

# Thick Film Chip Resistors

NRCV Series

## FEATURES

- EIA STANDARD SIZING 0402 (1/16W), 0603 (1/10W), 0805 (1/8W), 1206 (1/4W), 2010 (1/2W) AND 2512 (1W)
- HIGH VOLTAGE (100VDC ~ 3,000VDC)
- HIGH RESISTANCE VALUES (UP TO 100MΩ)
- THICK FILM ON ALUMINA SUBSTRATE, RuO<sub>2</sub>/Ag RESISTIVE LAYER
- GLASS AND EPOXY OVERCOAT

**NEW**  
High Voltage  
Resistors  
(Up to 3KV)



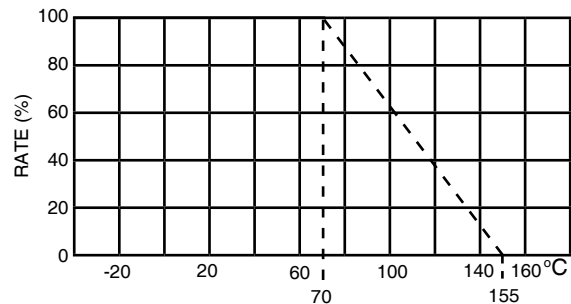
Type	EIA Size	Power Rating at 70°C	Max.*1 Working Voltage	Max.*2 Overload Voltage	Resistance Tolerance (Code)	Temperature Coefficient (ppm/°C)	Resistance Range (Ω)	Resistance Value	Operating Temperature Range (°C)			
NRCV04	0402	1/16W (0.063W)	100V	200V	±1% (F)	±100	39K ~ 1M	E-24,E-96	-55 ~ +155			
					±5% (J)							
					±1% (F)					±200	1.02M ~ 10M	E-96
					±5% (J)						1.1M ~ 20M	E-24
±5% (J)	±400	22M ~ 100M	E-24									
NRCV06	0603	1/10W (0.10W)	200V	400V	±1% (F)	±100	56K ~ 1M	E-24,E-96				
					±5% (J)							
					±1% (F)					±200	1.02M ~ 10M	E-96
					±5% (J)						1.1M ~ 20M	E-24
±5% (J)	±400	22M ~ 100M	E-24									
NRCV10	0805	1/8W (0.125W)	400V	800V	±1% (F)	±100	100K ~ 1M	E-24,E-96				
					±5% (J)							
					±1% (F)					±200	1.02M ~ 10M	E-96
					±5% (J)						1.1M ~ 20M	E-24
±5% (J)	±400	22M ~ 100M	E-24									
NRCV12	1206	1/4W (0.25W)	500V	1000V	±1% (F)	±100	100K ~ 1M	E-24,E-96				
					±5% (J)							
					±1% (F)					±200	1.02M ~ 10M	E-96
					±5% (J)						1.1M ~ 20M	E-24
±5% (J)	±400	22M ~ 100M	E-24									
NRCV50	2010	1/2W (0.50W)	2000V	3000V	±1% (F)	±100	51K ~ 1M	E-24,E-96				
					±5% (J)							
					±1% (F)				±200	1.02M ~ 10M	E-96	
					±5% (J)					1.1M ~ 20M	E-24	
±5% (J)	±400	22M ~ 100M	E-24									
NRCV100	2512	1W	3000V	4000V	±1% (F)	±100	30K ~ 1M	E-24,E-96				
					±5% (J)							
					±1% (F)				±200	1.02M ~ 10M	E-96	
					±5% (J)					1.1M ~ 20M	E-24	
±5% (J)	±400	22M ~ 100M	E-24									

Note \*1 - Maximum allowable continuous Working Voltage for all resistors is the lower of the two values:  
"Maximum Working Voltage" as specified above  
(or)

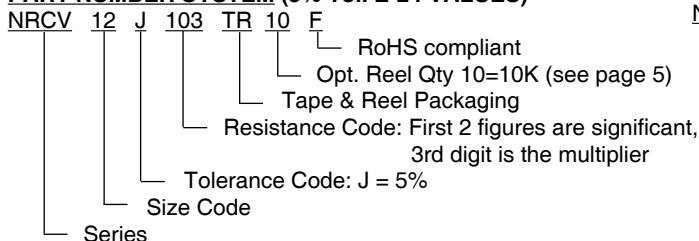
$$\sqrt{\text{Power rating (Watts)} \times \text{Resistance (Ohms)}}$$

Note \*2 - Maximum allowable Overload voltage is two times the Maximum Working Voltage (see Note \*1 above).

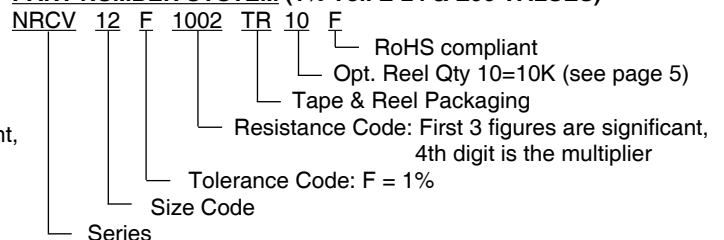
**Power Derating Curve:** For operation above 70°C, power rating must be derated according to the following chart:



### PART NUMBER SYSTEM (5% Tol. E-24 VALUES)

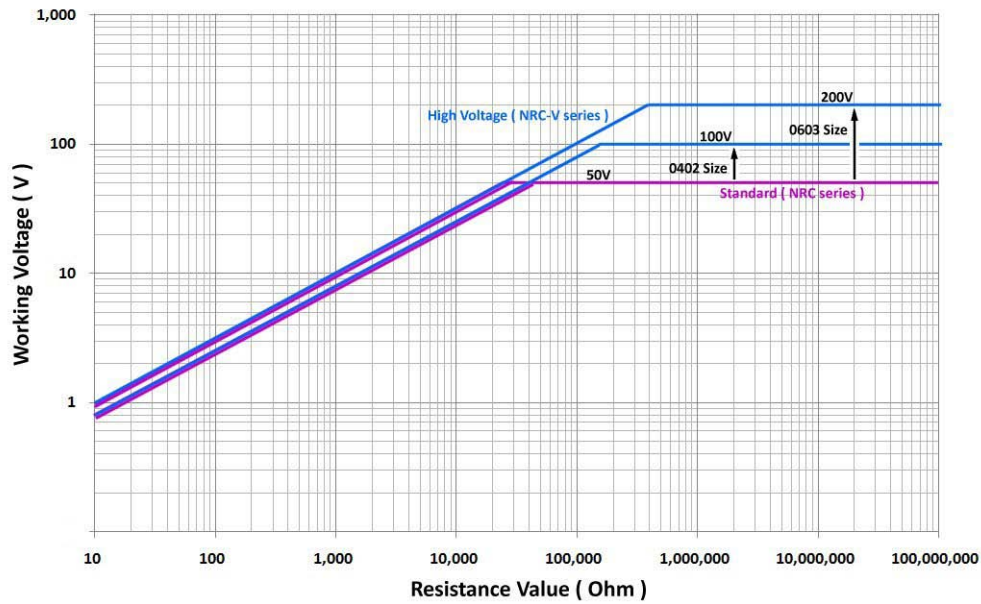


### PART NUMBER SYSTEM (1% Tol. E-24 & E96 VALUES)

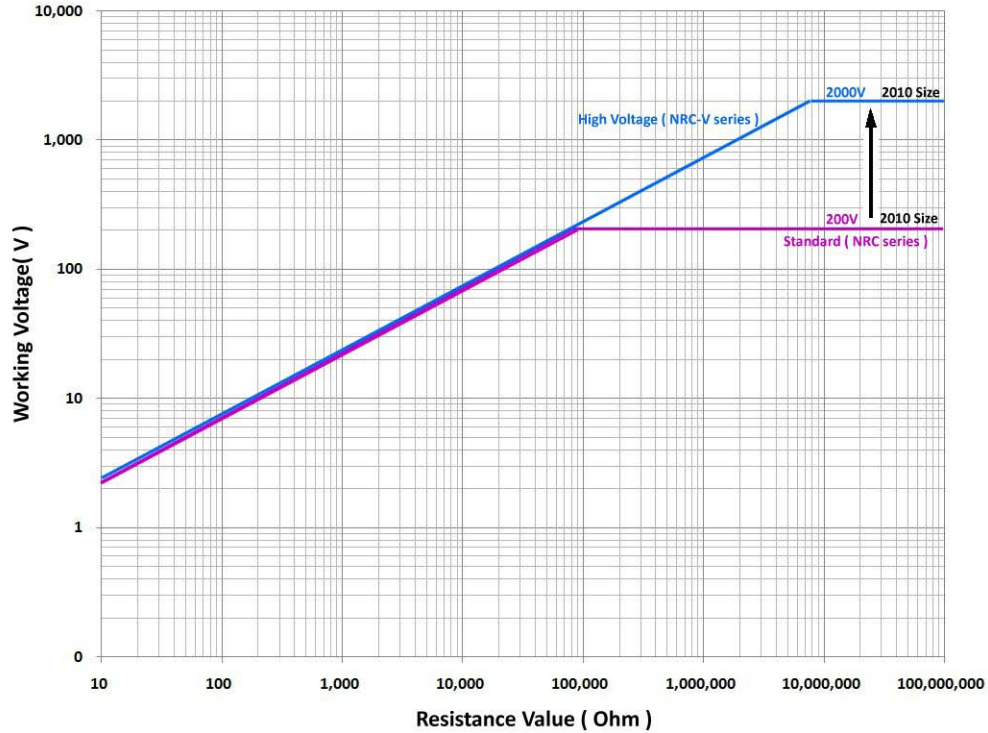


## NRCV Series - Examples of Advantage in Voltage Rating

0402 and 0603 Case Sizes



2010 Case Size



Based on voltage rating formula **Working Voltage** =  $\sqrt{\text{Power rating (Watts)} \times \text{Resistance (Ohms)}}$  the NRCV parts will have a higher voltage rating than the standard NRC parts in values above (see table below):

EIA Size	Resistance Value
0402	39.2K
0603	24.9K
0805	178K
1206	158K
2010	78.7K
2512	61.9K

Example: Maximum voltage for 0805 case size, 470K ohm part:

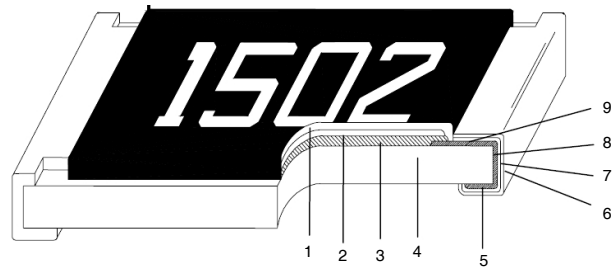
1. NRC10 (0.125W) maximum voltage is  $\sqrt{0.125 \text{ (Watts)} \times 470,000 \text{ (Ohms)}} = 242.3\text{V}$  or 150V whichever is less, so limit is **150V**
2. NRCV10 (0.125W) maximum voltage is  $\sqrt{0.125 \text{ (Watts)} \times 470,000 \text{ (Ohms)}} = 242.3\text{V}$  or 400V whichever is less, so limit is **242.3V**

## ENVIRONMENTAL CHARACTERISTICS

Item	Specification		Test Method
	Tol. 1%	Tol. 5%	
Temperature Coefficient of Resistance	As specified		JIS-C-5201-1 4.8 & IEC-60115-1 4.8 -55°C ~ +125°C, +25°C is the reference temperature
Short Time Overload	$\Delta R \pm(1\% + 0.05\Omega)$	$\Delta R \pm(2\% + 0.05\Omega)$	JIS-C-5201-1 4.13 & IEC-60115-1 4.13 RCWV x 2.5 or max overloading voltage whichever is less for 5 Seconds
Insulation Resistance	>10,000MΩ		JIS-C-5201-1 4.6 & IEC-60115-1 4.6 Maximum overload voltage for 1 minute
Endurance (Load Life)	$\Delta R \pm(2\% + 0.10\Omega)$	$\Delta R \pm(3\% + 0.10\Omega)$	JIS-C-5201-1 4.25 & IEC-60115-1 4.25.1 RCWV +70°C ± 2°C, 1.5 hours "ON", 0.5 hours "OFF" Total time 1,000 hours
Damp Heat with Load	$\Delta R \pm(2\% + 0.10\Omega)$	$\Delta R \pm(3\% + 0.10\Omega)$	JIS-C-5201-1 4.24 RCWV +40°C ± 2°C, 90~95% RH, 1.5 hour "ON", 0.5 hours "OFF" Total time 1,000 hours
Dry Heat	$\Delta R \pm(1\% + 0.05\Omega)$	$\Delta R \pm(1.5\% + 0.10\Omega)$	JIS-C-5201-1 4.23 & IEC-60115-1 2.23.2 at +155°C for 1,000 hours
Bending Strength	$\Delta R \pm(1\% + 0.05\Omega)$	$\Delta R \pm(1.0\% + 0.05\Omega)$	JIS-C-5201-1 4.33 & IEC-60115-1 4.33 Bend once for 5 seconds (0402 ~ 1206: 3mm, 2010, 2512: 2mm)
Solderability	95% minimum coverage		JIS-C-5201-1 4.17 & IEC-60115-1 4.17 245°C ± 5°C for 3 seconds
Resistance to Soldering Heat	$\Delta R \pm(0.5\% + 0.05\Omega)$	$\Delta R \pm(1.0\% + 0.05\Omega)$	JIS-C-5201-1 4.18 & IEC-60115-1 4.18 260°C ± 5°C for 10 seconds
Withstanding Voltage	No breakdown or flashover		JIS-C-5201-1 4.7 & IEC-60115-1 4.7 0402: 150V for 1 minute 0603: 300V for 1 minute 0805, 1206, 1210 and 2512: 500V for 1 minute
Leaching	Individual leaching area ≤ 5% Total leaching area ≤ 10%		JIS-C-5201-1 4.18 & IEC-60068-2-58 8.2.1 260°C ± 5°C for 30 seconds
Rapid Change in Temperature	$\Delta R \pm(0.5\% + 0.05\Omega)$	$\Delta R \pm(1.0\% + 0.05\Omega)$	JIS-C-5201-1 4.18 & IEC-60115-1 4.18 -55°C ~ 155°C, 5 cycles

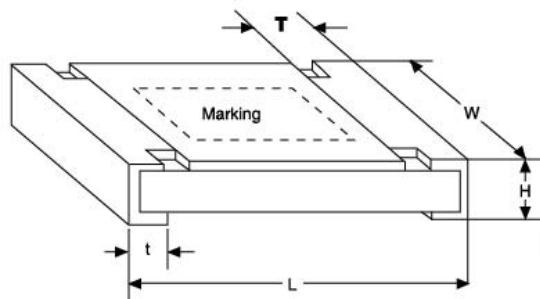
## CONSTRUCTION

No.	Item	Material
1	2nd Overcoat	Epoxy
2	Primary Overcoat	Glass
3	Resistive Layer	RuO <sub>2</sub>
4	Substrate	Alumina
5	Bottom Electrode	Ag
6	Termination Finish	Sn
7	Barrier Layer	Ni
8	Edge Electrode	NiCr
9	Top Electrode	Ag-Pd



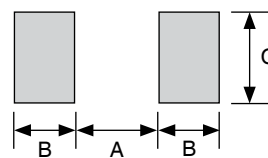
## COMPONENT DIMENSIONS (mm)

Type	EIA Size	L	W	H	T	t
NRCV04	0402	1.00 ± 0.05	0.50 ± 0.05	0.35 ± 0.05	0.20 ± 0.10	0.20 ± 0.10
NRCV06	0603	1.60 ± 0.15	0.80 ± 0.10	0.45 ± 0.10	0.30 ± 0.20	0.30 ± 0.20
NRCV10	0805	2.00 ± 0.20	1.25 ± 0.10	0.50 ± 0.10	0.40 ± 0.20	0.35 ± 0.20
NRCV12	1206	3.10 ± 0.10	1.55 ± 0.10	0.55 ± 0.10	0.50 ± 0.20	0.50 ± 0.25
NRCV50	2010	5.00 ± 0.10	2.50 ± 0.15	0.55 ± 0.10	0.50 ± 0.20	0.60 ± 0.25
NRCV100	2512	6.35 ± 0.10	3.10 ± 0.15	0.55 ± 0.10	0.50 ± 0.20	0.60 ± 0.25

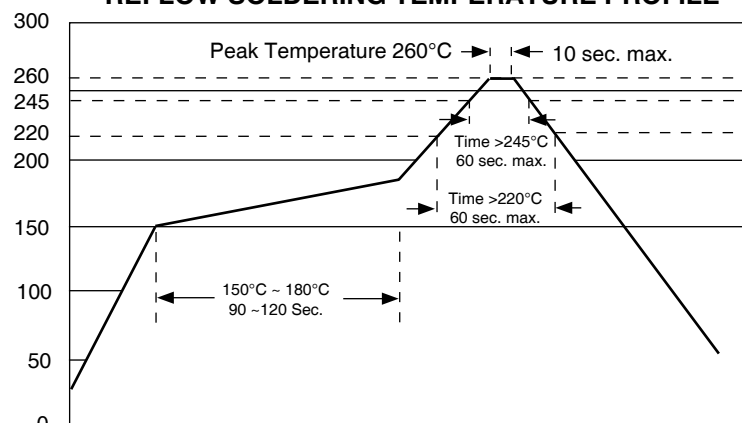


## LAND PATTERN DIMENSIONS (mm)

Type	EIA Size	A	B	C
NRCV04	0402	0.50	0.45	0.60
NRCV06	0603	0.90	0.60	0.90
NRCV10	0805	1.20	0.70	1.30
NRCV12	1206	2.00	0.90	1.60
NRCV50	2010	3.80	0.90	2.80
NRCV100	2512	3.80	1.60	3.50



## REFLOW SOLDERING TEMPERATURE PROFILE



## COMPONENT MARKING (Note: no marking on 0402 case size parts).

1. For **E-24** Series J ( $\pm 5\%$ ) Tolerance In 0603, 0805, 1206, 2010 and 2512 sizes: \_

3 DIGIT SYSTEM - First two digits are significant and third digit is multiplier

Examples: 100 = 10 ohms    101 = 100 ohms    102 = 1,000    103 = 10,000 ohms    104 = 100,000 ohms  
 105 = 1,000,000 ohms    106 = 10,000,000 ohms    107 = 100,000,000 ohms

2. For **E-96** Series F ( $\pm 1\%$ ) Tolerance in 0805, 1206 and 2010 and 2512 sizes:

4 DIGIT SYSTEM - First 3 digits are significant and fourth digit is multiplier, "R" represents decimal point

Examples: 10R0 = 10 ohms    1000 = 100 ohms    1001 = 1,000 ohms    1002 = 10,000    1003 = 100,000 ohms  
 1004 = 1,000,000 ohms    1005 = 10,000,000 ohms

3. For **E-96** Series F ( $\pm 1\%$ ) Tolerance in 0603 size (available from 10 ohm ~ 10Mohm)

Special 3 DIGIT SYSTEM below (Due to space restrictions)

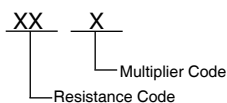
## 0603 E-96 VALUES 1% TOLERANCE RESISTANCE CODE

E-96							
Value	Code	Value	Code	Value	Code	Value	Code
100	01	102	02	105	03	107	04
110	05	113	06	115	07	118	08
121	09	124	10	127	11	130	12
133	13	137	14	140	15	143	16
147	17	150	18	154	19	158	20
162	21	165	22	169	23	174	24
178	25	182	26	187	27	191	28
196	29	200	30	205	31	210	32
215	33	221	34	226	35	232	36
237	37	243	38	249	39	255	40
261	41	267	42	274	43	280	44
287	45	294	46	301	47	309	48
316	49	324	50	332	51	340	52
348	53	357	54	365	55	374	56
383	57	392	58	402	59	412	60
422	61	432	62	442	63	453	64
464	65	475	66	487	67	499	68
511	69	523	70	536	71	549	72
562	73	576	74	590	75	604	76
619	77	634	78	649	79	665	80
681	81	698	82	715	83	732	84
750	85	768	86	787	87	806	88
825	89	845	90	866	91	887	92
909	93	931	94	953	95	976	96

## MULTIPLIER CODE

Code	A	B,b	C	D,d	E	F	G	H	X	Y	Z
Multiplier	10 <sup>0</sup>	10 <sup>1</sup>	10 <sup>2</sup>	10 <sup>3</sup>	10 <sup>4</sup>	10 <sup>5</sup>	10 <sup>6</sup>	10 <sup>7</sup>	10 <sup>-1</sup>	10 <sup>-2</sup>	10 <sup>-3</sup>

## CODING FORMULA



Example:  $10.2k\Omega = \frac{102}{02} \times 10^2 \Omega = 02C$

$33.2 \Omega = \frac{332}{51} \times 10^{-1} = 51X$

## MARKING EXAMPLES

10 $\Omega$  = 01X  
 7.5K $\Omega$  = 85B or 85b  
 150K $\Omega$  = 18D or 18d  
 6.81Meg $\Omega$  = 81E  
 10Meg $\Omega$  = 01F



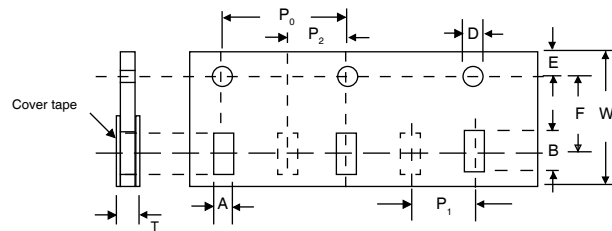
## PUNCHED TAPING SPECIFICATIONS

### 1. Reel Quantities

Type	EIA Size	Carrier Tape			Qty per 7" Reel	Qty per 10" Reel	Qty per 13" Reel
		Fig.	Material	Width (mm)			
NRCV04	0402	A	Paper	8	10,000	20,000	40,000
NRCV06	0603	A	Paper	8	5,000	10,000	20,000
NRCV10	0805	A	Paper	8	5,000	10,000	20,000
NRCV12	1206	A	Paper	8	5,000	10,000	20,000

### 2. Carrier Dimensions (mm)

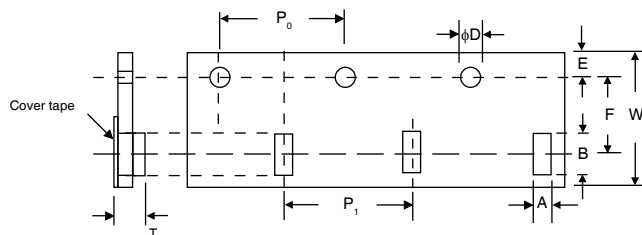
Type	EIA Size	A	B	D	E	F	P <sub>0</sub>	P <sub>1</sub>	P <sub>2</sub>	T	W
NRCV04	0402	0.65 ± 0.10	1.15 ± 0.10	1.5 <sup>+0.1</sup> / <sub>0</sub>	1.75 ± 0.1	3.5 ± 0.05	4.0 ± 0.1	4.0 ± 0.05	2.0 ± 0.05	2.0 ± 0.05	0.45 ± 0.10
NRCV06	0603	1.10 ± 0.10	1.90 ± 0.10								0.70 ± 0.10
NRCV10	0805	1.60 ± 0.10	2.40 ± 0.20								0.85 ± 0.10
NRCV12	1206	1.90 ± 0.10	3.50 ± 0.20								0.85 ± 0.10



### 3. EMBOSSED PLASTIC TAPE SPECIFICATION

#### Reel Quantities and Carrier Dimensions (mm)

Type	EIA Size	A	B	φD	E	F	P <sub>0</sub>	P <sub>1</sub>	P <sub>2</sub>	T	W	Qty per Reel	
												7" Reel	10" Reel
NRCV50	2010	2.8 ± 0.1	5.5 ± 0.1	1.5 <sup>+0.1</sup> / <sub>0</sub>	1.75 ± 0.1	5.5 ± 0.05	4.0 ± 0.1	4.0 ± 0.1	2.0 ± 0.05	1.2 ± 0	12.0 ± 0.1	4,000	8,000
NRCV100	2512	3.5 ± 0.1	6.7 ± 0.1										



## 4. REEL SPECIFICATIONS

Type	Reel Diameter		$\phi B$ (mm)	$\phi C$ (mm)	$\phi W$ (mm)	$\phi T$ (mm)	Reel Qty	Part Number Suffix
	$\phi A$							
NRCV04	7"	$178.5 \pm 1.5$	$60 +1 / -0$	$13.0 \pm 0.2$	$9.0 \pm 0.5$	$12.5 \pm 0.5$	10,000	TRF
	10"	$254 \pm 1.0$	$100 \pm 0.5$		$9.5 \pm 0.5$	$13.5 \pm 0.5$	20,000	TR20F
	13"	$330 \pm 1.0$	$100 \pm 0.5$		$9.5 \pm 0.5$	$13.5 \pm 0.5$	40,000	TR40F
NRCV06	7"	$178.5 \pm 1.5$	$60 +1 / -0$		$9.0 \pm 0.5$	$12.5 \pm 0.5$	5,000	TRF
NRCV10	10"	$254 \pm 1.0$	$100 \pm 0.5$		$9.5 \pm 0.5$	$13.5 \pm 0.5$	10,000	TR10F
NRCV12	13"	$330 \pm 1.0$	$100 \pm 0.5$		$9.5 \pm 0.5$	$13.5 \pm 0.5$	20,000	TR20F
NRCV50	7"	$178.5 \pm 1.5$	$60 +1 / -0$	$13.0 \pm 0.5$	$15.5 \pm 0.5$	4,000	TRF	
NRCV100	10"	$254 \pm 1.0$	$62 \pm 0.5$	$12.5 \pm 0.5$	$16.5 \pm 0.5$	8,000	TR8F	

