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Steel Testing

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NOMINAL MASS OF STEEL FOR REINFORCEMENT

STANDARD: IS: 1786-1985 (RA 2013)

- ❖ This method of test lays down the procedures for calculating Nominal Mass of steel for reinforcement.

PROCEDURE

The nominal mass per meter of individual sample, batch and coils shall be determined as given below:

- ❖ The tolerance on mass/weight for round and square bars shall be the percentage given in **Table-01/WI/IT/22** of the mass/weight calculated on the basis that the masses of the bar/wire of nominal diameter and of density 0.785 kg/cm^3 .
- ❖ Physical properties of all sizes of steel bars shall be as mentioned in **Table-02/WI/IT/22**
- ❖ Select all the test pieces wither by cutting the bars. The test pieces shall be of length not less than 1 meter and of full sections of the bars as rolled and subsequently cold worked and subjected to physical test without any further modifications.
- ❖ The nominal mass of an individual sample be calculated by determining the mass of any individual sample at random as specified in **Table-03/WI/IT/22 and** dividing the same by the actual length of the sample.
- ❖ The nominal mass of a batch shall be calculated by determining the mass of the test specimens taken as specified in **Table-03/WI/IT/22 and** dividing the same by the actual length of the specimens. Each specimen shall be of length not less than 0.5metre.
- ❖ The nominal mass of a coil shall be calculated by determining the mass of two samples of minimum 1metre length taken from each end of coil and dividing the same by the actual length of the samples.
- ❖ No test piece shall be enacted or subjected to heat treatment.
- ❖ Store steel for reinforcement in such a way to prevent any distortion and corrosion.

Table - 1/WI/IT/22
TOLERANCE ON NOMINAL MASS

S.No.	Nominal Size in mm	Tolerance on the Nominal Mass Percent		
		Batch	Individual Sample	Individual Sample of Coil (-x-)
1	Up to and including 10	± 7	- 8	± 8
2	Over 10, up to and including 16	± 5	- 6	+ 6
3	Over 16	± 3	- 4	± 4

Table - 2/WI/IT/22
PHYSICAL PROPERTIES OF STEEL BARS

S.No.	Property	Grade		
		Fe 415	Fe 500	Fe 550
1.	0.2% proof stress/yield stress, min. N/mm ²	415	500	550
2.	Elongation, percent min. on gauge length $5.65\sqrt{A}$, where A is the X- sectional Area	14.5	12	8
3.	Tensile Strength	10% more than actual proof stress but not less than 465 N/mm ²	8% more than actual proof stress but not less than 545 N/mm ²	6% more than actual proof stress but not less than 585 N/mm ²

Table – 3/WI/IT/22

FREQUENCY FOR NOMINAL MASS, TENSILE, BEND AND REBEND TESTS		
NOMINAL SIZE	QUANTITY	
	For casts /heats below 100tonnes	For casts /heats over 100tonnes
Under 10 mm	1 sample from each 25 tonnes or part thereof	1 sample from each 40 tonnes or part thereof
10 mm to 16 mm inclusive	1 sample from each 35 tonnes or part thereof	1 sample from each 45 tonnes or part thereof
Over 16 mm	1 sample from each 45 tonnes or part thereof	1 sample from each 50 tonnes or part thereof

ULTIMATE TENSILE STRENGTH AND YIELD STRESS TEST (REINFORCING BAR)

STANDARD: IS: 1608-2005 (RA 2013)

- This standard covers the procedure for determination of Proof Stress, Ultimate Tensile Strength and Elongation of Reinforcing bar.

EQUIPMENTS

1. Stainless steel scale – 1 m long
2. Vernier Scale – 300 mm travel with 0.02 mm least count
3. Weighing scale – 15 kg capacity with 1 g least count
4. Centre punch and small hammer
5. Universal Testing Machine – 1000 KN capacity
6. Mechanical Extensometer – (Double dial gauge)



PROCEDURE

- ❖ Take 800 mm long sample.
- ❖ Weigh the mass of reinforcing bar in weighing balance to the nearest 1.0 g.
- ❖ Calculate Mass/meter run (kg) and actual cross sectional area using density of steel (0.00785 kg/sq.mm/m run) – (A) mm²
- ❖ Mark the original gauge length on the sample. (G.L. = 5.65 √A)
- ❖ Fix the reinforcing bar to Universal Testing Machine.

- ❖ Fix the extensometer to reinforcing bar at the centre portion with a fixed gauge length. (50mm)
- ❖ Switch on the machine and apply the load gradually at an uniform rate of loading between 6 N/sq.mm/min to 60 N/sq.mm/min
- ❖ Note down the load corresponding to every 0.01 mm reading in the dial gauge till to get more than 0.4% strain on the sample. Plot the graph load Vs deflection and draw a parallel line to tangent at a distance of 0.2% strain. Measure 0.2% proof load where the line cuts on X axis.
- ❖ Remove the extensometer after getting more than 0.4% strain.
- ❖ Continue the load up to maximum load achieved until the rod gets broken.
- ❖ Join the broken two samples and note down the final gauge length.

CALCULATION

1. Mass / Meter = $\frac{\text{Mass (kg)}}{\text{Length (m)}}$
2. Area (mm²) = $\frac{\text{Mass / meter (kg)}}{\text{Density of steel (0.00785 kg/mm}^2\text{)}}$
3. Proof Stress (N/mm²) = $\frac{\text{Proof load (KN) x 100}}{\text{Area (mm}^2\text{)}}$
4. Ultimate Tensile Stress (N/mm²) = $\frac{\text{Ultimate Tensile Load (KN) x 100}}{\text{Area (mm}^2\text{)}}$
5. Elongation (%) = $\frac{\text{Final gauge length} - \text{Original gauge length}}{\text{Original gauge length}} \times 100$

BEND AND REBEND TEST (REINFORCING BAR)

STANDARD: IS: 1786-2008 and IS: 1599- 1985 (RA 2006)

- ❖ This standard covers the procedure for determination to conduct Bend and Rebend test on Reinforcing bar.

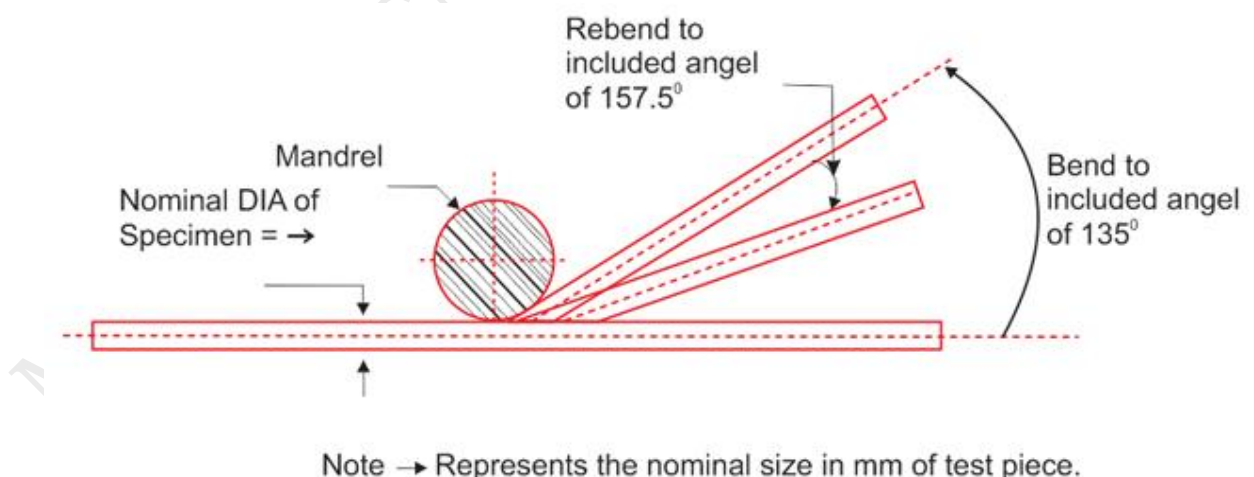
I Bend Test

EQUIPMENT:

1. Universal Testing Machine
2. Mandrels of required size (24 mm to 224 mm)

PROCEDURE:

- ❖ Test specimen of about 500 mm length is taken.
- ❖ Bend test attachment is adjusted to the required span.
- ❖ Mandrel is fixed to middle cross head of U T M.
- ❖ The specimen is placed on the Bend table horizontally.
- ❖ Make sure the specimen is placed at centre of the bend table.
- ❖ Load is applied gradually so that the specimen starts to bend uniformly.
- ❖ The application of load is continued till the specimen bends to 180° .
- ❖ The load is released and the specimen is removed.
- ❖ Check physically for any crack on the bent portion of the specimen.
- ❖ The test result is reported.



II Rebend Test

EQUIPMENT:

1. Universal Testing Machine
2. Mandrels of required sizes (24 mm to 224 mm)

3. Boiling water Tank

4. Stop watch

PROCEDURE:

- ❖ Test specimen of about 700 mm length is taken
- ❖ Bend test attachment is adjusted to the required span
- ❖ Mandrel is fixed to middle cross head of U T M
- ❖ The specimen is placed on the Bend table horizontally
- ❖ Make sure the specimen is placed at centre of the bend table
- ❖ Load is applied gradually so that the specimen starts to bend uniformly
- ❖ The application of load is continued till the specimen bends to 135° (included angle)
- ❖ The load is released and the specimen is removed
- ❖ The bent specimens placed in boiling water tank for 30 minutes
- ❖ The specimen is removed and allowed to cool to ambient temperature
- ❖ Rebend to $157 \frac{1}{2}^\circ$ (included angle) (test procedure sl. No. 4,5 & 6 is repeated)
- ❖ The load is released and removed the specimen
- ❖ Checked physically for any crack on the bent portion of the specimen
- ❖ The test result is reported.