

Scope of Work - QA and QC Service Provider for Aluminium and Power Business

Vedanta Limited, a subsidiary of Vedanta Resources Limited, is the world's leading Oil & Gas and Metals company, and one of the largest producers of Oil & Gas, Zinc, Lead, Silver, Copper, Iron Ore, Steel, and Aluminium & Power across India, South Africa, Namibia, and Australia.

Vedanta Aluminium and Power Business is India's largest primary aluminium producer having an installed smelting capacity of ~ 2.2 MTPA. It operates a 1.6 and 0.55 MTPA aluminium smelter with 3615 and 1740 MW thermal power generation facility at Jharsuguda in Orissa and Korba in Chhattisgarh respectively. It also operates a world-class alumina refinery with the production capacity of 2 MTPA at Lanjigarh, in Odisha (INDIA).

Vedanta invites expression of interest from competent Quality Assurance and Quality Control Service provider to take up end-to-end responsibility from sampling, handling from sampling source to lab, preparation, analysis and digital reporting for all raw materials, processes, and finished goods across all sites of the Aluminium Business. QA of all finished products before dispatch to Customer will also be a key responsibility of service provider.

Detailed Scope of work concerning all three aluminium and power business sites can be found below as per the following index.

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1. BALCO (Smelter and Coal)

1. Introduction

With Smelter capacity of 5.70 LTPA and poised for a future expansion up to 1.1 MTPA, Power generation capacity of 2010 M.W. BALCO's Vision is to be a world class Integrated Aluminium and Power producer generating sustainable value for all stakeholders. To keep up with the vision BALCO dwells on its core values of Excellence, Trust, Integrity, Innovation, Respect, Care and Entrepreneurship. At Balco, there are two Smelter plant, which includes Pot line, Carbon (Rodding/Bake oven/GAP) and FLA (Cast House/Foundry/R.P.), and Power plant -540 MW and 1200 MW.

Quality Assurance Lab being an ancillary of Pot Room, Carbon and Cast House, it gives technically valid analytical results by following Good Laboratory Practices, proper maintenance and housekeeping of Laboratory infrastructure and adherence to safety standards to ensure smooth process flow of the whole plant. There are totally three Labs -Plant-1 Lab & Plant-2 Lab (for Metal) and Coal Lab.

2. Outsourcing Model

The following table depicts the Current model and proposed model of Lab O&M Outsourcing structure.

METAL-QA:

Scope	Current Model	Proposed Model
Sampling at respective locations	By Operations/Balco Lab	3 rd Party
Preparation of Samples	Balco Lab	3 rd Party
Analysis of Samples	Balco Lab	3 rd Party
Report circulation	Balco Lab	3 rd Party
Equipment AMC's	Balco Lab	3 rd Party
Spares planning and requisition	Balco Lab	3 rd Party
Spares ordering	Balco Lab	3 rd Party
Glassware availability	Balco Lab	3 rd Party
Gas cylinders availability	Balco Lab	3 rd Party
Chemicals availability	Balco Lab	3 rd Party
Calibration compliance	Balco Lab	3 rd Party
Audit compliance	Balco Lab	3 rd Party
Available Infrastructure & Equipments	Balco Lab	Will be handed over to 3 rd Party

COAL-QA:

Scope	Current Model	Proposed Model
Sampling at respective locations	3 rd Party	3 rd Party
Preparation of Samples	By 3 rd Party under supervision of Balco Lab	Complete preparation and supervision by 3 rd Party
Analysis of Samples	Balco Lab	3 rd Party
Report circulation	Balco Lab	3 rd Party
Equipment AMC's	Balco Lab	3 rd Party
Spares planning and requisition	Balco Lab	3 rd Party
Spares ordering	Balco Lab	3 rd Party
Glassware planning and maintaining stock	Balco Lab	3 rd Party
Calibration compliance	Balco Lab	3 rd Party
Audit compliance	Balco Lab	3 rd Party
Available Infrastructure & Equipments	Balco Lab	Will be handed over to 3 rd Party

3. Outsourcing Scope

Present Lab facility will be completely handed over to Third party for operations. All spares and consumables to be maintained by Vendor and if any additional requirements, it has to be arranged by Vendor scope

(A) Coal Lab

1. Equipment required and Scope of work:

Coal Sampling: Mechanized coal sampling through Auger system by road

Coal Preparation:

12.5mm Jaw Crusher: Primary crushing of ROM coal for 12.5mm size output as I.S. standard

4.75mm crusher: Primary crushing of ROM coal for 4.75mm size output as ASTM standard

3.35mm Roll Crusher: Secondary crushing of coal from 12.5mm size to 3.35mm size output as I.S. standard

2.36mm Jaw Crusher: Secondary crushing of coal from 4.75mm size to 2.36mm size output as ASTM standard

Vibrating Cup Mill: For pulverizing to 72mesh size

Hammer Mill: For pulverizing to 72 / 60 mesh size

Coal Analysis:

Bomb Calorimeter: For determination of GCV

Muffle Furnace: For determination of ASH and V.M.

Oven: For determination of T.M. and I.M.
 Humidity Chamber: For determination of Eqb IM
 Air drying cabinet: For determination of T.M. for imported coal

2. Type of testing: Proximate analysis (T.M., I.M., V.M. & ASH), GCV, Eqb IM and Sulphur analysis by Mines wise on random basis

3. Testing procedure:

ASTM	BIS
D 3302-2019	IS 1350 : Part I : 1984 ,Reaffirmed 2019
D 5865-2019	IS 1350 : Part II : 2017
D 3173,D3173M-17A	IS 1350 : Part I : 1984,Reaffirmed 2019
D 3175-20	IS 1350 : Part I : 1984,Reaffirmed 2019
D 3174-18	IS 1350 : Part I : 1984,Reaffirmed 2019

4. Quantity/day/month/year: Approx. no of samples 60/day, 1800 /Month, 21600 /Year

5. Process sampling details:

Coal coming through road and rake mode in plant. Coal sample collection for road after gross weighment of truck through mechanized Auger sampler and for rake sample collection done through manual during the unload of rake at track hopper. Road sampling done by third party and rake sampling done by third party under supervision of Balco shift In charge.

Preparation:

Both (rake & road) Sample preparation done by Balco, Supporting manpower provide by third party. All rake & road samples passed through primary crusher 12.5 / 4.75mm size as per BIS / ASTM. Sample passed through secondary crusher to get 3.35/2.36 mm size. After secondary crusher output pulverized the size 212 / 250 micron (I.S. 72 / 60 meshes).

6. Daily /weekly/ monthly Report generation:

Daily: Coal analysis report, Rapid analysis report, AFB report, and Special and Random analysis report, Mines and Transporter wise report and Coal GCV MTD report.

Weekly: QCI loading report

Monthly: P.V. report, R&R report, Round robin report and ILC report

7. Key elements/parameters and their range for each raw material/sample type

S. No.	Parameters	Range of testing
1	Total Moisture (TM) %	3% -30%
2	Gross Calorific Value (GCV) Cal/g	1000-8000 cal/g
3	Inherent Moisture (I.M.) %	0.5%-25%

4	Volatile Matter (VM) %	10% - 50%
5	Ash %	3% - 75%

8. Collection of sample, preparation of sample, location of sample:

Collection of sample: Auger sampling point at 540mw near Coal gross weigh bridge by road and 540mw & 1200mw track hopper for rake

Preparation of sample: Coal preparation Lab near 540mw track hopper

9. Annual testing of lab equipment's to be covered in each section:

Equipment covered under AMC Leco AC 500 (M/s IR Technology Pvt. Ltd.) and Parr 6200 (M/s Orbit Technologies Pvt. Ltd.) bomb calorimeter.

10. Calibration details and frequency for every section:

All equipment calibration done by NABL accredited lab on yearly basis.

11. Safety requirements: Follow the equipment safety procedure as per equipment manual and HSE guideline.

12. Spares & consumable required: As per equipment's spare and consumables procure and maintain the inventory.

(B) Metal Lab

(i) Smelter Section

1. Equipment required and Scope of work:

Sample type	Equipment for sample preparation and testing
Alumina	XRF-XRD, Furnace, Balance, Bulk Density Tester, Seive Shaker Machine,
Aluminium Fluoride	XRF, Furnace, Balance, Bulk Density Tester, Seive Shaker Machine, Angle of repose and Flowability tester
Soda Ash	Spectrophotometer, B.D. Tester, Balance, Hot air Oven
Pot Bath sample	XRD, Pelletising Press and VCM machine
Silicon Metal	Furnace, Hot Plate, Spectrophotometer, Balance
Magnesium Alloy	Furnace, Hot Plate, Spectrophotometer, Balance
Titanium Alloy	Furnace, Hot Plate, Spectrophotometer, Balance
Strontium Alloy	Furnace, Hot Plate, Spectrophotometer, Balance
Degasser	Hot Plate, balance
Coverall Flux	Furnace, Hot Plate, AAS/ICP, Balance
Sodium Silicate	Furnace, Hot Plate, Spectrophotometer, Balance
Titanium Boron alloy (TiBOR)	Furnace, Hot Plate, Spectrophotometer, AAS/ICP, Balance
Pot Feeder sample	XRF Sieve Shaker Machine
Enriched Alumina	XRF Machine, Balance
Zero level Bath	XRF, Balance

Hi-Strength Casting Material	Spectrophotometer, P.H. Meter, mixture vibration table, Balance, Vernier, Furnace, Hot Air Oven
Dry Impervious material	Spectrophotometer, P.H. Meter, mixture vibration table, Balance, Vernier, Furnace, Hot Air Oven
Low strength Insulation Brick	Balance, Vernier, Furnace, UTE
High strength Insulation Brick	Balance, Vernier, Furnace, UTE
Carbofrax 11S	Balance, Vernier, Furnace, UTE, Vibrator mixer Machine
Light Pouring Refractory	Balance, Vernier, Furnace, UTE
Refractory Bricks	Balance, Vernier, Furnace, UTE
Hydrochloric Acid	R.D. bottle, Weighing bottle, Beaker, Volumetric Flask, Measuring Cylinder, Pipette, Conical Flask, Burette
Liquid Ammonium Hydroxide	R.D. bottle, Weighing bottle, Beaker, Volumetric Flask, Measuring Cylinder, Pipette, Conical Flask, Burette etc.
Compressor House Utility Water (Pot Line-1& 2)	pH meter, Conductivity Meter, Turbidity Meter, Balance, Furnace, Spectrophotometer
D.M. Water From Rectifier Line1 & 2	pH meter, Conductivity Meter, Turbidity Meter, Balance, Furnace, Spectrophotometer
Rod Mill Water From Cast House 2 &3	pH meter, Conductivity Meter, Turbidity Meter, Balance, Furnace, Spectrophotometer
ETP Water	pH meter, Conductivity Meter, Turbidity Meter, Balance, Furnace, Spectrophotometer
WTP Water	pH meter, Conductivity Meter, Turbidity Meter, Balance, Furnace, Spectrophotometer

2. Type of testing: Physical/Chemical/Wet check/Instrumental analysis

3. Testing procedure:

Standards	Raw material
ISO 802:1976 ISO 806:2004 ISO 903:1976 ISO 2926:2005 ISO 1232:1976 ISO 805:1976 ISO 900:1977 ISO 1618:1976 ISO 1617:1976 ISO 2069:1976 ISO 2071:1976 ASTM-E-1621-05	Alumina
IS 4129:1967 IS 4129:1967 Balco Lab developed method ISO 3393:1976	Aluminium Fluoride

IS 2277:1964	Silicon metal
ASTM : E 35 - 88 (2002)	Magnesium alloy
IS-6773 (2008)	Sodium Silicate
IS: 265: 1993	Hydrochloric Acid
IS: 799: 1985	Liquid Ammonium Hydroxide

4. Quantity/Report frequency/Key parameters/Sample collection point:

Sample type	Quantity	Report circulation	Key parameters	Sample Collection
Alumina	35 per month	Daily	Alumina (as Al ₂ O ₃) % 98.6 % (min) SiO ₂ % 0.020 %(max) Fe ₂ O ₃ % 0.020 %(max) TiO ₂ % 0.007 %(max) P ₂ O ₅ % 0.002% (max) V ₂ O ₅ % 0.003%(max) Na ₂ O % 0.50%(max) CaO % 0.050 % (max) ZnO % 0.002 % (max) LOI (0-300oC) % - LOI (300-1000oC) % 1. 0 % (max) Alpha Alumina % 8.0% (max) Angle of repose Degree - Bulk Density (Loose) kg/m ³ 950 - 1000 Bulk Density (Tapped) kg/m ³ +140 (ASTM) % - +200,'-140 % - +325,' -200 % - -325 % 10.0% (max)	At Alumina Handling point by Alumina handling persons
Aluminium Fluoride	10 per month	As per sample received	Purity as AlF ₃ % 95.0 min. Free Al ₂ O ₃ % 5.00 %max. P ₂ O ₅ % 0.020 max. SiO ₂ % 0.15 max Fe ₂ O ₃ % 0.050 max. SO ₄ % 0.50 max. Na ₂ O % 0.300 max. CaO % 0.098 max. MOI at 110°C % 1.0 max. LOI at 550oC for 1/2 hr % 1.0 max. Angle of repose kg/m ³ 35 max Flowability Degree 160 sec max Bulk Density (Kg/m ³) Sec 750 min. Screen > 0.85 mm % NIL -0.045 mm % 15% max.	Collected from Q.A. Lab at ALF3 Storage area
Soda Ash	3 Per month	As per sample received	Purity % 98.85 min Volatile Matter % 0.60 max Insoluble Matter % 0.15 max	Collected By QA Lab from Central stores storage area

			Sulphate as Na ₂ SO ₄ % 0.08 max Chloride as NaCl % 1.00 max Iron as Fe % 0.007 max Bulk Density kg/m ³ 500 - 700	
Pot Bath sample	4980 per month	Daily	B/R CaF ₂ % AlF ₃ %	PRPC
Silicon Metal	9-10 per month	As per sample received	Si % 99.50% Min Fe % 0.20% Max AL % 0.20% Max Ca % 0.02% Max	Collected By QA Lab from Central stores storage area
Magnesium Alloy		As per sample received	Mg % 99.90% Min Fe % 0.02% Max Si % 0.050% Max	Collected By QA Lab from Central stores storage area
Titanium Alloy		As per sample received	Ti % 80% Min Fe % 0.30% Max Si % 0.03% Max	Collected By QA Lab from Central stores storage area
Strontium Alloy		As per sample received	Sr % 9-11% Fe % 0.30% Max Si % 0.20% Max Ca % 0.03% Max	Collected By QA Lab from Central stores storage area
Degasser		As per sample received	50 % min	Collected By QA Lab from Central stores storage area
Coverall Flux		As per sample received	NaCl % 45 to 50 % NaF % 5 to 10 % KCl % 40 to 45 %	Collected By QA Lab from Central stores storage area
Sodium Silicate		As per sample received	SiO ₂ -35 to 50 %	Collected By QA Lab from Central stores storage area
Titanium Boron alloy (TiBOR)		As per sample received	Ti % 4.80-5.50 B % 0.9-1.1 Fe % 0.30% Max Si % 0.20% Max V % 0.20% Max	Collected By QA Lab from Central stores storage area
Pot Feeder sample	240 per month	Daily	Fe ₂ O ₃ ≤ 0.025 % ; SiO ₂ ≤ 0.025 % ; CaO ≤ 0.040 % & Size analysis	Collected by Pot room Process control
Enriched Alumina	180 per month	Daily	% F	Collected by FTP Team
Zero level Bath	60 per month	Daily	% Fe ₂ O ₃ ≤ 0.120 % SiO ₂ ≤ 0.350	Collected by Pot room Process control
Hi-Strength Casting Material		As per sample received	Bulk Density gm/cc 2.00 - 2.20 Linear Change When Heated at 816 Deg C % -0.1 to -0.4 Compressive Strength at 816 Deg C Mpa 8.0 - 16.0 Breaking Strength at 816 Deg C Mpa 1.0 - 2.5 Heat Conductivity at 429 Deg C W/mK 0.58 max Heat Conductivity at 649 Deg C W/mK 0.64 max SiO ₂ % 45 - 55	Collected By QA Lab from Central stores storage area

			Al ₂ O ₃ % 30 - 40 Fe ₂ O ₃ % 3 - 5 TiO ₂ % 2 - 3 CaO % 6 - 8	
Dry Impervious material	Monthly-4-5 Sample	As per sample received	SiO ₂ % 53 - 59 Al ₂ O ₃ % 35 - 42 Fe ₂ O ₃ % 1.5 - 3.5 TiO ₂ % 1 - 2 CaO % 0.2 - 0.7 MgO % 0.1 - 0.5 Volume Density Kg/m ³ 1920-2020 Linear change when heated at 816oC % None Heat Conductivity @ 200oC W/mK 0.34 max Heat Conductivity @ 420oC W/mK 0.39 max Heat Conductivity @ 650oC W/mK 0.43 max	Collected By QA Lab from Central stores storage area
Low strength Insulation Brick		As per sample received	Dimension (mm) 230 x 114 x 64 ±3, ±1, ±1 Volume Density (gm/cc) 0.45 - 0.55 Thermal Conductivity at 350oC (W/mk) 0.15 max Compressive Strength (MPa) 0.60 - 0.80 PLC (900 o C x 8 hr) (%) ± 2.0	Collected By QA Lab from Central stores storage area
High strength Insulation Brick		As per sample received	Dimension (mm) 230 x 114 x 64 ±3, ±1, ±1 Volume Density (gm/cc) 0.60 - 0.80 Thermal Conductivity at 350oC (W/mk) 0.17 max Compressive Strength (MPa) 2.0 min PLC (900 o C x 8 hr) (%) ± 1.0	Collected By QA Lab from Central stores storage area
Carbofrax 11S		As per sample received	Bulk Density (gm/cc) 2.50 min "Modulus of Rupture (at 110oC/24hrs) " (MPa) 6 min "Modulus of Rupture (at 815oC/3hrs) " (MPa) 5 min "Cold Crushing Strength (at 110oC/24hrs) " (MPa) 30 min "Cold Crushing Strength (at 815oC/3hrs) " (MPa) 24 min PLC (at 815oC/3hrs) (%) -0.20 max	Collected By QA Lab from Central stores storage area
Light Pouring Refractory		As per sample received	Bulk Density (gm/cc) 1.00 to 1.20 Thermal Conductivity at 700 o C (W/mk) 0.14 - 0.19 Modulus of Rupture (at 110oC/24hrs) (MPa) 0.98 min Modulus of Rupture (at 1000oC/3hrs) (MPa) 0.70 min Cold Crushing Strength (at 110oC/24hrs) (MPa) 3.89 min Cold Crushing Strength (at 1000 o C/3hrs) (MPa) 3.3 min PLC (8 hr.x900 o C) (%) 0 to - 0.67 Water Consumption (%) 35 – 50	Collected By QA Lab from Central stores storage area

Refractory Bricks		As per sample received	Dimension (mm) Length 230 (±3mm) Width 114 (±1mm) Thickness 64 (±1mm) Thermal Conductivity at 700 deg C (W/mk) 1.148 max Cold Crushing Strength (MPa) 35 min Apparent Porosity (%) 22 max Al ₂ O ₃ (%) 30 - 42	Collected By QA Lab from Central stores storage area
Hydrochloric Acid		As per sample received	HCl % by Mass 30 - 32 Relative Density g/cc 1.148 - 1.160	Collected By QA Lab from Central stores storage area
Liquid Ammonium Hydroxide		As per sample received	Ammonia (as NH ₃) % by Mass 20 - 25 Relative Density g/cc 0.904 - 0.920	Collected By QA Lab from Central stores storage area
Compressor House Utility Water (Pot Line-1& 2)	27 per month	weekly twice	pH - 7.8 - 8.8 Conductivity µs/cm 2000 max Fluoride mg/l 60 max Turbidity NTU 20 max Total Hardness mg/l 400 max Ca Hardness mg/l 300 max Mg Hardness mg/l 100 max Total Solid mg/l 1400 max Dissolve Solid mg/l 1350 max Suspended Solid mg/l 50 max Chloride mg/l 300 max FRC mg/l 0.5 max P Alkalinity mg/l 50 max M Alkalinity mg/l 280 max Total Alkalinity mg/l 330 max Fe ₂ O ₃ mg/l 3 max SiO ₂ mg/l 100 COC (TH) - 6.5 max	Collected by Utility team
DM Water From Rectifier Line1 & 2	67 per month	weekly twice	pH 6.0 - 7.0 Conductivity µs/cm 5 Max Fluoride NTU 2 Max Turbidity mg/l NIL Total Hardness mg/l Nil Total Solid mg/l - Dissolve Solid mg/l 300 Max Suspended Solid mg/l 5 Max	Collected by Rectifier team
Rod Mill Water From Cast House 2 &3	16 per month	weekly twice	pH - 7.0 - 8.0 Conductivity µs/cm 300 (Max) Chloride mg/l 9 (Max) Turbidity NTU 10 (Max) P Alkalinity mg/l 0 M Alkalinity mg/l 100 (Max) Total Alkalinity mg/l 100 (Max) Total Hardness mg/l 600 (Max) Ca Hardness mg/l 200 (Max) Mg Hardness mg/l 400 (Max) Total Solid mg/l 205 (Max) Dissolve Solid mg/l 200 (Max) Suspended Solid mg/l 5 (Max)	Collected by Cast House Process control

			Fe mg/l 0.5 (max) Si mg/l 20 (Max) Fluoride mg/l - Sulphate mg/l -	
ETP Water	32 per month	weekly twice	pH - 7.5 - 8.5 Conductivity $\mu\text{s/cm}$ 298 Max Fluoride mg/l Nil Turbidity NTU 15 max Total Hardness mg/l 60 max Ca Hardness mg/l 45 max Mg Hardness mg/l 15 max Chloride mg/l 20 Max P Alkanity mg/l Nil M Alkanity mg/l 35 Max Total Solid mg/l 220 Max Total Dissolve Solid mg/l 200 Max Total Suspended Solid mg/l 20 Max FRC mg/l 0.5 max Fe ₂ O ₃ mg/l 0.3 max SiO ₂ mg/l 10 max BOD mg/l Nil COD mg/l Nil Oil and grease mg/l Nil	Collected by ETP
WTP Water	6 per month	As per sample received	pH - 6.5 - 8.5 Conductivity $\mu\text{s/cm}$ - Fluoride mg/l 1.0 max Turbidity NTU 1 max Total Hardness mg/l 200 max Ca Hardness mg/l 75 max Mg Hardness mg/l 30 max Chloride mg/l 250 max Total Solid mg/l - Dissolve Solid mg/l 500 max Suspended Solid mg/l - FRC mg/l 0.2 Min Oil and grease mg/l	Collected by WTP

(ii) **Carbon Section**

1. Equipment required and Scope of work:

Sample type	Equipment for sample preparation and testing
C.P. Coke	Muffle Furnace, XRF, Sieve Shaking Machine, Bulk Density Tester, HGI, Roll Crusher, Helium pycnometer
C.T. Pitch	Viscometer, Coking Value Tester, Muffle Furnace, Water Content Tester, Spectrophotometer, AAS/ICP, Electronic balance Mettler Sample Press, Softening Point Tester, Toluene Insoluble Tester, Quinolone Insoluble tester

Baked Anode	CO2 Reactivity Tester, Electrical resistivity Apparatus, UTE-20,XRF,AAS/ICP, Air Permeability, He Pycnometer
Ramming mass	Sieve Shaker
Ferro Manganese/Ferrophosphorus	Muffle Furnace, AAS/ICP
Steel Shot	Analyser, AAS/ICP, Muffle Furnace, Sieve shaker
Graphite Power	Muffle Furnace , Sieve Shaker
Autogenous crusher Bath Input/Output 1&2	XRF, Palletizing Press
Rodding Bath(CB,FB,ZI,ACB,DUST,Alumina)	XRF, Palletizing Press
Cast Iron	XRF, Polishing Machine

2. Type of testing: Physical/chemical testing

3. Testing procedure:

Sample type	Standard
CP Coke	ISO 12980:2000 ASTM D 3173-11 ASTM D 4422-13 / ISO 8005:2005 ASTM D 3175-11 / IS 1448:Part-134:1989 ASTM D 2638-10 ASTM D 4292-10 ASTM D 293-93
C.T. Pitch	ISO 6376:1980 ASTM D2318-98 ISO 5940-2:2007(E)/ASTM D3104-99 (Reapproved 2010) / ISO 5940:1981 ASTM D-4616-95 ISO 8003:1985 ISO 8006:1985
Baked Anode	XRF - ISO 12980:2000 ASTM D 4422-13/ISO 8005:2005
Ramming mass	S 10116-1982
Ferro Manganese/Ferrophosphorus	YS/T285-1998 Annex – A
Steel Shot	IS 4606-1983.XRF Method
Graphite Power	IS 1350 : Part 3 ASTM D 4422-98/ISO 8005:2005 ASTM D3173-03 IS 1448 : Part 134 : 1989/ ASTM D 3175-07 1969 /ISO 5931:2000
Autogenous crusher Bath Input/Output 1&2	-
Rodding Bath(CB,FB,ZI,ACB,DUST,Alumina)	-
Cast Iron	IS 4606-1983 ,XRF Method

4. Quantity/Report frequency/Key parameters/Sample collection point:

Sample	Quantity	Report Circulation	Key parameters	Sample collection
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CP Coke	10 sample/Month	Daily	<p>Sulphur as S 2.5-3.5%</p> <p>Iron as Fe 0.035max%</p> <p>Silica as Si 0.035max%</p> <p>Titanium as Ti 0.0015max%</p> <p>Vanadium as V 0.0350max%</p> <p>Nickel as Ni 0.0250max%</p> <p>Sodium as Na 0.0100max%</p> <p>Calcium as Ca 0.0150max%</p> <p>Phosphorus as P 0.0020max%</p> <p>Moisture 0.30max%</p> <p>Ash Content 0.35max%</p> <p>VM 0.50max%</p> <p>Real Density 2.06-2.08 g/cc</p> <p>Vibrated Bulk Density > 0.85 g/cc</p> <p>Lc -</p> <p>+25 mm 0%</p> <p>-25 to +4.75mm 25%</p> <p>-4.75 to +0.85mm balance</p> <p>-0.85mm 25%</p>	Collected by GAP operation
CT Pitch	120 sample/Month	Daily	<p>Toluene Insoluble 6 to 12%</p> <p>Quinolone insoluble 30-37%</p> <p>Softening Point 109-114deg</p> <p>Beta resin(TI-QI) 20-26%</p> <p>Mesophase 0.0%</p> <p>Viscosity @ 160 o C 2200-2800cps</p> <p>Viscosity @ 180 o C 500-700cps</p> <p>Coking value 56 min%</p> <p>Lump Density 1.30 min g/cc</p> <p>Ash 0.25 max%</p> <p>Sodium as Na 0.020 max%</p> <p>Sulphur as S 0.60 max%</p> <p>Silica as Si 0.030 max%</p> <p>Iron as Fe 0.030 max%</p>	Collected by GAP operation/Q. A. Lab at GAP
Baked Anode	120 sample/Month	Daily	<p>Ash 0.50 Max</p> <p>Iron as Fe 0.060 max</p> <p>Silicon as Si 0.030 max</p> <p>Sodium as Na 0.035 max</p> <p>Calcium as Ca 0.0180 max</p> <p>Titanium as Ti 0.0015 max.</p> <p>Vanadium as V 0.0300 max</p> <p>Nickel as Ni 0.0250 max.</p> <p>Sulphur as S 2.3 - 3.5%</p>	Collected by Carbon process control
Ramming mass	2 sample/month	Daily	<p>Silica as Si 97%</p> <p>Iron Oxide as Fe₂O₃ 0.20 max%</p> <p>Boric Acid 1.0-1.3%</p> <p>Moisture 0.50 max%</p> <p>+6 mm 0-5 %</p> <p>+4 mm 0-10 %</p> <p>+2.36 mm 24-40 %</p> <p>+1.18 mm 14-22 %</p> <p>+0.85 mm *</p> <p>-0.85 mm 35-45 %</p>	Collected by Q.A. Lab from Central Stores storage area

Ferro Manganese/Ferro phosphorus	5 sample/year	Daily	Manganese as Mn 70 to 75% Phosphorus as P 20 to 25%	Collected by Q.A. Lab from Central Stores storage area
Steel Shot	5 sample/year	Daily	Silicon as Si 0.2-1.10% Manganese as Mn 1.20max% Sulphur as S 0.08max% Phosphorus as P 0.08max% Screen Analysis +2mm All Pass +1.7mm 5 (max) +1.18mm 80 (min.) +1mm 11 (max) -1mm 4 (max)	Collected by Q.A. Lab from Central Stores storage area
Graphite Power	3 sample /year	Daily	Fixed Carbon as C 98.5 min% Sulphur as S 0.50 max% Ash 0.50 max% Moisture 0.60 max% Volatile matter 0.50 max% size in mm 1-6 mm +6.00 +3.35 +2.80 +1.18 +0.85 -0.85	Collected by Q.A. Lab from Central Stores storage area
Autogenous crusher Bath Input/Out put1&2	30 sample/month	Daily	% Fe ₂ O ₃ % SiO ₂ % Free Alumina Sieve Analysis	Collected by Carbon process control
Rodding Bath(CB,FB,ZI,ACB ,DUST,Alumina)	75 sample/month	Daily	% Fe ₂ O ₃ % SiO ₂	Collected by Carbon process control
Cast Iron	60 sample/month	Daily	% C 3.3 - 3.7 % S 0.2 max % P 0.5 max % Mn 0.6 - 0.9 % Si 2.7 - 3.2 C.E 4.3 - 4.7	Collected by Carbon process control

(iii) **MTB & FG Section**

1. Equipment required and Scope of work:

Sample type	Equipment for sample preparation and testing
Wire rod and Rolled product	Kelvin bridge, UTE 20, Band Saw, Guillotine Shear, Instron , Techno fore, 4.5 digit micro ohm metre PE 16 R
Metal Button Sample	Optical Emission Spectrometer, Milling Machine & Polishing Machine

2. Type of testing: Electrical and Mechanical testing (MTB Section)

Chemical Analysis (F.G. Section)

3. Testing procedure:

Sample type	Standard
Wire rod and Rolled product	as per I.S. standard of respective test
Metal Button Sample	ASTM-E-1251-17a

4. Quantity/Report frequency/Key parameters/Sample collection point:

Sample	Quantity	Report Circulation	Key parameters	Sample collection
40681 Wire Rod and 11997 RP	Wire rod-3390 per month RP-1000 per month	Daily	UTS 8-13 kg/mm ² , Elongation %, Conductivity % IACS	Collection of sample from CH and SRS by Process Control
Metal Button Sample	30000 per month	Daily	Element Range-Si – 0.0006-25.0 %,Fe – 0.0001 – 10.0 %,Cu – 0.00001 – 15.0 %,Mn – 0.00005 – 2.0 %,Cr - 0.00002 – 1.0 %,Ni – 0.10 – 5.0 %,Zn – 0.0005 – 10.0 %,Ti – 0.0003 – 1.0 %,Ga - 0.00002 - 0.2 %,P - 0.0005 - 0.10 %,V - 0.0001 - 0.5 %,Mg – 0.00001 – 15 %,Zr - 0.0001 - 0.5 %,Na - 0.0001 - 0.1%,Ca -0.0001 - 0.30 %	Collection of sample by Pot room Process control, Cast House process control, Foundry process control

(iv) **Metallography & Oil Section**

1. Equipment required and Scope of work:

Sample type	Equipment for sample preparation and testing
HFO/LDO	Bomb calorimeter, Hydrometer, Viscometer, Distillation apparatus, for HFO/LDO testing
Diesel	Thermometer, Hydrometer
Emulsion oil	BOB Flask, pH meter
HRM Oil	BOB Flask, Oven, pH meter
NCRM OIL	Glassware, Viscometer, Brown Stain F/c, Flash point Cup, Hydrometer, vacuum pump, Distillation apparatus
Roll Coolant	Glassware, Viscometer, Brown Stain F/c, Flash point Cup, Hydrometer , vacuum pump, Distillation apparatus
Ingot	Power Hacksaw M/c, Abrasive Machine, Polishing machine, Microscope
Wire ROD	Power Hacksaw M/c, Abrasive Machine, Polishing machine, Microscope

Sheets	Power Hacksaw M/c, Abrasive Machine, Polishing machine, Microscope, Erichen DD testing M/c, Earing M/c
PODFA	PODFA Machine Power Hacksaw M/c, Abrasive Machine, Polishing machine, Microscope
Dross	Crucible F/c, Ball mill grinder
Pitch	Polishing machine, Microscope,
Hardness of Roll & Cutting wheel	Hardness tester

2. Type of testing: Metallography/Physical/Raw material

3. Testing procedure:

Sample type	Standard
HFO/LDO	IS1448
Diesel	IS1448
NCRM OIL	IS:1448(P-2),ASTM D92/72 ,
Roll Coolant	IS:1448(P-2),ASTM D92/72 ,
Ingot	ASTM E112, E340, E-407, E-3, E-1220-99, Smart Rad Manual
Wire ROD	ASTM E112, E340, E-407, E-3,
Sheets	ASTM E112, E340, E-407, E-3, E-648
Dross	IS-3191 for reference of Dross sampling. Recycle & secondary recovery of metals- Taylor, Soha, Jerrett
Pitch	ASTM D-4616-2013
Hardness of Roll & Cutting wheel	ASTM-A956 (2006)

4. Quantity/Report frequency/Key parameters/Sample collection point:

Sample	Quantity	Report Circulation	Key parameters	Sample collection
HFO/LDO	Avg 110-120 sample per month	Daily	GCV - GCV Min 10000 Calories/gram, Moisture -Max 1%, Density (HFO)- Density Max 0.9990 gm/cc , Viscosity/ Flash Point/ Ash & Sulphur as per operation requirement	B.O./ Foundry/ CH/ CPP2/ CPP3 sample collected from tanker by Lab persons
Diesel	Avg-10-15 sample per month	As per sample received	Density- 0.815 to 0.845 gm/cc	Petrol Pump by Lab persons
Emulsion oil	Avg 4-5 sample per day	Daily	pH-7-9, Oil%- 8-12 Free Oil-2 max	At CH1, CH3 by process control
HRM Oil	1 sample daily	Daily	pH-7-8, Conductivity-50-600µS/cm, Con-1-2%, ESI-0.80-0.90%	By SRS Process control

NCRM OIL	Weekly 2 sample	Weekly twice	TA- 3 mgKOH/ gm, LA 0.8-1.5%, Viscosity @ 40 deg- 2.6-3.0cst. Flash Point -110 deg Min,S/Solid -0.1 Max,Specific Density-0.77- 0.80,IBP-240-250 deg C, FBP-270-290 deg C,Recevery-96% min, Residue-4% Max, Color-2 ASTM Max	By SRS Process control
Roll Coolant	As per Tanker availability	As per Tanker availability	TA- 0.005 mgKOH/ gm Max, Viscosity @ 40 deg- 2.0-2.6cst. Flash Point -110 deg Min,Specific Density-0.80,IBP-240 deg C Min, FBP-280 deg C Max,Recevery-98% min, Residue-2% Max, Color-Colorless	By SRS Process control
Ingot	18 sample /day	Daily	Micro- Shrinkage Porosity- 400Micron Max, Macro- Heavy or Fine porosity, DP-A/B/C/D Grade, Radiation- 1 Micro Sieverts/Hr.	By ICM CH1 Process control
Wire ROD	Wire ROD - daily 1 sample Cast bar- Weekly Three	Wire ROD weekly, Cast bar- weekly three.	Metallography Analysis (Micro/ Macro/)	By Mill-1, Mill2 Process control CH3
Sheets	20-30 sample Monthly	As per sample receiving	Deep drawing- Below- 1mm-Min 6 mm, 1-2 mm- Min 9 mm. 2.5 - above- Min 11mm, Earing %- 3 max, Metallography test (Micro, macro, grain size, defect analysis,)	By SRS Process control
PODFA	20 sample per Month	Weekly 5 sample	Inclusion Test- 0.15 mm ² /kg	By CH1, CH3 and Foundry Process control
Dross	Monthly-100-110 Sample	As per sample received	% Al recovery	Dross shed sample taken by Lab persons, In presence of Scrap disposal team, Auditor, lab, Operation
Pitch	Daily- 6-8 sample	Daily	% Mesophase	From P-2 lab
Hardness of Roll & Cutting wheel	Monthly-3-4 Sample	As per operation requirement	Hardness HRC	By SRS / Foundry Operation

5. Chemical Consumption Details-Metal Lab

Chemical	Monthly consumption	Yearly consumption	Scope
Acetone	15 lit	180 lit	CT Pitch testing
Toluene	25 lit	300 lit	CT Pitch testing
Quinolone	6 lit	72 lit	CT Pitch testing
Starch	1000gm	12000 gm	Bath analysis In XRF
Boric Acid	1000gm	12000 gm	Alumina testing in XRF
Hydroxyl ammonium chloride	500gm	6000 gm	Wet check analysis
Sodium Acetate Buffer	500gm	6000 gm	Wet check analysis
WAX(Hoechst)	500gm	6000 gm	C.P. coke testing in XRF
xylene	6 lit	72 lit	HFO testing
Celite	250gm	3000 gm	CT Pitch filtration
Nitric acid	6 lit	72 lit	Oil testing
Sulphuric Acid	3 lit	36 lit	Oil testing
Sodium Chloride	500 gm	6000 gm	Oil testing
Hydrofluoric acid	500 ml	6000 ml	Oil testing

These all are very critical chemicals which is used in wet-check and instrument for raw, in-process and finished material

6. Annual Maintenance Contract-Metal Lab

Equipment covered under AMC/CMC:

Equipment	OEM/Make
XRF/XRD	Panalytical
OES	Thermofisher
Instron	Instron
Milling machine	Herzog
Microscope	Carl Zeiss
Bomb Calorimeter	Parr and IKA
Viscometer	Brookfield
UTN-20/UTE-20	Bluestar
Komputerized UTM	Star testing
Vibrating cup mill	Insmart
Palletising press	Insmart
Electronic balance, Softening point tester and Moisture analyser	Mettler toledo
Leco Analyser	Leco

7. Calibration details and frequency for every section:

All equipment calibration done by NABL accredited lab on yearly basis.

8. Safety requirements: Follow the equipment safety procedure as per equipment manual and HSE guideline.

9. Spares & consumable required: As per equipment's spare and consumables procure and maintain the inventory.

Note: Refer the Annexure - List of all Lab equipment.

4. Annexure

1. PLANT-1 LAB

S.No.	List of Equipment	Make
1	Knuth Polishing Machine 1	STRUERS
2	Knuth Polishing Machine 2	STRUERS
3	Knuth Polishing Machine 3	STRUERS
4	Microscope 1	ZEISS
5	Microscope 2	METALLOVERT
6	Hardness Tester 1(Vickers)	Fuel Instruments & Engineers Pvt. Ltd.
7	Abrasive Cutting Machine	BUEHLER
8	Specimen Mounting Machine	BUEHLER LTD
9	Bomb Calorimeter IKA	IKA
10	Centrifuge 1	REMI
11	Centrifuge 2	ELTEK
12	Brown Stain Testing Apparatus	
13	Viscometer	CANON INSTRUMENT COMPANY
14	Temp Oven - 1	S D Scientific Industries
15	Temp Oven - 2	S D Scientific Industries
16	Fumehood-1	S D Scientific Industries
17	Fumehood-2	S D Scientific Industries
18	Cubix Pro XRD	Panalytical
19	OES ARL 3460	Thermo ARL
20	VCM	Insmart Systems
21	Palletizing Press 2	Insmart Systems
22	Palletizing Press 1	Insmart Systems
23	INSTRON (Old)	INSTRON
24	INSTRON (New)	INSTRON
25	UTN 20 (Old)	Fuel Instruments & Engineers Pvt. Ltd.
26	UTN 20 (New)	Fuel Instruments & Engineers Pvt. Ltd.
27	Kelvin Bridge	Prestige Electronics
28	Conductivity Meter	TECHNOFOUR

29	Ball Mill	-
30	DD Testing Machine	Erichsen
31	Cupping Testing Machine	Erichsen
32	Belt Polishing Machine	-
33	Metal Polishing Machine	Unimate
34	Forging Hydraulic Press Machine	-
35	Drilling Machine	-
36	Rolling Machine	-
37	Power Hacksaw 1	-
38	Power Hacksaw 2	-
39	Lathe Machine	CHAMUNDI MACHINE TOOLS LTD
40	Power hacksaw	-
41	Band Saw 1	SONEX
42	Band Saw 2	SONEX
43	Polishing Machine	-
44	G Shear-1	-
45	G Shear-2	-
46	Grinder	-
47	Digital Temp Controller	Tempo
48	Chamber Furnace	Sperry Vickers Bombay
49	Crucible Furnace	-
50	Furnace	-
51	Podfa	ABB

2. PLANT-2 LAB

S.No.	List of Equipment	Make
1	XRD	Panalytical
2	XRF	Panalytical
3	XRD WATER CHILLER (spare)	Hyfra
4	XRF CHILLER	Hyfra
5	XRD CHILLER	WERNER FINLEY
6	MILLING MACHINE	HERZOG
7	POLISHING MACHINE	Unimat
8	UTE-20 MACHINE	FIE
9	SIEVE SHAKER 1	Retsch
10	SIEVE SHAKER 2	Retsch
11	PALLETISING PRESS 1	Insmart Systems
12	PALLETISING PRESS 2	Insmart Systems
13	JAW CRUSHER	Insmart
14	DIAMOND WHEEL SAW	R & D Carbon Ltd.

15	HGI TESTER	Cheminco
16	OES 1	Thermo Scientific
17	OES 2	Thermo Scientific
18	KELVIN BRIDGE	Toshniwal Industries
19	COMPUTERISED TENSILE TESTING	Star Testing Systems
20	ER	R & D Carbon Ltd.
21	BLAINE	R & D Carbon Ltd.
22	THERMAL EXPANSION	R & D Carbon Ltd.
23	AIR PERMEABILITY	R & D Carbon Ltd.
24	CO2 REACTIVITY TESTER	R & D Carbon Ltd.
25	TUMBLING APPARATUS	R & D Carbon Ltd.
26	VIBRATING CUP MILL 1	FRITSCH pulverisette
27	VIBRATING CUP MILL 2	Insmart System
28	HARDNESS TESTER	Brinell Hardness Tester
29	LECO ANALYZER	LECO
30	HELIUM PYCONOMETER	Micrometrics
31	OVEN 1	S D Scientific
32	OVEN 2	S D Scientific
33	OVEN 3	S D Scientific
34	OVEN 4	S D Scientific
35	FLOURINE DISTILLATION 1	Tempad
36	FLOURINE DISTILLATION 2	Tempad
37	HOT PLATE	Lab Hosp
38	WATER BATH 1	-
39	WATER BATH 2	-
40	SPECTROPHOTOMETER 1	HACH
41	SPECTROPHOTOMETER 2	HACH
42	MUFFLE FURNACE 1	S D Scientific
43	MUFFLE FURNACE 2	S D Scientific
44	MUFFLE FURNACE 3	S D Scientific
45	MUFFLE FURNACE 4 (Standby)	S D Scientific
46	FUME HOOD 1	S D Scientific
47	FUME HOOD 2	S D Scientific
48	FUME HOOD 3	S D Scientific
49	FUME HOOD 4	S D Scientific
50	FUME HOOD 5	S D Scientific
51	FUME HOOD 6	S D Scientific
52	MILLIPORE WATER 1	Millipore
53	MILLIPORE WATER 2	Millipore
54	SOFTENING POINT METTLER 1	Mettler
55	SOFTENING POINT METTLER 2	Mettler

56	METTLER SAMPLE PRESS	R & D Carbon Ltd.
57	TOLUENE INSOLUBLE	R & D Carbon Ltd.
58	QUINOLENE INSOLUBLE	-
59	VISCOSITY METER	Brookfield
60	SPARE VISCOSITY METER	Brookfield
61	ROLL CRUSHER	BICO INC
62	C V TESTER	Nabertherm Schweiz AG
63	BULK DENSITY COKE	-
64	ELECTRONIC BALANCE/LD TESTER	Anamed Instrument(P)Ltd
65	pH METER	Thermo
66	VIBRATORY FEEDER	FRITSCH
67	BAND SAW	Jai industries
68	MIXER MACHINE	Jai industries

3. COAL LAB

S.No.	List of Equipment	Make
1	Bomb Calorimeter-1	PARR
2	Bomb Calorimeter-2	LECO
3	Bomb Calorimeter-3	LECO
4	Humidity Chamber-1	S D Scientific Industries
5	Humidity Chamber-2	S D Scientific Industries
6	Furnace-1	VERDER SCIENTIFIC
7	Furnace-2	VERDER SCIENTIFIC
8	Furnace-3	VERDER SCIENTIFIC
9	Air oven-1	VERDER SCIENTIFIC
10	Air oven-2	VERDER SCIENTIFIC
11	Air Dryer	AMALGAMATED BIOTECH

2. Vedanta Limited – Al & Power, Jharsuguda

Scope of work – Smelter Laboratory

Business Overview

The Aluminium Business comprises bauxite mining, alumina refining and aluminium smelting operations in India. It comprises two operating companies BALCO and Vedanta Limited (Aluminium & Power) (at Lanjigarh and Jharsuguda).

Vedanta Limited (Aluminium & Power) includes the annual extraction of 3 million tons of bauxite from a mine in the Niyamgiri Hills; Lanjigarh projects at the foot of the Niyamgiri Hills (refinery with associated captive power plant) and Jharsuguda Project at Brundamal, in the Jharsuguda district, some 350 km from the refinery (17500,000 TPA aluminium smelter, associated 1,215MW Captive power plant and 2400 MW Thermal power plant) in the state of Odisha.

Product ranges of Vedanta Limited-Aluminium and Power, Jharsuguda

- a) Smelter: Aluminium ingots, billets, wire rods & slabs, T ingots, cast bar, sow ingots
- b) Captive Power Plant: Captive in nature and is utilized in Aluminium production
- c) Thermal Power Plant: Independent in nature and is utilized in aluminium production & state grid

Certification:

Vedanta Limited, Jharsuguda is ISO 9001:2015, ISO 14001: 2015, ISO 45001: 2018, ISO 17025:2017 and IATF 16949:2016 certified.

Job Type:

Sampling, preparation, analysis, preservation, and reporting of raw material and finished goods within the stipulated time.

Detailed Scope of work:

Vedanta Jharsuguda complex has comprised of two smelter laboratories namely Plant-1 and Plant-2 (SEZ) laboratory.

A. Raw-materials and other incoming materials:

1. Raw material Sampling:

1.1 CP Coke and Calcined Alumina:

- Service Partner shall carry out sampling manually, supplier-wise for the specified of the raw material received at Vedanta Limited, Jharsuguda by Trucks, Rakes, BTAP on 24*7 basis. Necessary tools and consumables to be provided by Service Partner.
- Ensuring sample collection from each rake or truck as agreed and mentioned in the SOP framed by Vedanta, which is as per IS/ISO/ASTM standards.
- 3. Samples collected should be individually sealed and packed and should contain all the relevant details of the sample (sample id, date, quantity ect) using unique code. Unique code as per Vedanta requirement. Barcode instrument and its related accessories to be provided by Service Partner.
- The sealed sample should be handed over to laboratory team for further preparation and analysis of samples.
- Sample preservation and disposal as per Vedanta SOP.
- Any abnormality or deviation observed during the sampling or preparation process, the activity to be stopped and inform to Vedanta representative for necessary directions.

1.2 AIF₃, Bath Cryolite, and Soda Ash

- Service Partner shall carry out sampling manually with the help of sampling tools for Supplier-wise received at storage area on 24*7 basis.
- Ensuring sample collection from each rake or as agreed and mentioned in the SOP framed by Vedanta which is as per IS/ISO/ASTM standards.
- Samples collected should be individually sealed and packed and should contain all the relevant details of the sample (sample id, date, quantity etc.) using unique code. Unique code as per Vedanta requirement. Barcode instrument and its related accessories to be provided by Service Partner.
- The sealed sample should be handed over to laboratory team for further preparation and analysis of samples.
- Sample preservation and disposal as per Vedanta SOP.
- Any abnormality or deviation observed during the sampling or preparation process, the activity to be stopped and inform to Vedanta representative for necessary directions.

1.3 Pitch

- Service Partner shall carry out sampling manually with the help of sampling tools of the pitch tanker received at plant store on 24*7 basis.
- Ensuring sample collection from each rake or as agreed and mentioned in the SOP framed by Vedanta which is as per IS/ISO/ASTM standards.
- After the sample collected GAP will assign a system generated code for the tankers.
- Samples collected should be individually sealed and packed and should contain all the relevant details of the sample (sample id, date, quantity etc) using unique code. Unique code as per Vedanta requirement. Barcode instrument and its related accessories to be provided by Service Partner.
- The sealed sample should be handed over to laboratory team for further preparation and analysis of samples.
- Sample preservation and disposal as per Vedanta SOP.
- Any abnormality or deviation observed during the sampling or preparation process, the activity to be stopped and inform to Vedanta representative for necessary directions.
- After 6pm, Pitch and Fuel oil samples to be transported from plant-1 to plant-2 lab for preparation and analysis.

1.4 Fuel Oil

- Service Partner shall carry out sampling manually with the help of sampling tools of the tanker received at plant store on 24*7 basis.
- Ensuring sample collection from each rake or as agreed and mentioned in the SOP framed by Vedanta which is as per IS/ISO/ASTM standards.
- After the sample collected Bake Oven will assign a system generated code for the tankers.
- Samples collected should be individually sealed and packed and should contain all the relevant details of the sample (sample id, date, quantity etc) using unique code. Unique code as per Vedanta requirement. Barcode instrument and its related accessories to be provided by Service Partner.
- The sealed sample must be locked in a box with proper lock and key and should be handed over to laboratory team for further preparation and analysis of samples.
- Sample preservation and disposal as per Vedanta SOP.
- Any abnormality or deviation observed during the sampling or preparation process, the activity to be stopped and inform to Vedanta representative for necessary directions.

1.5 Cast House Raw materials

- Service Partner shall carry out sampling manually for the cast house raw material received at plant store.
- Ensuring sample collection from each lot or bag as agreed and mentioned in the SOP framed by Vedanta which is as per IS/ISO/ASTM standards.

- Samples collected should contain all the relevant details of the sample (sample id, date, quantity etc).
- The collected sample should be handed over to laboratory for further preparation and analysis of sample.
- Sample preservation and disposal as per Vedanta SOP.
- Any abnormality or deviation observed during the sampling or preparation process, the activity to be stopped and inform to Vedanta representative for necessary directions.

1.6 Other incoming materials/consumables:

- The list of other incoming materials or consumables is given in the annexure-1.
- Sampling of these incoming materials/consumables will be done by respective department and will be submitted at laboratory for analysis.
- Samples collected should contain all the relevant details of the sample (sample id, date, quantity etc).
- Sample to be prepared, analysed and reported in stipulated time.
- Sample preservation and disposal as per Vedanta SOP.

2. Preparation:

The raw material/incoming materials collected and deposited in the lab should be prepared as agreed and mentioned in the SOP framed by Vedanta which is as per IS/ISO/ASTM standards.

3. Analysis

The raw material/incoming materials prepared by laboratory should be analysed as agreed and mentioned in the SOP framed by Vedanta which is as per IS/ISO/ASTM standards.

4. Reporting and Quality clearance

The raw material/incoming material analysed should be reported as per agreed Service Level Agreement and quality clearance/rejection or Acceptance under deviation should be done within 3 days of GRN posting.

B.Finished Goods:

1. Sampling:

- Sampling will be done by Potline and Cast House Process Team.
- Potmetal sampling will be done by Potline team and submitted at laboratory
- Casthouse sampling such as B.C.,AC,Rod, metallography will be done and submitted at laboratory.

2. Preparation:

The sample received from Potline & Casthouse in the laboratory should be prepared by laboratory team before analysis as agreed and mentioned in the SOP framed by Vedanta which is as per IS/ISO/ASTM standards.

3. Analysis:

- The prepared sample should be analyzed as agreed and mentioned in the SOP framed by Vedanta which is as per IS/ISO/ASTM standards.
- Metallography samples to be analysed by trained metallurgy engineer and approved by Vedanta.
- Sample preservation and disposal to be done as per Vedanta requirement.

4. Reporting and Quality clearance:

The sample analysed should be reported as per agreed Service Level Agreement or quality plan and quality clearance/rejection or Acceptance under deviation should be done as per stipulated time.

C. In process Materials:

- a. Inprocess material will be sampled by respective vendor department and submitted to laboratory. Carbon Plant related inprocess samples to be collected by service partner and submit to laboratory.
- b. The list of inprocess materials is given in the annexure-2
- c. Samples collected should be contain all the relevant details of the sample (sample id, date, quantity etc).
- d. The collected sample should be handed over to laboratory for further preparation and analysis of sample.
- e. Sample preservation and disposal as per Vedanta SOP.

D. By-product and Scrap:

- a. Service Partner shall carry out sampling as desired by Vedanta for byproduct such as Aluminium Dross, Spent Potline, Refractories, Coke dust, Soot dust etc and Scrap.
 - b. Samples collected should be contain all the relevant details of the sample (sample id, date, quantity etc).
 - c. The collected sample should be handed over to laboratory for further preparation and analysis of sample.
 - d. Sample preservation and disposal as per Vedanta SOP.
- List of critical equipment's is provided in the annexure-3.
 - Samples to be transported between plant-1 and plant-2 for preparation and analysis on daily basis.

- Qualification and experience of sampler, analyst, supervisor and site Akbar will be as per Vedanta requirement.
- Installation of cameras as and when required shall be in the Scope of Service Partner.
- Service Partner shall carry out Cross Validation of other area samples.
- Samples from Load Port/Discharge port will be analyzed by 3P.
- Service Partner should maintain daily logbook report for sample collection, preparation and analysis as required by VAL Quality Team. All the relevant records are the property of VLJ and it should not be taken outside the Vedanta premises. Confidentiality of analysis details should be maintained and should not share without any writing permission from VL QUALITY TEAM. If found legal action will be taken under Jharsuguda jurisdiction.
- Service Partner will be responsible for maintaining a log/register book and must note down the lab equipment performance on day-to-day basis. Observation and reporting activity to be carried out by SERVICE PARTNER for Lab equipment as it is being operated by them. Service Partner should document (By mail or by logbook) its observation as well as its reporting to V.L. Quality team.
- Service Partner shall however use SRM/CRM for cross check of instruments where applicable and report the health of the equipment from time to time to V.L. Quality Team.
- Service Partner shall depute a Site-In charge who would be responsible to coordinate with our assigned personnel. A team comprising experienced inspectors, chemist, samplers, and technicians should assist him round the clock who would be responsible for operations and maintenance and would also maintain appropriate documentation of the daily operations. The manpower is to be deployed as per the monthly Manpower Structure plan
 - a. Samplers
 - b. Supervisor
 - c. Sample preparation team
 - d. Chemist/Analyst
 - e. Site Incharge
- Service partner shall bring new staff within issue of the contract and shall rotate its staff location as per Vedanta guidelines. In case of any service partner personnel found guilty of any misconduct, then service partner and V.L. will initiate investigation and appropriate action shall be taken to this effect.
- As a control measure regular internal audits should be carried out by SERVICE PARTNER and Management performance evaluation meetings with V.L. Team shall be conducted monthly or as required by VLJ team.
- Performance scorecard of SERVICE PARTNER will be evaluated on monthly basis and will be reviewed.
- Revision of SOP is the discretion of VAL Quality team, and it can be modified in accordance with IS/ISO/ASTM standards with time-to-time requirements. It is an integral part of the contract and shall be binding till the execution of the contract.
- Any additional samples for cross checking or any other purpose as provided by Vedanta team to be carried out.

- Proper Housekeeping and 5S to be maintained at all related work areas. All paraphernalia for the same to be provided by the Service Partner. All 5S related expenses are to be borne by Service Partner.
- Service partner must carry out ILC/GRR/round robin every month in other NABL accredited Labs.
- Supply of category wise manpower (competent engineers, skilled, semiskilled & unskilled workmen) with a provision to keep extra in each category to meet the minimum daily requirement for round the clock operation and maintenance including Sunday and Holidays.
- Service partner shall provide all safety related PPEs to its employees and adherence to Vedanta safety guidelines.
- Service partner is responsible for Vedanta Sustainability Assurance Program (VSAP) audit and its compliance.
- Service partner is responsible for Internal & External IMS Audit/Quality related audit/Customer audit & its documentation.
- Service partner shall provide suitable vehicles for the transportation of their manpower at workplace 24x7.
- During the term of the contract, the agency shall maintain an adequate record of spare parts usage on weekly basis and projection of critical spares requirement and submit to the Area in-charge of VLJ.
- Service partner must provide all consumables like gas cylinder, CRM, Calibration standards, Crucible, glassware' chemicals etc related to testing.
- Breakdown report book: The agency shall maintain breakdown report book for keeping a record of breakdown, its analysis, and recommendations.
- Preparation and maintaining history card if any for equipment on regular basis.
- PM and calibration shall be carried out by the Service Partner as and when required.
- Providing training of any nature to the Engineer, Supervisor or Technicians deployed for operation and maintenance, if required, it will be the responsibility of successful tenderer to provide advance training and monitoring service knowledge and tools to their staff.

ANNEXURE-1

Raw material and Consumables			
SL No	Sample Details	SL No	Sample Details
1	Ball Mill Balls	19	Titanium Tablet
2	HSD	20	Chromium Tablet (80%)
3	Round Bar stub steel	21	Manganese Metal (80%)
4	Pig Iron	22	Strontium Metal (10%)
5	Steel Shot 460	23	Tibal Rod (5% Ti)
6	Ramming Mass	24	Magnesium Metal
7	Dense Castable	25	Metallic Silicon – 553
8	Coil Coat	26	Metallic Silicon – 441
9	Ferro Phosphorus	27	Metallic Silicon – 2202
10	Ferro Manganese	28	Copper hardener (80%)

11	Ferro Silicon	29	Copper hardener (30%)
12	Graphite Powder	30	Boron Waffles/Hardener (10%)
13	Colloidal Graphite Solution	31	Iron Tablet 80%
14	Raw AlF3	32	Dross Samples
15	Bath Cryolite	33	PV Samples Carbon
16	Soda Ash Powder	34	PV Samples Pot Room
17	Resister Coke	35	Metallography
18	Synthetic Graphite Premium		

ANNEXURE-2

Inprocess Samples			
SL No	Sample Details	SL No	Sample Details
1	CP Coke	14	Cast Iron
2	Process CP Coke	15	Raw Alumina
3	Coal Tar Pitch Consignment	16	Pot Bath Samples
4	Process CT Pitch	17	Pot Alumina for Size Analysis
5	Butt Samples	18	Pot & Ftp Alumina for iron silicon
6	Ball Mill Products	19	FTP En. Alumina for Enrichment
7	Green Scrap samples	20	FTP Alumina for Size Analysis
8	HFO	21	Cover bath Samples from Pot Room
9	Process HFO	22	Pot Metal
10	Packing Coke	23	Wirerod
11	FTP En. Alumina	24	Cast metal
12	Soot Samples	25	Rodding bath Samples
13	Baked Anodes	26	Water Samples

ANNEXURE-3

Plant 1 Equipment			
SL No	Name of the equipment	S.L. No	Name of the equipment
1	Optical Emission Spectrometer (OES)	36	Table Top Sieve Shaker
2	pH meter	37	Vibrating Cup Mill
3	Orion Multiparameter analyser meter	38	Jaw Crusher
4	HERZOG Milling Machine	39	Sample Divider
5	X-RAY FLUORESCENCE (XRF)	40	Vibratory Bull Density (VBD of CP Coke)
6	Cubix Pro X-ray Diffraction (XRD)	41	Vibration Pad
7	Chiller	42	Pellets Press Machine
8	UPS	43	Disc Pulveriser
9	Fume Hood	44	Automatic Milling Machine

10	Hot Plate	45	Auto Bath Grinder
11	Muffle Furnace	46	Sartorius Analytical balance
12	Hot air Oven	47	Moisture Analyser Balance
13	Top Opening Furnace	48	Millipore Elix 3/5/10/15
14	Electric Water Bath	49	Mili-Q
15	Vacuum Pump	50	Vacuum Pump
16	Diamond wheel Saw RDC 148	51	Computerised UTS Tester
17	Thermal Conductivity RDC 143	52	Automatic Mounting Press
18	Air Permeability RDC 145	53	Variable Speed Grinder polisher
19	Specific Electrical Resistance RDC 150	54	Abrasive cutter
20	Flexural Strength RDC 187	55	Electropolisher Cell module
21	CO2 Reactivity-Coke RDC 141	56	Sample Mounting
22	CO2 Reactivity-Anode RDC 146/3	57	Digital Vernier Caliper
23	Tumbling Apparatus RDC 181	58	Metallurgical Microscope
24	Coking Value RDC 178	59	Ohm Meter
25	Mettler Sample press RDC 182	60	Vickers's Hardness Tester
26	Mettler Softening Point Tester	61	Rockwell Hardness Tester
27	Tapped Bulk Density (TBD)- Coke RDC 153	62	Brinell HARDNESS Tester
28	Viscometer	63	Lathe Machine
29	C&S Analyser CS-230	64	Polishing Machine
30	Bomb Calorimeter AC-350	65	Drill Machine
31	Oxygen Analyser RO 500	66	Centrifuge
32	Helium Pycnometer	67	Digital Turbidity Meter
33	Surface Area Analyser (BET)	68	Laser Particle size Analyser
34	UV-VIS Spectrometer	69	Ice Maker
35	Atomic Absorption Spectrometer	70	Refrigerator

Plant 2 Equipment			
SL No	Name of the equipment	S.L. No	Name of the equipment
1	Optical Emission Spectrometer and its accessories	46	Air Reactivity for Coke
2	HERZOG Automated milling machine	47	Bench Drilling machine
3	HERZOG Manual milling machine	48	Air Reactivity for anode
4	HERZOG Auto Bath Grinder and accessories	49	Compressive strength & Youngs Modulus
5	Pelletising Press	50	Resiflex
6	VIBRATING CUP MILL	51	Mettler sample press
7	XRF	52	Mettler softening point tester
8	XRD	53	karl fischer moisture titrator

9	Chiller	54	Orion multi-parameter analyzer meter(2 star)
10	Chiller	55	Orion multi-parameter analyzer meter (5 star)
11	Unimat Polishing Machine	56	Cast Iron spectrometer
12	Sprue Cutter	57	Polishing Machine for Cast iron polishing
13	Atomic Absorption Spectrophotometer	58	Digimatic calliper
14	UV-VIS Spectrophotometer	59	Water bath
15	Oxygen Analyser	60	Softening point tester with stirrer (Ring and Ball Apparatus)
16	Carbon-Sulphur- Analyser	61	Dean & stark apparatus
17	BOMB CALORIMETER	62	flash point tester
18	GAS (HELIUM) PYCNOMETER	63	coil heater
19	BET Surface Area Analyzer	64	Hotplate (300°Cmax)
20	Millipore Distillation Unit	65	Hot air Oven (0-350°C)
21	UTS Testing Machine	66	Hot air Oven (0-200°C)
22	Micro-ohm meter	67	Drilling machine-Handy
23	Oil Centrifuge	68	Rod Cutter
24	Grinder and Polisher	69	Vacuum Pump
25	Automatic Mounting Press	70	Heating Mantle
26	Cutter for aluminium billet Delta 6	71	Refrigerator
27	Electropolisher	72	Vacuum Cleaner
28	Abrasive Cutter	73	Ice Maker
29	Metallurgical Microscope	74	Muffle Furnace (1200 °C max)
30	Laser Partical size analyzer (1500μ with desirable lens)	75	Muffle Furnace (1500 °C max)
31	Jaw Crusher	76	Fume Hood
32	Sample Divider	77	Moisture Analyzer
33	Sieve shaker	78	Analytical balance
34	Riffle divider (L-1,S-3)	79	Viscometer
35	SpecificElectrical Resistance apparatus	80	Fluorine distillation manifold with steam generator
36	Air permeability tester	81	UPS
37	Thermal Conductivity Apparatus	82	Brinell hardness tester
38	Flexural strength apparatus	83	Distillation unit
39	DIAMOND WHEEL SAW	84	Lathe Machine
40	CO2 Reactivity for coke	85	Ball mill
41	CO2 Reactivity for Anode	86	Drilling Machine
42	TUMBLING APPARATUS	87	Pulveriser
43	COKING VALUE (ALCAN) 0-1000°C	88	Rod Straightner
44	Volatile matter Furnace 0-1000°C	89	Bulk Density Apparatus
45	Bulk Density Apparatus	90	Angle of repose

3. Vedanta Limited - Lanjigarh

Overview

The Alumina refinery at Lanjigarh Laboratory includes two units: **central laboratory** and **processing laboratory**.

Processing laboratory analyses the samples from different phases of the production processes in the refinery. The processing laboratory covers all the productions for 24h (3 shifts operations) ,

The Central laboratory analyses samples of the raw materials, final products and intermediate-stage samples in the factory. The majority of the analysis in the Central laboratory are performed by using the more complex instrumental techniques. Although not accredited, the laboratory provides the quality of the analysis using the certified and reference materials, comparing its analysis with client's laboratory analysis.

Both Central laboratory and **Processing laboratory** involves 26 direct manpower and 30 indirect manpower to perform the activities, based on the required frequency .

Scope of Work:

1. Collection of specified quantity of sample as per the type of test to be conducted. The sample to be collected will be within the battery limit of Alumina refinery as instructed by VLL-QA shift in charges.
2. The sample collected should be brought to the respective lab for further preparation of the sample. The remaining material should be dumped back to specific area as prescribed by VLL.
3. The list of all equipment for preparation/analysis of the sample will be given on requirement.
4. Preparation of sample has to be done by utilizing the plant equipment mentioned. Each sample after preparation has to be given a sample ID as per instruction of the VLL-QA shift in charges.
5. Sampling of materials will be done on 24 X 7 basis including Sundays on a shift-wise basis.
6. Regular inspection, preventive-maintenance and upkeep of all the machines, equipment, utility services, housekeeping & upkeep of all the facilities for sampling.
7. Daily report on status of control parameters, sampling done as per the format prescribed by VLL shall be submitted to site in-charge on daily basis.
8. The tentative manpower is to be deployed/supplied before start of work in a phase wise manner (as communicated by the VLL) to execute the work effectively as mentioned in the scope of work. Phase-wise requirement will be intimated in 2-3months advance by the VLL.
9. In case of any urgency as directed by VLL, sample collection/preparation/analysis job has to carried out in addition to scheduled work.

10. The contractor shall regularly maintain log-books at respective labs/sections/sub-sections as instructed by VLL.
11. Sample collection and handling of samples between site and laboratories. The contractor has to arrange the transportation of the sample from the sample collection point to the respective lab and vice-e-versa.
12. Full time supervision and overall co-ordination for smooth functioning of all the groups i.e., maintenance group, technological assistance group and waste handling group etc. must be ensured by the Contractor.
13. Preparation and maintaining history card if any for equipment on regular basis.
14. Periodic equipment inspection and preparation of inspection report for submission to VLL (Engineer-In-Charge).
15. Regular reporting to VLL officials regarding status/condition of all equipment.
16. At the start and end of every shift, respective shift in charge/supervisor/technician will give status report to VLL Engineer in-charge or his representative as assigned. Any major work should be intimated immediately.
17. The deployment of sufficient manpower in shifts and ensuring smooth operation of plant will be the responsibility of contractor. All the shift personnel will report to respective lab-supervisor of the contractor administratively.
18. The contractor/agency shall coordinate with operation team (may be an another agency) for arranging shutdown/restoration of power if required for sampling with a due intimation to VLL shift in-charge.
19. Record keeping of all the activities as per QMS, EMS, OHSAS and 5S/QC system as per VLL requirements. It may be in the form of soft copy or hard copy as required by VLL.
 - a. Logbook: The agency shall maintain daily logbook (job detail register) for the work done, spares/consumables used, casualty (if any) etc. and get it signed by Engineer in-charge of VLL or his representative at the end of the shift/day.
 - b. Breakdown report book: The agency shall maintain breakdown report book for keeping a record of breakdown, its analysis and recommendations.
 - c. Attendance register: Shift wise attendance register for the personnel engaged is to be maintained and get it signed by shift-in-charge of VLL in shifts and by the Engineer-in-charge of VLL or his representative at the end of the G- shift/day.
20. Supply of category wise manpower (competent engineers, skilled, semiskilled & unskilled workmen) with a provision to keep extra in each category to meet the minimum daily requirement for round the clock operation and maintenance including Sunday and Holidays.
21. To mobilize additional manpower on requirement as communicated by VLL within 3months of communication as per the same quoted rates
22. Providing training of any nature to the Engineer, Supervisor or Technicians deployed for operation and maintenance, if required, it will be the responsibility of successful tenderer to provide advance training and monitoring service knowledge and tools to their staff.
23. Supply of required ISI marked Safety Appliances/Personal Protective Equipment (PPE) for contractor's manpower like hand gloves, shoes, jackets, safety belts, aprons, earplugs, dust mask etc. and adherence to maintain safety practices during the work.
24. Contractor shall provide suitable vehicles for the transportation of their manpower at workplace.

25. During the term of the contract, the agency shall maintain an adequate record of spare parts usage on weekly basis and projection of critical spares requirement and submit to the Engineer in-charge of VLL.

The scope of the contractor is not limited to above. The contractor is liable to act as per instructions of the VLL in case of any other work.

SL No	Type of Work	SL No	Type of Work
1	Auto titration - (Alumina /caustic) ,(C/S ratio)	31	FO Rake Sampling & Preparation
2	Solids analysis (SOLID gpl/mgpl)	32	HSD & LDO Sampling
3	Wet analysis	33	Waste Disposal
4	Instrumental analysis	34	Stock Pile / Yard Sampling
5	Density Measurement	35	Miscellaneous Work
6	Conductivity Measurement	36	Reporting
7	LPSA-Laser particle size analysis	37	Data updating in MES /AMPLA/LIMS
8	Sieve -Analysis	38	UV-Spectrophotometer
9	Moisture -Analysis	39	Settling test
10	Turbidity Analysis	40	Digestion test
11	Red Mud Analysis	41	Polymer optimisation test
12	Alumina analysis	42	LIME TCA formation test
13	Hydrate analysis	43	Operation of Microwave Oven
14	Bauxite analysis	44	Operation of Moisture Analyzer
15	NACT & ACT , Drinking Water Analysis	45	Operation of Tap Density Meter
16	Sampling -Liquids , Solids , bulk raw materials	46	Operation of Jaw crusher, Roll crusher & Disc Pulverizer
17	Sample preparation	47	Operation of Turbo mixture
18	Sample analysis	48	Operation of Herzog & Insmart Pulveriser
19	Operation of XRF & XRD	49	Operation of Flask Shaker
20	XRF fusion bead preparation	50	Operation of Hot air Oven
21	Total organic carbon analysis	51	Operation of Muffle Furnace
22	CHNS analysis	52	Operation of Indigenous Bomb Digestor
23	Oxalate analysis (IC chromatography)	53	Standardization of Potentiometric Titrator
24	Calibration, Standardisation & Reagent Preparation	54	Operation of Bomb calorimeter (AC 350 /AC 550)
25	Monthly Inventory sampling - Wip ,Bulk raw materials	55	Operation of Leco & Eltra Thermo Gravimetric Analyzer (TGA)
26	Slurry/ Bayer Liquor Collection	56	Operation of Microwave Digestion Oven
27	Alumina Rake Sampling & Sample Prepn.	57	Operation and Standardization of AAS Spectrometer
28	Lime Rake Sampling & Prepn.	58	Operation of Flame Photometer
29	Lime Grit Collection & Grinding	59	Sampling Of Caustic Lye

30	Crushed Lime Collection & Preparation	60	AMC , Sapres - SAP clearance
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Note : Above type of works are indicative and not exhaustive