Chemical surface treatment process

	units	12/5/05 Decision	DESY Horiz	Jlab Horiz	KEK (Nomura) Horiz	FNAL SMTF	ANL filled	Cornell vertical	DESY Henkel Horiz
Electropolishing			EP 1/9	EP 1/5	EP				
Voltage	V		17?		15-25		15 20		(12-18)
mode			CW	CW	CW		pulsed		CW
Current	mA / cm^2		49-58		40~50		30 to 50		
Power	W / cm^2		1						
Temperature of liquid (start-end)	C		24-35		25~32		28 32		22-30
Temperature of cavity	C				30~35				
Acid flow rate	l/min		9-11		6		agitate		(7.5)
rotation speed	rpm		1.5-2	1	(1.4)				(0.5)
H2 screen details			360 degrees	180 degrees	180 degrees				none
nitrogen purge for H2			30lpm	1cfm	none				
cathode masking			iris/BT	iris/BT	iris/BT				
seal material			PVDF		viton				
Nb content	gpl		10		9				
Heat exchanger			PVDF tube	PVDF tube	PFA tube		3003 series AL		
Acid quality (grade)			electronic	electronic	reagent		reagent		
storage volume	l		150	240	1000/100				800
masking material			PTFE tape	PTFE tape					
cathode to NB ratio									
Cathode material	AL purity		99.99		1100 series				
Cathode shape			tube	tube	tube				shaped
Cathode dia			1.0 inch	1.3inchs	25 mm				
etching speed	micron / min		0,4		0,4				
total removal	micron		180-200		80		150		
additional removal	micron		?		30				
total time for a treatment			6+2 h		(3.5)				
contact location			2 stif ring, 2 dish head		all EQ plus beam tube				
experience			> 200hr		> 3600 hr				
diff temp in to out	C		8		10				
Care after EP									
water rinsing	min		60	60	60 *				
drying	min		0	30					
proceee till HPR	min		120	30	30~45				
water temp of rinse	c		20	29	50				
conductivity water out	uS		400						
resistivity water out	Mohm-cm								
Chemical polishing			BCP 1:1:2	BCP 1:1:2	BCP 1:1:1				
Etching speed	micron / min		1,1-0,9	1.2-0.7	8~10 **				
Acid Temperature	C		15-18	10	25				
Acid Flow rate	l/m		3-20	15,2	stirring				
Drain time	sec		80		20 ***				

High Pressure Rinsing for Assembly

	units	12/5/2005 Decision	tol	DESY	Jlab	KEK Nomura	KEK AR-east	KEK STF	FNAL (A0)
Basic parameters									
Pressure after final filter	bar	70-120		100	96	80 ***	70		83
Period	hr/cell				0,83	1	1		0,125
Flow rate	liter / min			15-20	9,1	10	10		18
rotation/up-down		separate motion							
Cavity Rotation speed	rpm				2	10	10		10
Wand up down/speed	cm/min				1	20	20		3,5
Water quality									
Resistivity	MΩ cm			18,2	18,2	18	6		18,2
TOC	ppb			<1	< 6	~20	100~300		<20
Bacteria count	cfu				< 50	<1	~20		<20/liter
meas. Point					POU	POU	POU		in line
Particle count at pressure	counts/ml				0,88	Non	Non		NA
Nitrogen overflow				yes	cleanroom air	no	no		yes
Spray Head Nozzle									
nozzle material				**saphire**	Ti	ss303	ss303		Sapphire
head material				SS 1.4429	ss316L	ss303	ss303		SS316L
number of holes				8	2	8	8		8, 2 types
hole size	Dia (cm)			0,04	0,09	00:05	00:05		4-0.04,4-0.02
jet direction	angle in degrees			+30 up -30 down	40	45deg	45deg		
type of nozzle				solid jet	fan jet	solid jet	solid jet		
errosion				no	?	Yes **	Yes **		No
measurement needed for all									
Filter									
filter size	um			0,02	0,04	0,22	0,22		0,04
location				POU	POU	POU	POU		POU
Other cares									
Cavity Environment				Class 100 (10)	Class 100 air brought in	Class 100 air brought in	Class 100 air brought in		Class 100 N2
dust free mechanism					?				N2 purge, room vac
potential difference between nozzle and cavity				under investigation	Unknown	10~20mV			
grounded?				yes	no		yes		
particle migration free					?				
Water Temperature	C			20	29	room temp			
Transportation									
transfer from hpr to drying area	min			1	10	240	60		
Transfer time from chem to HPR (EP)	min			45	60	90	90		
Transfer time from chem to HPR (BCP)	min			3	30	60	30		3 hrs
Transfer method (EP)				water filled	wet	wet	wet		
Transfer method (BCP)				water filled	wet	water filled	water filled		Wet/filled
sealing after chem for transfer to hpr				closed	closed	closed	closed		
Drying Process After HPR									
when				after HPR	after HPR	after assembly *	after assembly		after HPR
method				Class 10 area	Class 10 area	evacuation	evacuation		Hang under class 10 HEPA
Assembly									
Clean room class				10	10		10		10
Evacuation									
Setup						for VT	<--		
Speciality									
Total time for the treatment	hrs				4	1 (Single) 6 (9-cell)	<--		
Number of treatments needed for vertical test				1+6	2	1	1		

Limitation on performance

Too much HPR degrades performanc e?

More investigation needed on

Ranking??

comments

*	Sometimes, drying is performed in clean room (class 10) with beam pipe open during night.	allways	

ANL	Cornell

120
5 h/cavity
15

18

<1
POU

SS 17-4
SS 17-4
8
0,07

various
solid jet
?

0,04
POU

class 100 dry
cuum

22-30

0

30
water filled
water filled

open

after HPR

class 100
counter~0

100

Pure Water Facility

	units	12/5/05 Decision	DESY	DESY 1cell	Jlab	KEK AR-east	KEK AR-east	KEK (Nomura)	FNAL SMTF	ANL
Pure water										
City water prefilter size	um		none	10	5		none	Non		
Carbon filter volume	m3				0,17	yes	0,002	Non		
Reverse Osmosis type	single /dual stages		single	single	single	none	-	Non	single	
Permeate rate	lpm		12	7	22,7		20			
Concentrate rate	lpm		6	3	9,1					
Storage volume	liters		4000	500	3785,4		1300		3800	
						single pass design		2		
Ultra-pure water										
Circulation rate	lpm		20		127,3		-		19	
Loop Resistivity	M-ohm-cm		18,2	18	18,2	(6-7)	18	18	18,2	
Water Temperature	C		15,2	20	29		RT	RT		
Number of loops	#		2	1	2		2	1	1	
Number of drops	#		5	4	8		3	5	7	
ultrafiltration size	um		0,02	none	0,02		0,1	UF module	0,05	
# post filters			1	1	2		1		2	
post filter	um		0.2	0.2	0,54	(0.1)			0,2	
UV frequencies			?	?	(194, 256)		-	1	1	
Ion bed workers	m3			46L	0,17					
Ion bed polishers	m3			46L	0,17					
loop pressure	Atm	3		3bar	1,7				2,1	
Production capacity	lpm		20					> 10		
particle count				0.5 (0.2um)						
POU Chemistry										
TOC	ppb		0,4-1,4	7-10	NA		NA		NA	
Bacteria count max	cfu		<=5		<50		> 500		>50	
Bacteria count typical	cfu		<= 3		<50		~ 500		>50	
Final Filter size	um		0,2		NA		NA		NA	

Liquid particle count avg	counts/ml	0,08		0,09			NA
POU HPR							
TOC	ppb	<=1.41		<6	100 ~ 300	~20	<20
Bacteria count max	cfu	0		>500	500		100/liter
Bacteria count typical	cfu	0		<50	40/ml	<1/ml	10/liter
Final Filter size	um	0,04	00:04	0,04	0,1	0,2	0,04
Liquid particle count avg (0.3)	counts/ml	0,02		0,88	NA	NA	NA
POU Part cleaning							
TOC	ppb	<=1,46		NA	40		NA
Bacteria count max	cfu	0		NA	10 ~ 50		NA
Bacteria count typical	cfu	0		NA	20		NA
Final Filter size		0,02		NA	0.1 ~ 0.2		NA
Liquid particle count avg	counts/ml	1,04		NA	-		NA

Cornell

Cleanroom for various activities

	units	12/5/05 Decision	DESY	Jlab	KEK AR-east	KEK Nomura	KEK STF	FNAL SMTF	ANL	Cornell
Cleanroom areas										
Sub component chemistry area	m2		101.6	20,9	-			10	18	
Cleanroom class	FED 209E		10 000	NR				NR	NR	
Subcomponent degreasing area	m2		2.0	62,8	-			8	20	
Cleanroom class	FED 209E		10 000	NR				1.000	1000	
Cavity chemistry (BCP) area	m2		0.8	22,6				17	18	
Cleanroom class	FED 209E		10 000	100				NR	NR	
Cavity Chemistry (EP) area	m2		35.4	36,5		30		17	18	
Cleanroom class	FED 209E		outside cleanroom	10.000		Non		NR	NR	
Cavity HPR area	m2		1,5	22,6	9	12		9	23	
Cleanroom class	FED 209E		10	100	1000	1000		100	100	
Cavity assembly area for vertical test	m2		23	6,4	10			18	15	
Cleanroom class	FED 209E		10	10	10			10	100	
String assembly area	m2		103,7	45,1		14		67	20	
Cleanroom class	FED 209E		10 / 100	100		ISO 4		10	100	
Vertical stand area	m2			88,8				10	?	
Cleanroom class	FED 209E			100.000				NR		

Module assembly area	m2		117,8	100	linac tunnel
Cleanroom class	FED 209E	none	NR	NR	NR
Module staging area	m2		120,8	110	linac tunnel
Cleanroom class	FED 209E		NR	NR	NR

L340xc

Fed 209E
1
10
100
1000
10.000
100.000

NR-not rated

Component Cleaning Requirements

	12/5/05 Decision	DESY	Jlab	KEK AR-east	KEK AR-east	KEK STF	ANL	Cornell
Cavity Qualification								
Input coupler, field probe assemblies		Untrasonic + UPW rinse	Ultrasonic + UPW rinse+ nitrogen dry	CP + Ultrasonic in PW	CP + HPR(PW) + Ultrasonic in UPW		Ultrasonic+manual HPR	
UHV components		ultrsaonic +UPW + annealing	Ultrasonic + UPW rinse+ nitrogen dry		Ultrasonic in UPW		same	
Nut/Bolt Hardware		dish washer + Ultrasonic +UOW	Ultrasonic + UPW rinse+ nitrogen dry		Non		same	
String Assembly								
input coupler, pickup		UPW Ultrasonic baking	Ultrasonic + UPW rinse+ nitrogen dry	CP + Ultrasonic in PW			Ultrasonic+manual HPR	
UHV components		ultrsaonic +UPW + annealing	Ultrasonic + UPW rinse+ nitrogen dry				same	

Nut/Bolt Hardware	dish washer + Ultrasonic +UOW	Ultrasonic + UPW rinse+ nitrogen dry	same
Horizontal Test (Chechia)			
UHV components			
Nut/Bolt Hardware			
Module Fabrication			
UHV components		Ultrasonic + UPW rinse+ nitrogen dry	
Nut/Bolt Hardware		Ultrasonic + UPW rinse+ nitrogen dry	

Evacuation system for various stages

	units	12/5/05 Decision	DESY	Jlab	KEK AR-east	KEK STF	FNAL SMTF	ANL	Cornell
UHV Systems for Cavity Evacuation									
UHV pump type			TMP	TMP	IP		TMP	TMP (maglev)	
Pumping Speed (Air)	lps			60	250		100	300	
Roughing pump type			oil free	scroll	TMP + Rotary *		Rotary Vane	scroll	
Roughing pump speed (Air)	lpm			250	250		100	600	
Typical Baseline Pressure	mbar			1,00E-08	3,00E-08		1,00E-08	1,00E-08	
RGA	AMU			100	He detector		up to 100	He leak check	
UHV Systems for Vertical Test									
UHV pump type			oil free TMP	TMP	No pumping		TMP		
Pumping Speed (Air)	lps			60	-		100		
Roughing pump type				scroll	-		Rotary vane		
Roughing pump speed (Air)	lpm			250	-		100		
Typical Baseline Pressure	mbar			1,00E-08	-		5,00E-09		
RGA	AMU			100	-		up to 100		
Evacuation method during test				Metal valve or active pump	1,00E-05		IP		
Leak check after VT					Closed with metal valve				
UHV Systems for Horizontal Assembly									
UHV pump type			oil free TMP	TMP and ion pump			NA	TMP (maglev)	
Pumping Speed (Air)	lps			60/11			NA	300	
Roughing pump type				scroll			NA	scroll	
Roughing pump speed (Air)	lpm			250			NA	600	
Typical Baseline Pressure	mbar			1,00E-08			NA	1,00E-08	
RGA	AMU			100			NA	He leak check	
as of assembly							NA		
for Chechia									
in cryostat									

Heat treatment

	units	12/5/05 Decision	tol	DESY	Jlab	KEK New	FNAL SMTF	ANL	Cornell	
Niobium Purification										
Baseline Pressure (Room Temp)	mbar				<4e-7		NA			
Ramp Rate	C/min				5		NA			
Soak Temperature	C			1350	1250		NA			
Pressure at Temp	mbar				4,00E-06		NA			
Soak Time	min				180		NA			
Ramp Down Rate	C/min				NA		NA			
Pump Capacity	l/s (air)				3000		NA			
Pump Capacity	l/s (hydrogen)				5000		NA			
Chamber Hot Zone size	cm-length				160		NA			
	cm-width				58		NA			
	cm-height				58		NA			
Experience	processes completed				40		NA			
High Temperature Baking/Annealing										
Pressure Empty	mbar			<1e-8	<4e-7	1e-6 Torr	1,00E-07	5,00E-08		
Ramp Rate	C/min				5	20	<5	1,7		
Soak Temperature	C	750	(--0,+50)	800	600	750	750	600		
Pressure at Temp	mbar	1,00E-06			5,30E-05	5e-5 Torr	<8.0E-08	5,00E-04		
Soak Time	hrs	3			10	3	3	10		
Ramp Down Rate	C/min			NA	NA	~8 hy *	<1	~3		
Pump Capacity	l/s (air)				3000	10000	500			
Pump Capacity	l/s (hydrogen)				5000		750			
Chamber Hot Zone	cm-length				160	300	76	140		
	cm-width				58	ϕ 50	16	75		
	cm-height				58		16	75		
Experience	processes completed				200	10	6	2		
temp before opening	c	50								
decision 600 800c										
Low Temperature (120C) Baking										
Purpose				Q improvement		oxydized layer treatment	NA			
Temperature	C	120	(--0,+15)	120-135	120	120	NA	120		needs to be verified with 9 cell cavities
Period	hr	10-48		48	48	48	NA	48		
inside cavity				vacuum	vacuum	vacuum		vacuum		
outside cavity				Nitogen	Atm nitrogen	air	NA	helium		
Pump				oil free TMP		IP / TMP	NA	TMP (maglev)		