

KES

**Valve Train Wear Test Procedure
For Evaluating Automobile
Gasoline Engine Oils**

KES T – L095

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1. Purpose

The purpose of this standard is to establish an integrated test method that evaluates wear resistance of valve train among the practical performances of engine oils.

2. Scope of Application

This standard determines the test method that evaluates wear resistance of valve train for gasoline engine lubricating oil (Engine oil).

Remark : Among these standards the units and dimensions in { } are expressed by SI and recorded as a reference.

3. Terminology

Terminology used for this standard shall be as follow.

(1) Valve Train

Among the engine parts it means Rocker Arm and Cam Shaft.

(2) Motoring Valve Train Wear Test

A test that evaluates the worn state of valve train by driving engine driven by a motor.

(3) Firing Valve Train Wear Test

A test that evaluates the worn state of valve train by driving actual engine.

(4) Reference Oil

Prepared engine oil ahead of time used for confirming whether the evaluation is done correctly.

(5) Flushing

It means washing the inside of short-term-driven lubricating system according to motoring or firing without a disassembly of an engine.

4. Test Types

Test types shall be as following.

- (1) Motoring Valve Train Wear Test
- (2) Firing Valve Train Wear Test

5. Test Equipment

Test equipment shall be the auxiliary, such as driving system, control system, and measuring instruments, etc. for an engine. Refer to table 1 for details.

Table 1 Engine Test Equipment

Equipment		Motoring Test	Firing Test
Types			
Important Engine Option	Form	Toyota 20R	Nissan L18
	Total Displacement cm³	2189	1770
	Number of Cycles	4	4
	Number of Cylinders	4	4
	Valve Type	OHC	OHC
	Compression Ratio	8.4	8.5
	Maximum Power PS / rpm { Kw / rpm }	110 / 5200 { 80.9 / 5200 }	105 / 6000{ 77.2 / 6000 }
	Maximum Torque Kgf · m / rpm { Nm / rpm }	17.5 / 2400{ 171.6 / 2400 }	15.0 / 3600{ 147.1 / 3600 }
	Blow-by Type	Closed	Closed
	Cooling System	Water	Water
Inhale System		—	For the case that inhales power use power system or other systems in accordance
Driving System		Motor for engine driving or power system	—
Meters		RPM meter, Thermo Meter, oil pressure meter or lowermost point of contact oil pressure meter	RPM meter, Thermo Meter, Oil pressure meter, exhausted gas meter(Co, Co₂), gas mileage meter
Auxiliary Systems		Cooling, Heating System	Cooling, exhaustion, fueling system
Remarks		Except piston, con-rod, fly wheel from engine	Test for all equipment

6. Reference Oils

- (1) When using a public notification engine for the first time, or when deeded, it is the rule to test the very first reference oil. Make it sure that the test correctly follows item 8.
- (2) Although the reference oils are 4 types as table 2 indicates, for each test method, M_1 and F_1 indicates high average points, M_2 and F_2 indicates low average points.

Table 2 Types of Reference Oils

Contents of Reference Oils	Types of Reference Oils	Motoring Test	Firing Test
Engine oil whose valve train wear	M_1	O	—
Test results is good	F_1	—	O
Engine oil whose valve train wear	M_2	O	—
Test results is not so good	F_2	—	O

Remark : Test the ones with “O”

Table 3 General Character of Reference Oils

Items		M_1	M_2	F_1	F_2
Reference Oils					
Specific Gravity 15 / 4 °C		0.876	0.871	0.879	0.87
Flash Point °C		220	226	215	221
Viscosity Cst	40°C	81.44	59.27	54.58	52.68
	100°C	13.25	10.07	10.12	9.98
Viscosity index		165	157	175	183
Pour Point °C		Less than -30	Less than -30	Less than -40	Less than -40
Total acid value KOH mg / g		1.80	1.20	2.16	1.42
Total base value KOH mg / g		7.56	2.05	6.75	2.57
Sulfuric wt %		0.61	0.33	0.99	0.53

Remark : Other characters than those on table 3 shall satisfy table 12 and 13.

7. Test Method

7.1 Motoring Valve Train Wear Test

- (1) Remove the auxiliary systems except unnecessary parts as follow.
 - (a) Remove the Piston and Connecting Rod.
 - (b) After sealing up by inserting a lead bar into connecting rod's oil hole on the crank shaft, push it with a connection rod Metal.

Link them with a band
 - (c) Unnecessary overall parts for the test can be excepted.
 - (d) Except the fly wheel.
 - (e) Set a cooling system for the control of flow temperature of oil pan, attach a heating system, or change the fan blade angle, quantity, and dimensions.
 - (f) For safety's sake attach lowermost point contact oil pressure meter and power switch for motors.
- (2) On each test, use brand news for the engine parts indicated on table 4.

Table 4 Replaceable Parts for Engine

Parts	Part No.
Cam Shaft	13511~35010
Rocker Arm	13810~38012
Oil Filter	15601~44011

7.1.2 Test Condition

Test condition shall be as table 5.

Table 5 Test Condition

Items	Conditions
Engine revolution rpm	1000 ± 50
Oil pan fluid temperature °C	60 ~ 65
Pressure in main oil gallery kgf / cm ² { Kpa }	More than 1.5 {147.1}
Engine load kg · f · m { Nm }	0 { 0 }
Duration of Test h	200

Remark : Oil pan fluid temperature shall be measured at the line level of oil level gauge.

(Refer to figure 1.)

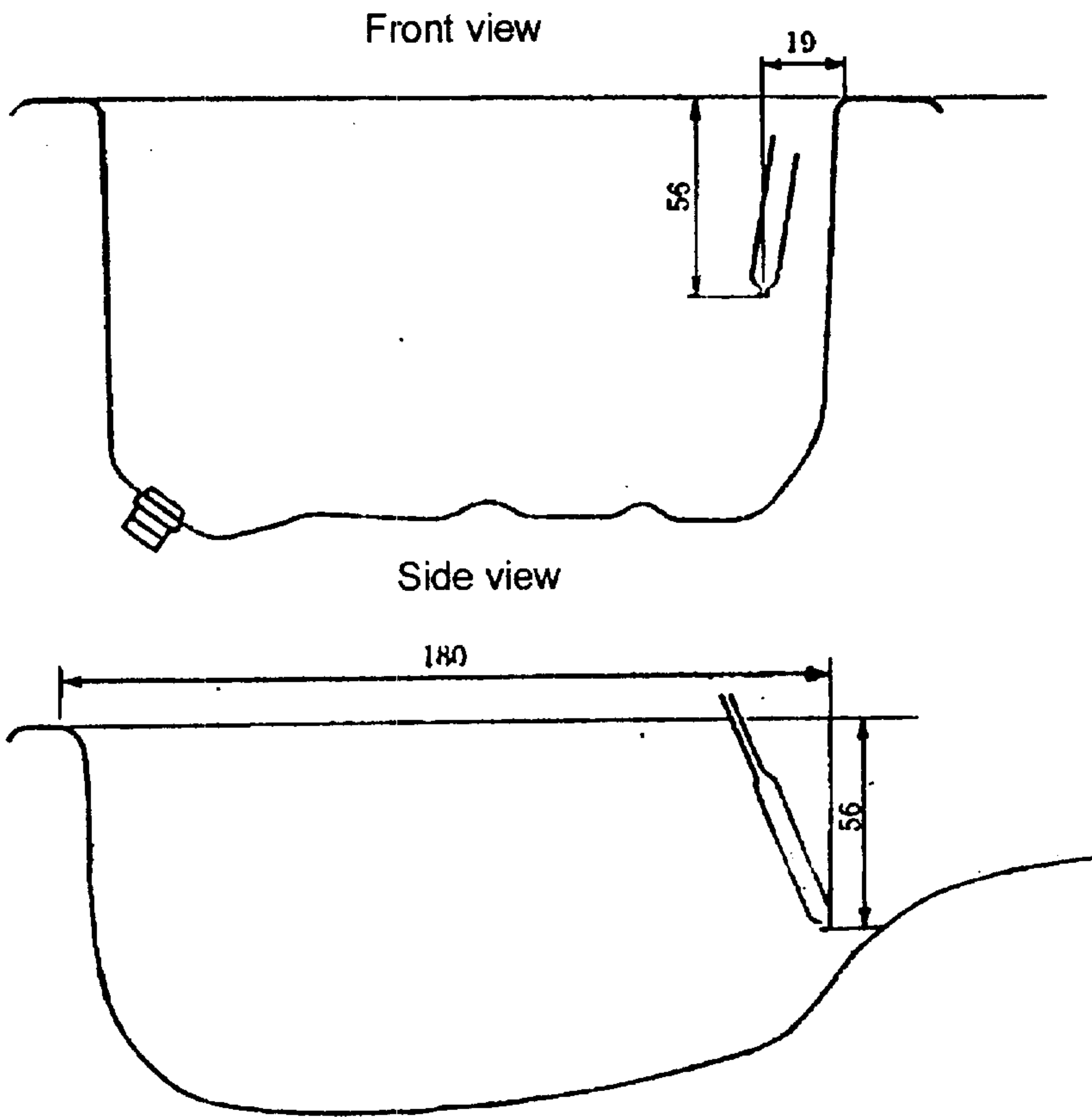


Figure 1 Measuring spot for oil pan fluid temperature

7.1.3 Test Order

Test it as following order.

- (1) Wash the cam shaft and rocker arm for test use with dissolution.
- (2) Remove oil due to the one on the cylinder head.
- (3) Replace the oil filter.
- (4) Assembly the cam shaft and rocker arm.
- (5) Adjust the valve clearance. (Inhale 0.20 mm, exhale 0.30 mm in warm condition)
- (6) Insert the publicly notified oil.
- (7) Do flushing once at 1000 rpm for 15 minutes.
- (8) Drain out the oil after flushing.
- (9) Insert the oil, and set the oil level at H with an oil level gauge.
- (10) Begin the test.
- (11) Fix the temperature and oil pressure as table 5 within 5 minutes.
- (12) Evaluate as item (1) and (2) of 7.1.4 at 100 hour.
- (13) End the test at 200 hour.
- (14) Disassembly them after finishing the test.
- (15) Wash them with dissolution after removing the oil pan.

7.1.4 Evaluation

At 100 hours since the test began, or after finishing the test, evaluate following items.

- (1) Have an evaluation point of the damage on the rocker arm pad surface as indicated by item 1 on appendix 2.
- (2) Have an evaluation point of the pitting damage on cam shaft nose as indicated by item 2 on appendix 2.
- (3) Have the amount of worn part by measuring the cam shaft's sizes before and after the test by 1 / 100 mm with, for example, a micrometer.

The measuring spot is indicated on figure 2. Also, in order to get accurate data, repeat 3 times.

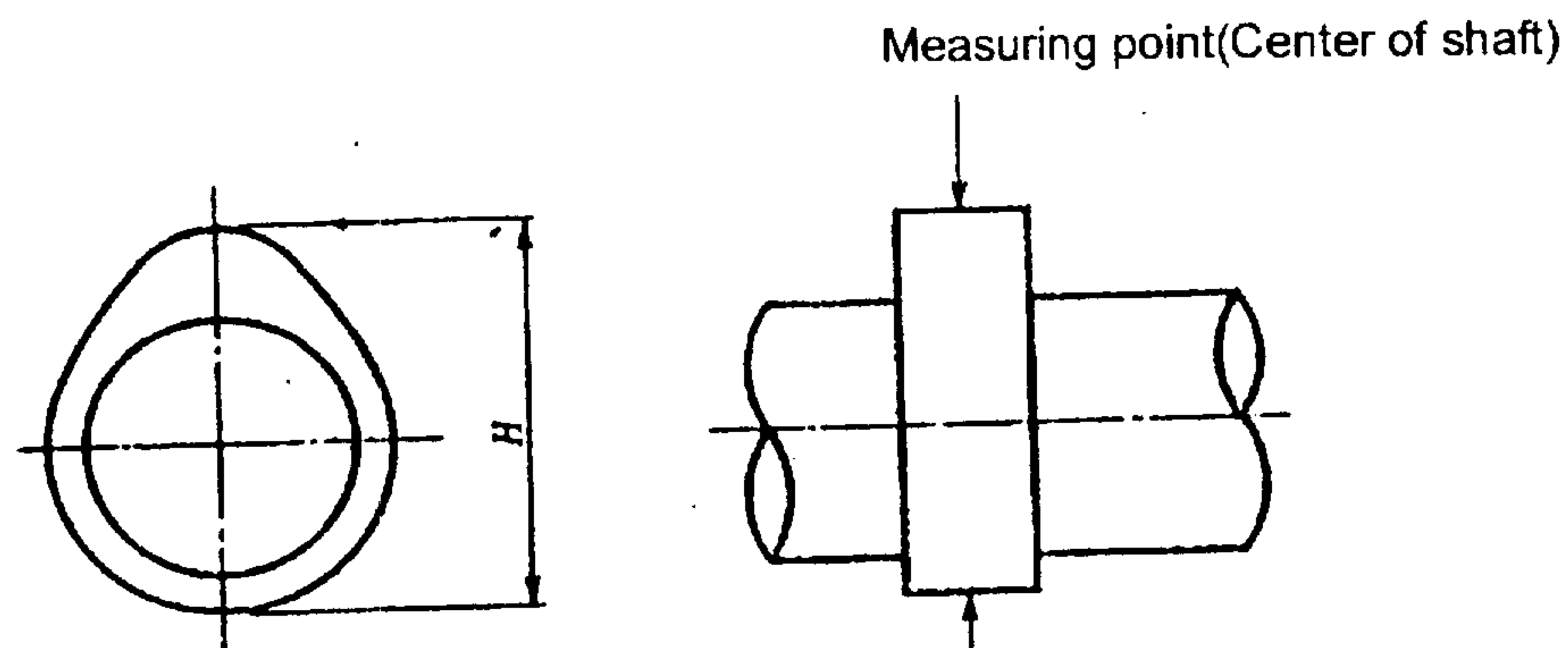


Figure 2 Measuring spot for outside diameter of cam shaft

7.1.5 Recording

Recording shall be as follow.

- (1) Record the scuffing evaluation point on the surface of rocker arm pad evaluated by 7.1.4, pitting evaluation point on the cam shaft nose, and the amount of worn part of the cam shaft.
- (2) Take a picture of the state of the cam nose and rocker arm pad after the test.

Picturing skill shall follow the appendix.

- (3) Record the fluid and driving states during the test.

7.2 Firing Valve Train Wear Test

7.2.1 Test Standard

- (1) Equip the auxiliary equipment required for engine driving as following.
 - (a) Air Cleaner
 - (b) Fan Blade
 - (c) Ignition Coil

- (d) Starter
- (e) Engine Mount

(2) For spring load setting adjust it as follow.

- (a) Between the outer spring and inner spring, which are used in L68 engine, replace the outer spring and increase the load in reference condition. Parts' No. and controlling method for valve springs is indicated on table 6.
- (b) After measuring the spring load, if it is in the standard value, use it again for next test.

The test method for spring load is indicated on figure 3.

Table 6 Test method for spring load

Parts' No.	Length taken mm	Length starting change mm	Standard load Kgf { N }		Remarks
			Original	When changing	
13203-E4100	40	30	21.3 ± 1.5 { 2.9 ± 15 }	47.7 ± 3.4 { 468 ± 33 }	For outer
13203-21002	40	30	48.4 ± 1.5 { 279 ± 15 }	60.0 ± 3.0 { 588 ± 27 }	"
13204-23000	35	25	12.3 ± 0.9 { 121 ± 9 }	24.8 ± 1.3 { 243 ± 13 }	For inner

Remarks : The standard state is the assembly of 13203-E4100 and 13204-23000.

17% increase is the assembly of 13203-21002 and 13204-23000.

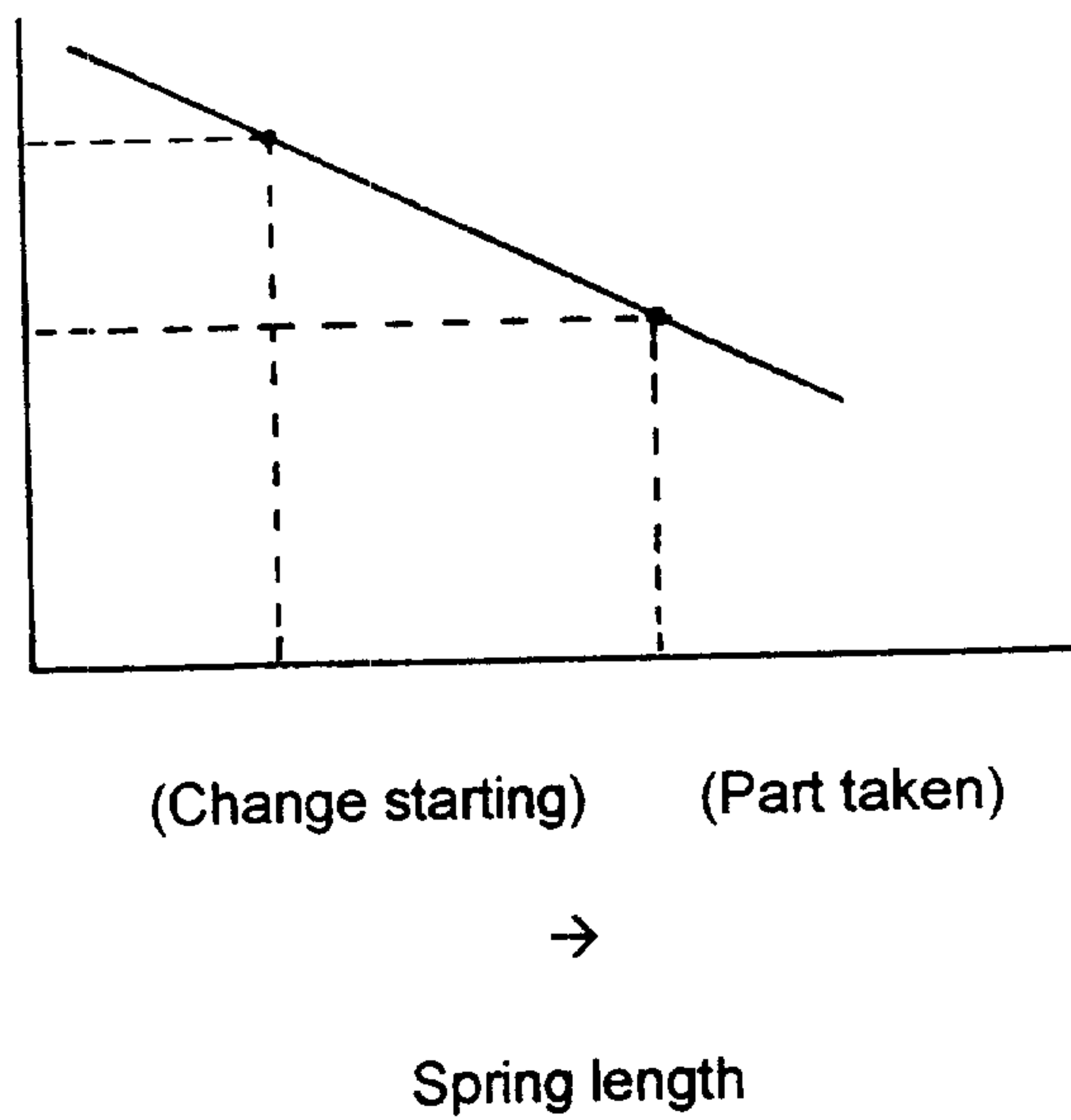


Figure 3 Measuring method of spring load

- (a) Set the spring on the barnet(Spring) tester.
- (b) Measure both ends of the length taken, prepare a graph.
- (c) Read the load for necessary length on the graph.

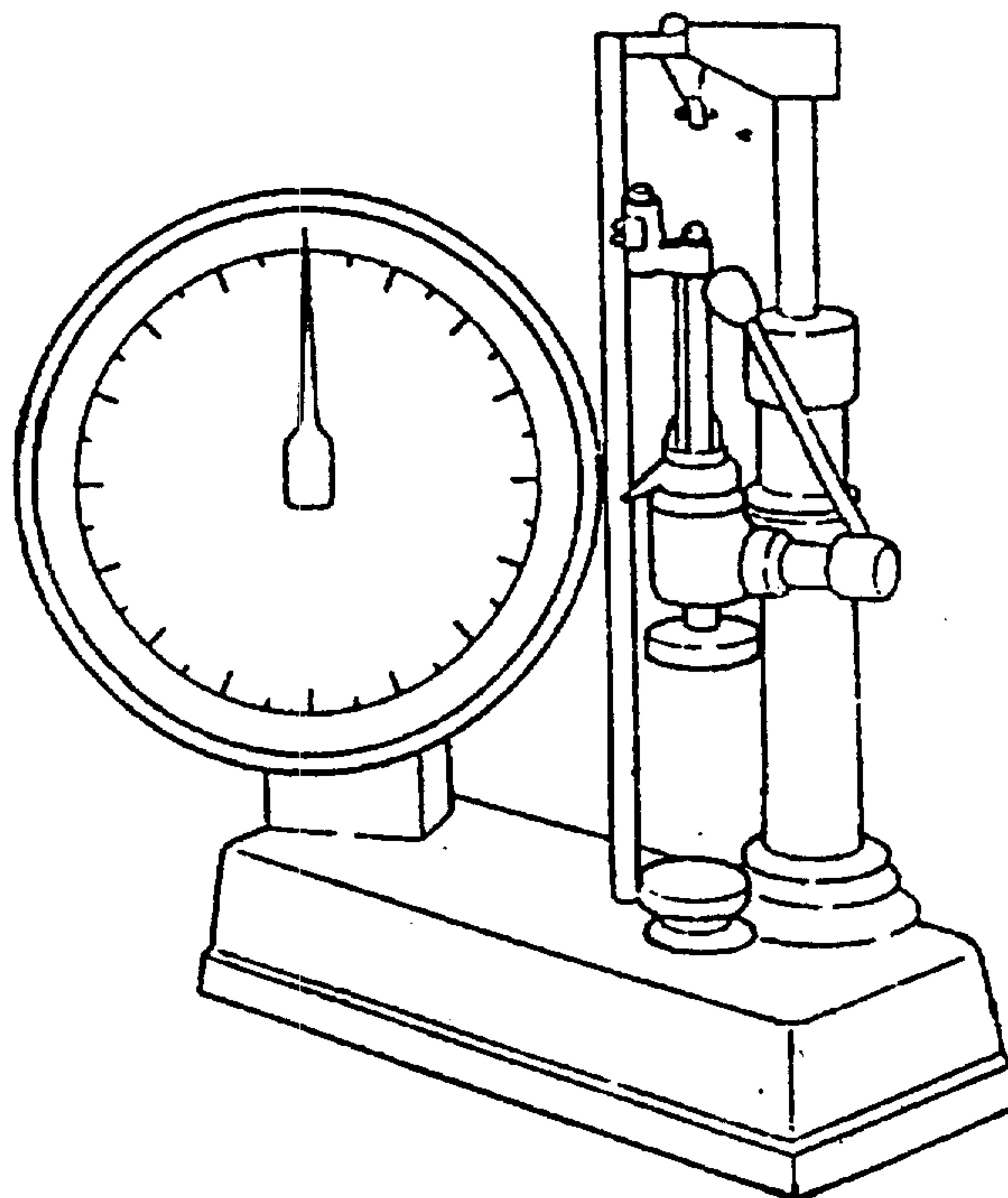


Figure 4 Barnet tester