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| Traveler Title | SNSPPU Cavity RF Incoming Inspection | | | |
| Traveler Abstract | RF Incoming Inspection of SNSPPU production cavities | | | |
| Traveler ID | SNSPPU-CAV-RFIN | | | |
| Traveler Revision | R1 | | | |
| Traveler Author | P. Dhakal | | | |
| Traveler Date | 27-Apr-20 | | | |
| NCR Informative Emails | Edaly | | | |
| NCR Dispositioners | Kdavis,forehand,kwilson | | | |
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| Approval Dates |  |  |  |  |
| Approval Title | Author | Reviewer | Reviewer | Project Manager |

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| References | List and Hyperlink all documents related to this traveler. This includes, but is not limited to: safety (THAs, SOPs, etc), drawings, procedures, and facility related documents. | | | |
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| Revision Note |  |
| R1 | Initial release of this Traveler. |

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| **RF Inspection Goals:**  This traveler covers the inspections required for RF acceptance of incoming SNSPPU. The RF inspections shall be carried out in the RF tuning area as soon as possible after the initial receipt inspection is completed. A Vector Network Analyzer,  50 Ohm RF cables with Type-N connectors, an RF amplifier and a digital multimeter are required. Additionally, the ambient conditions shall be recorded (temperature, pressure and relative humidity) using either a weather station or the electronic data logger already available in the RF tuning area for this purpose.  The main goal of the RF inspection is to measure the **warm frequencies (under vacuum) for all six fundamental passband modes, record the transmission spectrum for the fundamental passband modes, record the vendor data for the passband modes in case the cavity documents are provided in copy with the cavity, store and upload the Excel spreadsheet with all data to M-drive, check whether the accelerating mode pi-mode frequency is within the specified range and eventually check the electrical integrity of all RF antennas. After completion of the RF inspection, the cavity is handed over to visual and CMM inspections.**  Careful handling of the cavity is mandatory at all times. This includes transferring the cavity to another work station during or after the inspections.  **Prior the delivery, the cavity has been completely post-processed including the main and final Electropolishing. The cavity has also been tuned to a warm target frequency (toleranced ± 100 kHz) and tuned field flat (field flatness is toleranced > 90%, which is the ratio of the minimum to the maximum field amplitude measured along the cavity referring to the center of the cavity cells on axis). Furthermore, the cavity has been straightened to specified values on the vendor’s cavity tuning machine. The only chance to evaluate whether the field flatness has been affected during the shipment is to measure the fundamental passband mode frequencies and compare the data with the vendor data recorded before shipment.**  **Each SNSPPU production cavity is delivered without helium vessel under vacuum and at this point has passed 3 acceptance levels (hold points), the last hold point permitting shipment to JLab. The frequencies of all six fundamental mode passband modes have been recorded just prior to shipment by the vendor with the cavity under vacuum. The same measurements shall be repeated after the delivery, which provides a measure whether and how much frequencies have changed due to potential deformations of the cavity cells. Such deformations may occur as a consequence of (mis-)handling (shock events) during the transit..**  **The as-delivered cavity is also equipped with qualification hardware ready for vertical cold tests, which includes one high-Q fixed antenna (SST) attached to the main coupler port, one pickup antenna feedthrough (Kyocera, Drawing GMM-B4787) attached to the small ports on the opposite side of the main coupler port. The beam tube flange on the short beam tube side carries a right angle valve (VAT). A Burst disc is attached on the other side of beam tube. The figure below highlights the hardware accessories assembled at the time of delivery.**   |  |  | | --- | --- | | **Field Probe** | **FPC** | | | |
| Step No. | Instructions | Data Input |
| 1 | **RF Inspection Basic Data**  **Recipient of cavity for RF inspection**  **Cavity Serial Number**  **Date of Arrival for RF inspection** | [[PrepTech1]] <<SRFCVP>>  [[CAVSN]] <<CAVSN>>  **[[InspectionDateTime]] <<TIMESTAMP>>** |
| 2 | **Check Presence of Cavity Documents provided by Vendor**  **The vendor should have provided a binder with documents and data taken during production (hard copies) that shall be provided to the RF tuning inspection area with the cavity.**  **Has cavity documentation been provided with the cavity? If not, check corresponding traveler on Pansophy for existence of documents and/or call the cavity receipt inspector for clarification.**  **Do cavity documents exist based on traveler records/receipt inspector?**  **If vendor documents are present, provide all documents to SOTR or representative after completion of the inspection (as soon as possible).**  Other Comments | [[CavDoc\_Provided]] <<YESNO>>  [[CavDoc\_Exist]] <<YESNO>>  [[CavDoc\_Comment]] <<COMMENT>> |
| 3 | **Measure and record transmission spectrum of fundamental passband at room temperature (under vacuum) using the VNA connected to a PC. Leave cable connected as in Step 3.**  Preparation:  Set Start Frequency to 790 MHz  Set Stop Frequency to 805 MHz  Use maximum points per sweep (20001 if possible) when applicable. Set IFBW to 300 Hz.  **Capture spectral data (S21) in new Excel spreadsheet (name worksheet: Spectrum).**  **Has spectrum been recorded?**  Other Comments | [[SpektrumRecorded]] <<YESNO>>  [[Passband\_Comment1]] <<COMMENT>> |

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| **Step No** | **Instructions** | **Data Inputs** |
| 4 | **Record all 6 Fundamental Passband Mode Frequencies in Transmission (S21) using a Vector Network Analyzer (VNA). It is recommended to use an Agilent VNA with up to 20001 data point per sweep.**  Preparation: Attach cable 1 from VNA port 1 to main coupler port antenna (high-Q fixed antenna, SST Inc.) and cable 2 from VNA port 2 to field probe port antenna (Kyocera). Use amplifier in the return path (cable 2) if required to capture modes with low signal transmission.  **Technician performing RF measurements**  **Create a new worksheet (name: ‘Modes’).** **Record data with at least 3 significant digits behind comma** (xxxx.xxx MHz) **and store results in Excel file in new worksheet ‘Modes’.** Measure one mode at a time and set span width of VNA appropriately for best accuracy (IFBW ~ 300 Hz, at least 1601 points per sweep)  Pi-mode frequency (~804 MHz)  5/6Pi-mode frequency (~803.2 MHz)  4/6Pi-mode frequency (~801 MHz)  3/6Pi-mode frequency (~798 MHz)  2/6Pi-mode frequency (~795 MHz)  1/6Pi-mode frequency (~792.6 MHz)  Was amplifier required?  **Enter all fundamental passband mode frequencies in Spreadsheet ‘Modes’**  Preparation:   1. Enter numbers 1 to 6 in first Excel worksheet column in cells A2 to A7. The table header in cell A1 is “mode number”   Enter frequencies with increasing value (pi/6 mode to pi-mode) in column 2 from cells B2 to B7. The table header ins cell B2 is “frequency (MHz)” | **[[PrepTech2]] <<SRFCVP>>**  [[Freq\_Pi]] <<FLOAT>>  [[Freq\_5Pi6]] <<FLOAT>>  [[Freq\_4Pi6]] <<FLOAT>>  [[Freq\_3Pi6]] <<FLOAT>>  [[Freq\_2Pi6]] <<FLOAT>>  [[Freq\_1Pi6]] <<FLOAT>>  [[AmplifierUsed]] <<YESNO>> |
| 5 | **Record Ambient Conditions in Tuning Area**  **(use weather station or existing electronic data logger and convert units to units given below)**  Temperature (Units in K)  Pressure (Unit in mbar)  Relative Humidity (Units in %)  Denote ambient conditions in same Excel worksheet “Modes”:  Cell E2 = temperature,  Cell F2 = pressure and  Cell G2 = relative humidity with table headers in  E1 = Temperature (K)  F1 = Pressure (mbar)  G1 = Relative Humidity (%)  Note that the Pi-mode frequency at ambient conditions must have been pre-tuned to 804MHz ± 100 kHz by the vendor (warm frequency at 22 deg. C with cavity under vacuum).  **Have all 6 passband modes and ambient conditions been entered in Excel Spreadsheet?**  Other Comments | **[[Temp]]** <<FLOAT>>  **[[Pressure]]** <<FLOAT>>  **[[rHumidity]]** <<FLOAT>>  [[Data\_Entered]] <<YESNO>>  [[Worksheet\_Comment]] <<COMMENT>> |

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| **Step No** | **Instructions** | **Data Inputs** |
| 6 | **Check whether accelerating pi-mode recorded in step 4 (cell A7 in worksheet ‘Modes”) resonates within**  **803.95 to 804.06 MHz ?**  e.g. nominal center frequency is  804 MHz +/- 100 kHz at 21 deg. C ambient temperature.  **If not, contact SOTR as soon as possible (initiate NCR)**  Other Comments | [[Pi\_Mode\_OK]] <<YESNO>>  [[Passband\_Comment2]] <<COMMENT>> |

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| **Step No** | **Instructions** | **Data Inputs** |
| 7 | **Take vendor supplied documents and search for the fundamental mode passband frequencies recorded for the cavity just prior shipment (last record of frequency data) with cavity measured warm in vacuum.** If documents do not exist (cf. Step 2) skip the measurement. In this case data may be provided later based on electronic documents).  **Store mode frequencies in existing Excel worksheet ‘Modes’. Denote all 6 fundamental passband mode frequencies with increasing frequency (Pi/6-mode to Pi-mode) in cell C2 to C7.** Table header in C1 is ‘frequencies measured by vendor before shipment (MHz)’.  In case ambient conditions have been recorded by the vendor, denote those:  Cell E4 = temperature  Cell F4 = pressure  Cell G4 = relative humidity  If units are different to those in cells E1, F1, and G1 denote differing units in cells E3, F3, and G3.  **Have all 6 passband modes been entered in Excel spreadsheet?**  Other comments | [[VendorData\_Entered]] <<YESNO>>  [[Worksheet2\_Comment]] <<COMMENT>> |
| 8 | **Upload Excel spreadsheet to M-drive for documentation and storage**  **Folder link is:**  M:\asd\asddata\CavityTuning\SNSPPU\FM\_Spectra\  **Preparation:**   1. **Save Excel spreadsheet with spectral and all fundamental passband modes data to M-drive (store locally if required)** 2. **Name Excel spreadsheet referring to date and serial number of cavity:**   **Naming Convention: YYYY-MM-DD-CAVSN.xlsx**  (M:\asd\asddata\CavityTuning\SNSPPU\FM\_Spectra\YYYY-MM-DD-CAVSN.xlsx)  **Has the Excel Spreadsheet been uploaded to M-Drive?**  **Other Comments** | [[ExcelUpload]] <<FILEUPLOAD>>  [[DataUploaded]] <<YESNO>>  [[Excel\_Comment]] <<COMMENT>> |
| 9 | **Status and RF Antenna Inner Conductors (Pins)**  Carefully remove protection caps from RF antennas (at field probe (FP) port, main coupler (MC) port)  Check if pins are loose by gently trying to move the inner pin laterally (no excess force allowed).  Which connector pins are OK/Not OK?  MC Pin OK?  FP Pin OK?  Other Comments | [[MC\_PinStatus]] {{OK,NOTOK}} <<RADIO>>  [[HOMA\_PinStatus]] {{OK,NOTOK}} <<RADIO>>  [[HOMB\_PinStatus]] {{OK,NOTOK}} <<RADIO>>  [[FP\_PinStatus]] {{OK,NOTOK}} <<RADIO>>  [[Pin\_Comment]] <<COMMENT>> |

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| **Step No** | **Instructions** | **Data Inputs** |
| 10 | **Check of Electrical Short in all Connectors**  Use a digital multimeter and measure the resistance between the outer and inner conductor. The conductors should be isolated. A small resistance indicates a short.  Are connectors OK (isolated)?  MC Connector OK?  FP Connector OK?  Other Comments | [[MC\_ConStatus]] {{OK,NOTOK}} <<RADIO>>  [[HOMA\_ConStatus]] {{OK,NOTOK}} <<RADIO>>  [[HOMB\_ConStatus]] {{OK,NOTOK}} <<RADIO>>  [[FP\_ConStatus]] {{OK,NOTOK}} <<RADIO>>  [[Connectors\_Comment]] <<COMMENT>> |
| 11 | **Results of inspections**  **The cavity has been accepted to proceed to visual and CMM inspections. If not, inform SOTR or representative and issue NCR. If vendor documents are present, provide all documents to SOTR or representative as soon as possible.**  Other Comments | **[[**RF\_Inspection**]] <<YESNO>>**  [[RF\_Inspection\_Comment]] <<COMMENT>> |