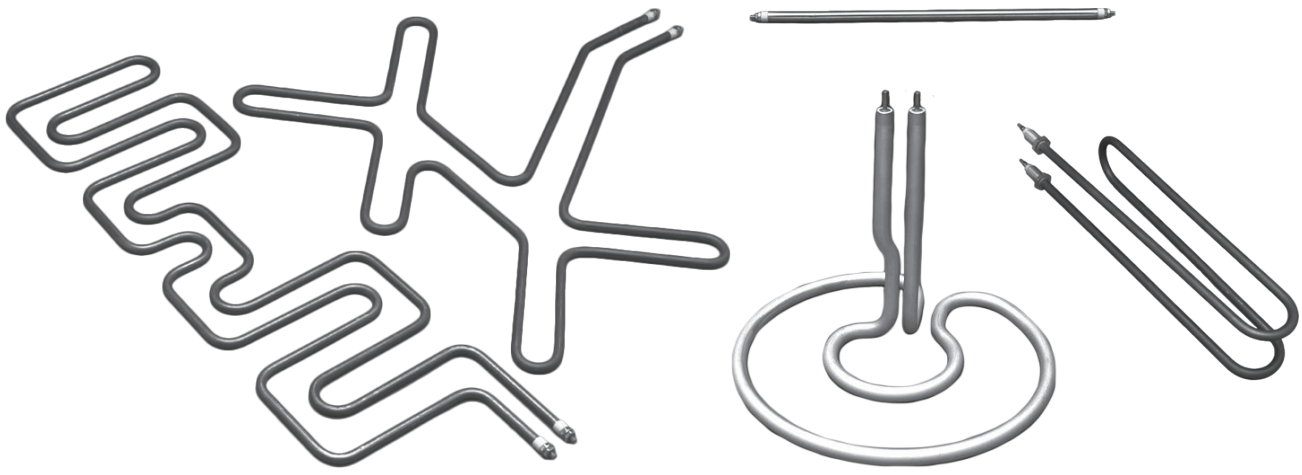
DUREX INDUSTRIES

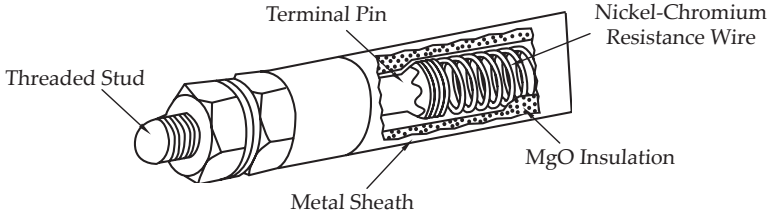
closing the loop on thermal solutions

Tubular Heaters

INTRODUCTION

Highly versatile and economical Durex tubular heating elements are applied in virtually every conceivable type of heating application. These robust heaters are a reliable thermal source used to heat a multitude of liquids, gases, and solids and can be applied straight or bent into complex formations. Tubular heaters are also used for radiant heating in open air or in vacuum atmospheres. The elements can be cast into or clamped onto metal to form heated parts. A wide selection of standard designs are available or they can be custom designed for your requirements. Durex Industries' application and design engineering team are available to assist in specifying the proper heater configuration.





Design Features

Precision helical wound nickel-chromium resistance wire

◦ Provides uniform thermal profile

Circumferential cold pin-to-wire fusion weld

◦ Ensures robust connection for long heater life

Compacted, high purity MgO dielectric insulation

◦ Extends resistance wire life at high temperatures

Recompacted bends

◦ Provides longer life by ensuring insulation integrity

UL & CSA recognized elements available

◦ Assures safe and reliable performance

Typical Applications

- Metal mold, die and platen heating
- Medical and analytical device heating
- Cast into metal parts and platens
- Cut and seal heads on packaging equipment
- Tank wall and pipe heating
- Liquid immersion & circulation heaters
- Furnace & oven heating
- Comfort heating and freeze protection
- Process air and gas heating
- Thermoforming, curing, drying

190 Detroit Street, Cary, Illinois 60013 • Phone: 847-639-5600 • Fax: 847-639-2199 • Web: www.durexindustries.com • TOLL FREE: 800-762-3468

TUBULAR HEATER SPECIFICATIONS

Physical and Electrical Specifications

Sheath Diameter +-0.005″ (+-0.13mm)	0.260″ (6.60mm)	0.315″ (8.00mm)	0.375″ (9.52mm)	0.430″ (10.92mm)	0.475″ (12.07mm)	0.496″ (12.60mm)
Sheath Length Max.	404″ (10,260mm)	370″ (9398mm)	337″ (8560mm)	329″ (8356mm)	281″ (7137mm)	263″ (6680mm)
Maximum Voltage	250	480	480	600	600	600
Maximum Amperage	15	30	30	40	40	40
Wattage Tolerance	Industry Standard +5% -10%					
Resistance Tolerance	Industry Standard +10% -5%					

Length Specifications

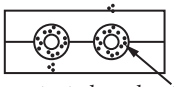
Overall Sheath Length	11-20″	21-50″	51-80″	81-110″	111-140″	141-170″	171-200″	201″ & up
Sheath Length	± 3/32″	± 1/8″	± 5/32″	± 3/16″	± 7/32″	± 1/4″	± 3/8″	± 1/2″
Heated Length	± 1/4″	± 1/2″	± 7/8″	± 1 1/8″	± 1 3/8 “	± 1 5/8″	± 1 7/8″	± 2 3/8″
Minimum Unheated	1″	1 1/4″	1 ½″	1 5/8″	1 ¾″	2″	2 ¼″	2 ½″

APPLICATION GUIDELINES

Heating Metal Parts

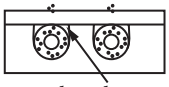
Below are the installation methods for heating metals in order of best to least effective.

BEST - Cast In or Milled Groove Plates



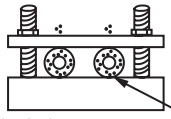
Excellent contact along heater sheath

GOOD - Milled Groove & Plate



Air gaps reduce heat transfer

FAIR - Clamp On

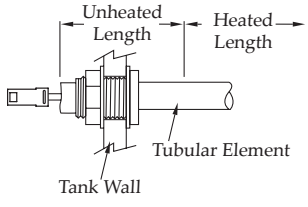


Very little heater-to-part contact makes it difficult to transfer heat

Durex recommends to “press fit” the tubular element into milled groove plates for extended heater life. Ensure that all heated portions of the heater are in contact with the part. Heat transfer cement should be used to promote heat transfer. If clamps are used, they should be closely spaced and not over tightened to ensure good heater-to-part contact. Allow for up to 10% length increase due to thermal expansion during heating.

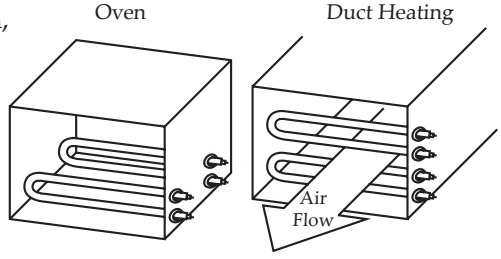
Heating Liquids

To prevent overheating or fouling the heater element, ensure the heated portion of the tubular heater is immersed in liquid AT ALL TIMES. For optimal results, properly match the sheath material and heater watt density to the liquid application. Factory installed fittings or field installed compression fittings are used to mount and seal the tubular element against the tank wall. Refer to the Immersion, Circulation and Over-The-Side Heater sections of the catalog for other liquid heating products.



Heating Air & Gases

Tubular elements are typically formed into a “U” hairpin or other formation, installed through wall openings and secured with lock washers, clips, threaded fittings, mounting bracket or flange. For optimal results, use an Incoloy® sheath and ensure reasonable watt densities are used. Allow for 10% length increase due to thermal expansion. For horizontal installations, provide supports at least every 18” of length to avoid element sagging due to high temperatures. Refer to the Circulation and Duct Heater sections of the catalog for forced air and gas heating products.



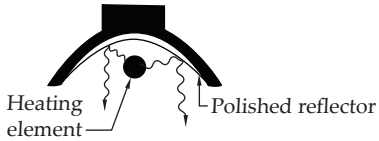
190 Detroit Street, Cary, Illinois 60013 • Phone: 847-639-5600 • Fax: 847-639-2199 • Web: www.durexindustries.com • TOLL FREE: 800-762-3468

APPLICATION GUIDELINES

Radiant Heating and Vacuums

Tubular heaters used for radiant heating typically use reflectors to direct heat energy toward the part being heated. This works well for warming, drying and curing applications. However, when using heaters in a vacuum, the only heat transfer is through radiation, so reduce watt density by 20% to 30% versus air heating. Aluminum sheath as well as Inconel® sheathed heaters are typically used with vacuum feed through assemblies. Durex can test and measure vacuum leakage rates down to $8x10^{-8}$ SCCS He ($3x10^{-6}$ Pa l/s).

REFLECTIVE RADIANT HEATER



General Temperature and Watt Density Guidelines

Tubular Sheath & Watt Density Guidelines

Heated Medium	Process Temperature °F (°C)	Sheath Material	Max. Watt Density W/in² (W/cm²)
Solids			
Clamp On to Metal	To 500 (260) To 1000 (540)	Incoloy®	20 (3) 10 (1.5)
Milled Groove Molds, Etc.	To 500 (260) To 1000 (540)	Incoloy®	60 (9) 30 (4.5)
Vacuum Platens	To 650 (345) To 1000 (540)	Aluminum, SS Incoloy® or Inconel®	40 (6) 20 (3)
Liquids			
Clean, Potable Water	To 212 (100) To 500 (260)	Copper Incoloy®	60 - 90 (9 - 14) 30 - 40 (4.5 - 6)
De-I Water	To 212 (100)	316SS	60 (9)
Process Water & Very Diluted Corrosives	To 200 (95)	304SS or Incoloy®	48 (7.5)
Mild or Dilute Acids & Alkalies	To 200 (95)	Incoloy®, 316SS or Inconel®	15 - 23 (2.3 - 3.5)
Oils (Depends on Type & Use)	50 - 600 (10 - 315)	Steel	6 - 23 (1 - 3.5)
Air			
Ovens, Natural Convection	To 700 (370) To 1200 (650)	Incoloy®	30 (4.5) 10 (2.3)
Flowing Air @ min. 500 fpm	To 800 (425) To 1000 (650)	Incoloy®	30 (4.5) 23 (3.5)

Maximum Recommended Sheath Temperatures

Sheath Material	Maximum Temperature in Air °F (°C)	Typical Applications
Standard Available Sheath Materials		
Copper	350 (175)	Clean, potable water heating
Aluminum	750 (400)	Vacuum platens
Steel	750 (400)	Oils, glycol, molten salts, non-corrosives
304 SS	1200 (650)	Improved corrosion resistance over steel
316 SS	1200 (650)	De-ionized water and some corrosives
Incoloy® 840	1600 (870)	Improved corrosion resistance over steel and 304SS
Incoloy® 800	1600 (870)	Improved resistance to chloride attack, other corrosives
Other Available Sheath Materials		
321 SS	1200 (650)	Improved corrosion resistance over steel and 304SS
Incoloy® 825	1600 (870)	Highly resistant to many acids, salts and other media
Inconel® 600	1800 (980)	Highly resistant to many acids, salts and other media

190 Detroit Street, Cary, Illinois 60013 • Phone: 847-639-5600 • Fax: 847-639-2199 • Web: www.durexindustries.com • TOLL FREE: 800-762-3468

CONSTRUCTION OPTIONS

Unheated Length

The unheated length can be varied to suit application requirements. Longer unheated sections are often used to keep the termination area cool or to focus heat generation in a specific area of the part or media being heated.

Distributed Wattage

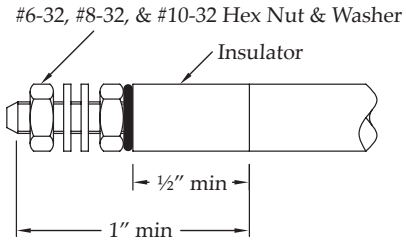
Durex tubular heaters can be tailor-made to vary the watt density along the length of the heater.
This aids in temperature uniformity in mold applications or to make up for heat losses close to the ends.

Sheath Treatment and Finish

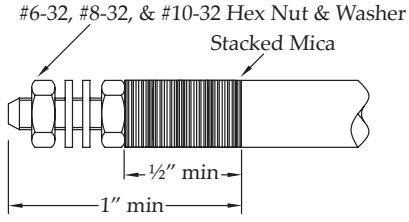
For pharmaceutical and other "clean" applications, a bright anneal finish can be supplied. Also available, depending on configuration, is sheath passivation which removes any free iron that may stain or rust the finish of the sheath.

TERMINATION OPTIONS

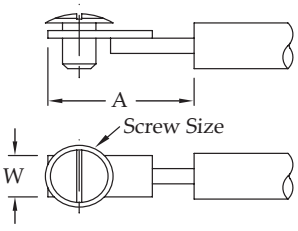
TYPE S
Threaded Stud Terminal with Ceramic Insulator



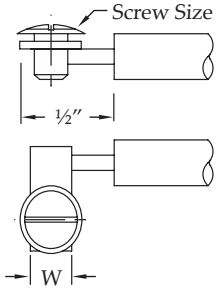
TYPE S1
Threaded Stud Terminal with Stacked Mica



TYPE L
Screw Lug Terminal

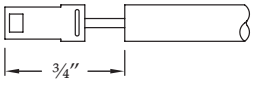


TYPE L1
Screw Lug Terminal 90°

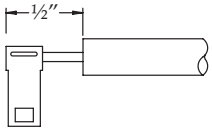


Screw Size	Dia.	A	W
#8-32	To 0.315"	7/8"	5/16"
#10-32	0.375" and above	1 1/16"	7/16"
Maximum 240V			

TYPE D
Quick Connect

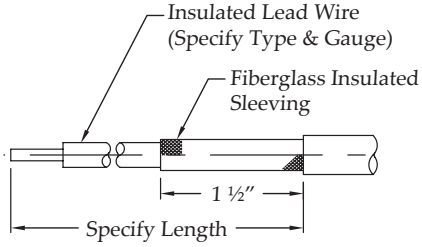


TYPE D1
Quick Connect 90°



Maximum 240V

TYPE W
Leadwire Terminal Assembly



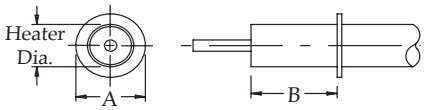
Type	Insulation	Max. Temperature	Volts
WS	Silicone	390°F (200°C)	600V
WF	Fiberglass	480°F (250°C)	600V
WM	Mica/Glass	840°F (450°C)	600V

Note: If protective armor cable (hose) is required, please consult factory.

190 Detroit Street, Cary, Illinois 60013 • Phone: 847-639-5600 • Fax: 847-639-2199 • Web: www.durexindustries.com • TOLL FREE: 800-762-3468

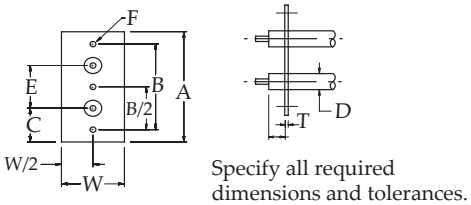
MOUNTING OPTIONS

TYPE R
Locator Washers



Heater Dia.	A	B
0.260″	3/4″	Specify
0.315″	5/8″	Specify
0.375″	3/4″	Specify
0.430″	3/4″	Specify
0.475″	3/4″	Specify

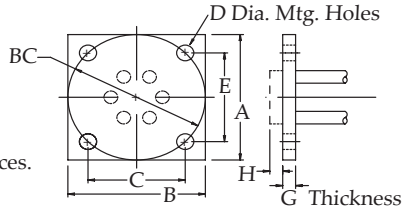
TYPE K
Mounting Bracket



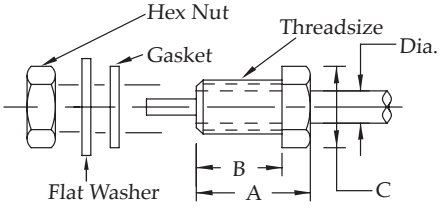
Specify all required dimensions and tolerances.

TYPE F
Mounting Flange

Specify all required dimensions and tolerances.



TYPE B
Threaded Bulkhead Fittings



Type	Material
BB	Brass
BS	Steel
B4	304SS

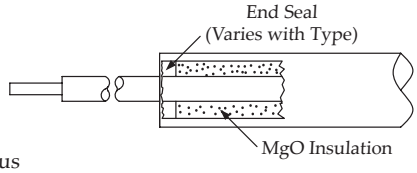
Dia.	Thread	A	B	C
0.260″	1/2 - 20	3/4″	5/8″	3/4″
0.315″	1/2 - 20	3/4″	5/8″	3/4″
0.375″	5/8 - 18	15/16″	3/4″	7/8″
0.430″	5/8 - 18	15/16″	3/4″	7/8″
0.475″	3/4 - 20	1″	7/8″	1″

SEAL OPTIONS

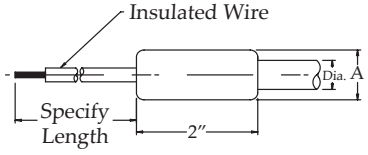
TYPE G - Silicone Conformal Coating - General Protection, Porous
Max. temperature: 220°F (105°C)

TYPE E - Epoxy Seal - Moisture and Contamination Resistant (better choice for long-term moisture resistance), Low porosity
Max. temperature: 450°F (230°C)

TYPE V - Silicone RTV - Moisture and Contamination Protection, Porous
Max. temperature: 400°F (200°C)

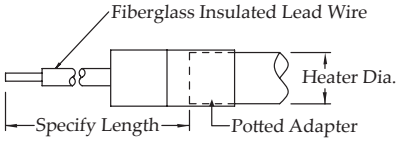


TYPE M
Silicone Rubber Overmold
Max. temperature: 300°F (150°C)



Dia.	A
0.260″	7/16″
0.315″	7/16″
0.430″	5/8″

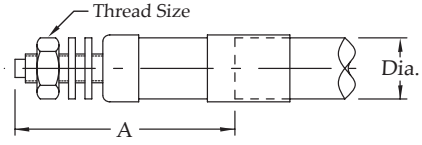
TYPE PA
Potted Adapter



Potted protection tube ensures an integral bond between wire insulation, the seal, and protective sleeving that may be required.

- Type PS is silicone RTV and silicone insulated lead wire
- Type PP is epoxy coating and Fiberglass insulated lead wire
- Type PT is epoxy coating and Teflon® insulated lead wire

TYPE HS
Ceramic to Metal Hermetic Terminals
Max. temperature: 1000°F (540°C)



Thread Size	Dia.	W
#8-32	0.260″	1 3/4″
#10-32	0.315″	1 7/8″
#1/4-28	0.430″	2 1/8″

190 Detroit Street, Cary, Illinois 60013 • Phone: 847-639-5600 • Fax: 847-639-2199 • Web: www.durexindustries.com • TOLL FREE: 800-762-3468

BENDING OPTIONS

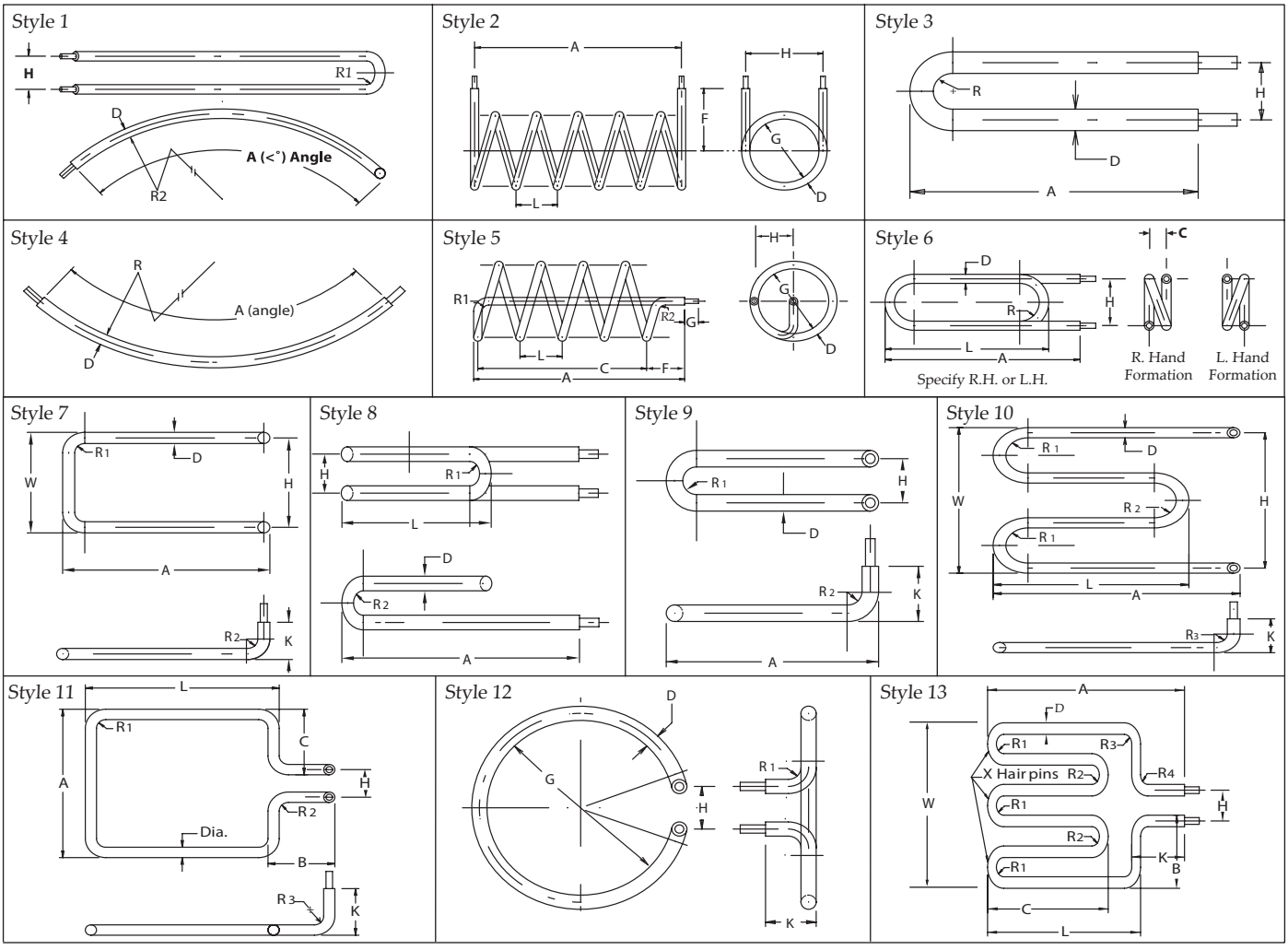
Tubular elements can be formed into 2-D and 3-D shapes to better suit application requirements. Typical bend configurations are shown across the following pages. Ensure to allow for up to 10% dimensional increase due to thermal expansion and to provide adequate support to prevent element sagging due to high temperatures. If field bending of straight elements is necessary, contact Durex for field bending guidelines prior to bending. Also specify "full sheath anneal" on the order to allow for field bending.

Bend Tolerances for Incoloy® and Stainless Steel Sheath Elements

Bend Data Reference	Heater Diameter					
	0.260″	0.315″	0.375″	0.430″	0.475″	0.490″
Minimum Bend Radius Standard	0.437″	0.562″	0.687″	0.75″	0.812″	0.875″
Minimum Bend Radius w/Repressed Bend	0.375″	0.50″	0.562″	0.625″	0.687″	0.75″
Standard Bend Tolerances	±1/8″	±1/8″	±1/8″	±1/8″	±1/8″	±1/8″
Special Bend Tolerances	±1/16″	±1/16″	±1/16″	±1/16″	±1/16″	±1/16″
Precision Bend Tolerances w/Tooling	±0.005″	±0.005″	±0.005″	±0.005″	±0.005″	±0.005″

Note: Tighter bend radii possible for steel and copper sheath elements. Please consult Durex for more information.

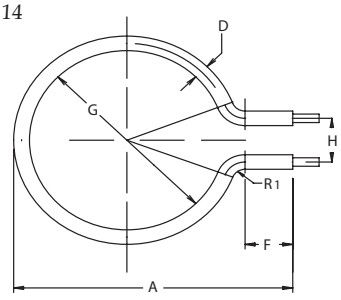
TYPICAL BEND FORMATIONS



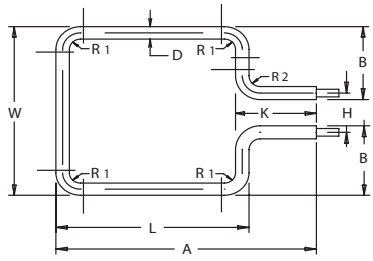
190 Detroit Street, Cary, Illinois 60013 • Phone: 847-639-5600 • Fax: 847-639-2199 • Web: www.durexindustries.com • TOLL FREE: 800-762-3468

TYPICAL BEND FORMATIONS

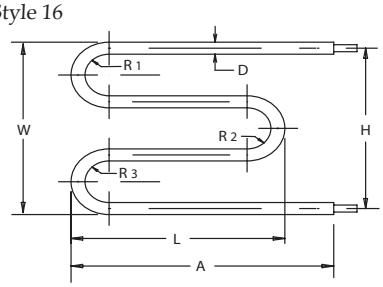
Style 14



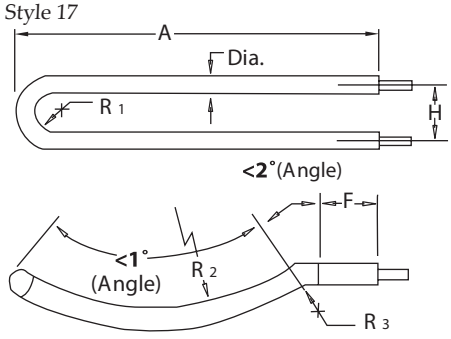
Style 15



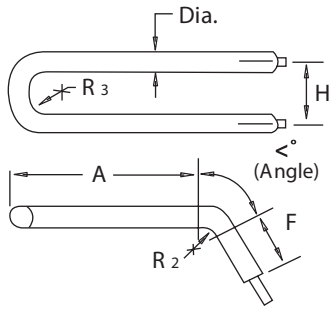
Style 16



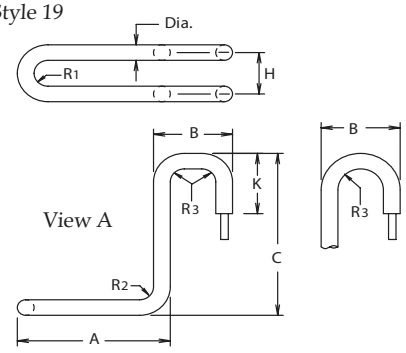
Style 17



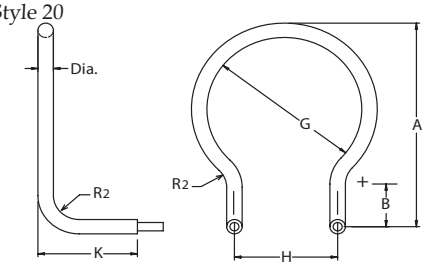
Style 18



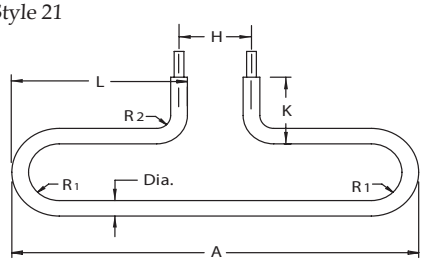
Style 19



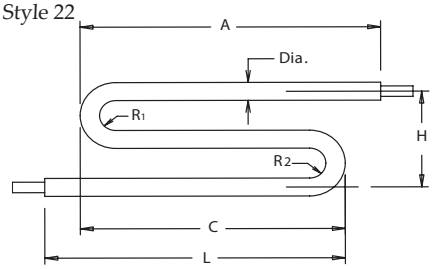
Style 20



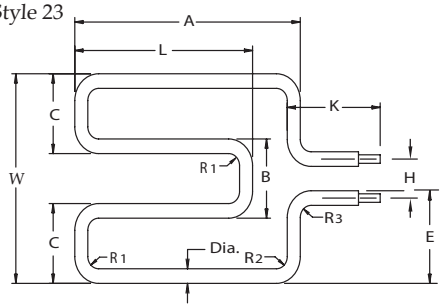
Style 21



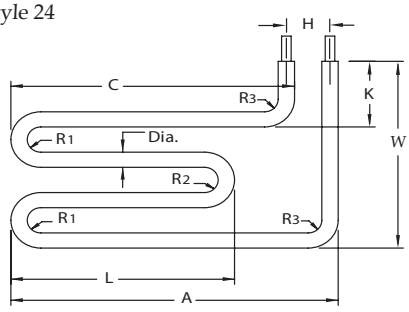
Style 22



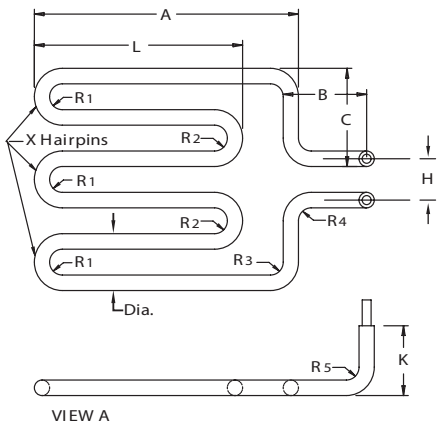
Style 23



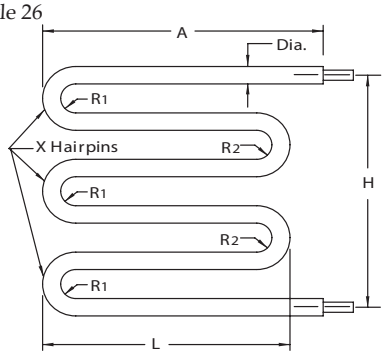
Style 24



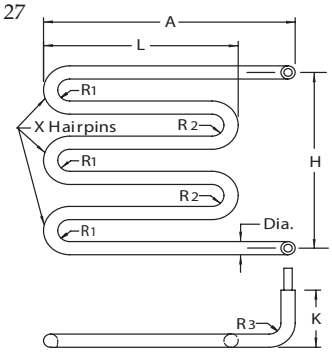
Style 25



Style 26



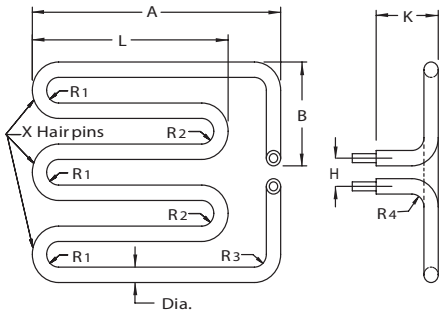
Style 27



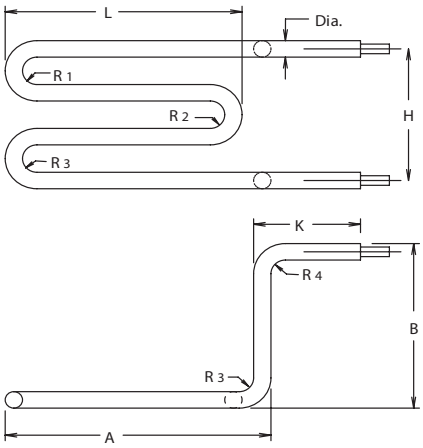
190 Detroit Street, Cary, Illinois 60013 • Phone: 847-639-5600 • Fax: 847-639-2199 • Web: www.durexindustries.com • TOLL FREE: 800-762-3468

TYPICAL BEND FORMATIONS

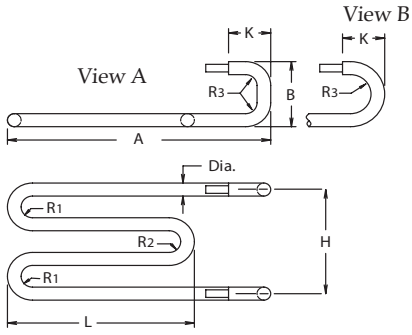
Style 28



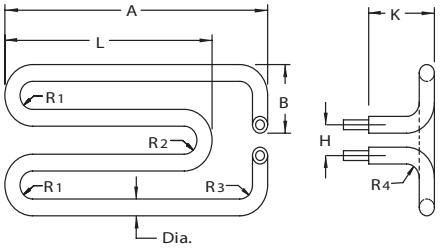
Style 29



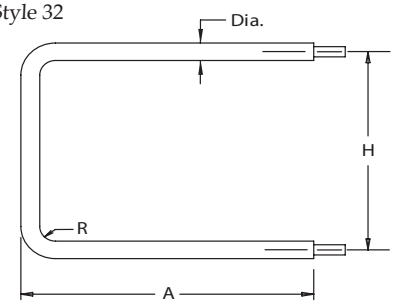
Style 30



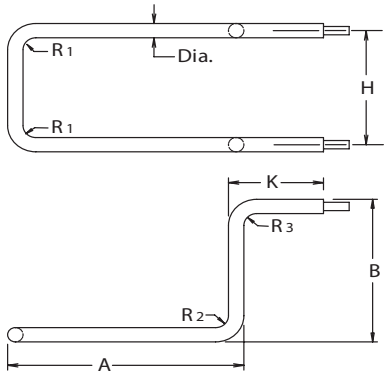
Style 31



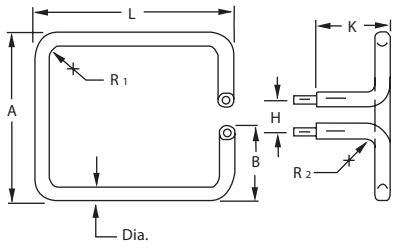
Style 32



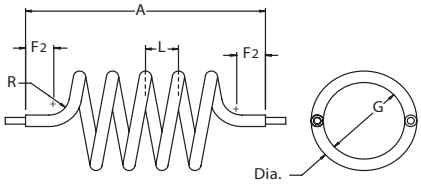
Style 33



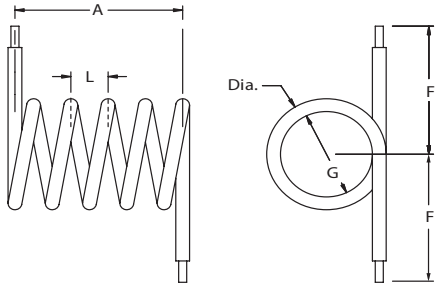
Style 34



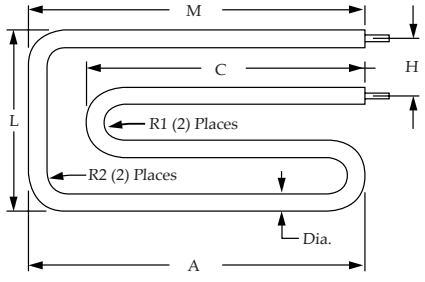
Style 35



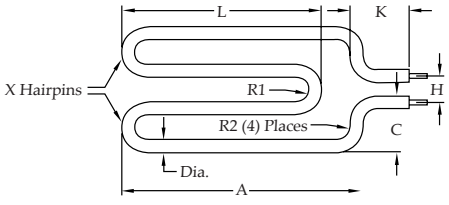
Style 36



Style 37



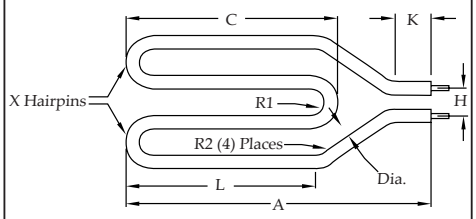
Style 38



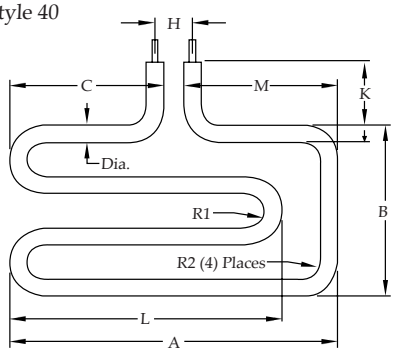
190 Detroit Street, Cary, Illinois 60013 • Phone: 847-639-5600 • Fax: 847-639-2199 • Web: www.durexindustries.com • TOLL FREE: 800-762-3468

TYPICAL BEND FORMATIONS

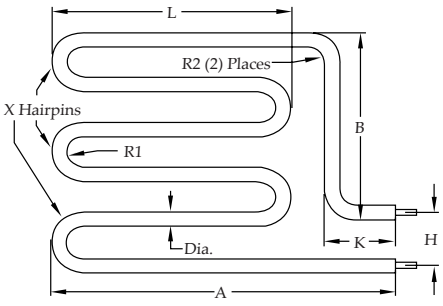
Style 39



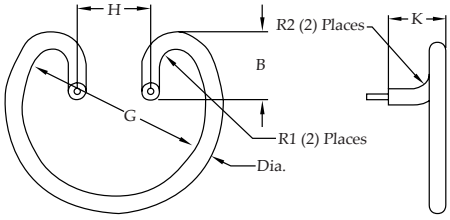
Style 40



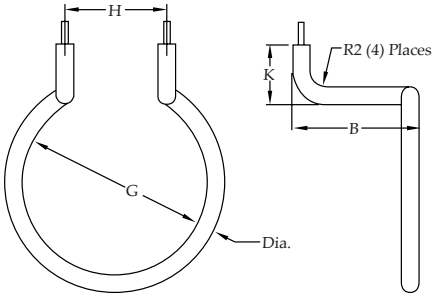
Style 41



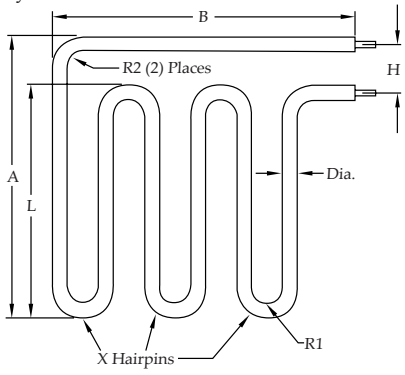
Style 42



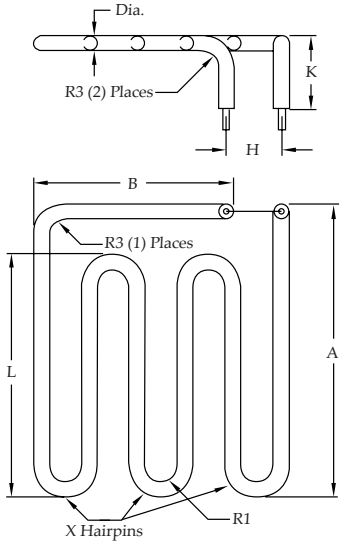
Style 43



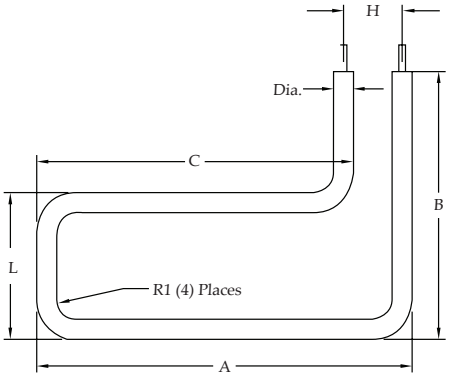
Style 44



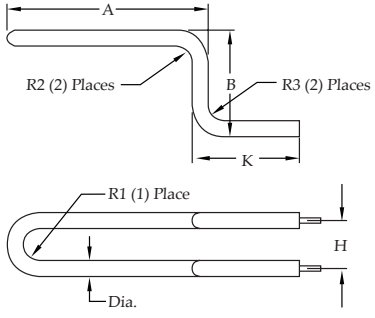
Style 45



Style 46



Style 47



190 Detroit Street, Cary, Illinois 60013 • Phone: 847-639-5600 • Fax: 847-639-2199 • Web: www.durexindustries.com • TOLL FREE: 800-762-3468