	0.01	0.02	+0.01
7	Runout of flange end face of spindle	Apply a test indicator close to the periphery on the flange end face of main spindle. Rotate the spindle and find the maximum difference in reading of the indicator. Shift the point of indicator to the opposite face of flange and repeat the process. The larger of the two maximum differences shall be the measurement value required.		0.015	0.02 Rear	0.01 0.03

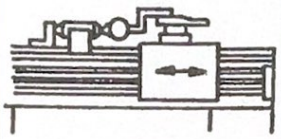
Unit : mm

No.	Inspection item		Measuring method	Diagram of measuring method	Tolerance: Swing of engine lathe — Under 500	Tolerance: Swing of engine lathe — 500 and over and under 1000	Measured Value
8	Centre runout		apply a test indicator at right angle against the cone of the centre fitted to the main spindle. The maximum difference in reading of the indicator obtained while rotating the spindle shall be the measurement value required. The process prescribed shall be carried out on the centre of tailstock spindle as well.		0.015	0.02	0.015
9	Parallelism of longitudinal motion of carriage to centre line of tailstock spindle	a. In vertical plane	Apply a test indicator fixed to the carriage against the top of tailstock spindle. Slide the carriage and obtain reading of the indicator when the spindle is shifted in and out. The difference between the two readings shall be the measurement value required (12).	Per 150 	No drooping of tailstock spindle at free end		
					0.02	0.03	0.03
		b. In horizontal plane			Tailstock spindle shall not lean to further side.		
					0.01	0.015	0.015
10	Parallelism of longitudinal motion of carriage to centre line of tailstock spindle hole	a. In vertical plane	Apply a test indicator fixed to the carriage against the test bar fitted to the tailstock spindle hole. Slide the carriage and obtain reading of the indicator. The maximum difference in reading shall be the measurement value required.	Per 300 of test bar 	Test bar shall not droop at free end.		
					0.02	0.03	0.03
		b. In horizontal plane			Test bar shall not lean to further side.		
					0.02	0.03	0.015
11	Difference in centre height between headstock and tailstock		Apply a test indicator fixed to the carriage against the each end of test bar held between the centres of main spindle and tail stock spindle. The difference between the two readings from each end of test bar, shall be the measurement value required (12)(13)		Tailstock side shall not be lower than headstock side.		0.05m PRE-RESERVE FOR HEAT DEFORMING RATE
					0.02	0.03	

Unit : mm

No.	Inspection item		Measuring method	Diagram of measuring method	Tolerance: Swing of engine lathe — Under 500	Tolerance: Swing of engine lathe — 500 and over and under 1000	Measured Value
12	Squareness of motion of cross slide with centre line of main spindle		Fit a face plate or a driving plate to the main spindle. Apply a test indicator fixed to the cross slide against a point on the plate given distance away from the centre. Obtain reading of the indicator on the horizontal line through the centre of spindle. Next, rotate the plate 180 degrees, traverse the cross slide and obtain another reading when the indicator is brought to the same point where previous reading has been taken. The difference between the two readings shall be the measurement value required.	Per 300 	Cross slide shall not move away from head stock when traversed forward. 0.02	0.03	-0.005
13	Parallelism of centre line of lead screw end bearing to carriage slideways	a. In vertical plane	Put test indicator against the outside of the lead screw ends on the slideway (the measuring base) of the bed, and measure the deviation in upward and downward directions or in front and rear directions with test indicator The difference in readings shall be the measurement value required.		0.10	0.12	0.1
		b. In horizontal plane			0.10	0.12	0.1
14	Deviations in alignment of centre line of lead screw end bearing with centre line of half nut	a. In vertical plane	Engage the half nut at mid-position on the lead screw. Next, put the test indicator on the slideway of the bed as the measuring base and apply the point of indicator to the central part and each end of the lead screw. Measure the distance in upward and downward directions or in front and rear directions from slideway The largest in difference of the reading shall be taken as the measurement value required.		0.15	0.20	0.1
		b. In horizontal plane			0.15	0.15	0.1
15	Axial slip of lead screw		Apply a test indicator against a steel ball inserted into the centre hole of lead screw end. Rotate the screw with the half nut on, and traverse the carriage alternately to right and left. The largest difference in readiug of the indicator odtained while rotating the lead screw shall be the measurement value required.		0.01	0.02	0.02

Unit : mm

No.	Inspection item	Measuring method	Diagram of measuring method	Tolerance		Measured Value
				Swing of engine lathe		
				Under 500	500 and over and under 1000	
16	Pitch error of lead screw	Rotate the lead screw with the half nut on. The difference between the theoretical distance and the actual distance of the carriage movement shall be measured by means of a measuring gage bar of certain length and a test indicator at not less than three positions, the centre and each end. However, when the lead screw has been tested prior to the assembly by means more stringent than the test specified, the test prescribed may be left out.	Per 300 	0.03	0.04	0.02/m

Notes (1) Choose where there is no sagging for measuring point.

(2) Take g as small as possible.

(3) Conversion value shall conform to the following:

$$\text{Conversion value} = \frac{d}{d - do} \times (\text{maximum difference in distance})$$

(4) Finished surface shall not be crowned at central part.

(5) The longitudinal direction of bed refers to the lengthwise direction, and the direction right angle thereto is referred to as the transverse direction of the machine.

(6) The precision level shall remain truly horizontal at mid position of the bed. Either end of the bed shall not show tendency to sag towards the centre.

(7) The steel wire need not necessarily be aligned on the centre line of the main spindle.

(8) The steel wire shall be so adjusted that the readings of the micrometer microscope at each end coincide with each other.

(9) The test bar shall be so adjusted that at the both and of measuring position, the reading of test indicator to coincide.

(10) In this measurement, the test bar shall be rotated once as it is fitted to the main spindle, and the position at which its runout throughout the total length becomes the minimum shall be considered as the basis of measurement.

(11) Adjust the test bar so that the reading of test indicator at the gripped end and the tip shall be approximately the same.

(12) In measuring, the tailstock and tail spindle shall be tightly clamped.

(13) The test bar shall be supported between the centres with the minimum runout in the direction on which the measurement shall be made.