

Milestones in Pressure Tube Manufacturing

- 1955 – Chase Copper and Brass pioneers the use of copper jackets to permit the extrusion of titanium.
- 1957 – AECL contacts Chase to develop seamless zirconium tubes.
- 1959 – Chase produces seamless Zr 2 tubes for NPD and then Douglas Point.
- 1962 – Chase Copper and Brass creates Chase Zirconium Division, later called Chase Nuclear.
- 1964 – Chase Nuclear develops Zr-2.5% Nb tubes which are strengthened employing a solution anneal and age hardening treatment, subsequently supply Kanup (Pakistan) and Fugen (Japan).
- 1967 – Chase and AECL develop Zr-2.5% Nb tubes strengthened by controlled cold work. The process is determined to be more economical than strengthening the alloy by heat treatment.
- 1971 – Bristol Aerospace takes over autoclaving and inspecting pressure tubes from Canadian General Electric.
- 1971 – Beta Quenching is introduced in order to refine the grain size and produce a more random grain orientation in the billet. The first 577 are quenched then NRU data suggested the practice should be stopped. It was later discovered the data was incorrect.
- 1972 – Wah Chang installs a rotary forge improving the consistency of forged billets.
- 1973 – Ontario succeeds in convincing Chase to manufacture Pressure Tubes in Ontario. The Arnprior facility is constructed and commences finishing tubes in 1975.
- 1975 – Chase experiments with, and refines, the extrusion billet heating practice.
- 1976 – ID blasting is replaced by ID pickling in order to reduce suspected stress risers in the tubes. Pickling is performed at Bristol Aerospace.
- 1981 – The first hollow quenched billets are produced for Bruce 2. AECL then reverts to quenching solids (as the cost of hollow quenching was higher) however went back to hollow quenching in 1993.
- 1985 – After the accident at 3 Mile Island, Chase Nuclear is sold and renamed Nu-Tech Precision Metals.
- 1988 – Nu-Tech purchases Bristol's assets – pickling, autoclaving and final inspection is moved to Arnprior.
- 1989 – 100% Eddy Current examination is added to find shallow surface defects potentially missed by Ultrasonics.
- 1989 – The practice of sampling each tube for hydrogen is introduced and allowable hydrogen levels are lowered.
- 1991 – An electrically heated walking beam furnace is commissioned which enables more uniform heating and less opportunity for hydrogen pick up.
- 1992 – Quad melting is introduced for the manufacturing of all pressure tubes.
- 1995 – Nu-Tech closes the Waterbury facility and builds a new pressure tube extrusion plant in Arnprior.
- 1996 – Due to a US trade embargo on China, AECL and Nu-Tech qualify Chepetsky Mechanical Works to make Zr-2.5% Nb.
- 2005 – Nu-Tech invests heavily in expanding pressure tube manufacturing, testing and quality assurance capabilities. Slight modifications are made to the melt chemistry.

**Nu-Tech Precision Metals Has Supplied Every Pressure Tube Installed
In Every Candu Reactor Operating Everywhere In The World.
Please contact us to discuss your Zirconium Pressure Tube requirements.**



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Zirconium Pressure Tubes

PRESSURE TUBE HISTORY 1959 - 2010

Reactor	PreFix	Location	Manufacturing Date	Manufacturers Melt / Tube / Inspection	Material	Re-Melt Cycles	Beta Quench / Method	ID Finish	H Test	EC Test
The Reactors with Zircalloy 2 Pressure Tubes										
NPD	None	Ontario	1959 / 60	WC / NT	Zircalloy 2	2	No	Blasted	No	No
Douglas Point	None	Ontario	1961 / 62	WC / NT	Zircalloy 2	2	No	Blasted	No	No
RAPP 1 & 2	None	India	1965 - 69	WC / NT	Zircalloy 2	2	No	Blasted	No	No
Pickering 1 & 2 (Zr - 2)	None	Ontario	1966 / 67	WC / NT	Zircalloy 2	2	No	Blasted	No	No
The Reactors with Zr - 2.5% Nb Pressure Tubes Strengthened by Heat Treatment										
Gentilly 1	None	Quebec	1967	WC / NT	Zr 2.5 Nb	2	No	Blasted	No	No
Kanup	None	Pakistan	1968	WC / NT	Zr 2.5 Nb	2	No	Blasted	No	No
Fugen	None	Japan	1969	WC / NT	Zr 2.5 Nb	2	No	Blasted	No	No
The Reactors with Zr - 2.5" Nb Pressure Tubes Strengthened by Controlled Cold Work										
Pickering 3 & 4	None	Ontario	1968 - 70	WC / NT / CGE	Zr 2.5 Nb	2	No	Blasted	No	No
Bruce 1 - 4	None	Ontario	1971 - 73	WC / NT / BRI	Zr 2.5 Nb	2	577 Yes / Log, balance No	Blasted	No	No
Gentilly 2	A	Quebec	1973 / 74	WC / NT / BRI	Zr 2.5 Nb	2	No	Blasted	No	No
Cordoba (Embalse)	B	Argentina	1974	WC / NT / BRI	Zr 2.5 Nb	2	No	Blasted	No	No
Pickering 5 & 6	C	Ontario	1975 / 76	WC / NT / BRI	Zr 2.5 Nb	2	No	Blasted	No	No
Lepreau	E	New Brunswick	1976 / 77	WC / NT / BRI	Zr 2.5 Nb	2	No	Blasted	No	No
Wolsong 1	F	Korea	1976 / 77	WC / NT / BRI	Zr 2.5 Nb	2	Yes / Solid Log	Pickled	No	No
Pickering 7 & 8	D	Ontario	1977 / 78	WC / NT / BRI	Zr 2.5 Nb	2	Yes / Solid Log	Pickled	No	No
Bruce 5 - 7	G	Ontario	1978 / 79	WC / NT / BRI	Zr 2.5 Nb	2	Yes / Solid Log	Pickled	No	No
Bruce 8	G	Ontario	1979	WC / NT / BRI	Zr 2.5 Nb	2	Yes / Solid Log	Honed	No	No
Darlington 1, 3, 4	H	Ontario	1980 - 82	WC / NT / NT	Zr 2.5 Nb	2	Yes / Solid Log	Honed	No	No
Darlington 2	H	Ontario	1981	WC / NT / NT	Zr 2.5 Nb	2	Yes / Hollow Billet	Honed	No	No
Cernavoda 1 & 2	M & N	Romania	1982 / 83	WC / NT / NT	Zr 2.5 Nb	2	Yes / Solid Log	Honed	No	No
Pickering 1 & 2 Retube	R	Ontario	1984 / 85	WC / NT / NT	Zr 2.5 Nb	2	Yes / Solid Log	Honed	No	No
Pickering 3 & 4 Retube	Y	Ontario	1988 - 91	WC / NT / NT	Zr 2.5 Nb	2	Yes / Solid Billet	Honed	Yes	Yes for Unit 4
Wolsong 2	W	Korea	1991 / 92	WC / NT / NT	Zr 2.5 Nb	2	Yes / Solid Billet	Honed	Yes	Yes
Bruce A Retube - Aborted	BB	Ontario	1992 / 93	WC / NT / NT	Zr 2.5 Nb	4	Yes / 25 Solid Billet Bal Hollow	Honed	Yes	Yes
Wolsong 3 & 4	W	Korea	1993 - 95	WC / NT / NT	Zr 2.5 Nb	4	Yes / Hollow Billet	Honed	Yes	Yes
Qinshan 1 & 2	CC	China	1997 - 99	CMP / NT / NT	Zr 2.5 Nb	2	Yes / Hollow Billet	Honed	Yes	Yes
Bruce 1 & 2 Retube	AA	Ontario	2006 / 07	WC / NT / NT	Zr 2.5 Nb	4	Yes / Hollow Billet	Honed	Yes	Yes
Lepreau Retube	DD	New Brunswick	2007	WC / NT / NT	Zr 2.5 Nb	4	Yes / Hollow Billet	Honed	Yes	Yes
Wolsong 1 Retube	DD	Korea	2008	WC / NT / NT	Zr 2.5 Nb	4	Yes / Hollow Billet	Honed	Yes	Yes
Gentilly 2 Retube	FF	Quebec	2009 / 10	WC / NT / NT	Zr 2.5 Nb	4	Yes / Hollow Billet	Honed	Yes	Yes
WC - ATI Wah Chang, NT - Nu-Tech Precision Metals, CGE -Canadian General Electric, BRI - Bristol Aerospace, CMP - Chepetsk Mechanical Plant										
Sources : Nu-Tech Archives, "Pressure Tube Manufacturing 1960 to 2000", Syd Aldridge (Unpublished)										



NU-TECH PRECISION METALS HAS SUPPLIED EVERY PRESSURE TUBE INSTALLED IN EVERY CANDU REACTOR OPERATING EVERYWHERE IN THE WORLD