No. C&M/M&P/Spectro/2024 **Dated 06.05.2024**

TECHNICAL SPECIFICATIONS FOR OPTICAL EMISSION SPECTROMETER

1. **Description :** Computer Controlled Direct Reading Optical Emission Spectrometer working on arc-spark Principal.
2. **Brand : Any Brand meeting this specification.**

2.1 Purpose for which required and basic design features :

The spectrometer is required for the analysis of Fe, Al & Cu based alloys.

2.2 For rapid, accurate, repetitive, reproducible and quantitative metallurgical analysis of Solid Samples of ferrous and non-ferrous materials. The spectrometer shall be capable of testing of alloying elements including Nitrogen, Oxygen etc in **Ferrous and Non Ferrous alloys.**

3. **Other Requirements :**

3.1 The operation of the spectrometer should be simple. The spectrometer shall be of such design that it ensures the safety of the operator and the machine at all times

3.2 High resolution CMOS multi detectors shall be provided to cover the functional wavelength of all the elements in the entire usable spectrum.

3.3 The spectrometer should be computer controlled with operations executed by computer software program and direct display of the concentration in percentage of the various elements analyzed and also visual display on Monitor with printing facilities.

4. **Main Characteristics:**

4.1 **Optical Spectrometer System**:

4.1.1 The spectrometer shall be complete with **Vacuum Sealed Optical system.** The spectrometer shall be **Supplied Pre-calibrated for matrices and element ranges along with a set of setting-up standards for each of the bases indicated in Annexure A.**

4.1.2 Spectrometer should cover entire usable spectrum/elements. It should be designed on Paschen Runge mounting with **focal length of minimum 400 mm**. The entire optical cell shall be under vacuum sealed system.

4.1.3 The optical design arrangement shall cover **the wavelengths 120 to 671 nm or better** to cover all elements /ranges including **Nitrogen** in Steels.

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4.1.4 **Suitable high resolution CMOS detectors** with voltage controls should be provided to achieve best sensitivity for the wavelength of the element chosen. **Minimum no. of detectors shall be 15 to avoid any interference of Spectrum.**

4.1.5 **4096 Pixel per CMOS to provide an Average Resolution of 0.010 nm/pixel or better.**

4.2 Sample Excitation System (Spark source/plasma generator & Spark stand)

4.2.1 The excitation source shall represent fully solid state circuit.

4.2.2 The depth of spark shall be minimum and it should be removable by gentle grinding up to the satisfaction level of consignee/ operator..

4.2.3 Three sides open spark stand with universal adjustable sample clamp. Air cooled sample stand with Argon flush at stand for optimized low Argon consumption.

4.2.4 It shall have Exchangeable top plate for individual matrices.

4.2.5 Quick change sample stand shall be provided. The sample stand should preferably be open type to accommodate large samples. The sample stand shall be capable of accommodating samples up to 80 mm dia and 65 mm height.

4.2.6 **Two sets of Adopters or arrangements shall be provided for samples having smaller surface area/ diameter (such as rod/wire of size 0.5 - 11 mm dia,).**

4.2.7 Carbon or metal powder output shall be minimum at burn to the satisfaction level of consignee/ operator.

4.2.8 Sound level at the time of sparking shall be minimum such that it should not disturb normal hearing to the satisfaction of consignee.

4.2.9 Standardization of the spectrometer shall be applicable at minimum & maximum range of elements for each base, bidder to furnish details at the time of installation/commissioning of Spectrometer.

4.2.10 Setting-Up Standards: A full set of setting –up standards for EACH of the bases that spectrometer is ordered for.

4.3 Vacuum System for Optics.

4.3.1 The vacuum control shall be via software.

4.3.2 The suitable vacuum level shall be obtained in quickest possible time to analyze all the elements. The Vacuum pump should be capable for automatically running on demand & should be **low noise turbo molecular type with dry membrane without any oil seals.**

4.3.3 The vacuum system should based on direct light path.

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4.4 Power Input, Distribution and Voltage Regulation:

4.4.1 The equipment shall be provided with necessary power cables , connectors , switch gears etc and a suitable on line 3KVA UPS for the entire system with minimum 30 min. battery backup time.

4.5 Computer System:

4.5.1 The spectrometer should be equipped with computer system to control and monitor primary spectrometer functions integration, A/D Conversion and diagnostics. It should be supported by **Computer system with Printer.**. The computer shall conform the following features:

- Processor – Intel Core i5 or i7
- 8 GB RAM minimum.
- Hard Disk 1 TB Min (SSD)
- Minimum 23 inch Colour TFT Monitor
- Two USB Port, one parallel printer port minimum.
- Key Board (multimedia) with Scroll mouse
- Network capability.
- Operating System Window 10
- Clock/calendar board with battery backup

4.6 Software:

4.6.1 All functions as well as output sequence should be determined by suitable software programs including storage of one time standardization and calibration curves of the equipment so as to avoid periodical standardization and calibration through menu drive interactive programming. The software should be able to preserve story of records of 10000 samples.

4.6.2 The software shall control the following functions of spectro meter :- Flush, pre-burn and Spark including integration time. Variable sample excitation and/ or source parameters pre-burn/integration.

4.6.3 The software shall automate the following functions:

* Operating system latest version.
* Burn data in concentration percentage or ppm, intensity, intensity Ratio, Corrected or Standardization intensity Ratio
* Automatic curve fit for calibration curves
* Automatic program selection through computer
* Automatic switch over of spectral lines
* Inter element interference correction and matrix correction

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* Global pre calibration for over all programs provided at analytical programme with supply of setting up standards for standardization.
* Automatic repeatability check with static.
* Graphical display of calibration curve with Zoom facility.
* Standard library
* Provision of program for updating of calibration using customer standard
* Provision of software edition of activation of new matrices / element
* Automatic control of all measuring conditions.
* Storage of complete spectral information for future evaluation.
* Graphical display of spectra for quantitative evaluation.
* Diagnostics including Argon pressure watchdog, vacuum level watchdog, automated spectral drift control with log files, log files for standardization routine and error message, visual display of complete spectra with store and compare functions.
- Automatic hardware diagnostics.
* Data storage and retrieval on analysis scheme.
* Storage file should be compatible with excel to create daily report.

Software support/updates for the full life of instrument shall have to be ensured by the supplier free of cost during Warranty & AMC

7. Concomitant Accessories:

Following Accessories of reputed Make shall also be provided with the spectrometer. Cost of these to be included in the bid.

- On-line 3KVA UPS (Emerson or equivalent) with 30 min. of battery back-up
- **Single Disc (dia 300 mm) Sample grinding, Polishing Machine with safety cover, Air blower, Dust collector** and magnetic sample holder **with Variable speed, Max. Speed 2400 RPM**. Power 220V, 50 Hz. 0.75 Hp motor Self breaking and with **50 nos. of spare Polishing papers**
- Capital spares to ensure reaction to failure/breakdowns during the warranty period and to support maintenance in the post warranty period.
- Spares & Consumables for minimum Two years normal operation and maintenance.
- The spare parts should also include **minimum Ten (10) number of electrodes and other consumable items for a minimum period of 02 years operation @ 100 samples per day.**
- **Full set of Setting up standards for EACH of bases.**
- **One sets of Primary Standards (CRM) listed at Annexure B**
- **Two Nos.** Dual Stage Stainless Steel Argon Gas regulators with SS diaphragm.

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8. Infrastructural Requirements

8.1 The bidder shall indicate the space, air conditioning and other requirement for optimal performance of the machine. The spectrometer shall be capable of operation at temperature range of 20 to 24 `C.

8.2 Technical Specification and quantity and Purity of Argon Gas required for initial commissioning shall also be furnished.

8.3 The bidder shall furnish the electrical power requirement for the machine along with sub system.

9. Training

9.1 After commissioning, Training to 5 Supervisors and 2 officers at RCF to their full satisfaction for one week.

10. Installation and Commissioning and Proving Test

10.1 The firm or his agent shall be required to carry out a joint check at the consignee`s end along with the consignee before unpacking is done to avoid subsequent complaints regarding short shipment or transit damages. It is necessary that consignee to avoid commissioning delays due to shortages/transit damages do this joint inspection immediately on receipt of the machine.

10.2 The firm shall arrange the unloading and shifting of equipment from the lorry/vehicle to the installation site.

10.3 The firm or his agent shall demonstrate performance of this machine after successful commissioning at the consignee for a period of three working days. There after consignee shall watch the machine performance for a period of three month before final proving test certificate is issued.

11. Annual Maintenance Contract

11.1 Bidders are required to quote for a Comprehensive Annual Maintenance (Cost of AMC) for three years after expiry of warranty period.

11.2 The option to award AMC shall remain with the consignee after completion of warranty.

12. Warranty:

12.1 Firm shall have to provide warranty for 24 months after the commissioning of the instrument.

13. All the technical claims made by the firm shall be correct and if any claim found incorrect firm will be debarred from RCF for five years.

14. ANNEXURE A – Technical parameters for FE, Al and Cu base alloys.

15. ANNEXURE B- List of required Primary Standards (CRM) to be supplied along with specified material.

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Annexure-A (Page 3 Pages)

ANNEXURE-A/PRE-CALIBRATED ELEMENTS/RANGES IN FE BASE

ELEMENTS		Orientation		Low Alloy		Cast Irons		Cr Hard & Ni Resist		Stainless Steel		Mn Steel	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Al	Aluminum	0.001	6	0.0005	1.6	0.0002	1.6	0.0005	0.3	0.0005	6	0.0005	0.6
As	Arsenic			0.0005	0.15	0.0001	0.15						
B	Boron			0.0001	0.15	0.0001	0.15	0.0001	0.1	0.0001	0.1		
Bi	Bismuth			0.0005	0.15	0.0005	0.15						
C	Carbon	0.001	5.5	0.0005	1.8	1	5	1	5	0.0005	2.5	0.0005	2
Ca	Calcium			0.0001	0.008					0.0001	0.008		
Ce	Cerium					0.001	0.2						
Co	Cobalt	0.0005	14	0.0005	1.25	0.0005	2	0.0005	0.35	0.0005	10	0.0005	0.6
Cr	Chromium	0.0005	45	0.0005	6	0.0005	3	0.0005	40	0.0005	40	0.0005	6
Cu	Copper	0.0002	12	0.0002	1	0.0002	3	0.0002	11	0.0002	5	0.0002	1
La	Lanthanum					0.0002	0.1						
Mg	Magnesium					0.0001	0.15						
Mn	Manganese	0.0005	24	0.0005	3	0.0005	2.5	0.0005	2.5	0.0005	18	5	24
Mo	Molybdenum	0.0005	12	0.0005	2	0.0005	2	0.0005	4.5	0.0005	8	0.0005	2.5
N	Nitrogen			0.001	0.8	0.001	0.5			0.001	1	0.001	0.8
Nb	Niobium	0.0005	3.5	0.0005	2	0.0005	0.2	0.0005	0.5	0.0005	3.5	0.0005	2
Ni	Nickel	0.0005	55	0.0005	6	0.0005	4	0.0005	35	0.0005	55	0.0005	4.5
P	Phosphorous	0.0005	0.2	0.0005	0.2	0.0002	2	0.0005	0.25	0.0005	0.2	0.0005	0.2
Pb	Lead	0.001	0.5	0.0005	0.15	0.001	0.5			0.001	0.5	0.001	0.5
S	Sulfur	0.0005	0.2	0.0005	0.4	0.0005	0.2	0.0005	0.2	0.0005	0.4	0.0005	0.2
Sb	Antimony			0.0005	0.2	0.0005	0.25			0.002	0.2		
Se	Selenium			0.001	0.25	0.001	0.25			0.0005	0.25		
Si	Silicon	0.001	5.5	0.0005	2.25	0.0005	5.5	0.001	7	0.0005	2.5	0.0005	2.5
Sn	Tin	0.0005	0.3	0.0005	0.3	0.0005	0.3	0.0005	0.2	0.0005	0.3	0.0005	0.3
Ta	Tantalum			0.005	0.3					0.005	0.2		
Te	Tellurium					0.0005	0.2						
Ti	Titanium	0.0002	1	0.0002	1	0.0002	0.5	0.0002	0.5	0.0002	2	0.0002	1.3
V	Vanadium	0.0005	12	0.0005	1	0.0002	1	0.0005	1	0.0005	2	0.0005	0.5
W	Tungsten	0.002	24	0.002	2	0.003	0.2	0.002	0.5	0.003	4	0.003	1.5
Zn	Zinc			0.0002	0.05	0.0002	0.05						
Zr	Zirconium			0.0005	0.5	0.0005	0.2			0.0005	0.5		
FE	Iron	REFERENCE											

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ANNEXURE-A/PRE-CALIBRATED ELEMENTS/RANGES IN AL BASE

ELEMENTS		Orientation		Low Alloy		Al-Cu Alloy		Al-Mg Alloy		Al-Si/Cu Alloy		Al-Zn-Si Alloy	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Ag	Silver	0.0001	1.2	0.0001	1.2	0.0001	1.2	0.0001	1.2	0.0001	1.2	0.0001	1.2
As	Arsenic	0.003	0.05	0.0003	0.05								
B	Boron	0.0001	0.025	0.0001	0.025	0.0001	0.025	0.0001	0.025	0.0001	0.025	0.0001	0.025
Ba	Barium	0.0001	0.0001	0.0001	0.025	0.0001	0.025	0.0001	0.025	0.0001	0.025	0.0001	0.025
Be	Beryllium	0.0001	0.02	0.0001	0.02	0.0001	0.02	0.0001	0.02	0.0001	0.02	0.0001	0.02
Bi	Bismuth	0.0005	0.75	0.0005	0.75	0.0005	0.75	0.001	0.75	0.001	0.75	0.0005	0.75
Ca	Calcium	0.0001	0.025	0.0001	0.02	0.0001	0.02	0.0001	0.02	0.0001	0.025	0.0001	0.02
Cd	Cadmium	0.0002	0.5	0.0002	0.15	0.0002	0.35	0.0002	0.35	0.0002	0.35	0.0002	0.35
Ce	Cerium	0.0002	0.05	0.0002	0.05	0.0005	0.05	0.0005	0.05	0.0002	0.05	0.0005	0.05
Co	Cobalt	0.0003	0.5	0.0003	0.5	0.0003	0.5	0.0003	0.5	0.0003	0.5	0.0003	0.5
Cr	Chromium	0.0002	0.6	0.0002	0.6	0.0002	0.6	0.0002	0.6	0.0002	0.25	0.0002	0.6
Cu	Copper	0.0003	12	0.0003	1	0.001	11	0.0003	0.5	0.0003	10	0.0003	2.5
Fe	Iron	0.0005	3	0.0005	3	0.0002	3	0.0005	3	0.0005	3	0.0005	1
Ga	Gallium	0.0001	0.2	0.0001	0.2	0.0001	0.12	0.0001	0.12	0.0001	0.12	0.0001	0.12
Hg	Mercury	0.0005	0.1	0.0005	0.1	0.0005	0.1	0.0005	0.1	0.0005	0.1	0.0005	0.1
In	Indium	0.0001	0.12	0.0001	0.15	0.0005	0.15	0.0005	0.15	0.0005	0.15	0.0001	0.15
La	Lanthanum	0.0001	0.05	0.0001	0.05	0.0005	0.05	0.0005	0.05	0.0005	0.05	0.0001	0.05
Li	Lithium	0.0001	0.025	0.0001	0.025	0.0001	0.025	0.0001	0.025	0.0001	0.025	0.0001	0.025
Mg	Magnesium	0.0005	13	0.0002	2	0.0005	5.5	0.0005	13	0.0005	5	0.0005	5
Mn	Manganese	0.0002	2.2	0.0002	2.2	0.0002	2.2	0.0002	0.5	0.0002	0.5	0.0002	1.5
Mo	Molybdenum	0.0002	1	0.0002	1	0.0002	1	0.0002	1	0.0002	1	0.0002	1
Na	Sodium	0.0001	0.025	0.0001	0.025	0.0001	0.025	0.0001	0.025	0.0001	0.025	0.0001	0.025
Ni	Nickel	0.0005	5.5	0.0005	1	0.0005	5.5	0.0005	5.5	0.0005	5.5	0.0005	1
P	Phosphorous	0.0015	0.075	0.0015	0.06	0.0015	0.075	0.0015	0.075	0.0015	0.075	0.0015	0.075
Pb	Lead	0.0002	1.75	0.0002	1.75	0.001	1	0.001	1.75	0.0002	1	0.001	1
Sb	Antimony	0.001	0.75	0.001	0.2	0.001	0.75	0.001	0.2	0.001	0.2	0.001	0.2
Sc	Scandium	0.0001	0.06	0.0001	0.06	0.0001	0.06	0.0001	0.06	0.0001	0.06	0.0001	0.06
Si	Silicon	0.0003	28	0.0003	1.5	0.0003	2	0.0003	1.25	1	25	0.0003	20
Sn	Tin	0.0002	4.2	0.0002	1.25	0.0002	4	0.0002	1.25	0.0002	1.25	0.0002	5
Sr	Strontium	0.0001	0.15	0.0001	0.15	0.0001	0.15	0.0001	0.15	0.0001	0.15	0.0001	0.15
Ti	Titanium	0.0002	1	0.0002	1	0.0002	0.5	0.0002	1	0.0002	1	0.0002	1
Tl	Thallium	0.0003	0.025	0.0003	0.025								
V	Vanadium	0.0003	0.35	0.0003	0.35	0.0003	0.15	0.0003	0.15	0.0003	0.15	0.0003	0.15
Zn	Zinc	0.0005	13	0.0002	2	0.0005	3.5	0.0005	2	0.0005	1	0.0005	13
Zr	Zirconium	0.0005	1	0.0005	1	0.0005	1	0.0005	0.25	0.0005	0.25	0.0005	1
Al	Aluminium	REFERENCE											

ANNEXURE-A PRE-CALIBRATED ELEMENTS/RANGES IN COPPER BASE

ELEMENTS		GLOBAL		Pure Copper		Cu-Zn Brass		Cu-Sn-Pb Bronze		Gunmetal		Cu-Ni Alloy		Cu-Al Alloy	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Ag	Silver	0.0005	5	0.0002	1.2	0.0005	0.5	0.0005	1.2	0.0005	1.2	0.0002	0.5		
Al	Aluminum	0.001	12	0.0002	0.25	0.0005	4	0.0005	1	0.0005	1	0.0004	1.7	0.0004	13
As	Arsenic	0.001	2	0.0001	0.5	0.0002	0.5	0.0005	1.8	0.0005	1.8			0.0002	0.5
Au	Gold			0.0002	0.015										
B	Boron	0.0001	0.05	0.0001	0.1							0.0001	0.1		
Be	Beryllium	0.0005	2.2	0.0001	1							0.0001	0.2		
Bi	Bismuth	0.001	7	0.0001	0.1	0.001	7	0.0005	7	0.0005	1	0.0005	0.4		
C	Carbon											0.0002	0.1		
Cd	Cadmium	0.0005	1.2	0.0001	1.3	0.0005	0.6	0.0005	0.5	0.0005	0.5	0.001	0.5		
Co	Cobalt	0.001	3.6	0.0003	1	0.0005	0.5	0.0005	0.75	0.0005	0.75	0.0005	0.2		
Cr	Chromium	0.0005	3.2	0.0002	1.5	0.0002	0.5	0.0002	0.1	0.0002	0.1	0.0002	3.2	0.0005	0.5
Fe	Iron	0.0005	7	0.0003	0.5	0.0003	2	0.0003	2.5	0.0003	1	0.0003	3	0.0003	8
Mg	Magnesium	0.0001	0.2	0.0001	0.1	0.0001	0.05					0.0001	0.1	0.0001	0.25
Mn	Manganese	0.0005	22	0.0001	0.2	0.0003	20	0.0002	2.5	0.0002	1	0.0001	5	0.0001	7
Nb	Niobium											0.0005	1		
Ni	Nickel	0.001	40	0.0005	0.6	0.001	5	0.0005	3.5	0.0005	3.5	5	42	0.001	8
O	Oxygen			0.001	0.05										
P	Phosphorous	0.0005	1.2	0.0002	0.3	0.0002	0.25	0.0002	1.2	0.0002	1.2	0.0002	0.3	0.0002	0.2
Pb	Lead	0.0002	24	0.0002	1	0.002	5	0.0005	24	0.0005	24	0.0002	0.5	0.0002	1
S	Sulphur	0.0005	0.5	0.0002	0.1	0.0002	0.1	0.0002	0.2	0.0002	0.2	0.0002	0.2	0.0002	0.5
Sb	Antimony	0.001	5	0.0005	0.4	0.001	0.8	0.001	4.5	0.001	1.2	0.001	0.5		
Se	Selenium	0.001	1.6	0.0001	0.4	0.0002	1.5	0.0002	1.6			0.001	0.5		
Si	Silicon	0.0005	4	0.0002	2	0.0002	4	0.0005	8	0.0005	1	0.025	4	0.0002	1
Sn	Tin	0.0005	20	0.0001	0.5	0.0001	11	0.0001	18	0.0001	18	0.0005	0.5	0.0001	0.5
Te	Tellurium	0.002	1	0.0005	1										
Ti	Titanium	0.0002	0.08									0.0002	0.1		
Zn	Zinc	0.001	50	0.0002	0.5	0.0005	50	0.0002	15	0.0002	15	0.0002	1.5	0.0002	1
Zr	Zirconium	0.0005	0.2	0.0002	0.2							0.0001	0.2		
Cu	Copper	REFERENCE													

Prepared by CMS/Speclr

Checked ~~Prepared~~ by ACMT

~~Approved~~ Checked by CMT

Reviewed by Dy-CME/QA-II

Approved by CME/QA-I

ANNEXURE B

1. One set each of the following Primary standard samples to be provided with the Spectrometer.
2. Standards listed here under for each alloy with specific part number to be provided only.

FERROUS BASE

1.	Plain Carbon Steel	(SS-CRM 605/2)	ONE Piece
2.	Low Alloy Steel	(CRM 12 X 352 & 12XLA5)	ONE Piece each
3.	Austenitic Stainless Steel	(SS-CRM 465/1)	TWO Piece
4.	Ferretic Stainless Steel	(SS-CRM 70)	ONE Piece
5.	Tool Steel	(32-C)	ONE Piece

ALUMINIUM BASE

1.	511 X G3000B3	TWO Piece
2.	54 X G13H4	ONE Piece

COPPER BASE

1.	UZ 40 Brass	ONE Piece
2.	CURM 09.04-4	ONE Piece
3.	P-Bronze	ONE Piece

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