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COMPLIANCE & STANDARDS

Aggregate Testing: Essential Quality Control Tests for IS 383 Compliance

Essential aggregate quality tests for IS 383 compliance. Sieve analysis, flakiness index, and other tests with acceptance criteria.

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Quality control testing is essential for aggregate producers to ensure their products meet IS 383 specifications and customer requirements. Understanding the key tests, their procedures, and acceptance criteria enables plant managers to maintain consistent quality while optimizing production. This guide covers the essential tests required for IS 383:2016 compliance and practical quality control implementation.

IS 383:2016 Overview

Scope and Classification

IS 383:2016 "Coarse and Fine Aggregates for Concrete" specifies requirements for aggregates used in cement concrete:

AGGREGATE TYPE	SIZE RANGE	PRIMARY REQUIREMENTS
Coarse aggregate	4.75mm and above	Gradation, flakiness, impact, crushing
Fine aggregate	Below 4.75mm	Gradation, fineness modulus, clay content
All-in aggregate	Combined grading	Combined limits apply

Quality Characteristics

IS 383 specifies limits for several quality parameters:

PROPERTY	COARSE AGGREGATE LIMIT	FINE AGGREGATE LIMIT
Flakiness index	≤25% (Zone I), ≤40% (others)	Not applicable
Elongation index	≤25% (combined FI+EI ≤45%)	Not applicable
Aggregate impact value	≤30% (wearing), ≤45% (other)	Not applicable
Aggregate crushing value	≤30% (wearing), ≤45% (other)	Not applicable
Clay lumps and friable particles	≤1%	≤1%
Material finer than 75 micron	≤3%	≤3% (crushed), ≤15% (manufactured sand)

Essential Tests: Procedures and Requirements

Test 1: Sieve Analysis (IS 2386 Part 1)

Sieve analysis determines particle size distribution, the most fundamental aggregate property:

Equipment required:

- Standard test sieves (IS 460): 80, 40, 20, 10, 4.75, 2.36, 1.18, 0.600, 0.300, 0.150mm

- Mechanical sieve shaker
- Balance accurate to 0.1% of sample mass
- Sample splitter or riffle box

Procedure summary:

1. Obtain representative sample (minimum 10kg for 40mm aggregate)
2. Dry sample to constant mass at 105-110°C
3. Weigh sample accurately
4. Place in nested sieves and shake for minimum 10 minutes
5. Weigh material retained on each sieve
6. Calculate percentage passing each sieve

IS 383 gradation limits for coarse aggregate (20mm nominal):

SIEVE SIZE	PERCENTAGE PASSING
40mm	100
20mm	85-100
10mm	0-20
4.75mm	0-5

IS 383 gradation zones for fine aggregate:

SIEVE SIZE	ZONE I	ZONE II	ZONE III	ZONE IV
10mm	100	100	100	100
4.75mm	90-100	90-100	90-100	95-100
2.36mm	60-95	75-100	85-100	95-100
1.18mm	30-70	55-90	75-100	90-100
600µm	15-34	35-59	60-79	80-100
300µm	5-20	8-30	12-40	15-50
150µm	0-10	0-10	0-10	0-15

Test 2: Flakiness and Elongation Index (IS 2386 Part 1)

Particle shape affects concrete workability and strength:

Flakiness index procedure:

1. Separate sample into size fractions on standard sieves
2. Pass each fraction through corresponding thickness gauge slot
3. Weigh particles passing through (flaky particles)
4. Calculate percentage flaky particles

Elongation index procedure:

1. Separate sample into size fractions
2. Test each particle against length gauge
3. Particles longer than 1.8× mean dimension are elongated
4. Calculate percentage elongated particles

Thickness and length gauge dimensions:

SIZE FRACTION (MM)	THICKNESS GAUGE (MM)	LENGTH GAUGE (MM)
63-50	33.9	101.6
50-40	27.0	81.0
40-25	19.5	58.5
25-20	13.5	40.5
20-16	10.8	32.4
16-12.5	8.55	25.65
12.5-10	6.75	20.25

Test 3: Aggregate Impact Value (IS 2386 Part 4)

Impact value measures resistance to sudden shock loading:

Equipment:

- Aggregate impact testing machine (IS specification)

- Cylindrical steel cup (internal diameter 102mm, depth 50mm)
- Steel hammer 14kg, drop height 380mm
- Test sieves 12.5mm, 10mm, 2.36mm

Procedure:

1. Prepare sample passing 12.5mm, retained on 10mm
2. Fill cup in three layers, tamping each 25 times
3. Weigh sample (W1)
4. Apply 15 blows with hammer
5. Sieve through 2.36mm sieve
6. Weigh material passing (W2)
7. Aggregate Impact Value = (W2/W1) × 100%

Acceptance limits:

APPLICATION	MAXIMUM AIV
Wearing surfaces	30%
Non-wearing surfaces	45%

Test 4: Aggregate Crushing Value (IS 2386 Part 4)

Crushing value measures resistance to gradual compressive loading:

Procedure:

1. Prepare sample passing 12.5mm, retained on 10mm
2. Fill cylindrical mould in three layers, tamping each 25 times
3. Weigh sample (W1)
4. Apply 400 kN load over 10 minutes
5. Sieve through 2.36mm
6. Weigh material passing (W2)
7. Aggregate Crushing Value = (W2/W1) × 100%

Acceptance limits:

APPLICATION	MAXIMUM ACV
Wearing surfaces	30%
Non-wearing surfaces	45%

Test 5: Material Finer than 75 Micron (IS 2386 Part 1)

Fine dust content affects concrete workability and water demand:

Wet sieving procedure:

1. Weigh dry sample (W1)
2. Place in container, add water and agitate
3. Decant wash water through 75µm sieve
4. Repeat until wash water is clear
5. Dry and weigh residue (W2)
6. Material finer than 75µm = (W1-W2)/W1 × 100%

Limits for manufactured sand:

- Maximum 15% material finer than 75µm (IS 383)
- Stricter limits may apply for specific applications

Test 6: Fineness Modulus (Fine Aggregate)

Fineness modulus indicates overall fineness of fine aggregate:

Calculation:

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Fineness Modulus = Σ(cumulative % retained on standard sieves) / 100

Standard sieves: 150µm, 300µm, 600µm, 1.18mm, 2.36mm, 4.75mm, 10mm, 20mm, 40mm, 80mm

Example calculation:
150µm cumulative retained: 98%
300µm cumulative retained: 88%
600µm cumulative retained: 70%
1.18mm cumulative retained: 45%
2.36mm cumulative retained: 20%
4.75mm cumulative retained: 2%
Sum = 323
Fineness Modulus = 323/100 = 3.23
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Typical FM ranges:

ZONE	FINENESS MODULUS RANGE	CHARACTERISTIC
Zone I	3.1-3.7	Coarse sand
Zone II	2.6-3.1	Medium sand (most desirable)
Zone III	2.1-2.6	Fine sand
Zone IV	1.5-2.1	Very fine sand

Quality Control Implementation

Testing Frequency

TEST	PRODUCTION QC	SOURCE QUALIFICATION
Sieve analysis	Every shift or 500 tonnes	10 samples minimum
Flakiness/elongation	Daily or 1000 tonnes	5 samples minimum
Impact/crushing value	Weekly or source change	3 samples minimum
Material <75µm	Every shift for M-sand	10 samples minimum
Specific gravity	Monthly or source change	3 samples minimum

Sampling Procedures

Representative sampling is critical for accurate results:

Stockpile sampling:

- Sample from multiple points around stockpile
- Avoid segregated areas (base, sides)
- Dig into pile to avoid surface segregation
- Combine increments for composite sample

Belt sampling:

- Stop belt and take full cross-section cuts
- Take minimum 5 increments spread over production period
- Combine and reduce to test portion

Minimum sample sizes (IS 2386):

MAXIMUM AGGREGATE SIZE	MINIMUM SAMPLE MASS
40mm	50kg field, 25kg lab
20mm	25kg field, 13kg lab
10mm	13kg field, 6.5kg lab
Fine aggregate	10kg field, 5kg lab

Control Charts and Trending

Use statistical process control for quality monitoring:

Key control parameters:

- Percentage passing key sieve sizes
- Fineness modulus (fine aggregate)
- Flakiness index
- Material finer than 75µm

Control chart limits:

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Upper Control Limit (UCL) = Mean + 3σ
Lower Control Limit (LCL) = Mean - 3σ
Warning limits at ±2σ

Action triggers:
- Single point beyond control limits
- 7 consecutive points on one side of mean
- 7 consecutive points trending up or down
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Corrective Actions

TEST FAILURE	PROBABLE CAUSE	CORRECTIVE ACTION
Gradation out of spec	Screen wear, blinding, wrong settings	Inspect screens, adjust settings
High flakiness	Crusher settings, rock orientation	Adjust CSS, check feed arrangement
High fines content	Washer efficiency, screen blinding	Check wash water, clean screens
High impact/crushing value	Source rock quality	Reject material, change source
Wrong FM zone	Screen settings, blending	Adjust screens, modify blend ratio

Laboratory Setup Requirements

Essential Equipment

EQUIPMENT	IS SPECIFICATION	APPROXIMATE COST (RS)
Test sieve set with shaker	IS 460	1,50,000
Aggregate impact tester	IS 2386-4	1,25,000
Aggregate crushing value apparatus	IS 2386-4	1,00,000
Flakiness and elongation gauges	IS 2386-1	35,000
Electronic balance (0.1g accuracy)	General	45,000
Drying oven (105-110°C)	General	40,000
Sample splitter/riffle	General	25,000

Personnel Requirements

- Trained laboratory technician (minimum 1 per shift)
- Quality control supervisor (overall responsibility)
- Regular training updates on test procedures

- Documentation and record keeping systems

Documentation and Certification

Test Reports

Each test report should include:

- Sample identification and date
- Sampling location and method
- Test procedure reference (IS number)
- Results and acceptance criteria
- Pass/fail determination
- Technician signature and date

Mill Test Certificates

Provide customers with certificates including:

- Aggregate source and type
- Complete gradation analysis
- Physical properties (AIV, ACV, flakiness)
- Reference to IS 383 compliance
- Authorized signatory

Systematic quality control testing ensures consistent IS 383 compliance, maintains customer satisfaction, and enables continuous process improvement. Investment in proper testing equipment and trained personnel delivers significant returns through reduced rejections and premium product positioning.

Topics: #Aggregate Testing #IS 383 #Quality Control #Standards

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