Materials for Automobiles

1.IS 3848 Jominy End Quench Test for Hardenability of Steel
2. Material for leaf spring of a truck

Lec. 4B

11 August 2011

IS 3848 Test Basics

	3. PRINCIPLE OF THE TEST 3.1 The test consists in heating a test piece to a given temperature for a specified period of time followed by water quenching at one end and measuring the hardness at various points, from the quenched end along the length of the test piece in order to determine the hardenability of the steel by variation of this hardness.

Test details

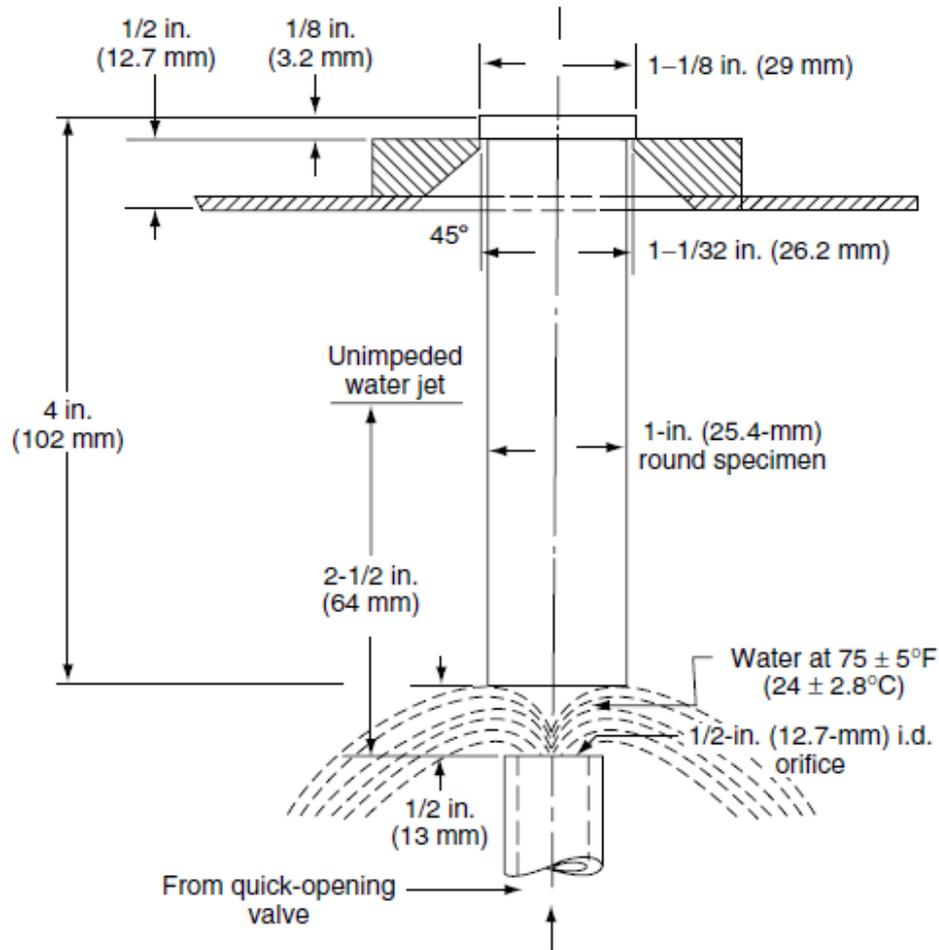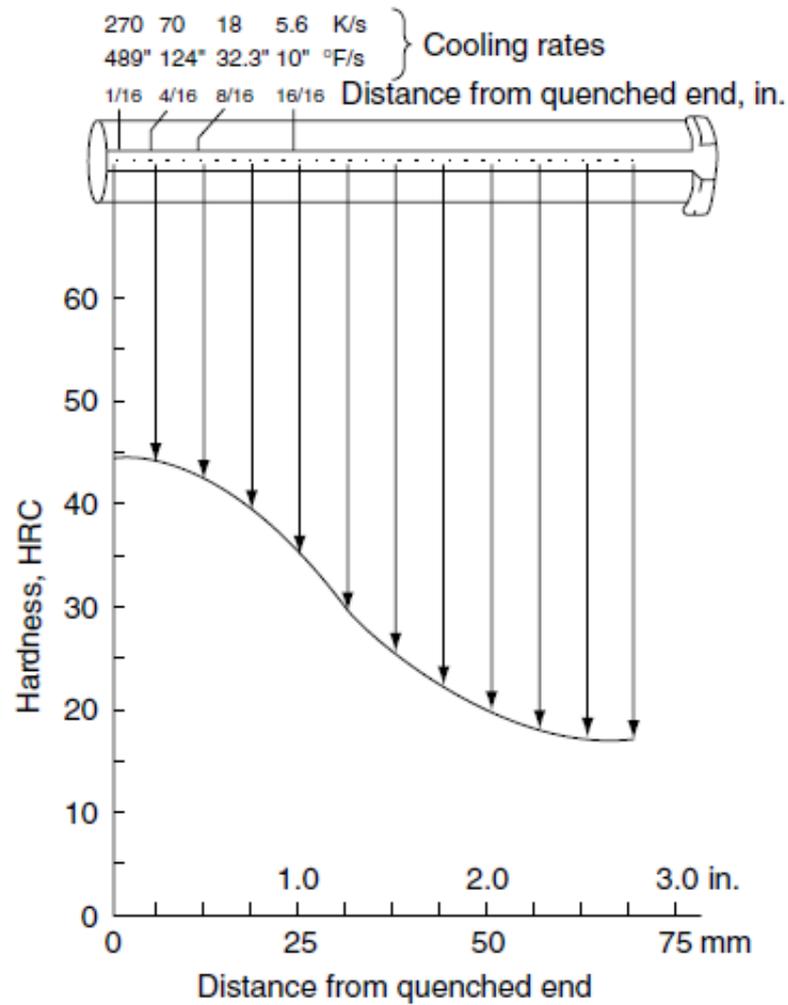| No.	Description	Value
1	Total length of test piece (mm)	100±0.5
2	Diameter of test piece (mm)	25(+0-5, - 0)
3	Time test is maintained at heating temp (min)	30±5
4	Max time lag between Test piece removal from furnace and start of quench (sec)	5
5	Temperature of water (˚C)	5 to 30
6	ID of vertical water supply pipe (mm)	12.5 ± 0.5
7	Height of water jet without test piece in position (mm)	65 ± 10
8	Distance from test piece bottom to tip of nozzle (mm)	12.5 ± 0.5
9	Depth of flats for measuring hardness (mm)	0.4 to 0.5

Test Set Up

1/2 in. (12.7 mm) 1/8 in. (3.2 mm)

1–1/8 in. (29 mm)

45°

1–1/32 in. (26.2 mm)

Unimpeded water jet

4 in. (102 mm)

1-in. (25.4-mm) round specimen

2-1/2 in. (64 mm)

Water at 75 ± 5°F (24 ± 2.8°C)

1/2-in. (12.7-mm) i.d. orifice

1/2 in. (13 mm)

From quick-opening valve

FIGURE 5.20 Jominy specimen and its quenching conditions for end-quench hardenability test.

270 70   18   5.6   K/s
489" 124" 32.3" 10" °F/s } Cooling rates

1/16   4/16   8/16   16/16 Distance from quenched end, in.

Hardness, HRC

60

50

40

30

20

10

0

1.0   2.0   3.0 in.

0   25   50   75 mm

Distance from quenched end

6.1 Heating of the Test Piece

6.1.1
The test piece shall be heated uniformly and then maintained
for not less than 30 min at the specified temperature.
For particular types of furnaces, this duration may be laid down as a result
of previous experience, establishing the minimum time necessary for the
centre 'of the piece to reach the desired temperature (this temperature
may be verified, for example, by means of a thermocouple
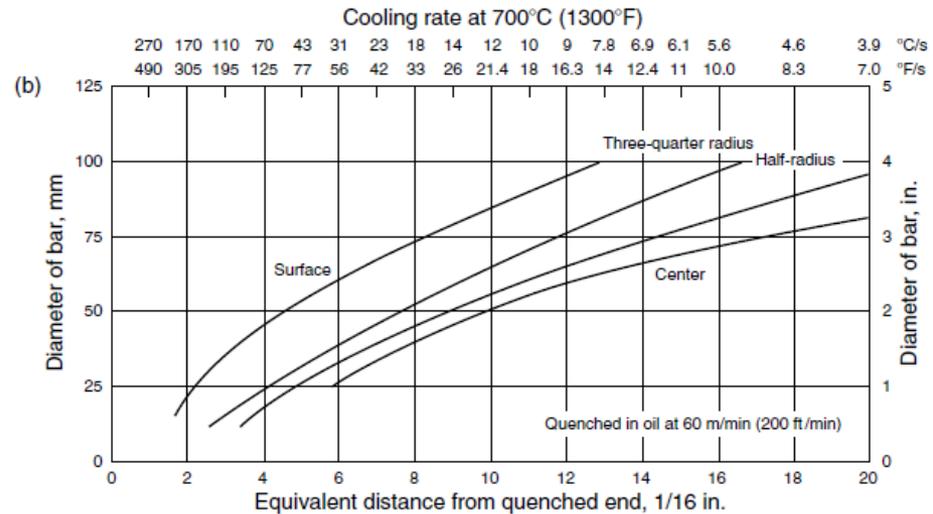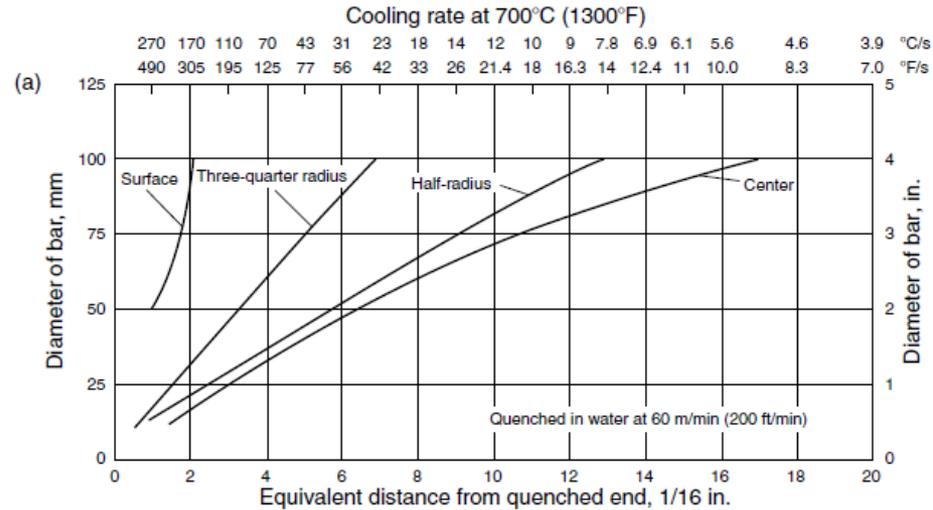placed in a hole drilled along the axis of the test piece at the head end).
6.1.2 Precautions shall be taken to avoid any decarburization of the test
piece as well as its carburization or a marked oxidation. A furnace
with a controlled atmosphere may be used or the test piece may be placed
in a mild steel vessel.
The bottom of this vessel shall be covered either with a graphite
plate or with a cast iron shot on which the test piece shall rest.

Test details

	6.2.7 The water supply tap shall be opened as soon as the test piece is fixed in position and the time of spraying shall be at least 10 min. After this time, the cooling of the test piece shall be completed by immersing it in cold water.
	7.1 Two flats for measuring the hardness shall be ground on the surface 180" apart and parallel to the axis of the test piece, along its entire length. The two flats shall be at the same distance away from the product surface. They shall be 0.4 to 0.5 mm deep and shall be ground with an abundant supply of coolant so as to prevent any heating likely to modify the microstructure of the quenched test piece.

Relation between Diameter and Hardenabilty
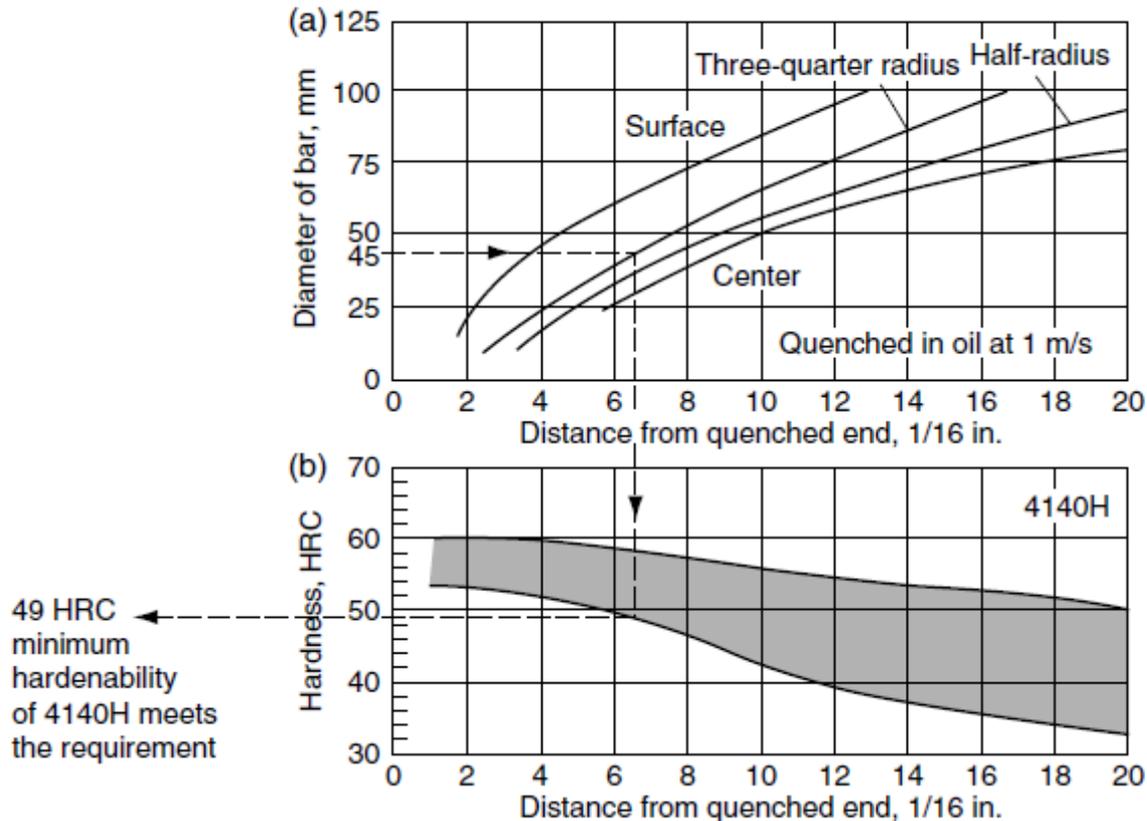
Hardenability Chart SAE 4140 H

FIGURE 5.54 Selecting a steel of adequate hardenability. (a) equivalent cooling rates (and hardness after quenching) for characteristic points on a round bar's cross section and along the Jominy end-quench specimen. (b) Hardenability band of AISI 4140H steel. (From *Metals Handbook*, 9th ed., Vol. 1, ASM International, Metals Park, OH, 1978, pp. 473–474, p. 493.)
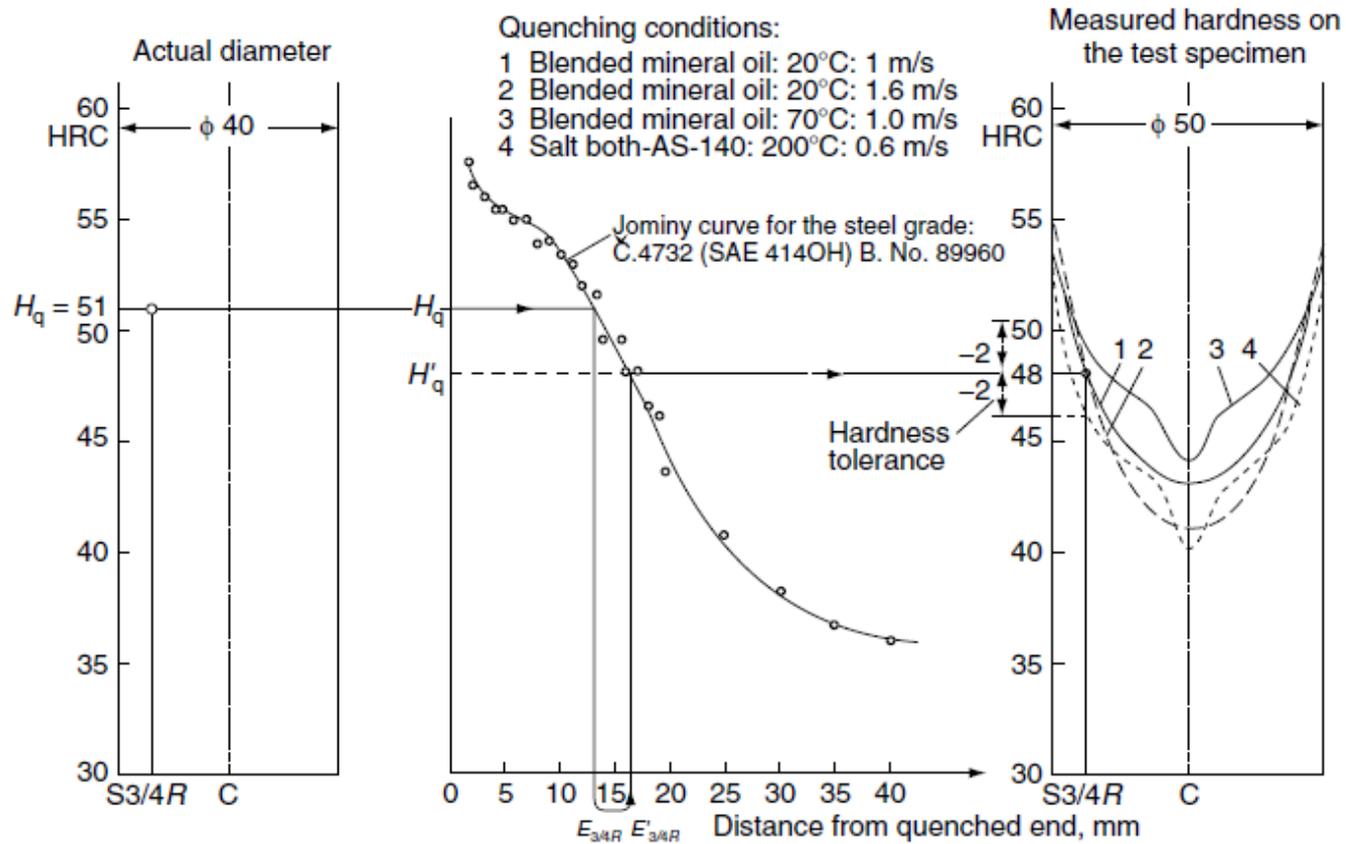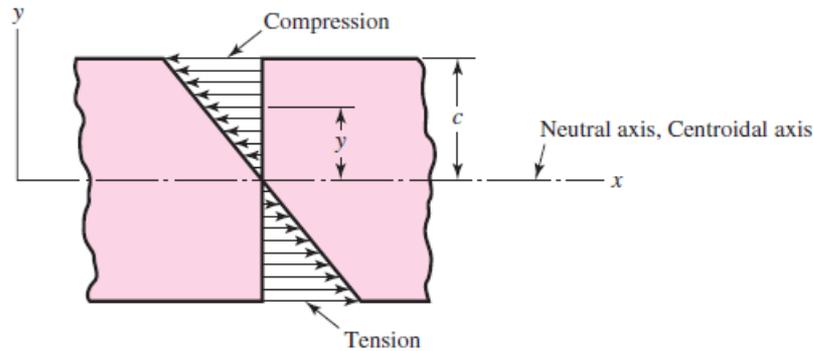
Correlation Diameter vs Hardenabilty SAE 4140H

FIGURE 5.68 An example of computer-aided selection of quenching conditions (From B. Liščić, H.M. Tensi, and W. Luty, *Theory and Technology of Quenching*, Springer-Verlag, Berlin, 1992.)

Figure 3–14

Bending stresses according to Eq. (3–24).

The bending stress varies linearly with the distance from the neutral axis, y, and is given by

$$\sigma_x = -\frac{My}{I} \qquad\qquad (3\text{--}24)$$

where I is the second *moment of area* about the z axis. That is

$$I = \int y^2 dA \qquad\qquad (3\text{--}25)$$

The stress distribution given by Eq. (3–24) is shown in Fig. 3–14. The maximum magnitude of the bending stress will occur where y has the greatest magnitude. Designating σ_{max} as the maximum *magnitude* of the bending stress, and c as the maximum *magnitude* of y
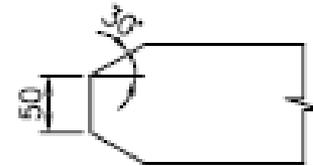
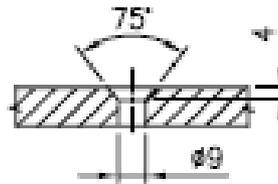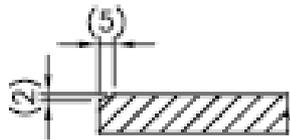$$\sigma_{max} = \frac{Mc}{I} \qquad\qquad (3\text{--}26a)$$

Equation (3–24) can still be used to ascertain as to whether σ_{max} is tensile or compressive. Equation (3–26a) is often written as

$$\sigma_{max} = \frac{M}{Z} \qquad\qquad (3\text{--}26b)$$

where $Z = I/c$ is called the *section modulus*.

Leaf Spring

CAMBER GRADING $ SYMBOL

C/B NUT TIGHTENING TORQUE 160NM
CRIMP BY PUNCH

101.6

44 TYP

1583/1580

1524 (SPRING CENTER)

127 C/FLAT

45 TYP

25 TYP

DETAIL-E (TYP)
ON ALL LEAVES

RIVET HOLE DETAIL
LEAVES-3 & 8

V-CUTTING DETAILS
LEAVES-4,5,6,7 & 9
BOTH ENDS
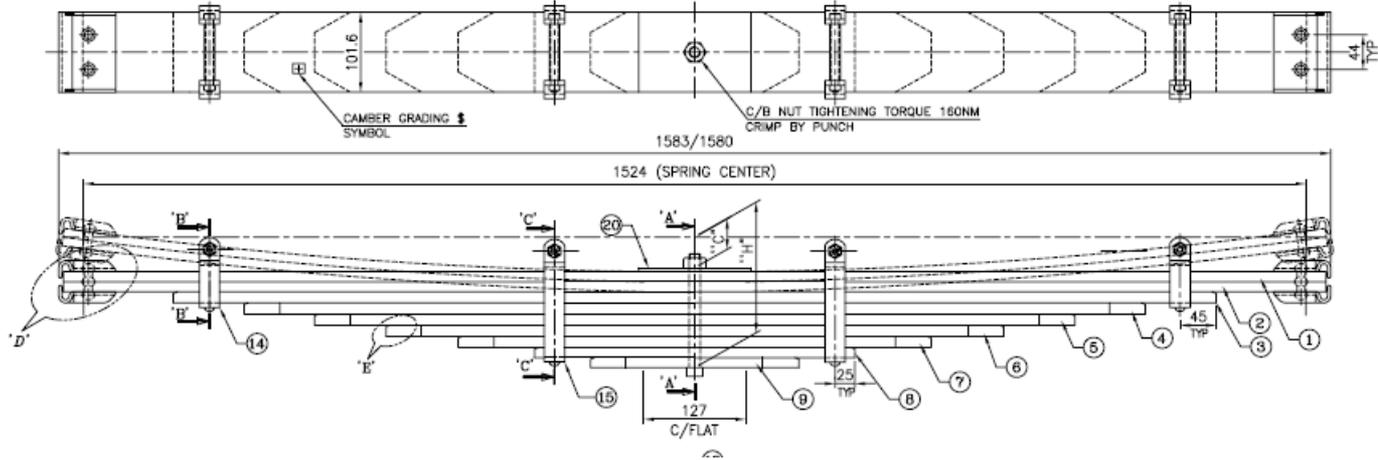
NOTES:

1. TOLERANCE ON THICKNESS +0.22/−0.16mm (FOR PLATE THICKNESS ABOVE 10mm)
   AND +0.20/−0.15 (FOR PLATE THICKNESS UPTO 10mm)

2. MATERIAL : REFER TABLE

3. HEAT TREATMENT, HARDENED & TEMPERED.

◆ 4. HARDNESS: 375 TO 444 BHN (TESTED WITH 10mm DIA BALL UNDER 3000 Kg LOAD).

5. GRAIN SIZE: AS PER ASTM 5 ~ 8

◆ 6. ALL LEAVES SHOULD BE SHOTPEENED, ON TENSION SIDE AND EDGES WITH STEEL SHOTS
   TO ALMEN STRIP C−0.18mm MIN. AS ARC HEIGHT. COVERAGE 90%MIN.(AS PER SAE J442).
   (ALT. ALMEN STRIP A TO 0.635 MIN)

7. ALL LOOSE LEAVES & ASSEMBLY TO BE COATED WITH APPROPRIATE PAINT TO MEET 240 HOURS MIN SSR
   ON EXPOSED SURFACE OF THE LEAF.

8. TOUCH UP SHALL BE DONE AFTER ASSEMBLY IF REQUIRED.

9. COMPLETE SPRING ASSY TO BE SCRAGGED TO A DEFLECTION : 187mm

10. EXCEPT FOR THE LEAVES WITH CLAMPS AND MAIN LEAF, ALL THE OTHER LEAVES SHOULD
    HAVE SPEARED ENDS AS SHOWN.

11. TENSION SIDE OF LEAVES TO BE LUBRICATED BY GRAPHITE PRIMER / GRAPHITE GREASE TO IS 508.

12. FULL DECARBURIZATION NOT PERMISSABLE, PARTIAL DECARBURIZATION SHOULD BE <0.20mm.

13. INTER LEAF GAP SHOULD BE NOT MORE THAN 3mm IN FREE CONDITION.

14. SPRING CLAMP TO BE 100% VISUALLY INSPECTED FOR CRACK

15. NO COLD WORKING TO BE DONE TO CORRECT CAMBER AFTER SHOT PEENING.

16. ASSY. SPAN IN FLAT CONDITION.

17. CLEANLINESS : MAX POSSIBLE NON−METALLIC INCLUSIONS 2a , 2b , 2c & 2d
    FOR THIN SERIES AS PER IS−4163 Fig. 5

18. FREE CAMBERS CHOSEN FOR INDUVIDUAL LEAVES INCLUDING MAIN LEAF MUST BE SUCH AS
    TO INDUCE A COMPRESSIVE STRESS IN MAIN LEAF ON TENSION SIDE OF THE ORDER OF 10 Kgf/mm^2

19. MATERIAL FOR CENTER BOLT : TO CONFORM TO PROPERTY CLASS 10.9 AS PER IS:1367(PART III)

20. CLAMPING DETAILS: BOLT SIZE: M16x1.5
    PITCH BETWEEN CLAMPING BOLTS: 97mm
              TIGHTENING TORQUE: 175NM

Material used for Leaf spring

S.No	PART No.	PART NAME	MATERIAL	QTY
9		LEAF No : 9	EN45A / SUP9	1
8		LEAF No : 8	EN45A / SUP9	1
7		LEAF No : 7	SUP 11A / 50CrV4	1
6		LEAF No : 6	SUP 11A / 50CrV4	1
5		LEAF No : 5	SUP 11A / 50CrV4	1
4		LEAF No : 4	SUP 11A / 50CrV4	1
3		LEAF No : 3	SUP 11A / 50CrV4	1
2		LEAF No : 2	EN45A / SUP9	1
1		LEAF No : 1	EN45A / SUP9	1

Material Grade	JIS G 4801 SUP 11A		
Condition	Rolled Bar		
Reduction ratio	36:1 minimum		
Chemical Composition %	C	0.55-0.65	
	Si	0.15-0.35	
	Mn	0.70-1.00	
	S	0.035 Max	
	P	0.035Max	
	Cr	0.70-1.00	
	B	0.0005 Min	
Grain size ASTM E112	5 to 8		
Macrostructure	Better than C2, R2, S2 as per ASTM E381		
Inclusion Rating (100X) (ASTM E 45)	Type	Thin	Thick
	A type	2	-
	B Type	2	-
	C Type	2	-
	D Type	2	-