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Guideline (not under Configuration Control)

Appendix 1 Base Pressures and Expected Pumping Speeds

Approval Process			
	Name	*Action*	*Affiliation*
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Change Log			
Appendix 1 Base Pressures and Expected Pumping Speeds (2ELEJT)			
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v1.0	In Work	27 Aug 2008	
v1.1	In Work	22 Sep 2008	
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v1.3	Signed	24 Mar 2009	
v1.4	Disapproved	02 Sep 2009	Minor changes to text for consistency with Vacuum Handbook
v1.5	Approved	09 Sep 2009	Minor changes to text to clarify pumping speed(s)
v1.6	Approved	23 Sep 2013	Number of TCPs updated to reflect current design (from 8 to 6)

ITER Vacuum Handbook
Appendix 1

Base Pressures pertaining to Vacuum Classification and Expected Vacuum System Pumping Speed

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1 Scope

This appendix relates gives base pressures that it is expected systems with a Vacuum Classification will operate. The appendix also gives the expected pumping speeds of ITER vacuum systems. This appendix is intended as a guide and figures will be updated as the system design matures.

2 Base Pressures

Base pressures pertaining to VQC are given in Table 2-1.

	VQC1[1]	VQC2[2]	VQC3[3]	VQC4[3]
Base Pressure (Pa)	10^{-7} - 10^{-4}	<10^{-4}	10^{-6} -10^{2}	10^{-4}

[1] Before operations, the base pressure in the ITER vacuum vessel will be required to be 10^{-5} Pa or less for hydrogen isotopes and 10^{-7} Pa or less for any other individual species at 100 °C after bake-out and conditioning.
[2]Pressures at ambient (with magnets cold). Lower values expected if total pressure is not helium dominated.
[3]Total pressure when pump down, some system may operate at higher pressures.

Table 2-1 Base pressure pertaining to VQC

3 Pumping speeds for Cryopumps

The expected pumping speeds various large ITER cryopumps are given in Table 3-1. Pumping speeds are given at the pump inlet with inlet valves fully open.

Cryopumping System	VQC	Pumping Speed ($m^3 \cdot s^{-1}$)				
		H_2	D_2	DT	He	N_2
Torus Vacuum Cryopump[1]	**1A**	78	55	49	52	21
Cryostat Vacuum Cryopump[2]	**2A**	>78	>55	>49	>52	>21
Heating Neutral Beam Cryopump	**1A**	4700	3600	3255	TBD[3]	1380
Diagnostic Neutral Beam Cryopump	**1A**	2900	2270	2035	TBD[3]	860

[1] The torus cryopumping system consists of 6 cryosorption pumps for which the individual pumping speed is given. The total pumping speed is dependent on the operating cycle of the pumps. The conductance of the divertor duct restricts the total pumping speed available. Modelling of the 2001 divertor duct configuration gave a maximum molecular flow pumping speed for Deuterium of 20 m^3/s when using 4 ducts for the pumping. The current more open divertor duct configuration is estimated to give a molecular flow pumping speed for Deuterium of 100 m^3/s when using 4 ducts and 4 pumps for the pumping.

[2] One cryopump only, not including the cold surfaces of the magnets or the thermal shield. Pumping speed of the torus cryopump is used, but the gas conductance to the pump housing will be higher than for the torus pump. Two pumps are available to pump, but at times one will have to be offline for regeneration.

[3] Pending Monte Carlo simulations.

Table 3-1 Expected pumping speeds of large cryopumps

4 Pumping speeds for roughing pumps.

The design of the roughing system and the roughing lines is at an early stage and hence pumping speed cannot yet be accurately provided. The figures below outline the required provisional roughing pump(s) performance.

- Torus ~1330 m^3 ,10^5 Pa to 10 Pa in 24 Hours.
- 1 torus cryopump, ~18 m^3, max 30 $KPam^{3\dagger}$ (Hydrogen isotopes), to 10 Pa in 150 sec.
- Cryostat ~8500 m^3 ,10^5 Pa to 10 Pa in 24 Hours.
- 1 cryostat cryopump, ~18 m^3, max 30 $KPam^3$ (Helium + Hydrogen), to 10 Pa in 150 sec.
- NIBs ~ 171 m^3 + 171 m^3 + 170 m^3 + 93 m^3, 10^5 Pa to 10 Pa in 24 Hours.
- 1 NIB cryo-pump, ~170 m^3, max 300 $KPam^3$ (Hydrogen isotopes), to 20 Pa in 650 sec.
- PI – overnight gas transfer to TEP.
- Adequate pumping for Auxiliaries.

†May double