

27B
REPORT NO. GDC-DDG-67-006 - END

THE STABILITY OF ECCENTRICALLY STIFFENED CIRCULAR CYLINDERS. 2*

VOLUME 3: 2*
APPENDIX 6

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APPENDIX A

SUPPLEMENTARY CRITICAL STRESS CURVES

A.1 GENERAL

The curves of this appendix present the critical stress values of SECTION 5.1 in a slightly different format from that of Figures 4, 5, and 6. In particular, the abscissa has been changed from (R/N^*t) to simply (R/t) . This results in an increased number of design curves since it is then necessary to provide separate families for selected fixed values of N^* . All of the curves given here were obtained from digital computer program 4196 used in conjunction with an automatic plotting machine.

A.2 CURVES

A.2.1 7075-T6 ALUMINUM ALLOY

Table XV lists the families provided here for longitudinally stiffened cylinders made of 7075-T6 aluminum alloy. These curves are based upon the following values for the indicated material properties:

	E	$= 10.5 \times 10^6$	psi
	ν	$= .33$	
	σ_{cy}	$= 67,000$	psi
Ramberg-Osgood	n	$= 10$	
Ramberg-Osgood	$\sigma_{.7}$	$= 70,000$	psi

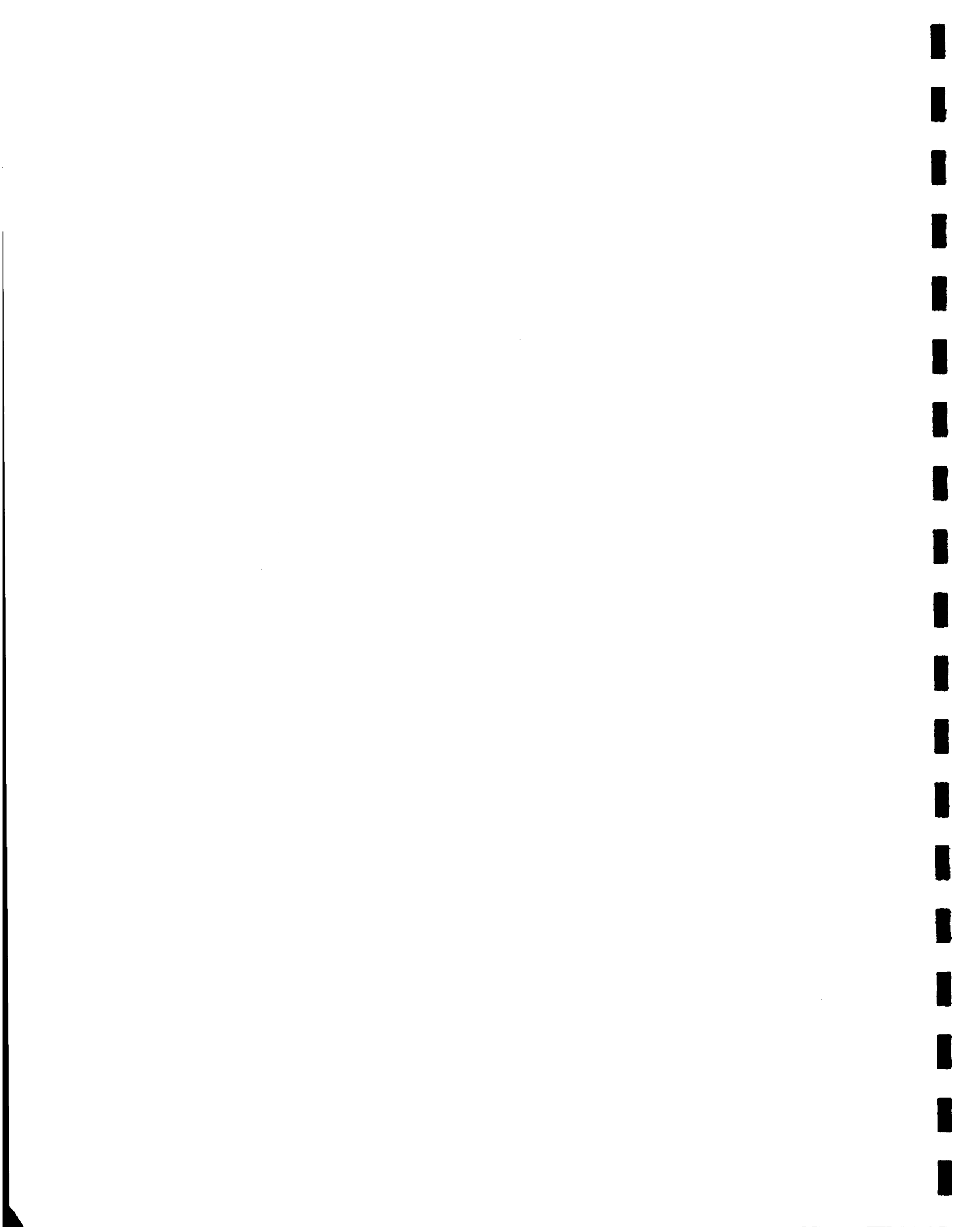
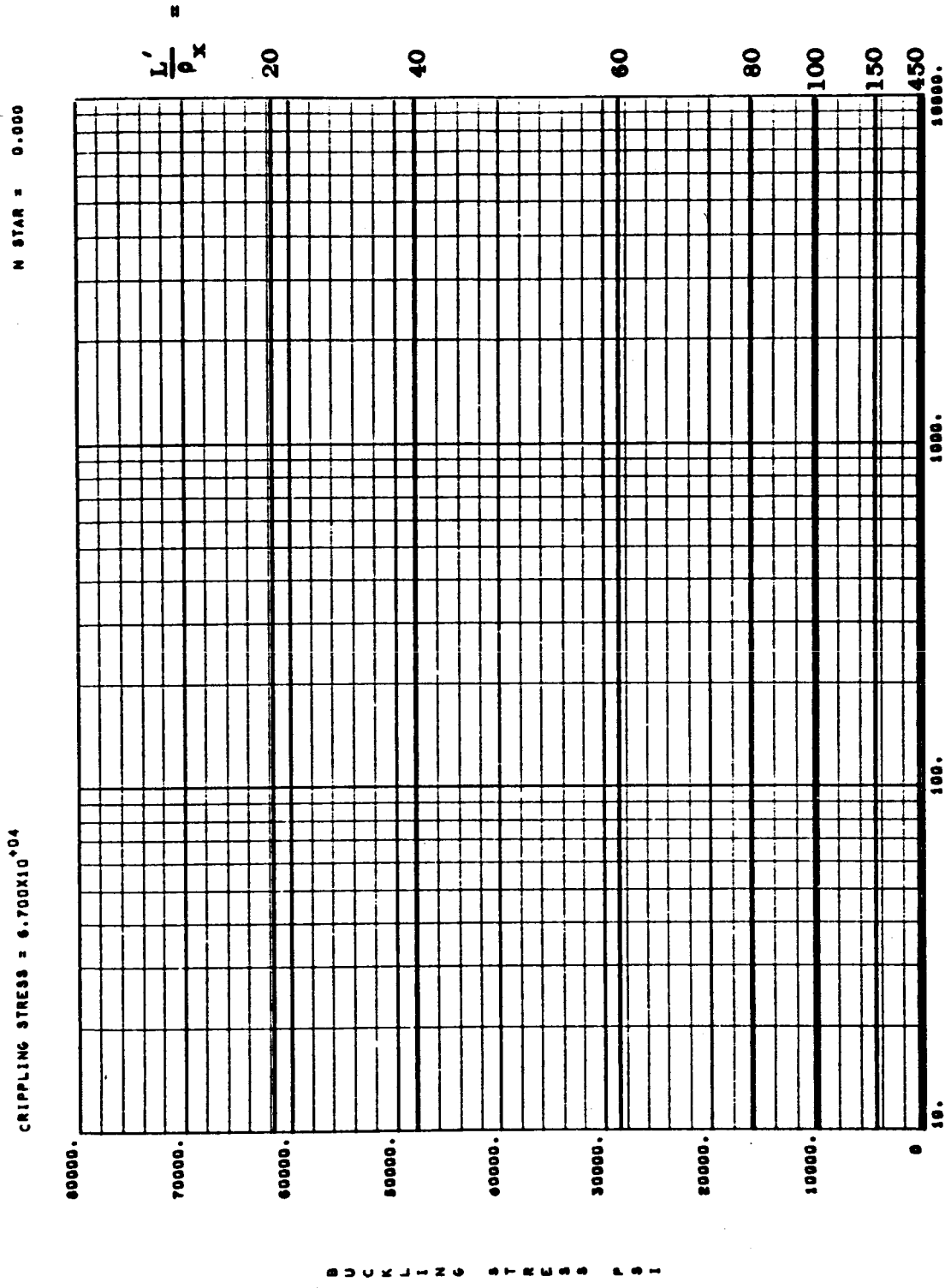


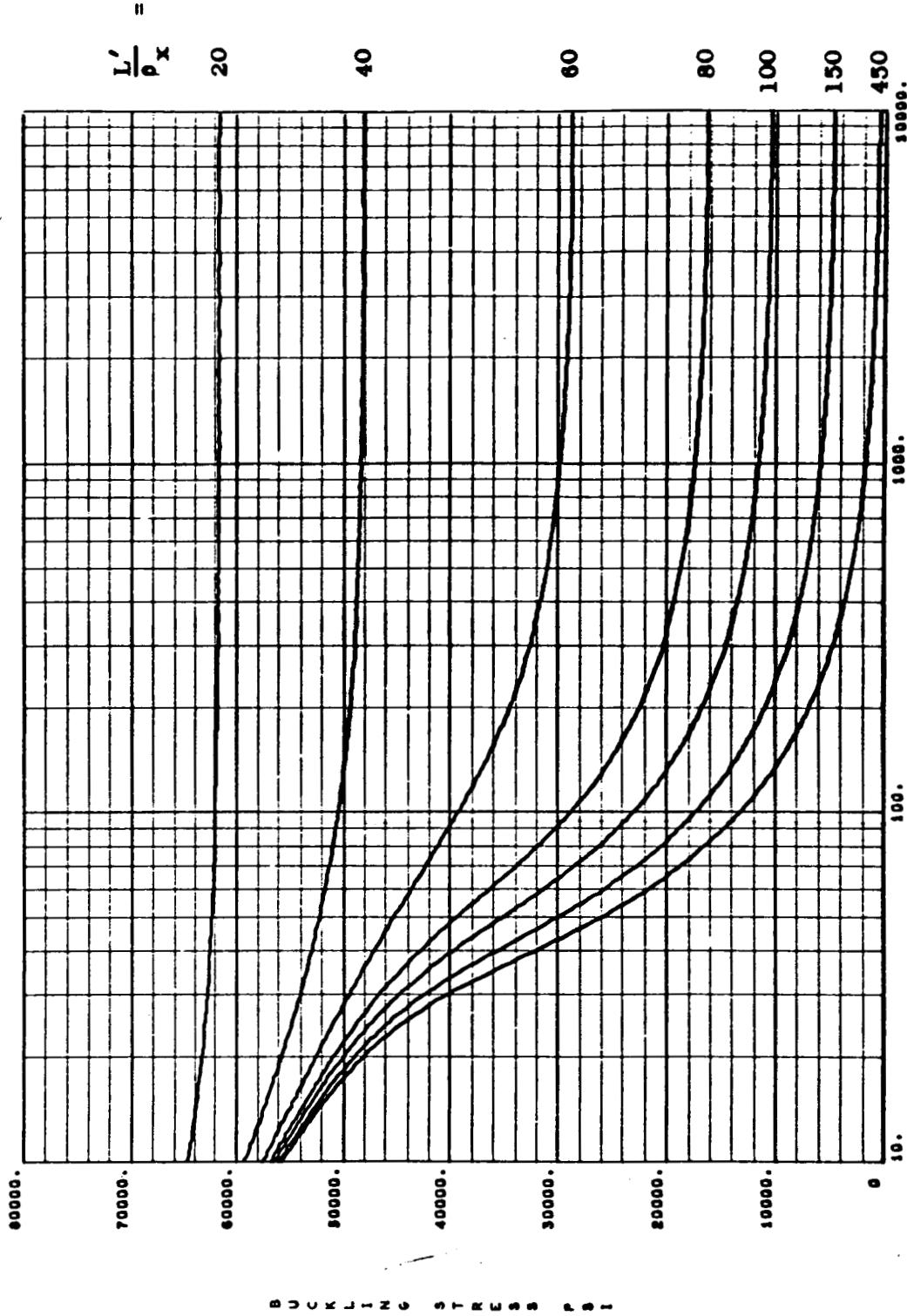
TABLE XV - Table of Contents for Supplementary
Curves of Compressive Buckling Stress
for Longitudinally Stiffened Cylinders;
Material - 7075-T6 Aluminum Alloy

<u>Figure Number</u>	<u>Crippling Stress, σ_{cc}</u>	<u>N*</u>	<u>Page</u>
16(a)	67,000	0.0	A-5
16(b)	67,000	0.2	A-6
16(c)	67,000	0.4	A-7
16(d)	67,000	0.6	A-8
16(e)	67,000	0.8	A-9
16(f)	67,000	1.0	A-10
16(g)	67,000	1.2	A-11
16(h)	67,000	1.4	A-12
16(i)	67,000	1.6	A-13
16(j)	67,000	1.8	A-14
16(k)	67,000	2.0	A-15
17(a)	60,000	0.0	A-16
17(b)	60,000	0.2	A-17
17(c)	60,000	0.4	A-18
17(d)	60,000	0.6	A-19
17(e)	60,000	0.8	A-20
17(f)	60,000	1.0	A-21
17(g)	60,000	1.2	A-22
17(h)	60,000	1.4	A-23
17(i)	60,000	1.6	A-24
17(j)	60,000	1.8	A-25
17(k)	60,000	2.0	A-26
18(a)	50,000	0.0	A-27
18(b)	50,000	0.2	A-28
18(c)	50,000	0.4	A-29
18(d)	50,000	0.6	A-30
18(e)	50,000	0.8	A-31
18(f)	50,000	1.0	A-32
18(g)	50,000	1.2	A-33
18(h)	50,000	1.4	A-34
18(i)	50,000	1.6	A-35
18(j)	50,000	1.8	A-36
18(k)	50,000	2.0	A-37

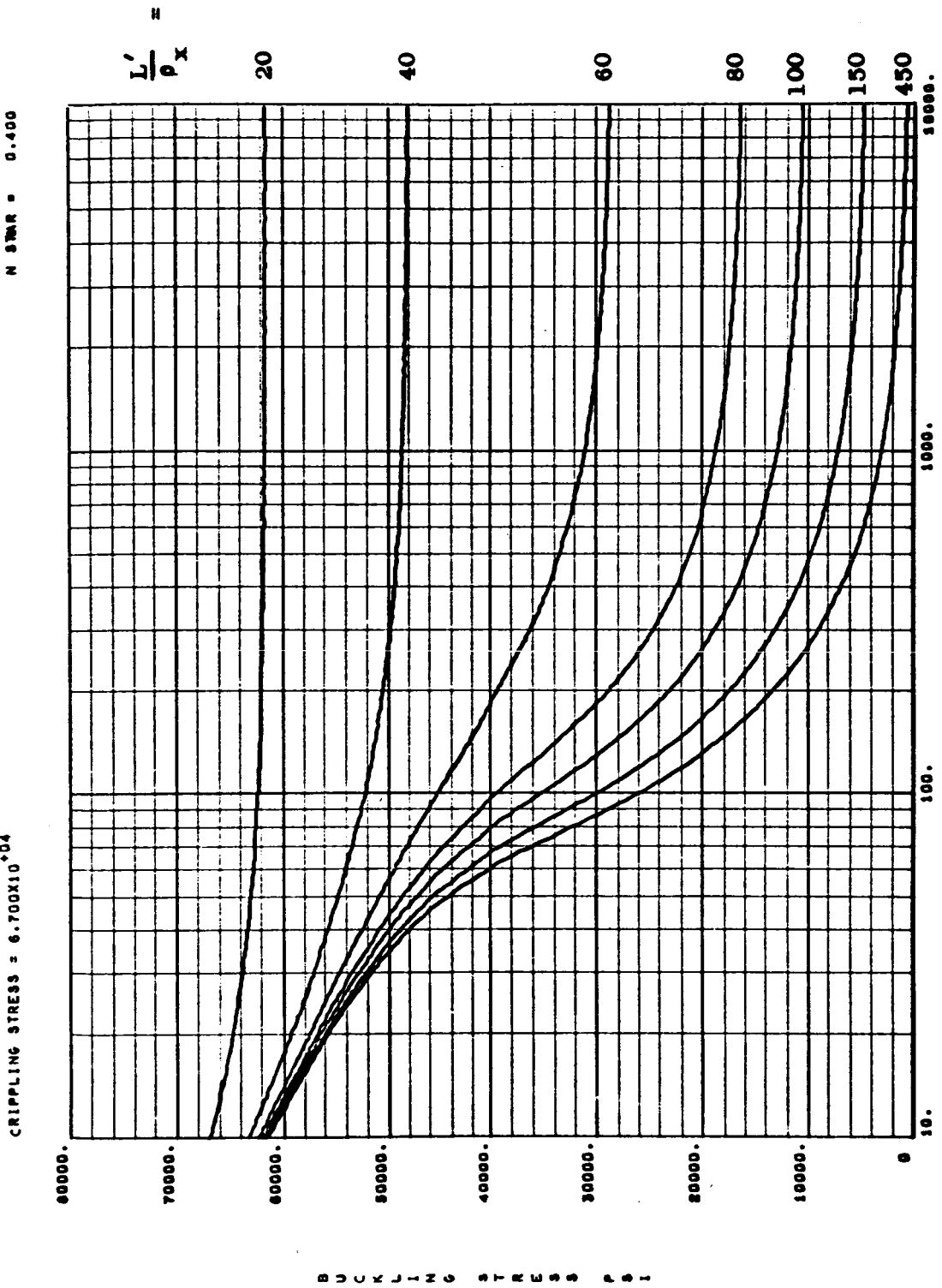


N STAR = 0.200

CRIPPLING STRESS = 6.700×10^4



COMPRESSIVE BUCKLING STRESS FOR
 LONGITUDINALLY STIFFENED CYLINDERS
 MATERIAL - 7075-T6 ALUMINUM ALLOY
 Figure 16(b)

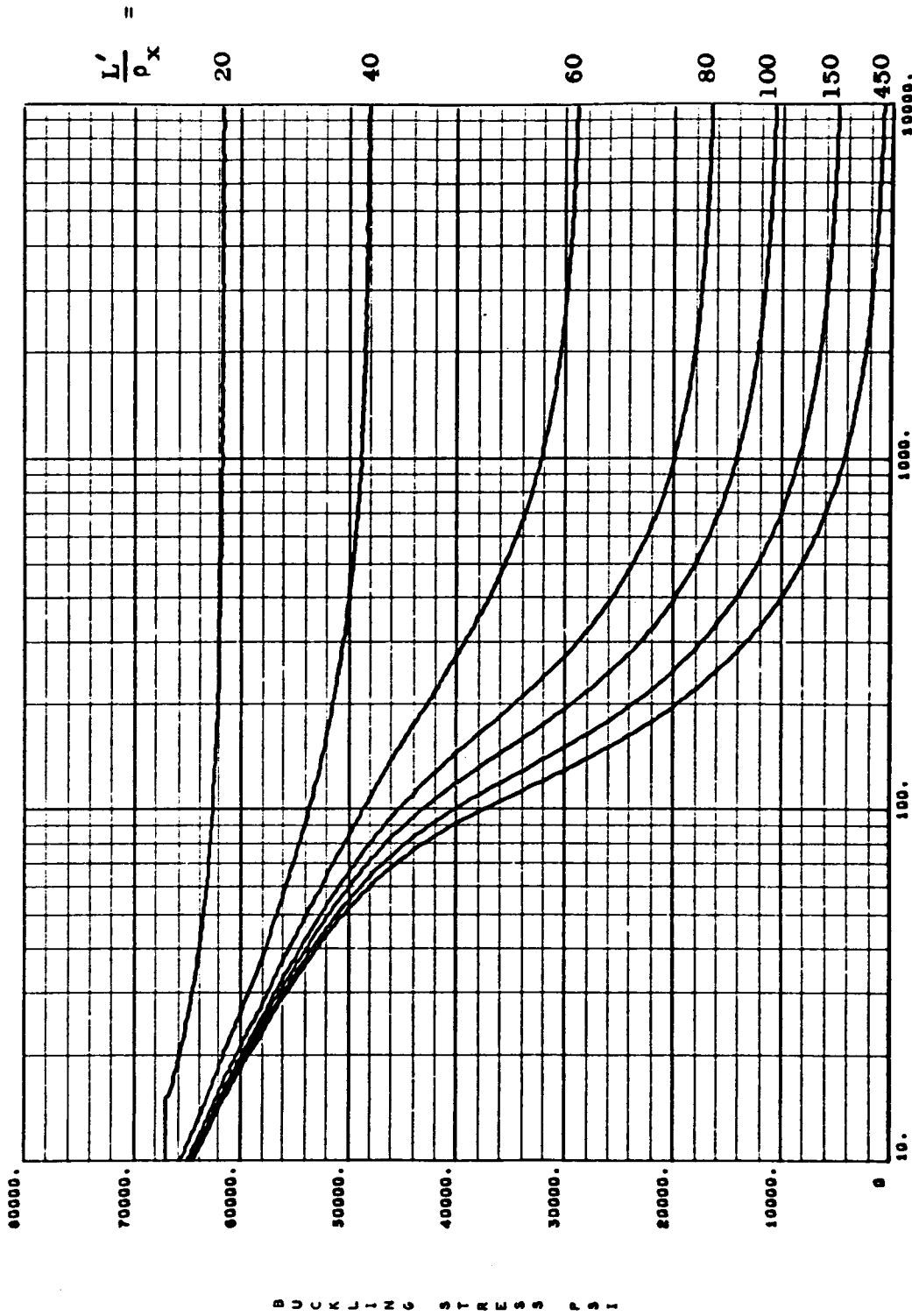


COMPRESSION BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 7075-T6 ALUMINUM ALLOY

Figure 16(c)

N STAR = 0.600

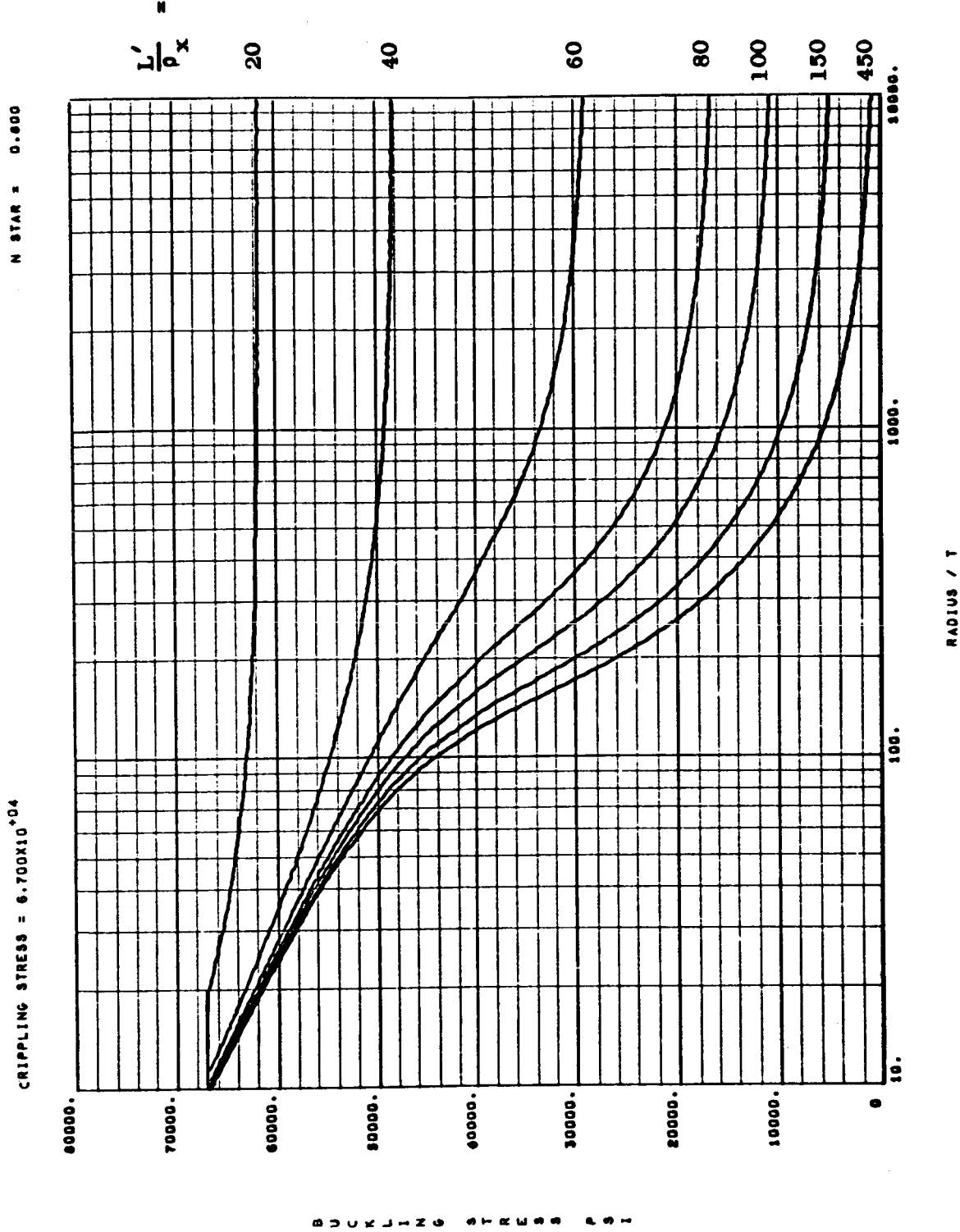
CRIPPLING STRESS = 6.700×10^{-4}



RADIUS / T

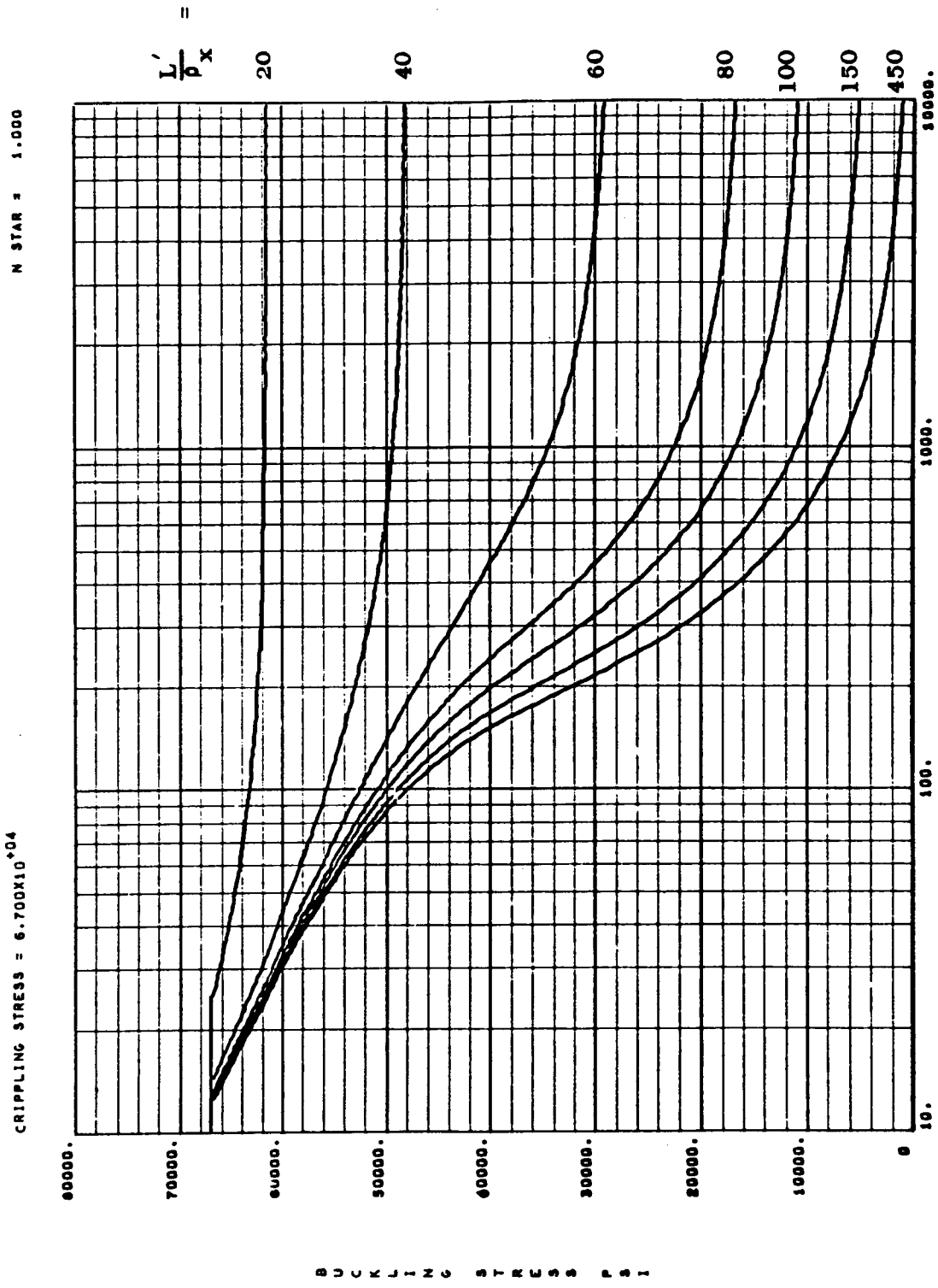
COMPRESSIVE BUCKLING STRESS FOR
 LONGITUDINALLY STIFFENED CYLINDERS
 MATERIAL - 7075-T6 ALUMINUM ALLOY

Figure 16(d)



COMPRESSIVE BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 7075-T6 ALUMINUM ALLOY

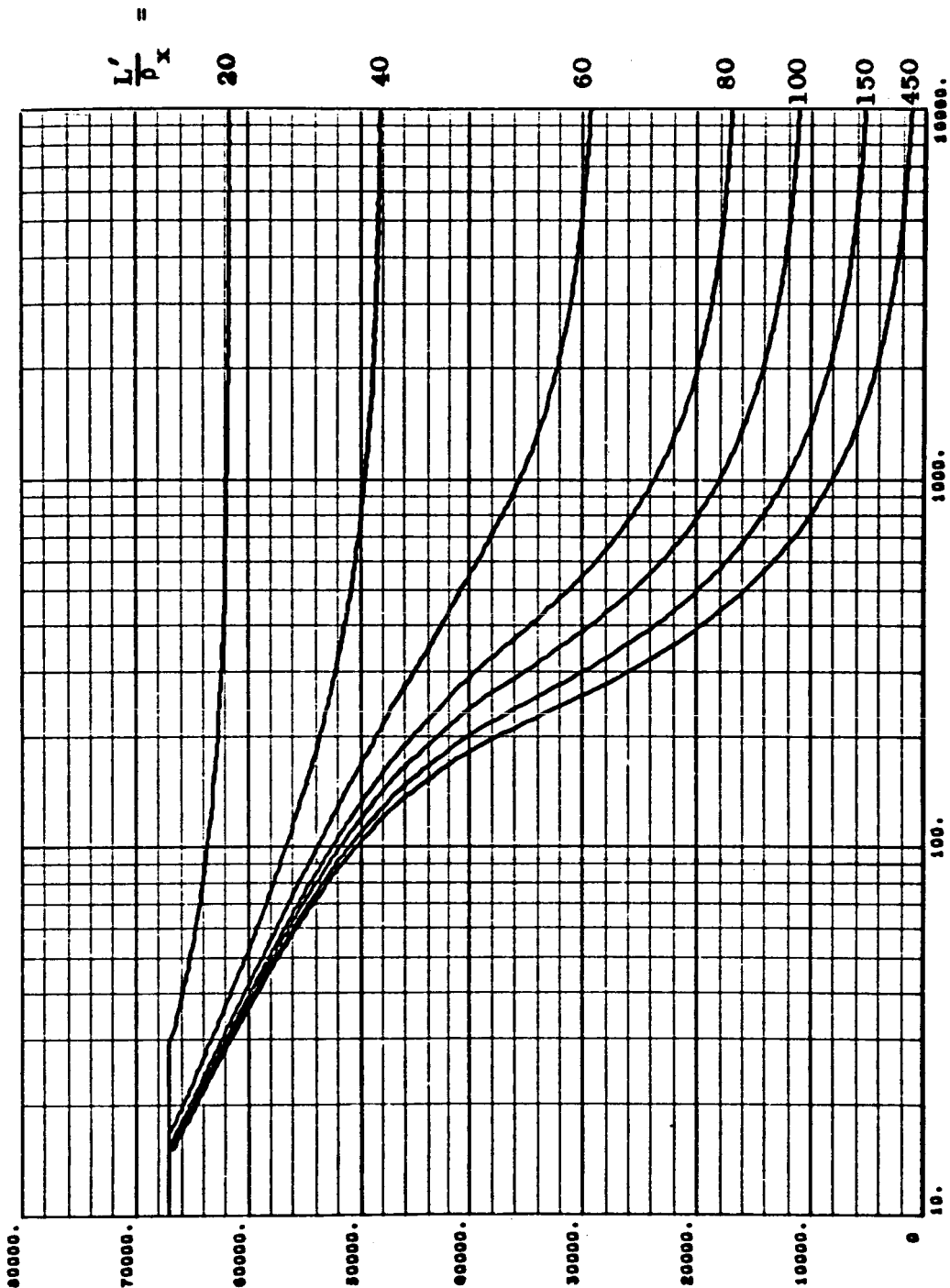
Figure 16 (e)



COMPRESSIVE BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 7075-T6 ALUMINUM ALLOY
Figure 16(f)

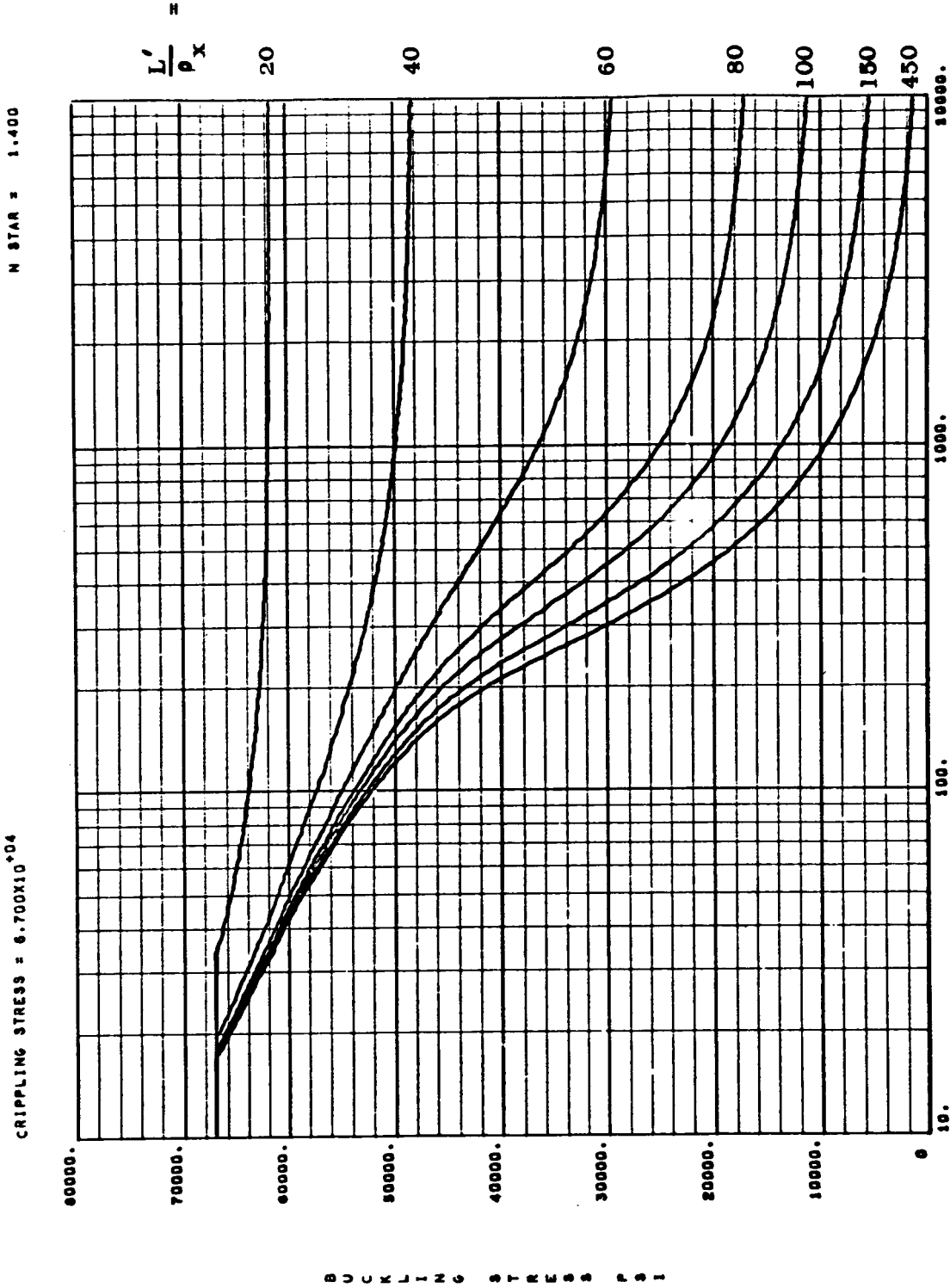
N STAR = 1.200

CRIPPLING STRESS = 6.700×10^{-4}



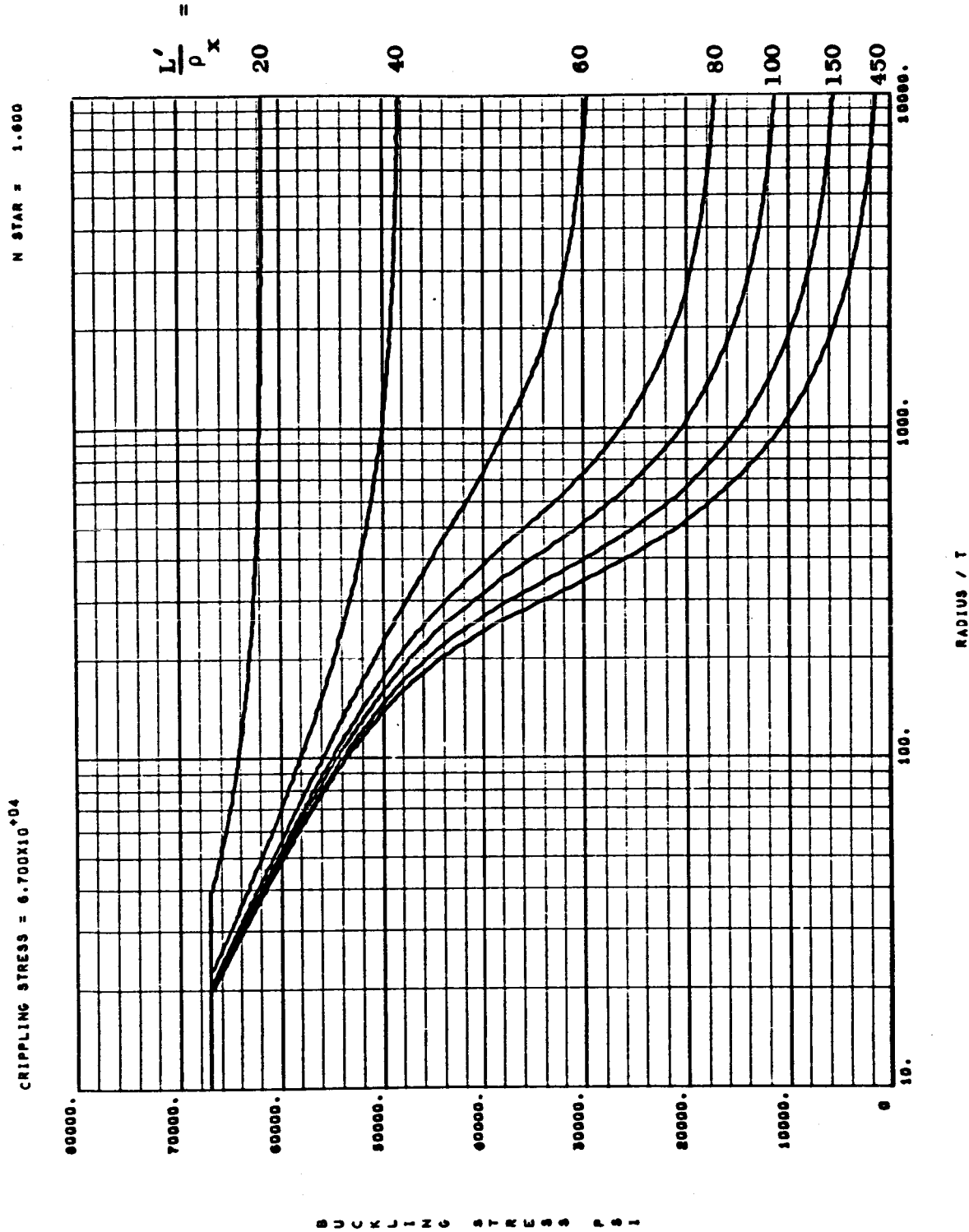
B U C K L I N G S T R E S S P S I

COMPRESSIVE BUCKLING STRESS FOR
 LONGITUDINALLY STIFFENED CYLINDERS
 MATERIAL - 7075-T6 ALUMINUM ALLOY
 Figure 16(g)



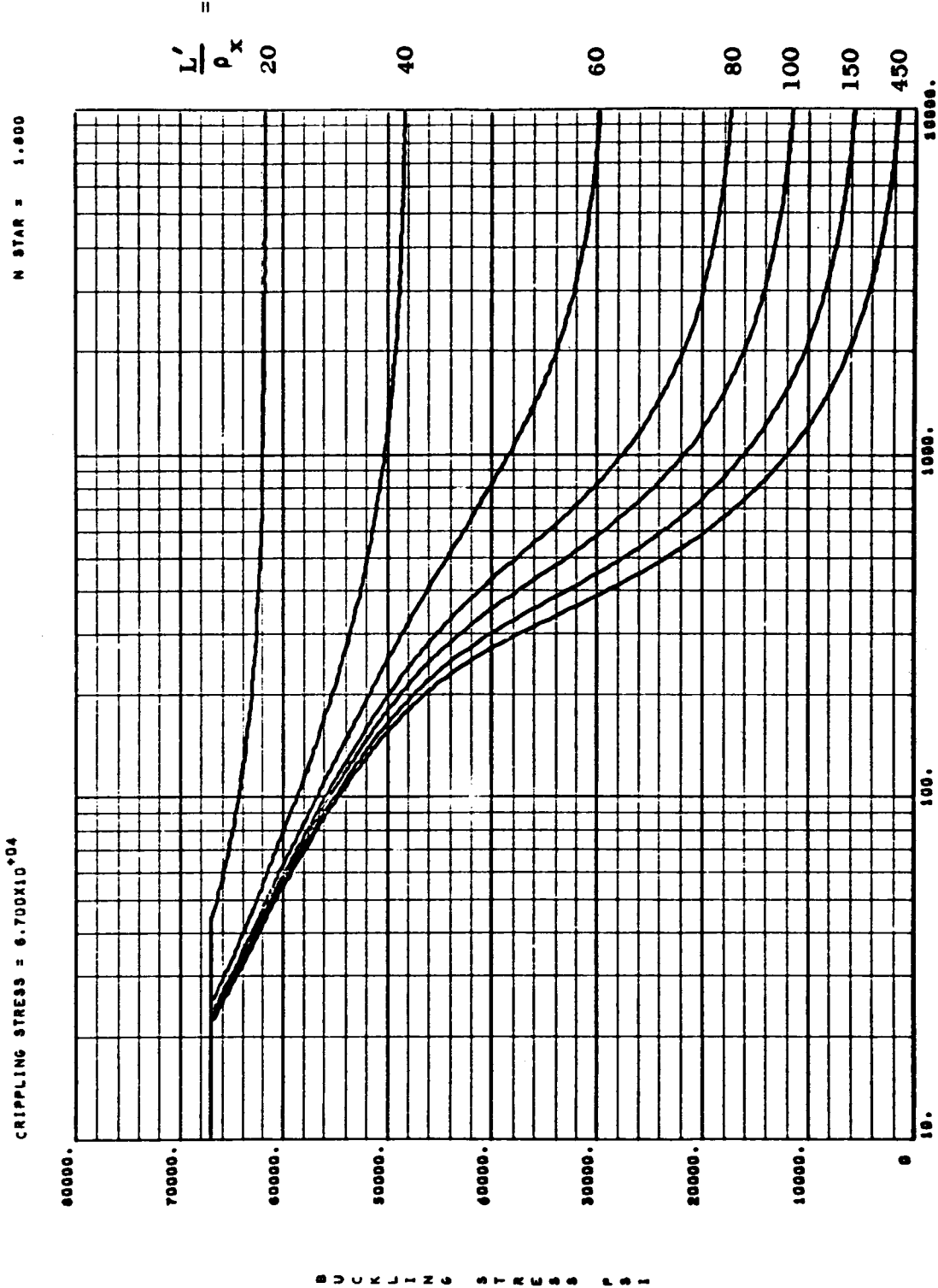
COMPRESSIVE BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 7075-T6 ALUMINUM ALLOY

Figure 16(h)



COMPRESSION BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 7075-T6 ALUMINUM ALLOY

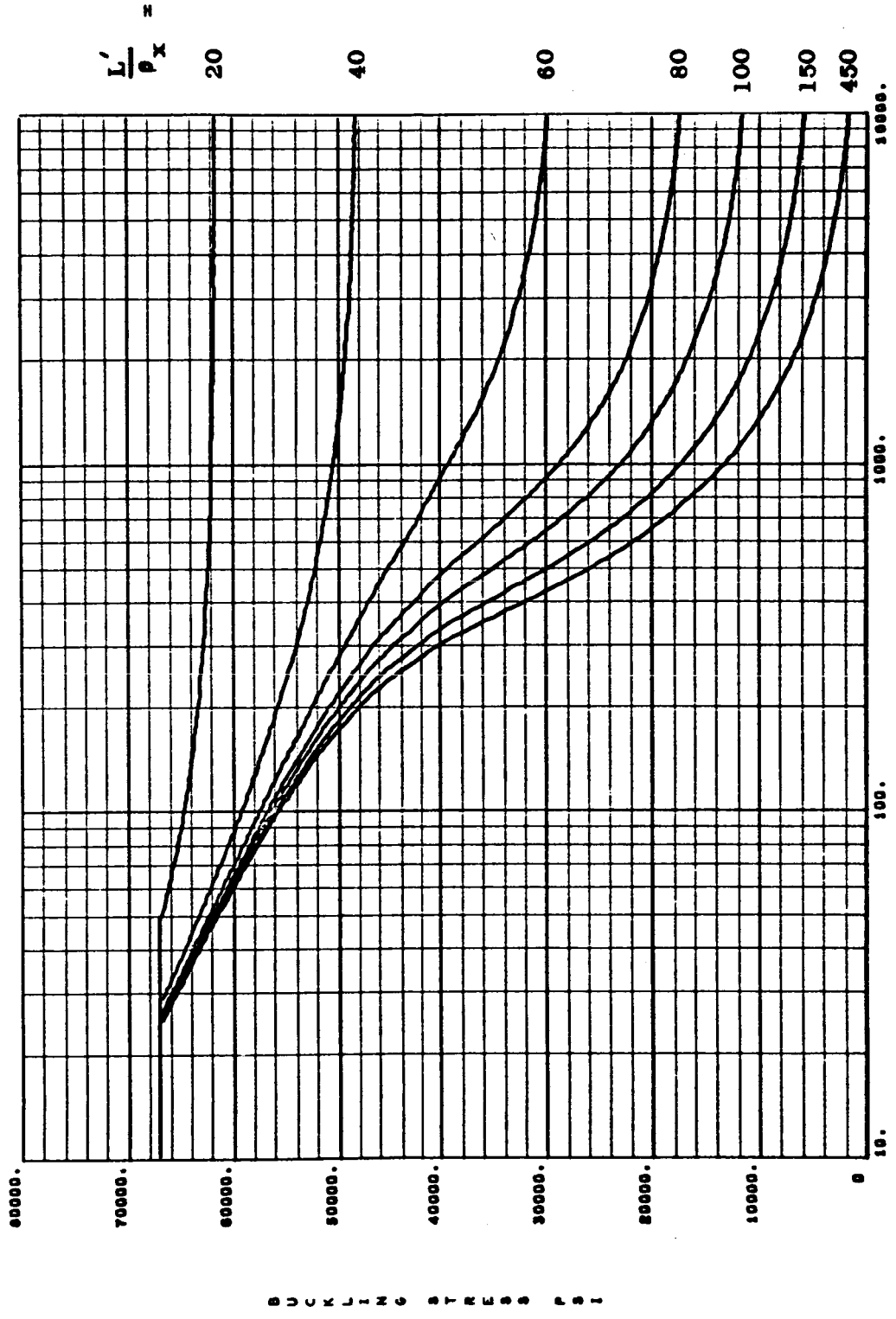
Figure 16 (i)



COMPRESSION BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 7075-T6 ALUMINUM ALLOY
Figure 16(j)

N STAR = 2.000

CRIPPLING STRESS = 6.700×10^{10}



B U C K L I N G S T R E S S

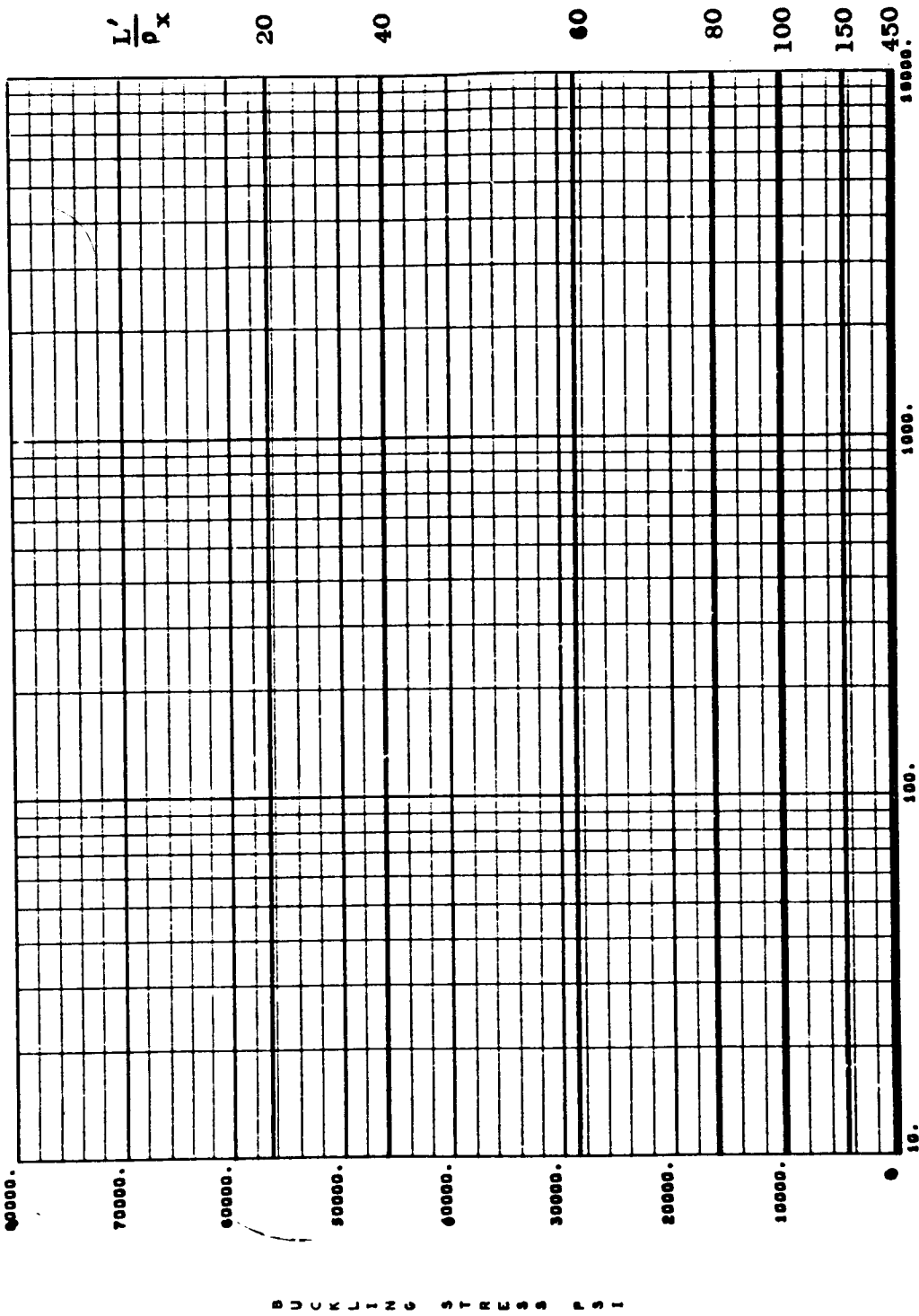
RADIUS / T

COMPRESSIVE BUCKLING STRESS FOR LONGITUDINALLY STIFFENED CYLINDERS

MATERIAL - 7075-T6 ALUMINUM ALLOY

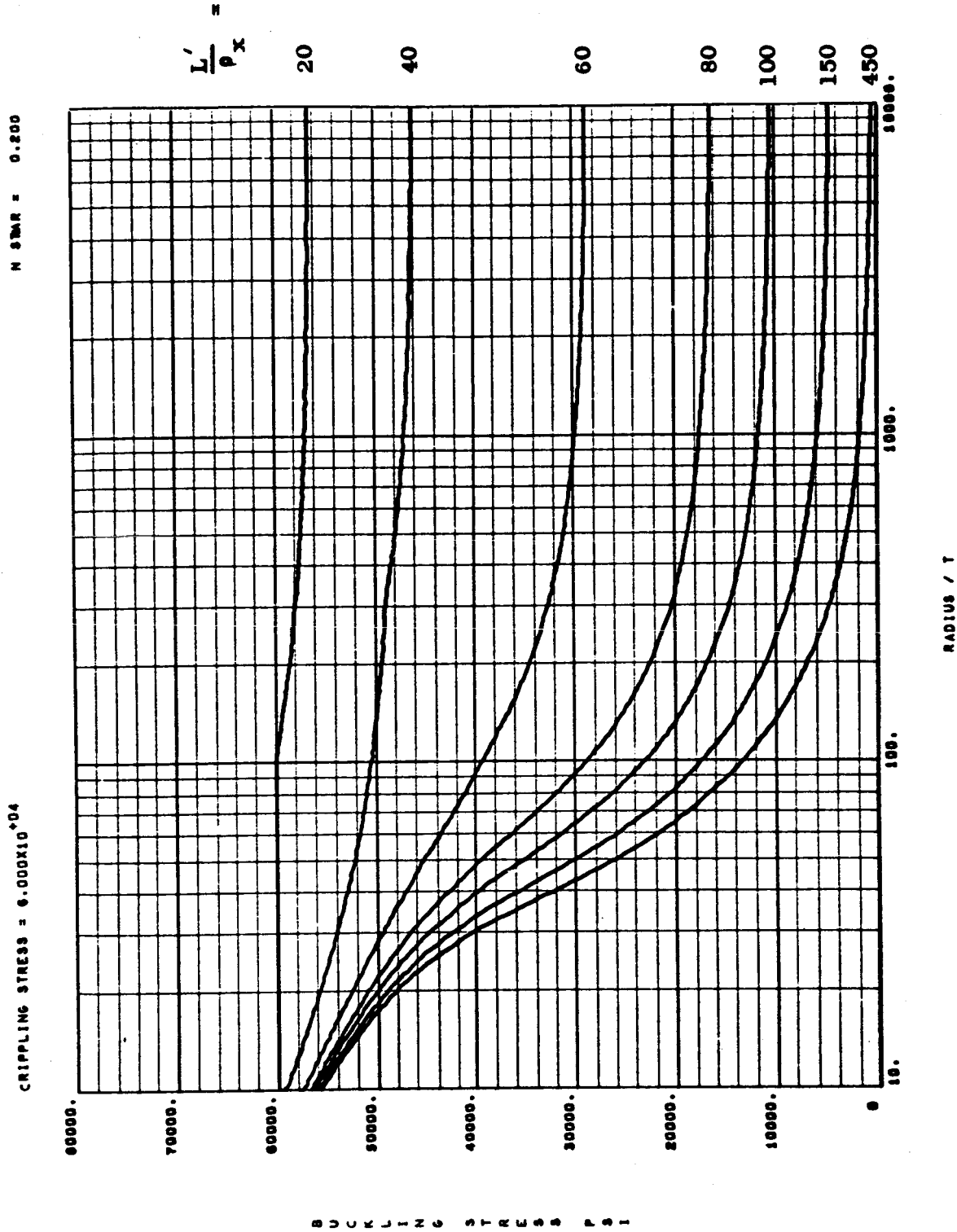
Figure 16(k)

CRIPPLING STRESS = 6.000×10^{-4} N STAR = 0.000



COMPRESSIVE BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 7075-T6 ALUMINUM ALLOY

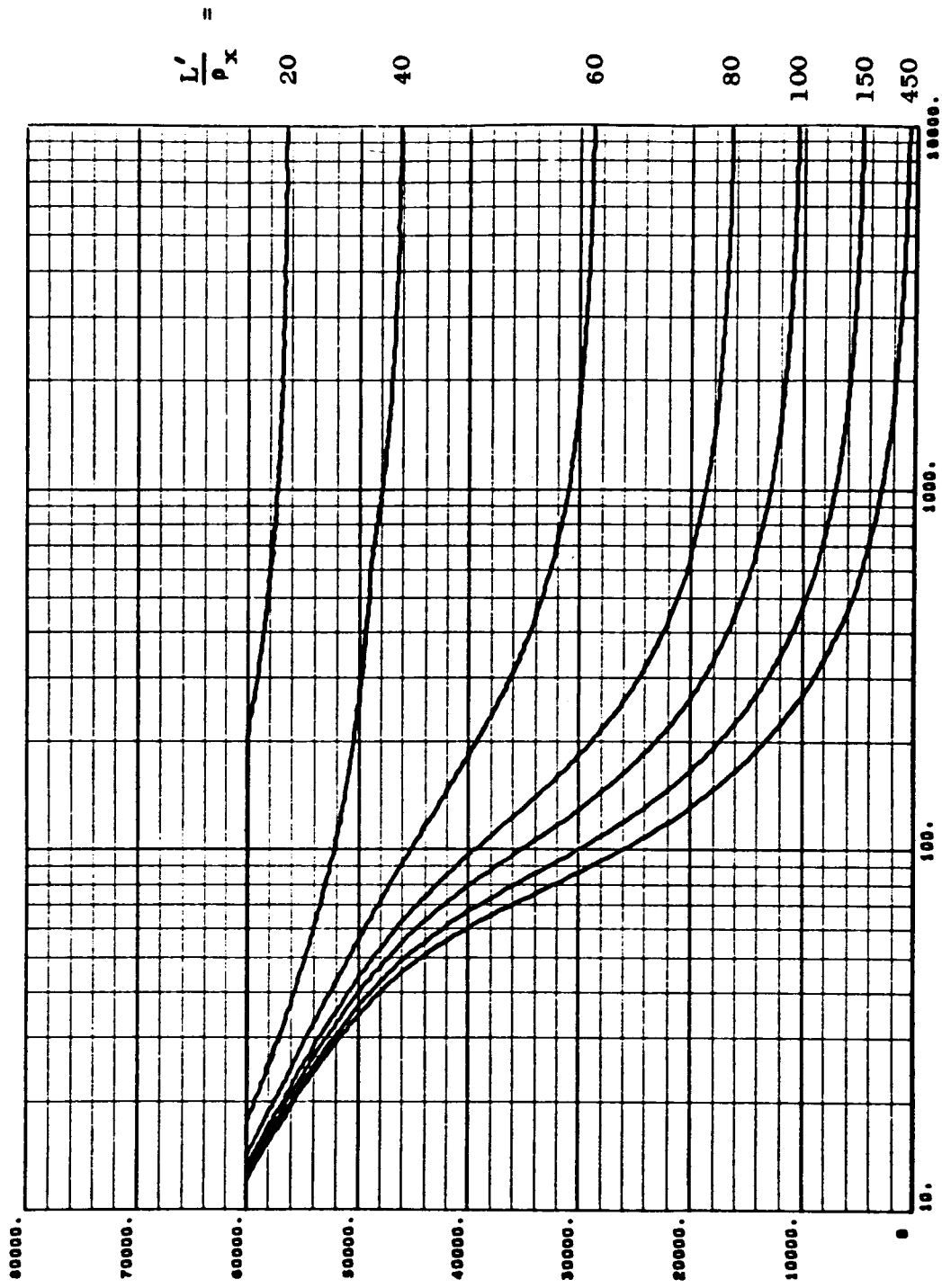
Figure 17(a)



COMPRESSIVE BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 7075-T6 ALUMINUM ALLOY
Figure 17(b)

M STAR = 0.400

CRIPPLING STRESS = 6.000×10^{10}



B U C K L I N G S T R E S S

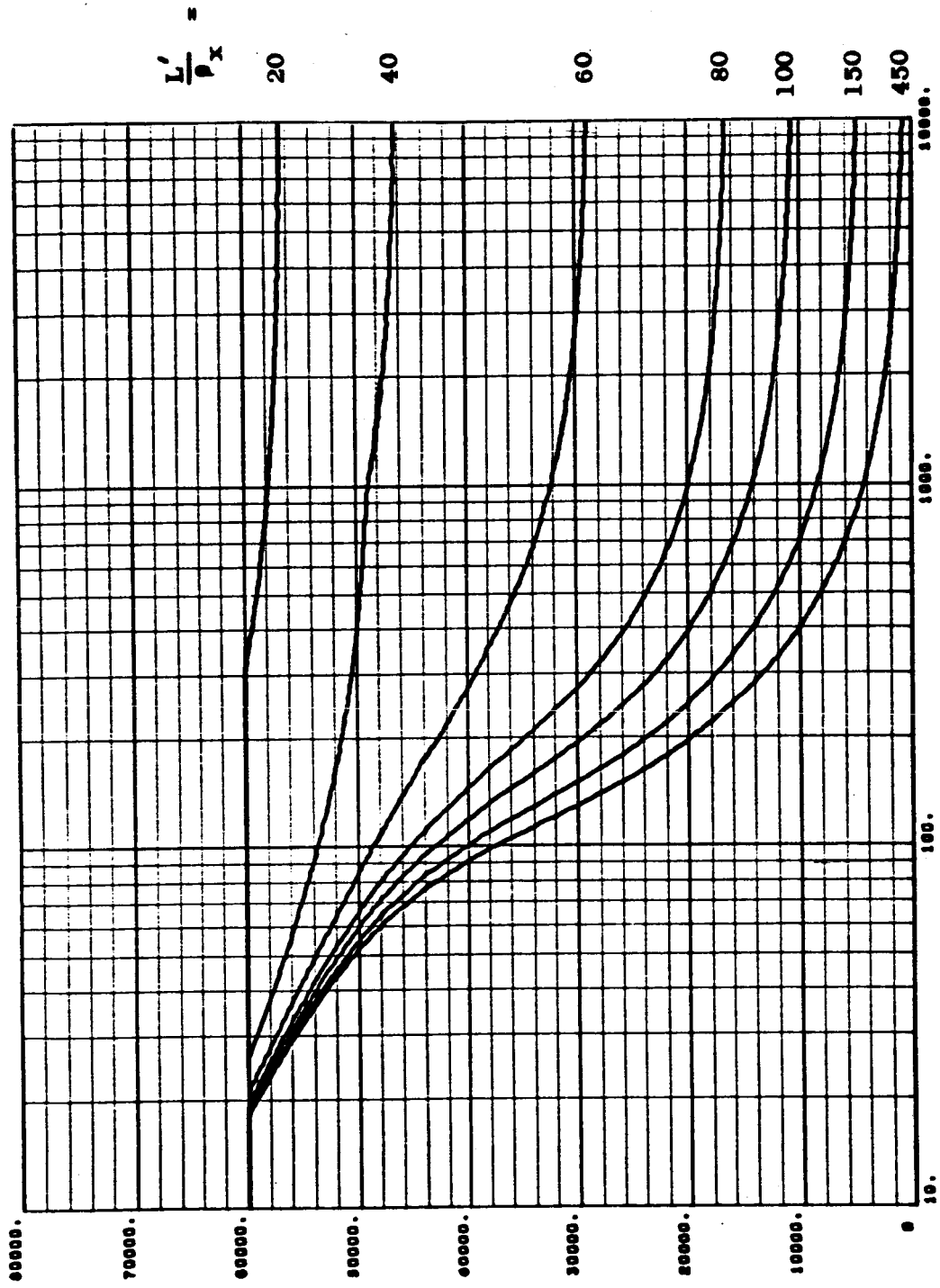
RADIUS / r

COMPRESSIVE BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 7075-T6 ALUMINUM ALLOY

Figure 17(c)

N STAR = 0.600

CRIPPLING STRESS = 6.000X10⁺⁰⁴



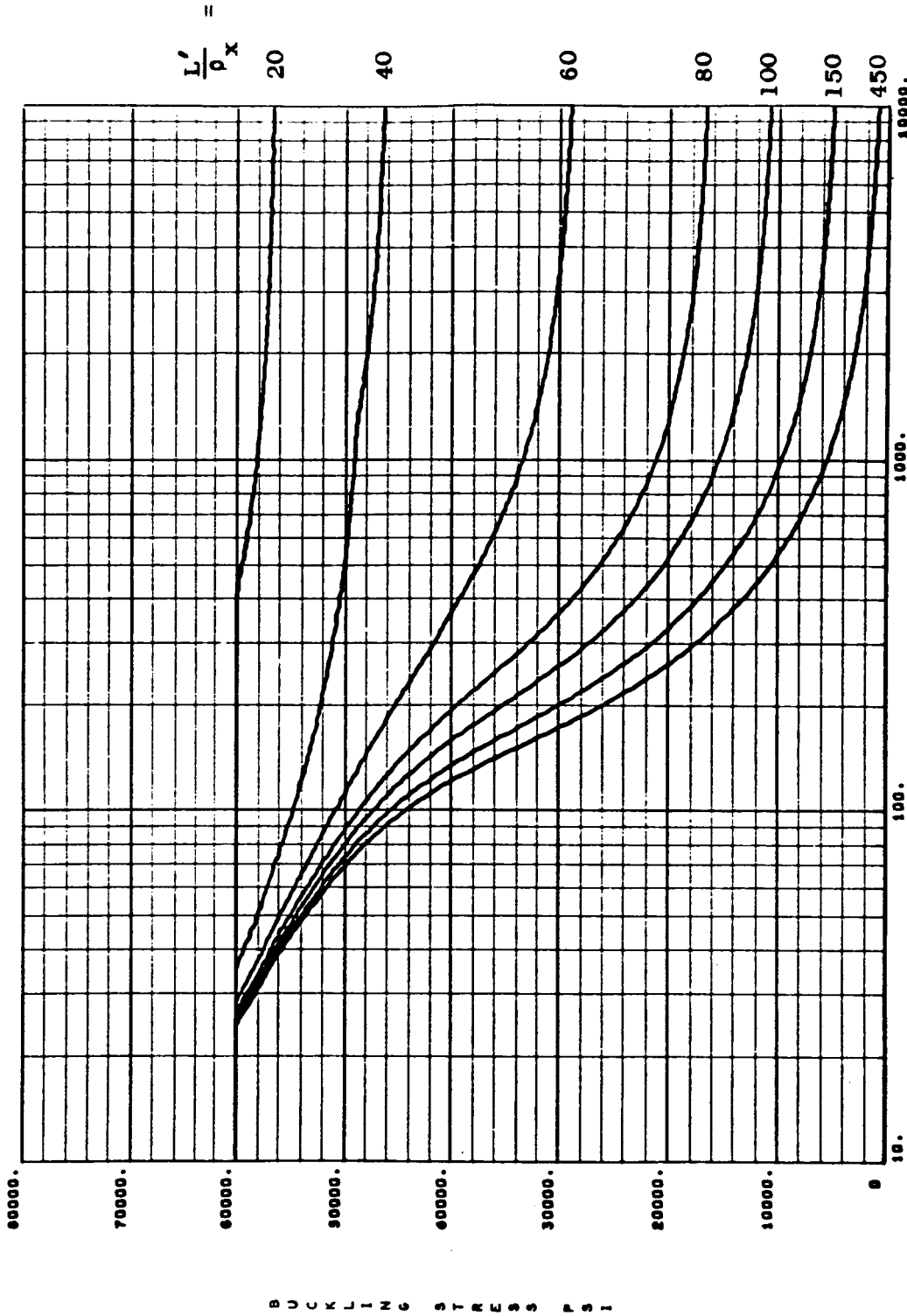
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COMPRESSIVE BUCKLING STRESS FOR
 LONGITUDINALLY STIFFENED CYLINDERS
 MATERIAL - 7075-T6 ALUMINUM ALLOY

Figure 17(d)

N STAR = 0.600

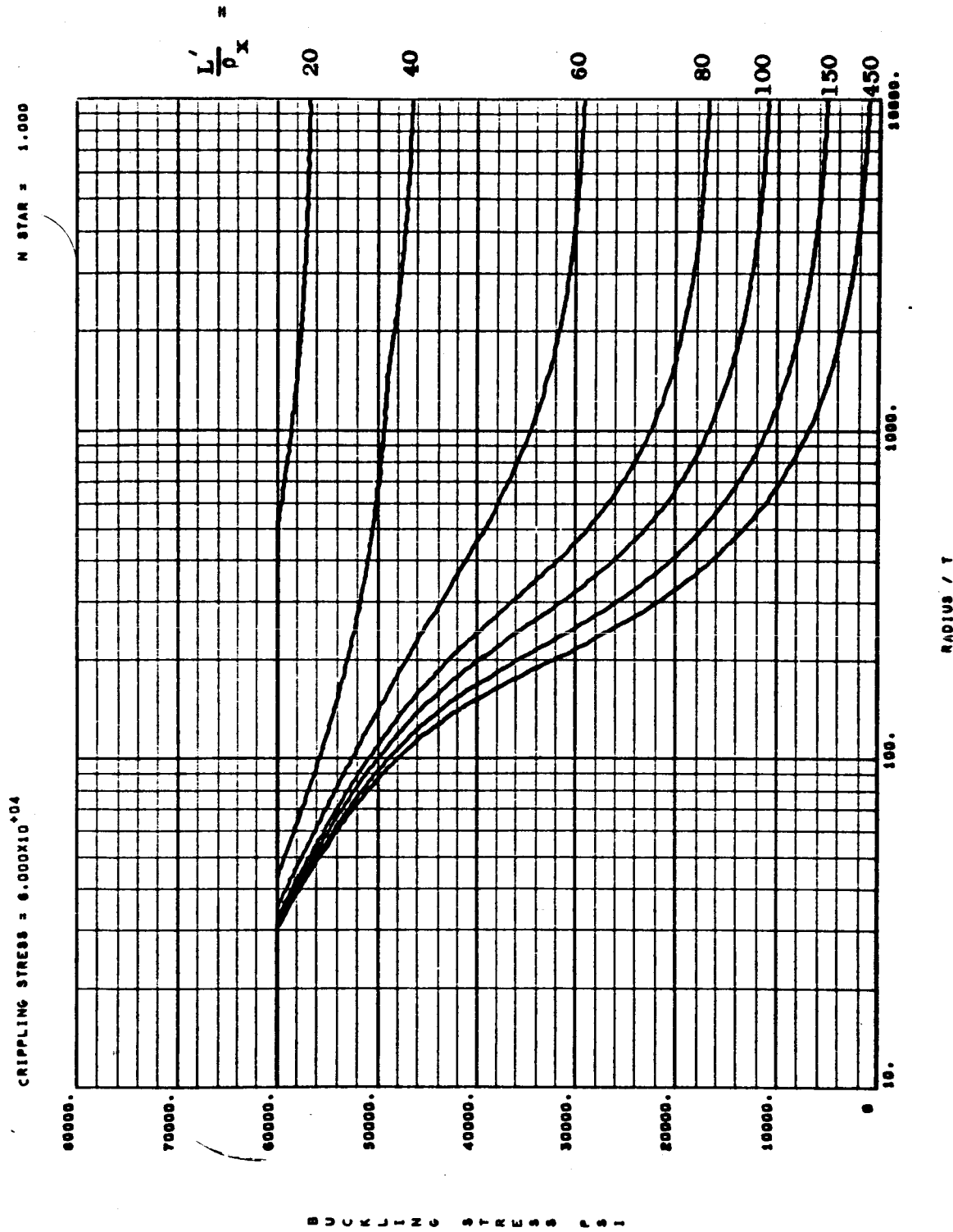
CRIPPLING STRESS = 6.000×10^4



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COMPRESSIVE BUCKLING STRESS FOR
 LONGITUDINALLY STIFFENED CYLINDERS
 MATERIAL - 7075-T6 ALUMINUM ALLOY

Figure 17(e)

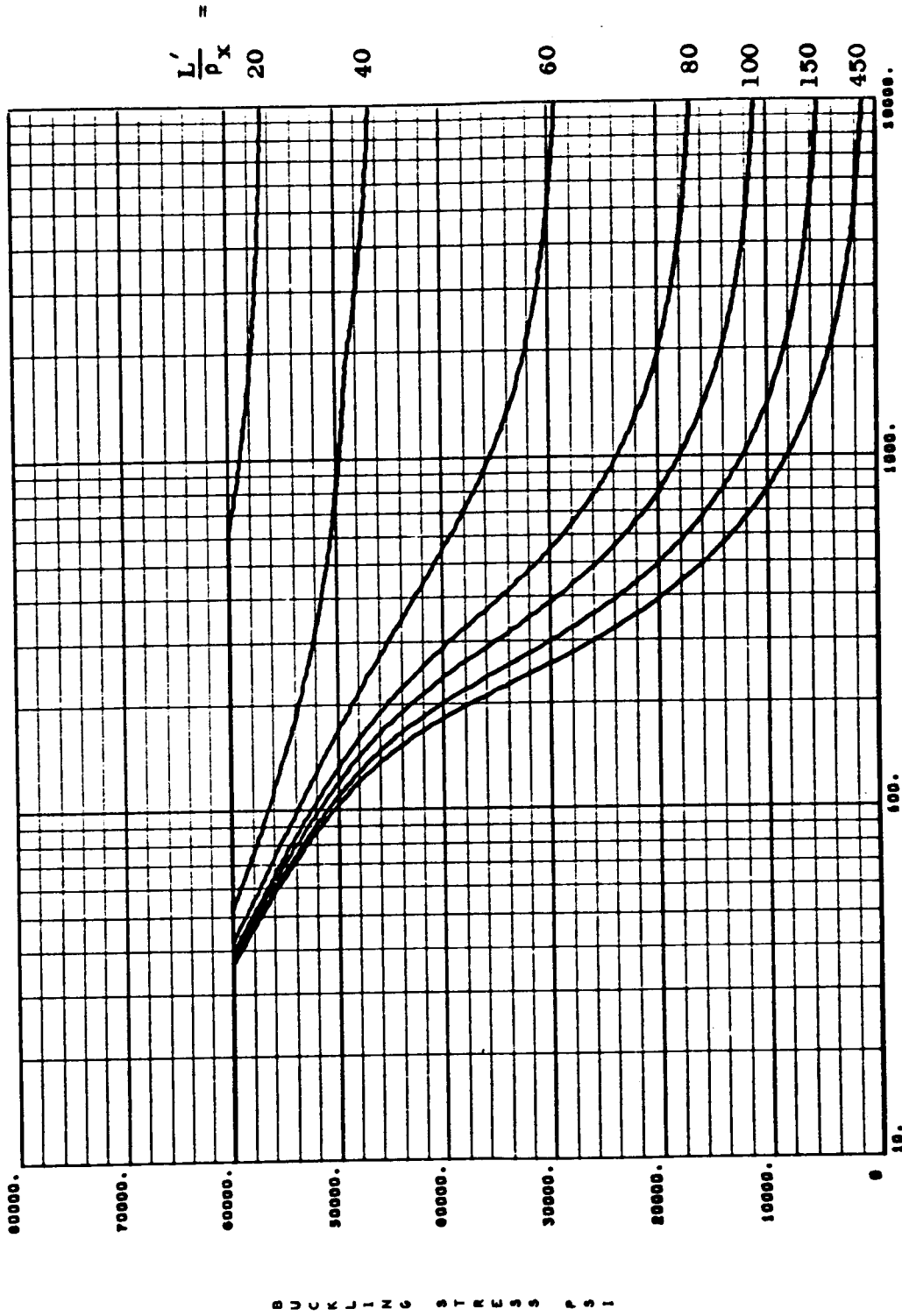


COMPRESSIVE BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 7075-T6 ALUMINUM ALLOY

Figure 17(f)

N STAR = 1.800

CRIPPLING STRESS = $6.000 \times 10^{+04}$

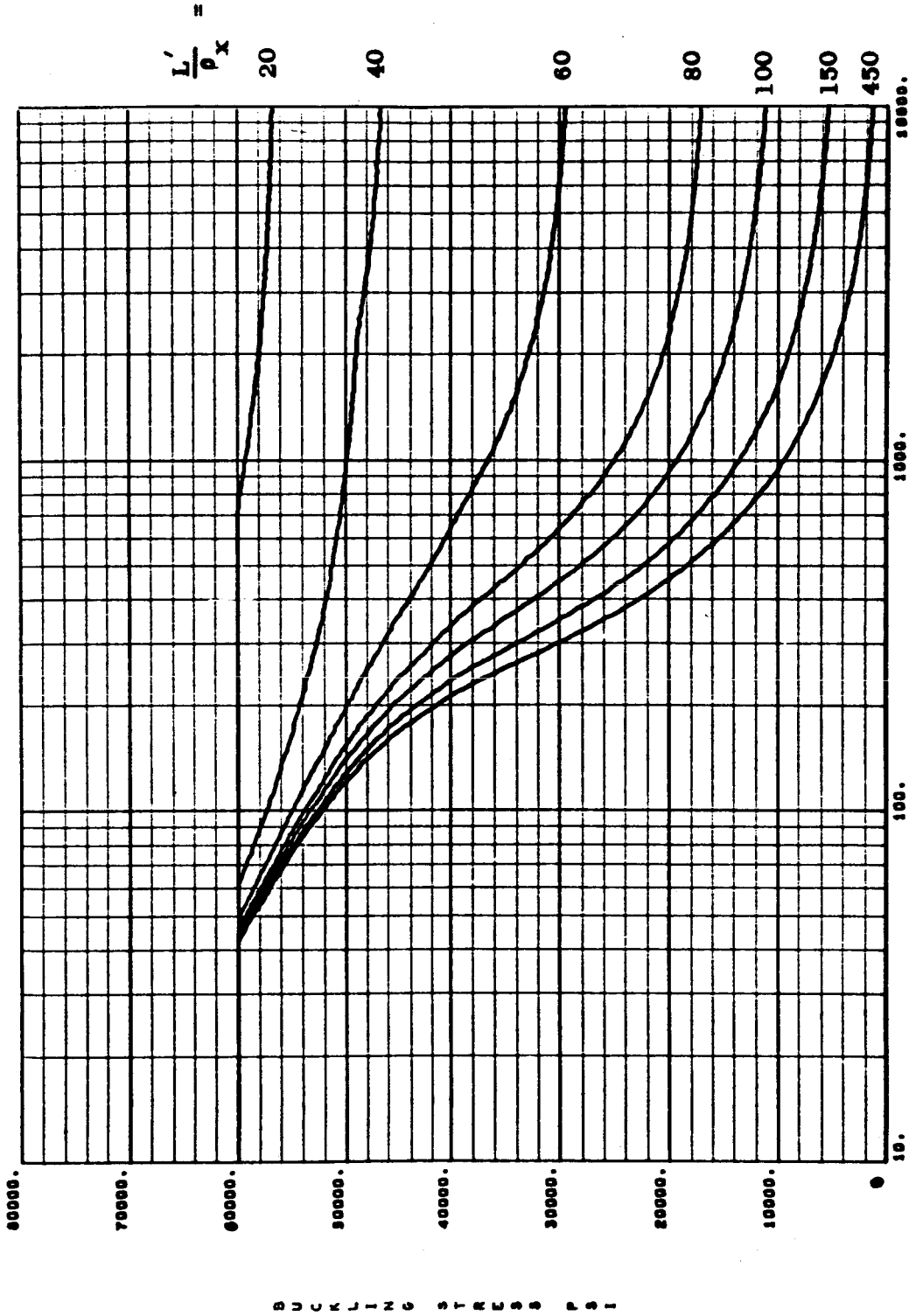


COMPRESSIVE BUCKLING STRESS FOR
 LONGITUDINALLY STIFFENED CYLINDERS
 MATERIAL - 7075-T6 ALUMINUM ALLOY

Figure 17(g)

N STAR = 1.400

CRIPPLING STRESS = 6.0000×10^{10}



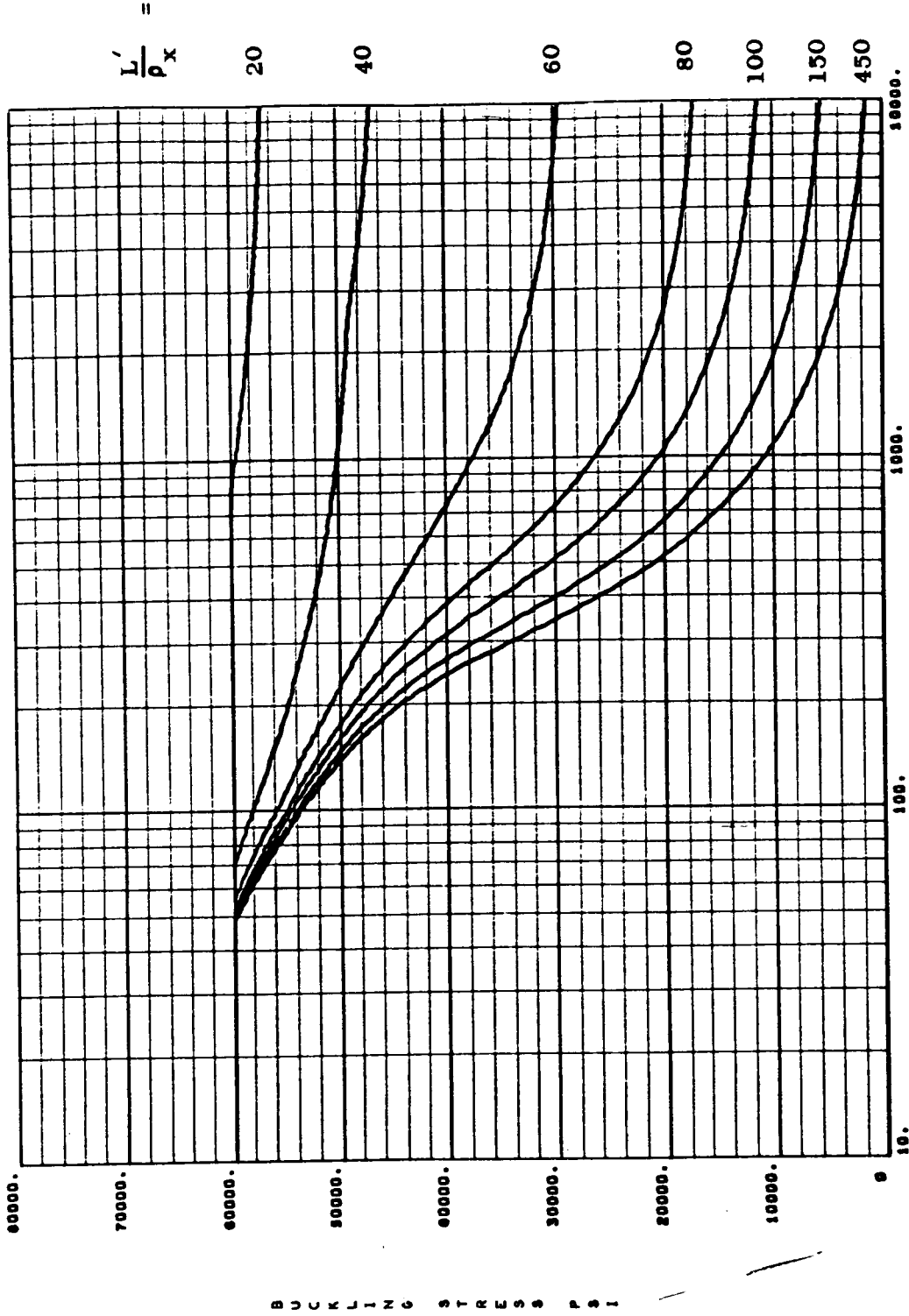
RADIUS / T

COMPRESSIVE BUCKLING STRESS FOR
 LONGITUDINALLY STIFFENED CYLINDERS
 MATERIAL - 7075-T6 ALUMINUM ALLOY

Figure 17(h)

N STAR = 1.600

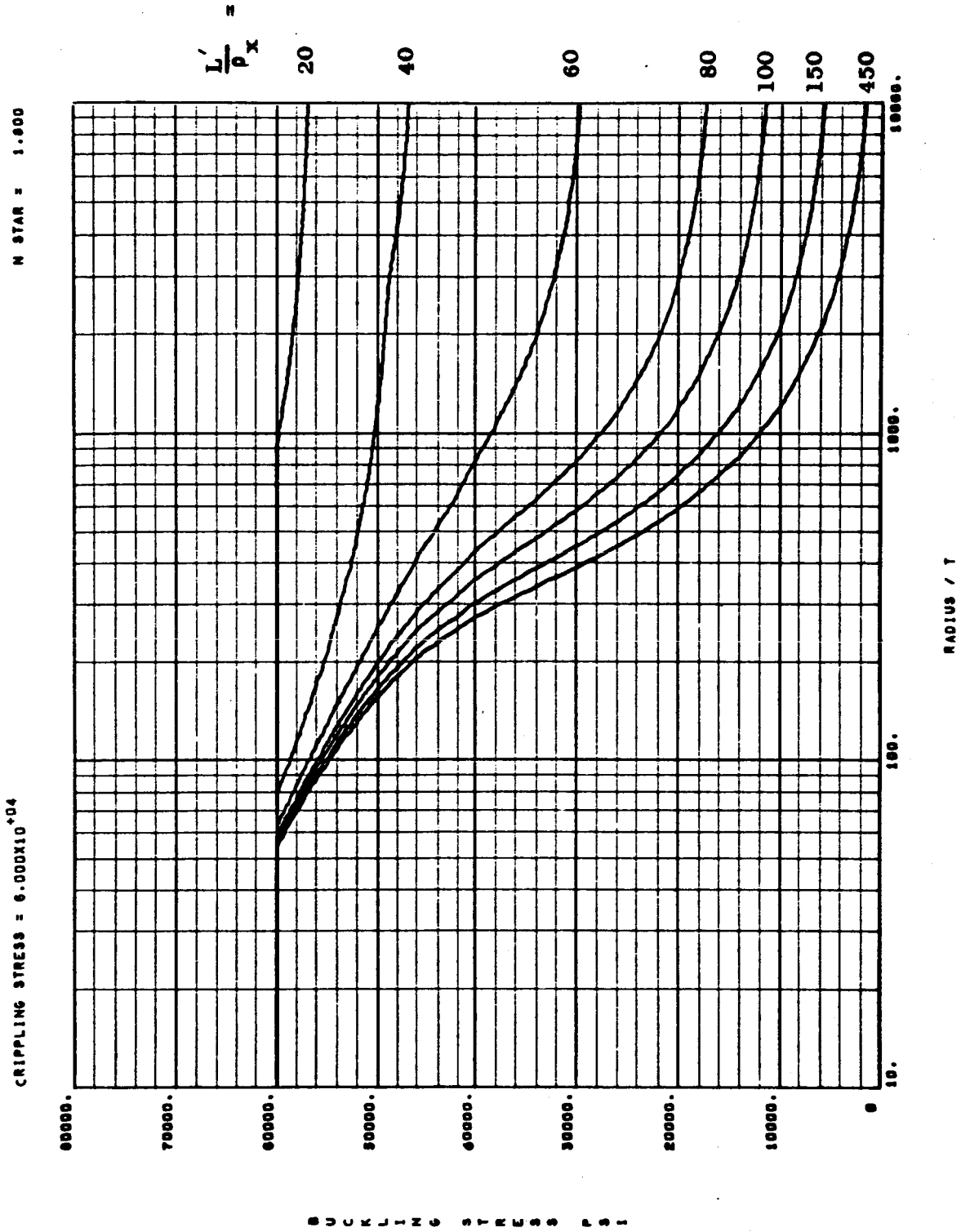
CRIPPLING STRESS = $6.000 \times 10^{+04}$



RADIUS / T

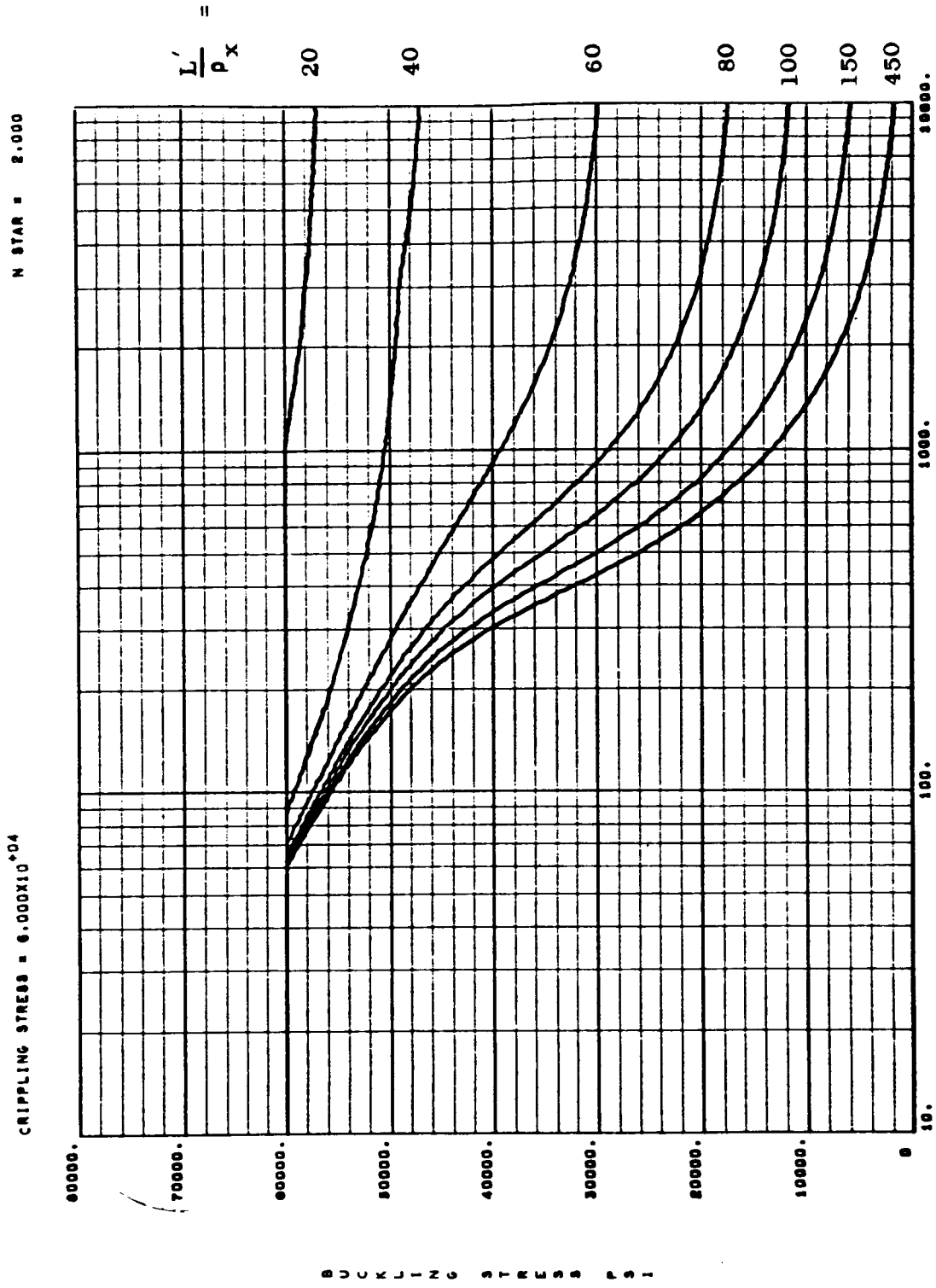
COMPRESSIVE BUCKLING STRESS FOR
 LONGITUDINALLY STIFFENED CYLINDERS
 MATERIAL - 7075-T6 ALUMINUM ALLOY

Figure 17(i)



COMPRESSIVE BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 7075-T6 ALUMINUM ALLOY

Figure 17(j)

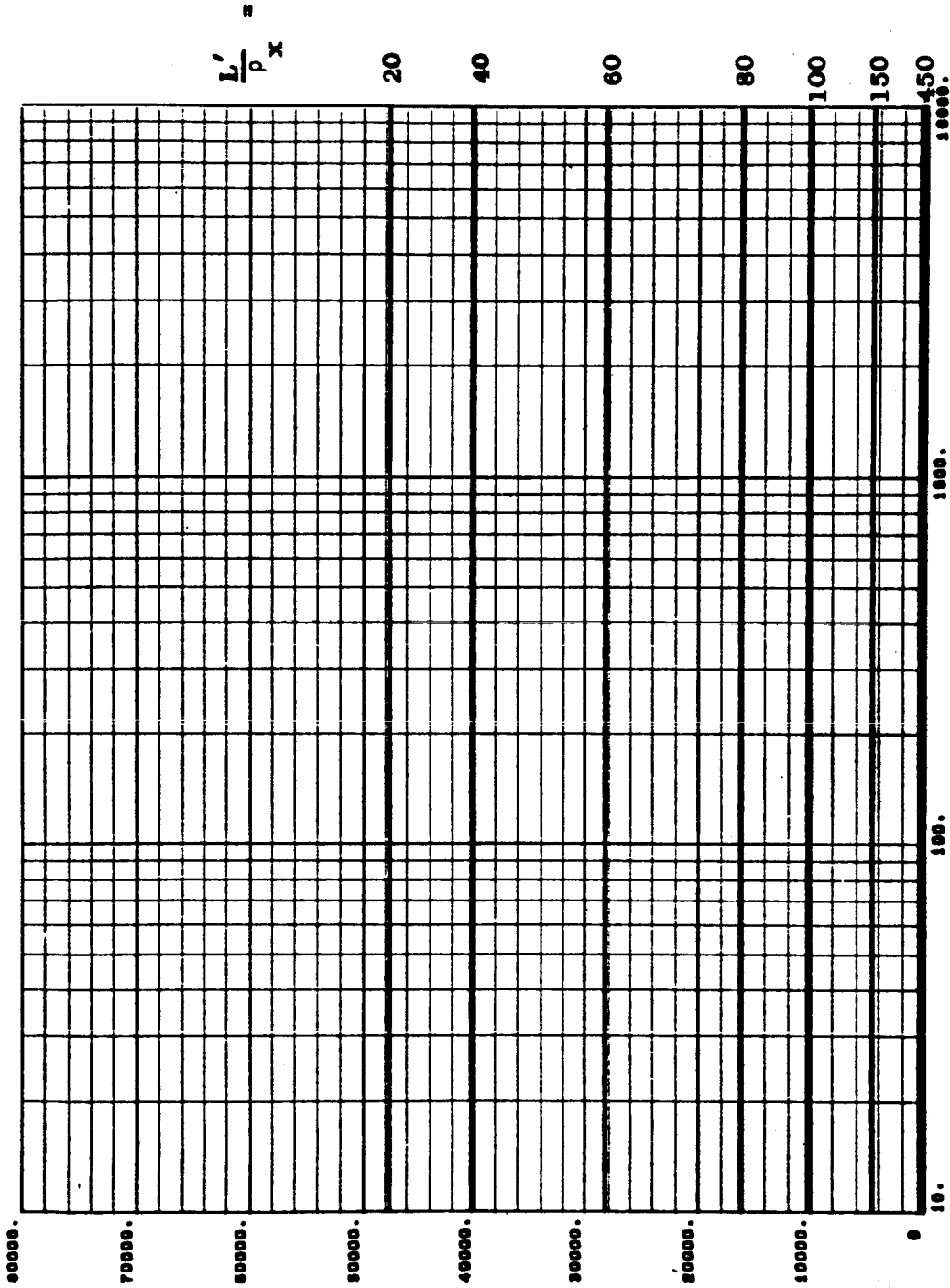


COMPRESSIVE BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 7075-T6 ALUMINUM ALLOY

Figure 17(k)

CRIPPLING STRESS = $3.000 \times 10^{+04}$

M STAIR = 0.000



$\frac{L'}{P} \times$

20

40

60

80

100

150

450

10000.

1000.

100.

10.

RADIUS / T

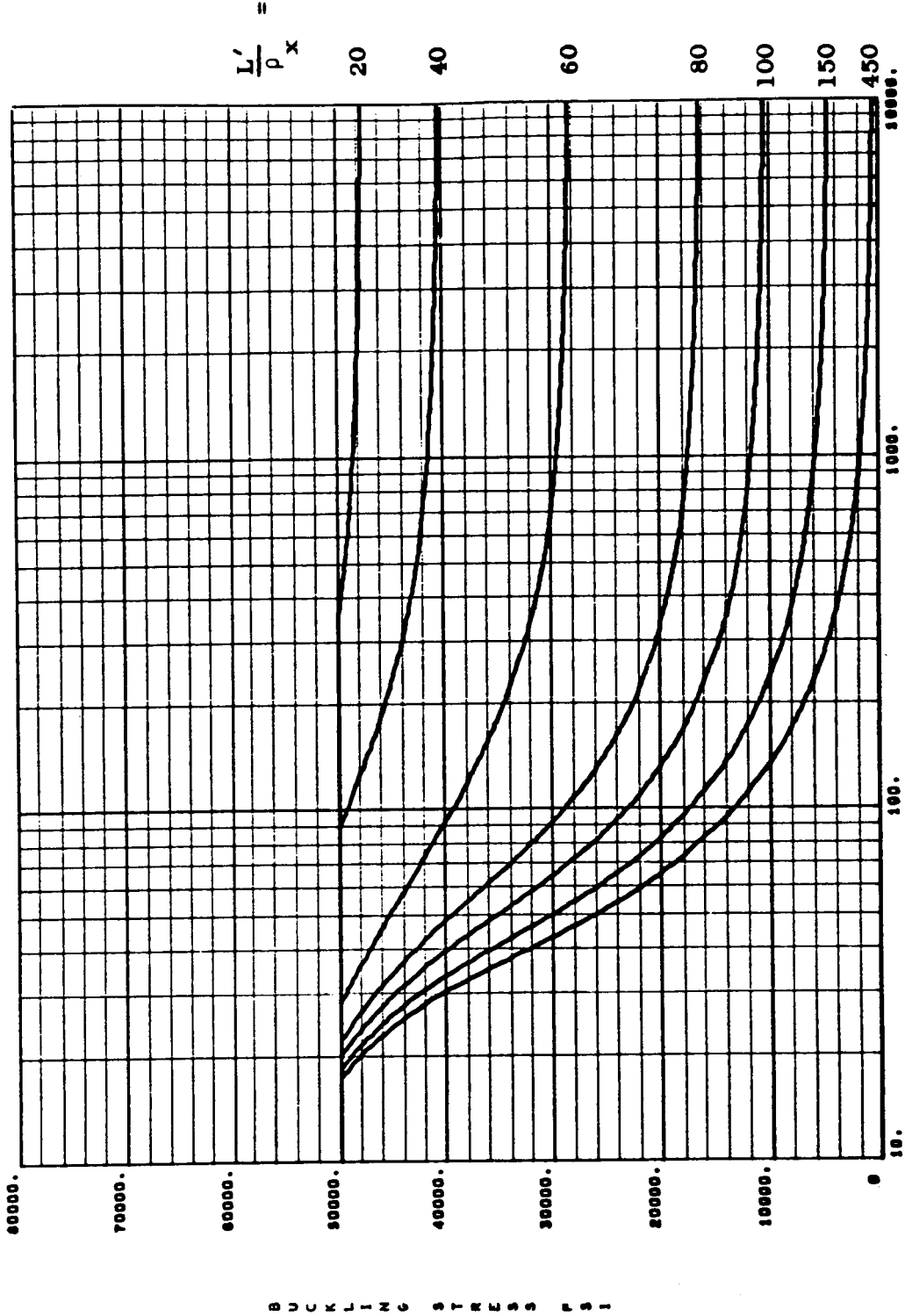
COMPRESSIVE BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 7075-T6 ALUMINUM ALLOY

Figure 18(a)

B U C K L I N G S T R E S S P S I

N STAR = 0.500

CRIPPLING STRESS = 5.000×10^{-04}



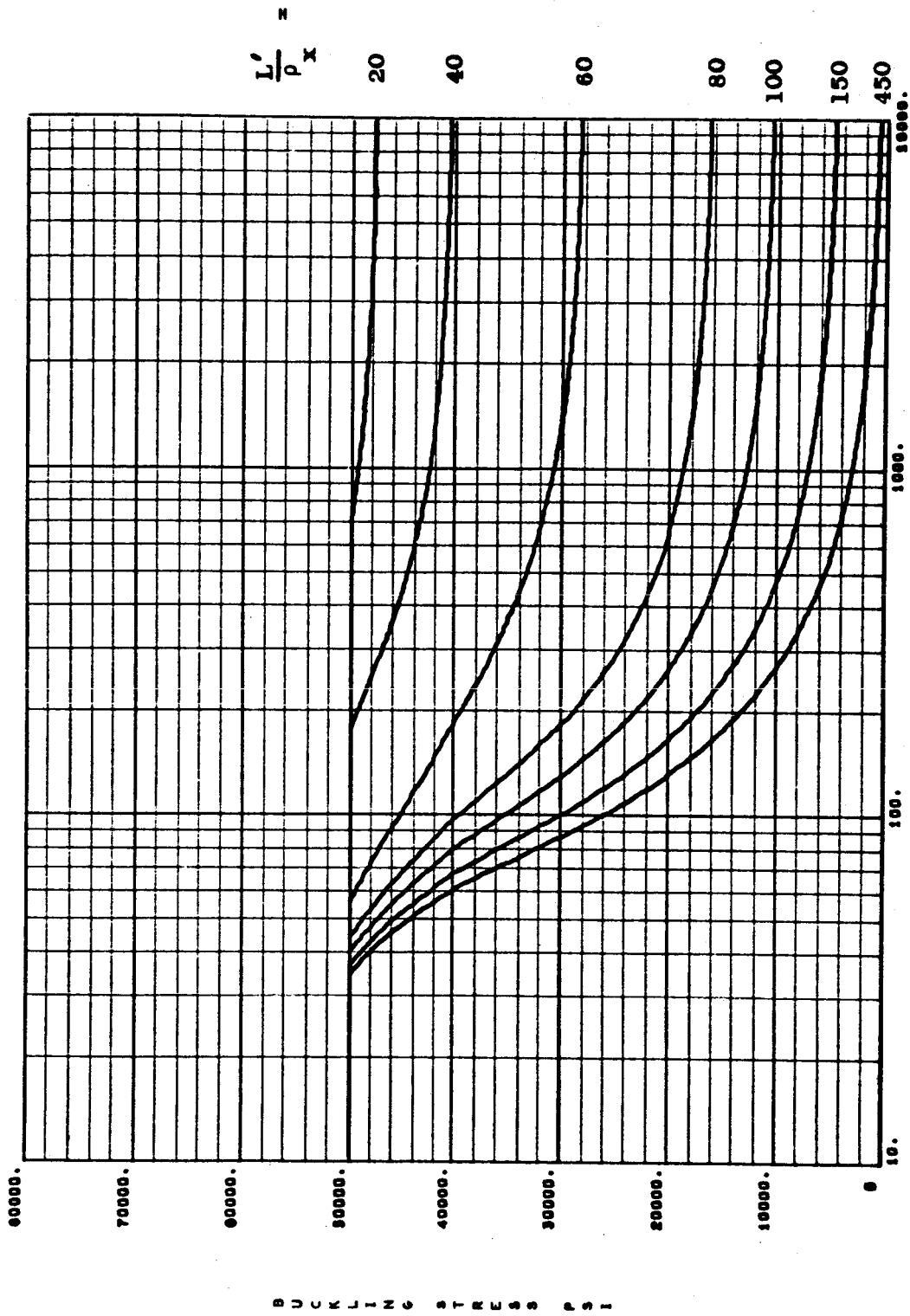
RADIUS / T

COMPRESSIVE BUCKLING STRESS FOR
 LONGITUDINALLY STIFFENED CYLINDERS
 MATERIAL - 7075-T6 ALUMINUM ALLOY

Figure 18(b)

M STAIR = 0.400

CRIPPLING STRESS = 5.000×10^{10} PSI



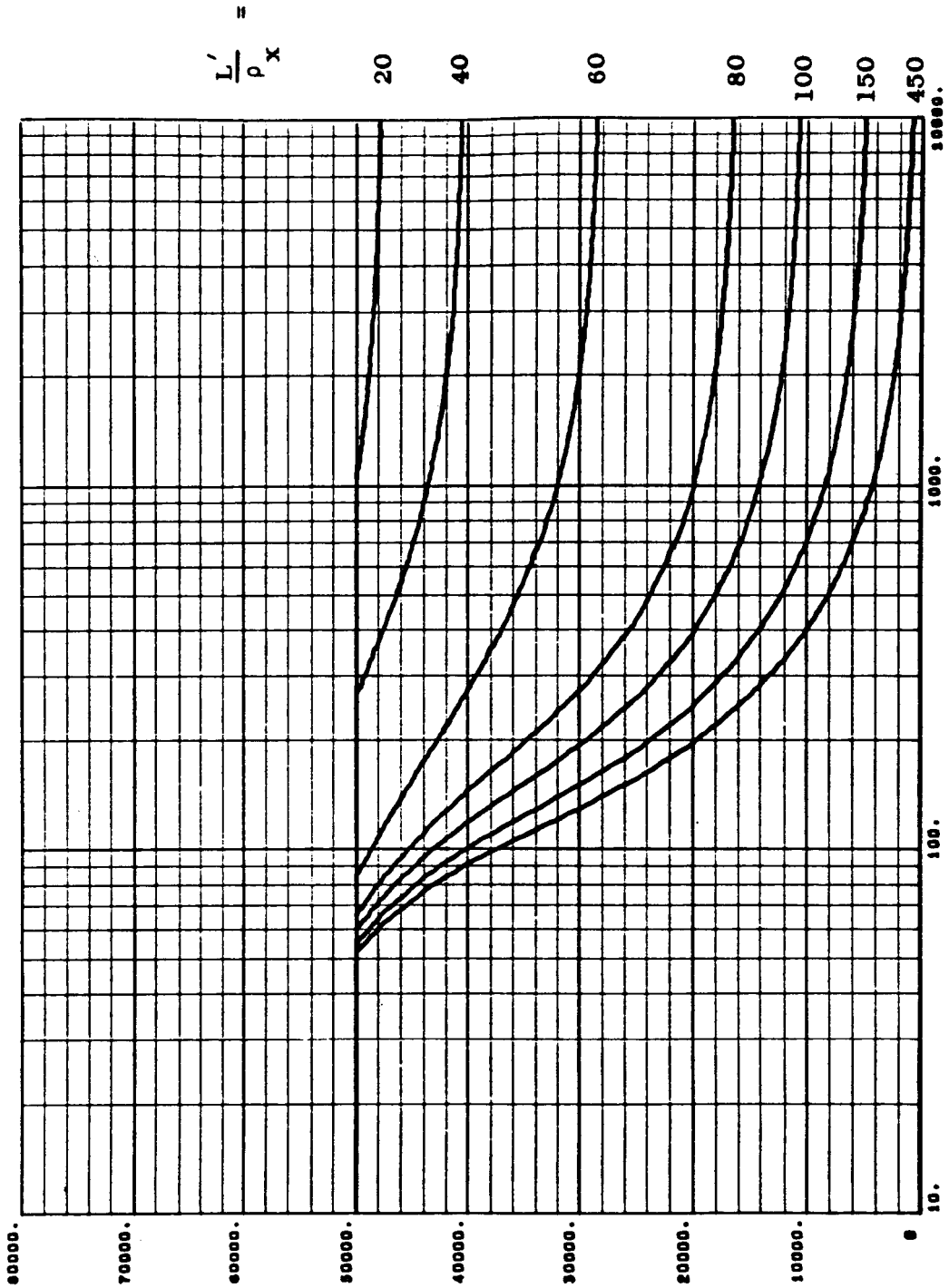
RADIUS / T

COMPRESSIVE BUCKLING STRESS FOR
 LONGITUDINALLY STIFFENED CYLINDERS
 MATERIAL - 7075-T6 ALUMINUM ALLOY

Figure 18(c)

CRIPPLING STRESS = $5.000 \times 10^{10} \sigma_{04}$

M STAY = 0.600

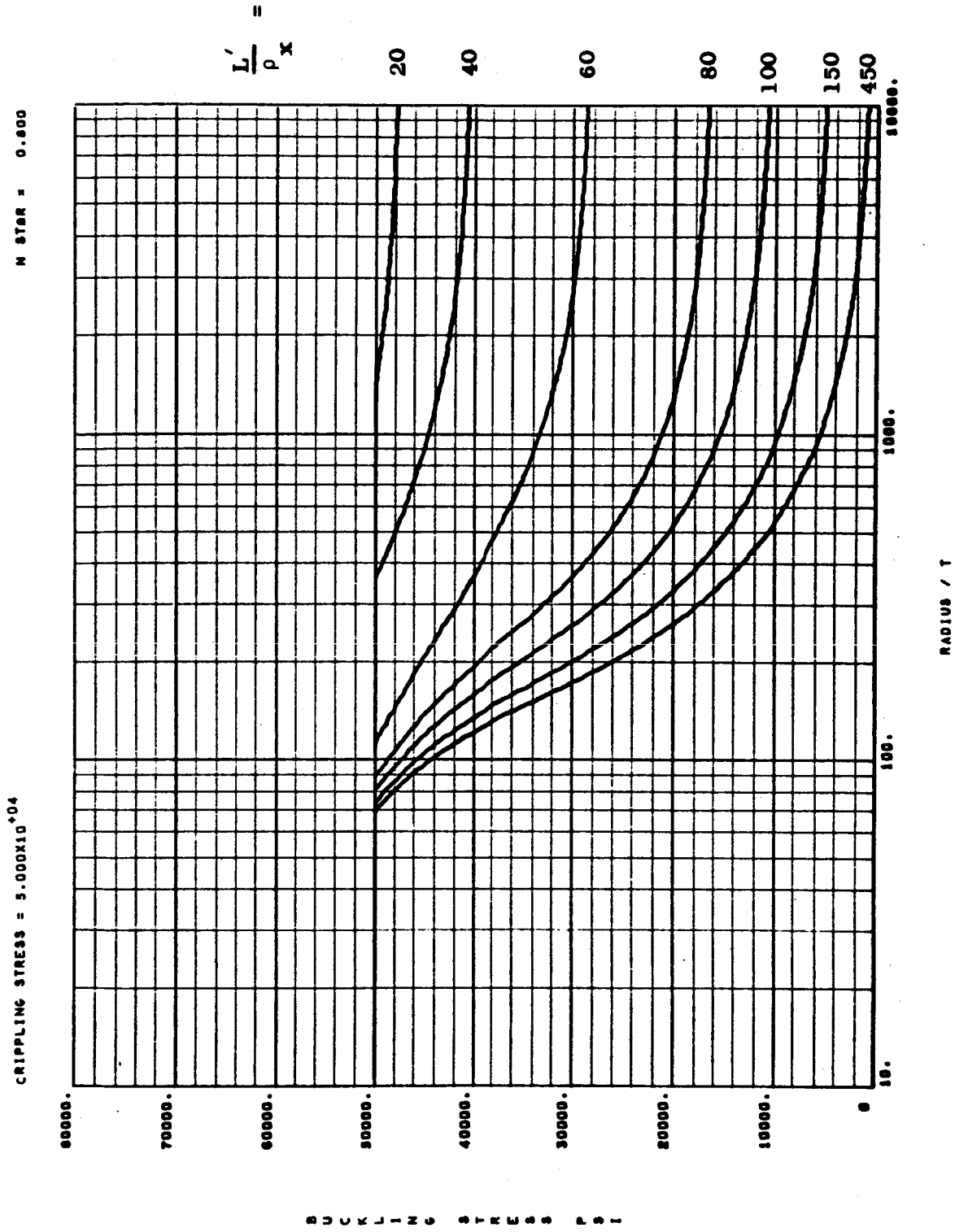


B U C K L I N G S T R E S S

RADIUS / T

COMPRESSIVE BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 7075-T6 ALUMINUM ALLOY

Figure 18(d)

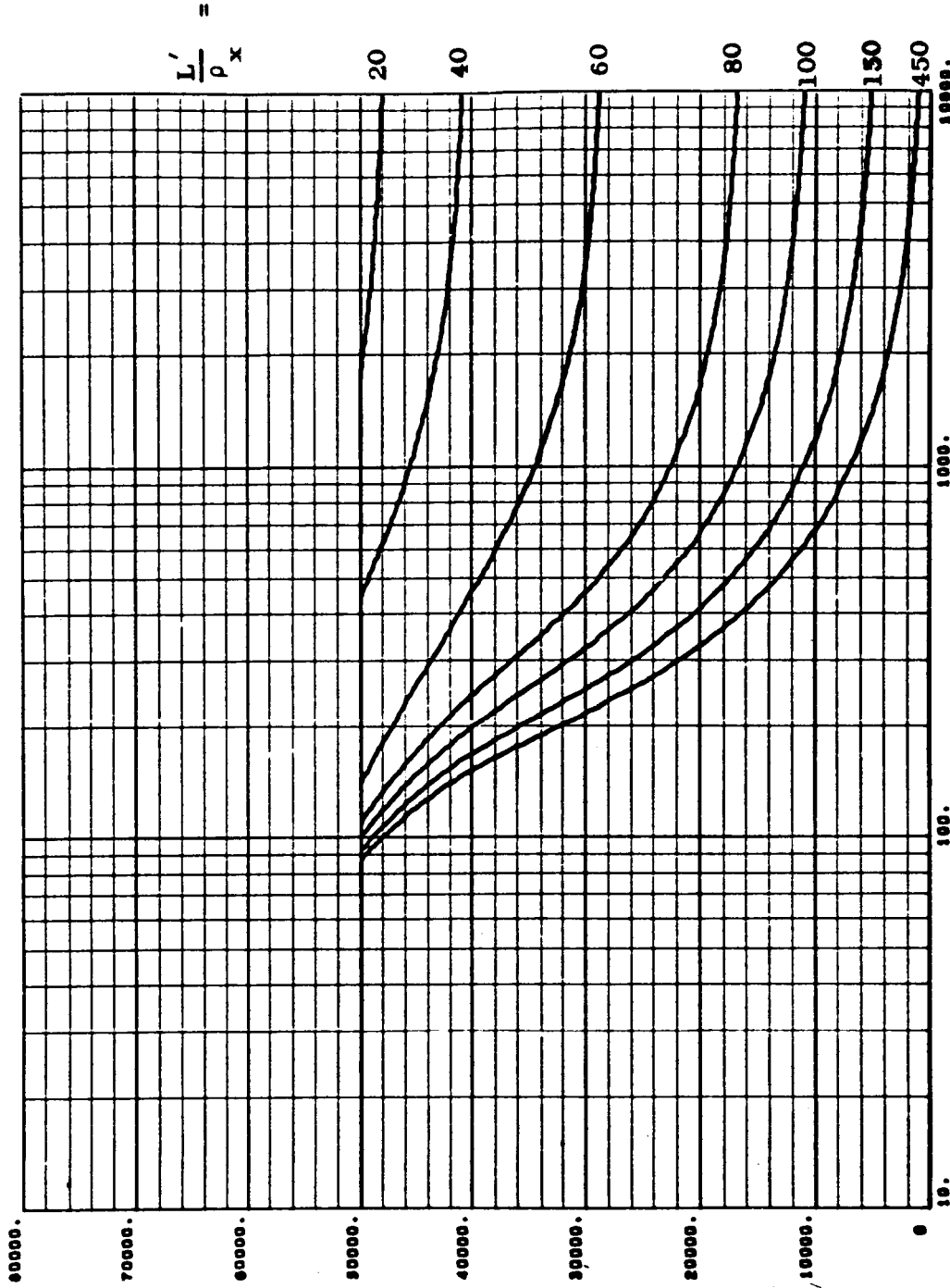


COMPRESSION BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 7075-T6 ALUMINUM ALLOY

Figure 18(e)

N STAR = 1.000

CRIPPLING STRESS = 5.000×10^{-4}



B U C K L I N G S T R E S S P L O T

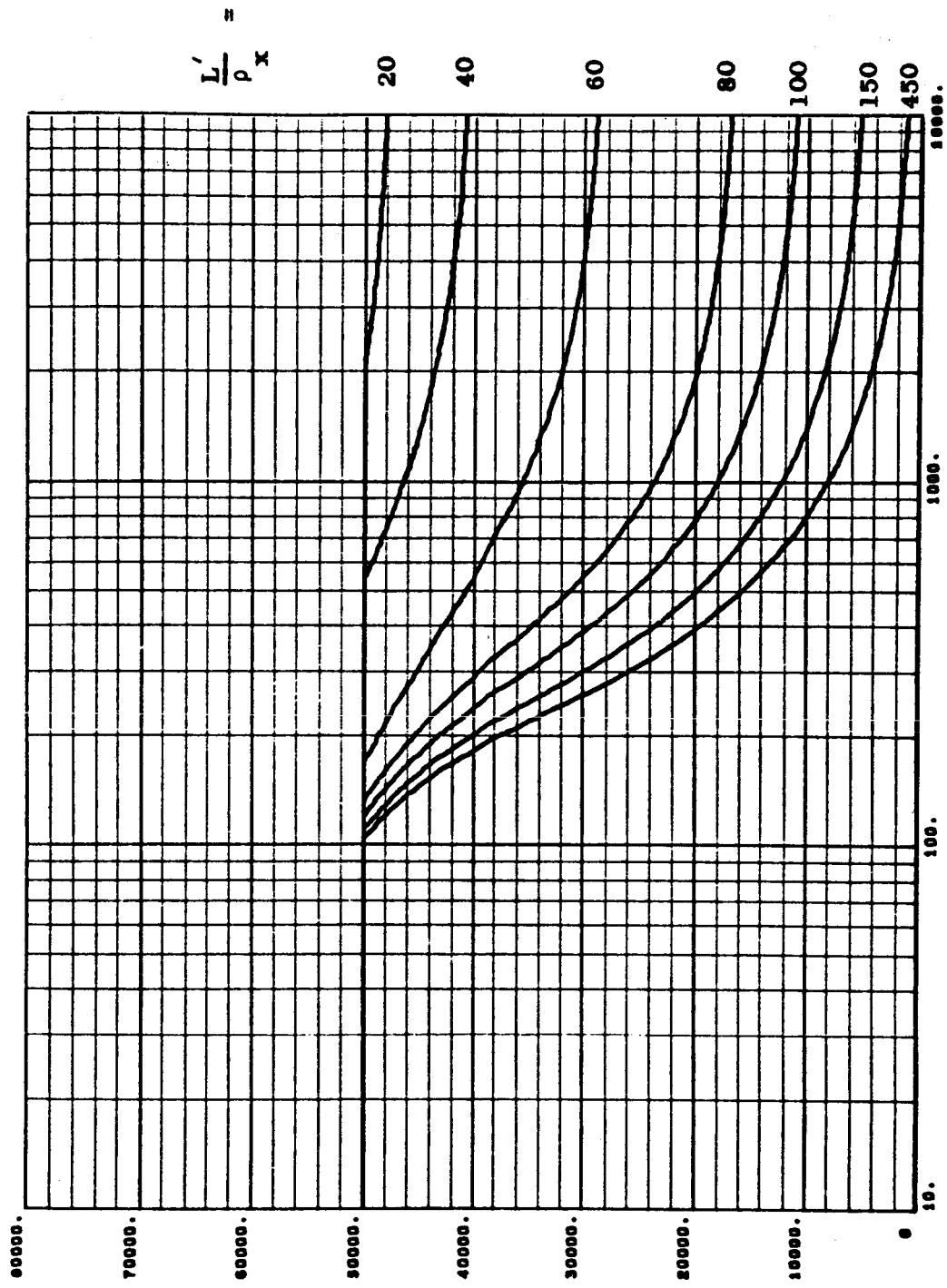
RADIUS / T

COMPRESSIVE BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 7075-T6 ALUMINUM ALLOY

Figure 18(f)

CRIPPLING STRESS = 5.000X10⁺⁰⁴

NOMER = 1.000

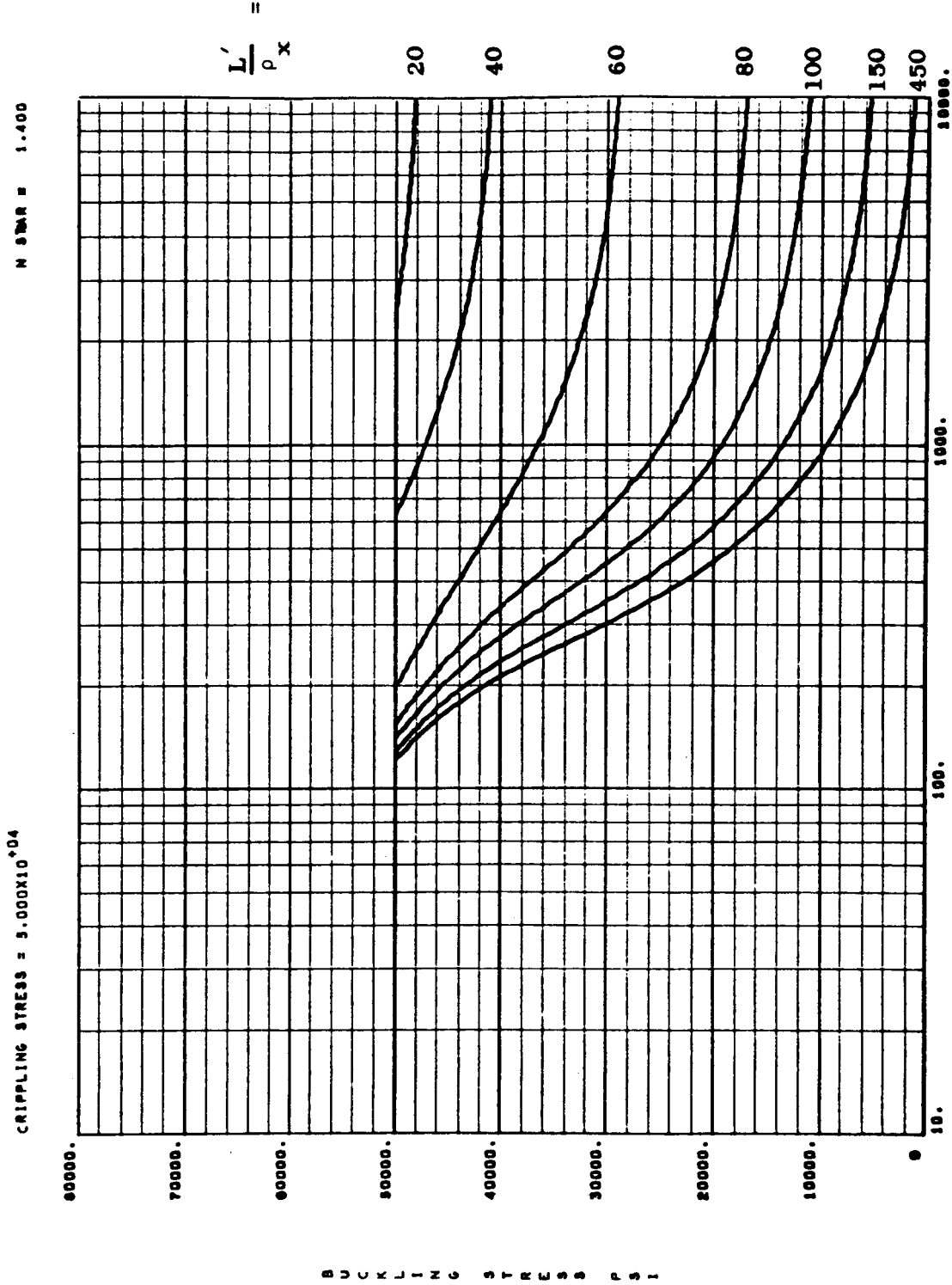


BUCKLING STRESS

RADIUS / T

COMPRESSIVE BUCKLING STRESS FOR
 LONGITUDINALLY STIFFENED CYLINDERS
 MATERIAL - 7075-T6 ALUMINUM ALLOY

Figure 18(g)



RADIUS / r

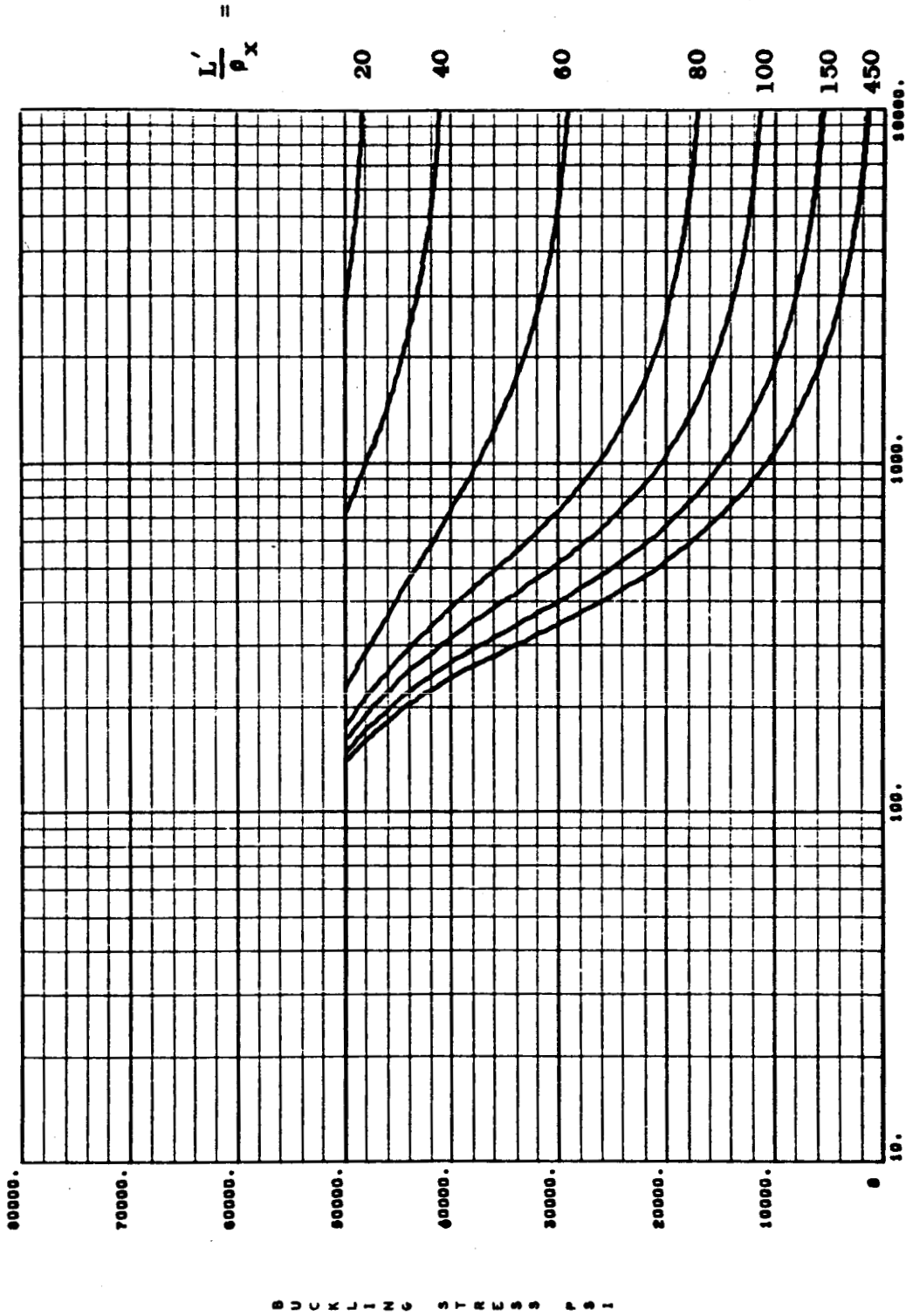
COMPRESSIVE BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS

MATERIAL - 7075-T6 ALUMINUM ALLOY

Figure 18(h)

N STAR = 1.600

CRIPPLING STRESS = $5.000 \times 10^{+04}$

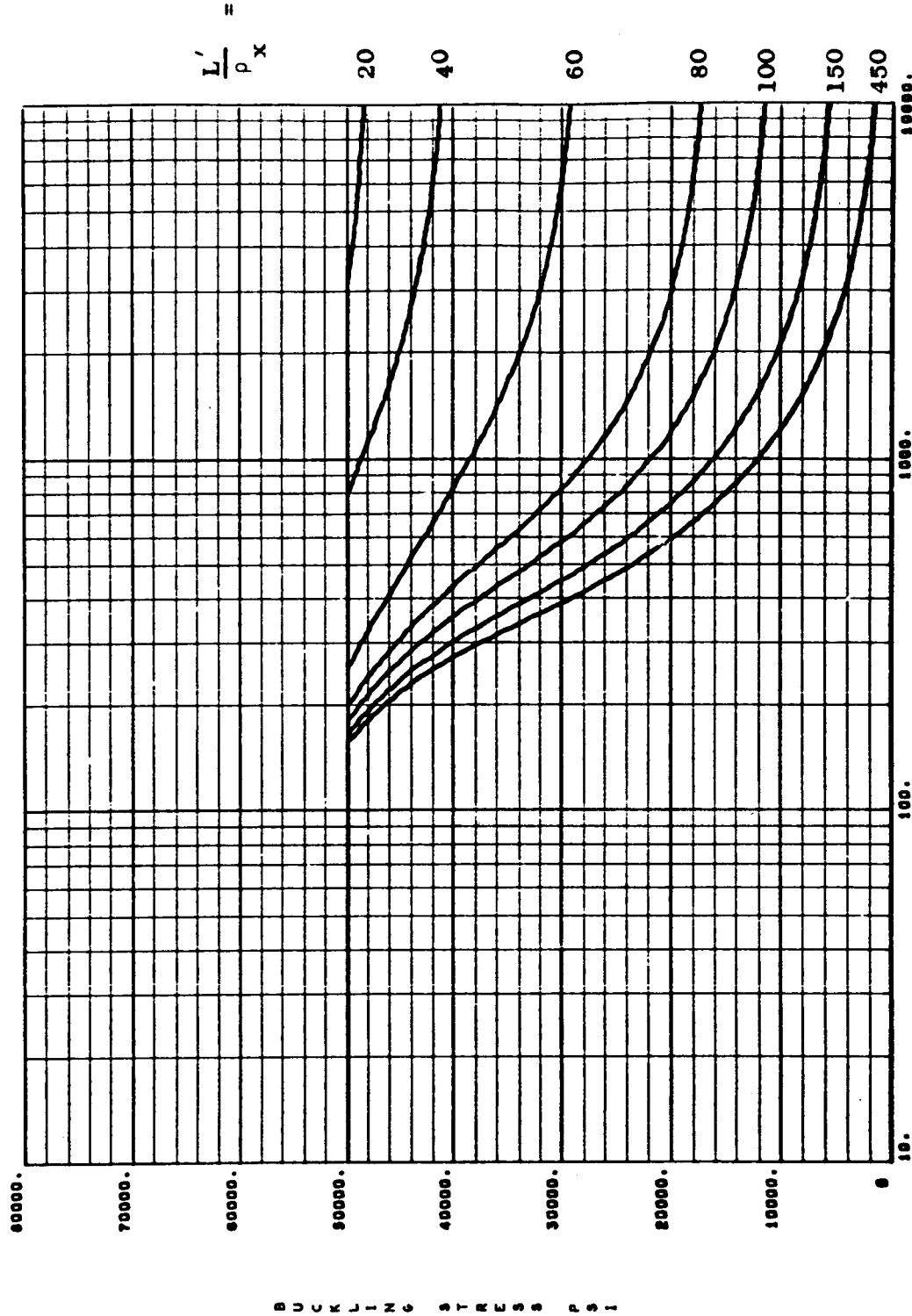


COMPRESSIVE BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 7075-T6 ALUMINUM ALLOY

Figure 18(i)

N STAR = 1.000

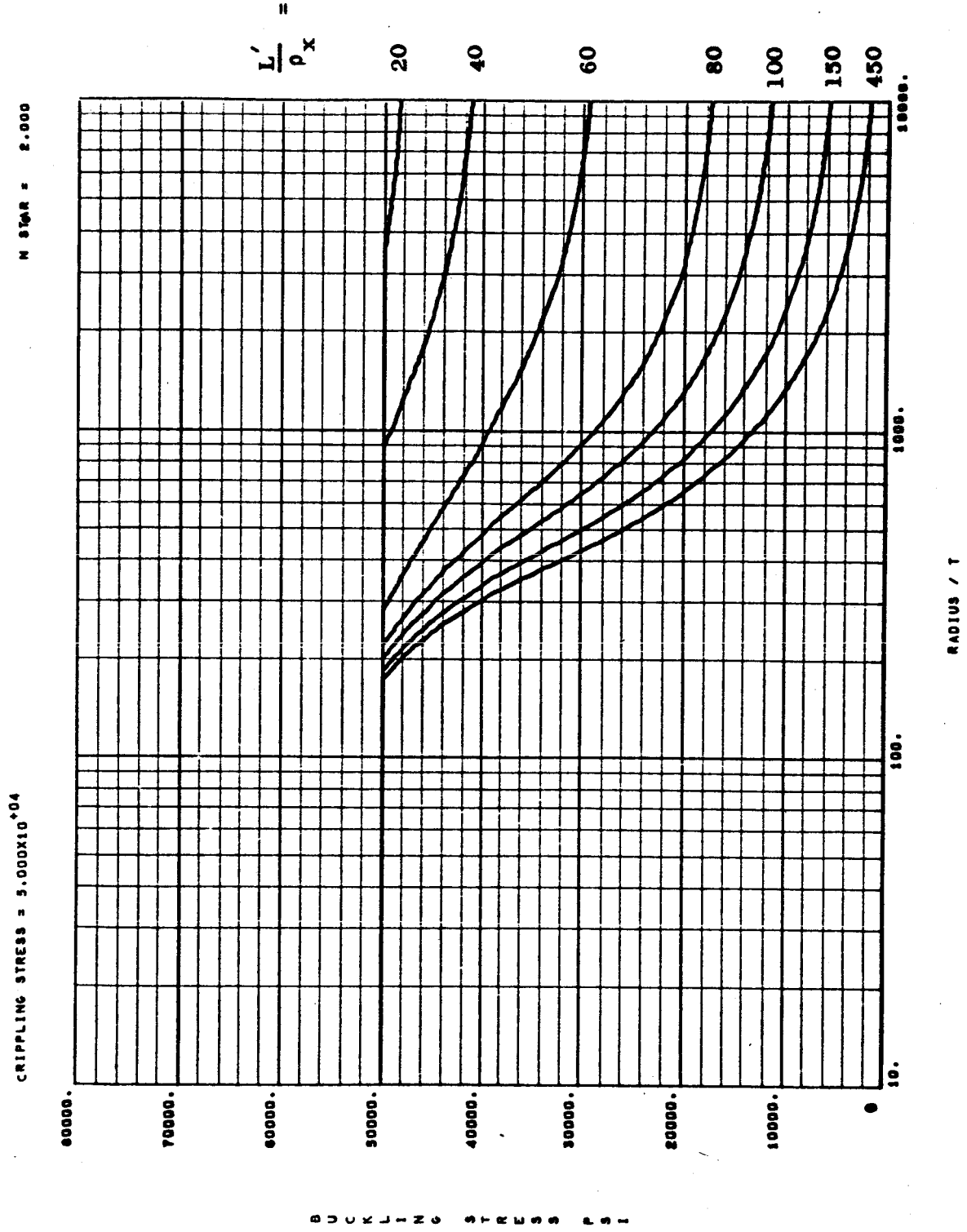
CRIPPLING STRESS = 5.000×10^{-4}



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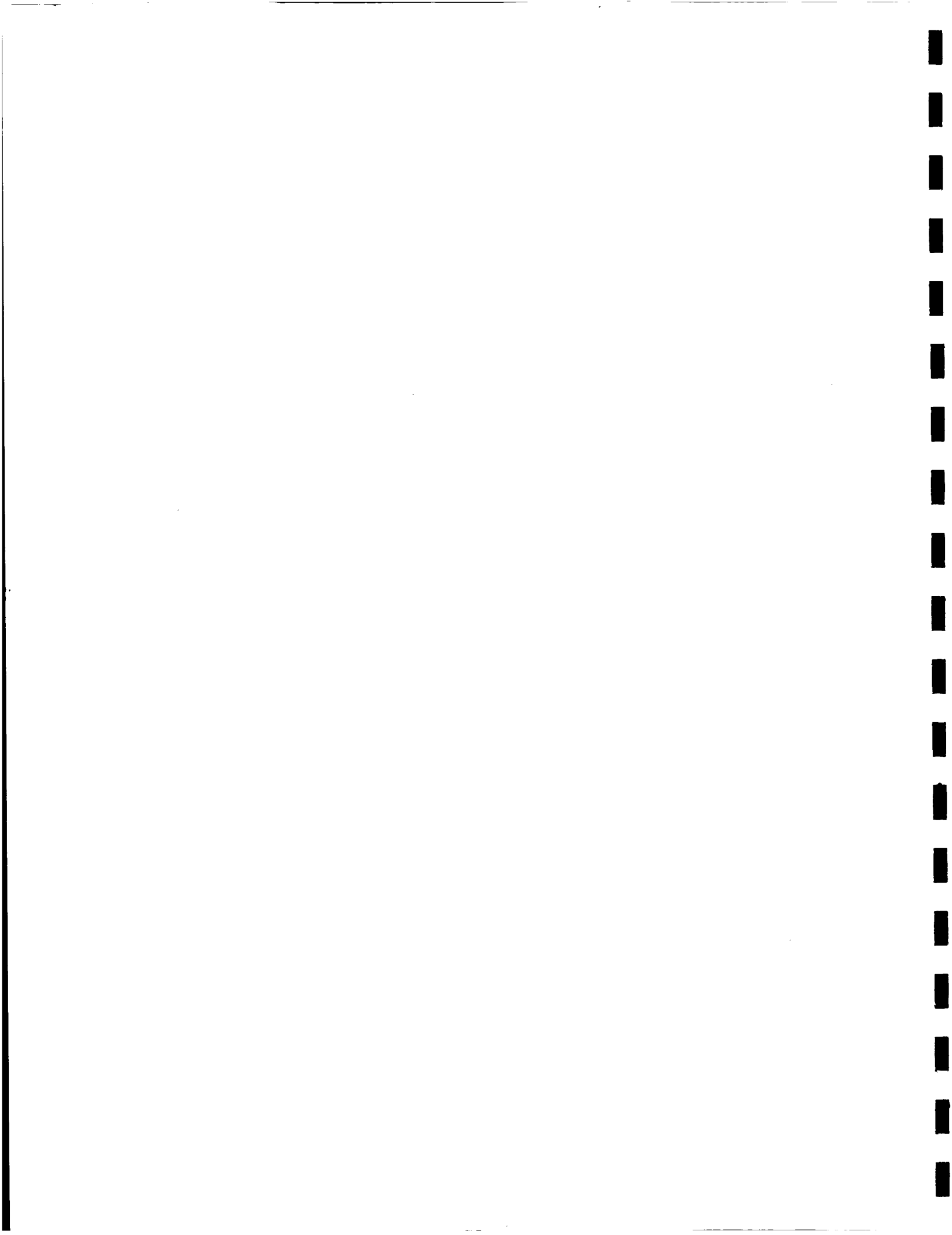
COMPRESSIVE BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 7075-T6 ALUMINUM ALLOY

Figure 18(j)



COMPRESSIVE BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 7075-T6 ALUMINUM ALLOY

Figure 18(k)



A.2.2 6Al-4V TITANIUM ALLOY (Annealed)

Table XVI lists the families provided here for longitudinally stiffened cylinders made of annealed 6Al-4V titanium alloy. These curves are based upon the following values for the indicated material properties:

	E	=	16.4×10^6	psi
	ν	=	.30	
	σ_{cy}	=	132,000	psi
Ramberg-Osgood	n	=	35	
Ramberg-Osgood	$\sigma_{.7}$	=	133,500	psi

TABLE XVI - Table of Contents for Supplementary Curves of Compressive Buckling Stress for Longitudinally Stiffened Cylinders; Material - 6Al-4V Titanium Alloy (Annealed)

<u>Figure Number</u>	<u>Crippling Stress, σ_{cc}</u>	<u>N^*</u>	<u>Page</u>
19(a)	132,000	0.0	A-43
19(b)	132,000	0.2	A-44
19(c)	132,000	0.4	A-45
19(d)	132,000	0.6	A-46
19(e)	132,000	0.8	A-47
19(f)	132,000	1.0	A-48
19(g)	132,000	1.2	A-49
19(h)	132,000	1.4	A-50
19(i)	132,000	1.6	A-51
19(j)	132,000	1.8	A-52
19(k)	132,000	2.0	A-53
20(a)	110,000	0.0	A-54
20(b)	110,000	0.2	A-55
20(c)	110,000	0.4	A-56
20(d)	110,000	0.6	A-57
20(e)	110,000	0.8	A-58
20(f)	110,000	1.0	A-59
20(g)	110,000	1.2	A-60
20(h)	110,000	1.4	A-61
20(i)	110,000	1.6	A-62
20(j)	110,000	1.8	A-63
20(k)	110,000	2.0	A-64

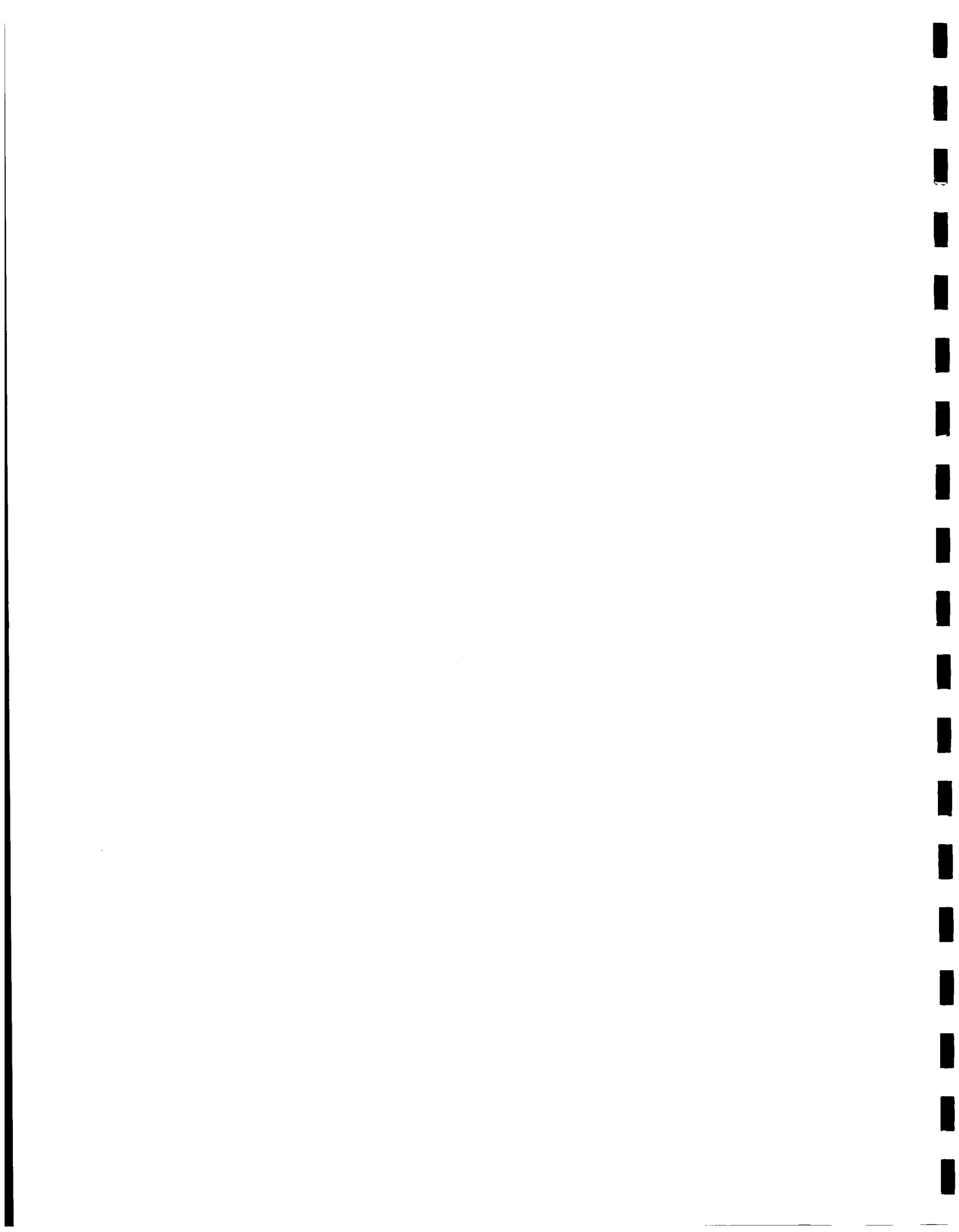
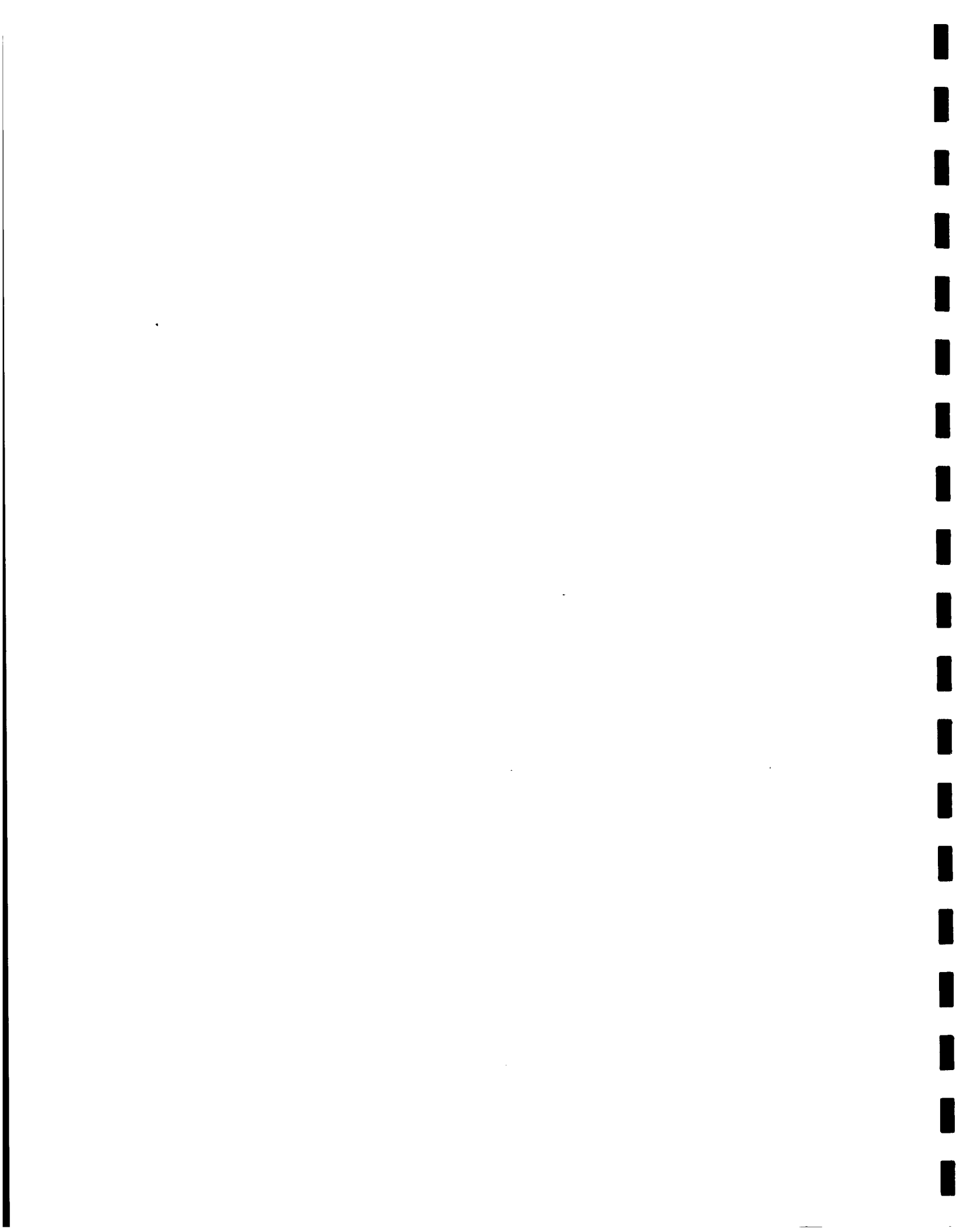


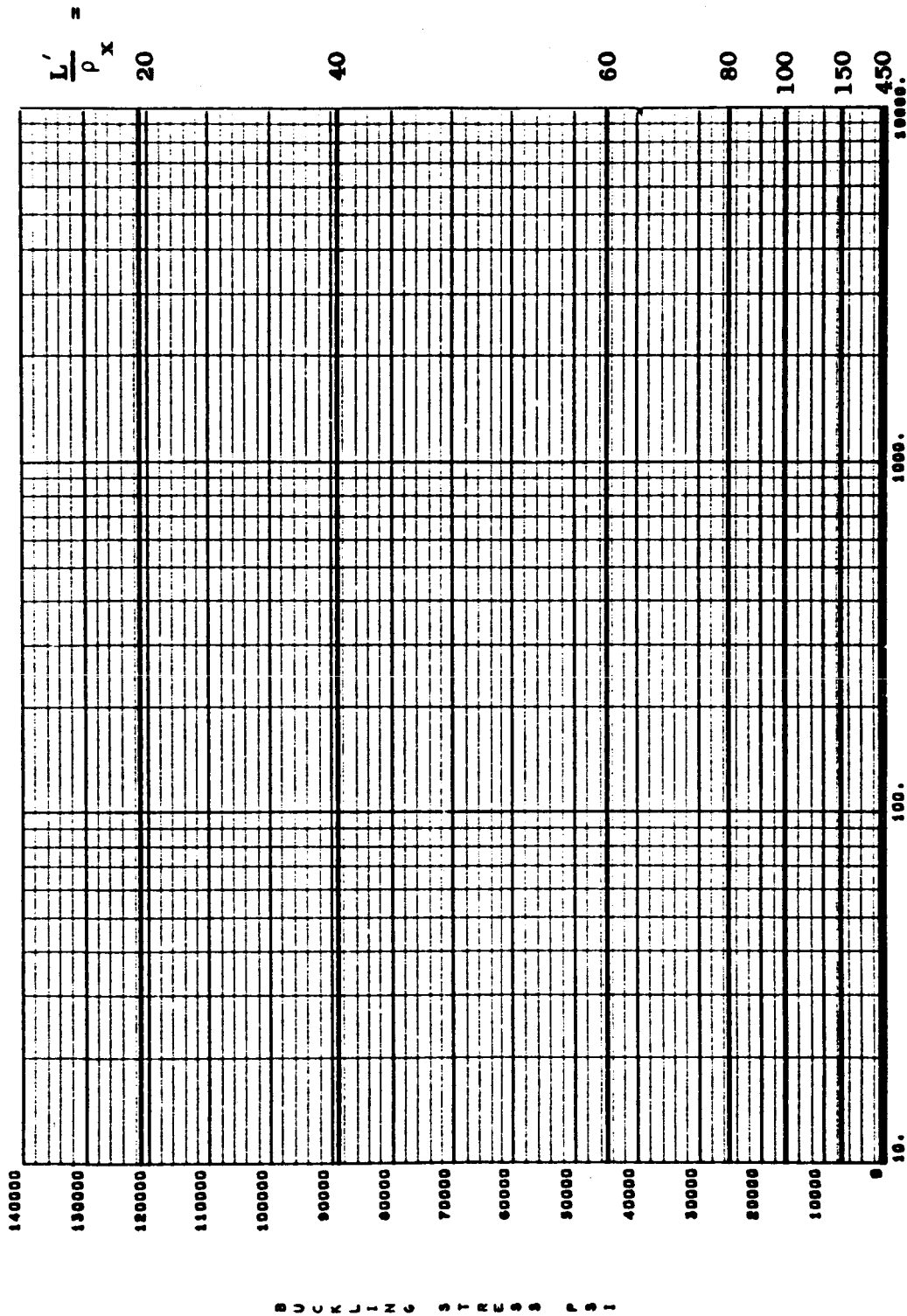
TABLE XVI - Table of Contents for Supplementary Curves
of Compressive Buckling Stress for
Longitudinally Stiffened Cylinders; Material -
6Al-4V Titanium Alloy (Annealed); (Continued)

<u>Figure Number</u>	<u>Crippling Stress, σ_{cc}</u>	<u>N*</u>	<u>Page</u>
21(a)	90,000	0.0	A-65
21(b)	90,000	0.2	A-66
21(c)	90,000	0.4	A-67
21(d)	90,000	0.6	A-68
21(e)	90,000	0.8	A-69
21(f)	90,000	1.0	A-70
21(g)	90,000	1.2	A-71
21(h)	90,000	1.4	A-72
21(i)	90,000	1.6	A-73
21(j)	90,000	1.8	A-74
21(k)	90,000	2.0	A-75



N STAIR = 0.000

CRIPPLING STRESS = 1.320×10^{10}



B U C K L I N G S T R E S S

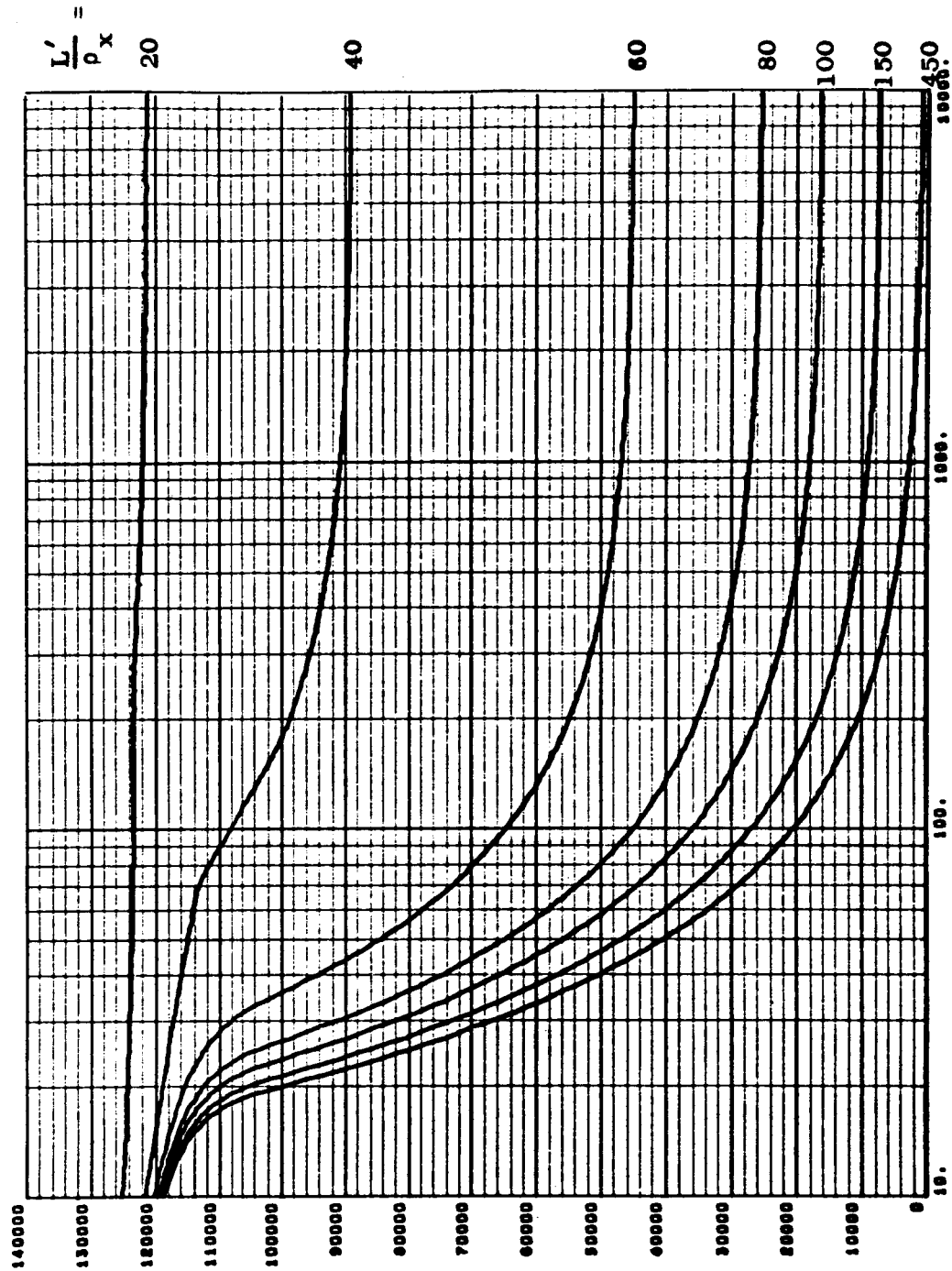
RADIUS / T

COMPRESSIVE BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 6Al-4V TITANIUM ALLOY (ANNEALED)

Figure 19(a)

N STAR = 0.200

CRIPPLING STRESS = 1.320×10^5

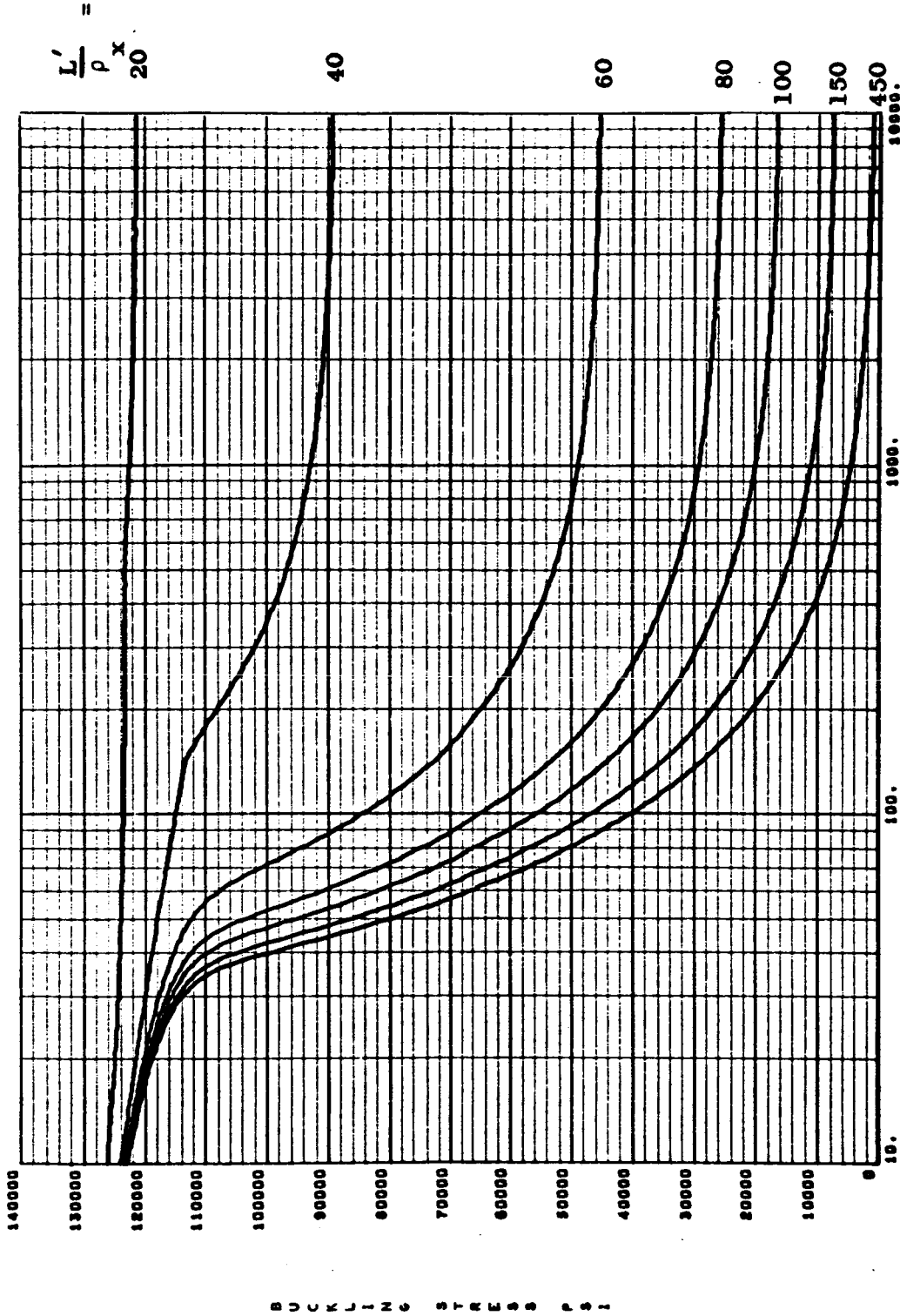


COMPRESSIVE BUCKLING STRESS FOR
 LONGITUDINALLY STIFFENED CYLINDERS
 MATERIAL - 6Al-4V TITANIUM ALLOY (ANNEALED)

Figure 19(b)

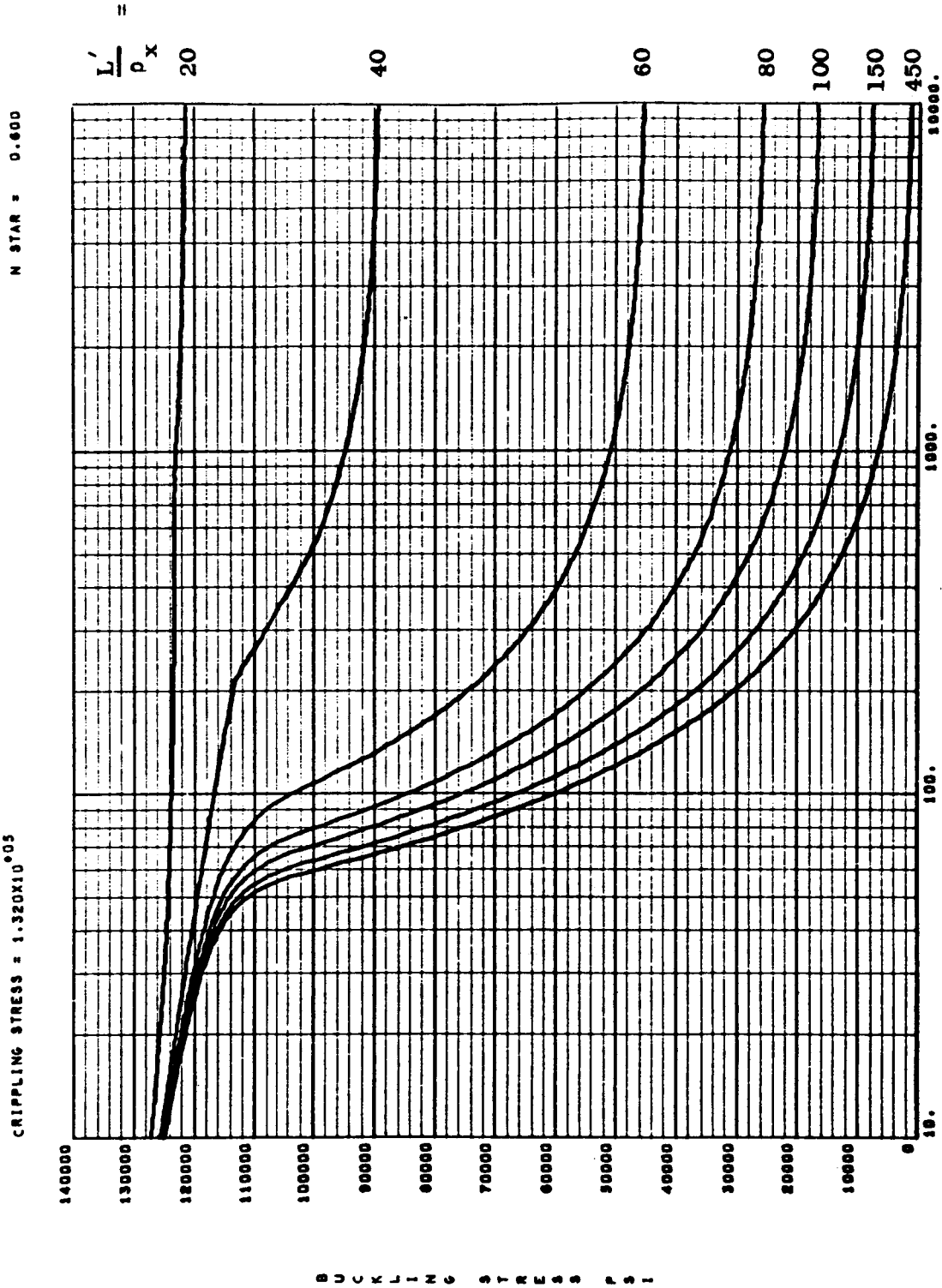
N STAR = 0.400

CRIPPLING STRESS = 1.320×10^6



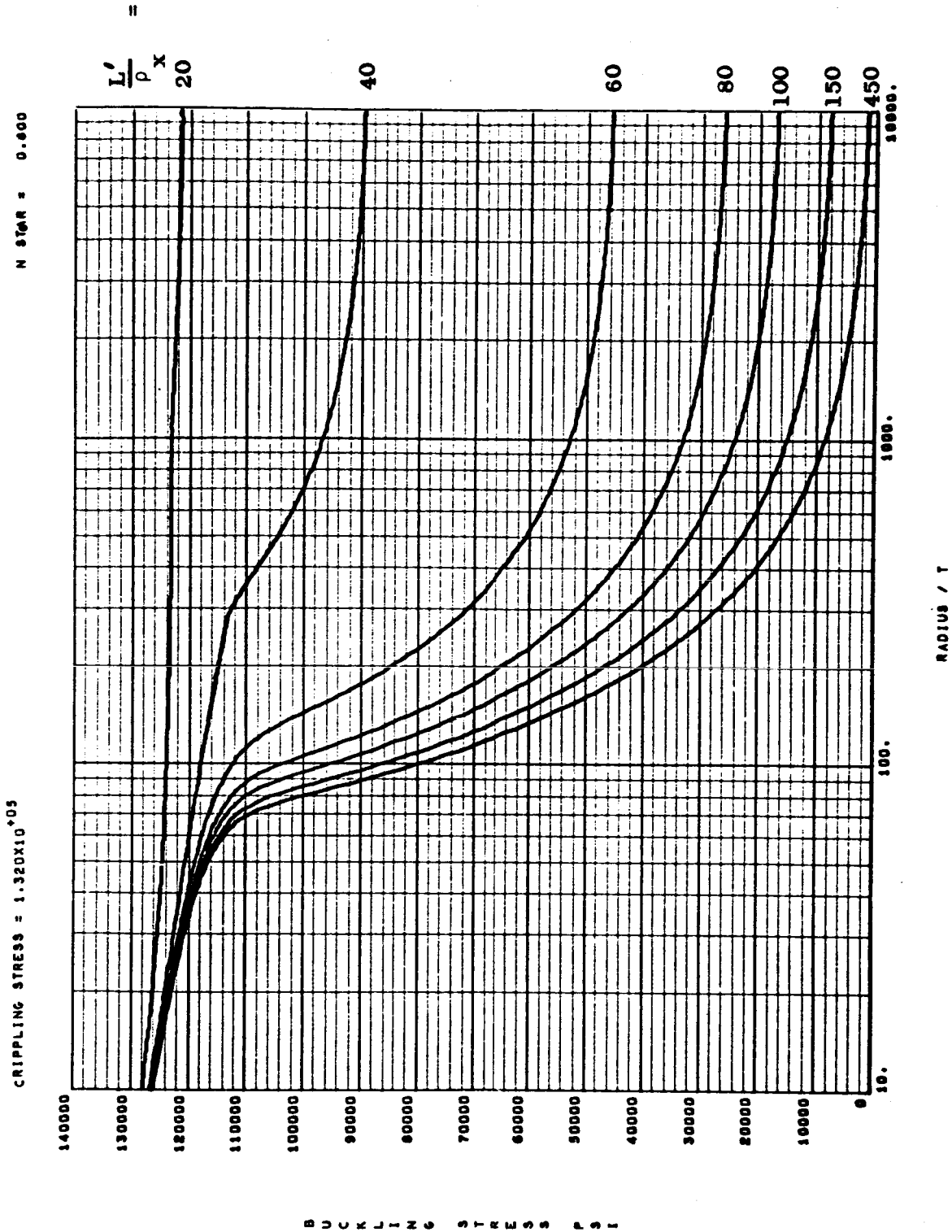
COMPRESSIVE BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 6Al-4V TITANIUM ALLOY (ANNEALED)

Figure 19(c)



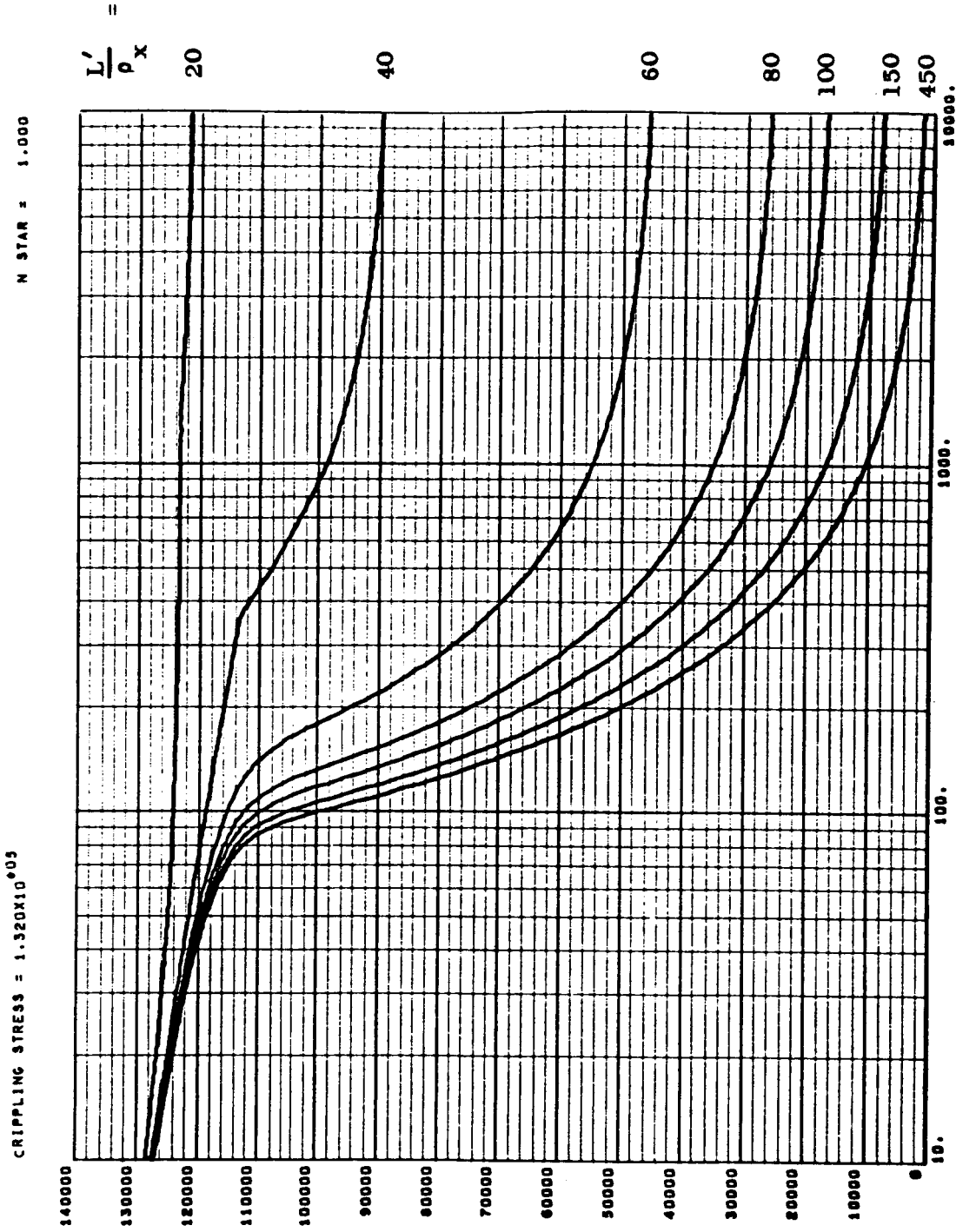
COMPRESSIVE BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 6Al-4V TITANIUM ALLOY (ANNEALED)

Figure 19(d)



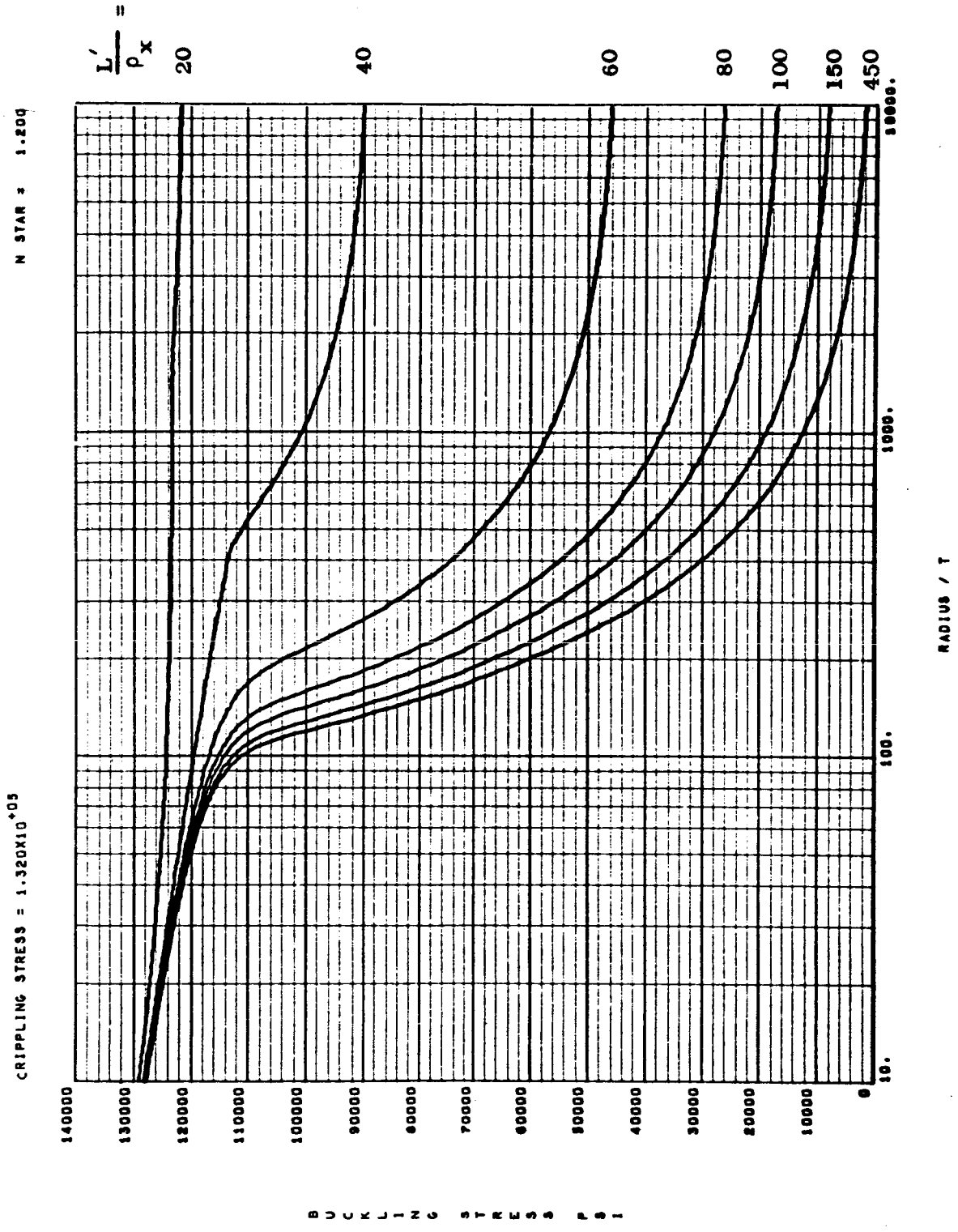
COMPRESSIVE BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL -6Al-4V TITANIUM ALLOY (ANNEALED)

Figure 19(e)

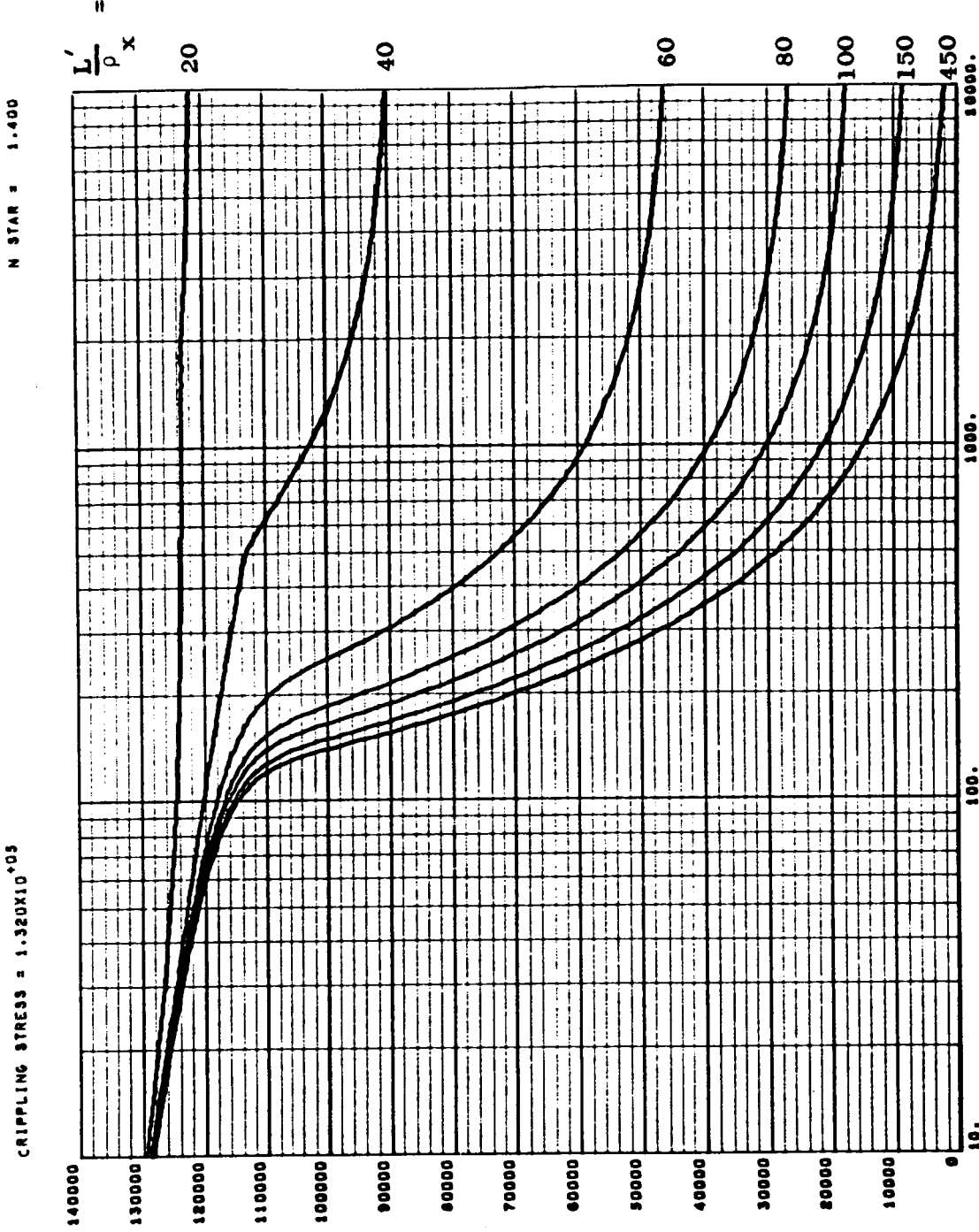


COMPRESSIVE BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 6Al-4V TITANIUM ALLOY (ANNEALED)

Figure 19(f)



COMPRESSIVE BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 6Al-4V TITANIUM ALLOY (ANNEALED)
Figure 19(g)

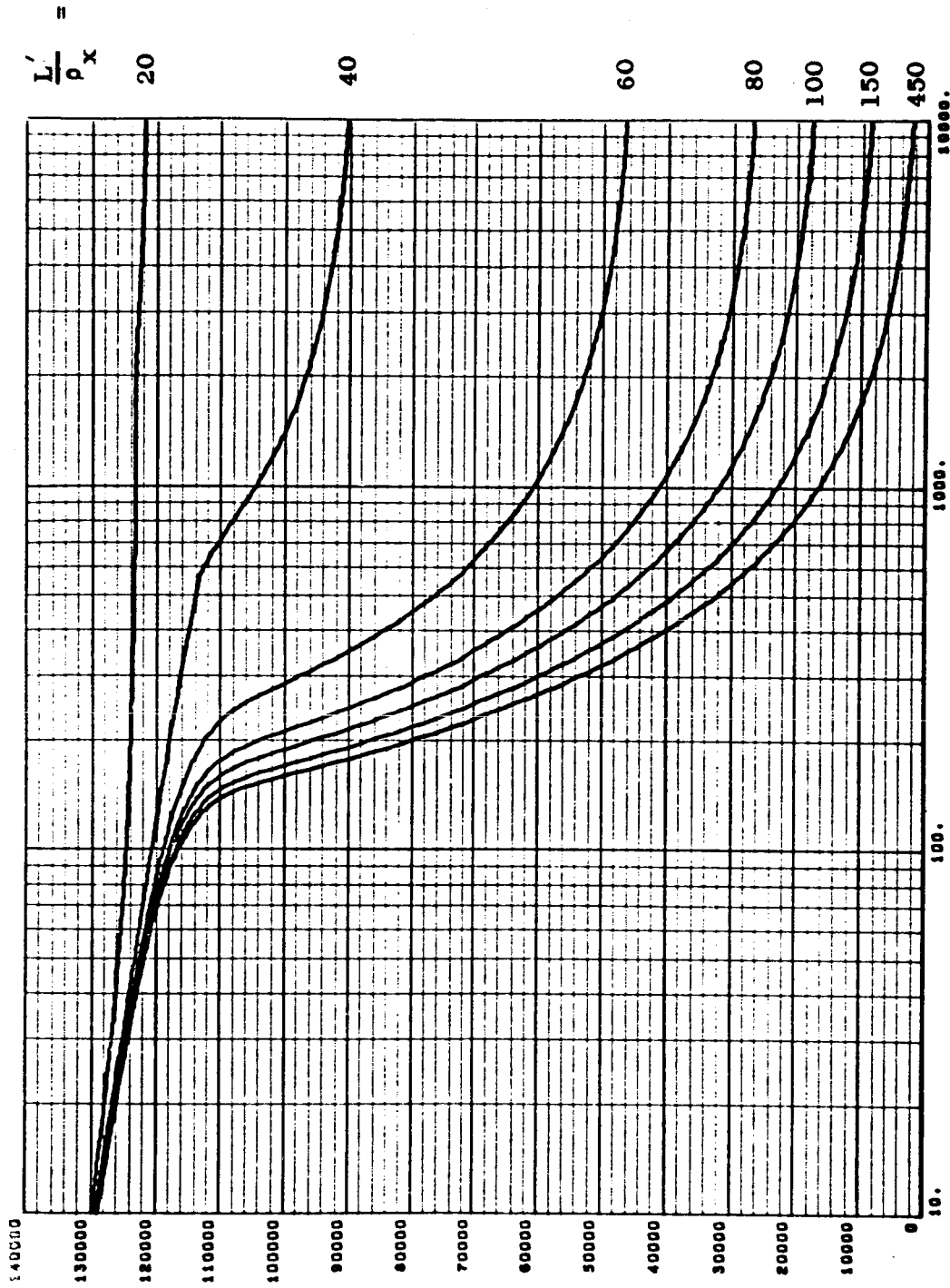


COMPRESSION BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 6Al-4V TITANIUM ALLOY (ANNEALED)

Figure 19(h)

N STAR = 1.600

CRIPPLING STRESS = 1.320×10^5



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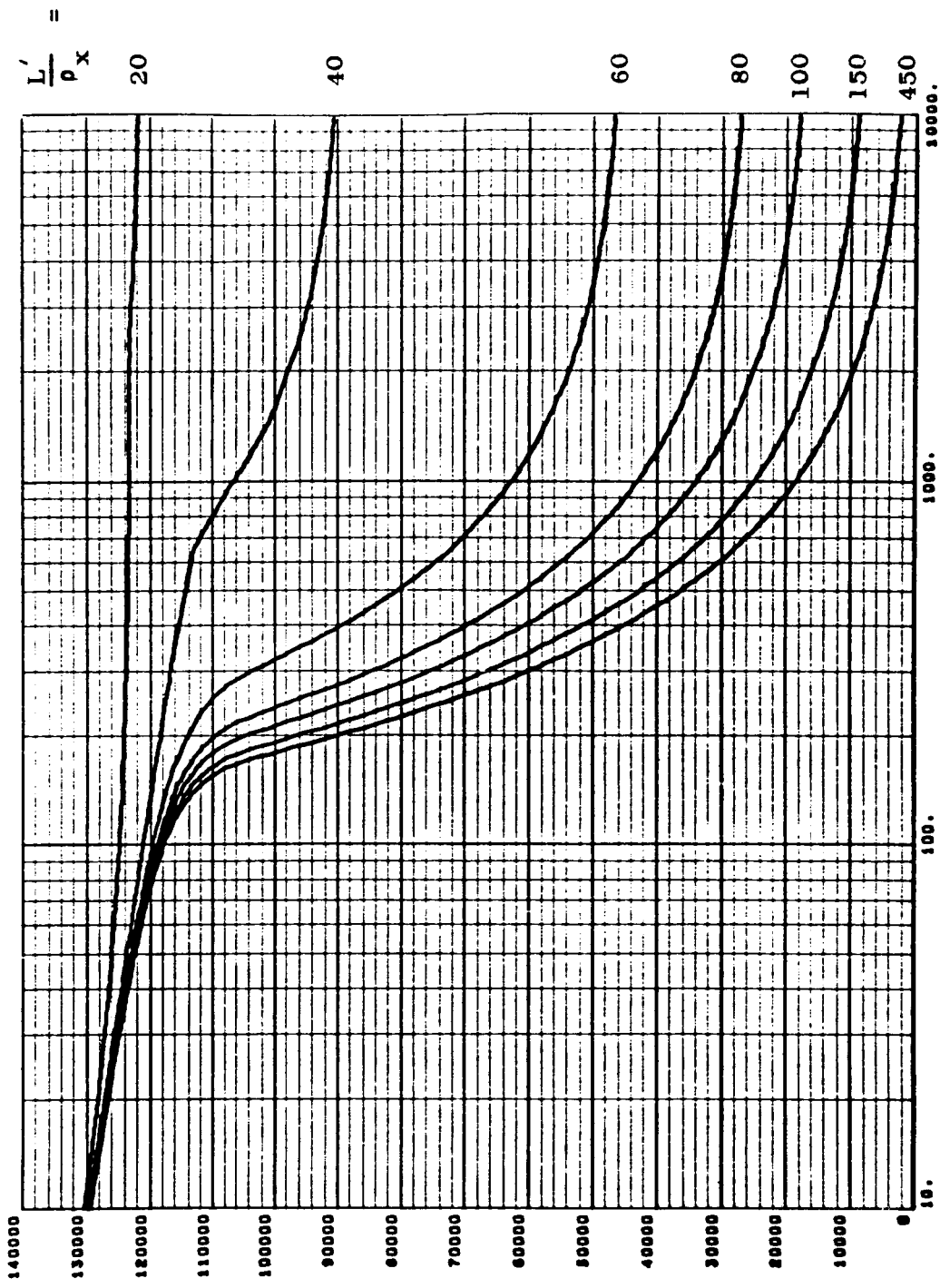
R A D I U S / T

COMPRESSIVE BUCKLING STRESS FOR
 LONGITUDINALLY STIFFENED CYLINDERS
 MATERIAL - 6Al-4V TITANIUM ALLOY (ANNEALED)

Figure 19(i)

N STAR = 1.600

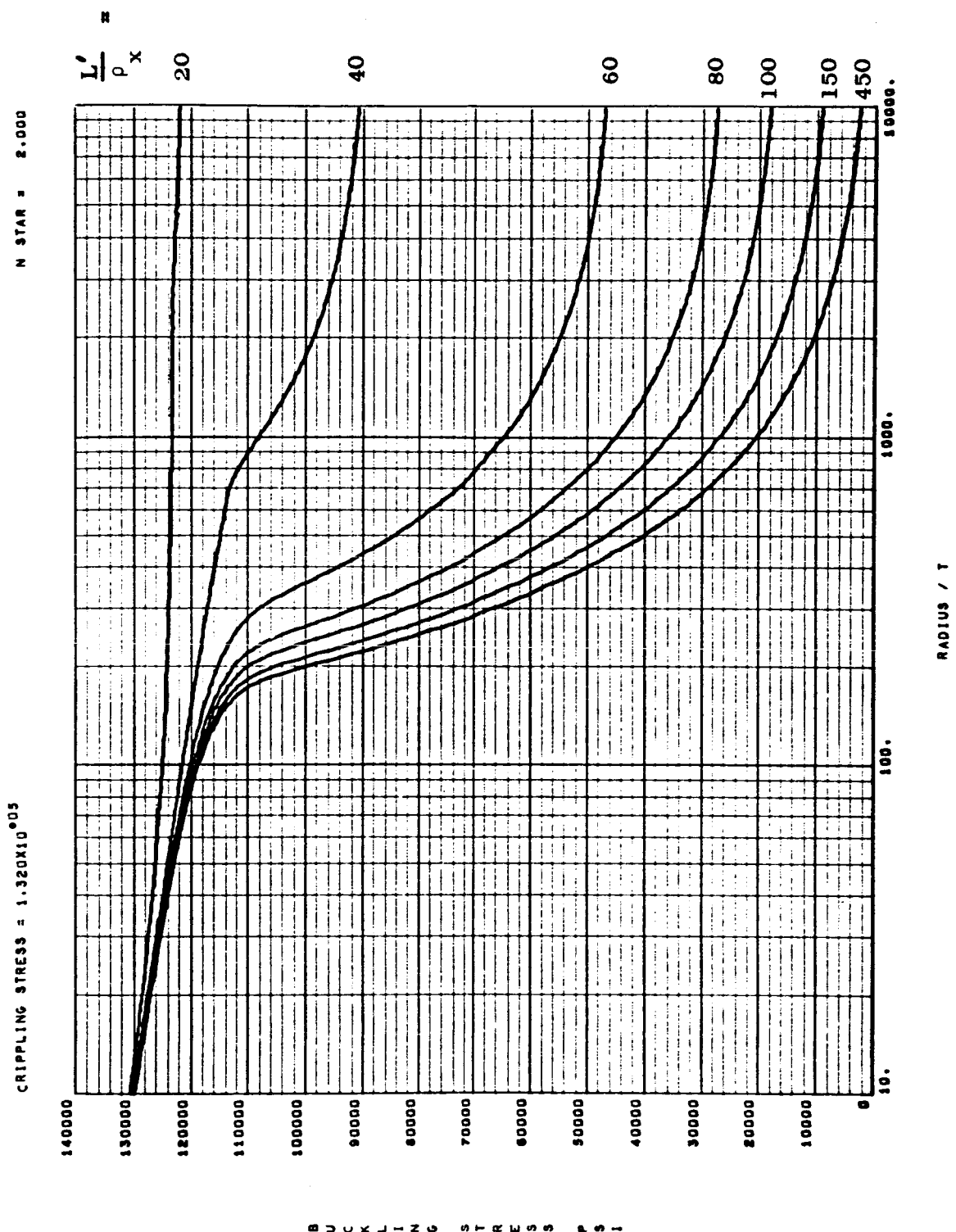
CRIPPLING STRESS = 1.32×10^5



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COMPRESSIVE BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 6Al-4V TITANIUM ALLOY (ANNEALED)

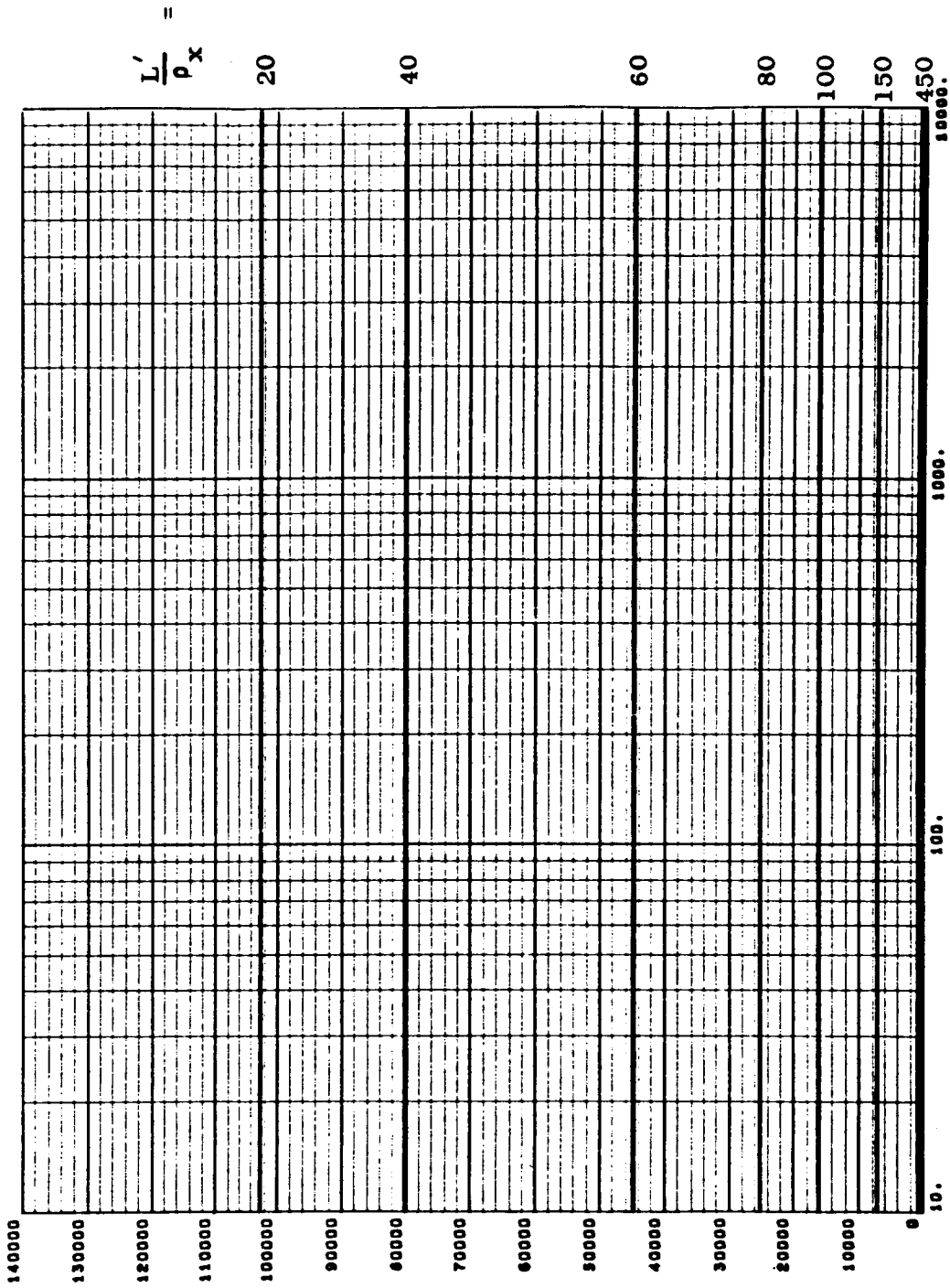
Figure 19(j)



COMPRESSIVE BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 6Al-4V TITANIUM ALLOY (ANNEALED)
Figure 19(k)

N STAR = 0.000

CRIPPLING STRESS = $1.100 \times 10^{+05}$



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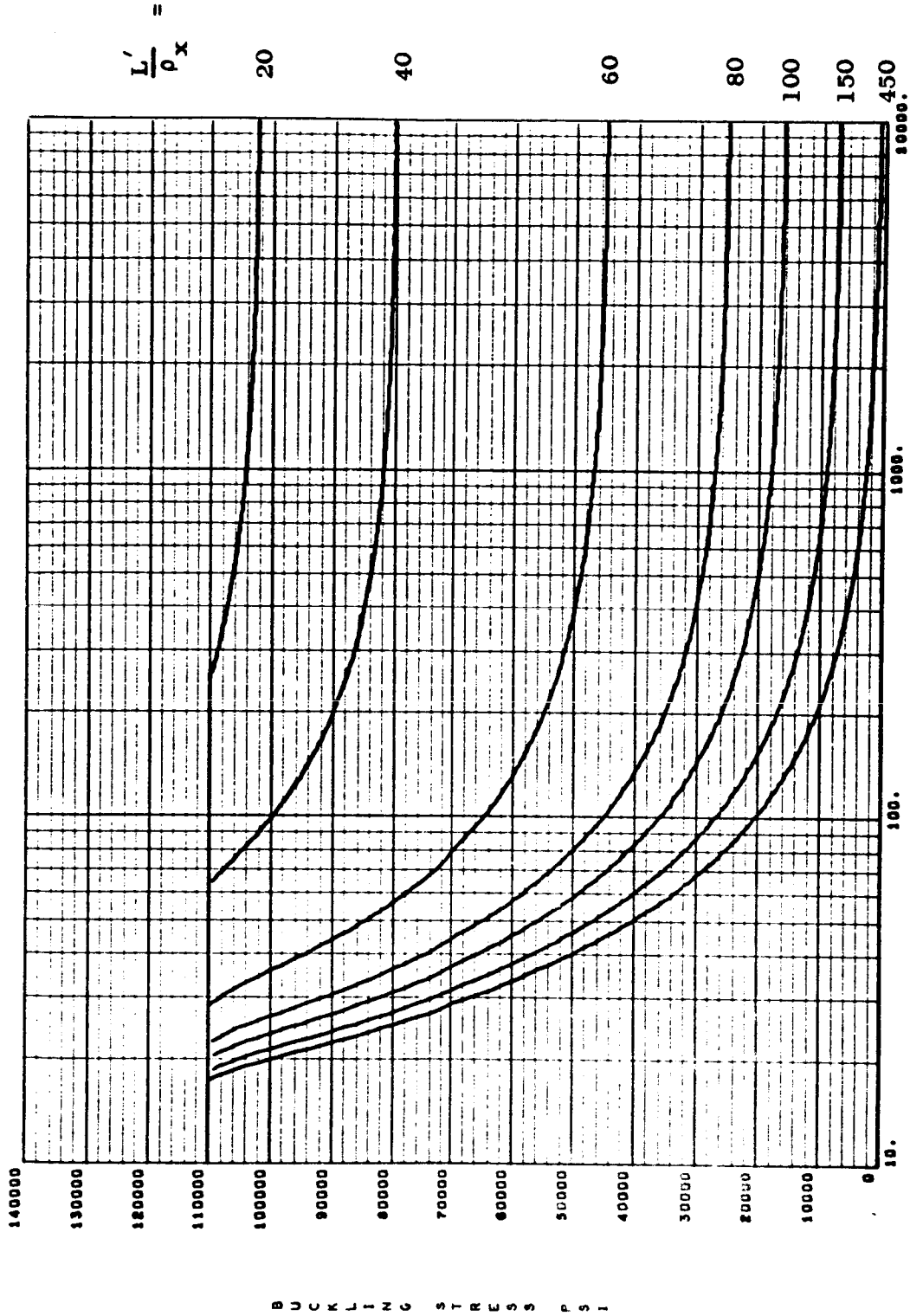
RADIUS / T

COMPRESSION STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 6Al-4V TITANIUM ALLOY (ANNEALED)

Figure 20 (a)

N STAR = 0.200

CRIPPLING STRESS = 1.100×10^{10} N/m^2

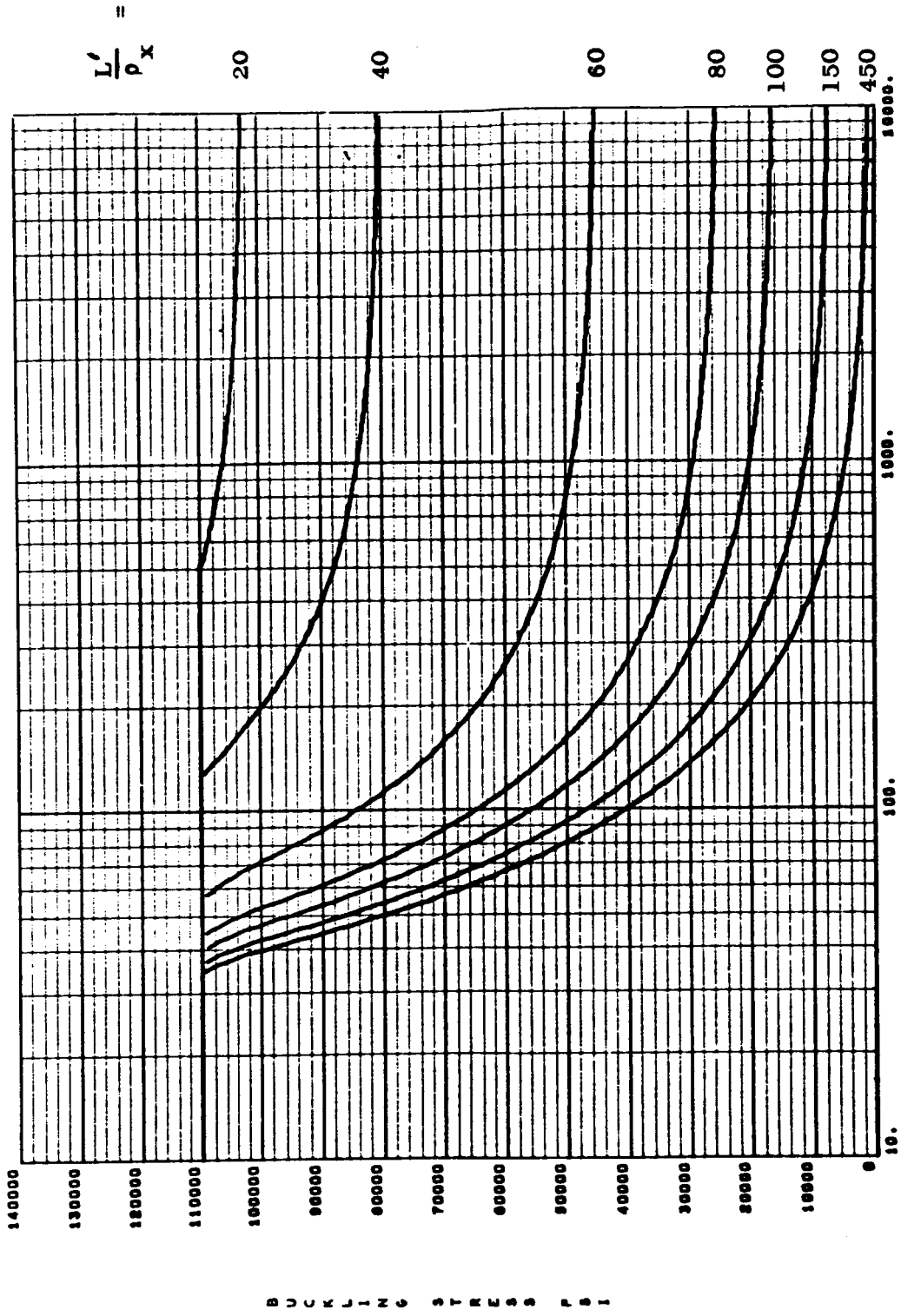


RADIUS / T

COMPRESSIVE BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL -6Al-4V TITANIUM ALLOY (ANNEALED)
Figure 20(b)

N STAR = 0.400

CRIPPLING STRESS = 1.100×10^6

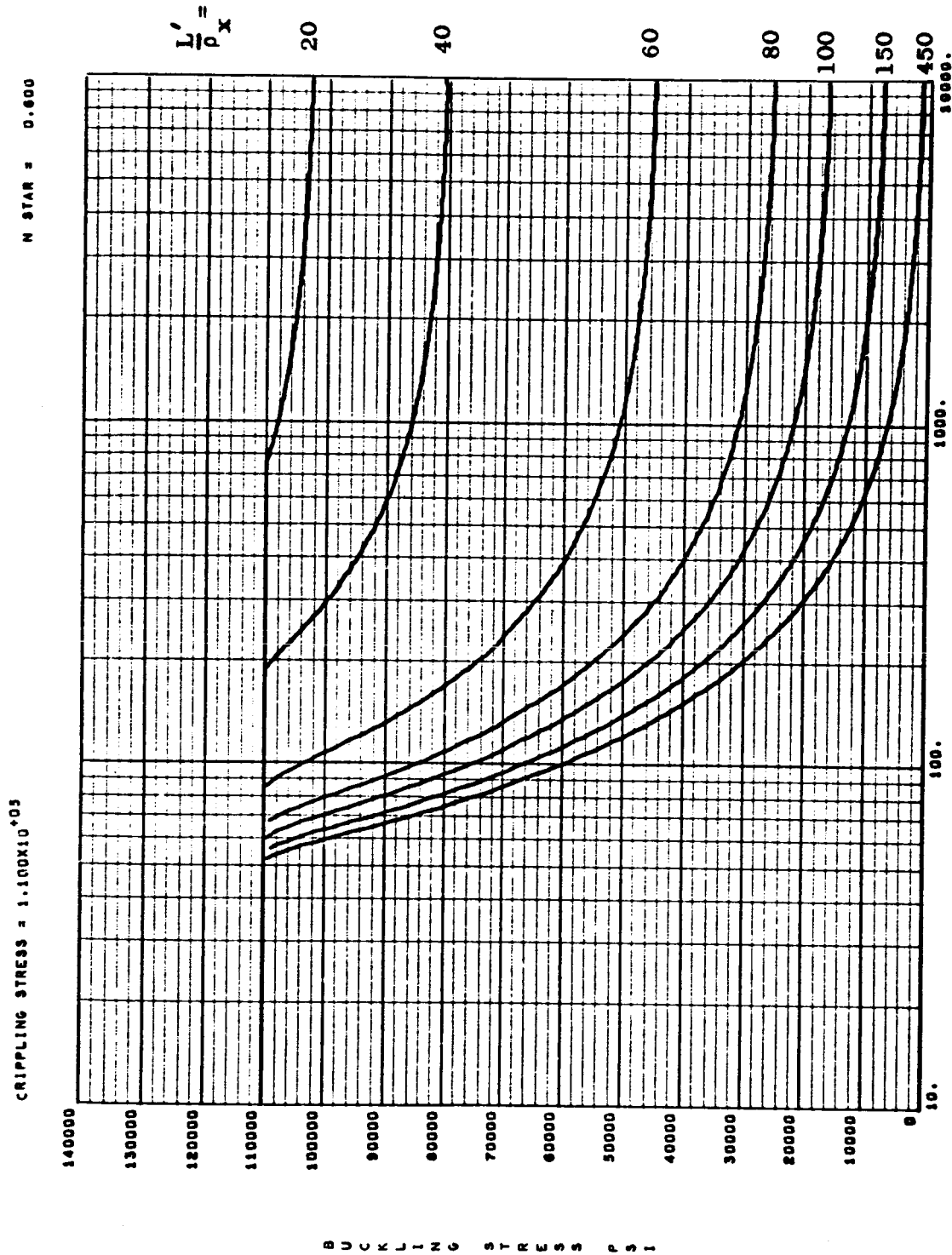


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RADIUS / r

COMPRESSIVE BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 6Al-4V TITANIUM ALLOY (ANNEALED)

Figure 20(c)

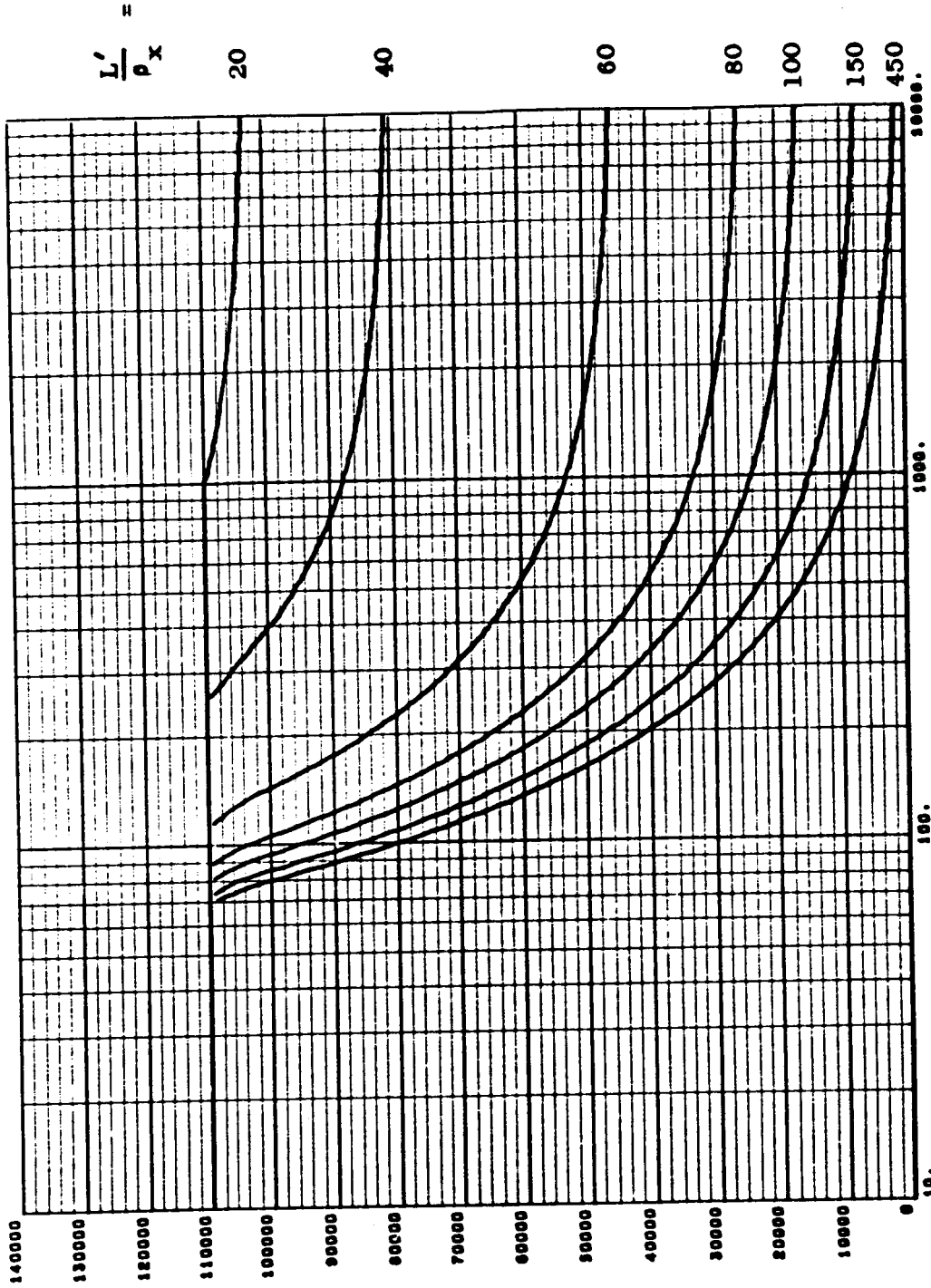


COMPRESSIVE BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 6Al-4V TITANIUM ALLOY (ANNEALED)

Figure 20(d)

N SWR = 0.800

CRIPPLING STRESS = 1.100×10^{10}

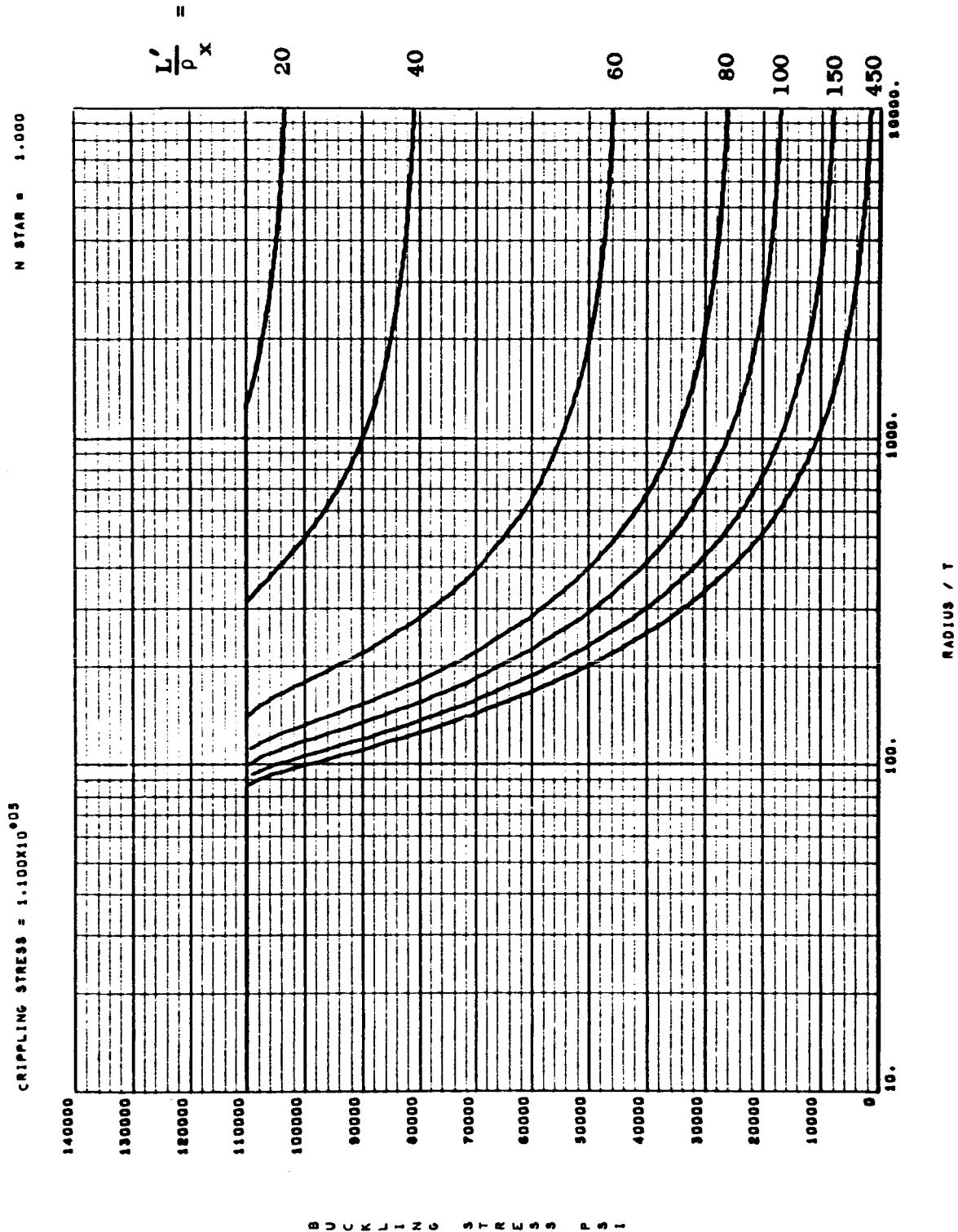


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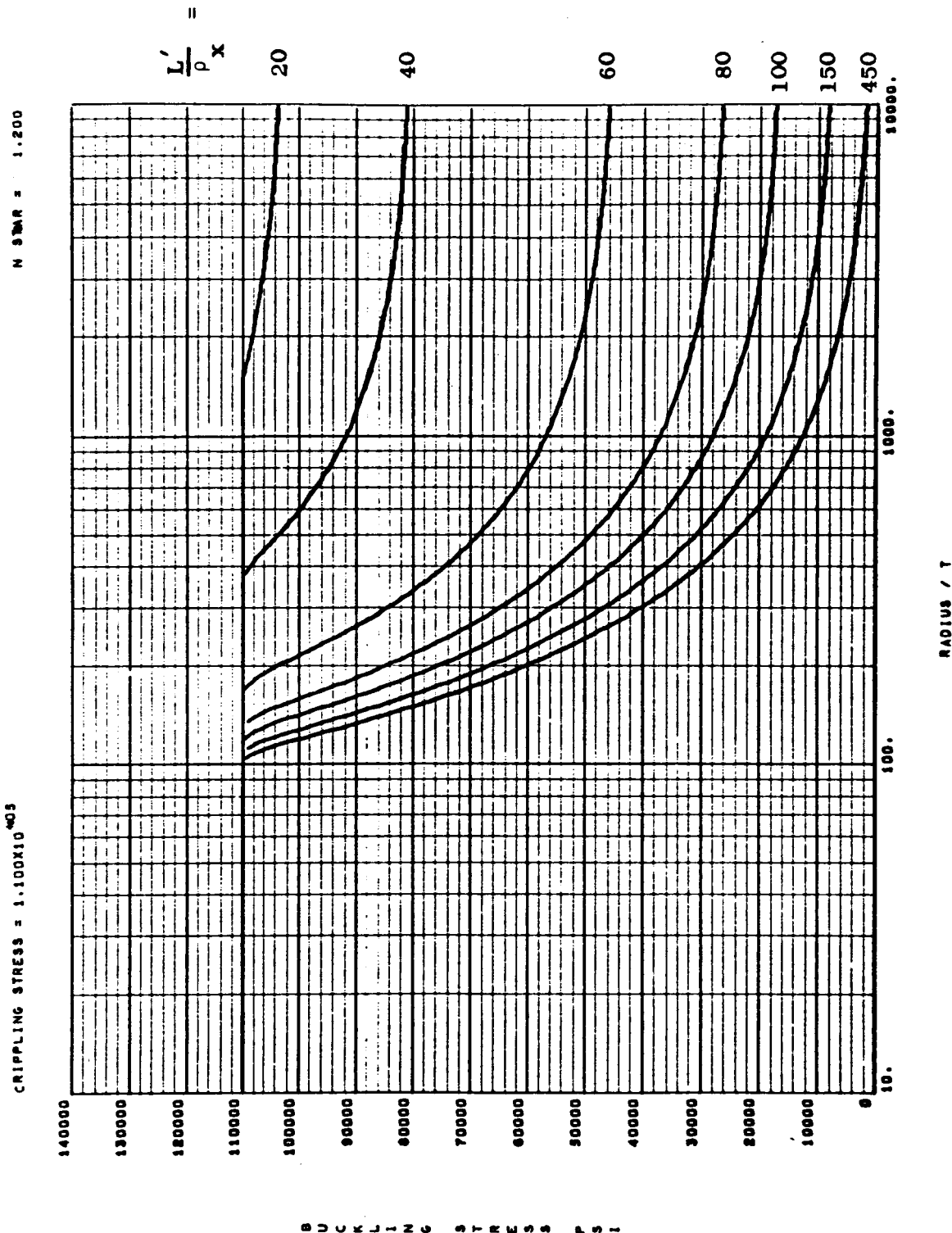
COMPRESSIVE BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 6Al-4V TITANIUM ALLOY (ANNEALED)

Figure 20(e)



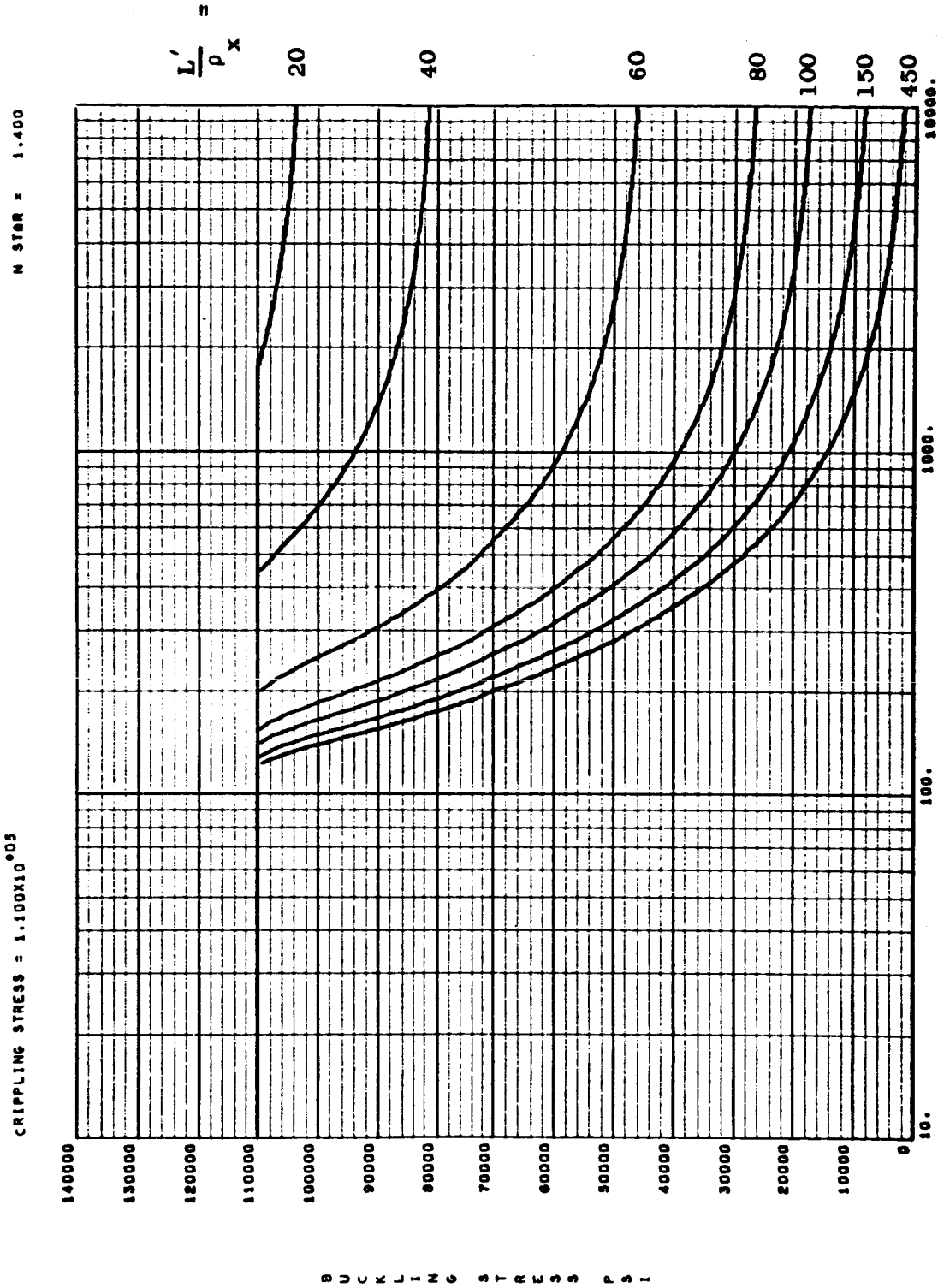
COMPRESSION BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 6Al-4V TITANIUM ALLOY (ANNEALED)

Figure 20(f)



COMPRESSIVE BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 6Al-4V TITANIUM ALLOY (ANNEALED)

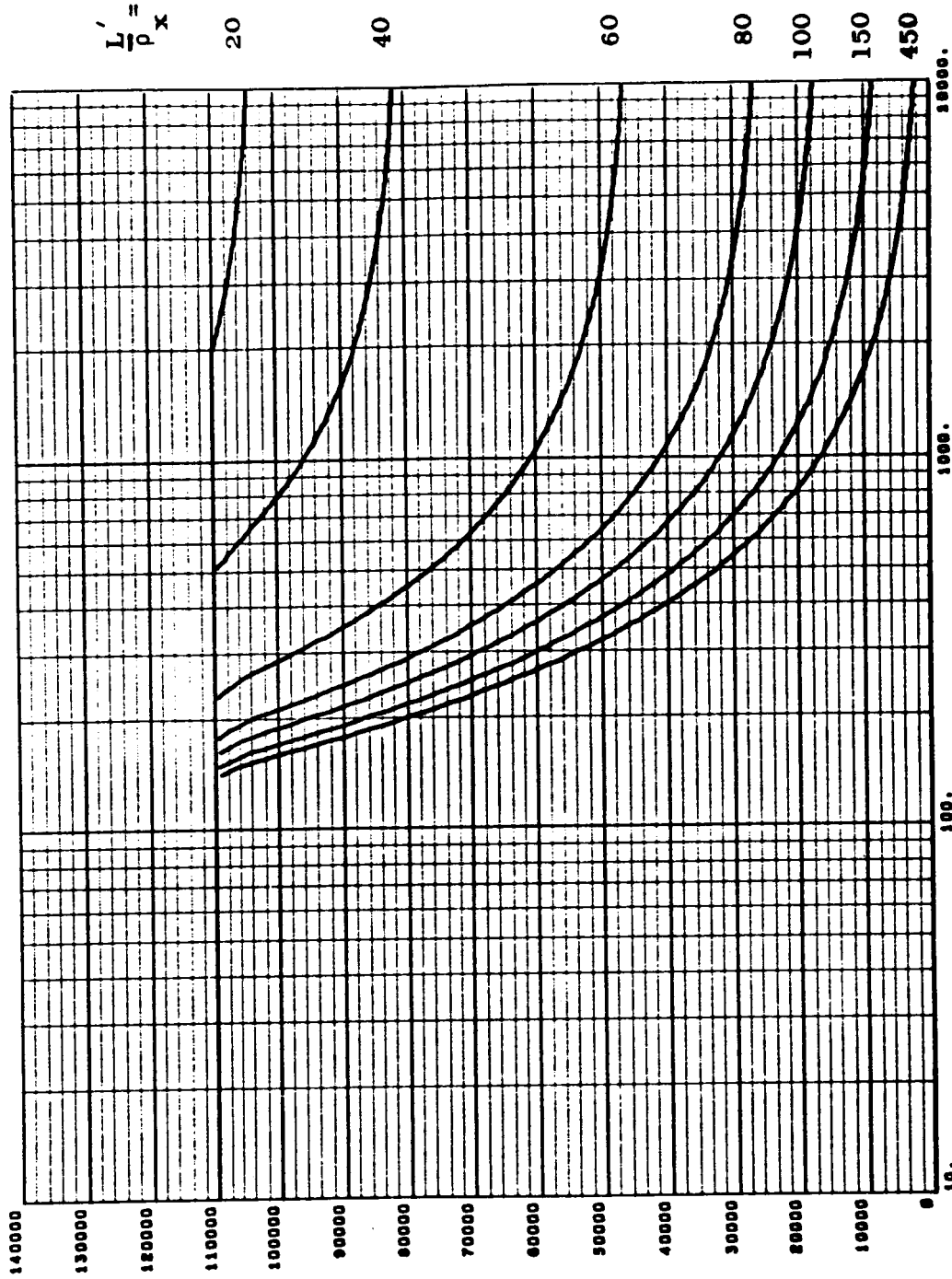
Figure 20(g)



COMPRESSION BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 6Al-4V TITANIUM ALLOY (ANNEALED)
Figure 20(h)

N STAR = 1.600

CRIPPLING STRESS = 1.100×10^6 05

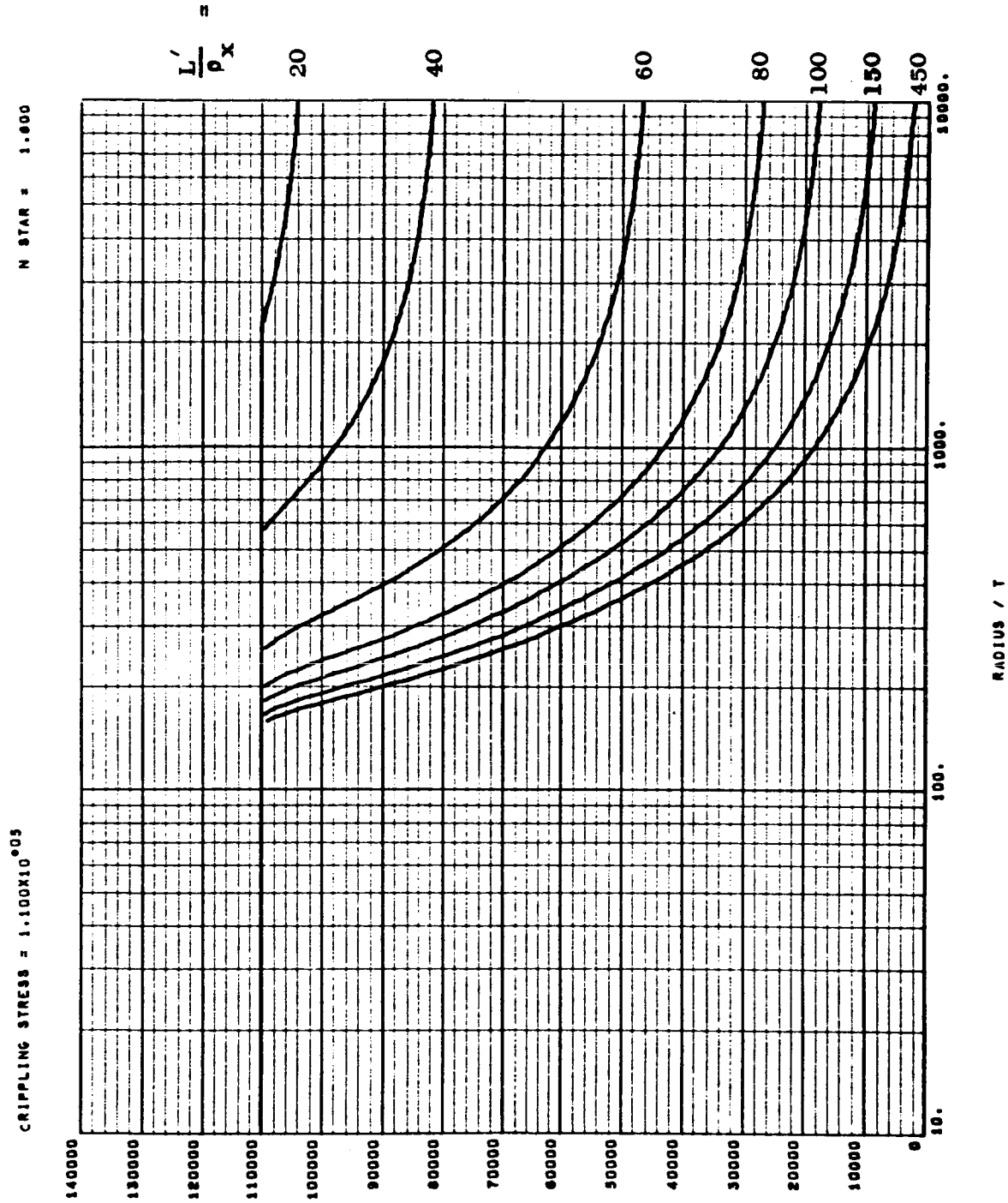


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RADIUS / T

COMPRESSIVE BUCKLING STRESS FOR
 LONGITUDINALLY STIFFENED CYLINDERS
 MATERIAL - 6Al-4V TITANIUM ALLOY (ANNEALED)

Figure 20(i)

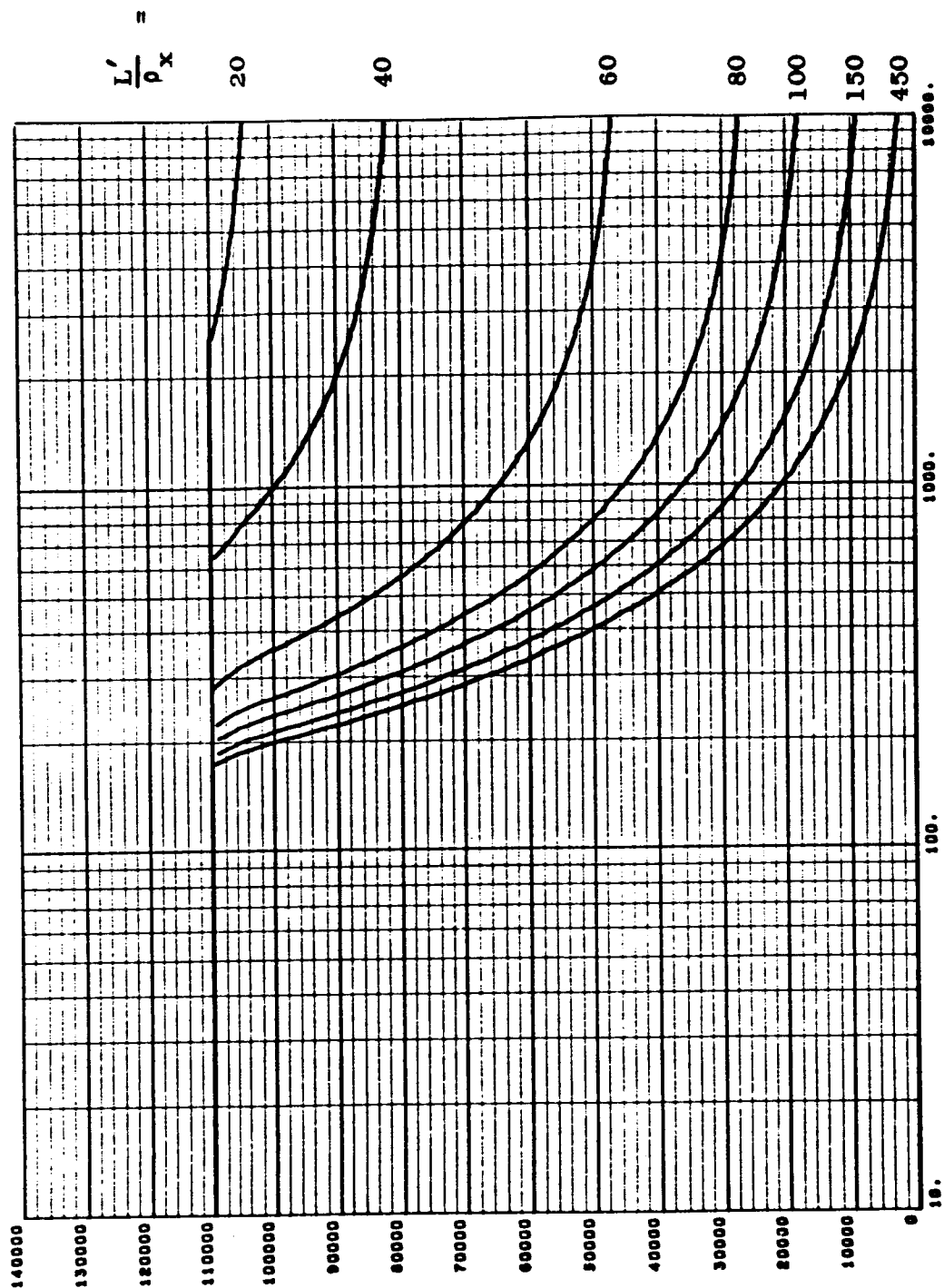


COMPRESSION BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 6Al-4V TITANIUM ALLOY (ANNEALED)

Figure 20(j)

N STAR = 2.000

CRIPPLING STRESS = 1.100×10^5

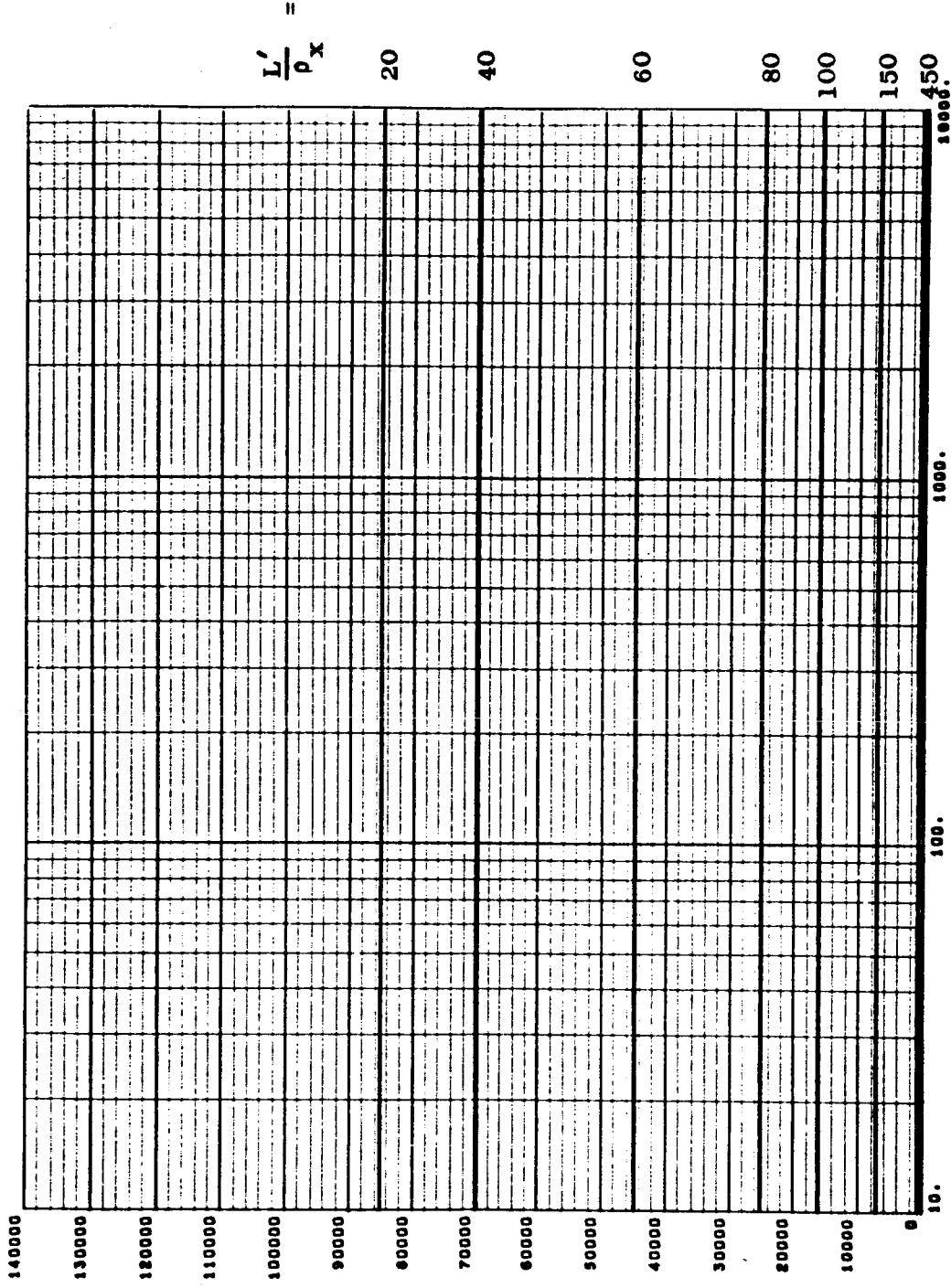


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COMPRESSIVE BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 6Al-4V TITANIUM ALLOY (ANNEALED)

Figure 20(k)

CRIPPLING STRESS = 9.000×10^{-04}
N STAIR = 0.000



$\frac{L'}{\rho x} =$

20

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80

100

150

450

RADIUS / T

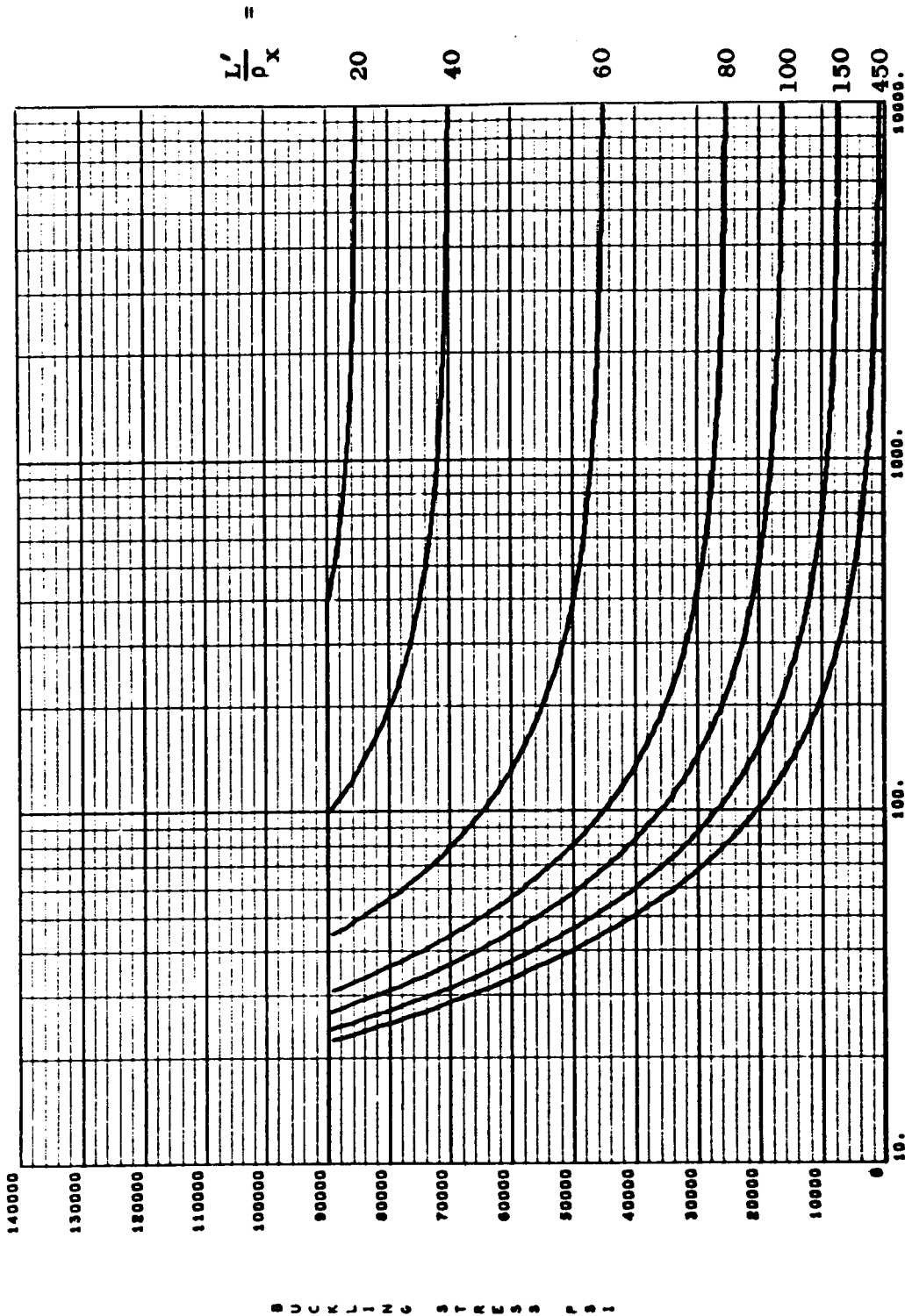
COMPRESSIVE BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 6Al-4V TITANIUM ALLOY (ANNEALED)

Figure 21(a)

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N STAR = 0.200

CRIPPLING STRESS = 9.000×10^{404}



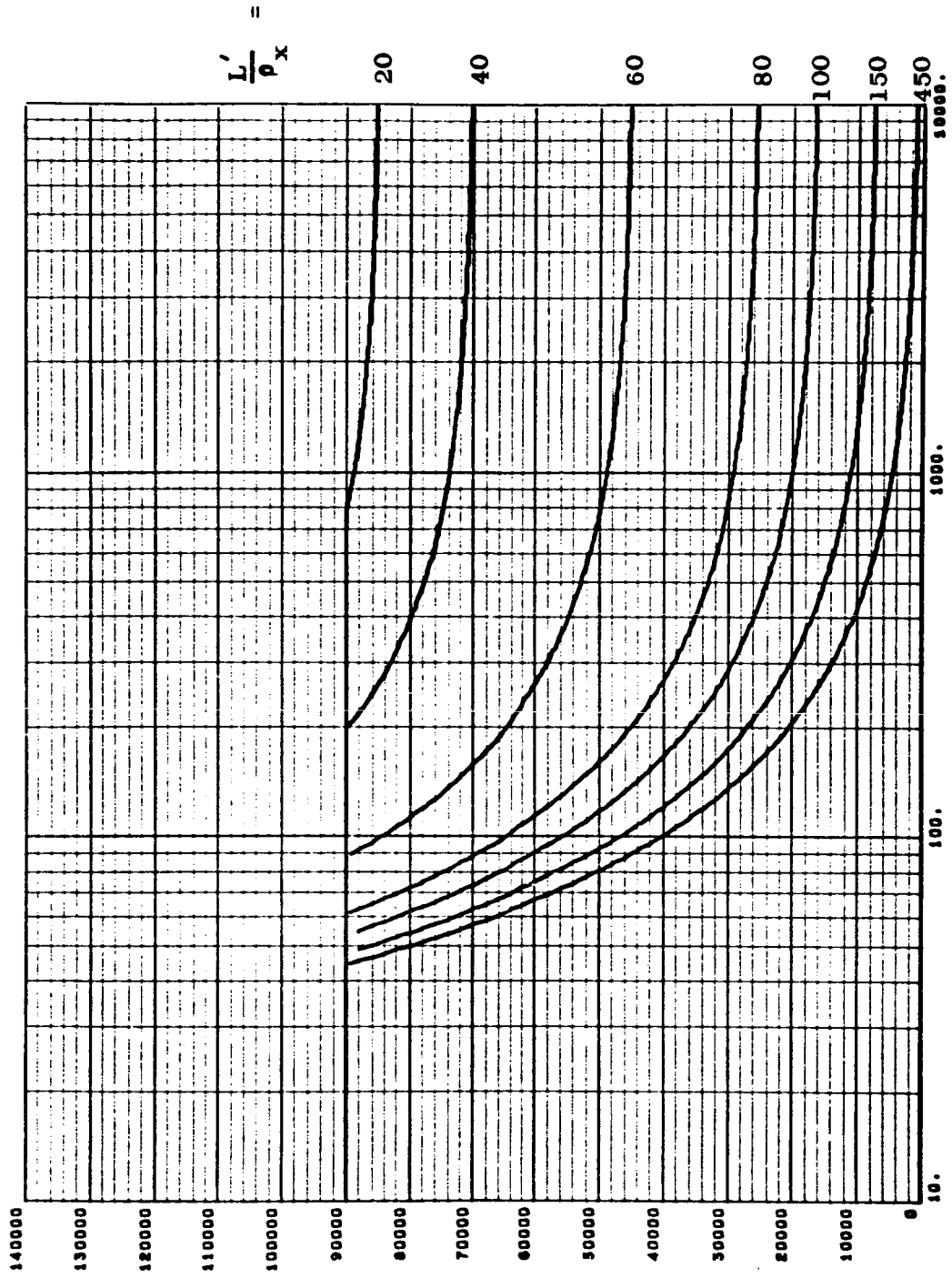
RADIUS / r

COMPRESSIVE BUCKLING STRESS FOR
 LONGITUDINALLY STIFFENED CYLINDERS
 MATERIAL - 6Al-4V TITANIUM ALLOY (ANNEALED)

Figure 21(b)

CRIPPLING STRESS = $9.000 \times 10^{10} \text{ PSI}^2$

$N \text{ STOR} = 0.400$

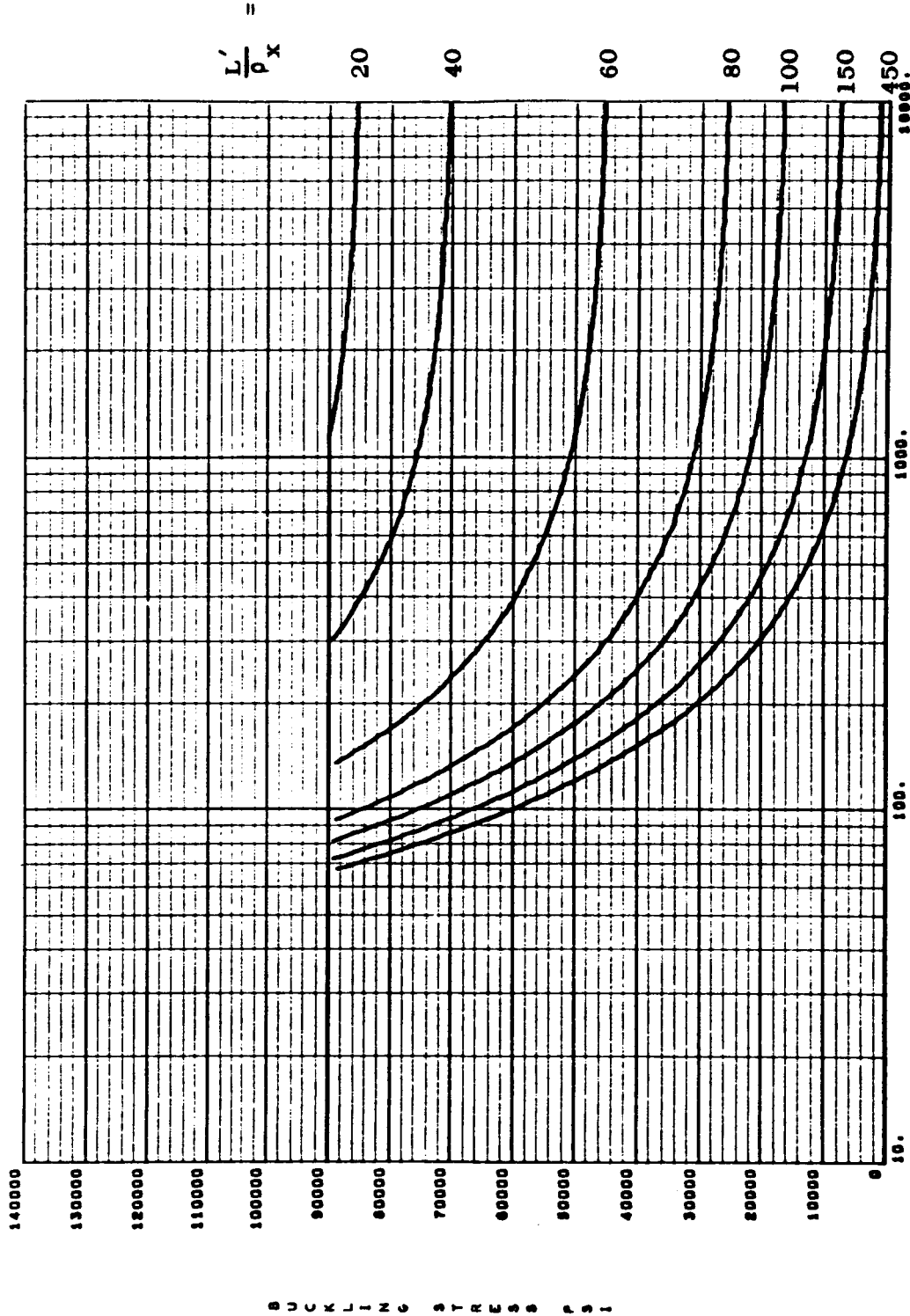


COMPRESSIVE BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 6Al-4V TITANIUM ALLOY (ANNEALED)

Figure 21(c)

N STAR = 0.600

CRIPPLING STRESS = 9.000×10^{-4}



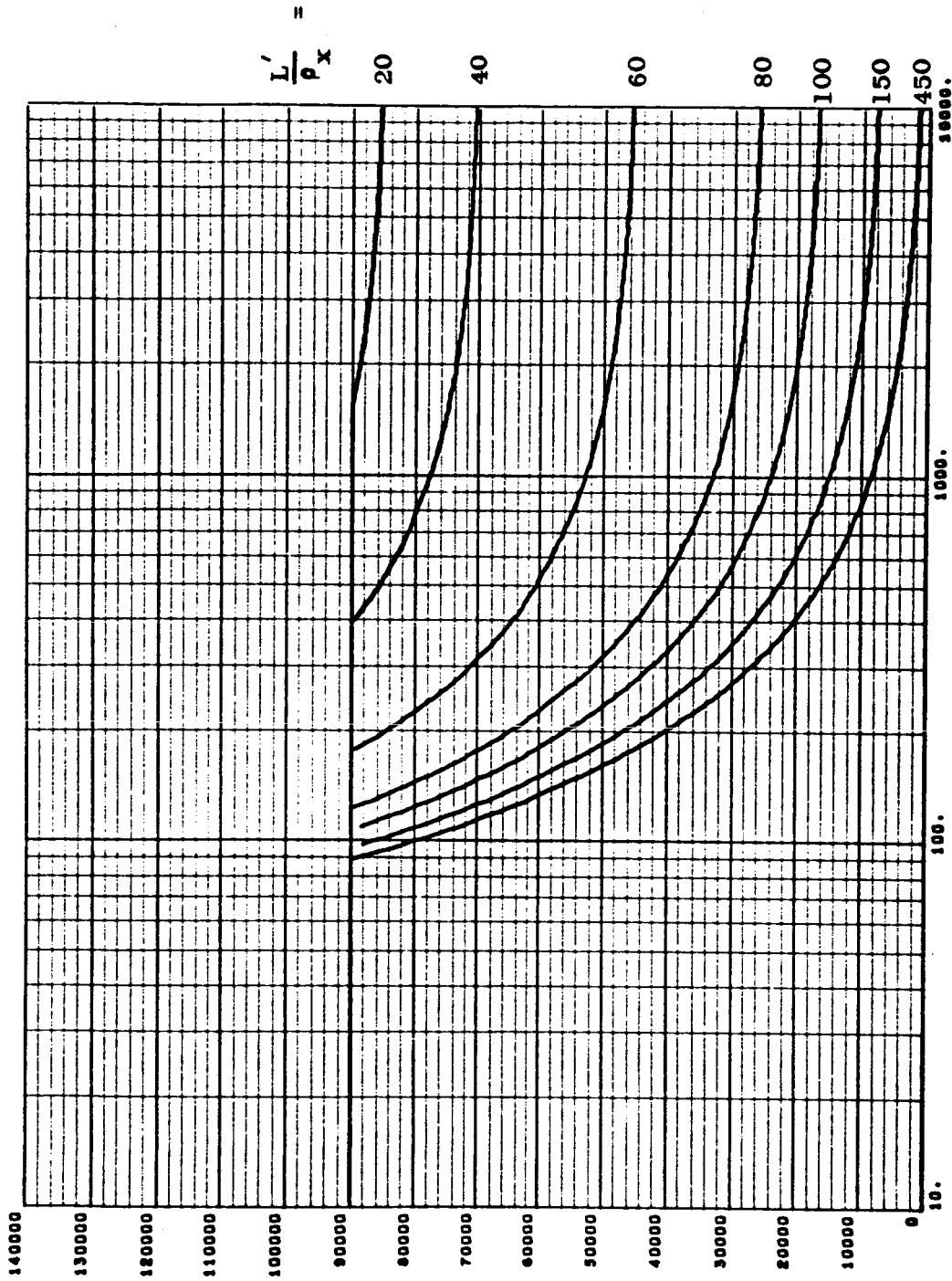
RADIUS / T

COMPRESSIVE BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 6Al-4V TITANIUM ALLOY (ANNEALED)

Figure 2j(d)

N STAR = 0.000

CRIPPLING STRESS = 9.000×10^{-04}



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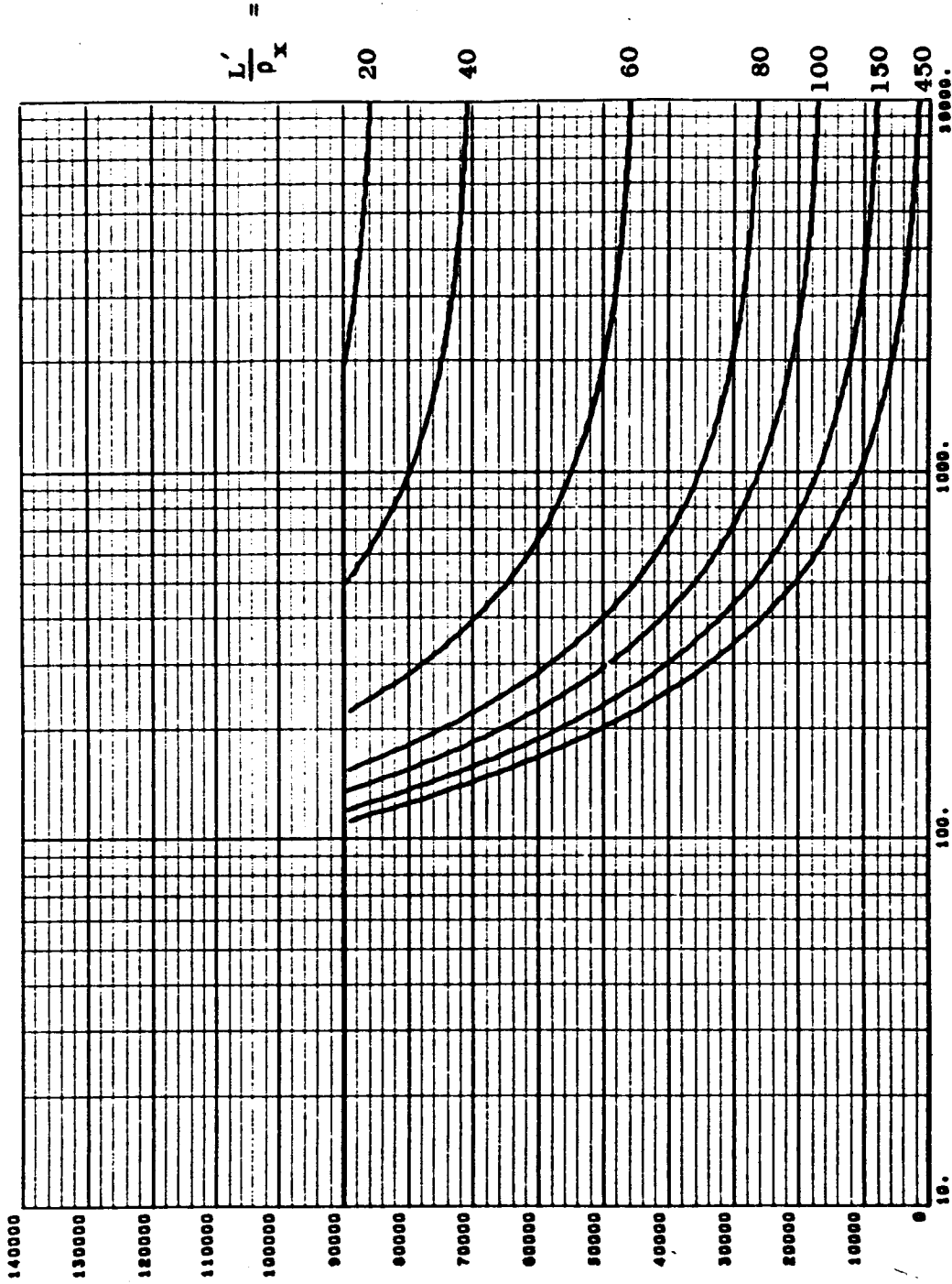
RADIUS / T

COMPRESSIVE BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 6Al-4V TITANIUM ALLOY (ANNEALED)

Figure 21(e)

N STAIR = 1.000

CRIPPLING STRESS = $9.000 \times 10^{+04}$

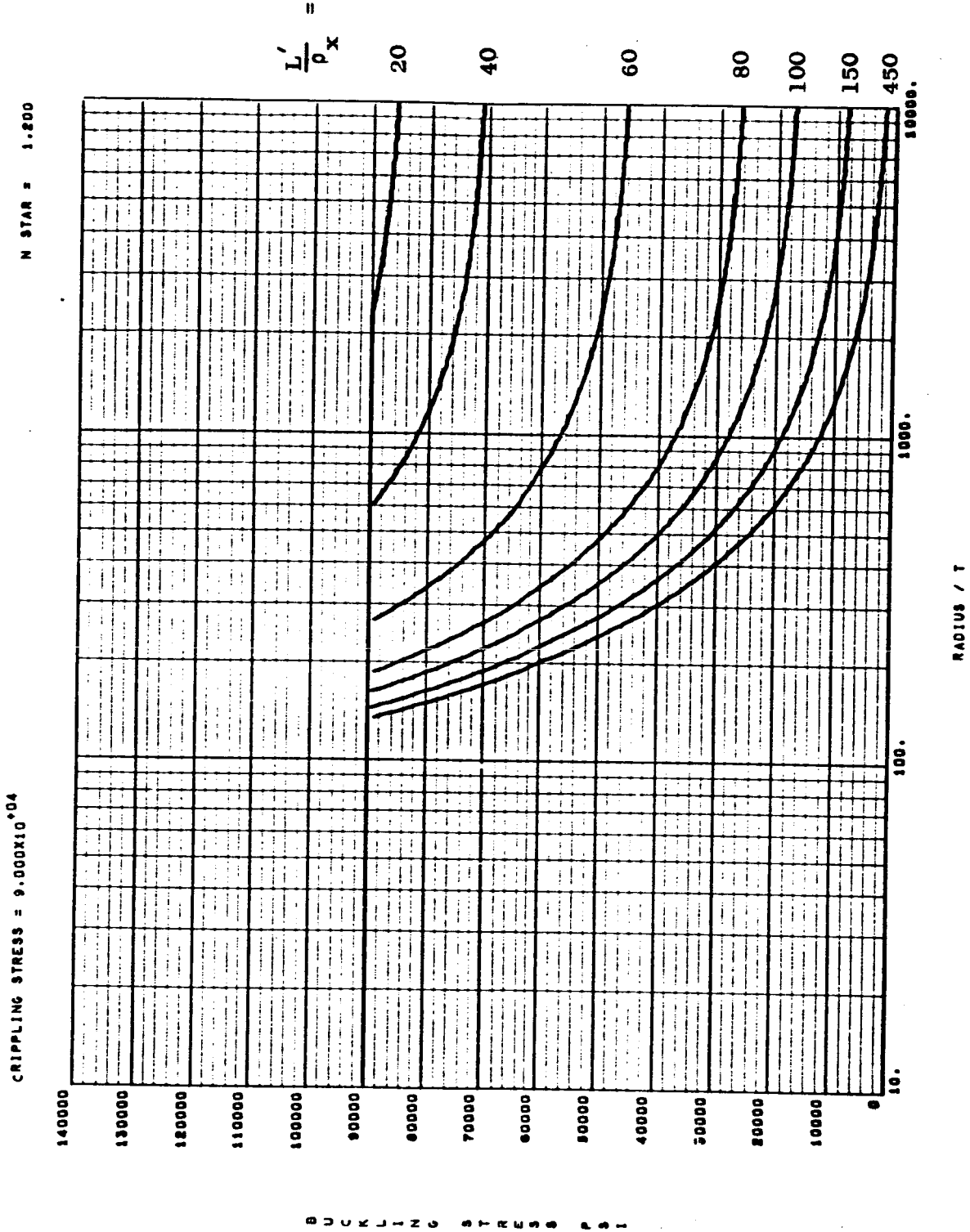


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RADIUS / r

COMPRESSIVE BUCKLING STRESS FOR
 LONGITUDINALLY STIFFENED CYLINDERS
 MATERIAL - 6Al-4V TITANIUM ALLOY (ANNEALED)

Figure 21(f)

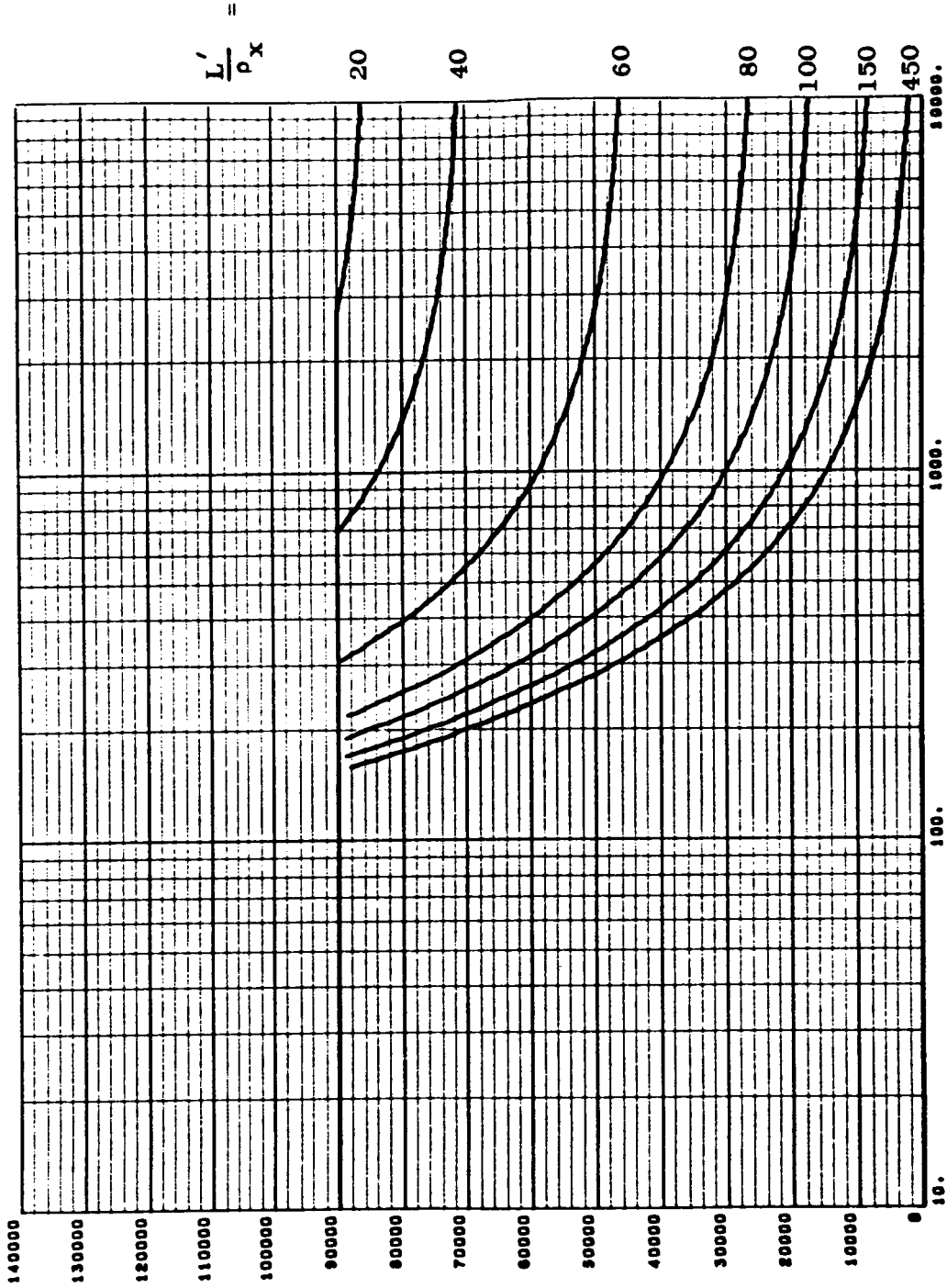


COMPRESSION BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 6Al-4V TITANIUM ALLOY (ANNEALED)

Figure 21(g)

N STAR = 1.400

CRIPPLING STRESS = $9.000 \times 10^{+04}$



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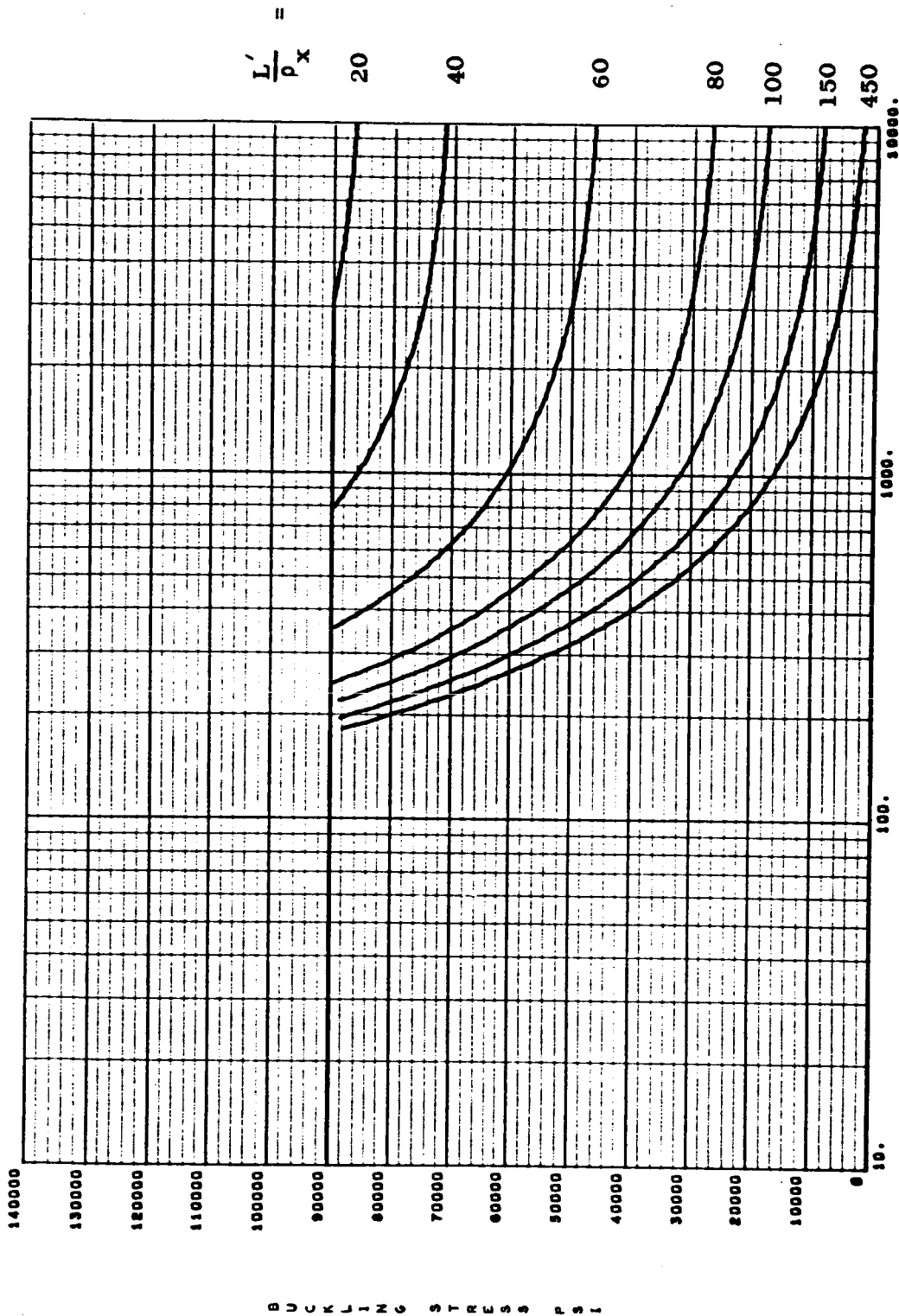
R A D I U S / T

COMPRESSIVE BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL -6Al-4V TITANIUM ALLOY (ANNEALED)

Figure 21(h)

N STAR = 1.000

CRIPPLING STRESS = 9.000×10^{-04}

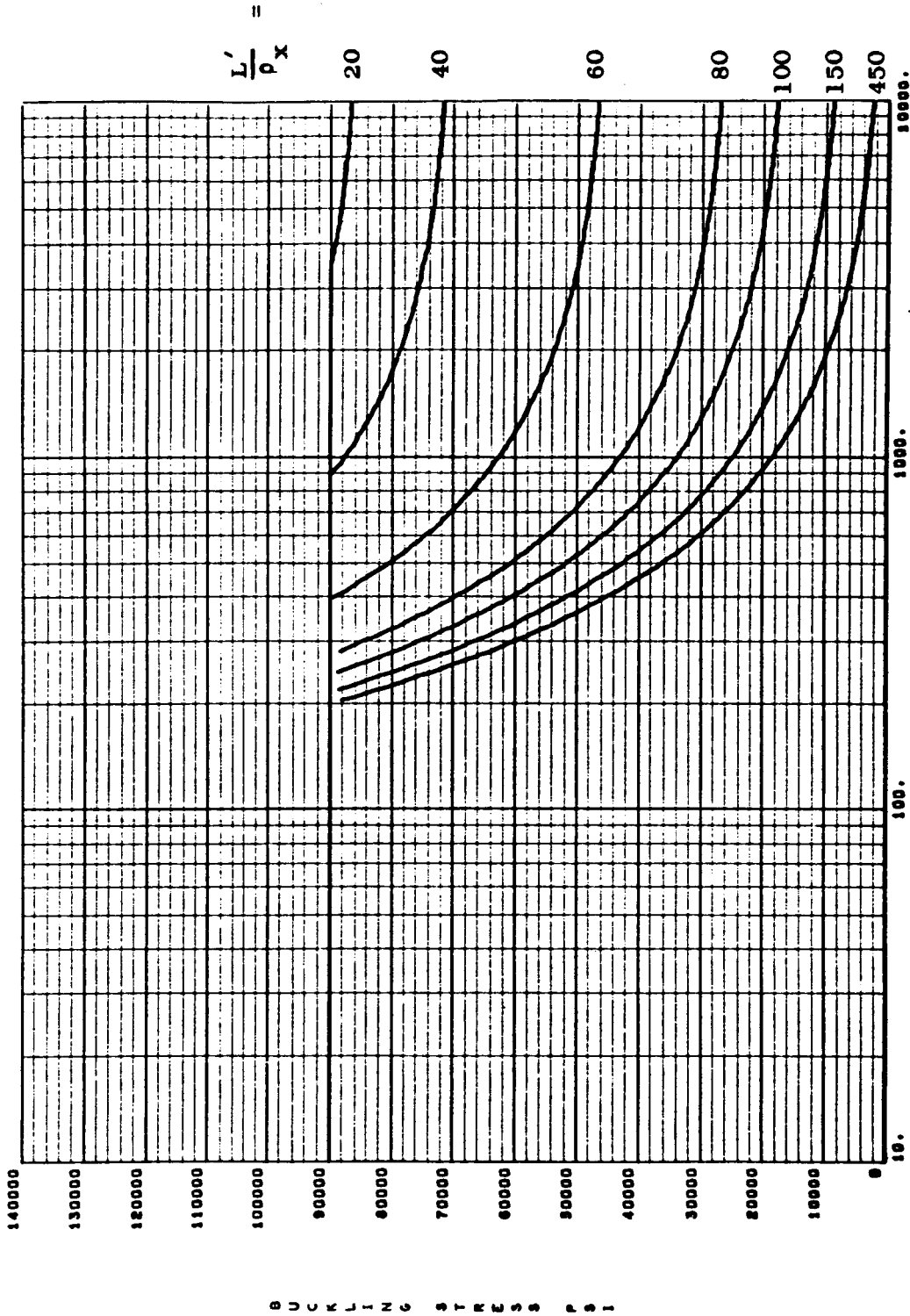


COMPRESSIVE BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 6Al-4V TITANIUM ALLOY (ANNEALED)

Figure 21(i)

N STAR = 1.800

CRIPPLING STRESS = 9.000×10^{-04}



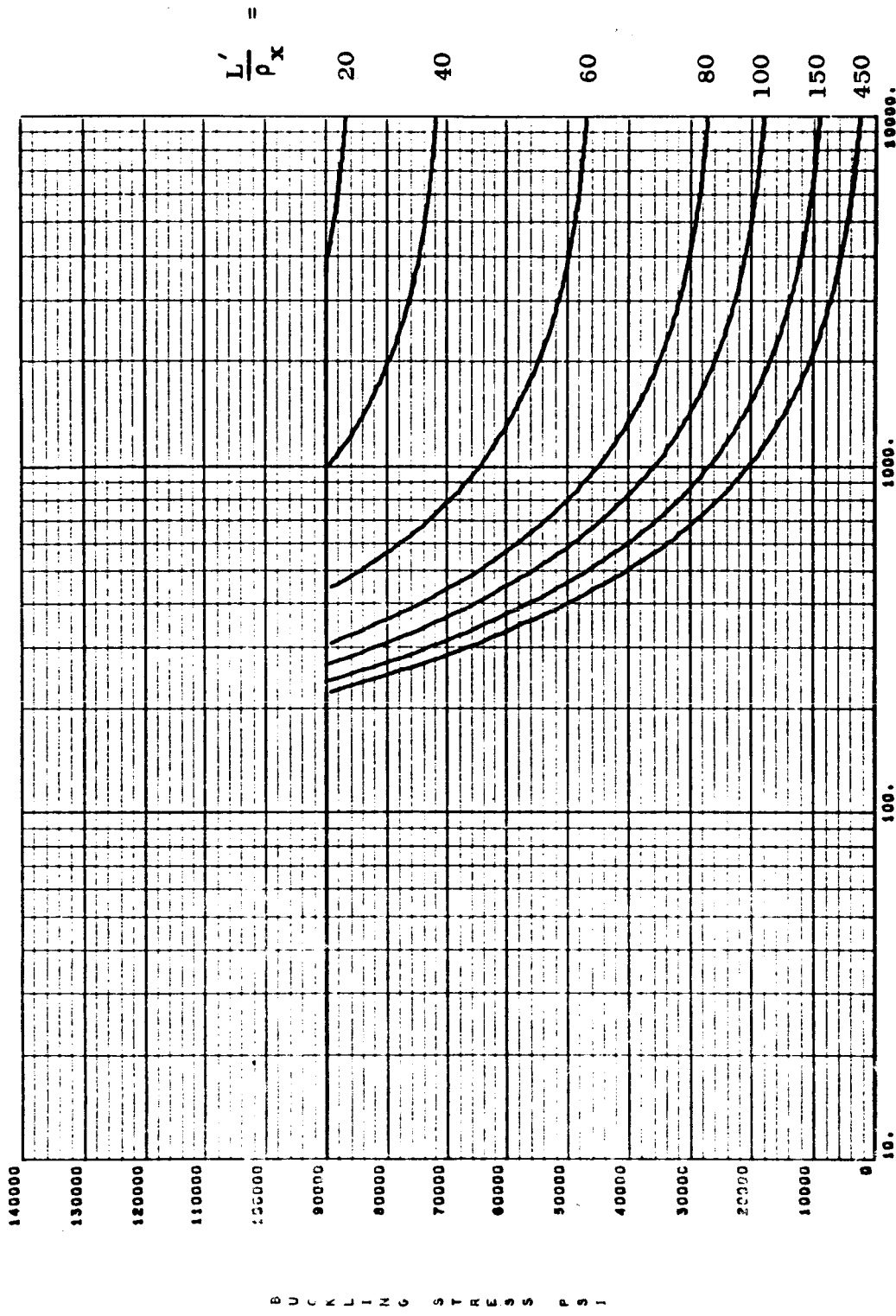
RADIUS / T

COMPRESSIVE BUCKLING STRESS FOR
 LONGITUDINALLY STIFFENED CYLINDERS
 MATERIAL - 6Al-4V TITANIUM ALLOY (ANNEALED)

Figure 21(j)

N STAR = 2.000

CRIPPLING STRESS = $9.000 \times 10^{10} \text{ MO}^4$



COMPRESSIVE BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 6Al-4V TITANIUM ALLOY (ANNEALED)

Figure 21(k)

A.2.3 718 NICKEL ALLOY (Annealed + Double Aged)

Table XVII lists the families provided here for longitudinally stiffened cylinders made of 718 nickel alloy (annealed + double aged). These curves are based upon the following values for the indicated material properties:

	E	=	29.0×10^6	psi
	ν	=	.30	
	σ_{cy}	=	150,000	psi
Ramberg-Osgood	n	=	12.7	
Ramberg-Osgood	$\sigma_{.7}$	=	150,500	psi

TABLE XVII - Table of Contents for Supplementary Curves of Compressive Buckling Stress for Longitudinally Stiffened Cylinders; Material - 718 Nickel Alloy (Annealed + Double Aged)

<u>Figure Number</u>	<u>Crippling Stress, σ_{cc}</u>	<u>N*</u>	<u>Page</u>
22(a)	150,000	0.0	A-81
22(b)	150,000	0.2	A-82
22(c)	150,000	0.4	A-83
22(d)	150,000	0.6	A-84
22(e)	150,000	0.8	A-85
22(f)	150,000	1.0	A-86
22(g)	150,000	1.2	A-87
22(h)	150,000	1.4	A-88
22(i)	150,000	1.6	A-89
22(j)	150,000	1.8	A-90
22(k)	150,000	2.0	A-91
23(a)	130,000	0.0	A-92
23(b)	130,000	0.2	A-93
23(c)	130,000	0.4	A-94
23(d)	130,000	0.6	A-95

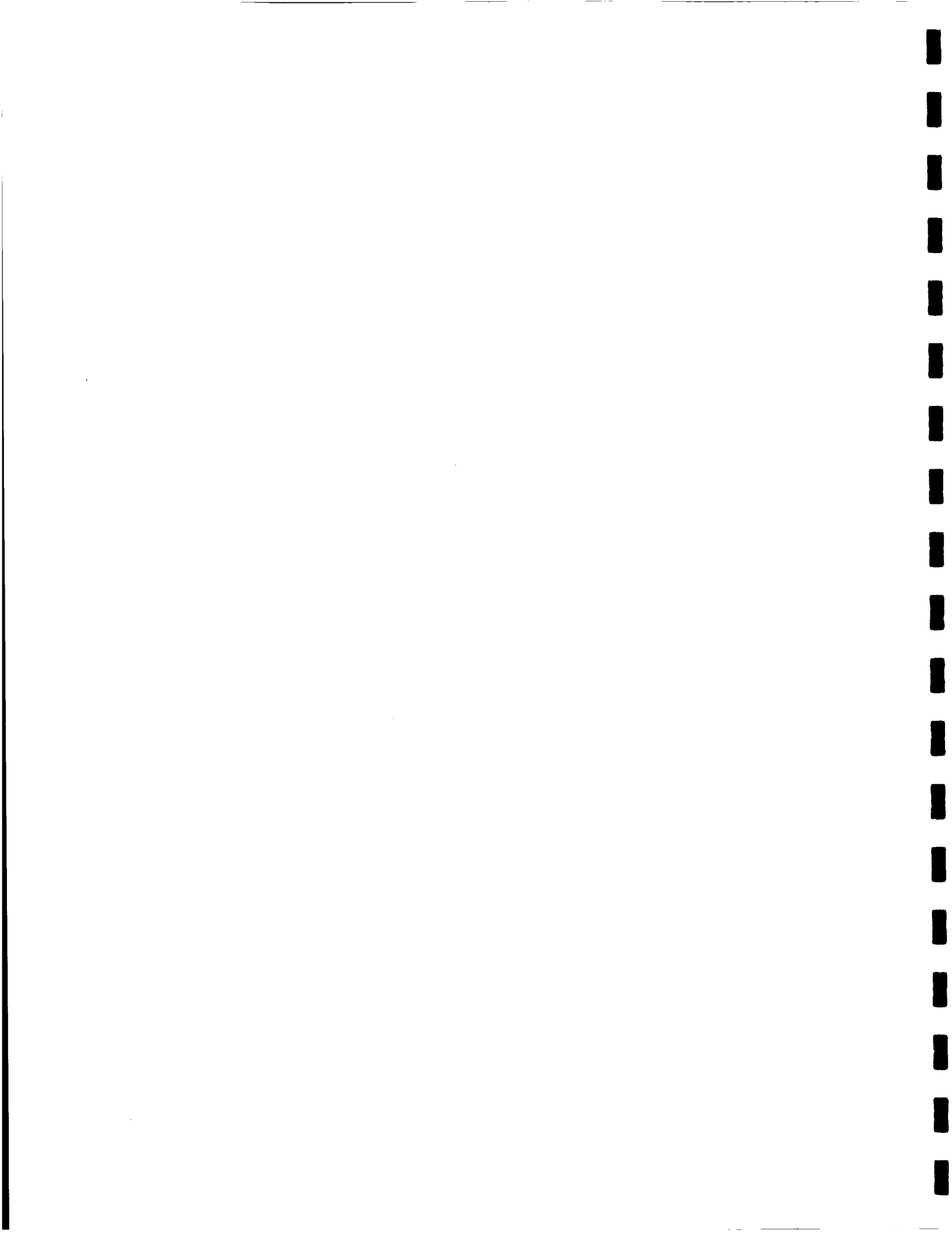
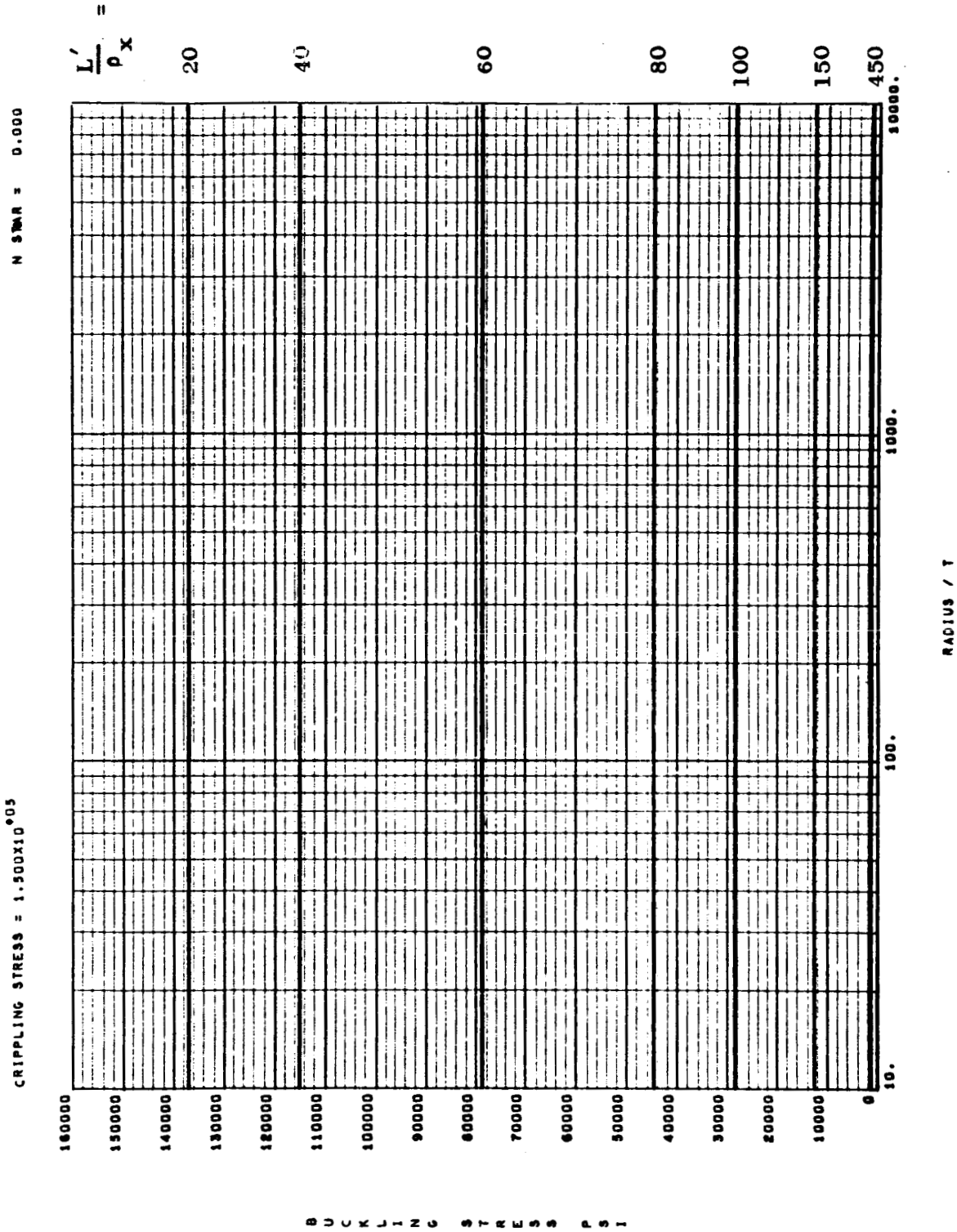


TABLE XVII - Table of Contents for Supplementary
Curves of Compressive Buckling Stress
for Longitudinally Stiffened Cylinders;
Material - 718 Nickel Alloy (Annealed
+ Double Aged) ; (Continued)

<u>Figure Number</u>	<u>Crippling Stress, σ_{cc}</u>	<u>N*</u>	<u>Page</u>
23(e)	130,000	0.8	A-96
23(f)	130,000	1.0	A-97
23(g)	130,000	1.2	A-98
23(h)	130,000	1.4	A-99
23(i)	130,000	1.6	A-100
23(j)	130,000	1.8	A-101
23(k)	130,000	2.0	A-102
24(a)	110,000	0.0	A-103
24(b)	110,000	0.2	A-104
24(c)	110,000	0.4	A-105
24(d)	110,000	0.6	A-106
24(e)	110,000	0.8	A-107
24(f)	110,000	1.0	A-108
24(g)	110,000	1.2	A-109
24(h)	110,000	1.4	A-110
24(i)	110,000	1.6	A-111
24(j)	110,000	1.8	A-112
24(k)	110,000	2.0	A-113



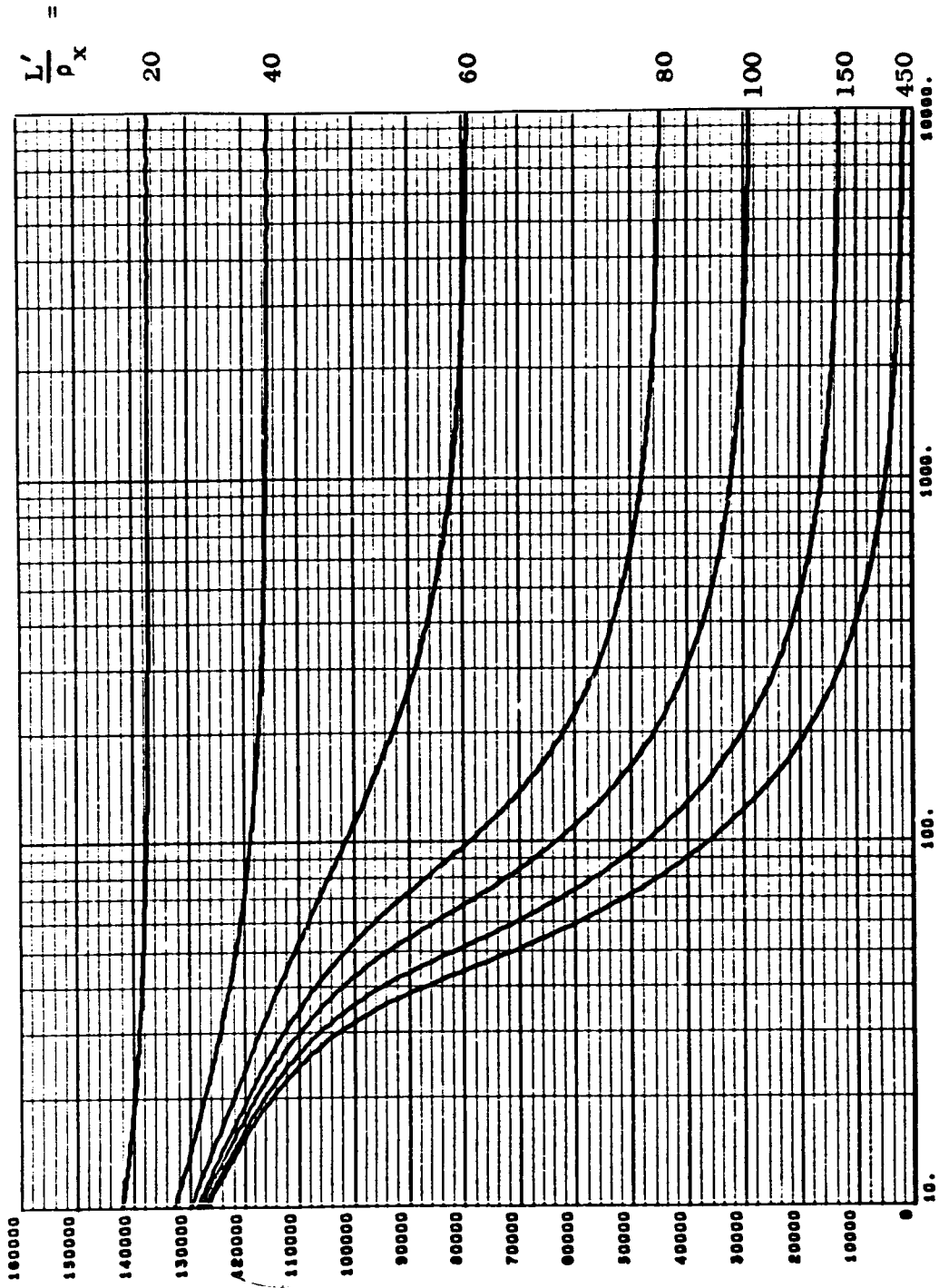


COMPRESSIVE BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 718 NICKEL ALLOY (ANNEALED + DOUBLE AGED)

Figure 22(a)

N STAY = 0.200

CRIPPLING STRESS = 1.500×10^5



B U C K L I N G S T R E S S

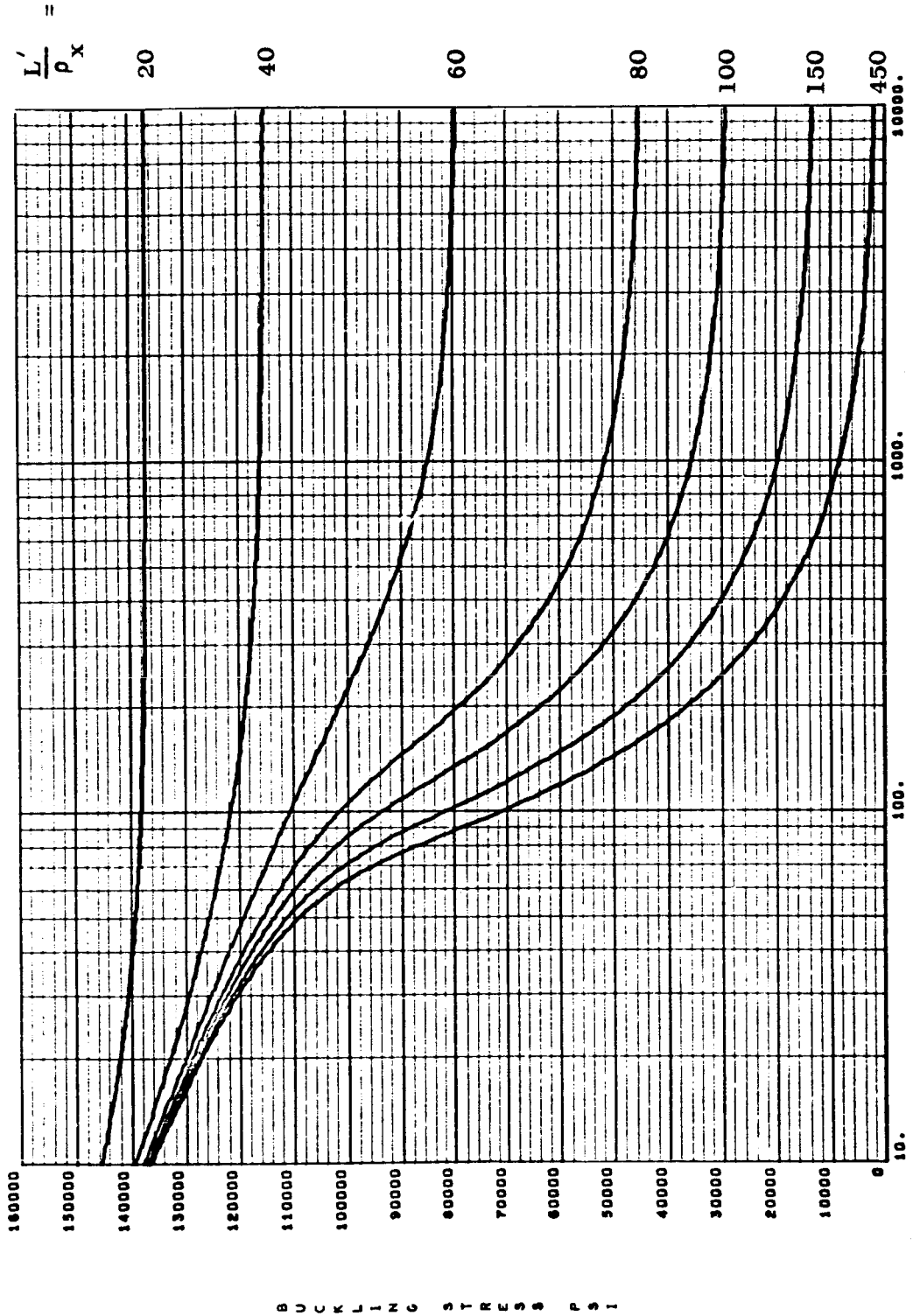
R A D I U S / T

COMPRESSIVE BUCKLING STRESS FOR
 LONGITUDINALLY STIFFENED CYLINDERS
 MATERIAL - 718 NICKEL ALLOY (ANNEALED + DOUBLE AGED)

Figure 22(b)

N STAR = 0.400

CRIPPLING STRESS = 1.500×10^4

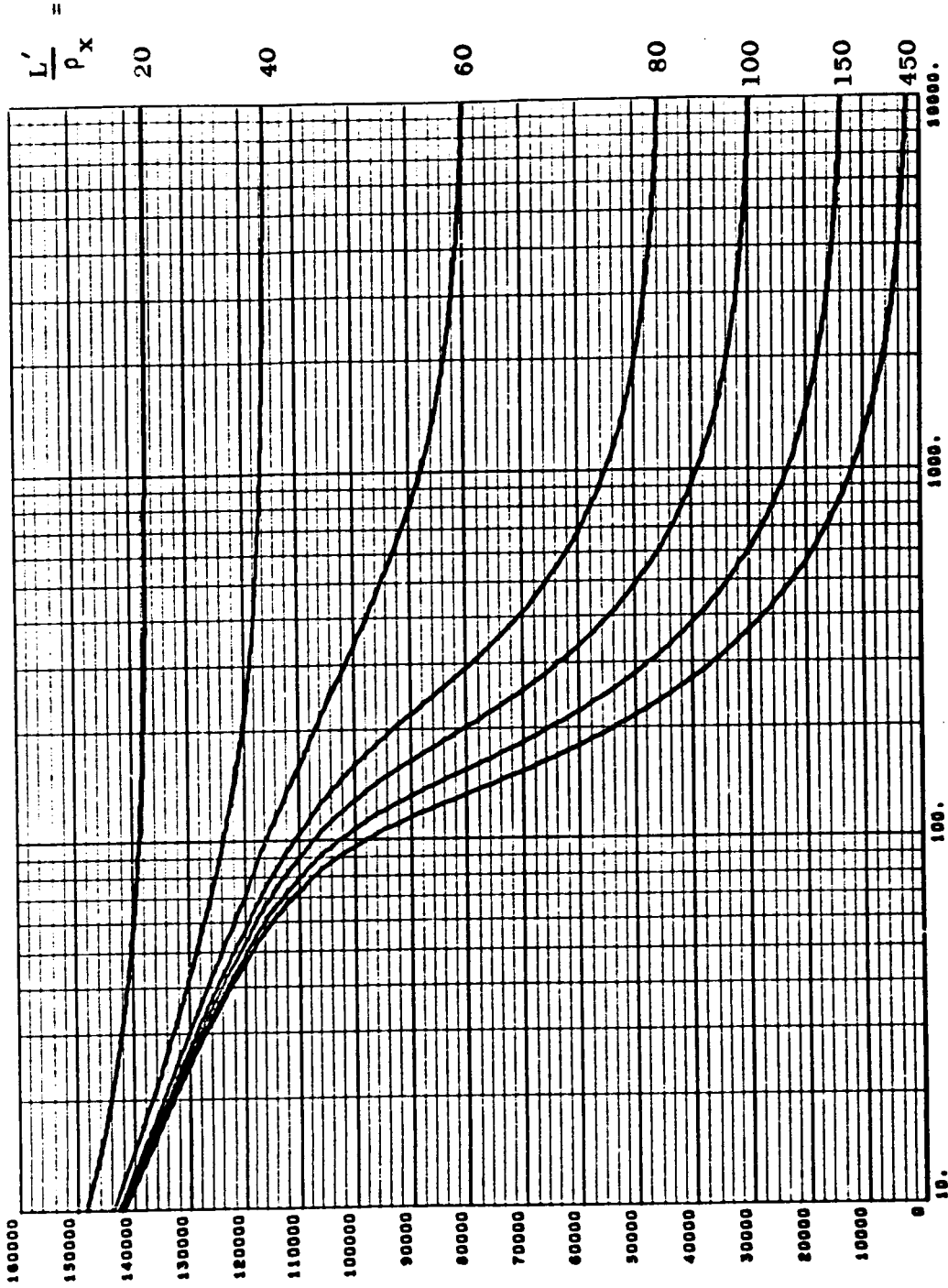


COMPRESSIVE BUCKLING STRESS FOR
 LONGITUDINALLY STIFFENED CYLINDERS
 MATERIAL - 718 NICKEL ALLOY (ANNEALED + DOUBLE AGED)

Figure 22(c)

N STAR = 0.600

CRIPPLING STRESS = $1.500 \times 10^4 \sigma_s$



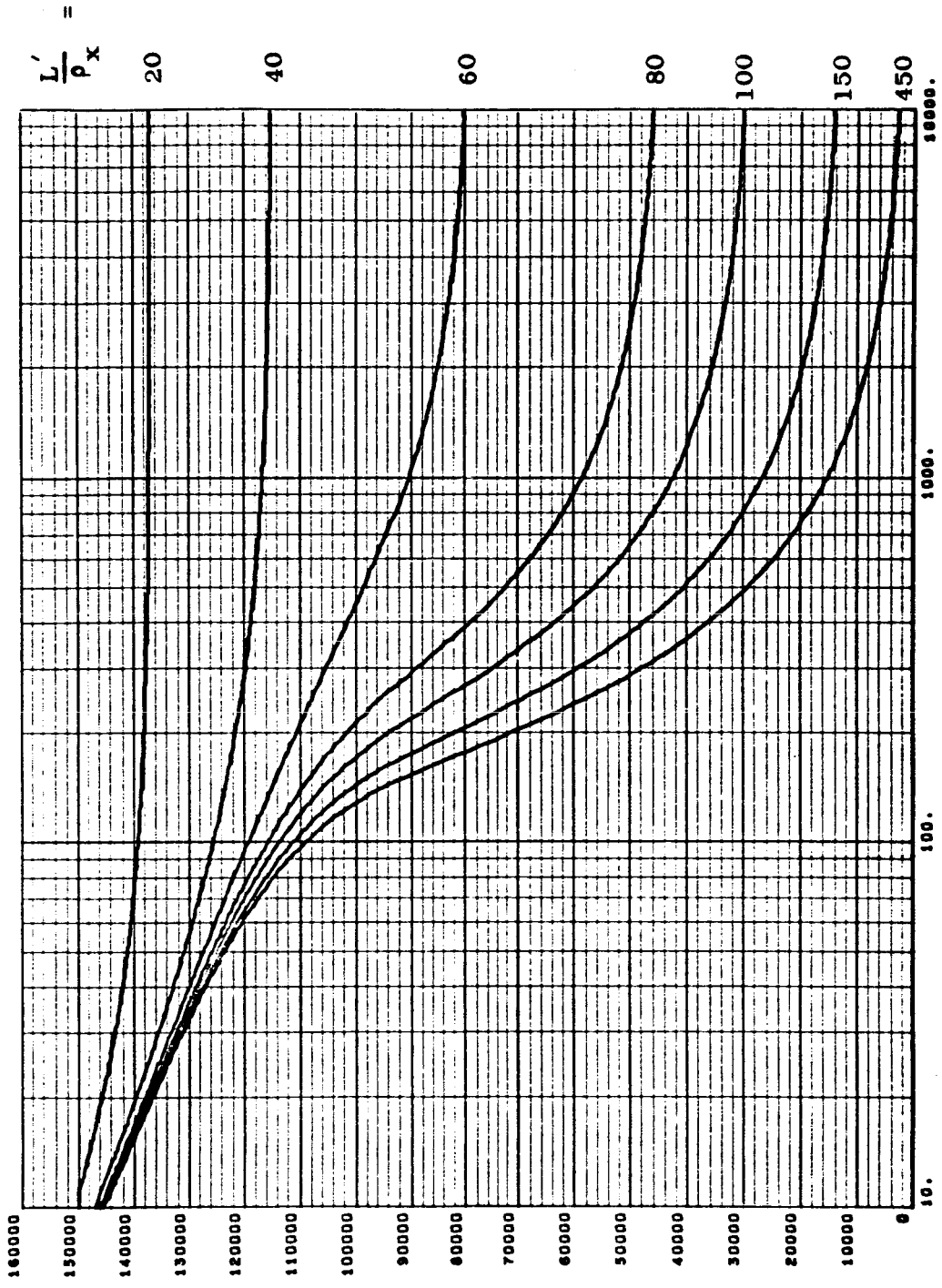
B U C K L I N G S T R E S S P S I

RADIUS / T

COMPRESSIVE BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 718 NICKEL ALLOY (ANNEALED + DOUBLE AGED)

Figure 22(d)

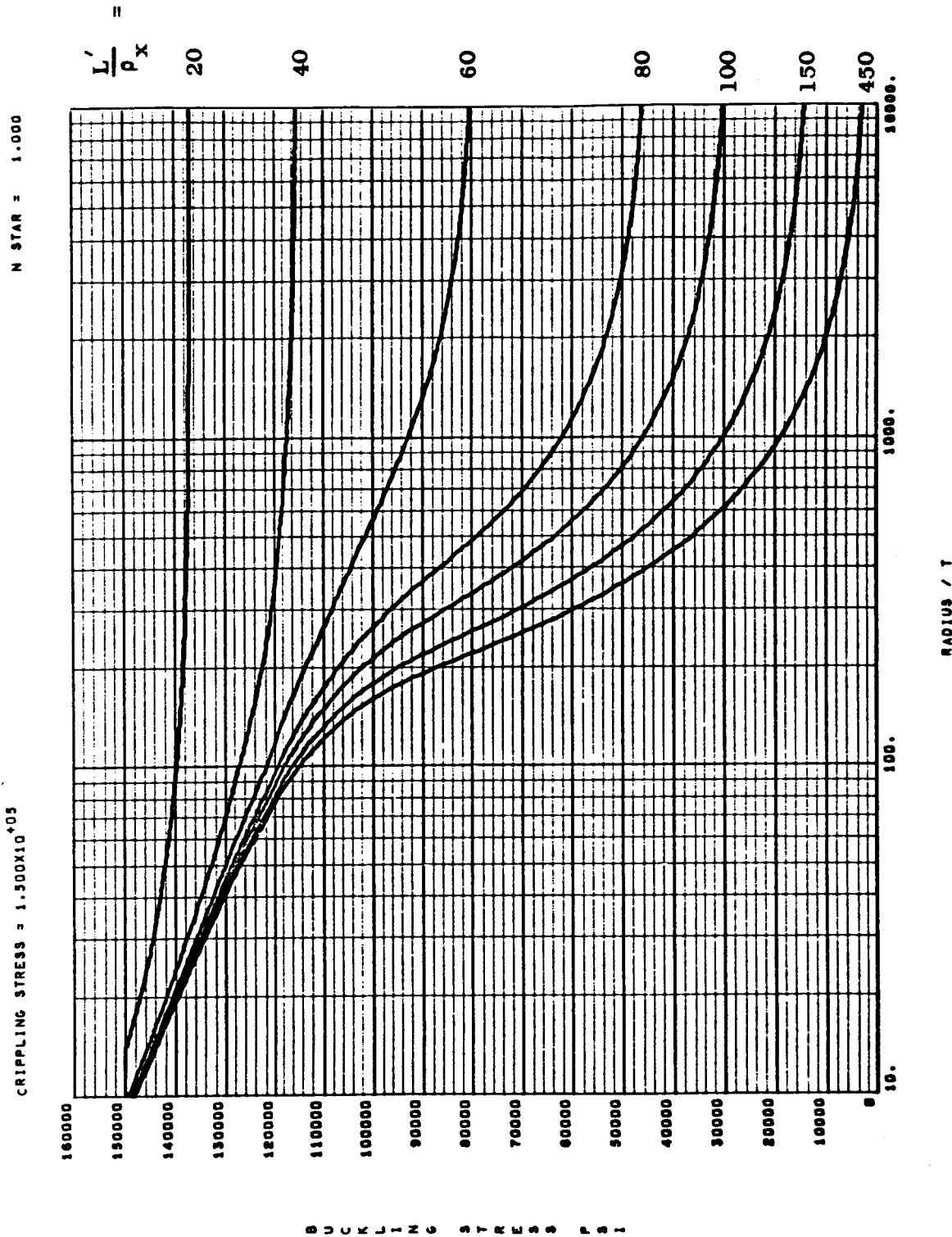
CRIPPLING STRESS = 1.500×10^4 PSI
N STAR = 0.000



B U C K L I N G S T R E S S P S I

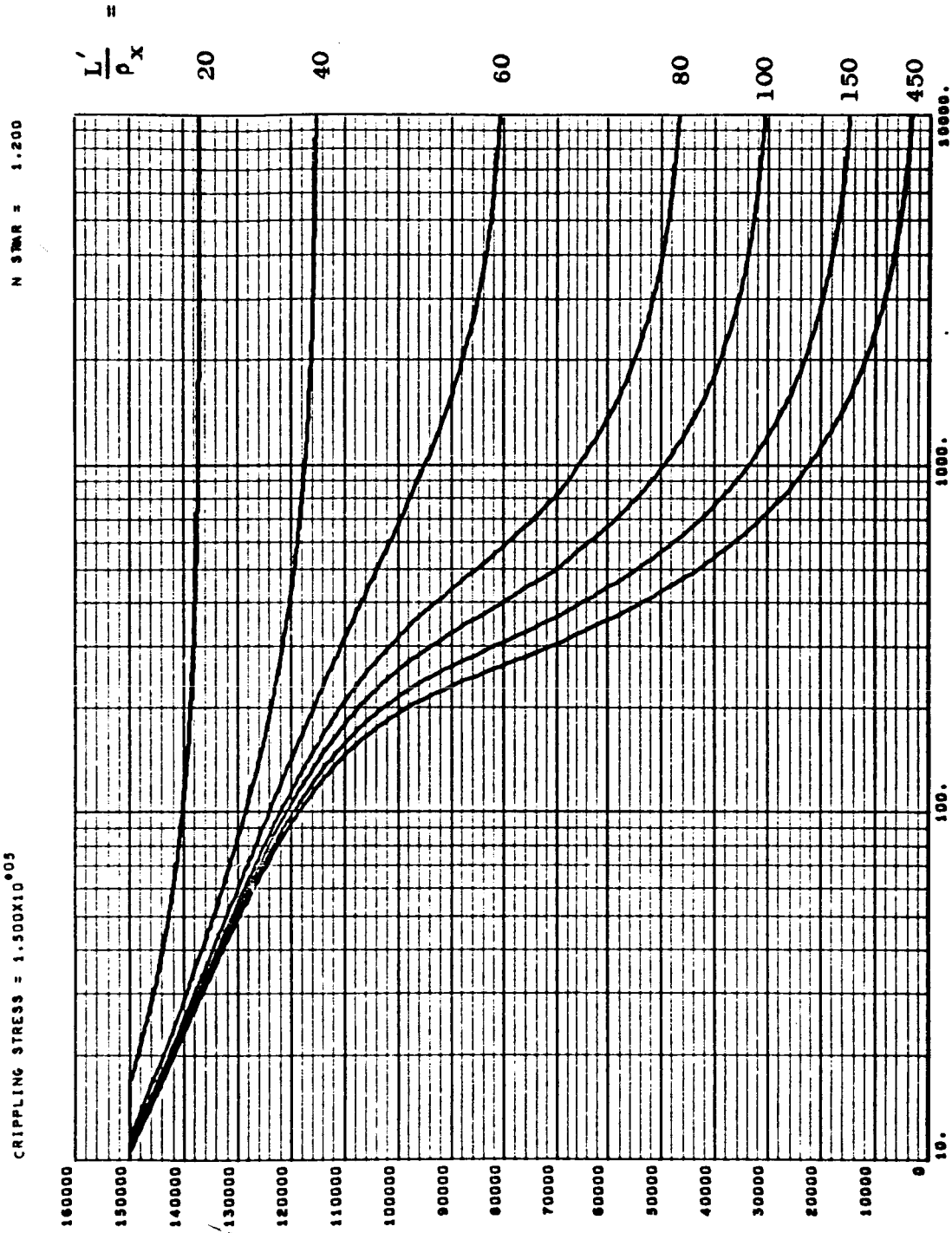
COMPRESSIVE BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 718 NICKEL ALLOY (ANNEALED + DOUBLE AGED)

Figure 22(e)



COMPRESSIVE BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 718 NICKEL ALLOY (ANNEALED + DOUBLE AGED)

Figure 22(f)

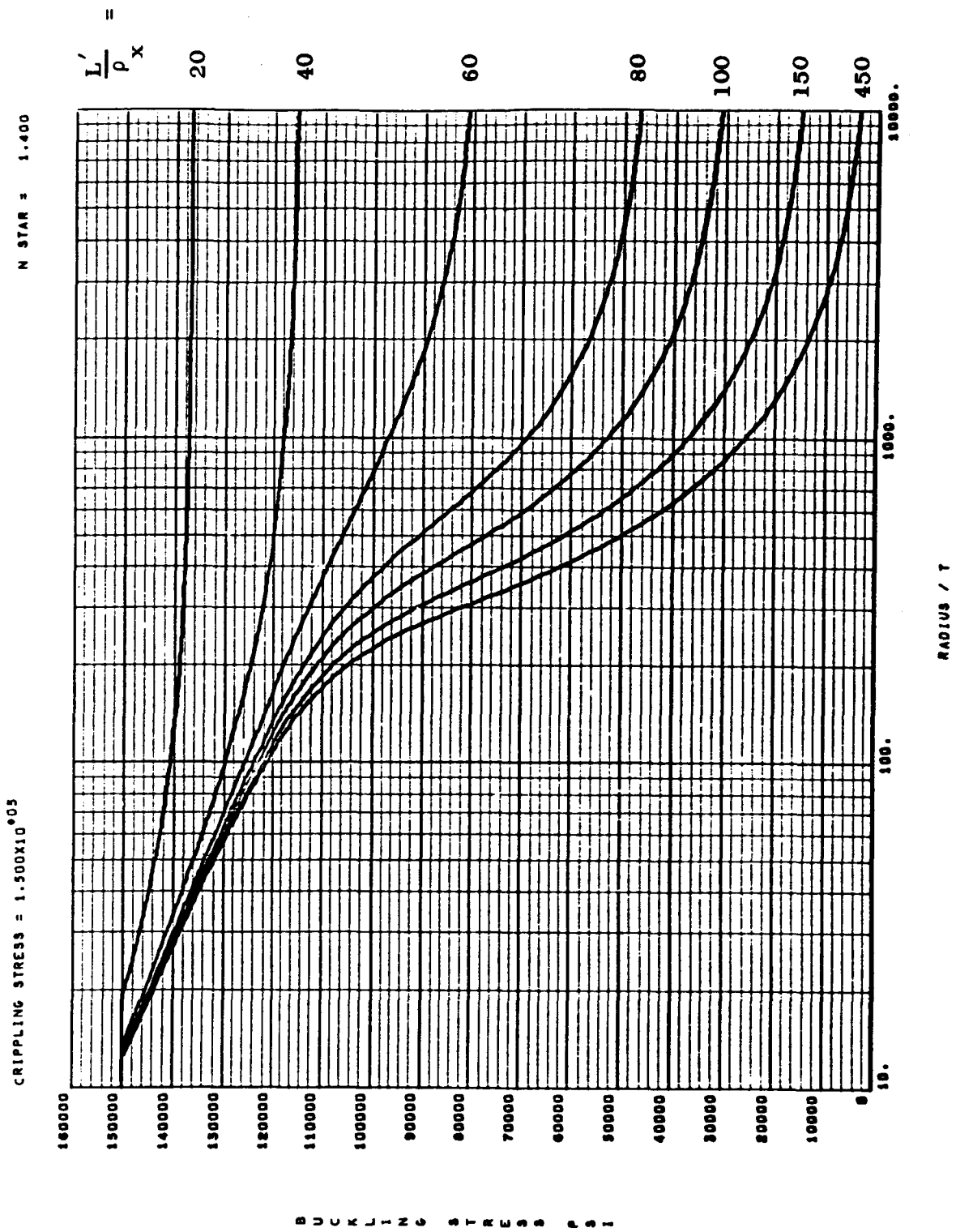


B U C K L I N G S T R E S S P L

RADIUS / r

COMPRESSIVE BUCKLING STRESS FOR
 LONGITUDINALLY STIFFENED CYLINDERS
 MATERIAL - 718 NICKEL ALLOY (ANNEALED + DOUBLE AGED)

Figure 22(g)

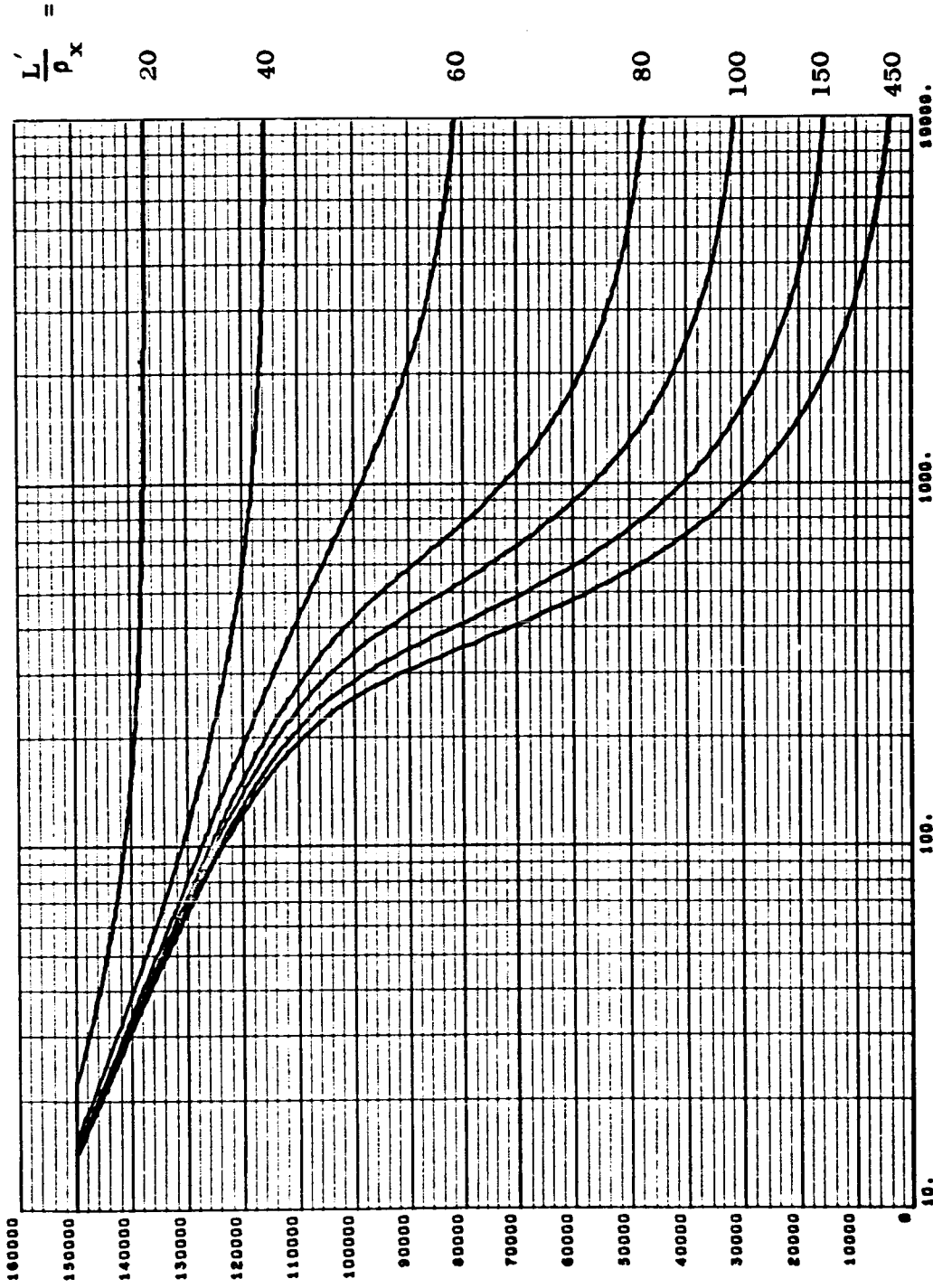


COMPRESSION BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 718 NICKEL ALLOY (ANNEALED + DOUBLE AGED)

Figure 22(h)

N STAR = 1.600

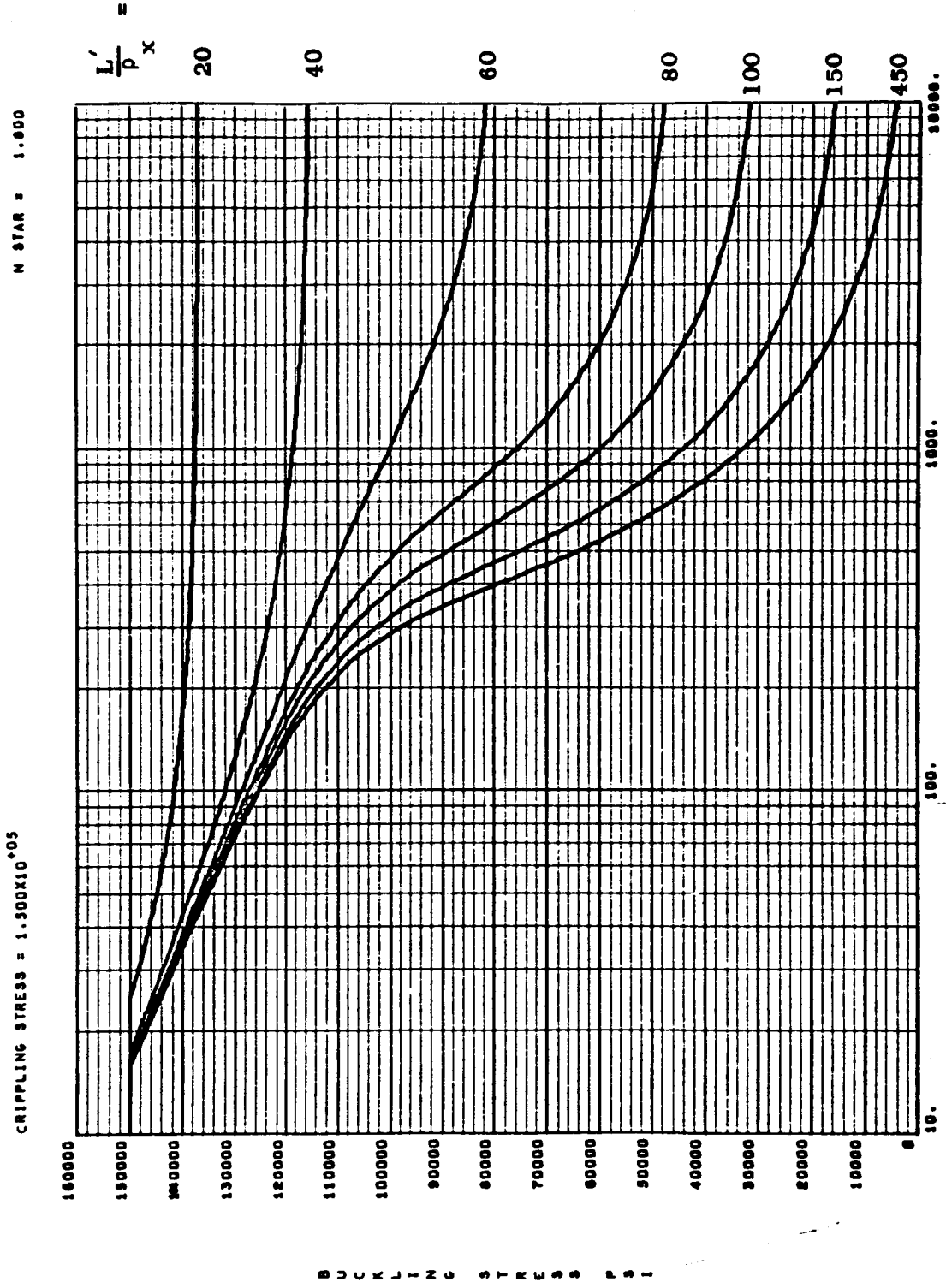
CRIPPLING STRESS = 1.500×10^{-05}



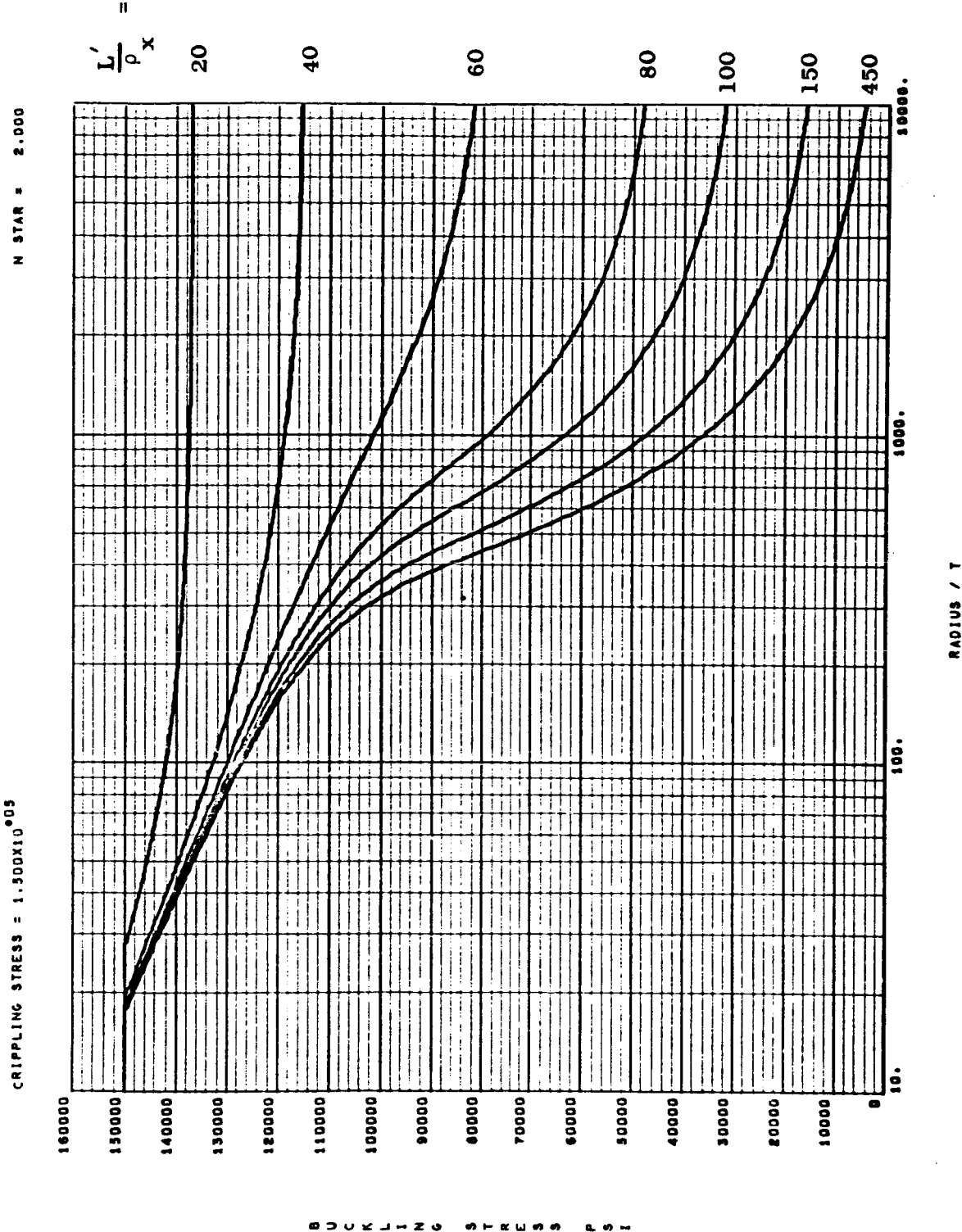
B U C K L I N G S T R E S S P L O T

COMPRESSIVE BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 718 NICKEL ALLOY (ANNEALED + DOUBLE AGED)

Figure 22(i)



COMPRESSIVE BUCKLING STRESS FOR
 LONGITUDINALLY STIFFENED CYLINDERS
 MATERIAL - 718 NICKEL ALLOY (ANNEALED + DOUBLE AGED)
 Figure 22(j)

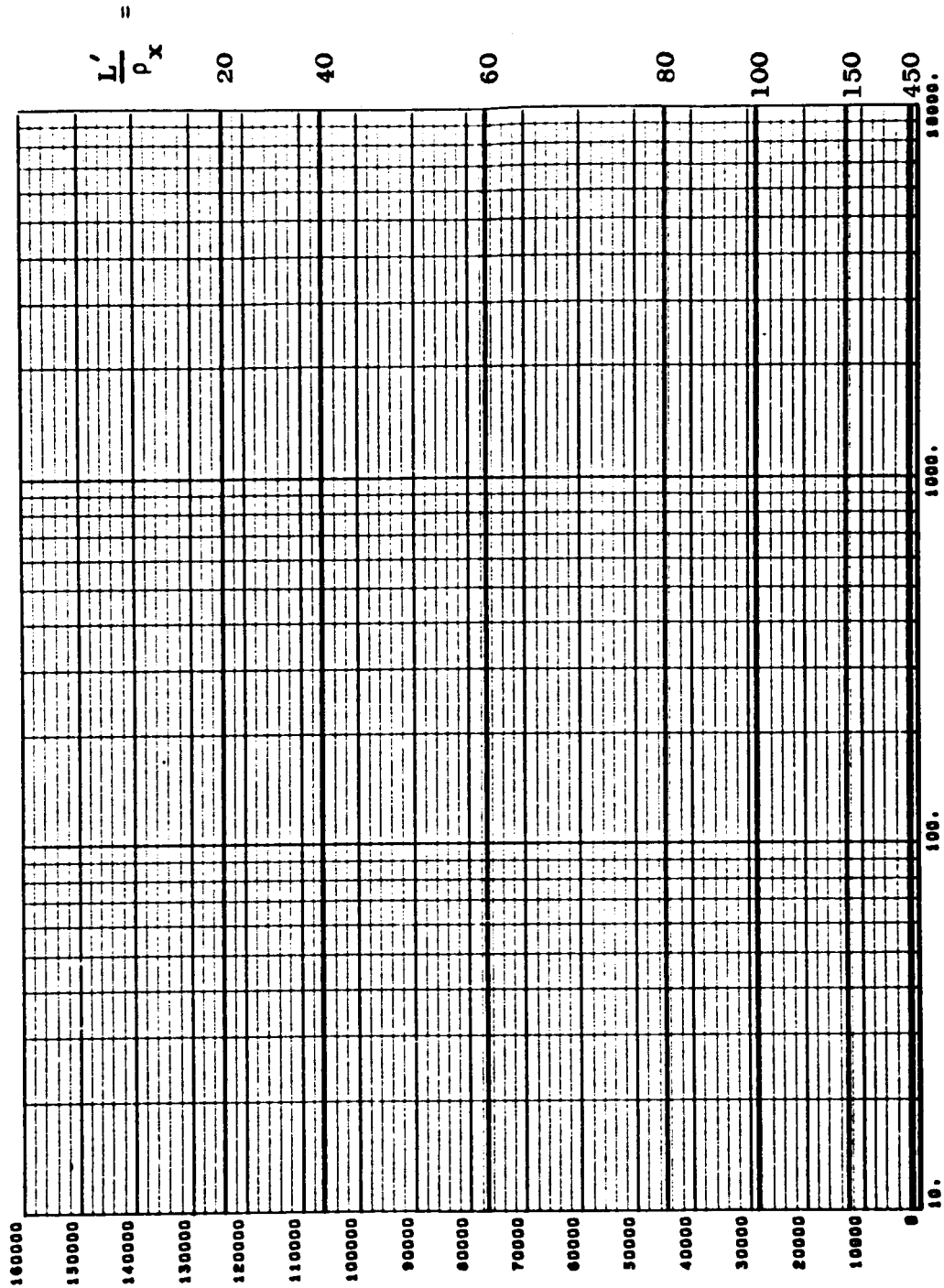


COMPRESSIVE BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 718 NICKEL ALLOY (ANNEALED + DOUBLE AGED)

Figure 22(k)

N STAR = 0.000

CRIPPLING STRESS = $1.300 \times 10^{+05}$



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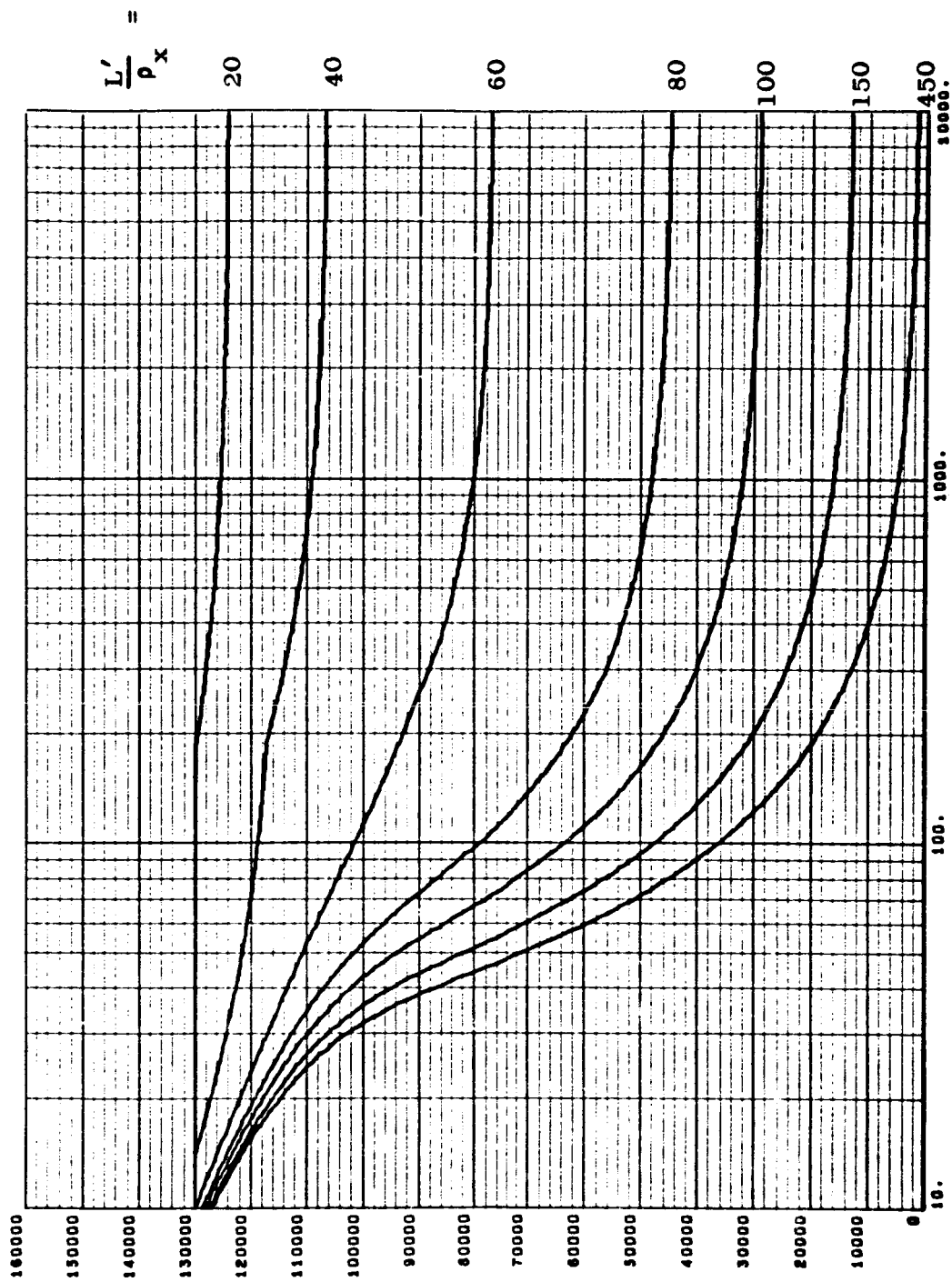
RADIUS / T

COMPRESSIVE BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL -718 NICKEL ALLOY (ANNEALED + DOUBLE AGED)

Figure 23(a)

N STAR = 0.200

CRIPPLING STRESS = 1.300×10^5



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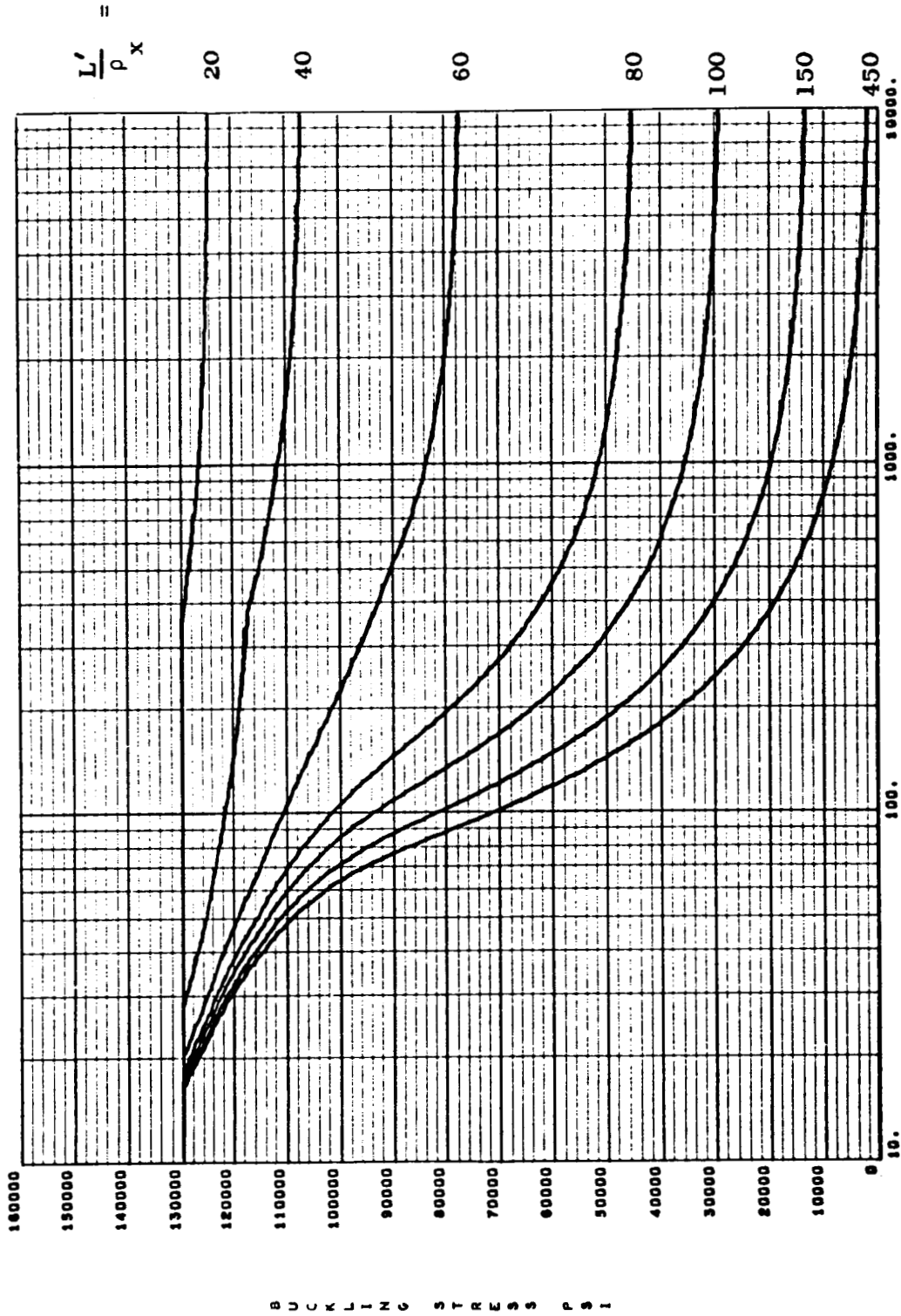
RADIUS / T

COMPRESSIVE BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 718 NICKEL ALLOY (ANNEALED + DOUBLE AGED)

Figure 23(b)

N STAR = 0.400

CRIPPLING STRESS = $1.300 \times 10^{+05}$



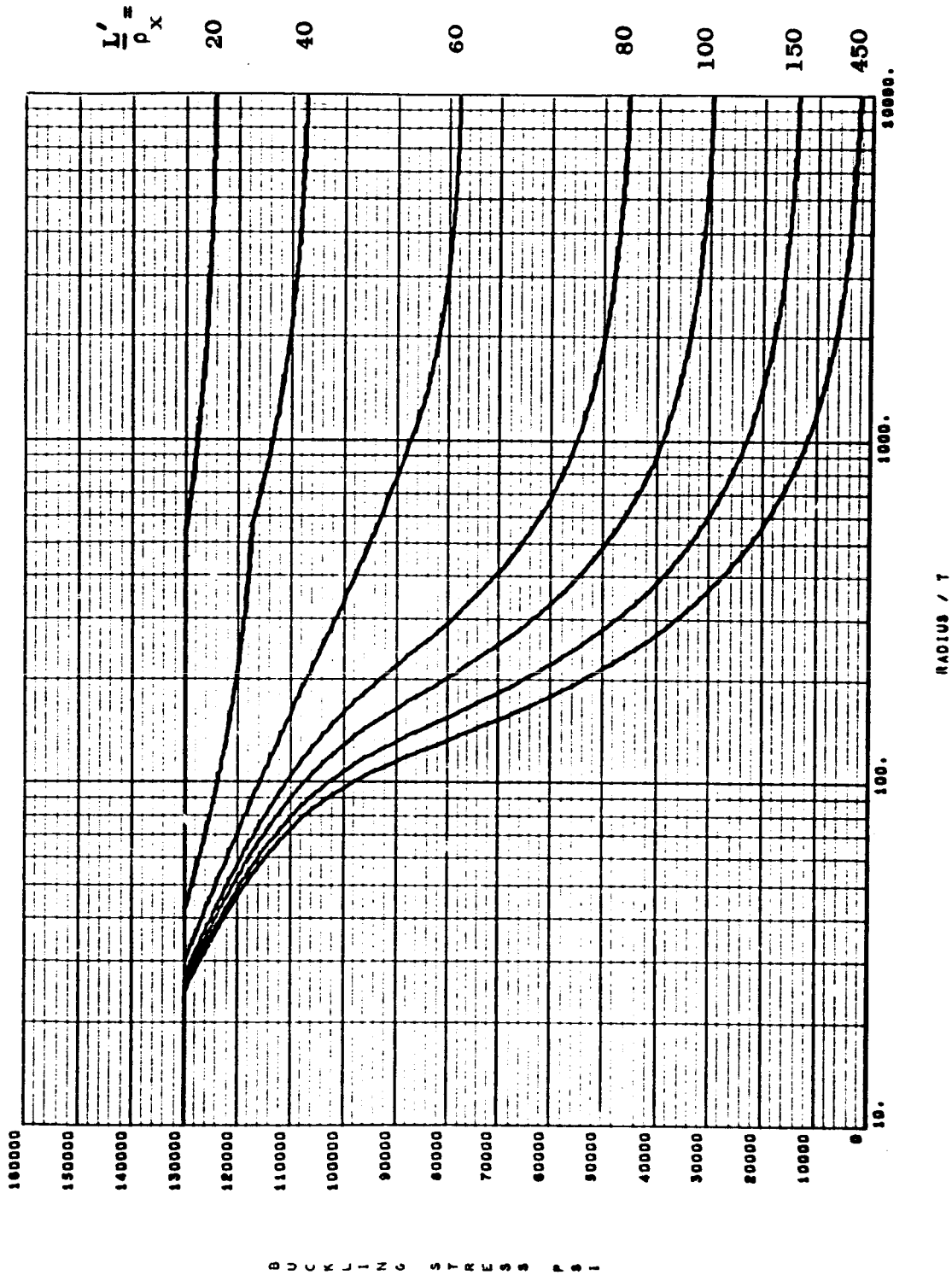
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R A D I U S / T

COMPRESSIVE BUCKLING STRESS FOR
 LONGITUDINALLY STIFFENED CYLINDERS
 MATERIAL - 718 NICKEL ALLOY (ANNEALED + DOUBLE AGED)

Figure 23(c)

CRIPPLING STRESS = 1.300×10^6 PSI
N STAR = 0.600

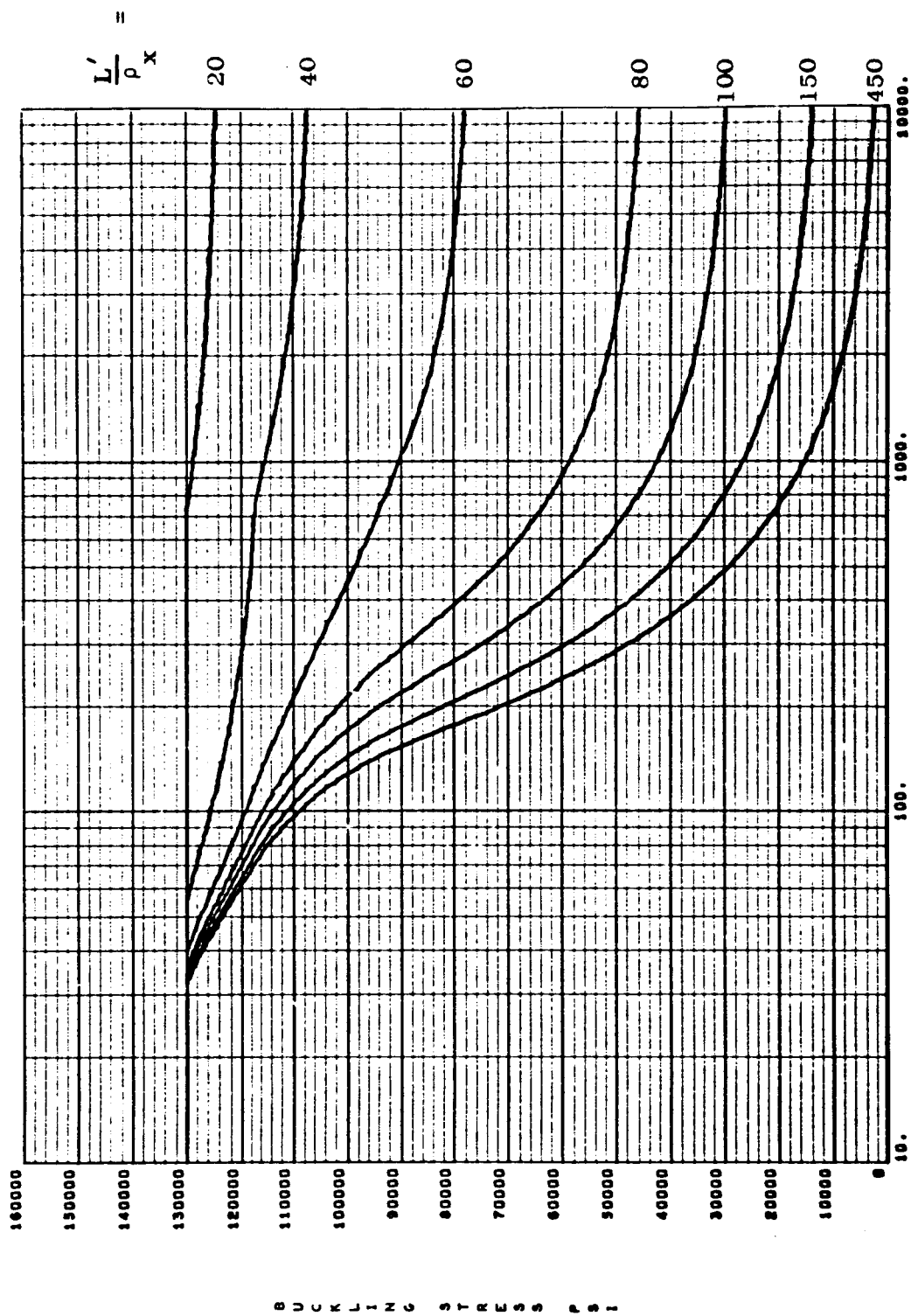


COMPRESSIVE BUCKLING STRESS FOR
 LONGITUDINALLY STIFFENED CYLINDERS
 MATERIAL - 718 NICKEL ALLOY (ANNEALED + DOUBLE AGED)

Figure 23(d)

N STAR = 0.600

CRIPPLING STRESS = $1.300 \times 10^{+05}$



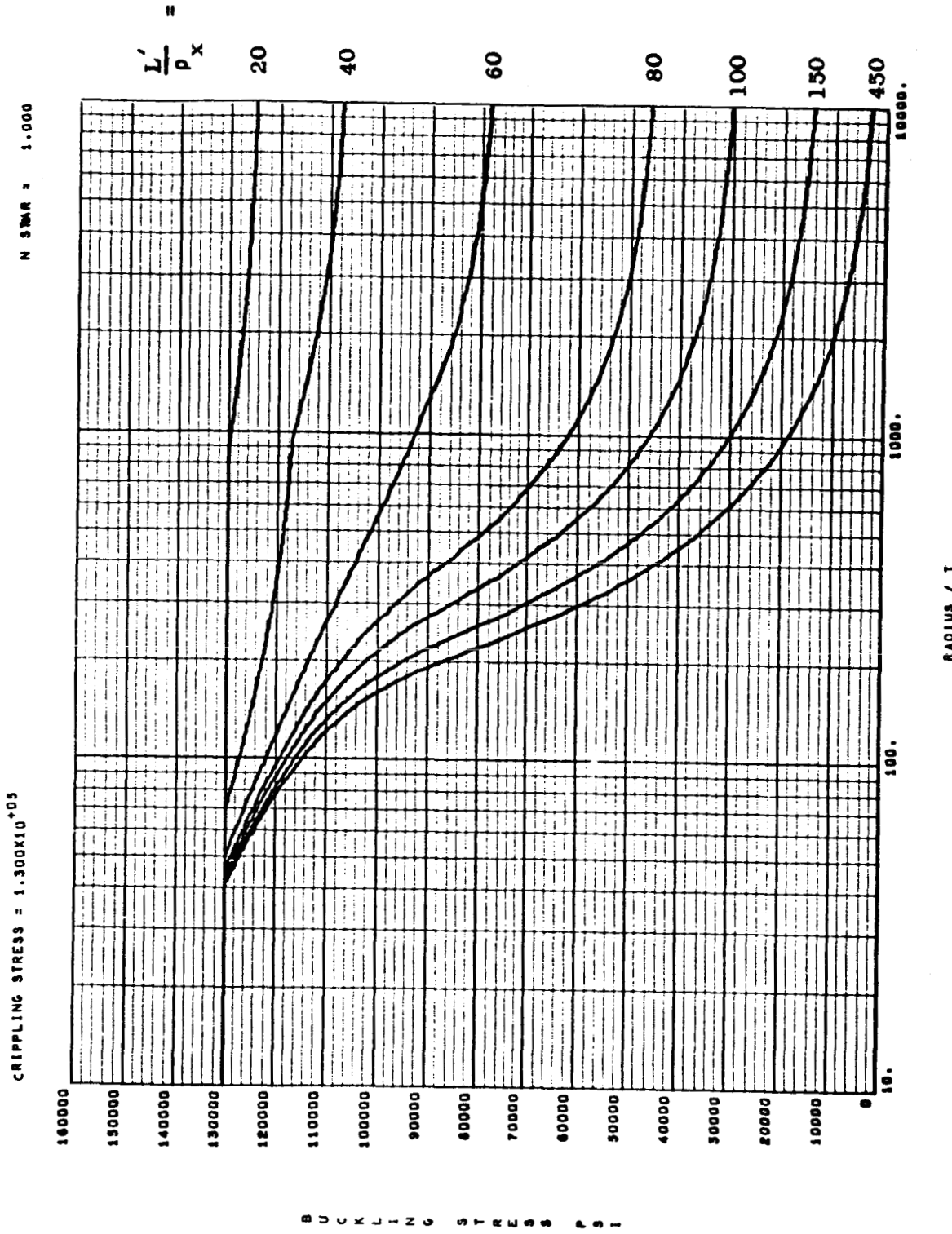
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RADIUS / T

COMPRESSIVE BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS

MATERIAL - 718 NICKEL ALLOY (ANNEALED + DOUBLE AGED)

Figure 23(e)

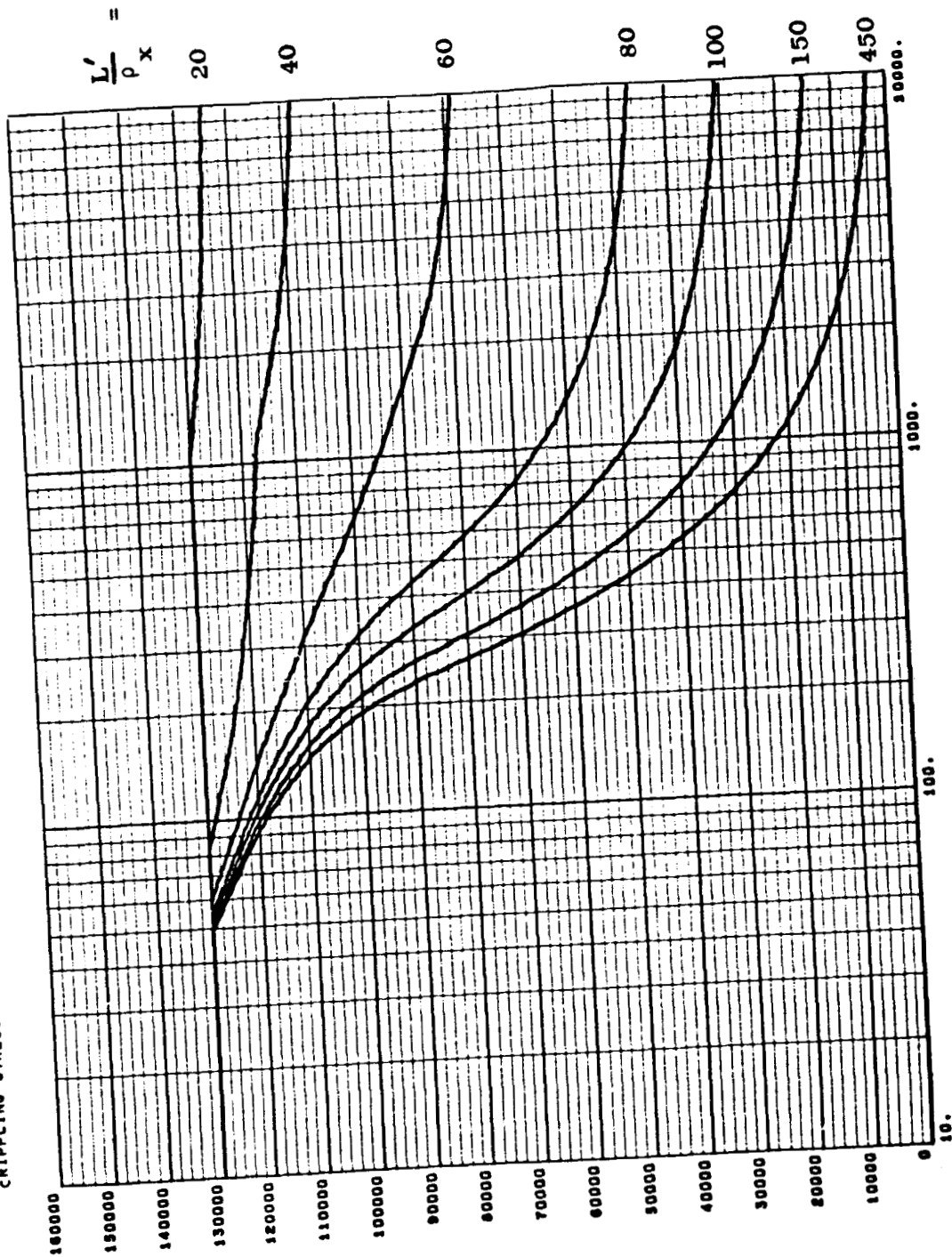


COMPRESSION BUCKLING STRESS FOR
 LONGITUDINALLY STIFFENED CYLINDERS
 MATERIAL - 718 NICKEL ALLOY (ANNEALED + DOUBLE AGED)

Figure 23(f)

N STAR = 1.200

CRIPPLING STRESS = 1.300×10^{10} DYNES

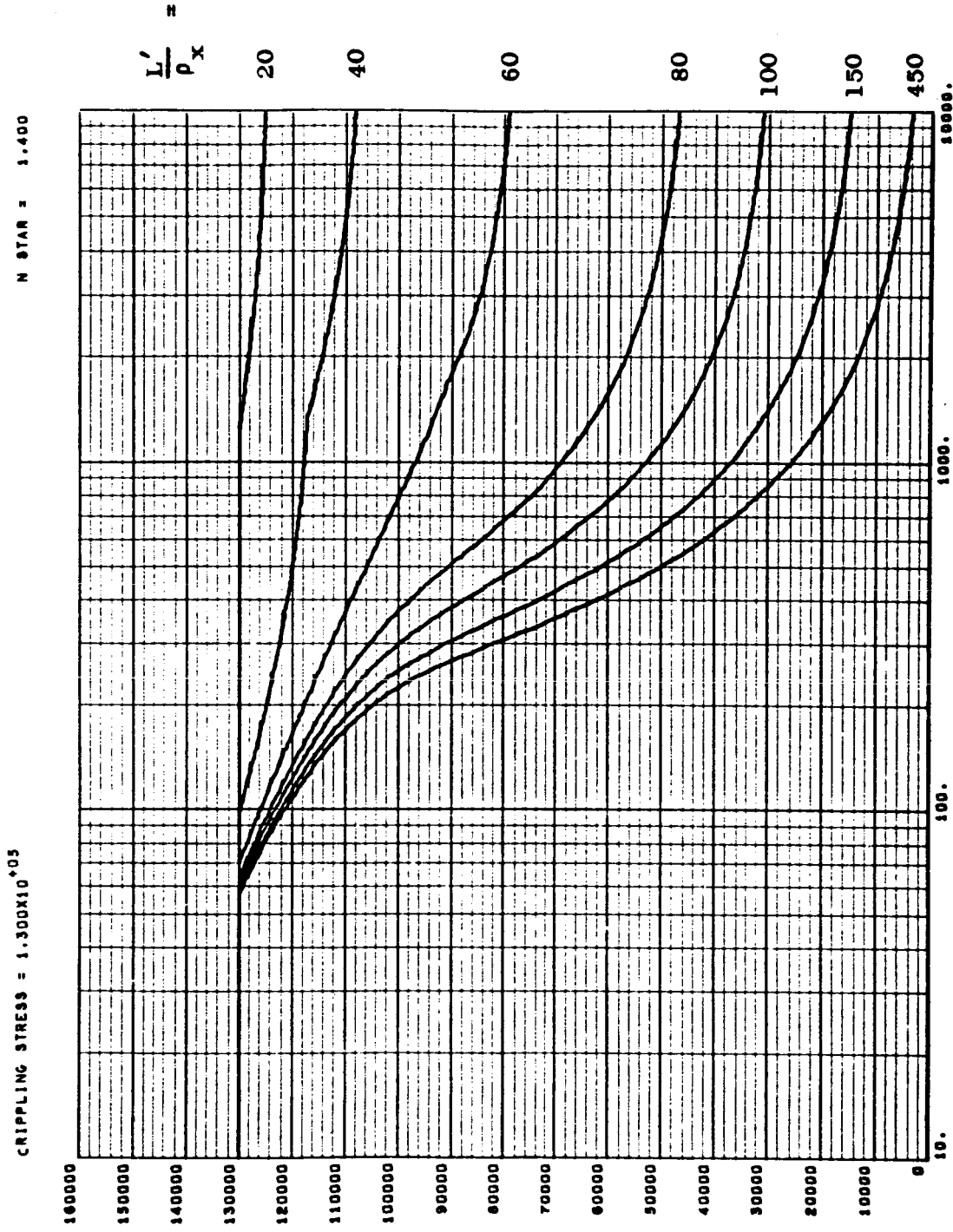


BUCKLING STRESS

RADIUS / T

COMPRESSIVE BUCKLING STRESS FOR LONGITUDINALLY STIFFENED CYLINDERS MATERIAL - 718 NICKEL ALLOY (ANNEALED + DOUBLE AGED)

Figure 23(g)

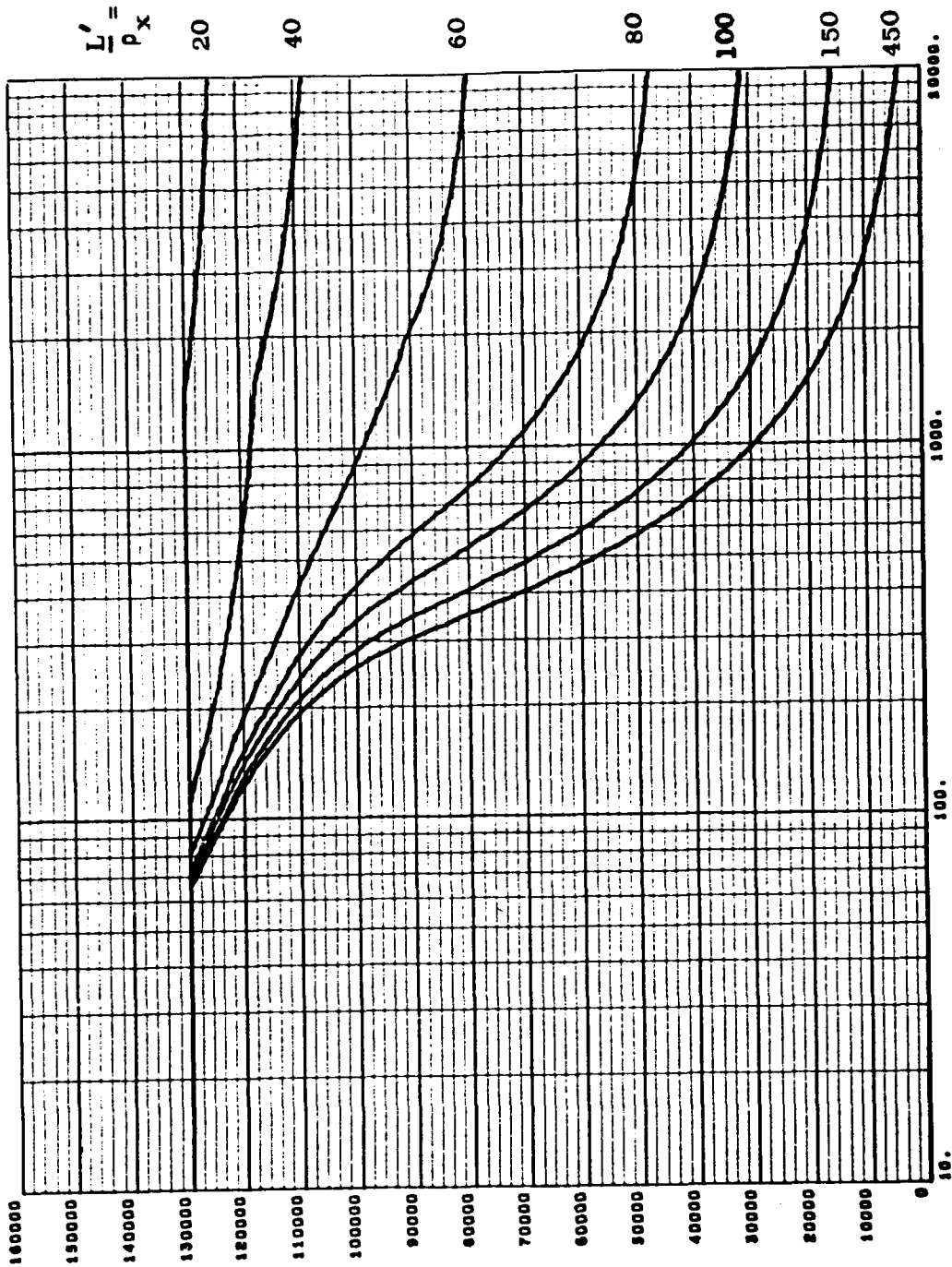


COMPRESSION BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 718 NICKEL ALLOY (ANNEALED + DOUBLE AGED)

Figure 23(h)

N STAR = 1.600

CRIPPLING STRESS = 1.300×10^6 PSI



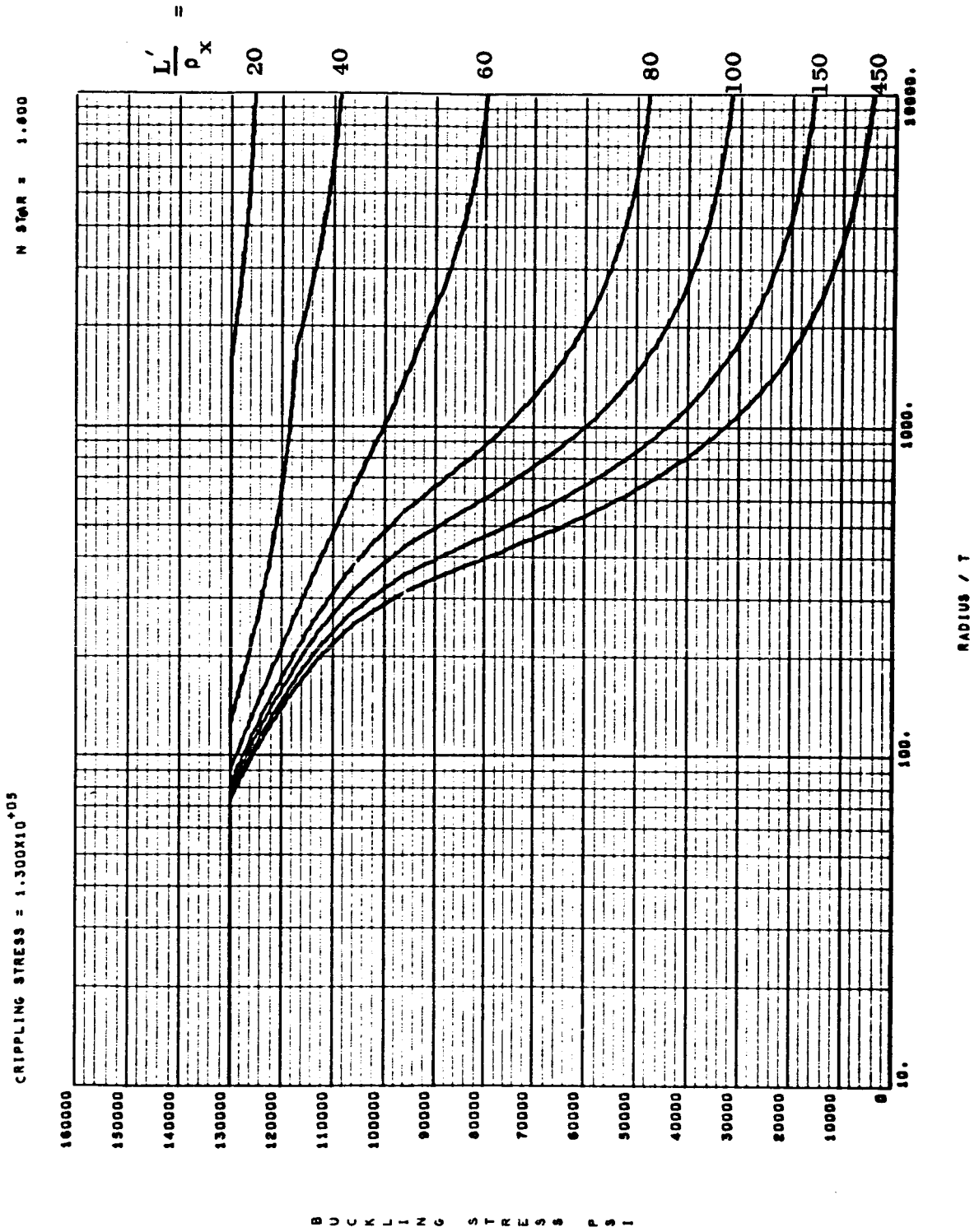
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RADIUS / T

COMPRESSIVE BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS

MATERIAL - 718 NICKEL ALLOY (ANNEALED + DOUBLE AGED)

Figure 23(i)

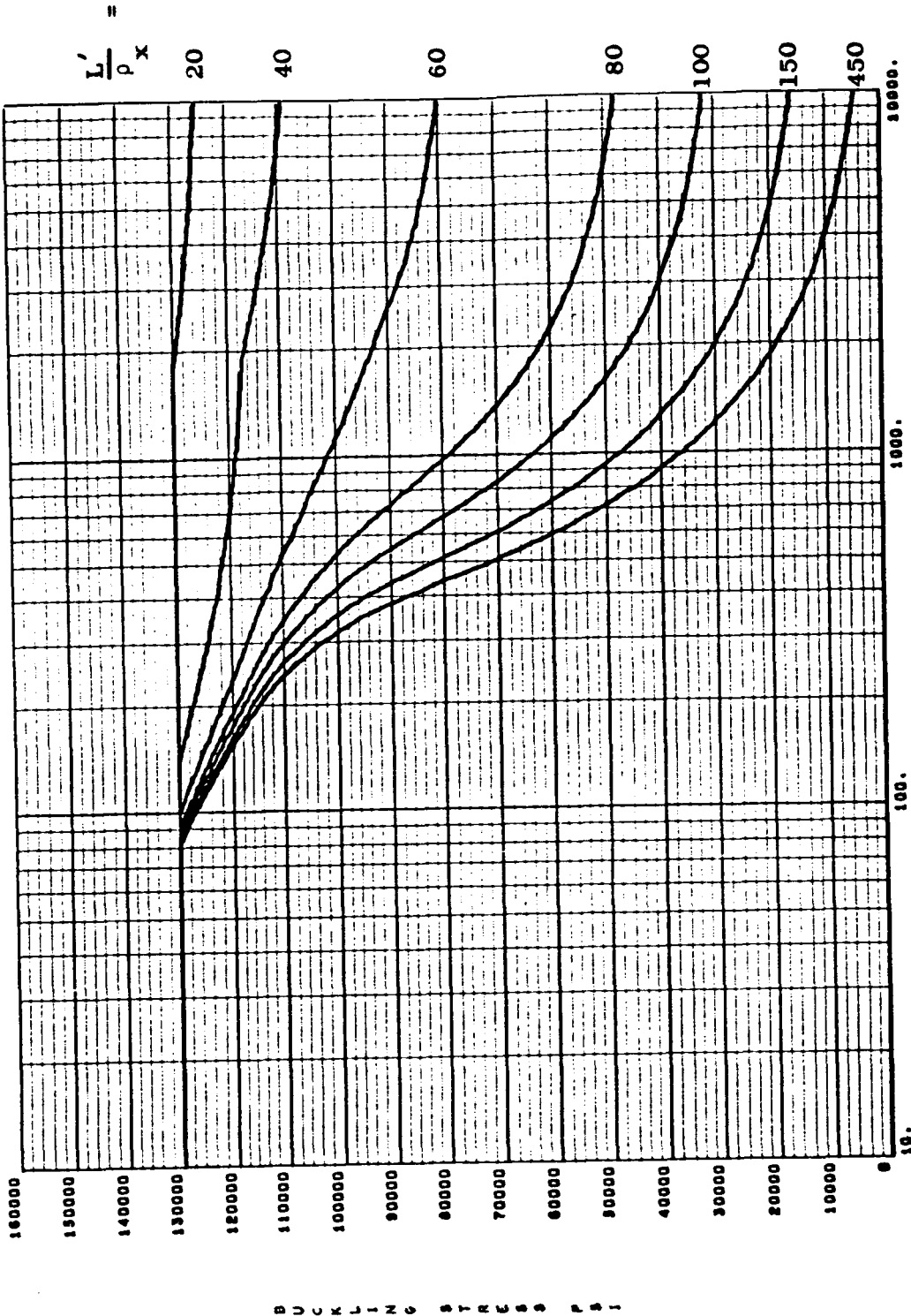


COMPRESSION BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 718 NICKEL ALLOY (ANNEALED + DOUBLE AGED)

Figure 23(j)

N STAR = 2.000

CRIPPLING STRESS = 1.300×10^{-5}

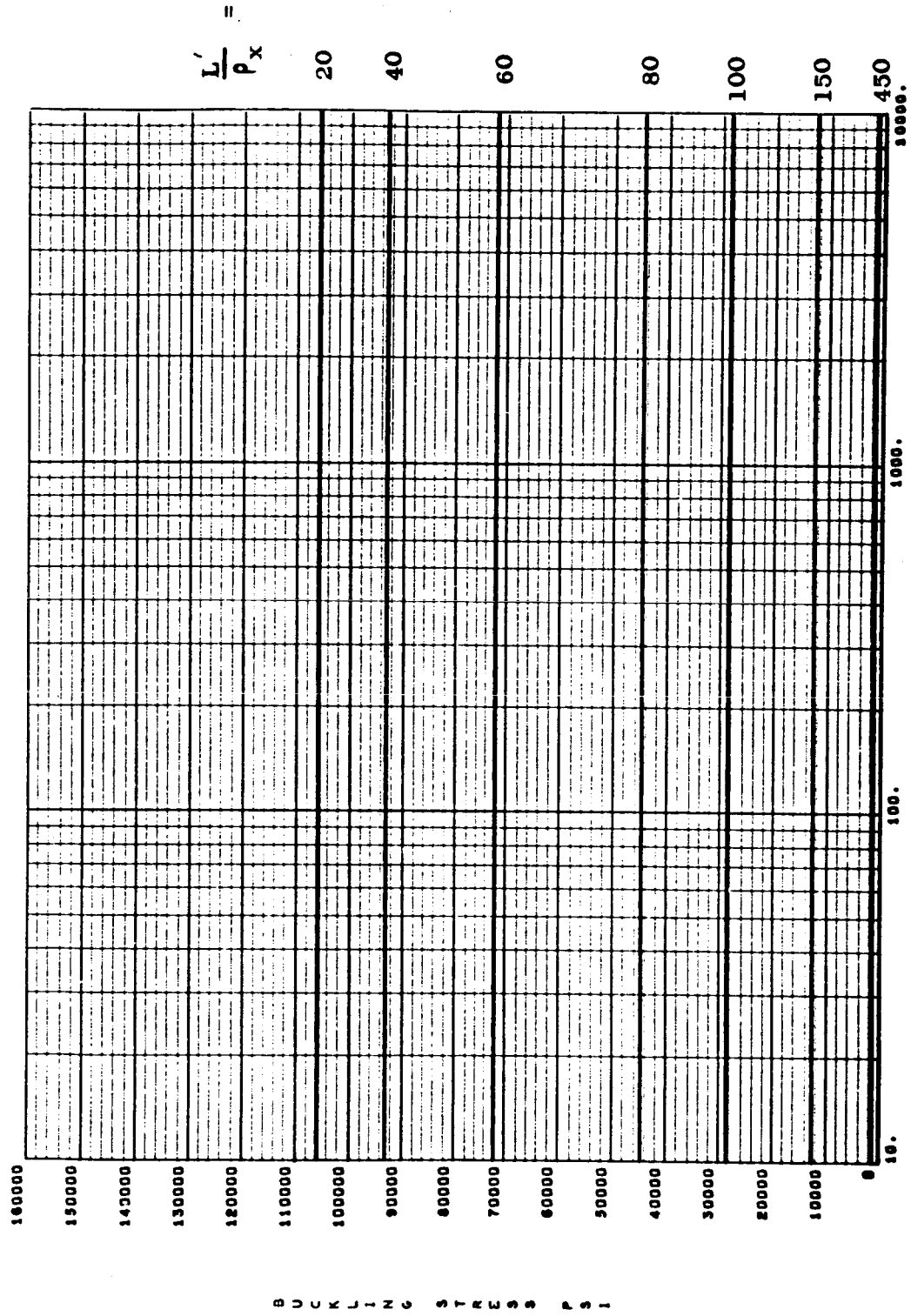


RADIUS / T

COMPRESSIVE BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 718 NICKEL ALLOY (ANNEALED + DOUBLE AGED)

Figure 25(k)

CRIPPLING STRESS = $1.100 \times 10^{+05}$ N STAR = 0.000



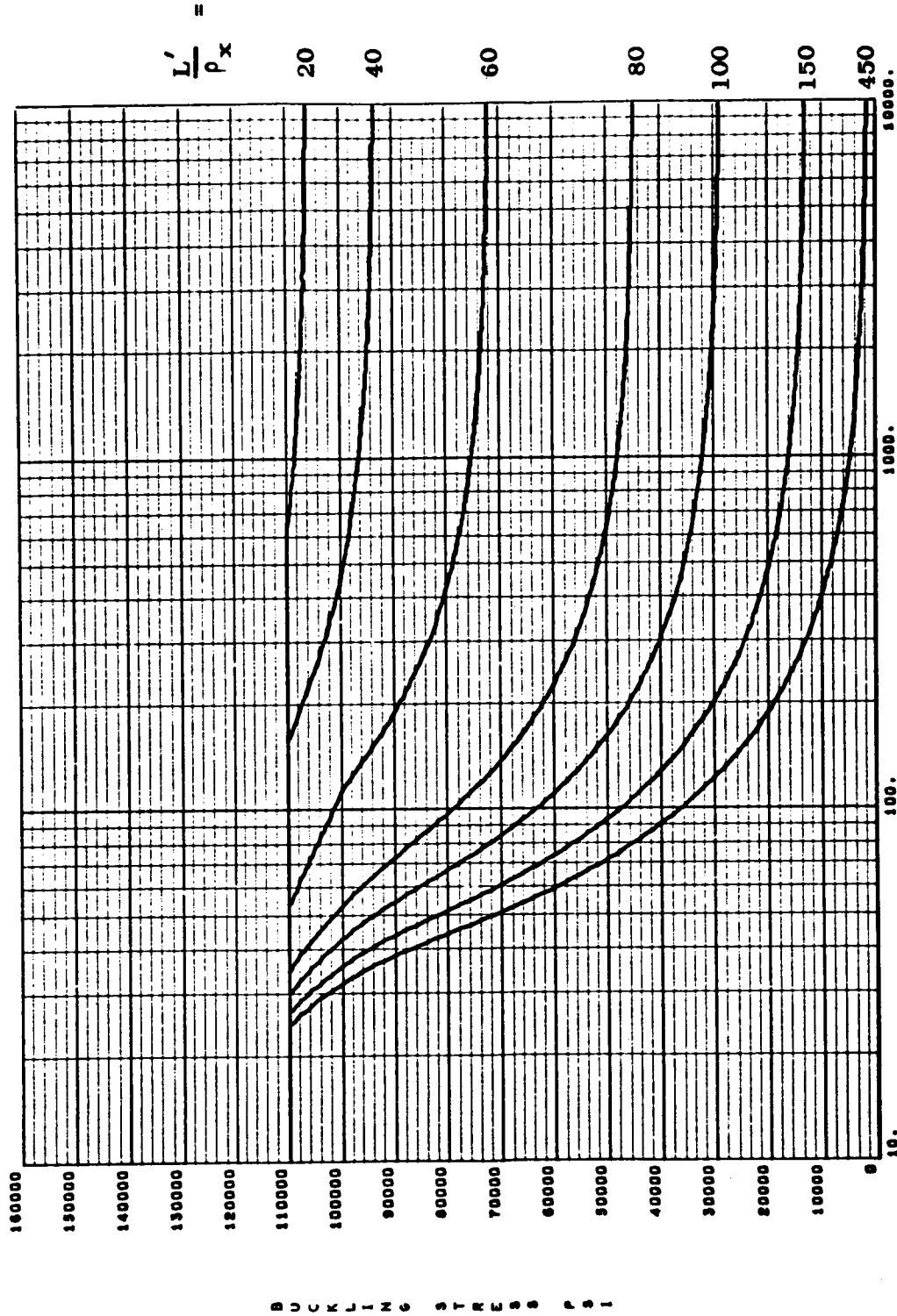
RADIUS / T

**COMPRESSIVE BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 718 NICKEL ALLOY (ANNEALED + DOUBLE AGED)**

Figure 24(a)

M STAR = 0.200

CRIPPLING STRESS = 1.100×10^6 MDS

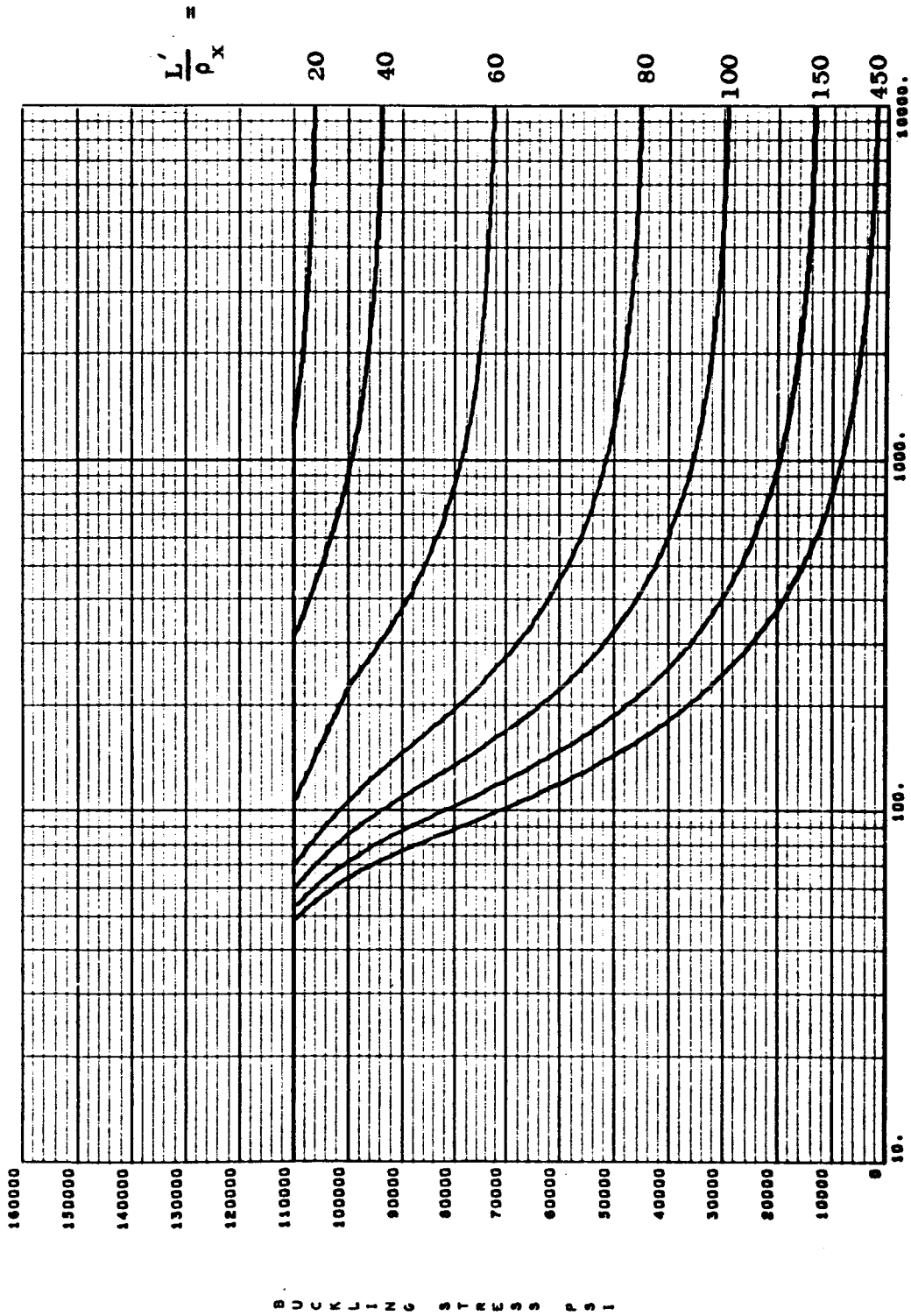


COMPRESSIVE BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 718 NICKEL ALLOY (ANNEALED + DOUBLE AGED)

Figure 24(b)

N STAR = 0.400

CRIPPLING STRESS = 1.100×10^{10}

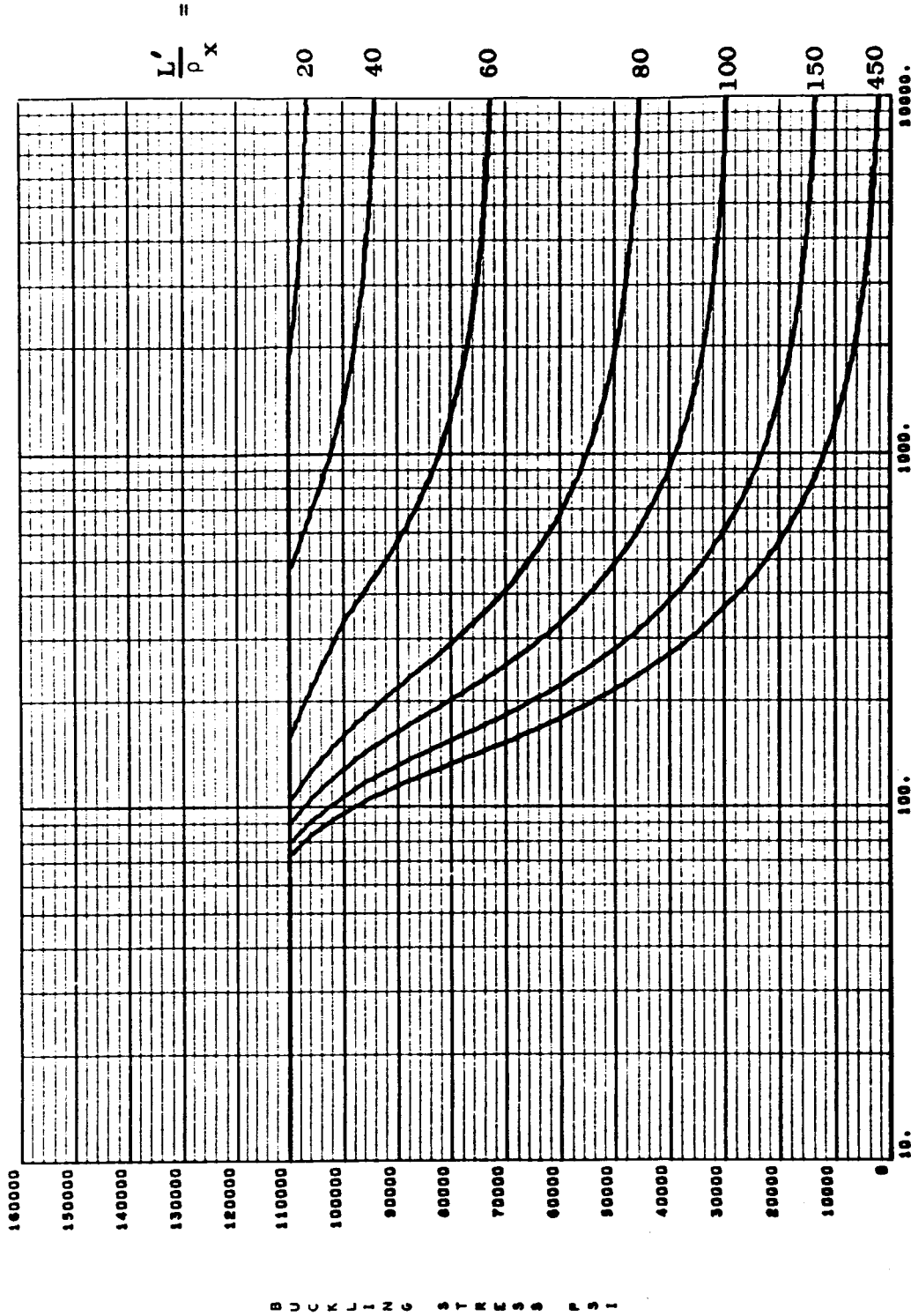


COMPRESSIVE BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 718 NICKEL ALLOY (ANNEALED + DOUBLE AGED)

Figure 24(c)

N STAR = 0.600

CRIPPLING STRESS = 1.100×10^{10}



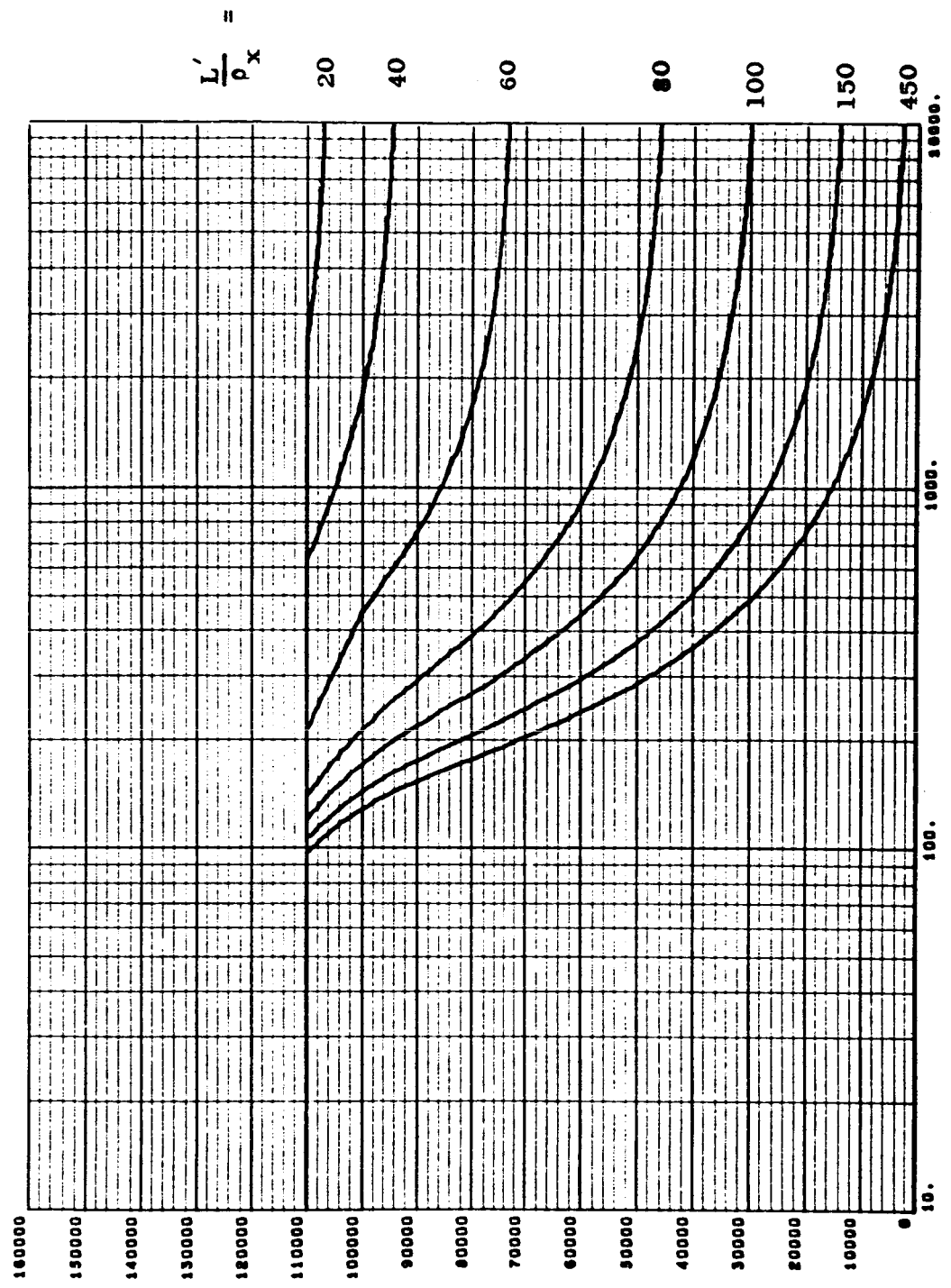
RADIUS / T

COMPRESSIVE BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 718 NICKEL ALLOY (ANNEALED + DOUBLE AGED)

Figure 24(d)

CRIPPLING STRESS = 1.100×10^{10} + 05

N STAR = 0.000



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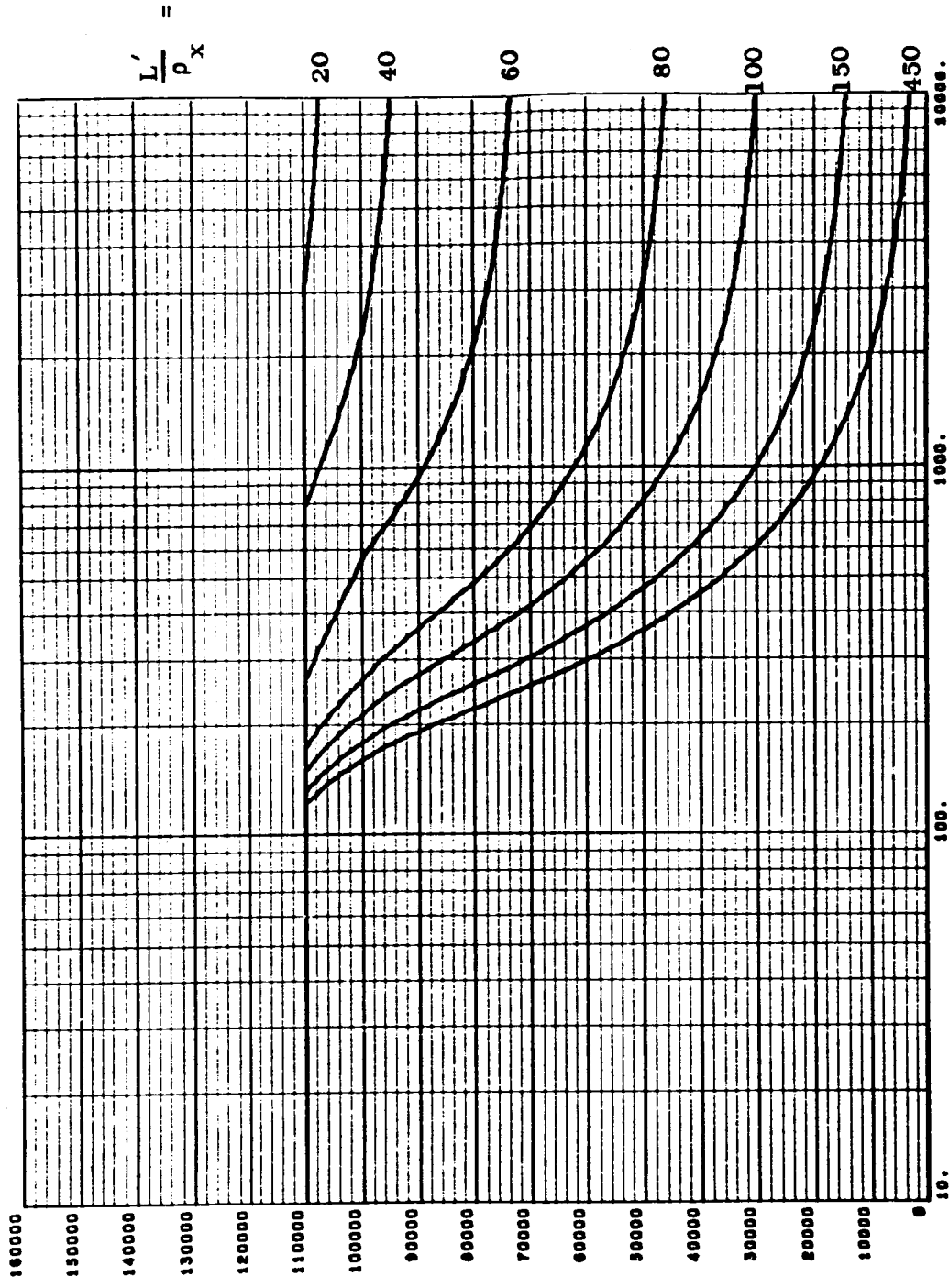
RADIUS / T

COMPRESSIVE BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 718 NICKEL ALLOY (ANNEALED + DOUBLE AGED)

Figure 24(e)

N STAR = 1.000

CRIPPLING STRESS = 1.100×10^{10}



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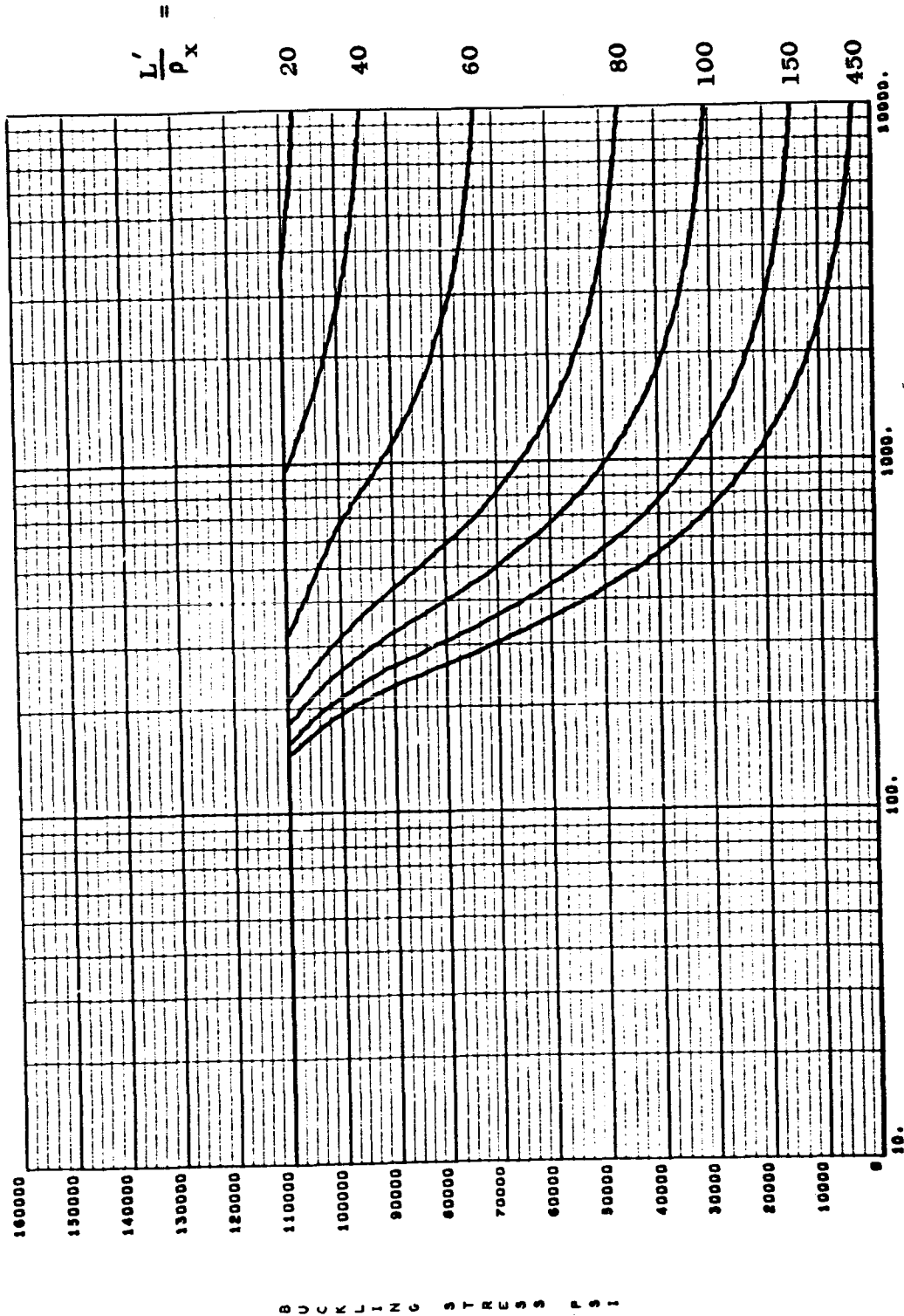
RADIUS / T

COMPRESSIVE BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL -718 NICKEL ALLOY (ANNEALED + DOUBLE AGED)

Figure 24(f)

N STAR = 1.200

CRIPPLING STRESS = 1.100×10^5

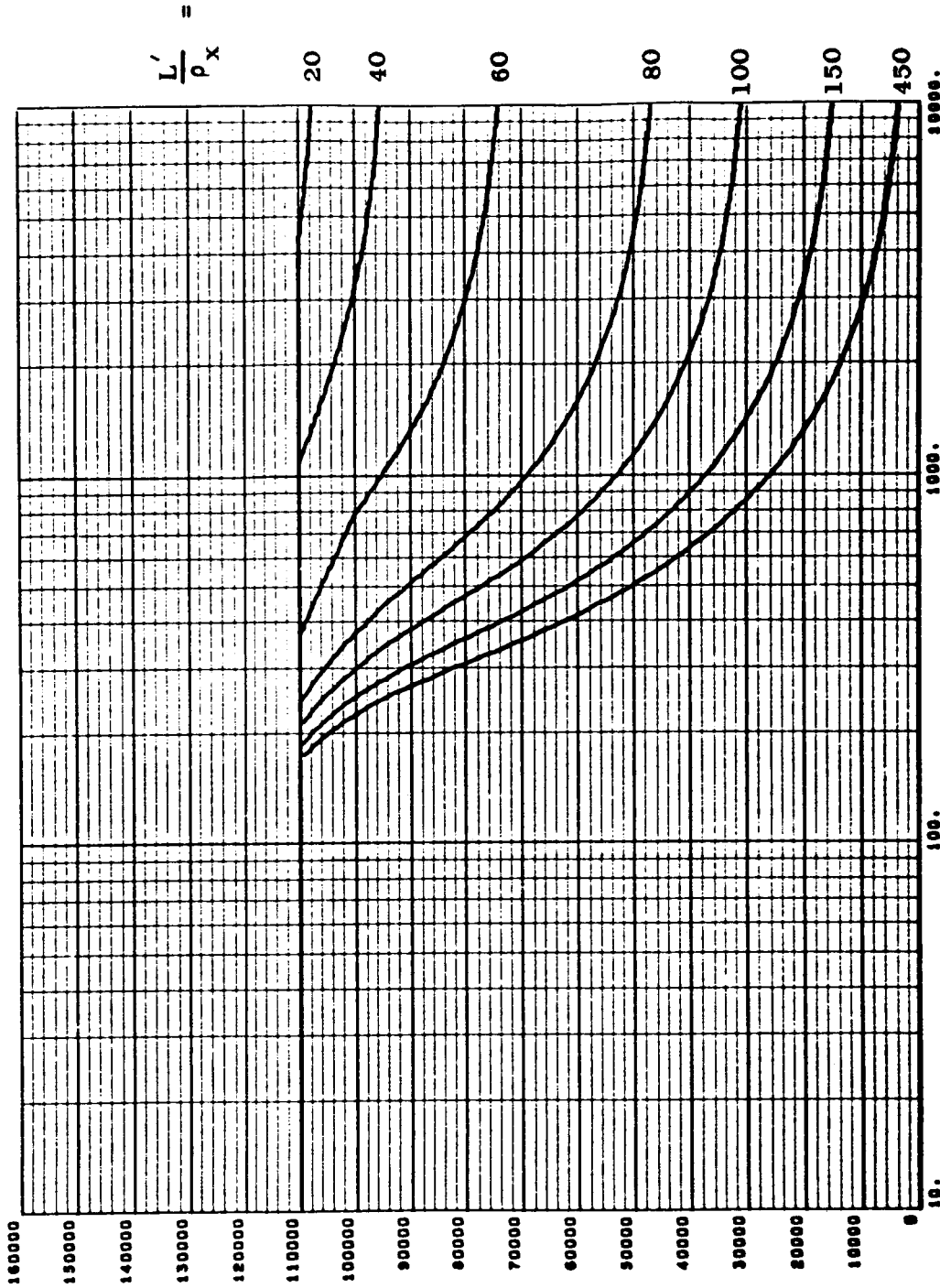


COMPRESSIVE BUCKLING STRESS FOR
 LONGITUDINALLY STIFFENED CYLINDERS
 MATERIAL -718 NICKEL ALLOY (ANNEALED + DOUBLE AGED)

Figure 24(g)

N SWAR = 1.400

CRIPPLING STRESS = 1.100×10^6

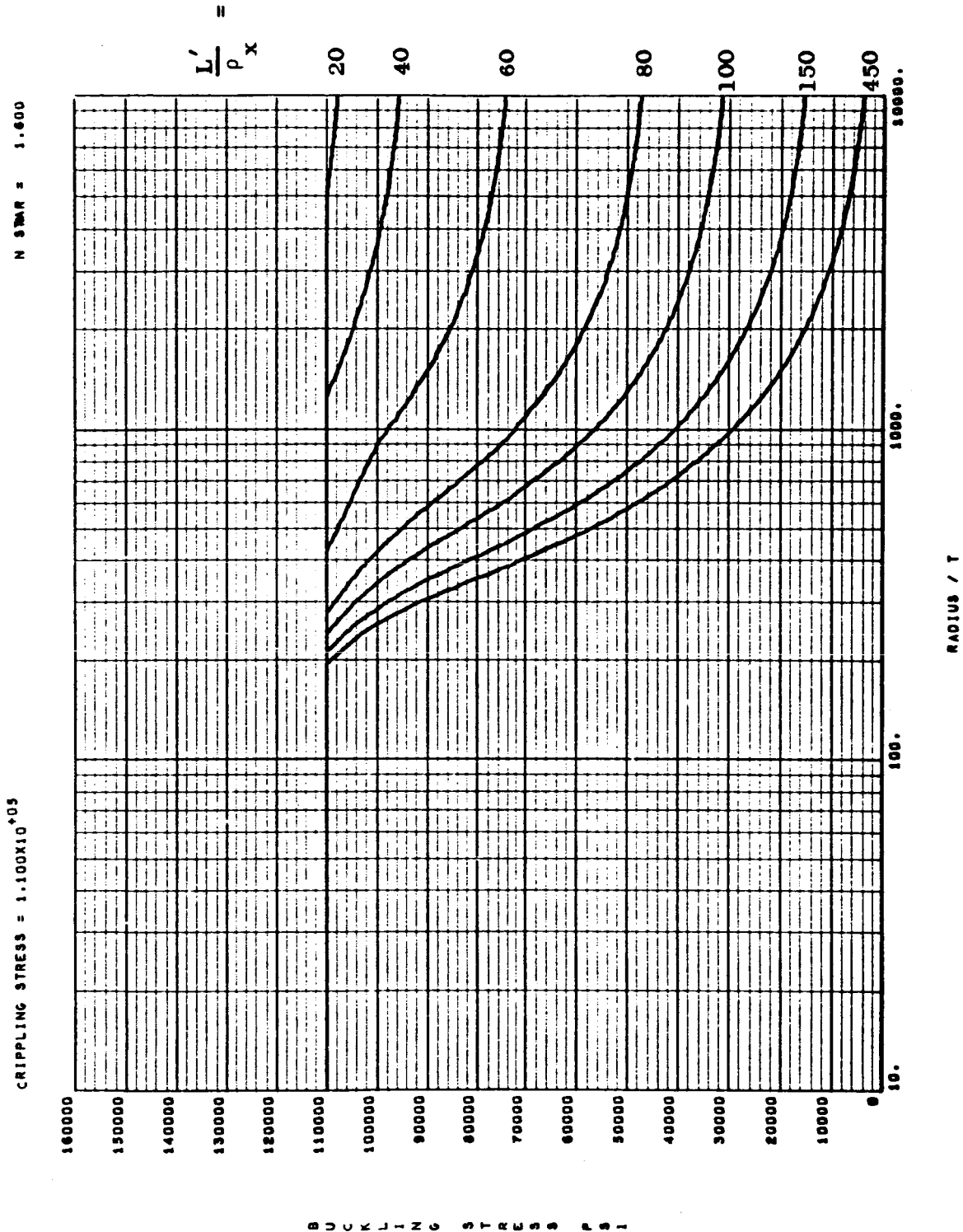


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RADIUS / T

COMPRESSIVE BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 718 NICKEL ALLOY (ANNEALED + DOUBLE AGED)

Figure 24(h)

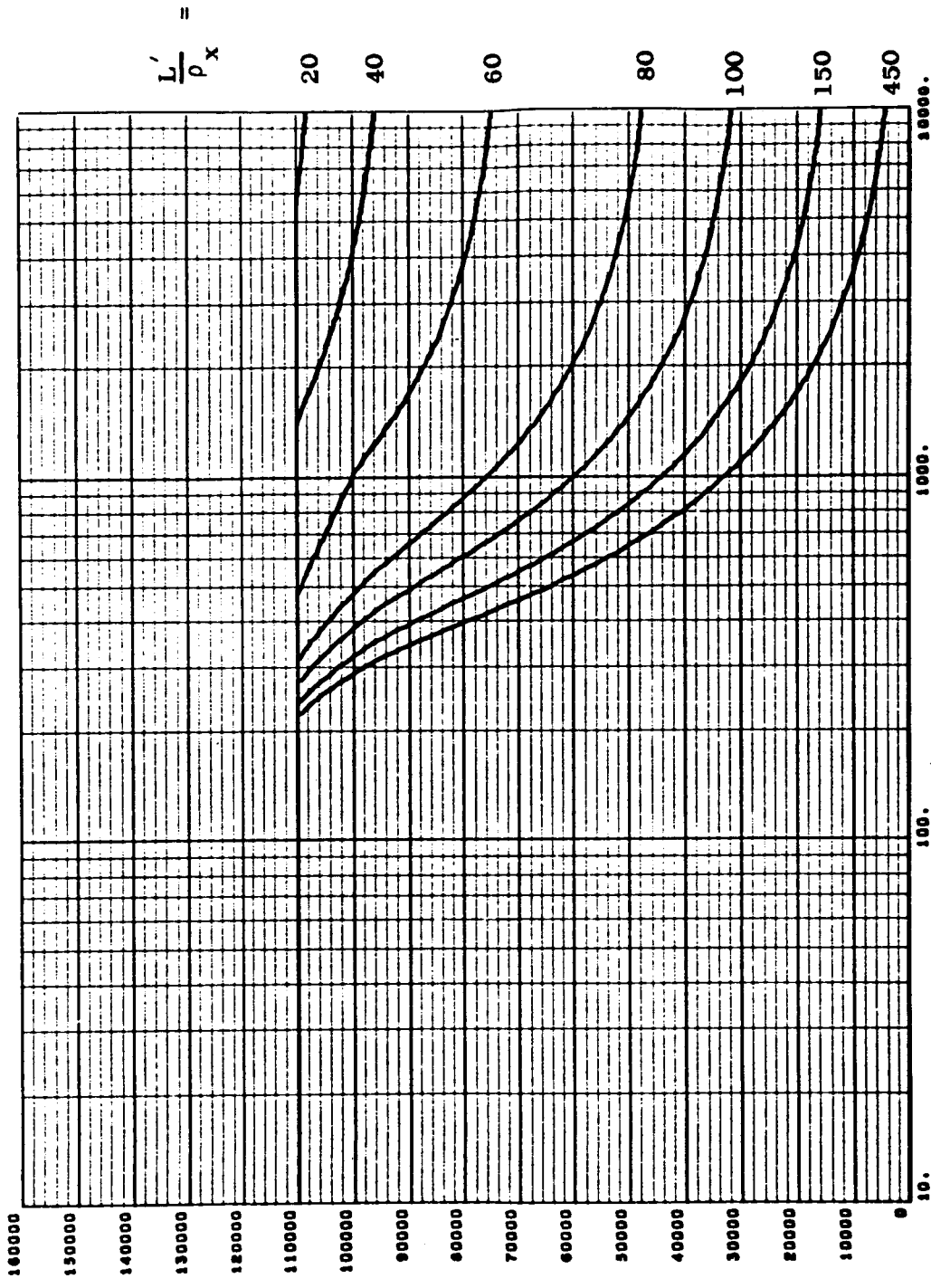


COMPRESSION BUCKLING STRESS FOR
 LONGITUDINALLY STIFFENED CYLINDERS
 MATERIAL - 718 NICKEL ALLOY (ANNEALED + DOUBLE AGED)

Figure 24(i)

N STAR = 1.600

CRIPPLING STRESS = 1.100×10^{10}



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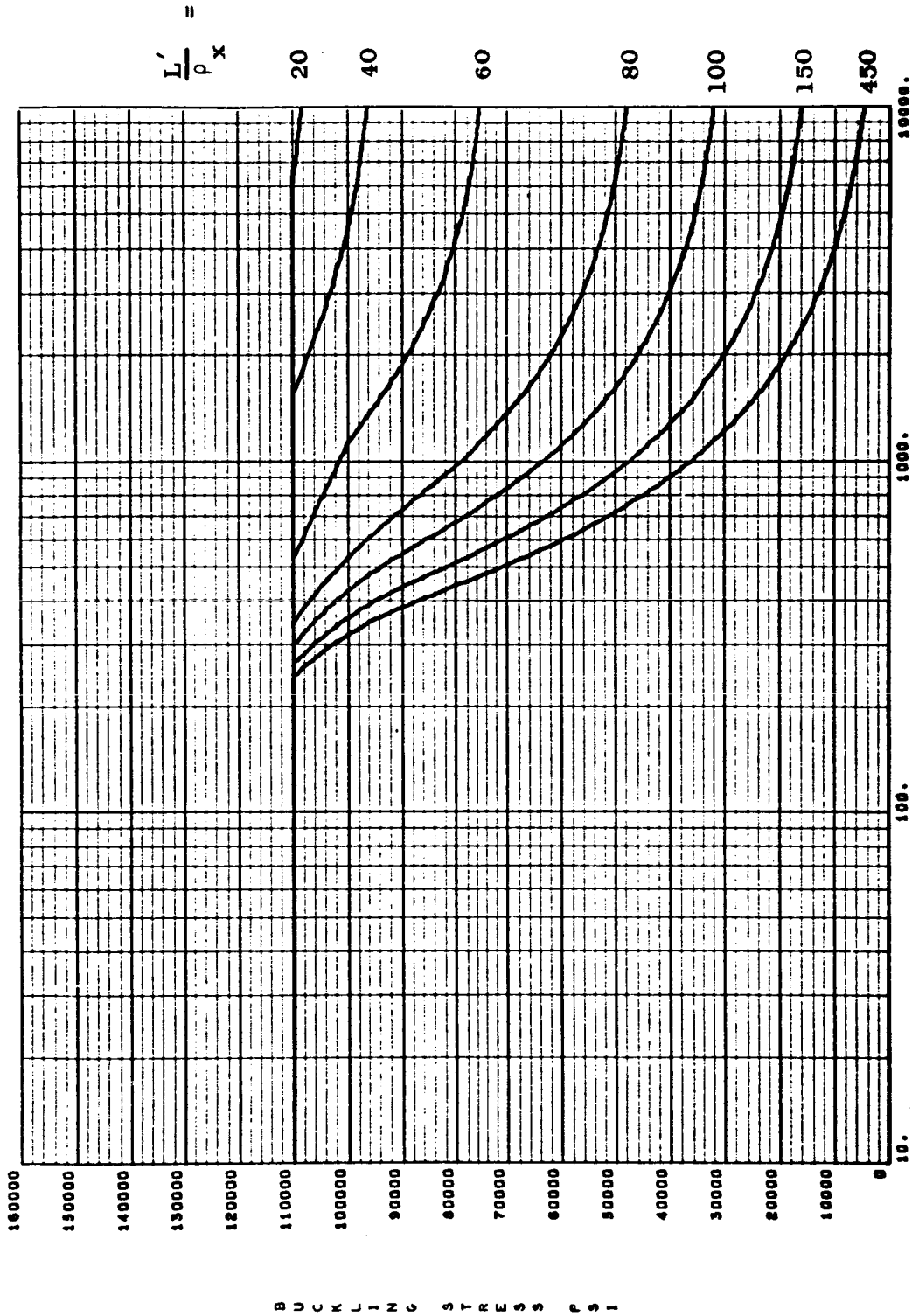
RADIUS / T

COMPRESSIVE BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 718 NICKEL ALLOY (ANNEALED + DOUBLE AGED)

Figure 24(j)

N STAR = 2.000

CRIPPLING STRESS = $1.100 \times 10^{+05}$



COMPRESSIVE BUCKLING STRESS FOR
LONGITUDINALLY STIFFENED CYLINDERS
MATERIAL - 718 NICKEL ALLOY (ANNEALED + DOUBLE AGED)

Figure 24(k)

APPENDIX B

NONDIMENSIONAL CURVES WHICH ARE NOT
RESTRICTED TO SINGLE MATERIAL

For skin-stringer combinations having slenderness ratios which satisfy the inequality

$$\frac{L'}{\rho_x} \geq (\sqrt{2})(\pi) \left(\sqrt{\frac{E}{\sigma_{cc}}} \right) \quad (B-1)$$

the many material-dependent buckling curves of SECTION 5.1 and APPENDIX A can be replaced by the single nondimensional family of Figure 25. These latter curves are of a widely-known basic form which emerges from application of the Ramberg-Osgood [9] nondimensional stress-strain curves given in Figure 26. It appears that the information embodied in Figures 25 and 26 can be judiciously manipulated to permit similar application for cases where the inequality (B-1) is not satisfied. However, further development is required to establish the exact procedures by which this can be accomplished.

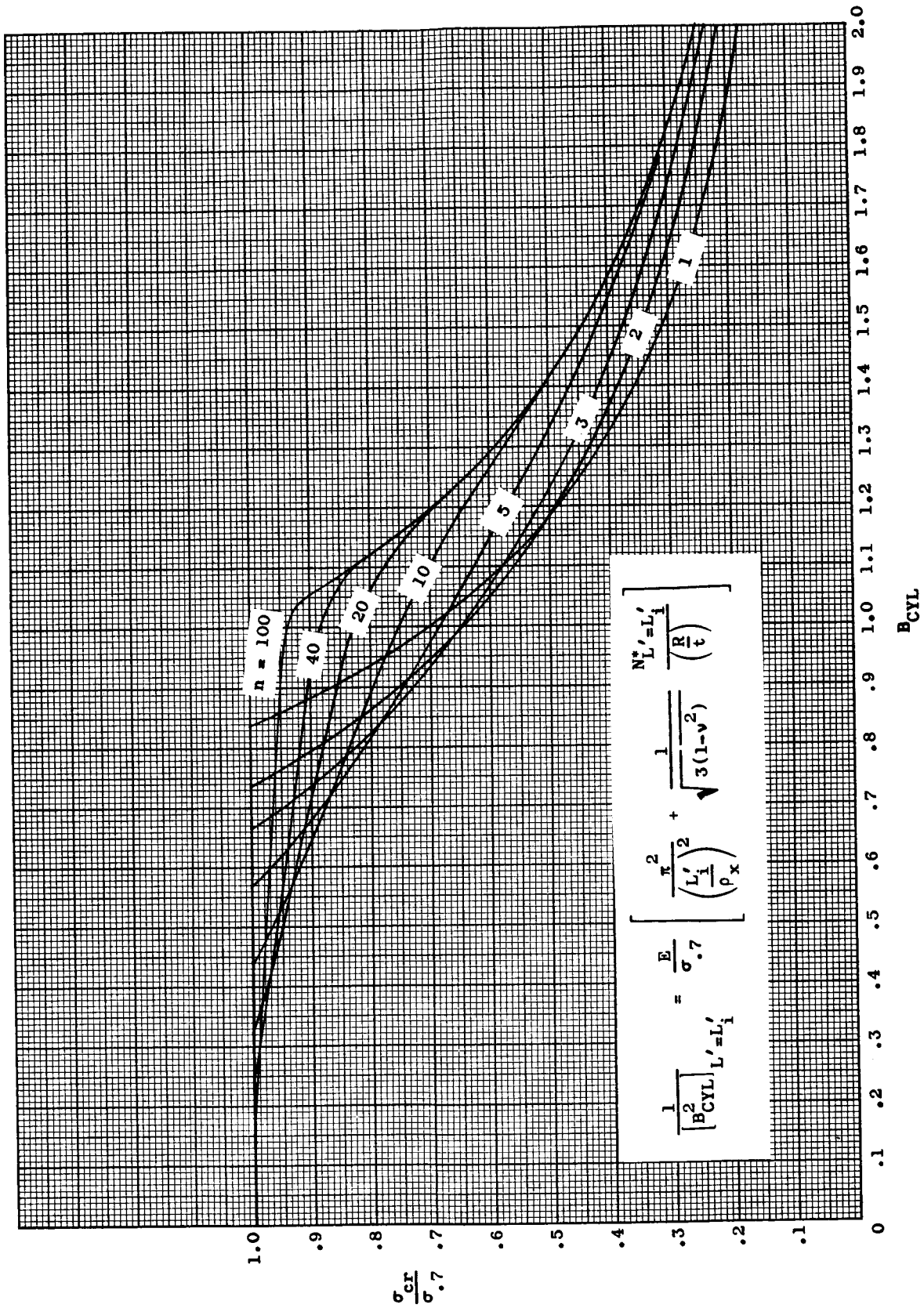


Figure 25(a) - Nondimensional Buckling Curves

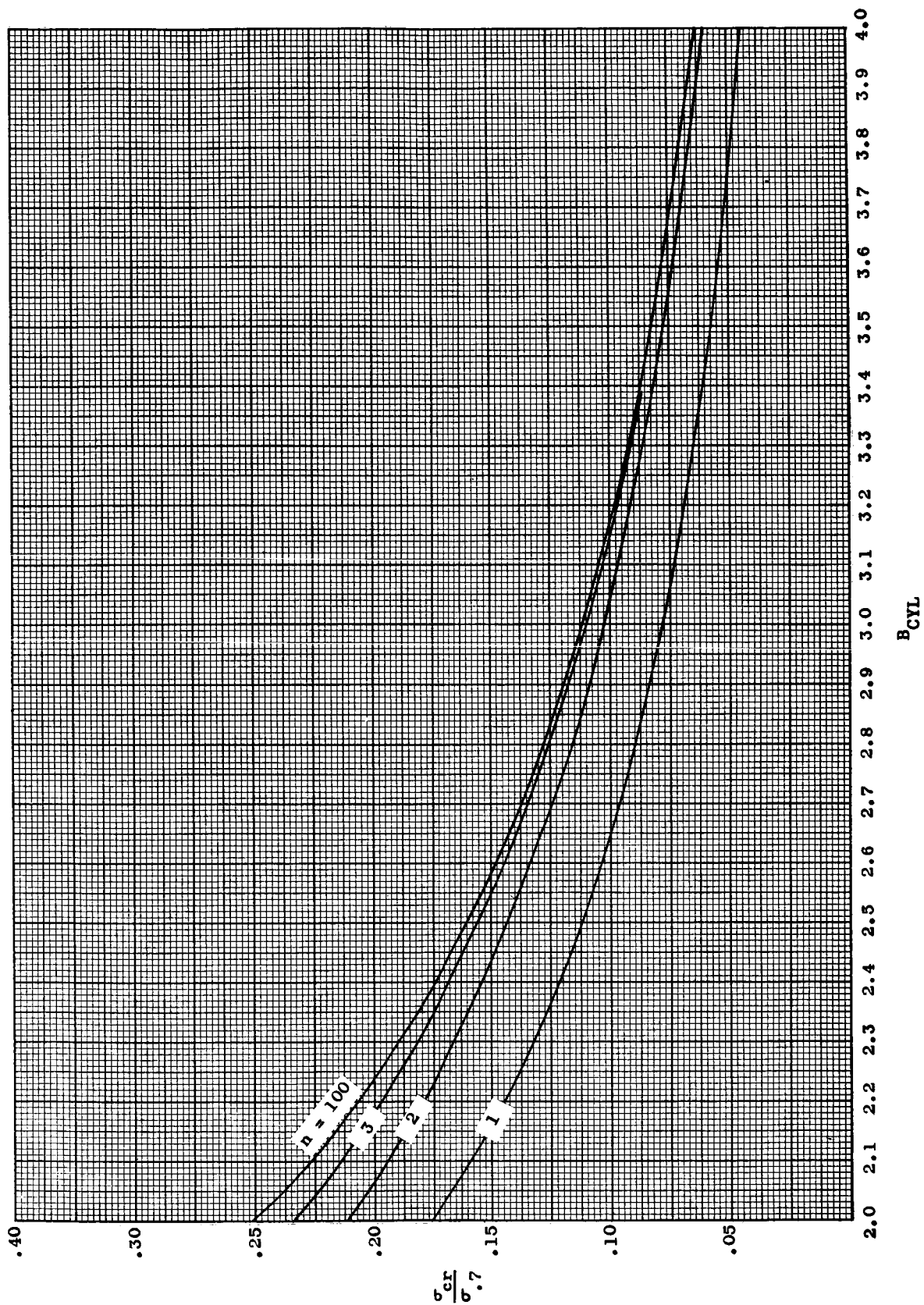


Figure 25(b) - Nondimensional Buckling Curves

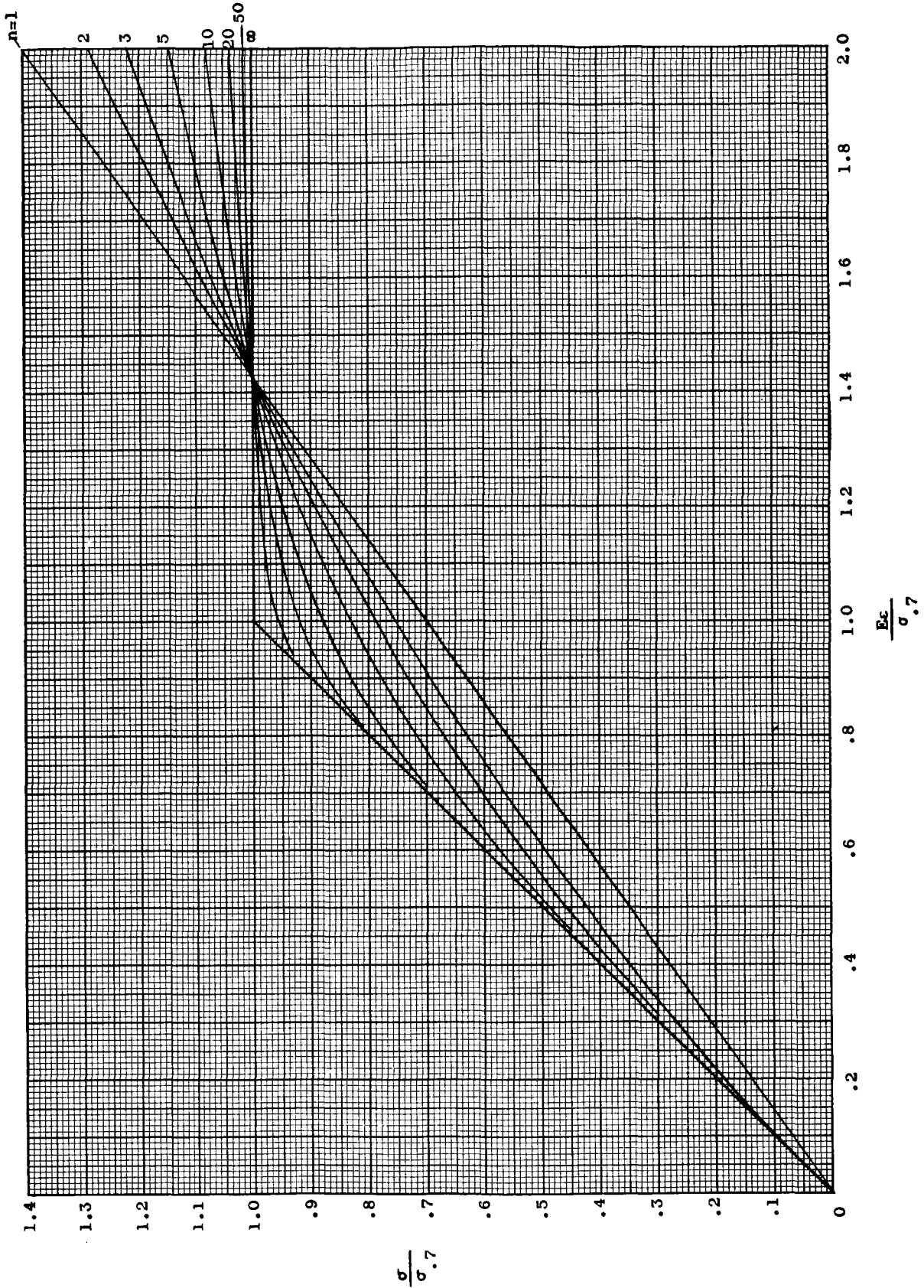


Figure 26 - Nondimensional Stress-Strain Curves