

(Validity of tensile properties from small specimens in CANDU pressure tube)

105 # 314

Zr-2.5%Nb

가 4.3 mm  
 (gage section) 가 2 mm  
 가 10 mm 25.4 mm  
 가

#### Abstract

It is well known that there is an anisotropy of physical and mechanical properties in the Zr-2.5%Nb pressure tube due to texture formed its fabrication processes. Although the tensile properties in the longitudinal and transverse direction have been reported widely, the tensile properties in the radial direction have not measured yet since there is a dimensional restriction of pressure tube. It seems important to know the tensile properties in the radial direction because there is an anisotropic delayed hydride cracking (DHC) behavior, this may provide the explanation for anisotropic DHC behavior. In order to measure the tensile properties in the radial direction, the small tensile specimens with a gage length about 2 mm were machined and tested in the radial, longitudinal, and transverse directions in the range of room temperature to 550 . The tensile results from transverse and longitudinal direction were compared to the relatively larger specimens with a gage length about 10 and 25.4 mm to check the validity of the result from the small tensile specimen. It is confirmed that the tensile properties from the small specimens have a sufficient validity and the tensile properties and deformation behavior in the radial direction have been known and understood.

1.

Zr-2.5%Nb

가

가 가

(delayed hydride cracking, DHC)

가

[1, 2].

(critical crack length, CCL)

가

DHC

CCL

가

가

[3].

DHC

DHC

(critical stress intensity factor,  $K_{IH}$ )

가

가

[4].

[5, 6].

as-received

가

DHC

DHC

DHC

DHC

[7]

DHC

, 가 ,

2.

Fig. 1

gage length

2 mm,

1

mm<sup>2</sup>

wire cutting

가

wire cutting

0.1 mm

가

Fig. 2

가

400

12

static

Instron model 4505

$5 \times 10^{-4} \text{ s}^{-1}$

100 Kg

load cell ,

0.2% offset yield

, offset

(displacement)

560

3.

Fig. 1 2

가 가

100-300  
가

가

200

Fig. 3

가

가

가

Fig. 4 5

gage section

2 mm gage section

가 10 mm

4x4 mm

gage section

가 25.4 mm

pin type

가

가

가

가

as-received

가

as-received

가 가

Fig. 6

, Fig. 7

가

[6].

가

4.

Zr-2.5%Nb  
5% 가 10% 500 가 100-300

5.

1. K. F. Amouzouvi and L. J. Clegg, *Metal. Transactions A* 18A (1987), pp. 1687-1694.
2. C. E. Coleman, B. A. Cheadle, C. D. Cann, and J. R. Theaker, *ASTM STP* 1295, 1996, pp. 884-898.
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6. S. S. Kim, Y. S. Kim, S. C. Kwon, S. B. Ahn, and K. N. Choo, *Transactions of 15th SMiRT*, 1999, pp. x-263-274.
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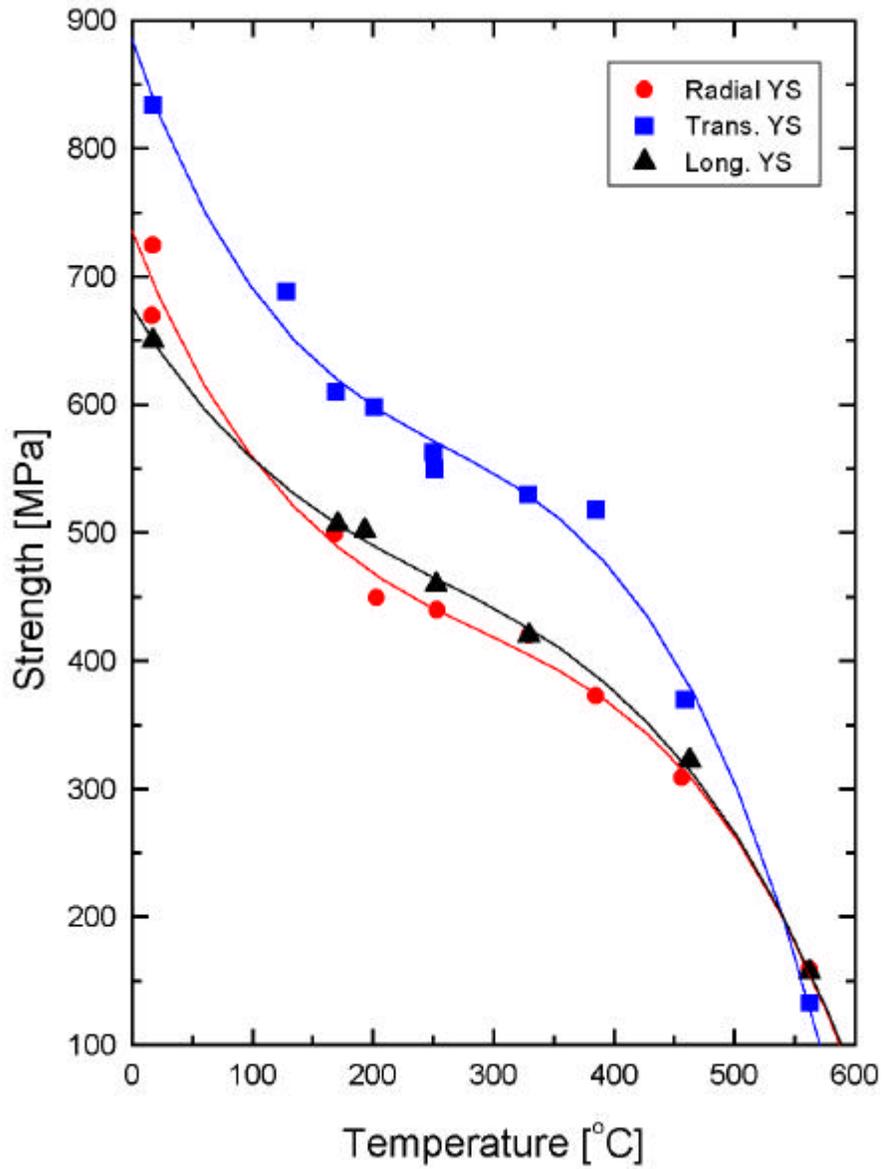


Fig. 1. Comparison of yield strengths measured from the small specimens in the radial, longitudinal, and transverse direction in Zr-2.5%Nb pressure tube.

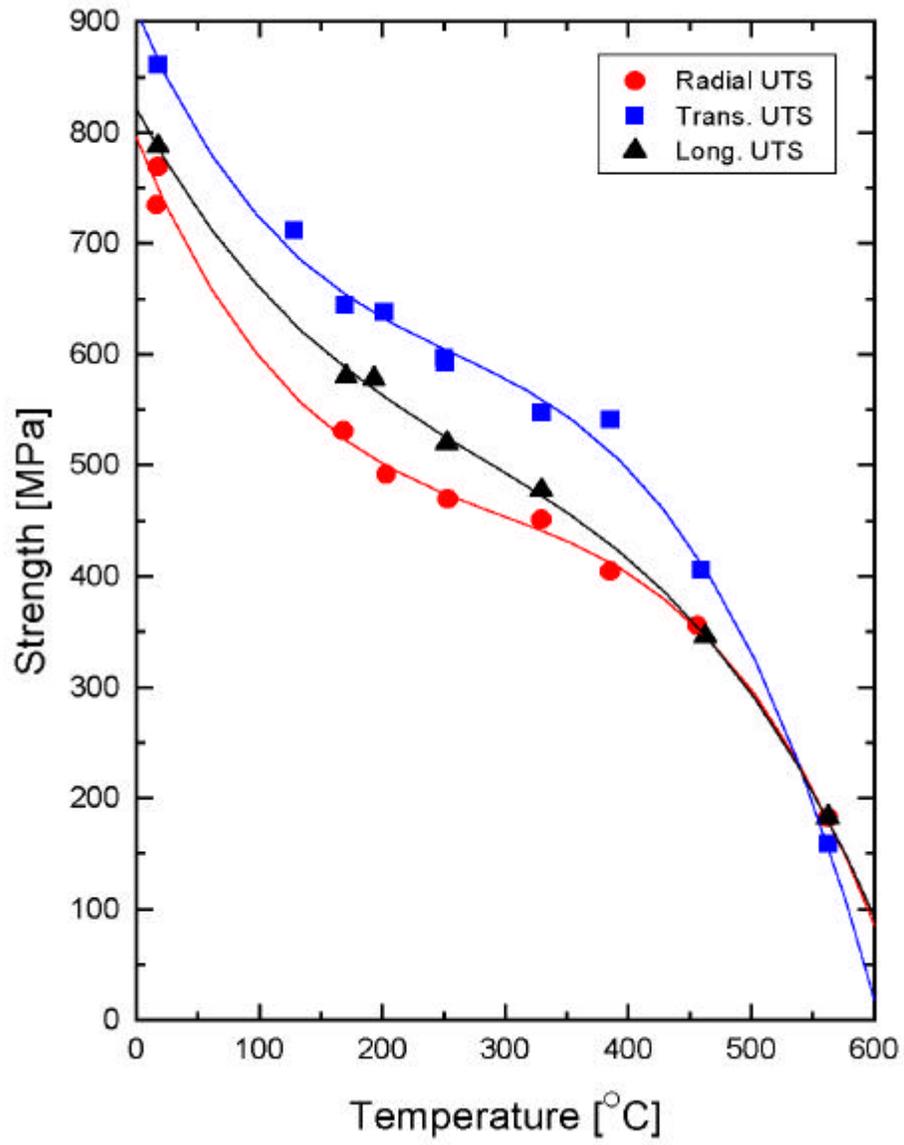
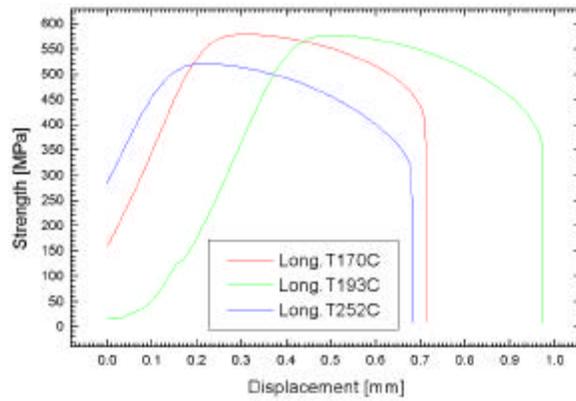
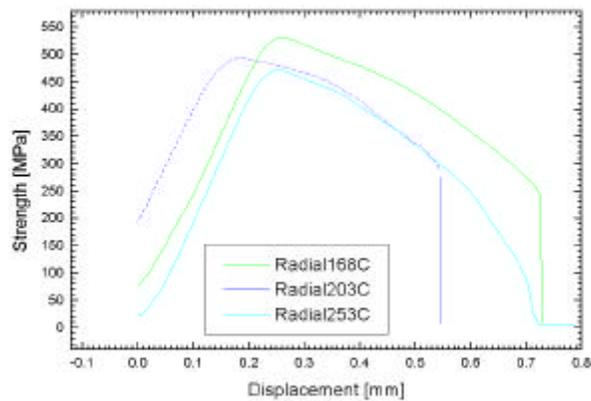


Fig. 2. Comparison of tensile strengths measured from the small specimens in the radial, longitudinal, and transverse direction in Zr-2.5%Nb pressure tube.

a) longitudinal direction



b) radial direction



c) transverse direction

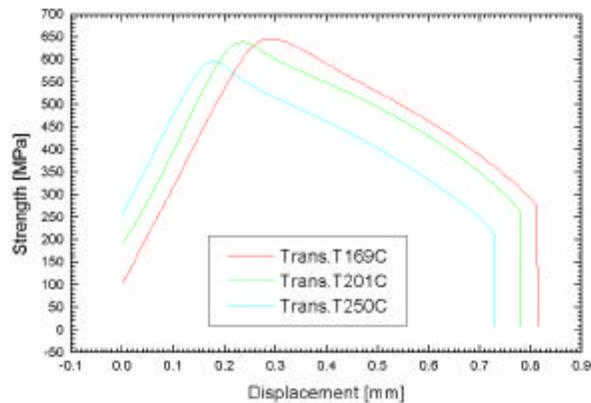


Fig. 3. Comparison of stress-strain curves obtained from the small specimens at about 200 and 250 in the radial, longitudinal, and transverse direction in Zr-2.5%Nb pressure tube.

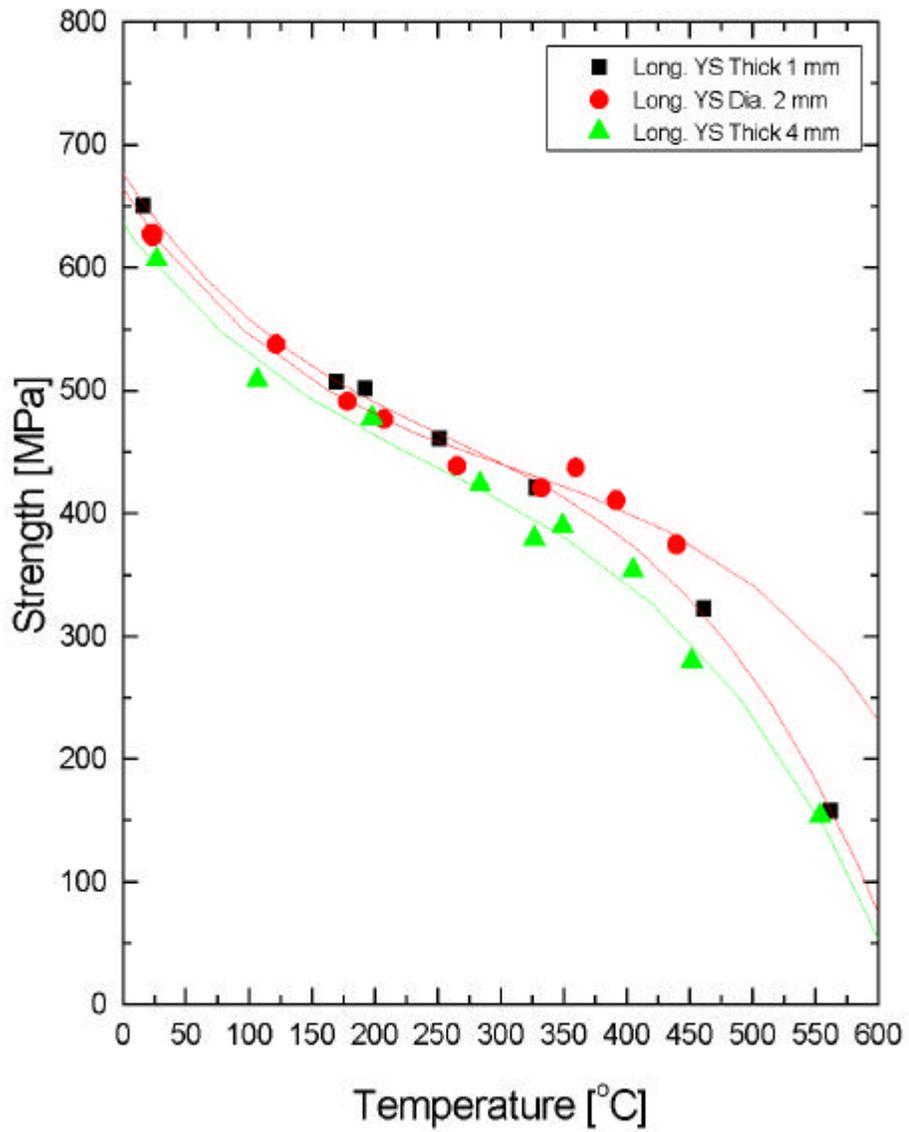


Fig. 4. Comparison of yield strengths measured from the variously sized specimens in the longitudinal direction in Zr-2.5%Nb pressure tube.

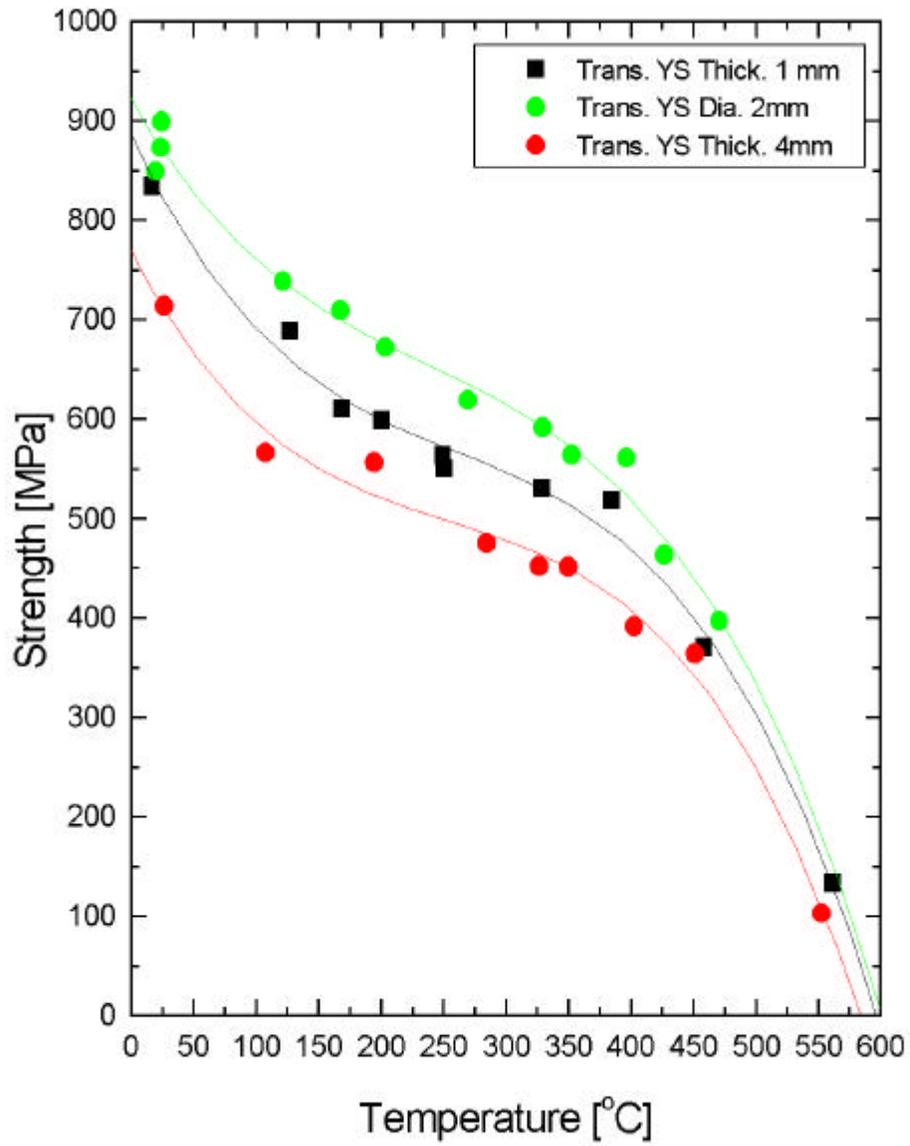


Fig. 5. Comparison of tensile strengths measured from the variously sized specimens in the transverse direction in Zr-2.5%Nb pressure tube.

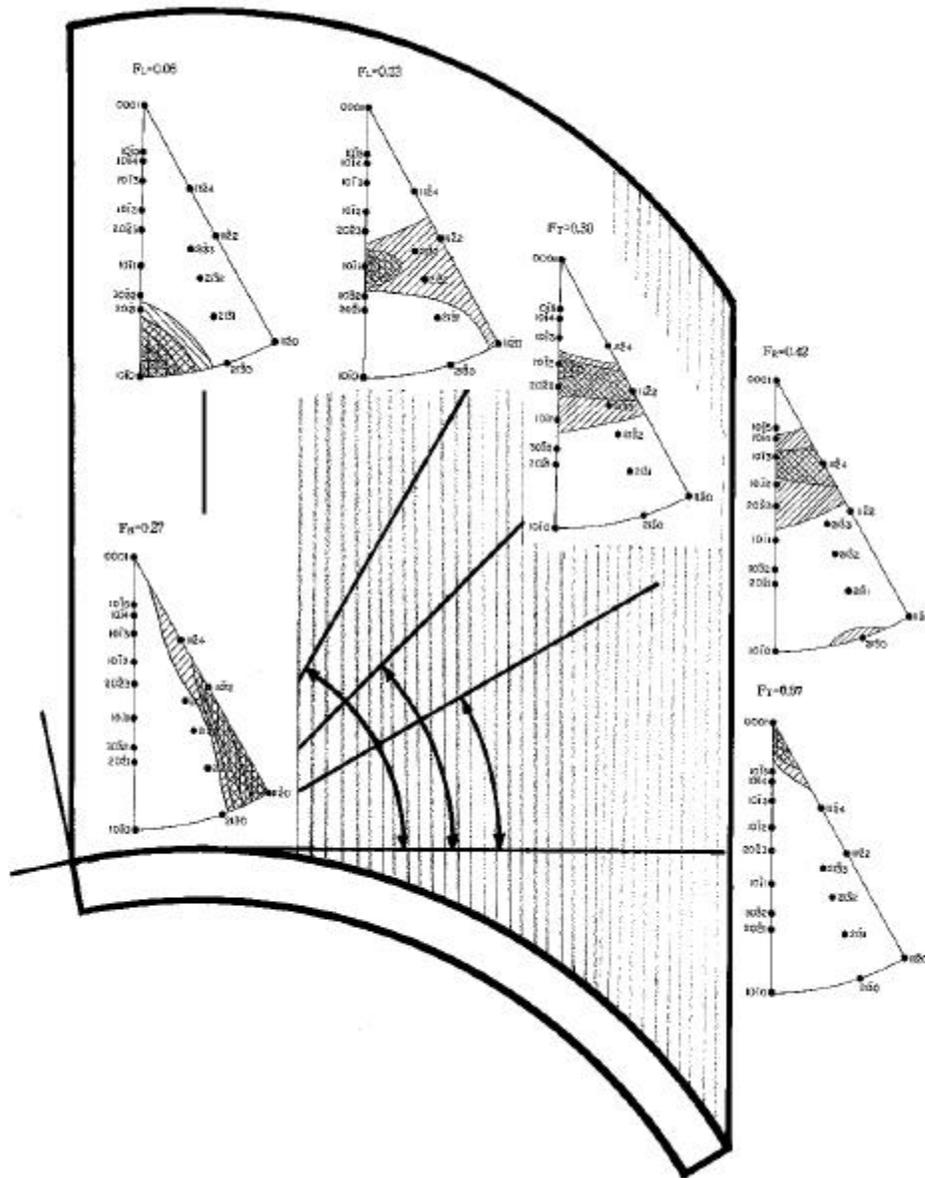


Fig. 6. Inverse pole figures in the various direction in the Zr-2.5%Nb pressure tube.

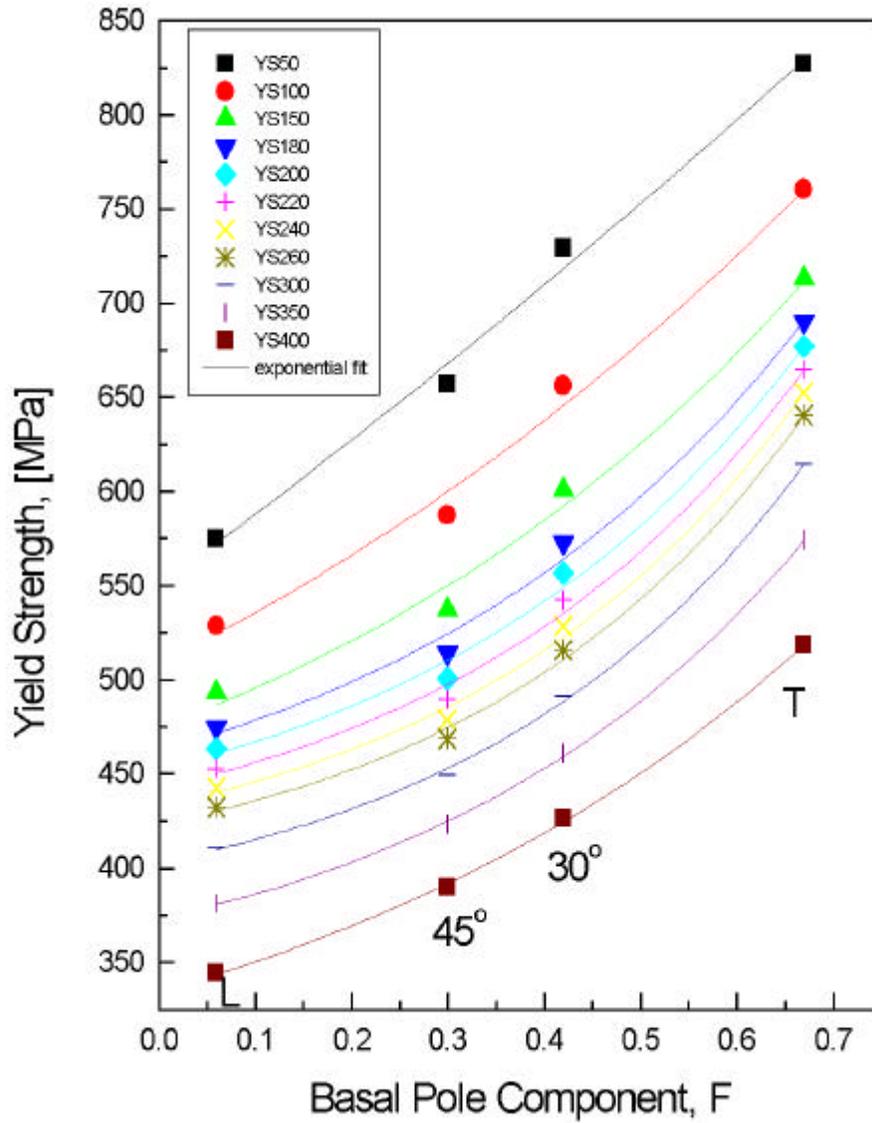


Fig. 7. The basal pole component dependency of yield strengths in the various direction at various temperature in Zr-2.5%Nb pressure tube.