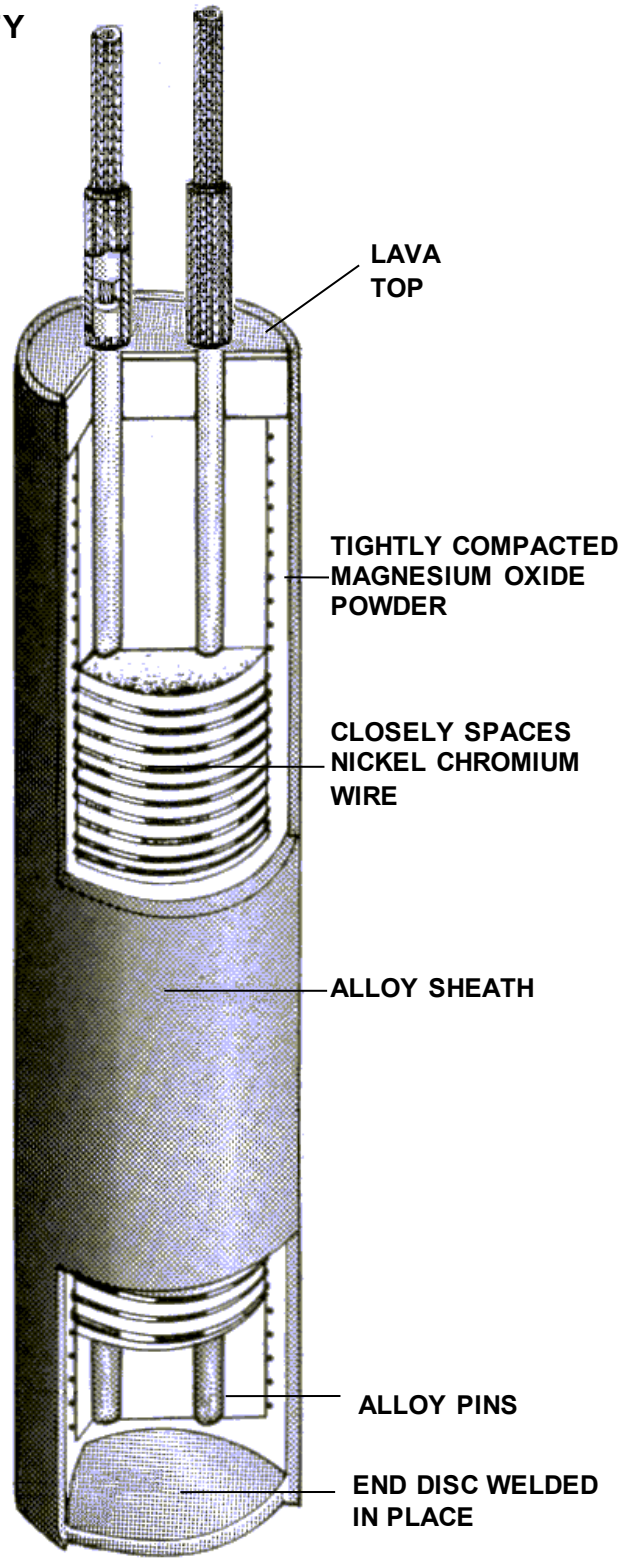
Cartridge Heaters-Redrod™

INTRODUCTION

REDROD™ "R" SERIES HIGH WATT DENSITY

AKINSUN High watt density cartridge heaters are manufactured to the highest industry standards using only premium materials. Our tight manufacturing controls results into uniform surface temperatures and resistance to oxidation and corrosion even at elevated temperatures. " R " series cartridge heaters are designed for higher temperatures, longer life even in the most severe, rugged and demanding applications. Their heavy duty, construction provides high dielectric strength as well as shock and vibration resistance.



Features

1. Incoloy or Stainless Steel Sheath
   Selected heavy wall tubing gives maximum heat transfer, high compaction, and is corrosion resistant.
2. Lava Cap
   With its high density or the ceramic cap locks the magnesium oxide in place, acts like an insulator between pin and sheath and also resists contamination.
3. Leads
   Flexible, non-asbestos fiberglass leads crimp connected mechanically.
4. Swaging
   Maximum swaging results in greatest cross section reduction of area, offering virtual conduction for highest watt densities.
5. Centering
   Mgo spacer precisely centers the wire wound core eliminating hot spots.

Calculating Heat Requirements

In Calculating the heat requirements to heat any substance, two things must be considered

A. The power required for the initial heat-up of the substance, and
B. The power required to keep the substance at the desired temperature.

The steps for calculating these requirements are shown below. The higher of the two power requirements should be used.

A . POWER REQUIREMENT FOR INITIAL HEAT-UP

1. Heat absorbed by material:

$$\frac{\text{Weight of material (lb)} \times \text{Specific heat (Btu/lb./ºF)} \times \text{Temperature difference (final - initial) (F)}}{\text{3412 (Btu/Kwh)}} = \_\_\_\_\_ \text{kwh}$$

2. Heat required for fusion or vaporization:*

$$\frac{\text{Weight of material (lb)} \times \text{Heat of fusion or vaporization (Btu/lb)}}{\text{3412 (Btu/ kwh)}} = \_\_\_\_\_ \text{kwh}$$

3. Heat required to replace average heat losses:

$$\frac{\text{Exposed surface area (sq ft)} \times \text{Heat loss at final Operating temperature (w/ sq ft)} \times \text{Time allowed for heat-up (hrs)}}{\text{1000 (w / kw)}} \times \frac{1}{2} \text{ to obtain an average loss} = \_\_\_\_\_ \text{kwh}$$

Total Heat Requirement for Initial Heat - up: =_____kwh

4. Heat to provide for contingencies, Safety Factor:

20% [Step 1 (kwh) + Step 2 (kwh) + Step 3 (kwh)]

=_____kwh

Total Power Requirement for Initial Heat - up:

$$\frac{\text{Step 1 (kwh)} + \text{Step 2 (kwh)} + \text{Step 3 (kwh)} + \text{Step 4 (kwh)}}{\text{Time allowed for heat - up (hrs)}} = \_\_\_\_\_ \text{kwh}$$

B. POWER REQUIREMENT FOR OPERATING HEAT

1. Heat absorbed by all materials added to the process:

$$\frac{\text{Weight of material added (lb)} \times \text{Specific heat (Btu/ lb/ºF)} \times \text{Temperature difference (final initial) F}}{\text{3412 (Btu / kwh)}} = \_\_\_\_\_ \text{kwh}$$

Note: The above Step must be repeated for each material added to the process.

2. Heat required for fusion or vaporization during process:*

$$\frac{\text{Weight of material (lb)} \times \text{Heat of fusion or vaporization (Btu/ lb)}}{\text{3412 (Btu/ kwh)}} = \_\_\_\_\_ \text{kwh}$$

3. Heat required to replace heat losses:

$$\frac{\text{Exposed surface area (sq ft)} \times \text{Heat loss at final operating temperature (w/ sq ft)} \times \text{Working cycle time (hrs)}}{\text{1000 (w/ kw)}} = \_\_\_\_\_ \text{kwh}$$

Total Heat Requirement per Working Cycle:

4. Heat to provide for contingencies, Safety Factor:

20% [step 1 (kwh) + step 2 (kwh) + step 3 (kwh)] =_____kwh

Total Power Requirement for Operating Heat:

$$\frac{\text{Step 1 (kwh)} + \text{Step 2 (kwh)} + \text{Step 4 (kwh)}}{\text{Working cycle time (hrs)}} = \_\_\_\_\_ \text{kwh}$$

*** Note** When the specific heat of a material changes at some temperature during the heat-up due to melting (fusion) or evaporation (vaporization) perform Step 1 for the heat absorbed from the initial temperature up to the temperature at the point of change add step 2 then repeat step 1 for heat absorbed from the point of change to the final operating temperature .

Guidelines for the Best Performance of Redrod™ Cartridge Heaters

AKINSUN cartridge heaters have been in use in various applications for years. Successful application depends on proper installation of heater, operating temperatures and heater watt density.

INSTALLATION RECOMMENDATION

1) Protect leads from spray oil and abrasive. Contaminating liquids and vapors can enter the unsealed cartridge heaters and cause insulation breakdown, resulting in heater burnout.

2) Leads must not extend into the hole containing the cartridge heater. Generally the lead end of the cartridge heater should be flush with the surface.

3) Thermal expansion and contraction due to cycling shortens heater life. We recommend reducing watt densities by 30% for those heaters subject to frequent cycling.

4) Full heated length of the heater should be in contact with metal to avoid burnout by operating in open air.

5) When machinery or the part where heater is installed is moving, anchor the leads securely. As little movement as possible should be allowed close to where the leads emerge from the heater. A loop in the lead wire will frequently extend lead life. Another solution is to terminate the cartridge heater leads at a terminal block, which moves from the heated assembly. Flexing is transferred to the extension lead, which can be economically replaced.

6) Avoid putting low temperature tapes on the leads exiting the heater. The adhesive on some tapes can enter the heater and turn to carbon, which is electrically conductive. Where glass tape cannot be avoided, a tape with a silicone-based adhesive is suggested.

7) When used in a vacuum application, make sure the lead end of the heater is outside the vacuum. When the lead end of the heater is inside the vacuum, a voltage of 120 volts or less is recommended on an unsealed heater, outgassing may be expected.

8) When using heaters near their maximum recommended watt density, it is preferred the temperature sensing probes be approximately ½" from the heater sheath.

Application of Redrod™ Cartridge Heaters in Platens, Dies, and Molds

When selecting cartridge heaters for above application the following factors are checked to insure the heater will experience longest possible life and provide sufficient heat for the job.

- **Heater Watt Density**
- **Proper Fit of Heater**
- **Proper measures against contamination**
- **Sufficient KW to heat and to compensate for heat losses**

Heater Watt Density

Watt density on the sheath of cartridge heater is defined as the wattage dissipated per square inch of the heated sheath surface. This watt density determines the internal wire being used. These factors are critical to the proper heating of the application and to the life expectancy of the heater

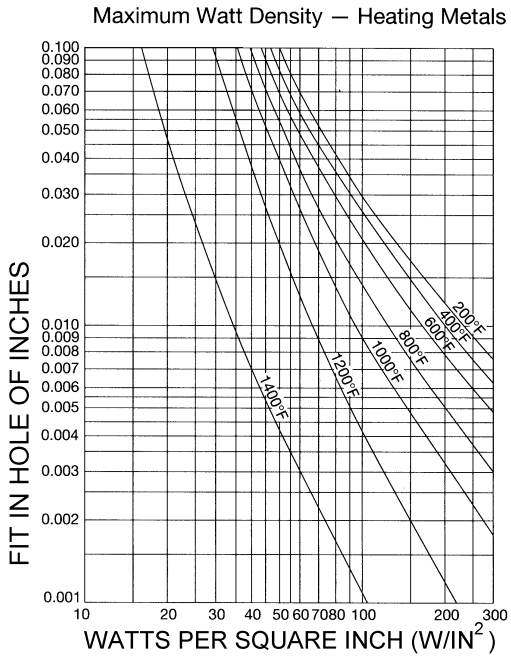
.

WATT DENSITY = HEATER WATTAGE/(HEATED LENGTH x HEATER DIAMETER x 3.1416)
= W/(HL x D x 3.1416)

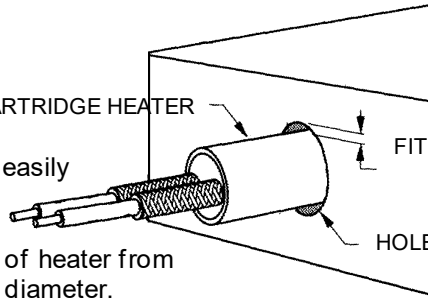
EXAMPLE: WHERE W = HEATER WATTAGE = 1200
D = DIAMETER = .5";
HL = HEATED LENGTH = 11"

WATT DENSITY = 1200/(11 x .5 x 3.1416) = 70 W/SQ. INCH

The following chart gives the maximum permissible sheath watt densities for a heater at a desired temperature on the metal.



This graph is useful for choosing AKINSUN'S REDROD cartridge heaters. The curves should be considered as guides and not precise limits. The chart will tell you either the maximum hole fit or recommended watt density of the heater. Enter the chart with either known variable, part fit in hole dimension or w/in². Then find the application temperature by reading up or over on the chart.



Fit of the heater is easily determined by subtracting the minimum diameter of heater from the maximum hole diameter.
Example: Take a hole diameter .500" minus a cartridge diameter of .496 ± .002 inch. The hole fit will be .500" - .494" = .006"

If the heater selected had watt density higher than that allowed by the graph, then these changes could be considered.

1. More heaters of lower watt densities should be used.
2. Using longer or larger diameter heaters.
3. Improving the fit by closer tolerances.
4. Reducing heat requirements by reducing heat losses or by allowing for longer heat-up time.

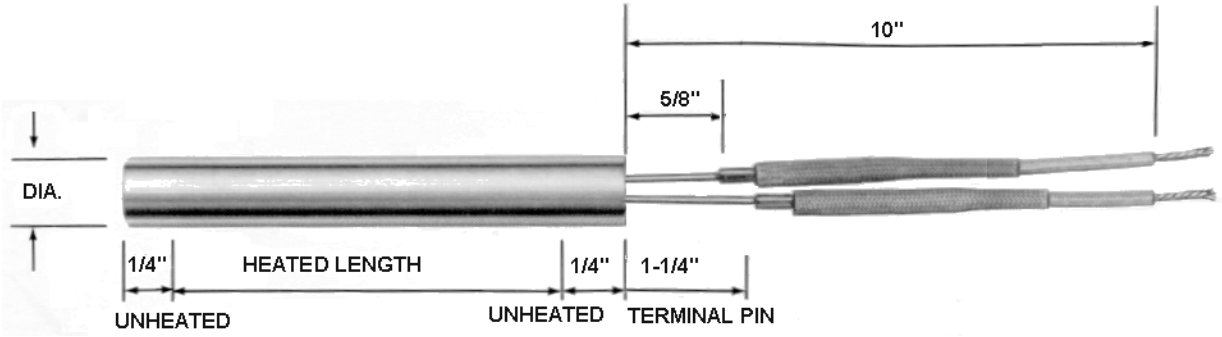
Also note, these graphs depict REDROD Cartridge heater used in steel parts. Therefore for either Stainless steel or aluminum and brass use the following correction factors.

1) STAINLESS STEEL add .0015" to fit being calculated.

2) ALUMINUM AND BRASS adds 100°F (38°C) to actual temperature.

Redrod™ Specifications

High Watt Density Cartridge heater



DIMENSIONAL DATA

DIAMETER	*NOMINALN.*	*1/4*	*3/8*	*1/2*	*5/8*	*3/4*	*1*
	NOMINAL MM	*6.00*	*9.52*	*12.70*	*15.87*	*19.05*	*25.40*
	ACTUAL IN.	*.246*	*.371*	*.496*	*.621*	*.746*	*.996*
	ACTUAL MM	*6.25*	*9.42*	*12.60*	*15.77*	*18.95*	*25.30*
LENGTH	*MINIMUM IN.*	*1*	*1*	*1*	*1 1/4*	*1 1/4*	*1 3/4*
	MINIMUM MM	*25.40*	*25.40*	*25.40*	*31.75*	*31.75*	*44.45*
	MAXIMUM IN.	*36*	*48*	*60*	*72*	*72*	*72*
	MAXIMUM MM	*915*	*1220*	*1520*	*1830*	*1830*	*1830*

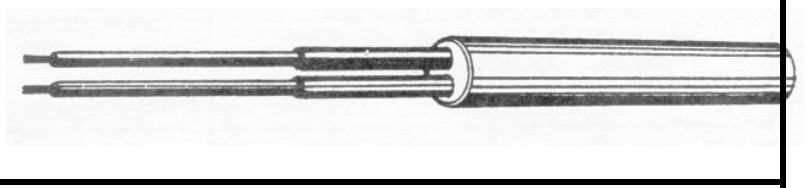
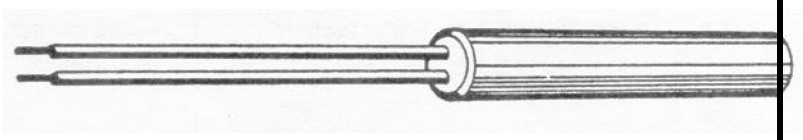
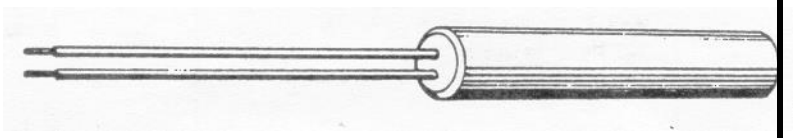
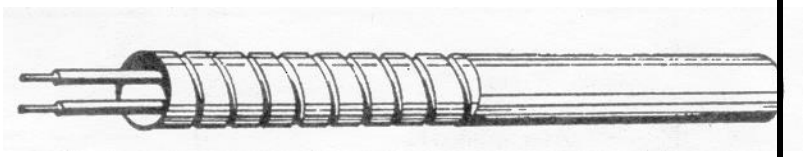
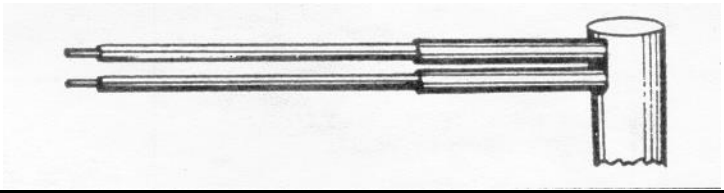
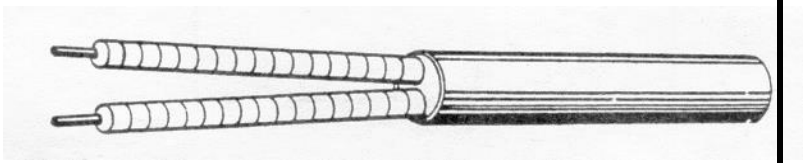
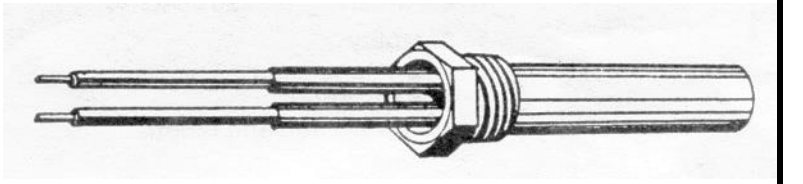
DIMENSIONAL TOLERANCES

DIAMETER	*INCHES*	*± .002*	*±.002*	*±.002*	*±.002*	*±.002*	*±.003*
	MM	*± .051*	*± .051*	*± .051*	*± .051*	*± .051*	*± .076*
LENGTH	*UP TO 4 1/2 IN.*	*± 3/32*	*± 3/32*	*± 3/32*	*± 3/32*	*± 3/32*	*± .125*
	ABOVE 4 1/2 IN.	*± 2 % OF SHEATH LENGTH*					
CAMBER	*UP TO 12 IN.*	*.010 IN. PER FOOT LENGTH*					
	OVER 12 IN.	*.020 IN. PER FOOT LENGTH*					

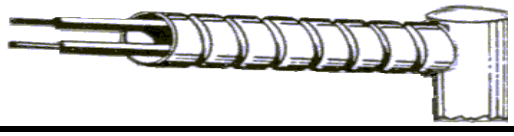
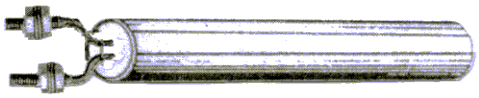
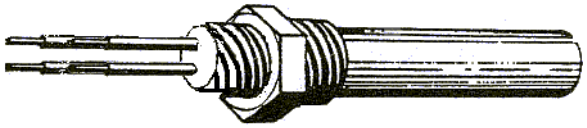
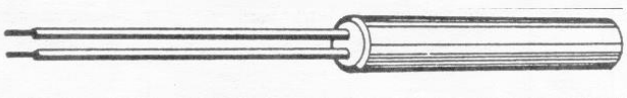
ELECTRICAL DATA

MAXIMUM VOLTS		*240*	*240*	*240*	*480*	*480*	*480*
MAXIMUM AMPS		*4.4*	*6.7*	*10.5*	*23*	*23*	*23*
MINIMUM WATTS	*1 IN.*	*100*	*65*	*40*	*35*	*30*	*---*
AT 120V FOR	*2 IN.*	*55*	*35*	*25*	*20*	*15*	*15*
HEATER LENGTH	*3 IN.*	*40*	*25*	*20*	*15*	*10*	*10*
MAXIMUM	*120*	*525*	*800*	*1160*	*2760*	*2760*	*2760*
WATTS AT	*240*	*1050*	*1600*	*2320*	*5520*	*5520*	*5520*
GIVEN VOLTS	*480*	*---*	*---*	*---*	*11000*	*11000*	*11000*

Termination and Style

TYPE	DESCRIPTION	
A	**Standard Leads.** *Leads 10″ standard crimp connected externally. Insulated with fiberglass sleeve.*	
B	**All Flexible Leads.** *Leads 10″ standard internally connected. Does not have any external modification, allows complete flexibility.*	
C	**Teflon Seal & Leads.** *requires 1″ cold section on lead end. Available in REDROD only. Max. Temp. at plug end 350°F. Leads are completely flexible.*	
D	**Flexible Conduit.** *12″ flexible conduit over 14″ leads. Diameter of cable does not exceed heater diameter.*	
F	**Right Angle Leads.** *Metal capped end disc. Requires 5/8″ cold end on top. Cannot be applied to stock.*	
G	**Ceramic Bead Heat Resistant Over Bare Leads.** *6″ beads over 6 1/2″ leads. Good for Temperatures to 1100°F.*	
H	**NPT Pipe Fittings.** *1/4″ Dia. requires 1/8-27 NPT* *3/8″ Dia. requires 1/4-18 NPT* *1/2″ Dia. requires 3/8-18 NPT* *5/8″ Dia. requires 1/2-14 NPT* *3/4″ Dia. requires 3/4-14 NPT*	

Termination and Style

TYPE	DESCRIPTION	
R	**Right Angle Conduit.** *12″ flexible conduit exit at right angle over 14″ leads.*	
S	**Screw Terminal.** *Provide quick, secure connection with ring or fork connectors. Available on 1/2″, 5/8″, 3/4″ and 1″ Dia.*	
T	**Immersion Heater.** *Double ender fittings Available in Brass, Steel and St. Stl.*	
U	**Sealed End.** *Available with Silicone Epoxy or Cement seal.*	

Cartridge Heater Ordering Information

When Ordering, Please Specify:

1. Quantity
2. Diameter
3. Sheath Length
4. Lead Variation and Length
5. Voltage
6. Wattage
7. Options
8. Special Construction

Order code example: R161216A05

R 16 1216 A 05

REDROD CARTRIDGE HEATER

HEATER DIAMETER 1/2”

LENGTH OF HEATER 12 ½

TYPE OF HEATER

MANUFACTURING CODE *

*ASSIGNED AT THE TIME OF MANUFACTURING

FRACTION	CODE
1/32	*01*
1/16	*02*
1/8	*04*
1/4	*08*
1/2	*16*
5/8	*20*
3/4	*24*

High Watt Density "Redrod™"

Standard Sizes and Ratings

DIAMETER INCHES	SHEATH LENGTH	VOLTS	WATTS	CATALOG NUMBER	WATT DENSITY
1/4" (Actual Dia. .246)	1"	120	80	R080100A02	208
	1"	120	100	R080100A13	260
	1"	120	150	R080100A04	390
	1 1/4"	120	75	R080108A01	130
	1 1/4"	120	100	R080108A02	175
	1 1/2"	120	50	R080116A01	67
	1 1/2"	120	100	R080116A16	130
	1 1/2"	240	175	R080116A05	228
	1 1/2"	210	200	R080116A06	260
	1 1/2"	240	200	R080116A07	260
	2"	120	80	R080200A30	70
	2"	240	125	R080200A02	108
	2"	120	150	R080200A03	160
	2"	240	150	R080200A04	160
	2"	120	250	R080200A07	215
	2"	240	250	R080200A08	215
	2 1/2"	120	250	R080216A16	160
	2 1/2"	240	250	R080216A13	160
	3"	120	200	R080300A02	134
	3"	240	200	R080300A03	134
	3"	120	300	R080300A04	156
	3"	240	300	R080300A05	156
	4"	120	100	R080400A01	35
	4"	120	200	R080400A02	75
	4"	240	200	R080400A03	75
	4 1/2"	120	200	R080416A03	65
	5"	240	350	R080500A02	100
	5"	120	400	R080500A26	115
	5"	240	400	R080500A03	115
	6"	120	400	R080600A01	95
3/8" (Actual Dia. .371)	1"	240	100	R120100A02	175
	1"	120	150	R120100A03	260
	1"	240	200	R120100A04	345
	1 1/4"	120	125	R120108A02	145
	1 1/4"	120	150	R120108A03	175
	1 1/4"	240	150	R120108A04	175
	1 1/4"	240	200	R120108A06	230
	1 1/4"	120	400	R120108A15	400
	1 1/2"	120	50	R120116A26	45
	1 1/2"	120	75	R120116A02	65
	1 1/2"	120	100	R120116A03	100
	1 1/2"	120	150	R120116A05	130
	1 1/2"	240	150	R120116A06	130
	1 1/2"	120	200	R120116A07	175
	1 1/2"	240	200	R120116A15	175

DIAMETER INCHES	SHEATH LENGTH	VOLTS	WATTS	CATALOG NUMBER	WATT DENSITY
3/8" (Actual Dia. .371)	1 3/4"	120	125	R120124A01	85
	1 3/4"	120	175	R120124A02	125
	1 3/4"	120	250	R120124A03	172
	1 3/4"	240	250	R120124A04	175
	2"	120	100	R120200A25	60
	2"	240	100	R120200A03	60
	2"	120	150	R120200A29	85
	2"	240	150	R120200A39	85
	2"	120	200	R120200A06	115
	2"	240	200	R120200A07	115
	2 1/4"	120	250	R120208A05	125
	2 1/4""	240	250	R120208A16	125
	2 1/4"	120	300	R120208A17	150
	2 1/4"	240	300	R120208A08	150
	2 1/4"	120	350	R120208A09	175
	2 1/4"	240	350	R120208A10	175
	2 1/2"	120	200	R120216A01	85
	2 1/2"	240	200	R120216A02	85
	2 1/2"	120	250	R120216A03	110
	2 1/2"	240	250	R120216A04	110
	2 1/2"	120	400	R120216A07	175
	2 1/2"	240	400	R120216A19	175
	2 1/2"	120	500	R120216A09	215
	2 1/2"	240	500	R120216A10	215
	3"	120	100	R120300A01	35
	3"	240	100	R120300A02	35
	3"	120	200	R120300A04	70
	3"	240	200	R120300A05	70
	3"	120	250	R120300A06	90
	3"	240	250	R120300A15	90
	3 1/2"	120	250	R120316A01	75
	3 1/2"	240	250	R120316A30	75
	3 1/2"	120	300	R120316A03	85
	3 1/2"	240	300	R120316A04	85
	4"	120	250	R120400A04	65
	4"	240	250	R120400A05	65
	4"	120	500	R120400A10	125
	4"	240	500	R120400A11	125
	4 1/2"	120	500	R120416A03	110
	4 1/2"	240	500	R120416A04	110
	5"	120	300	R120500A03	60
	5"	240	300	R120500A04	60
	5"	120	500	R120500A05	95
	5"	240	500	R120500A06	95
	6"	120	500	R120600A06	80

Akinsun HEAT CO., INC.

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High watt density " Redrod"		
Part Number	**Size** (inch)	**Price**
R160516A04	2 x52	
R160600A03	2 x6	
R160600A20	2 x6	
R160600A07	2 x6	
R160600A08	2 x6	
R160700A04	2 x7	
R160700A05	2 x7	
R160700A06	2 x7	
R160716A01	2 x72	
R160716A02	2 x72	
R160800A02	2 x8	
R160800A03	2 x8	
R160800A04	2 x8	
R160800A05	2 x8	
R160816A01	2 x82	
R160816A02	2 x82	
R160900A02	2 x9	
R160900A03	2 x9	
R160916A07	2 x92	
R160916A02	2 x92	
R161000A05	2 x10	
R161000A16	2 x10	
R161100A24	2 x11	
R161200A03	2 x12	
R161200A32	2 x12	
R161200A05	2 x12	
R161200A06	2 x12	
R161400A01	2 x14	
R161400A02	2 x14	
R161500A02	2 x15	
R161600A11	2 x16	
R161800A01	2 x18	
R161800A02	2 x18	
R200108A03	sx14	
R200116A04	s x12	
R200116A05	s x12	
R200200A01	s x2	
R200200A03	s x2	
R200208A02	s x24	
R200208A03	s x24	
R200300A21	s x3	
R200300A04	s x3	
R200300A05	s x3	
R200400A06	s x4	
R200400A07	s x4	
R200500A03	s x5	
R200500A04	s x5	
R200600A01	s x6	
R200600A03	s x6	
R200600A05	s x6	

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High watt density " Redrod"		
Part Number	**Size** (inch)	**Price**
R200616A15	s x62	
R200616A10	s x62	
R200700A01	s x7	
R200700A03	s x7	
R200700A04	s x7	
R200800A02	S x8	
R200800A04	s x8	
R200800A05	s x8	
R201000A03	s x10	
R201000A04	s x10	
R201000A05	s x10	
R201200A09	s x12	
R201200A16	s x12	
R201200A05	s x12	
R201500A01	s x15	
R201500A02	s x15	
R201600A09	s x16	
R201600A29	s x16	
R201800A24	s x18	
R201800A12	s x18	
R202000A20	s x20	
R202000A21	s x20	
R202400A01	s x24	
R202400A02	s x24	
R240300A01	w x3	
R240300A02	w x3	
R240400A01	w x4	
R240400A02	w x4	
R240400A03	w x4	
R240500A01	w x5	
R240500A02	w x5	
R240500A03	w x5	
R240600A01	w x6	
R240600A03	w x6	
R240600A04	w x6	
R240700A01	w x7	
R240700A02	w x7	
R240700A03	w x7	
R240800A01	w x8	
R240800A02	w x8	
R240800A03	w x8	
R240800A04	w x8	
R241000A01	w x10	
R241000A02	w x10	
R241200A01	w x12	
R241200A02	w x12	
R241300A08	w x13	
R241400A01	w x14	
R241400A02	w x14	
R241600A01	w x16	

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High watt density " Redrod"		
Part Number	**Size** (inch)	**Price**
R241800A01	w x18	
R241800A02	w x18	
R242000A08	w x20	
R242400A01	w x24	
R242400A03	w x24	

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Bolt heaters		
Part Number	**Size** (inch)	**Price**
V14001800		
V14002400		
V14003000		
V16001800		
V16002400		
V16003600		
V17001908		
V17002508		
V17003108		
V17004308		
V17005508		
V20001800		
V20002400		
V20003600		
V22001800		
V22002400		
V22003600		
V27001908		
V27002508		
V27003108		
V27003408		
V30002208		
V30002808		
V30003408		
V30004608		
V32022208		
V32022808		
V32023408		
V32024608		

High Watt Density "Redrod™"

Standard Sizes and Ratings

DIAMETER INCHES	SHEATH LENGTH	VOLTS	WATTS	CATALOG NUMBER	WATT DENSITY
(Actual Dia. .371)	8″	120	500	R120800A03	60
	8″	240	500	R120800A04	60
	8″	240	1000	R120800A07	115
	9″	240	1000	R120900A01	100
	10″	120	400	R121000A01	35
	10″	120	600	R121000A02	55
	10″	240	600	R121000A03	55
	10″	240	1000	R121000A04	90
	12″	120	600	R121200A12	45
	12″	240	600	R121200A02	45
	12″	240	1000	R121200A04	75
1/2″ (Actual Dia. .496)	1″	120	50	R160100A03	50
	1″	120	150	R160100A02	195
	1 1/4″	120	125	R160108A09	110
	1 1/4″	240	125	R160108A01	110
	1 1/4″	240	250	R160108A04	215
	1 1/2″	120	150	R160116A09	95
	1 1/2″	240	150	R160116A01	95
	1 1/2″	120	200	R160116A04	130
	1 1/2″	240	200	R160116A05	130
	2″	120	200	R160200A02	85
	2″	240	200	R160200A29	85
	2″	120	300	R160200A06	130
	2″	240	300	R160200A07	130
	2″	120	400	R160200A08	170
	2″	240	400	R160200A09	170
	2 1/4″	120	250	R160208A03	90
	2 1/4″	240	250	R160208A04	90
	2 1/4	120	500	R160208A07	185
	2 1/4″	240	500	R160208A08	185
	2 1/2″	120	100	R160216A01	35
	2 1/2″	240	100	R160216A02	35
	2 1/2″	120	250	R160216A03	80
	2 1/2″	240	250	R160216A04	80
	2 1/2″	120	500	R160216A09	160
	2 1/2″	240	500	R160216A10	160
	3″	120	250	R160300A03	65
	3″	240	250	R160300A25	65
	3″	120	500	R160300A09	130
	3″	240	500	R160300A10	130
	3 1/2″	120	250	R160316A01	55
	3 1/2″	240	250	R160316A02	55
	3 1/2″	120	500	R160316A04	105
	3 1/2″	240	500	R160316A05	105
	4″	120	300	R160400A05	55
	4″	240	300	R160400A06	55
	4″	120	500	R160400A11	95
	4″	240	500	R160400A12	95
	4 1/2″	120	750	R160416A03	120
	4 1/2″	240	750	R160416A04	120

DIAMETER INCHES	SHEATH LENGTH	VOLTS	WATTS	CATALOG NUMBER	WATT DENSITY
1/2″ (Actual Dia. .496)	5″	120	500	R160500A07	75
	5″	240	500	R160500A08	75
	5″	120	750	R160500A09	110
	5″	240	750	R160500A10	110
	5″	240	1000	R160500A11	145
	5 1/2″	120	750	R160516A03	95
	5 1/2″	240	750	R160516A04	95
	6″	120	500	R160600A03	60
	6″	240	500	R160600A20	60
	6″	120	1000	R160600A07	115
	6″	240	1000	R160600A08	115
	7″	120	600	R160700A04	60
	7″	240	600	R160700A05	60
	7″	240	1000	R160700A06	100
	7 1/2″	240	500	R160716A01	45
	7 1/2″	240	1000	R160716A02	95
	8″	120	500	R160800A02	45
	8″	240	500	R160800A03	45
	8″	120	1000	R160800A04	85
	8″	240	1000	R160800A05	85
	8 1/2″	240	500	R160816A01	40
	8 1/2″	240	1000	R160816A02	80
	9″	240	500	R160900A02	40
	9″	240	1000	R160900A03	75
	9 1/2″	240	500	R160916A07	35
	9 1/2″	240	1000	R160916A02	75
	10″	240	1000	R161000A05	70
	10″	240	1500	R161000A16	105
	11″	240	1000	R161100A24	60
	12″	120	1000	R161200A03	55
	12″	240	1000	R161200A32	55
	12″	240	1500	R161200A05	85
	12″	240	2000	R161200A06	115
	14″	240	1000	R161400A01	50
	14″	240	2300	R161400A02	110
	15″	240	1500	R161500A02	65
	16″	240	1000	R161600A11	40
	18″	240	1500	R161800A01	55
	18″	240	1700	R161800A02	60
5/8″ (Actual Dia. .621)	1 1/4″	120	200	R200108A03	135
	1 1/2″	120	250	R200116A04	130
	1 1/2″	240	250	R200116A05	130
	2″	120	100	R200200A01	35
	2″	240	500	R200200A03	170
	2 1/4″	120	350	R200208A02	105
	2 1/4″	240	350	R200208A03	105
	3″	240	250	R200300A21	50
	3″	120	500	R200300A04	105
	3″	240	500	R200300A05	105

High Watt Density "Redrod™"

Standard Sizes and Ratings

DIAMETER INCHES	SHEATH LENGTH	VOLTS	WATTS	CATALOG NUMBER	WATT DENSITY
5/8" (Actual Dia. .621)	4"	240	750	R200400A06	110
	4"	240	1000	R200400A07	150
	5"	240	500	R200500A03	60
	5"	240	750	R200500A04	85
	6"	120	300	R200600A01	30
	6"	240	500	R200600A03	50
	6"	240	1000	R200600A05	95
	6"	240	1500	R200600A06	140
	6 1/2"	120	500	R200616A15	45
	6 1/2"	240	500	R200616A10	45
	7"	120	500	R200700A01	40
	7"	240	1000	R200700A03	80
	7"	240	1500	R200700A04	120
	8"	240	500	R200800A02	35
	8"	240	1000	R200800A04	70
	8"	240	1500	R200800A05	102
	10"	240	1000	R201000A03	55
	10"	240	1500	R201000A04	80
	10"	240	2000	R201000A05	110
	12"	120	1500	R201200A09	65
	12"	240	1500	R201200A16	65
	12"	240	2000	R201200A05	90
	15"	240	750	R201500A01	30
	15"	240	2400	R201500A02	85
	16"	240	2500	R201600A09	85
	16"	240	4500	R201600A29	150
	18"	240	1500	R201800A24	45
	18"	240	3000	R201800A12	85
	20"	240	1500	R202000A20	40
	20"	240	4700	R202000A21	125
	24"	240	2000	R202400A01	45
	24"	240	4700	R202400A02	105

DIAMETER INCHES	SHEATH LENGTH	VOLTS	WATTS	CATALOG NUMBER	WATT DENSITY
3/4" (Actual Dia. .746)	3"	120	250	R240300A01	45
	3"	240	500	R240300A02	85
	4"	120	250	R240400A01	30
	4"	240	500	R240400A02	60
	4"	240	1000	R240400A03	125
	5"	120	300	R240500A01	30
	5"	240	300	R240500A02	50
	5"	240	1000	R240500A03	95
	6"	120	500	R240600A01	40
	6"	240	1000	R240600A03	80
	6"	240	2000	R240600A04	155
	7"	120	500	R240700A01	35
	7"	240	500	R240700A02	35
	7"	240	1000	R240700A03	65
	8"	120	500	R240800A01	30
	8"	240	500	R240800A02	30
	8"	240	1000	R240800A03	60
	8"	240	2000	R240800A04	115
	10"	240	1000	R241000A01	45
	10"	240	2000	R241000A02	90
	12"	240	2000	R241200A01	75
	12"	240	4000	R241200A02	150
	13"	240	1000	R241300A08	35
	14"	240	1250	R241400A01	40
	14"	240	2500	R241400A02	80
	16"	240	1800	R241600A01	50
	16"	240	4700	R241600A02	130
	18"	240	2000	R241800A01	50
	18"	240	5000	R241800A02	125
	20"	240	1150	R242000A08	25
	24"	240	1375	R242400A01	25
	24"	240	5500	R242400A03	100

Watt Density: Metric Size

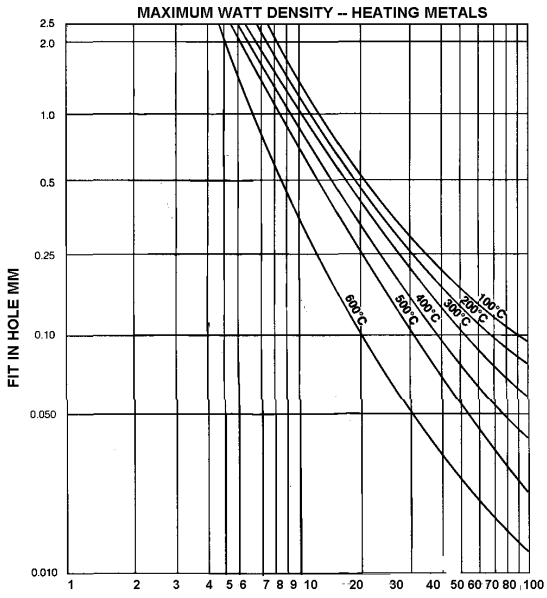
Watt density on the sheath of cartridge heater is defined as the wattage dissipated per cm square of the heated sheath surface. This watt density determines the internal wire being used. These factors are critical to the proper heating of the application and to the life expectancy of the heater.

WATT DENSITY = HEATER WATTAGE/(HEATED LENGTH x HEATER DIAMETER x 3.1416)
= W/(HL x D x 3.1416)

EXAMPLE: WHERE W = HEATER WATTAGE = 1200
D = DIAMETER = 16mm = 1.6cm
HL = HEATED LENGTH = 280mm = 28.00cm

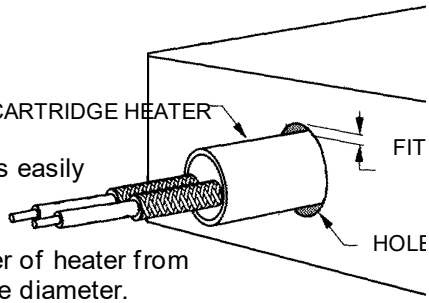
WATT DENSITY = 1200/(28.00 x 1.60 x 3.1416) = 8.53 W/cm²

The following chart gives the maximum permissible sheath watt densities for a heater at a desired temperature on the metal.



WATT DENSITY - W/CM²

This graph is useful for choosing AKINSUN REDROD metric size cartridge heaters. The curves should be considered as guides and not precise limits. The chart will tell you either the maximum hole fit or recommended watt density of the heater. Enter the chart with either known variable. part fit in hole dimension or w/cm². Then find the application temperature by reading up or over on the “Maximum Watt density- Heating Metals” chart.



Fit of the heater is easily Determined by Subtracting the Minimum diameter of heater from the maximum hole diameter.

Example: Take a hole diameter 16mm minus a cartridge diameter of 15.92 ± 0.051mm. The hole fit will be 16mm - 15.87mm = 0.131mm

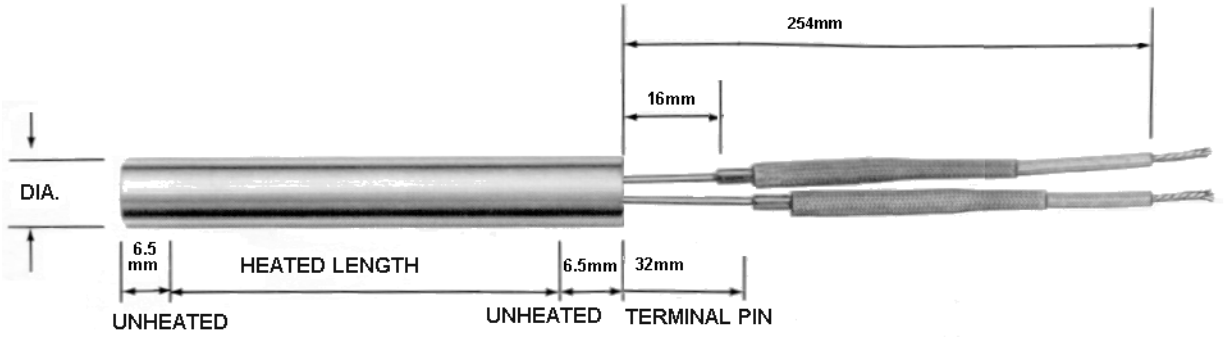
If the heater selected had watt density higher than that allowed by the graph, then these changes could be considered.

1. More heaters of lower watt densities should be used.
2. Using longer or larger diameter heaters.
3. Improving the fit by closer tolerances.
4. Reducing heat requirements by reducing heat losses or by allowing for longer heat-up time.

Also note, these graphs depict REDROD Metric Cartridge heater used in steel parts. Therefore for either Stainless steel or aluminum and brass use the following correction factors.

1) STAINLESS **STEEL** adds .038mm to fit being calculated.
2) ALUMINUM **AND BRASS** adds 100°F (38°C) to actual temperature, then enter the graph.

Metric Size High Watt Density/ Specifications



Metric size Cartridge Heaters are made exactly like our Redrod series swaged Cartridge Heaters. Using the same material and construction procedures.

DIMENSIONAL DATA

DIAMETER	*NOMINAL MM*	*10*	*12*	*12.5*	*16*	*20*
	NOMINAL IN	*.394*	*.472*	*.492*	*.630*	*.787*
	ACTUAL MM	*9.93*	*11.90*	*12.42*	*5.92*	*19.91*
	ACTUAL IN	*.390*	*.468*	*.488*	*.626*	*.784*
LENGTH	*MINIMUM MM*	*25.40*	*25.40*	*25.40*	*31.75*	*31.75*
	MINIMUM IN	*1*	*1*	*1*	*1¼*	*1¼*
	MAXIMUM MM	*1220*	*1220*	*1520*	*1830*	*1830*
	MAXIMUM IN	*48*	*48*	*60*	*72*	*72*

DIMENSIONAL TOLERANCES

DIAMETER	*MM*	*± .051*	*± .051*	*± .051*	*± .051*	*± .051*
	INCHES	*± .002*	*±.002*	*±.002*	*±.002*	*±.002*
LENGTH	*UP TO 115MM*	*± 2.4*	*± 2.4*	*±.2.4*	*±2.4*	*±2.4*
	ABOVE 115MM	*± 2 % OF SHEATH LENGTH*				
CAMBER	*UP TO 30 MM*	*0.254MM PER 300 MM LENGTH*				
	OVER 30MM	*0.510MM PER 300 MM LENGTH*				

E LECTRICAL DATA

MAXIMUM VOLTS		*240*	*240*	*240*	*480*	*480*
MAXIMUM AMPS		*4.4*	*6.7*	*10.5*	*23*	*23*
MINIMUM WATTS	*25.4 MM LONG*	*100*	*65*	*40*	*35*	*30*
AT 120V FOR	*50.8 MM LONG*	*55*	*35*	*25*	*20*	*15*
HEATER LENGTH	*76.2 MM LONG*	*40*	*25*	*20*	*15*	*10*
MAXIMUM	*120*	*525*	*800*	*1160*	*2760*	*2760*
WATTS AT	*240*	*1050*	*1600*	*2320*	*5520*	*5520*
GIVEN VOLTS	*480*	*---*	*---*	*---*	*11000*	*11000*

Metric size Cartridge Heaters are available in almost any terminations and styles as shown in Redrod series Cartridge Heaters. Please consult factory for details.