

SECTION - C

TECHNICAL SPECIFICATIONS OF STORES AND DRAWINGS.

Technical Specifications of Integrated High Resolution Spectrometer System comprising of Spectrograph, CCD Detector, Imaging Fiber Adapter, Fiber Bundle/Array with Coupling Ferrule, External Shutter, System Integration, Control and Data Acquisition System alongwith required accessories as per the technical specifications mentioned in the tender documents.



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Technical Specifications

IPR intends to procure an integrated system comprising of spectrograph, CCD detector, imaging fiber adapter, fiber bundle with a coupling ferrule and external shutter. Accordingly, the technical specifications are grouped into five categories: 1) Imaging spectrograph 2) Imaging fiber adapter and fiber array 3) CCD detector 4) System Integration, Control and Data acquisition 5) Acceptance Test

I.A) Technical specifications of Imaging Spectrograph			
Sr No	Item	Specification	Description
1	Type Mount	Visible imaging spectrograph Preferably Czerny-Turner	Any modified Czerny Turner which comply with IPR technical specifications can also be quoted as an option.
2	F#(F-number)	4 to 7	Vendor may choose to quote the appropriate focal length of the instrument which yields the desired F# in the specified range.
3	Image distortion# at the exit focal plane		Vendor has to choose a suitable imaging optics in the spectrograph to achieve this imaging specification. <i># Image distortion means the size of the image at the focal plane after correcting all the aberrations such as spherical aberrations, astigmatism etc.</i>
4	Grating type	Plane reflecting holographic	Vendor to specify the blaze wavelength Grating. An appropriate blaze angle has to be chosen such that it has maximum grating efficiency in the range 500-650nm.
5	Required no of gratings Grating groove density Grating no .1 Grating no .2 Grating no. 3 Grating configuration/ mount :	Three 1800 1/mm 1200 1/mm 600 1/mm Turret is preferable.	
6	Linear dispersion(nm/mm)	~ 0.95 nm/mm (1800l/mm) ~ 1.5 nm/mm (1200 1/mm) ~ 3.2 nm/mm (600 1/mm)	
7	Wavelength resolution with CCD detector	~0.05nm (1800 1/mm) ~0.07nm (1200 1/mm) ~0.13 nm (600 1/mm)	This is to be achieved, when the input slit width is of the order of pixel size of the CCD detector. Vendor has to clearly mention the wavelength resolution which can be

			achieved across the focal plane of the CCD detector.
8	Wavelength coverage with CCD detector	~10 nm (1800 l/mm) ~20 nm (1200l/mm) ~40nm (600l/mm)	
I.B) Entrance and exit ports with slit assembly			
1	No of entrance ports	Two ports (one motorized slit assembly and one manual bilateral slit)	Externally controlled motorized micrometers to vary the slit width. A mechanism to vary slit height should also be available.
2	No of exit ports	Two ports	The additional exit port should be similar to the manual slit assembly used at the entrance port.
3	Diverter mirrors	One for Entrance port One for Exit	Divertor mirror to select the desired entrance/ exit ports.
I.C) External shutter			
Note: If the CCDs exposure is controlled by the internal electronic shutter provided in the detector head. Vendor has to clearly mention the above feature in the quotation.			
1	Shutter	Shutter for CCD exposure	Shutter to be mounted at the entrance port of the Spectrograph.
2	Shutter Aperture Size	Expose the entire CCD	
3	Shutter Open time	~ 5ms	
4	Delay in close and opening	≤ 20 ms(Approx)	
II) Technical specifications of Imaging fiber adapter and fiber array			
Sr no	Item	Specification	Description
1	Optical fiber array terminated with a common ferrule.	<ul style="list-style-type: none"> An array of maximum 18 optical fibers have to be aligned vertically. [An example fiber arrangement drawing is given in Appendix-1] At one end, the array has to be terminated with a common ferrule. At the other end, each fiber has to be separately terminated with a SMA 905 connector/ termination. 	The ferrule has to be compatible with the quoted imaging fiber adapter. The intensity of all the fiber images has to be nearly same across the focal plane <i>Vendor can also suggest the maximum no of fibers in the fiber array based on the quoted CCD height. This should be clearly mentioned in the quotation.</i>
2	Optical fiber	Type : Multimode Single core Silica Core diameter : 0.4 mm Length: 2 meters with standard SMA terminations.	
3	Imaging fiber adapter	<ul style="list-style-type: none"> An imaging fiber adapter which couples light to the input of the spectrograph has to be provided at the 	Vendor can suggest alternative coupling mechanisms, if any, for coupling the fiber array to the input

		<p>entrance of the spectrograph.</p> <ul style="list-style-type: none"> It should have provision for transverse and longitudinal adjustments. 	of the spectrograph and quote for the same.
III) Technical specifications of CCD detector			
Sr no	Item	Specification	Description
1	Grade	Scientific grade ,Grade 1	
2	Type	Back illuminated	
3	Dimension	At least 12 mm of vertical coverage. and results~10 nm wavelength coverage when the 1800 l/mm grating is used.	The chip vertical dimensions has to accommodate the image of fiber array as mentioned in item. II, Sr.no.1.
4	Sealing	Hermetically sealed /All metallic vacuum sealing	Permanent vacuum and Maintenance free
5	Head Cooling	TE cooled up to -50 C or better	
6	Read out rate	~1MHz read rate ~3 frames/sec under no binning condition.	Vendor has to specify the actual achievable frames per second including the shutter opening and closing delays.
IV) System Integration, Control and Data Acquisition			
Sr no	Item	Specification	Description
1	CCD integration with Spectrograph	CCD should be aligned at the focal plane of the Spectrograph. Vendor has to provide the CCD coupling flange. Vendor has to provide the required accessories for the alignment of CCD.	
2	Fiber adapter and fiber array alignment at the entrance slit	The fiber array alignment has to ensure the imaging performance as specified in the spectrograph's Technical specifications. (Item.I, Sr.No 3)	
3	Wave length scanning	The wavelength scanning speed and scanning resolution has to ensure fast spectral measurements.	The scanning of the grating should be computer controlled by the same software which controls the CCD.
4	Wavelength calibration	Option has to be provided in the instrument's operation software.	
5	Data acquisition and Control	The integrated system including shutter should be operable and controlled by single PC and single software. The integrated system should be operable in synchronization with an external trigger. System operation in remote mode is essential.	Vendor to provide detailed information on this mode of operation and accessories required if any

Additional requirements: All the cables, tools and power supplies (~ 220 V and 50Hz) have to be provided by vendor. All the technical manuals and along with the operation manual for hard ware and software have to be provided by the vendor during commissioning at IPR.

V. Acceptance Test

The final acceptance of the product will be given after the following two tests:

1. Pre-dispatch test at factory site by the vendor. (Pre-dispatch test by IPR personnel at factory (vendor) site is not required).
2. Final acceptance test at IPR.

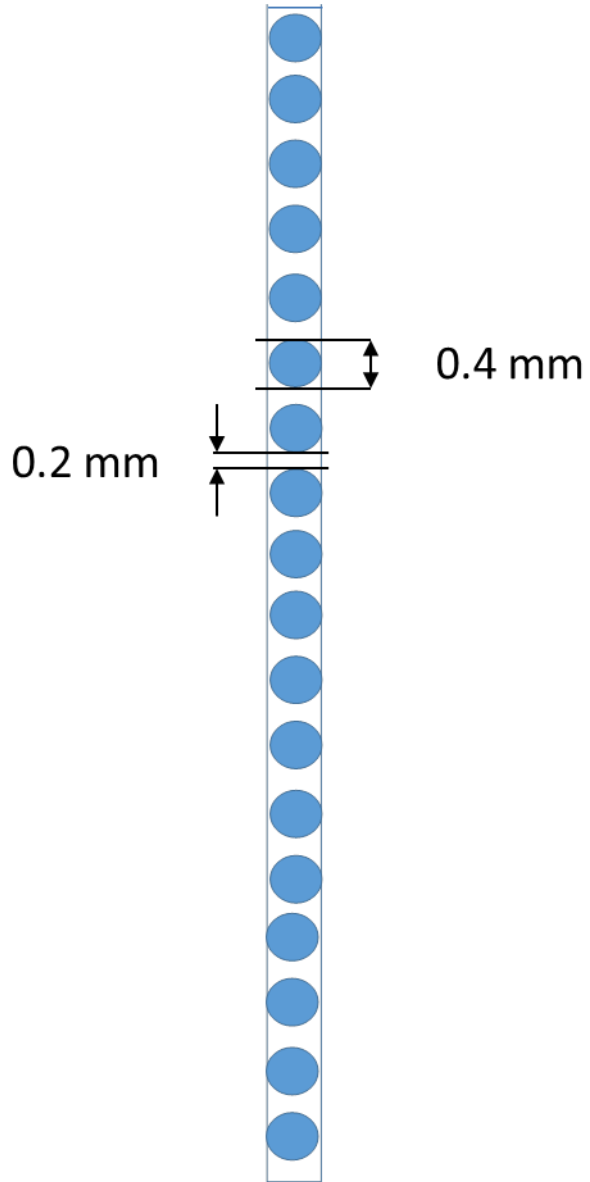
Part I: Pre-dispatch test at factory site by the vendor:

Vendor will carry out detailed test and evaluation of the instrument as per mutually agreeable procedures. In Appendix -2, details of the relevant acceptance test procedures are described. If further modifications are necessary, vendor can suggest the same to IPR. The vendor will send a detailed test report to IPR before the dispatch of the equipment. The test report will be evaluated by IPR and if found satisfactory, IPR will send the dispatch clearance certificate.

Part II: Acceptance Test at IPR:

At IPR, installation, testing and demonstration of the instrument and its performance should be carried out either by the principal or by their Indian representative. After successful commissioning at IPR, acceptance will be given only when it complies with all the technical specifications and reproduces the same results that were obtained during the pre-dispatch test by the vendor at their factory site.

Appendix- 1



Appendix-2

ACCEPTANCE TEST PROCEDURE OF THE SPECTROGRAPH WITH CCD DETECTOR

All the below acceptance tests are to be done.

1) Test for the imaging performance

At the entrance of the spectrograph	Fiber array coupled and aligned using imaging fiber adapter.
Light sources	<ol style="list-style-type: none"> 1) Integrating sphere and a Quartz Tungsten lamp 2) Low pressure Mercury lamp
Spectrograph Settings	<p>Configuration 1: Slit width : ~ pixel size of CCD Slit height : ~ height of CCD</p> <p>Configuration 2: Slit width : ~ Size of fiber core (~ 0.4mm) Slit height : ~ height of CCD</p>
Test procedure	<p>Configuration 1 :</p> <ol style="list-style-type: none"> a) Scan the spectrum from 250-800nm using light source.1 b) Record 435.8nm or 546.1nm using light source.2. <p>Configuration 2 : Record the spectrum in 0th order</p>
Configuration	Expected test result
Configuration 1	<ol style="list-style-type: none"> a) A dispersed spectrum consisting of distinct, spatially well resolved and uniformly illuminated tracks with the track to track separation remaining nearly across the focal plane of the CCD. The number of pixels in the non-illuminated region should be nearly equal (~10% or better) across the image plane of the CCD. b) When only one track is illuminated, the intensity reading in the other track should show counts corresponding to the background counts of CCD. The test has to be repeated by illuminating all the tracks one by one to check consistency across the image plane.
Configuration 2	Well resolved images of the fibers across the focal plane.

2) Test for average wavelength coverage and average wavelength dispersion

At the entrance of the spectrograph	Fiber array coupled and aligned using imaging fiber adapter.
Light source	Low pressure Mercury lamp
Spectrograph Settings	<p>Slit width : ~ pixel size of CCD Slit height : ~ height of CCD Configuration 1 : 1800 1/mm Configuration 2 : 1200 1/mm Configuration 3 : 600 1/mm</p>
Test procedure	<p>Scan two wavelengths in one frame: λ_1 and λ_2 Dispersion = $(\lambda_2 - \lambda_1) / W$ Where, W= No of pixels covered* pixel width (mm)</p>
Configuration	Expected test result
Configuration 1	~0.95 nm/mm and ~10 nm/mm
Configuration 2	~1.5 nm/mm and ~20 nm/mm
Configuration 3	~3.2 nm/mm and ~40 nm/mm

3) Test for wavelength resolution

At the entrance of the spectrograph	Fiber array coupled and aligned using imaging fiber adapter.
Light source	Low pressure Mercury lamp
Spectrograph Settings	Slit width : ~ pixel size of CCD Slit height : ~ height of CCD Configuration 1 : use 1800l/mm Configuration 2 : use 1200 l/mm Configuration 3 : use 600 l/mm
Test procedure	
Spectral lines	253nm, 313nm, 326.6nm, 435.8nm, 546.1nm, 626.2nm, 696.7nm and any emission line in between 700-1000 nm range for 1200 l/mm and 600 l/mm.
Configuration	Expected test result
Configuration 1	For the above mentioned spectral profiles, the pixels contained in FWHM of the profile multiplied by the appropriate reciprocal dispersion have to show the wavelength resolution as <i>about 0.05nm for all the recordings i.e. center, right and left edges of CCD.</i>
Configuration 2	For the above mentioned spectral profiles, the pixels contained in FWHM of the profile multiplied by the appropriate reciprocal dispersion have to show the wavelength resolution as <i>about 0.07nm for all the recordings i.e. center, right and left edges of CCD.</i>
Configuration 3	For the above mentioned spectral profiles, the pixels contained in FWHM of the profile multiplied by the appropriate reciprocal dispersion have to show the wavelength resolution as <i>about 0.13nm for all the recordings i.e. center, right and left edges of CCD.</i>

4) Test for the performance of CCD detector

At the entrance of the spectrograph	Fiber array coupled and aligned using imaging fiber adapter.
Light source	Any suitable light source
Spectrograph Settings	Slit width : ~ pixel size of CCD Slit height : ~ height of CCD
Shutter exposure time	Between 20 to 40msec
CCD read out rate	~1MHz(Typical)
Test procedure	By a mutually agreeable method
Tests	Expected test result
Frames	~3 frames per second without binning
Remote operation	Operation (spectrograph, CCD and shutter) and acquisition of spectra in remote mode using a standard external trigger.

:-COMPLIANCE STATEMENT:-

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Sr no	Item	IPR Specification	Description	Vendors Specification
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IV) System Integration, Control and Data Acquisition

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V. Acceptance criteria

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Authorized Signatory

Official Seal

Date :-