

List of Beam Based Machine Setup and Tuning Tasks for VECC Test Line

Task	Actuators	Monitors	Other elements ¹	Comment
1. Set up baseline orbit				
Set up ambient field compensation	Ambient field compensating coil	BPM1A BPM1B BPM3 FC1A FC1B FFC3	X/Y0 X/YCB1A X/YCB1B X/YCB2	All cavities and solenoids OFF
Set up orbit before ICM	X/Y0 X/YCB1A X/YCB1B X/YCB2 X/YCB3A X/YCB3B	BPM1A BPM1B BPM3 FC1A FC1B FFC3		Cavities and solenoids turned on in stages
2. Set up baseline optics				
Validate/fine-tune beam profile against design	SOL1 SOL2 SOL3	Screen 1A Screen 1B Screen 3 Screen 4 FC1A FC1B FFC3 FC4	X/Y0 X/YCB1A X/YCB1B X/YCB2 X/YCB3A X/YCB3B	All elements set to design at staged beam intensities
3. Buncher setup				
Buncher phase setup Bunch length at FFC3	Buncher phase	FFC3	X/YCB1B SOL1 SOL2	
Buncher phase setup Zero crossing / Crest determination	Buncher phase	ELBT1:Screen 0 ELBT1:FC0	MB0 dipole X/YCB1B	
Buncher gradient calibration	Buncher phase Buncher gradient	ELBT1:Screen 0 ELBT1:FC0	MB0 dipole X/YCB1B	

¹ For either transforming or compensating for actuator effects

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4. Orbit centering / Alignment evaluation				
Beam centering in SOL1	SOL1 X/Y0	BPM1B Screen 1B BPM1A Screen 1A		Find zero-response position for dithered signal. Special optics
Beam centering in buncher	Buncher phase Buncher gradient X/YCB1A	BPM1B Screen 1B BPM3 Screen 3		Find zero-response position for dithered signal. Special optics
Rigorous determination of offset in buncher	X/Y0 X/YCB1A	BPM1B Screen 1B BPM3 Screen 3		Measure aberration to buncher transport due to off-center orbit. Special optics
Beam centering in SOL2	SOL2 X/YCB1B	BPM3 Screen 3 EMBT:BPM0 EMBT:Screen 0		Find zero-response position for dithered signal. Special optics
Beam centering in SOL3	SOL3 X/YCB2	BPM3 Screen 3 EMBT:BPM0 EMBT:Screen 0		Find zero-response position for dithered signal. Special optics
5. ICM cavity setup				
ICM cavity phase setup Zero crossing / Crest determination	ICM cavity phase	EMBT1:Screen 0 EMBT1:FC0	MB1 dipole EMBT:X/YC0	
ICM cavity gradient calibration	ICM cavity phase ICM cavity gradient	EMBT1:Screen 0 EMBT1:FC0	MB1 dipole EMBT:X/YC0	
6. Beam phase space determination - Longitudinal				
Momentum spread – 100 - 300 keV		ELBT1:Screen 0 ELBT1:FC0	MB0 dipole X/YCB1B	Special optics
Longitudinal beam profile– 100 - 300 keV	SOL1 Deflecting cavity RFS0	ELBT1:Screen 1 ELBT1:FC1	MB0 dipole X/YCB1B	Special optics
Momentum spread – 10 MeV		EMBT1:Screen 0 EMBT1:FC0	MB1 dipole EMBT:X/YC0	Special optics
Longitudinal beam profile– 10 MeV	SOL1 Deflecting cavity RFS1	EMBT1:Screen 1 EMBT1:FC1	MB1 dipole EMBT:X/YC0	Special optics

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7. Beam phase space determination – Transverse				
Slit measurement		Screen 1B Wire scanner 1B		
Emittance measurement by solenoid scan - 100 - 300 keV	SOL1 SOL2	Screen 3 Wire scanner 3	X/YCB1A X/YCB1B X/YCB2	Special optics
Emittance measurement by solenoid scan – 10 MeV	EMBT:SOL0 EMBT:SOL1	EMBT Screen EMBT Wire scanner	EMBT X/YCB0	Special optics
8. Model based orbit correction				
Global orbit correction – 100-300 keV	X/Y0 X/YCB1A X/YCB1B X/YCB2 X/YCB3A X/YCB3B	Orbit information obtained from element dithering. BPM1A Screen 1A BPM1B Screen 1B BPM3 Screen 3		Avoid under-constrained steering
Global orbit correction – 10 MeV	EMBT:X/Y?	EMBT: BPM0 EMBT: Screen 0 EMBT:BPM1 EMBT: Screen 1		Avoid under-constrained steering
9. Model based beam profile matching				
Transverse matching – 100/300 keV	SOL1 SOL2 SOL3	Screen 1B Wire scanner 1B Screen 3 Wire scanner 3	X/YCB1A X/YCB1B X/YCB2	
Transverse matching – 10 MeV	EMBT:SOL0 EMBT:SOL1	EMBT Screen EMBT Wire scanner	EMBT X/YCB0	
10. Machine transport characterization				
Transfer matrix measurement -Transverse	All X/Y steerers	All BPM's and Screens	Active elements activated to various excitations Solenoids Buncher ICM Cavity	Local special optics possibly needed
Transfer matrix measurement -Longitudinal	TBD	TBD	TBD	

³ For either transforming or compensating for actuator effects