Chromalox®

Corrosion Resistant Products

Heating Solutions For Corrosive Applications

The First Name in Electric Heat

Chromalox®

The First Name in Electric Heat

Immersion Heating Solutions

Since 1917, Chromalox® has become the world's leading manufacturer of electric heating elements, electronic temperature controls, and heating systems. At Chromalox®, application engineering assistance, quality, longevity, safety, and unsurpassed customer support are all top priorities. With the largest most experienced sales force in the industry, there is an experienced application engineer in your immediate area who can help solve the most demanding heating requirements specific to your needs.

This catalog will aid you in finding the right heater, control, or heat transfer system for most open tank corrosive applications. In addition to the many corrosive resistant products herein, Chromalox® offers thousands of other types of products exclusively designed to meet most heating applications. For immediate assistance, or for more information on the entire line of Chromalox® products, contact your local representative listed on the back cover of this catalog.

Table of Contents

Chromalox®

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The First Name in Electric Heat

Standard Features and Heater Selection Guide

The Chromalox® Line of Corrosion Resistant Over-The-Side Products Incorporates many Standard Features:

G Series of metal and Teflon® immersion heaters:
- Standard over-temperature thermal fuse (optional resettable system available)
- Fully grounded metal sheath
- Vapor tight and acid resistant poly-pro housing
- 36” flexible conduit and lead wires

PT and CT Series of metal immersion heaters:
- Heavy duty grounded tubular element
- Low profile and light weight
- Vapor tight and acid resistant PVC housing
- 36” flexible conduit and lead wires

TP Series of Teflon® coated immersion heaters:
- Standard over-temperature protection
- Teflon coated fully grounded stainless steel sheath
- Low profile and light weight
- Vapor tight and acid resistant PVC housing

QM Series of quartz immersion heaters:
- Standard over-temperature thermal fuse (optional resettable system available)
- Replaceable Grounded INCOLOY® tubular elements
- Vapor tight and acid resistant poly-pro housing
- 36” flexible conduit and lead wires

GR and U Series of over-the-side heat exchangers:
- Fully pressure tested
- Low profile and light weight

CMX Heat Transfer Systems:
- Custom cast twin tank and pump assembly
- Microprocessor based temperature control
- Open and closed loop cooling options
- ASME 125 psi safety pressure relief valve

CES Steam Boilers:
- Low water cut-off/level control
- Integral electrical control
- ASME 100 psi safety pressure relief
- Long life heating elements

4468 Series Temperature/Power Control Panels:
- NEMA 4X construction
- Fused power transformer
- Full hose down design
- Many controller options

Shipment:
- 24 Hour Shipment on all **stock** (**S**) products
- 2 weeks or less on most non-stock (N) catalog items
- 2-4 weeks on most engineered specials
- 4-6 weeks for engineered special boilers or heat transfer systems

Heater Selection Guide:

The following heater selection guide will help you in selecting the proper heater for your intended application. The guide is not all inclusive, and any questions about choosing the proper heater or heat exchanger for your application should be discussed with your local Chromalox representative listed on the back cover of this catalog.

Material to be Heated**	Heater Series	Sheath Material	Watt Density (Typical)	pH Range (Typical)	Reference Pages
Alkaline solutions, copper sulphate, electro cleaners, mild acid baths, wash and dip tanks containing alkali, caustic soda, detergents, and aqueous solutions.	GS, GS3, GSL, GSL3, GSV3 PTH, CT, PTHF	Stainless Steel Stainless Steel	20-40 20-40	5 or above	3-7 1, 2
Alkali solutions, nitric, non-flouride chromic, and gold acids, nickle plating	GT, GT3, GTL, GTL3, GTV3 PTHT, CTT	Titanium Titanium	20-40 20-40	5 or above*	3-7 1
Non-alkaline pickling, electroplating and finishing solutions. Acid solutions	QM, QM3	Quartz	25	6 or below	17, 18
Severly corrosive solutions, acid solutions, flourides.	GTF, GTFN, GTFL, GTFNL GTFL3, GTF6, GTF9 TPR, TPF	Teflon Covered Teflon Covered Teflon Coated	10 10 20	All Ranges	8-11 12, 15, 16 13, 14

* Titanium can handle certain acids with much lower pH ranges. Consult corrosion guide at rear of catalog or local Chromalox representative.

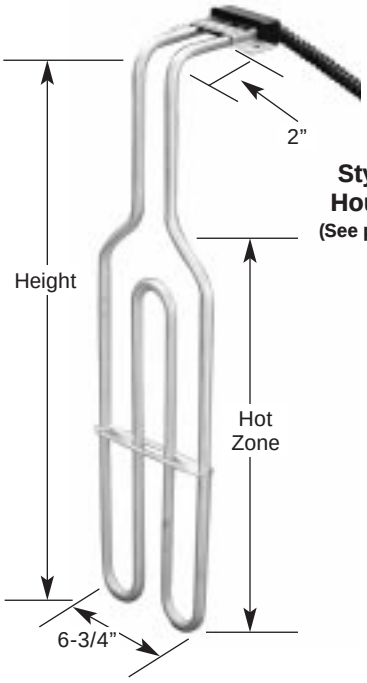
** For non corrosive solutions, screwplug, flanged or other heater products and controls, refer to our full-line product catalog (P-2000) or consult your local Chromalox representative for assistance.

Teflon® is a registered trademark of E.I. DuPont Co.
INCOLOY® is a registered trademark of Inco Alloys International Inc.

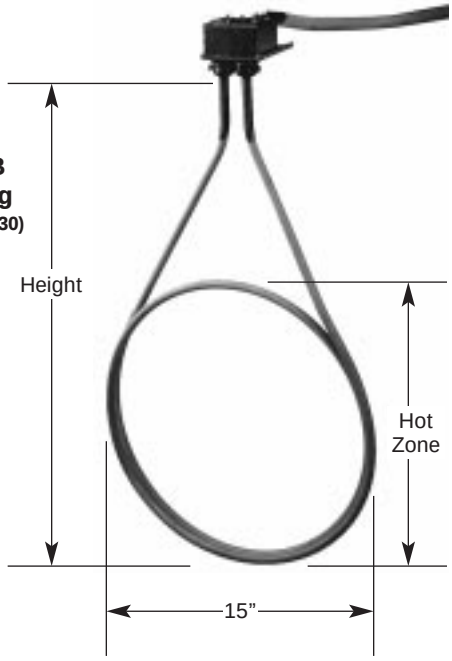
PTH and CT Metal Heaters
Light Weight Tubular Element

Features

- 1 to 9 kW
- 17 to 44 WPSI
  (others watt densities available)
- 120, 240 & 480 volts single phase
  (other voltages optional)
- Steel, 304 SS and other sheath
  materials and configurations available
- See PTHF line for standard 3 phase
  product offering



PTH*



CT

Specifications

316SS Catalog #	316SS PCN	Titanium Catalog #	Titanium PCN	kW	W/in²	Volts	Height (in.)	Hot Zone (in.)	Weight (lbs.)	Stock Status
PTH-101	326043	PTHT-101	098976	1	20	120	14	8	4	S
PTH-102	326051	PTHT-102	098984	1	20	240	14	8	4	S
PTH-202	326060	PTHT-202	098992	2	30	240	21	11	4	S
PTH-204	326078	PTHT-204	099004	2	30	480	21	11	4	S
PTH-302	326086	PTHT-302	099012	3	30	240	26	16	5	S
PTH-304	326094	PTHT-304	099020	3	30	480	26	16	5	S
PTH-402	326107	PTHT-402	099039	4	35	240	30	20	5	S
PTH-404	326115	PTHT-404	099047	4	35	480	30	20	5	S
PTH-602	326123	PTHT-602	099055	6	35	240	40	30	6	S
PTH-604	326131	PTHT-604	099063	6	35	480	40	30	6	S
PTH-902	326140	PTHT-902	099071	9	35	240	54	44	8	S
PTH-904	326158	PTHT-904	099080	9	35	480	54	44	8	S

Catalog #	PCN	Sheath Material	kW	W/in²	Volts	Height (in.)	Hot Zone (in.)	Weight (lbs.)	Stock Status
CTSS-50	195944	304 Stainless Steel	5	25	240	26	15	8	S
CTSS-75	195952	304 Stainless Steel	7.5	40	240	26	15	8	S
CTAC-50	195995	Carp. 20 Stainless	5	25	240	26	15	8	S
CTAC-75	196007	Carp. 20 Stainless	7.5	40	240	26	15	8	S
CTT-50	269350	Titanium	5	44	240	26	15	8	S
CTT-75	269368	Titanium	7.5	44	240	26	15	8	S
CTLC-50	195960	Chem. Pure Lead	5	17	240	26	15	8	S
CTLC-50	195979	Chem. Pure Lead	5	17	480	26	15	8	S

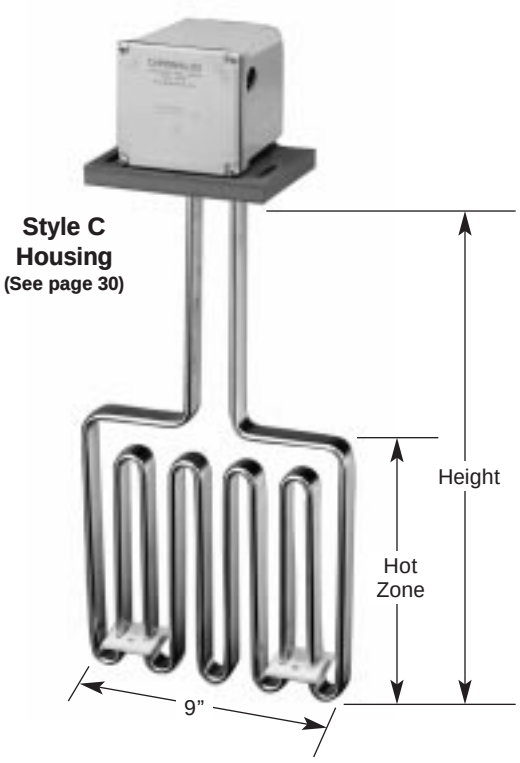
To Order: Specify quantity, catalog number, PCN, volts, watts, and phase.

QUICK SHIPMENT FROM STOCK

PTHF 3-Phase Metal Heaters
Stainless Steel Flat-Blade Element

Features

- 3 to 10 kW
- 20 WPSI
  (others watt densities available)
- 240 & 480 volts three phase standard
  (other voltages optional)
- 304 SS sheath standard, other sheath materials and other configurations available
- See PTH line for standard single phase product offering



Specifications

304SS Catalog #	304SS PCN	kW 20 W/in²	Volts	Phase	Height (in.)	Hot Zone (in.)	Weight (lbs.)	Stock Status
PTHF-302	098870	3	240*	1 or 3	16	7	7	**S**
PTHF-304	098880	3	480	1 or 3	16	7	7	N
PTHF-402	098896	4	240*	1 or 3	18	9	8	**S**
PTHF-404	098909	4	480	1 or 3	18	9	8	**S**
PTHF-602	098917	6	240*	3	22	13	9	N
PTHF-604	098925	6	480	3	22	13	9	N
PTHF-802	098933	8	240*	3	27	18	10	**S**
PTHF-804	098941	8	480	3	27	18	10	**S**
PTHF-1002	098950	10	240*	3	31	22	11	N
PTHF-1004	098968	10	480	3	31	22	11	N

To Order: Specify quantity, catalog number, PCN, volts, watts, and phase.

PTHF PRODUCTS
ENGINEERED SPECIFICALLY FOR CORROSIVE SOLUTIONS

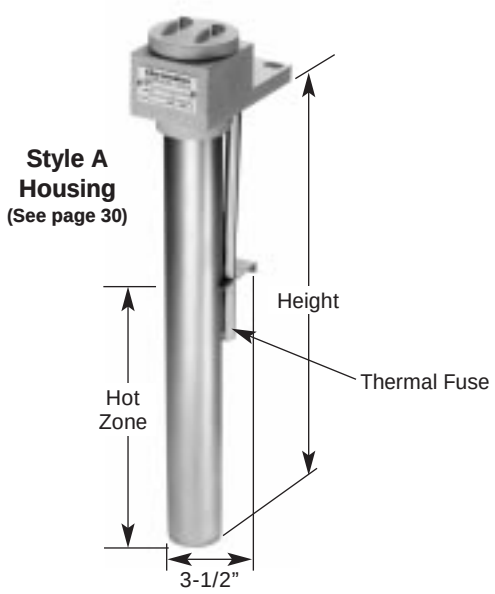
*UL®

QUICK SHIPMENT FROM STOCK

GS, GT Metal Heaters
Single 2” Diameter Element
With Over-Temp

Features

- 1 to 12 kW
- 20 and 40 WPSI
- 120, 240 & 480 volts single phase* other voltages optional
- Steel, 304 SS and other sheath materials and configurations available
- 1/2” O.D. fuse well (0.43” I.D.)



Specifications

316SS Catalog #	316SS PCN	Titanium Catalog #	Titanium PCN	kW 40 W/in²	kW 20 W/in²	Volts	Height (in.)	Hot Zone (in.)	Weight (lbs.)	Stock Status
GS-11	050016	GT-11	050331	1	-	120	11	6	6	**S**
GS-12	050024	GT-12	050340	1	-	240	11	6	6	**S**
GS-22	050032	GT-22	050358	2	-	240	17	10	9	**S**
GS-24	050040	GT-24	050366	2	-	480	17	10	9	**S**
GS-32	050059	GT-32	050374	3	-	240	23	16	11	**S**
GS-34	050067	GT-34	050382	3	-	480	23	16	11	**S**
GS-42	050075	GT-42	050390	4	-	240	29	20	13	**S**
GS-44	050083	GT-44	050403	4	-	480	29	20	13	**S**
GS-52	050091	GT-52	050411	5	-	240	35	25	16	**S**
GS-54	050104	GT-54	050420	5	-	480	35	25	16	**S**
GS-62	050112	GT-62	050438	6	-	240	40	30	18	**S**
GS-64	050120	GT-64	050446	6	-	480	40	30	18	**S**
GS-82	050139	GT-82	050454	8	-	240	47	37	21	N
GS-84	050147	GT-84	050462	8	-	480	47	37	21	N
GS-92	050155	GT-92	050470	9	-	240	54	44	23	N
GS-94	050163	GT-94	050489	9	-	480	54	44	23	N
GS-102	050171	GT-102	050497	10	-	240	59	49	25	N
GS-104	050180	GT-104	050500	10	-	480	59	49	25	N
GS-122	050198	GT-122	050518	12	-	240	68	58	29	N
GS-124	050200	GT-124	050526	12	-	480	68	58	29	N
GDS-12	050219	GDT-12	050534	-	1	240	17	10	9	**S**
GDS-14	050227	GDT-14	050542	-	1	480	17	10	9	**S**
GDS-22	050235	GDT-22	050550	-	2	240	29	20	13	**S**
GDS-24	050243	GDT-24	050569	-	2	480	29	20	13	**S**
GDS-32	050251	GDT-32	050577	-	3	240	40	30	17	**S**
GDS-34	050260	GDT-34	050585	-	3	480	40	30	17	**S**
GDS-42	050278	GDT-42	050593	-	4	240	47	37	21	N
GDS-44	050286	GDT-44	050606	-	4	480	47	37	21	N
GDS-52	050294	GDT-52	050614	-	5	240	59	49	25	N
GDS-54	050307	GDT-54	050622	-	5	480	59	49	25	N
GDS-62	050315	GDT-62	050630	-	6	240	68	58	29	N
GDS-64	050323	GDT-64	050649	-	6	480	68	58	29	N

To Order: Specify quantity, catalog number, PCN, volts, watts, and phase.
* Three phase available, consult Chromalox representative.

NEW PRODUCTS
ENGINEERED SPECIFICALLY FOR CORROSIVE SOLUTIONS

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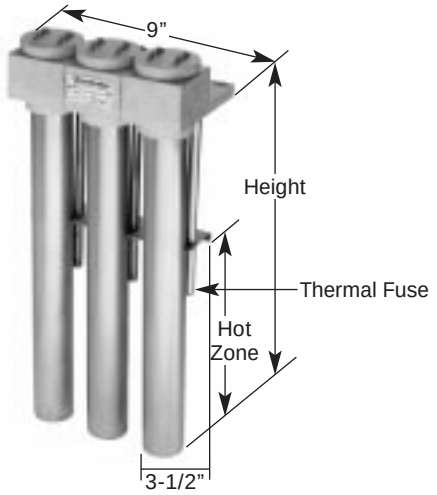
QUICK SHIPMENT FROM STOCK

GS3, GT3 Metal Heaters Triple 2" Diameter Elements With Over-Temp

Features

- 3 to 36 kW
- 20 and 40 WPSI
- 120, 240 & 480 volts* (other voltages optional)
- Steel, 304 SS and other sheath materials and configurations available
- Items shipped individually. **Pre-wired single terminal head available.
- 1/2" O.D. fuse well (0.43" I.D.)

Style A Housings
(See page 30)



Specifications

316SS Catalog #	316SS PCN	Titanium Catalog #	Titanium PCN	kW 40 W/in²	kW 20 W/in²	Volts	Height (in.)	Hot Zone (in.)	Weight (lbs.)	Stock Status
GS3-32	050657	GT3-32	050972	3	-	120	11	6	18	**S**
GS3-34	050665	GT3-34	050980	3	-	240	11	6	18	**S**
GS3-62	050673	GT3-62	050999	6	-	240	17	10	27	**S**
GS3-64	050681	GT3-64	051000	6	-	480	17	10	27	**S**
GS3-92	050690	GT3-92	051019	9	-	240	23	16	33	**S**
GS3-94	050702	GT3-94	051027	9	-	480	23	16	33	**S**
GS3-122	050710	GT3-122	051035	12	-	240	29	20	39	**S**
GS3-124	050729	GT3-124	051043	12	-	480	29	20	39	**S**
GS3-152	050737	GT3-152	051051	15	-	240	35	25	46	**S**
GS3-154	050745	GT3-154	051060	15	-	480	35	25	46	**S**
GS3-182	050753	GT3-182	051078	18	-	240	40	30	50	**S**
GS3-184	050761	GT3-184	051086	18	-	480	40	30	50	**S**
GS3-242	050770	GT3-242	051094	24	-	240	47	37	63	N
GS3-244	050788	GT3-244	051107	24	-	480	47	37	63	N
GS3-272	050796	GT3-272	051115	27	-	240	54	44	69	N
GS3-274	050809	GT3-274	051123	27	-	480	54	44	69	N
GS3-302	050817	GT3-302	051131	30	-	240	59	49	75	N
GS3-304	050825	GT3-304	051140	30	-	480	59	49	75	N
GS3-362	050833	GT3-362	051158	36	-	240	68	58	84	N
GS3-364	050841	GT3-364	051166	36	-	480	68	58	84	N
GDS3-362	050850	GDT3-362	051174	-	3	240	17	10	27	**S**
GDS3-364	050868	GDT3-364	051182	-	3	480	17	10	27	**S**
GDS3-62	050876	GDT3-62	051190	-	6	240	29	20	39	**S**
GDS3-64	050884	GDT3-64	051203	-	6	480	29	20	39	**S**
GDS3-92	050892	GDT3-92	051211	-	9	240	40	30	54	**S**
GDS3-94	050905	GDT3-94	051220	-	9	480	40	30	54	**S**
GDS3-122	050913	GDT3-122	051238	-	12	240	47	37	63	N
GDS3-124	050921	GDT3-124	051246	-	12	480	47	37	63	N
GDS3-152	050930	GDT3-152	051254	-	15	240	59	49	75	N
GDS3-154	050948	GDT3-154	051262	-	15	480	59	49	75	N
GDS3-182	050956	GDT3-182	051270	-	18	240	68	58	87	N
GDS3-184	050964	GDT3-184	051289	-	18	480	68	58	87	N

To Order: Specify quantity, catalog number, PCN, volts, watts, and phase.
* Three phase individual elements available, consult Chromalox representative.
** 10% charge for single head units.
Note: Items ship as three individual single phase units and can be field wired for three phase.

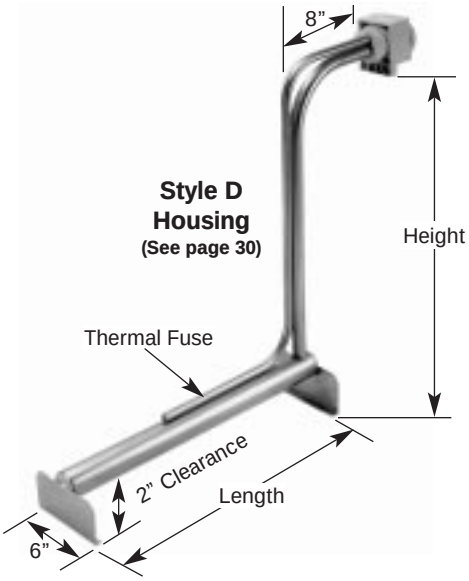
NEW PRODUCTS
ENGINEERED SPECIFICALLY FOR CORROSIVE SOLUTIONS

QUICK SHIPMENT FROM STOCK

GSL, GTL Metal L-Shaped Heaters Single 2” Diameter Element With Over-Temp

Features

- Made-to-order vertical heights (90˚ Riser bend standard, straight optional)
- 1 to 12 kW
- 20 and 40 WPSI
- 120, 240 & 480 volts single phase* (other voltages optional)
- Steel, 304 SS and other sheath materials and configurations available
- Standard 1” diameter riser and 5/8” O.D. fuse well (0.55 I.D.)



Specifications

316SS Catalog #	316SS PCN	Titanium Catalog #	Titanium PCN	kW 40 W/in²	kW 20 W/in²	Volts	Height (in.)	Length (in.)	Weight (lbs.)	Stock Status
GSL-11	051297	GTL-11	051617	1	-	120	15	13	11	N
GSL-12	051300	GTL-12	051625	1	-	240	15	13	11	N
GSL-22	051318	GTL-22	051633	2	-	240	19	17	12	N
GSL-24	051326	GTL-24	051641	2	-	480	19	17	12	N
GSL-32	051334	GTL-32	051650	3	-	240	25	22	13	**S**
GSL-34	051342	GTL-34	051668	3	-	480	25	22	13	N
GSL-42	051350	GTL-42	051676	4	-	240	25	26	14	N
GSL-44	051369	GTL-44	051684	4	-	480	25	26	14	N
GSL-52	051377	GTL-52	051692	5	-	240	37	31	15	N
GSL-54	051385	GTL-54	051705	5	-	480	37	31	15	N
GSL-62	051393	GTL-62	051713	6	-	240	50	36	16	**S**
GSL-64	051406	GTL-64	051721	6	-	480	50	36	16	N
GSL-82	051414	GTL-82	051730	8	-	240	50	44	19	N
GSL-84	051422	GTL-84	051748	8	-	480	50	44	19	N
GSL-92	051430	GTL-92	051756	9	-	240	50	50	21	N
GSL-94	051449	GTL-94	051764	9	-	480	50	50	21	N
GSL-102	051457	GTL-102	051772	10	-	240	50	55	23	N
GSL-104	051465	GTL-104	051780	10	-	480	50	55	23	N
GSL-122	051473	GTL-122	051799	12	-	240	50	64	26	N
GSL-124	051481	GTL-124	051801	12	-	480	50	64	26	N
GDSL-12	051490	GDTL-12	051810	-	1	240	19	17	12	N
GDSL-14	051502	GDTL-14	051828	-	1	480	19	17	12	N
GDSL-22	051510	GDTL-22	051836	-	2	240	25	26	14	N
GDSL-24	051529	GDTL-24	051844	-	2	480	25	26	14	N
GDSL-32	051537	GDTL-32	051852	-	3	240	50	36	16	N
GDSL-34	051545	GDTL-34	051860	-	3	480	50	36	16	N
GDSL-42	051553	GDTL-42	051879	-	4	240	50	44	19	N
GDSL-44	051561	GDTL-44	051887	-	4	480	50	44	19	N
GDSL-52	051570	GDTL-52	051895	-	5	240	50	55	23	N
GDSL-54	051588	GDTL-54	051908	-	5	480	50	55	23	N
GDSL-62	051596	GDTL-62	051916	-	6	240	50	64	26	N
GDSL-64	051609	GDTL-64	051924	-	6	480	50	64	26	N

To Order: Specify quantity, catalog number, PCN, volts, watts, and phase.

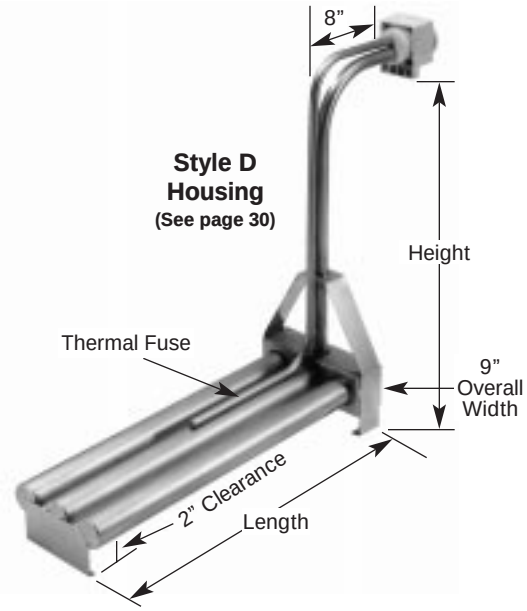
* Three phase available; consult Chromalox representative.

NEW PRODUCTS
ENGINEERED SPECIFICALLY FOR CORROSIVE SOLUTIONS

UL c UL

QUICK SHIPMENT FROM STOCK

GSL3, GTL3 Metal L-Shaped Heaters Triple 2" Diameter Element With Over-Temp



Features

- Made-to-order vertical heights (90° Riser bend standard, straight optional)
- 3 to 36 kW
- 20 and 40 WPSI
- 240 & 480 volts three phase (other voltages and single phase optional)
- Steel, 304 SS and other sheath materials and configurations available
- Standard 1" diameter riser and 5/8" O.D. fuse well (0.55 I.D.)

Specifications

316SS Catalog #	316SS PCN	Titanium Catalog #	Titanium PCN	kW 40 W/in²	kW 20 W/in²	Volts	Height (in.)	Length (in.)	Weight (lbs.)	Stock Status
GSL3-32	051932	GTL3-32	052257	3	-	240	15	13	25	N
GSL3-34	051940	GTL3-34	052265	3	-	480	15	13	25	N
GSL3-62	051959	GTL3-62	052273	6	-	240	37	17	29	N
GSL3-64	051967	GTL3-64	052281	6	-	480	37	17	29	N
GSL3-92	051975	GTL3-92	052290	9	-	240	37	22	35	N
GSL3-94	051983	GTL3-94	052302	9	-	480	37	22	35	**S**
GSL3-122	051991	GTL3-122	052310	12	-	240	37	26	43	N
GSL3-124	052003	GTL3-124	052329	12	-	480	37	26	43	N
GSL3-152	052011	GTL3-152	052337	15	-	240	37	31	50	N
GSL3-154	052020	GTL3-154	052345	15	-	480	37	31	50	**S**
GSL3-182	052038	GTL3-182	052353	18	-	240	50	36	58	N
GSL3-184	052046	GTL3-184	052361	18	-	480	50	36	58	**S**
GSL3-242	052054	GTL3-242	052370	24	-	240	50	44	69	N
GSL3-244	052062	GTL3-244	052388	24	-	480	50	44	69	N
GSL3-272	052070	GTL3-272	052396	27	-	240	50	50	76	N
GSL3-274	052089	GTL3-274	052409	27	-	480	50	50	76	N
GSL3-302	052097	GTL3-302	052417	30	-	240	50	55	83	N
GSL3-304	052100	GTL3-304	052425	30	-	480	50	55	83	N
GSL3-362	052118	GTL3-362	052433	36	-	240	50	64	94	N
GSL3-364	052126	GTL3-364	052441	36	-	480	50	64	94	N
GDSL3-32	052134	GDTL3-32	052450	-	3	240	15	17	29	N
GDSL3-34	052142	GDTL3-34	052468	-	3	480	15	17	29	N
GDSL3-62	052150	GDTL3-62	052476	-	6	240	37	26	43	N
GDSL3-64	052169	GDTL3-64	052484	-	6	480	37	26	43	N
GDSL3-92	052177	GDTL3-92	052492	-	9	240	50	36	58	N
GDSL3-94	052185	GDTL3-94	052505	-	9	480	50	36	58	N
GDSL3-122	052193	GDTL3-122	052513	-	12	240	50	44	69	N
GDSL3-124	052206	GDTL3-124	052521	-	12	480	50	44	69	N
GDSL3-152	052214	GDTL3-152	052530	-	15	240	50	55	83	N
GDSL3-154	052222	GDTL3-154	052548	-	15	480	50	55	83	N
GDSL3-182	052230	GDTL3-182	052556	-	18	240	50	64	94	N
GDSL3-184	052249	GDTL3-184	052564	-	18	480	50	64	94	N

To Order: Specify quantity, catalog number, PCN, volts, watts, and phase.

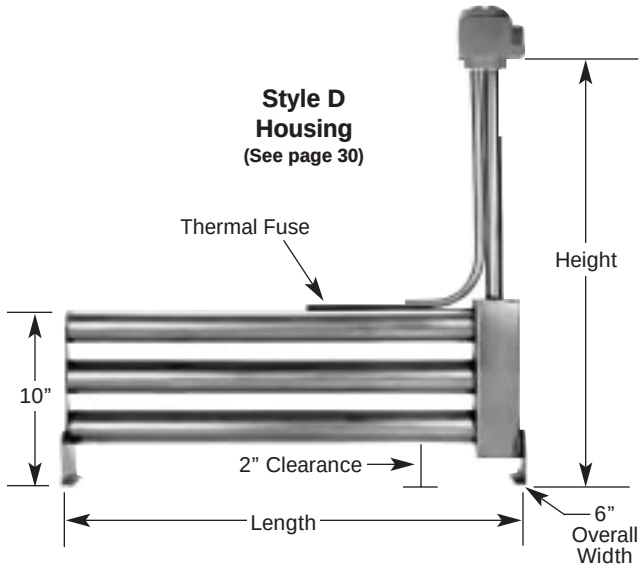
NEW PRODUCTS
ENGINEERED SPECIFICALLY FOR CORROSIVE SOLUTIONS

QUICK SHIPMENT FROM STOCK

GSV3, GTV3 Metal L-Shaped Heaters Triple 2” Diameter Stacked Elements With Over-Temp

Features

- Narrow Profile
- Made-to-order vertical heights (90˚ Riser bend standard, straight (shown) optional)
- 3 to 36 kW
- 20 and 40 WPSI
- 240 & 480 volts three phase (other voltages and single phase optional)
- Steel, 304 SS and other sheath materials and configurations available
- Standard 1” diameter riser and 5/8” O.D. fuse well (0.55 I.D.)



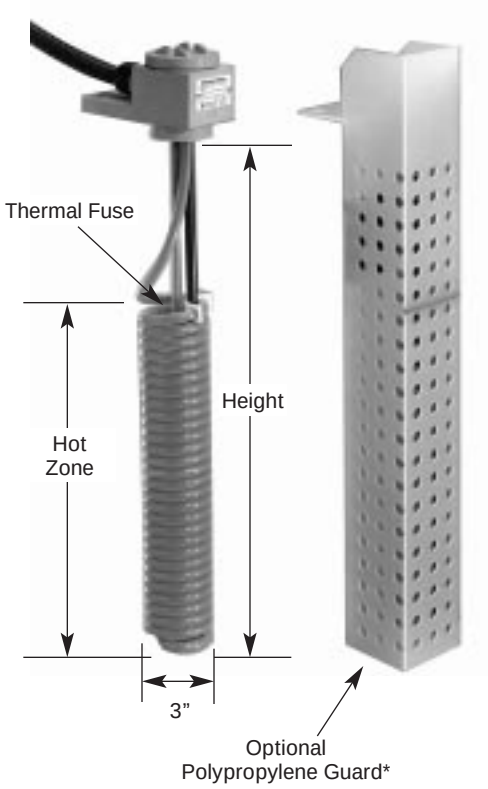
Specifications

316SS Catalog #	316SS PCN	Titanium Catalog #	Titanium PCN	kW 40 W/in²	kW 20 W/in²	Volts	Height (in.)	Length (in.)	Weight (lbs.)	Stock Status
GSV3-32	052572	GTV3-32	052898	3	-	240	15	13	25	N
GSV3-34	052580	GTV3-34	052900	3	-	480	15	13	25	N
GSV3-62	052599	GTV3-62	052919	6	-	240	37	17	29	N
GSV3-64	052601	GTV3-64	052927	6	-	480	37	17	29	N
GSV3-92	052610	GTV3-92	052935	9	-	240	37	22	35	N
GSV3-94	052628	GTV3-94	052943	9	-	480	37	22	35	N
GSV3-122	052636	GTV3-122	052951	12	-	240	37	26	43	N
GSV3-124	052644	GTV3-124	052960	12	-	480	37	26	43	N
GSV3-152	052652	GTV3-152	052978	15	-	240	50	31	50	N
GSV3-154	052660	GTV3-154	052986	15	-	480	50	31	50	N
GSV3-182	052679	GTV3-182	052994	18	-	240	50	36	58	N
GSV3-184	052687	GTV3-184	053006	18	-	480	50	36	58	N
GSV3-242	052695	GTV3-242	053014	24	-	240	50	44	69	N
GSV3-244	052708	GTV3-244	053022	24	-	480	50	44	69	N
GSV3-272	052716	GTV3-272	053030	27	-	240	50	50	76	N
GSV3-274	052724	GTV3-274	053049	27	-	480	50	50	76	N
GSV3-302	052732	GTV3-302	053057	30	-	240	50	55	83	N
GSV3-304	052740	GTV3-304	053065	30	-	480	50	55	83	N
GSV3-362	052759	GTV3-362	053073	36	-	240	50	64	94	N
GSV3-364	052767	GTV3-364	053081	36	-	480	50	64	94	N
GDSV3-32	052775	GDTV3-32	053090	-	3	240	15	17	29	N
GDSV3-34	052783	GDTV3-34	053102	-	3	480	15	17	29	N
GDSV3-62	052791	GDTV3-62	053110	-	6	240	37	26	43	N
GDSV3-64	052804	GDTV3-64	053129	-	6	480	37	26	43	N
GDSV3-92	052812	GDTV3-92	053137	-	9	240	50	36	58	N
GDSV3-94	052820	GDTV3-94	053145	-	9	480	50	36	58	N
GDSV3-122	052839	GDTV3-122	053153	-	12	240	50	44	69	N
GDSV3-124	052847	GDTV3-124	053161	-	12	480	50	44	69	N
GDSV3-152	052855	GDTV3-152	053170	-	15	240	50	55	83	N
GDSV3-154	052863	GDTV3-154	053188	-	15	480	50	55	83	N
GDSV3-182	052871	GDTV3-182	053196	-	18	240	50	64	94	N
GDSV3-184	052880	GDTV3-184	053209	-	18	480	50	64	94	N

To Order: Specify quantity, catalog number, PCN, volts, watts, and phase.

NEW PRODUCTS
ENGINEERED SPECIFICALLY FOR CORROSIVE SOLUTIONS

GTF Grounded Teflon® Covered Heaters
Straight Spiral Heater
With Over-Temp



Style A Housing
(See page 30)

Features

- Teflon covered, grounded stainless steel sheath
- 1 to 6 kW
- 10 WPSI
- 120, 240 & 480 volts single phase (other voltages optional)
- Optional polypropylene guard* (other materials available)
- Other configurations available
- 1/2” O.D. fuse well (0.44” I.D.)

Specifications

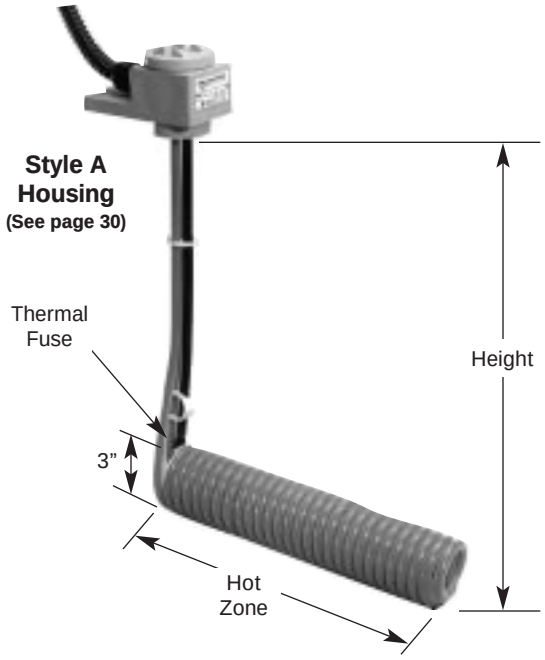
Teflon Catalog #	Teflon* PCN	kW 10 W/in²	Volts	Height (in.)	Hot Zone (in.)	Weight (lbs.)	Stock Status	Guard* PCN
GTF-11	053217	1	120	11	6	7	**S**	053330
GTF-12	053225	1	240	11	6	7	**S**	053330
GTF-22	053233	2	240	17	10	8	**S**	053348
GTF-24	053241	2	480	17	10	8	**S**	053348
GTF-32	053250	3	240	23	14	13	**S**	053356
GTF-34	053268	3	480	23	14	13	**S**	053356
GTF-42	053276	4	240	29	18	15	**S**	053364
GTF-44	053284	4	480	29	18	15	**S**	053364
GTF-52	053292	5	240	35	23	18	**S**	053372
GTF-54	053305	5	480	35	23	18	**S**	053372
GTF-62	053313	6	240	40	27	21	**S**	053380
GTF-64	053321	6	480	40	27	21	**S**	053380

To Order: Specify quantity, catalog number, PCN, volts, watts, and phase.
* Guard ordered separately, specify guard PCN. Guard adds approximately 1/2” to overall heater dimensions.

NEW PRODUCTS
ENGINEERED SPECIFICALLY FOR CORROSIVE SOLUTIONS

QUICK SHIPMENT FROM STOCK

GTFL Grounded Teflon® Covered Heaters
L-Shaped Spiral With Over-Temp



Features

- Teflon covered, grounded stainless steel sheath
- Made-to-order vertical heights
- 1 to 6 kW
- 10 WPSI
- 120, 240 & 480 volts single phase (other voltages optional)
- Optional polypropylene guard* (other materials available)
- Other configurations available
- 1/2” O.D. fuse well (0.44” I.D.)

Specifications

Teflon Catalog #	Teflon* PCN	kW 10 W/in²	Volts	Height (in.)	Length (in.)	Weight (lbs.)	Stock Status	Guard* PCN
GTFL-11	053698	1	120	12	9	8	N	053815
GTFL-12	053700	1	240	12	9	8	N	053815
GTFL-22	053719	2	240	18	13	9	N	053823
GTFL-24	053727	2	480	18	13	9	N	053823
GTFL-32	053735	3	240	18	17	13	N	053831
GTFL-34	053743	3	480	18	17	13	N	053831
GTFL-42	053751	4	240	18	21	16	N	053840
GTFL-44	053760	4	480	18	21	16	N	053840
GTFL-52	053778	5	240	18	25	18	N	053858
GTFL-54	053786	5	480	18	25	18	N	053858
GTFL-62	053794	6	240	18	29	21	N	053866
GTFL-64	053807	6	480	18	29	21	N	053866

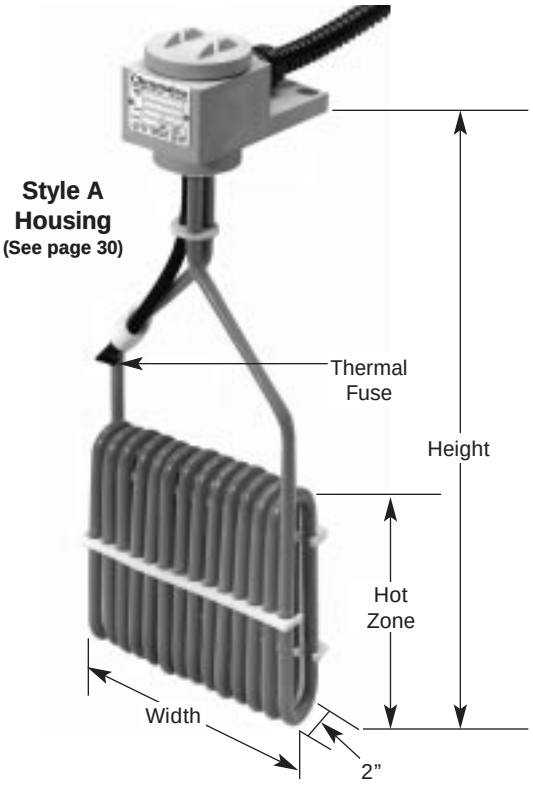
To Order: Specify quantity, catalog number, PCN, volts, watts, and phase.
* Guard (not shown), ordered separately, specify guard PCN. Guard adds approximately 1/2” to overall heater dimensions.

NEW PRODUCTS
ENGINEERED SPECIFICALLY FOR CORROSIVE SOLUTIONS

GTFN Grounded Teflon® Covered Heaters
Slim Line With Over-Temp

Features

- Teflon covered, grounded stainless steel sheath
- Narrow design requires less space
- 1 to 6 kW
- 10 WPSI
- 120, 240 & 480 volts single phase (other voltages optional)
- Optional polypropylene guard* (other materials available)
- Other configurations available
- 1/2” O.D. fuse well (0.44” I.D.)



Specifications

Teflon Catalog #	Teflon* PCN	kW 10 W/in²	Volts	Height (in.)	Hot Zone (in.)	Width (in.)	Weight (lbs.)	Stock Status	Guard* PCN
GTFN-11	053452	1	120	14	8	4	8	**S**	053575
GTFN-12	053460	1	240	14	8	4	8	**S**	053575
GTFN-22	053479	2	240	17	8	6	9	**S**	053583
GTFN-24	053487	2	480	17	8	6	9	**S**	053583
GTFN-32	053495	3	240	23	9	8	13	**S**	053591
GTFN-34	053508	3	480	23	9	8	13	**S**	053591
GTFN-42	053516	4	240	29	11	8	16	**S**	053604
GTFN-44	053524	4	480	29	11	8	16	**S**	053604
GTFN-52	053532	5	240	35	12	10	18	N	053612
GTFN-54	053540	5	480	35	12	10	18	N	053612
GTFN-62	053559	6	240	40	13	11	21	N	053620
GTFN-64	053567	6	480	40	13	11	21	N	053620

To Order: Specify quantity, catalog number, PCN, volts, watts, and phase.
* Guard (not shown), ordered separately, specify guard PCN. Guard adds approximately 1/2” to overall heater dimensions.

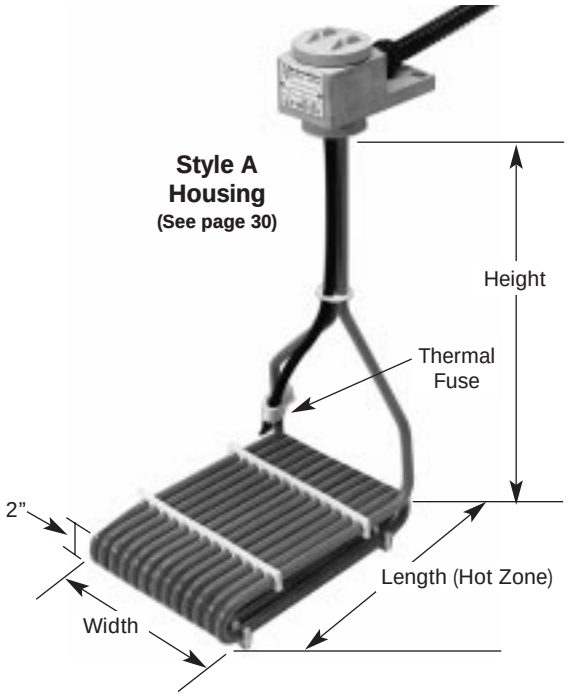
NEW PRODUCTS
ENGINEERED SPECIFICALLY FOR CORROSIVE SOLUTIONS

QUICK SHIPMENT FROM STOCK

GTFNL Grounded Teflon® Covered Heaters
Slim Line L-Shaped With Over-Temp

Features

- Teflon covered, grounded stainless steel sheath
- Made to order vertical heights available
- 1 to 6 kW
- 10 WPSI
- 120, 240 & 480 volts single phase (other voltages optional)
- Optional polypropylene guard* (other materials available)
- Other configurations available
- 1/2” O.D. fuse well (0.44” I.D.)



Specifications

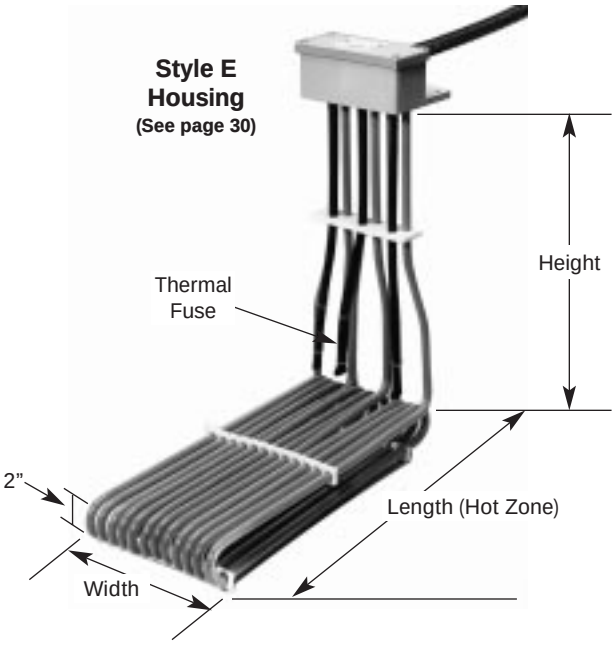
Teflon Catalog #	Teflon* PCN	kW 10 W/in²	Volts	Height (in.)	Length (in.)	Width (in.)	Weight (lbs.)	Stock Status	Guard* PCN
GTFNL-11	053938	1	120	12	8	4	6	S	054050
GTFNL-12	053946	1	240	12	8	4	6	S	054050
GTFNL-22	053954	2	240	18	8	6	8	S	054068
GTFNL-24	053962	2	480	18	8	6	8	S	054068
GTFNL-32	053970	3	240	18	9	7	12	S	054076
GTFNL-34	053989	3	480	18	9	7	12	S	054076
GTFNL-42	053997	4	240	18	11	8	15	S	054084
GTFNL-44	054009	4	480	18	11	8	15	S	054084
GTFNL-52	054017	5	240	18	12	9	19	S	054092
GTFNL-54	054025	5	480	18	12	9	19	S	054092
GTFNL-62	054033	6	240	18	13	10	23	S	054105
GTFNL-64	054041	6	480	18	13	10	23	S	054105

To Order: Specify quantity, catalog number, PCN, volts, watts, and phase.
* Guard (not shown), ordered separately, specify guard PCN. Guard adds approximately 1/2” to overall heater dimensions.

NEW PRODUCTS
ENGINEERED SPECIFICALLY FOR CORROSIVE SOLUTIONS

QUICK SHIPMENT FROM STOCK

GTFL3 Grounded Teflon® Covered Heaters
3 Element L-Shaped With Over-Temp



Features

- Teflon covered, grounded stainless steel sheath
- Narrow, bottom heating construction, with made-to-order vertical heights
- 3 to 18 kW
- 10 WPSI
- 240 & 480 volts three phase (other voltages and single phase optional)
- Optional polypropylene guard* (other materials available)
- Custom vertical heights and other configurations available
- 1/2” O.D. fuse well (0.44” I.D.)

Specifications

Teflon Catalog #	Teflon* PCN	kW 10 W/in²	Volts	Height (in.)	Length (in.)	Width (in.)	Weight (lbs.)	Stock Status	Guard* PCN
GTFL3-32	054172	3	240	18	13	7	20	N	054295
GTFL3-34	054180	3	480	18	13	7	20	N	054295
GTFL3-62	054199	6	240	18	19	10	22	N	054308
GTFL3-64	054201	6	480	18	19	10	22	N	054308
GTFL3-92	054210	9	240	18	23	12	36	N	054316
GTFL3-94	054228	9	480	18	23	12	36	N	054316
GTFL3-122	054236	12	240	18	30	12	42	N	054324
GTFL3-124	054244	12	480	18	30	12	42	N	054324
GTFL3-152	054252	15	240	18	37	12	48	N	054332
GTFL3-154	054260	15	480	18	37	12	48	N	054332
GTFL3-182	054279	18	240	18	45	12	54	N	054340
GTFL3-184	054287	18	480	18	45	12	54	N	054340

To Order: Specify quantity, catalog number, PCN, volts, watts, and phase.
* Guard (not shown), ordered separately, specify guard PCN. Guard adds approximately 1/2” to overall heater dimensions.

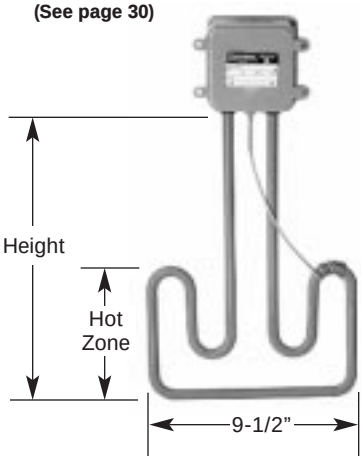
NEW PRODUCTS
ENGINEERED SPECIFICALLY FOR CORROSIVE SOLUTIONS

TPR Grounded Teflon® Coated Heaters Thermoplastic Coated Single Phase With Over-Temp

Features

- Teflon coated, grounded stainless steel sheath
- 1 to 8 kW
- 20 WPSI
- 120, 240 & 480 volts single phase (other voltages optional)
- Standard guard included
- Other configurations available

Style C Housing
(See page 30)



Guard* Included

Specifications

Teflon Catalog #	Teflon* PCN	kW 20 W/in²	Volts	Height (in.)	Hot Zone (in.)	Weight (lbs.)	Stock Status
TPR-101	097287	1	120	13	6	4	**S**
TPR-102	097295	1	240	13	6	4	**S**
TPR-202	097308	2	240	21	12	5	**S**
TPR-204	097316	2	480	21	12	5	**S**
TPR-302	097324	3	240	26	17	6	**S**
TPR-304	097332	3	480	26	17	6	**S**
TPR-402	097340	4	240	31	22	7	**S**
TPR-404	097359	4	480	31	22	7	**S**
TPR-602	097367	6	240	42	33	10	**S**
TPR-604	097375	6	480	42	33	10	**S**
TPR-802	097383	8	240	53	44	12	**S**
TPR-804	097391	8	480	53	44	12	**S**

To Order: Specify quantity, catalog number, PCN, volts, watts, and phase.
* Guard included.

TPR PRODUCTS
ENGINEERED SPECIFICALLY FOR CORROSIVE SOLUTIONS

QUICK SHIPMENT FROM STOCK

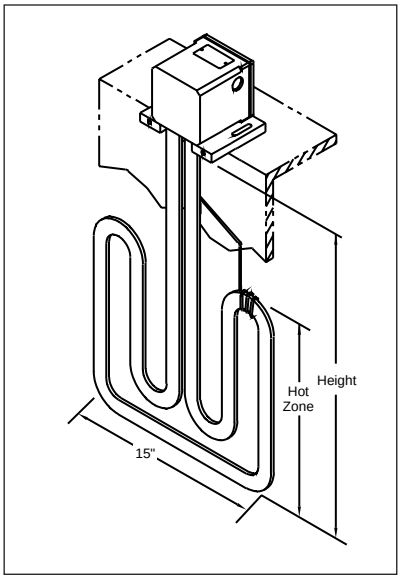
TPF Grounded Teflon® Coated Heaters Thermoplastic Coated 3-Phase Flat-blade With Over-Temp

Style C Housing
(See page 30)

Guard* Included

Features

- Teflon coated, grounded stainless steel sheath
- Low profile, three phase design
- 3 to 10 kW
- 20 WPSI
- 240 & 480 volts three phase (other voltages and single phase optional)
- Standard guard included
- Other configurations available



Specifications

Teflon Catalog #	Teflon* PCN	kW 20 W/in²	Volts	Height (in.)	Hot Zone (in.)	Weight (lbs.)	Stock Status
TPF-302	097439	3	240**	20	11	8	**S**
TPF-304	097447	3	480	20	11	8	**S**
TPF-402	097455	4	240**	23	14	9	**S**
TPF-404	097463	4	480	23	14	9	**S**
TPF-602	097471	6	240**	30	21	11	**S**
TPF-604	097480	6	480	30	21	11	**S**
TPF-802	097498	8	240**	37	28	12	**S**
TPF-804	097500	8	480	37	28	12	**S**
TPF-1002	097535	10	240**	44	35	14	**S**
TPF-1004	097543	10	480	44	35	14	**S**

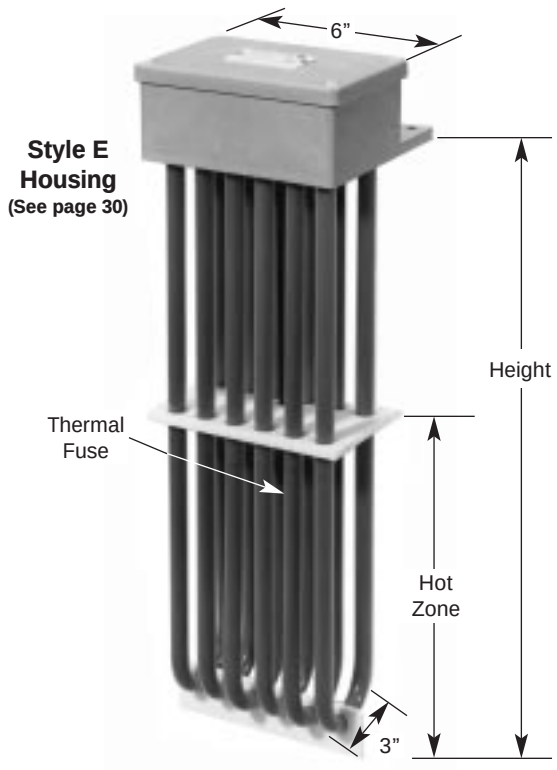
To Order: Specify quantity, catalog number, PCN, volts, watts, and phase.
* Guard included.

TPF PRODUCTS
ENGINEERED SPECIFICALLY FOR CORROSIVE SOLUTIONS

** UL® ** CSA®

QUICK SHIPMENT FROM STOCK

GTF6 Grounded Teflon® Covered Heaters
6 Element Teflon® With Over-Temp



Features

- Teflon covered, grounded stainless steel sheath
- Space efficient, 3 phase design
- 2 to 12 kW
- 10 WPSI
- 240 & 480 volts three phase (other voltages and single phase optional)
- Custom vertical heights and other configurations available
- Optional polypropylene guard* (other materials available)
- 1/2” O.D. fuse well (0.44” I.D.)

Specifications

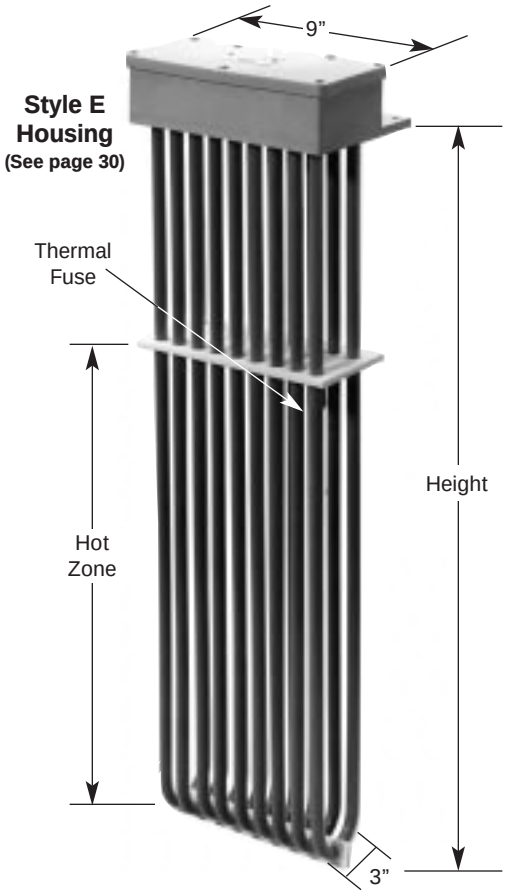
Teflon Catalog #	Teflon* PCN	kW 10 W/in²	Volts	Height (in.)	Hot Zone (in.)	Weight (lbs.)	Stock Status	Guard* PCN
GTF6-22	054412	2	240	17	9	19	S	054551
GTF6-24	054420	2	480	17	9	19	S	054551
GTF6-32	054439	3	240	23	15	22	S	054560
GTF6-34	054447	3	480	23	15	22	S	054560
GTF6-42	054455	4	240	29	21	24	S	054578
GTF6-44	054463	4	480	29	21	24	S	054578
GTF6-62	054471	6	240	35	27	27	S	054586
GTF6-64	054480	6	480	35	27	27	S	054586
GTF6-82	054498	8	240	47	38	33	S	054594
GTF6-84	054500	8	480	47	38	33	S	054594
GTF6-102	054519	10	240	59	47	40	S	054607
GTF6-104	054527	10	480	59	47	40	S	054607
GTF6-122	054535	12	240	68	55	45	S	054615
GTF6-124	054543	12	480	68	55	45	S	054615

To Order: Specify quantity, catalog number, PCN, volts, watts, and phase.
* Guard (not shown), ordered separately, specify guard PCN. Guard adds approximately 1/2” to overall heater dimensions.

NEW PRODUCTS
ENGINEERED SPECIFICALLY FOR CORROSIVE SOLUTIONS

QUICK SHIPMENT FROM STOCK

GTF9 Grounded Teflon® Covered Heaters
9 Element Teflon® With Over-Temp



Features

- Teflon covered, grounded stainless steel sheath
- Space efficient, 3 phase design
- 3 to 18 kW
- 10 WPSI
- 240 & 480 volts three phase (other voltages and single phase optional)
- Optional polypropylene guard* (other materials available)
- Custom vertical heights and other configurations available
- 1/2” O.D. fuse well (0.44” I.D.)

Specifications

Teflon Catalog #	Teflon* PCN	kW 10 W/in²	Volts	Height (in.)	Hot Zone (in.)	Weight (lbs.)	Stock Status	Guard* PCN
GTF9-32	054690	3	240	17	9	28	N	054834
GTF9-34	054703	3	480	17	9	28	N	054834
GTF9-452	054711	4.5	240	23	15	33	N	054842
GTF9-454	054720	4.5	480	23	15	33	N	054842
GTF9-62	054738	6	240	29	21	36	N	054850
GTF9-64	054746	6	480	29	21	36	N	054850
GTF9-92	054754	9	240	35	27	40	N	054869
GTF9-94	054762	9	480	35	27	40	N	054869
GTF9-122	054770	12	240	47	38	49	N	054877
GTF9-124	054789	12	480	47	38	49	N	054877
GTF9-152	054797	15	240	59	47	60	N	054885
GTF9-154	054800	15	480	59	47	60	N	054885
GTF9-182	054818	18	240	68	55	67	N	054893
GTF9-184	054826	18	480	68	55	67	N	054893

To Order: Specify quantity, catalog number, PCN, volts, watts, and phase.
* Guard (not shown), ordered separately, specify guard PCN. Guard adds approximately 1/2” to overall heater dimensions.

NEW PRODUCTS
ENGINEERED SPECIFICALLY FOR CORROSIVE SOLUTIONS

QM Quartz Heaters
Quartz Heater with Grounded Tubular Elements and Over-temp

Features

- Grounded INCOLOY® elements enclosed in a quartz tube
- 1 to 10 kW
- 25 WPSI
- 120, 240 & 480 volts single phase** (other voltages and three phase optional)
- Custom vertical heights and other configurations available
- Can be field wired
- Polypropylene Guard* (not shown) required for tank mounting. (Other materials available.)
- 5/8” O.D. fuse well (0.55” I.D.)

Specifications

Quartz Catalog #	Quartz* PCN	kW 25 W/in²	Volts	Height (in.)	Hot Zone (in.)	Weight (lbs.)	Stock Status	Guard* PCN
QM-11	054973	1	120	11	7	5	S	055132
QM-12	054981	1	240	11	7	5	S	055132
QM-22	054990	2	240	17	12	7	S	055140
QM-24	055001	2	480	17	12	7	S	055140
QM-32	055010	3	240	23	18	9	S	055159
QM-34	055028	3	480	23	18	9	S	055159
QM-42	055036	4	240	35	28	13	S	055167
QM-44	055044	4	480	35	28	13	S	055167
QM-52	055052	5	240	41	33	16	S	055175
QM-54	055060	5	480	41	33	16	S	055175
QM-62	055079	6	240	47	39	18	S	055183
QM-64	055087	6	480	47	39	18	S	055183
QM-82	055095	8	240	59	49	22	N	055191
QM-84	055108	8	480	59	49	22	N	055191
QM-102	055116	10	240	71	62	25	N	055204
QM-104	055124	10	480	71	62	25	N	055204

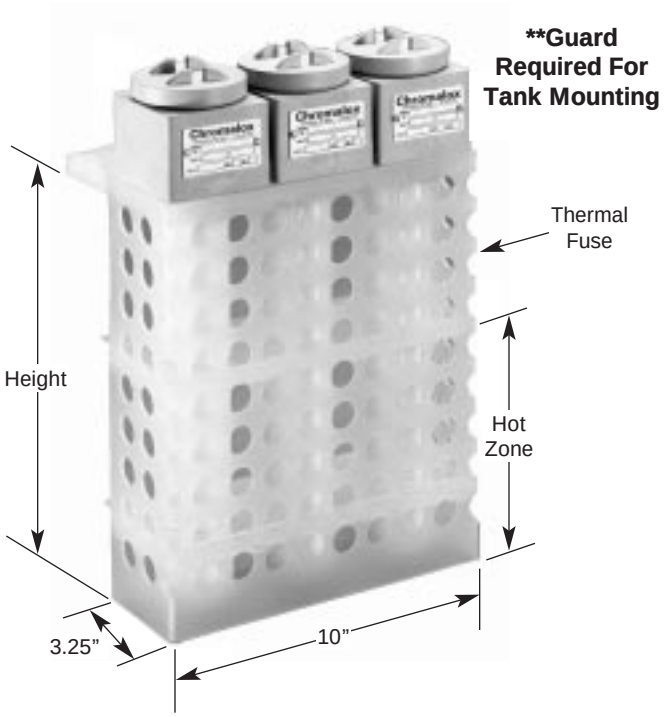
To Order: Specify quantity, catalog number, PCN, volts, watts, and phase.
* Guard (not shown), ordered separately, specify guard PCN. **Required for tank mounting.**
** 3 phase optional. Elements can be field wired for Three phase.
Note: Elements, quartz tube, and guard shipped separately.

NEW PRODUCTS
ENGINEERED SPECIFICALLY FOR CORROSIVE SOLUTIONS

UL C UL

QUICK SHIPMENT FROM STOCK

QM3 Quartz Heaters 3 Element Quartz with Grounded Tubular Elements and Over-Temp



Features

- Grounded INCOLOY® elements enclosed in a quartz tube
- 3 to 30 kW
- 25 WPSI
- 120, 240 & 480 volts single phase* (other voltages and three phase optional)
- Items shipped individually. Pre-wired single head/conduit assembly available
- Custom vertical heights and other configurations available
- Can be field wired
- Polypropylene Guard** (shown) required for tank mounting. (Other materials available.)
- 5/8” O.D. fuse well (0.55” I.D.)

Specifications

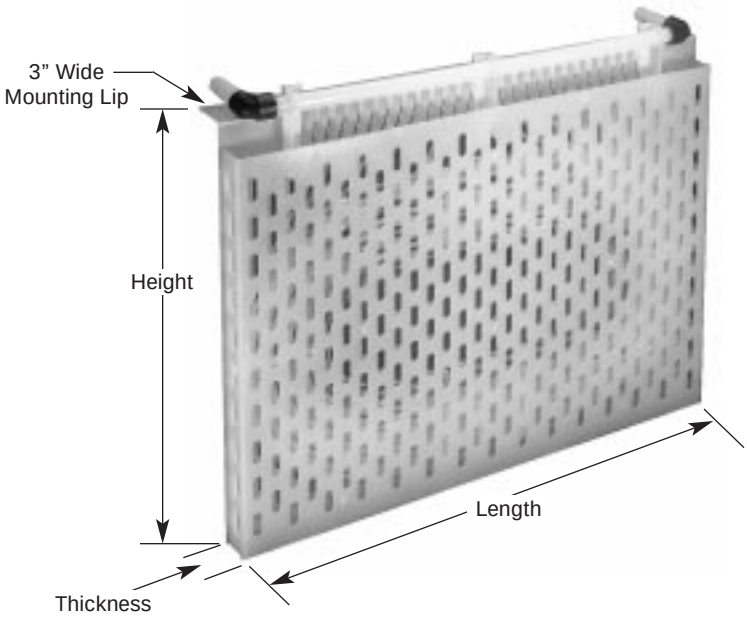
Quartz Catalog #	Quartz** PCN	kW 25 W/in²	Volts	Height (in.)	Hot Zone (in.)	Weight (lbs.)	Stock Status	Guard** PCN
QM3-31	055298	3	120	11	7	14	**S**	055458
QM3-32	055300	3	240	11	7	14	**S**	055458
QM3-62	055319	6	240	17	12	20	**S**	055466
QM3-64	055327	6	480	17	12	20	**S**	055466
QM3-92	055335	9	240	23	18	26	**S**	055474
QM3-94	055343	9	480	23	18	26	**S**	055474
QM3-122	055351	12	240	35	28	38	**S**	055482
QM3-124	055360	12	480	35	28	38	**S**	055482
QM3-152	055378	15	240	41	33	47	**S**	055490
QM3-154	055386	15	480	41	33	47	**S**	055490
QM3-182	055394	18	240	47	39	51	**S**	055503
QM3-184	055407	18	480	47	39	51	**S**	055503
QM3-242	055415	24	240	59	49	60	N	055511
QM3-244	055423	24	480	59	49	60	N	055511
QM3-302	055431	30	240	71	62	70	N	055520
QM3-304	055440	30	480	71	62	70	N	055520

To Order: Specify quantity, catalog number, PCN, volts, watts, and phase.
* Individual heaters single phase, can be field wired for three phase.
** Guard ordered separately, specify guard PCN. **Required for tank mounting.**
Note: Elements, quartz tube, and guard shipped separately.

NEW PRODUCTS
ENGINEERED SPECIFICALLY FOR CORROSIVE SOLUTIONS

QUICK SHIPMENT FROM STOCK

GRTF Teflon® Heat Exchangers
Teflon Heat/Cool Coils



Features

- Leak-resistant seal construction
- Maximum pressure of 25 PSI
- Weights included to prevent floating
- Fully pressure tested
- 5/16" O.D. Teflon tubing standard
- Polypropylene Guard standard
- Bottom styles and other piping configurations available, contact your local representative

Specifications

Teflon Catalog #	PCN	Height (in.)	Length (in.)	Thickness (in.)	Surf. Area (ft^2)	Mainfold NPT (in.)	Weight (lbs.)	Stock Status
GRTF-52	055618	28	22	2	5	3/4	12	N
GRTF-103	055626	28	22	3	10	3/4	20	N
GRTF-154	055634	28	22	4	15	3/4	28	N
GRTF-102	055642	36	30	2	10	3/4	25	N
GRTF-203	055650	36	30	3	20	1	42	N
GRTF-304	055669	36	30	4	30	1	60	N
GRTF-152	055677	42	36	2	15	3/4	35	N
GRTF-303	055685	42	36	3	30	1	60	N
GRTF-454	055693	42	36	4	45	1 1/2	80	N
GRTF-202	055706	47	41	2	20	1	40	N
GRTF-403	055714	47	41	3	40	1 1/2	80	N
GRTF-604	055722	47	41	4	60	1 1/2	120	N
GRTF-252	055730	52	46	2	25	1	50	N
GRTF-503	055749	52	46	3	50	1 1/2	90	N
GRTF-754	055757	52	46	4	75	1 1/2	130	N

To Order: Specify quantity, catalog number, PCN, steam or water, and surface area.

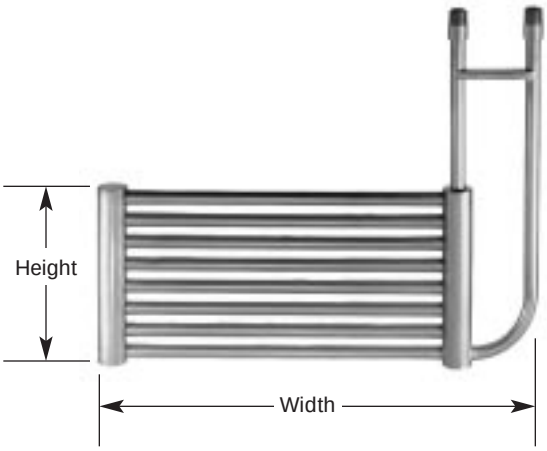
•Heat transfer coefficient steam = 50 BTU/HR/FT2/˚F
•Heat transfer coefficient liquid = 40 BTU/HR/FT2/˚F

NEW PRODUCTS
ENGINEERED SPECIFICALLY FOR CORROSIVE SOLUTIONS

GRT, GRS Metal Heat Exchangers
Titanium or SS Heat/Cool Grids

Features

- Low profile for minimal space consumption
- Standoffs, hooks and hanger straps, sold separately
- 1" NPT standard. Other sizes available depending on flow requirements.
- Fully pressure tested (100 psi max.)
- Highest quality construction
- Custom sizes and shapes available



Horizontal Style Coils Shown
(Vertical Available)

Specifications

316SS Catalog #	316SS PCN	Titanium Catalog #	Titanium PCN	Height (in.)	Width (in.)	Surf. Area (ft^2)	Weight (lbs.)	Stock Status
12" WIDTH (8 TUBES)								
GRS-12-24	056160	GRT-12-24	056880	12	24	4.6	13	N
GRS-12-30	056178	GRT-12-30	056899	12	30	5.6	15	N
GRS-12-36	056186	GRT-12-36	056901	12	36	6.7	18	N
GRS-12-48	056194	GRT-12-48	056910	12	48	8.8	24	N
GRS-12-60	056207	GRT-12-60	056928	12	60	10.9	30	N
GRS-12-72	056215	GRT-12-72	056936	12	72	13.7	34	N
GRS-12-84	056223	GRT-12-84	056944	12	84	15.1	38	N
GRS-12-96	056231	GRT-12-96	056952	12	96	17.2	43	N
GRS-12-108	056240	GRT-12-108	056960	12	108	19.2	48	N
GRS-12-120	056258	GRT-12-120	056979	12	120	21.3	53	N
GRS-12-132	056266	GRT-12-132	056987	12	132	23.4	59	N
GRS-12-144	056274	GRT-12-144	056995	12	144	25.5	64	N
18" WIDTH (12 TUBES)								
GRS-18-24	056282	GRT-18-24	057007	18	24	6.8	19	N
GRS-18-30	056290	GRT-18-30	057015	18	30	8.4	23	N
GRS-18-36	056303	GRT-18-36	057023	18	36	10.0	28	N
GRS-18-48	056311	GRT-18-48	057031	18	48	13.2	36	N
GRS-18-60	056320	GRT-18-60	057040	18	60	16.3	45	N
GRS-18-72	056338	GRT-18-72	057058	18	72	19.5	49	N
GRS-18-84	056346	GRT-18-84	057066	18	84	22.6	57	N
GRS-18-96	056354	GRT-18-96	057074	18	96	25.7	64	N
GRS-18-108	056362	GRT-18-108	057082	18	108	28.9	72	N
GRS-18-120	056370	GRT-18-120	057090	18	120	32.0	80	N
GRS-18-132	056389	GRT-18-132	057103	18	132	35.2	88	N
GRS-18-144	056397	GRT-18-144	057111	18	144	38.3	96	N

Continued

NEW PRODUCTS
ENGINEERED SPECIFICALLY FOR CORROSIVE SOLUTIONS

316SS Catalog #	316SS PCN	Titanium Catalog #	Titanium PCN	Height (in.)	Width (in.)	Surf. Area (ft^2)	Weight (lbs.)	Stock Status
24" WIDTH (16 TUBES)								
GRS-24-24	056400	GRT-24-24	057120	24	24	9.4	26	N
GRS-24-30	056418	GRT-24-30	057138	24	30	11.5	32	N
GRS-24-36	056426	GRT-24-36	057146	24	36	13.6	37	N
GRS-24-48	056434	GRT-24-48	057154	24	48	17.8	49	N
GRS-24-60	056442	GRT-24-60	057162	24	60	22.0	61	N
GRS-24-72	056450	GRT-24-72	057170	24	72	26.1	65	N
GRS-24-84	056469	GRT-24-84	057189	24	84	30.3	76	N
GRS-24-96	056477	GRT-24-96	057197	24	96	34.6	87	N
GRS-24-108	056485	GRT-24-108	057200	24	108	38.7	97	N
GRS-24-120	056493	GRT-24-120	057218	24	120	42.9	107	N
GRS-24-132	056506	GRT-24-132	057226	24	132	47.1	118	N
GRS-24-144	056514	GRT-24-144	057234	24	144	51.3	128	N
30" WIDTH (20 TUBES)								
GRS-30-24	056522	GRT-30-24	057242	30	24	11.5	32	N
GRS-30-30	056530	GRT-30-30	057250	30	30	14.2	39	N
GRS-30-36	056549	GRT-30-36	057269	30	36	16.8	46	N
GRS-30-48	056557	GRT-30-48	057277	30	48	22.0	61	N
GRS-30-60	056565	GRT-30-60	057285	30	60	27.2	75	N
GRS-30-72	056573	GRT-30-72	057293	30	72	32.5	81	N
GRS-30-84	056581	GRT-30-84	057306	30	84	37.7	94	N
GRS-30-96	056590	GRT-30-96	057314	30	96	42.9	107	N
GRS-30-108	056602	GRT-30-108	057322	30	108	48.2	121	N
GRS-30-120	056610	GRT-30-120	057330	30	120	53.4	133	N
GRS-30-132	056629	GRT-30-132	057349	30	132	58.6	147	N
GRS-30-144	056637	GRT-30-144	057357	30	144	63.9	160	N
36" WIDTH (24 TUBES)								
GRS-36-24	056645	GRT-36-24	057365	36	24	13.7	38	N
GRS-36-30	056653	GRT-36-30	057373	36	30	16.8	46	N
GRS-36-36	056661	GRT-36-36	057381	36	36	20.0	55	N
GRS-36-48	056670	GRT-36-48	057390	36	48	26.3	72	N
GRS-36-60	056688	GRT-36-60	057402	36	60	32.5	89	N
GRS-36-72	056696	GRT-36-72	057410	36	72	38.8	97	N
GRS-36-84	056709	GRT-36-84	057429	36	84	45.1	113	N
GRS-36-96	056717	GRT-36-96	057437	36	96	51.4	129	N
GRS-36-108	056725	GRT-36-108	057445	36	108	57.7	144	N
GRS-36-120	056733	GRT-36-120	057453	36	120	64.0	160	N
GRS-36-132	056741	GRT-36-132	057461	36	132	70.3	176	N
GRS-36-144	056750	GRT-36-144	057470	36	144	76.6	192	N
42" WIDTH (28 TUBES)								
GRS-42-24	056768	GRT-42-24	057488	42	24	15.8	43	N
GRS-42-30	056776	GRT-42-30	057496	42	30	19.5	54	N
GRS-42-36	056784	GRT-42-36	057509	42	36	23.2	64	N
GRS-42-48	056792	GRT-42-48	057517	42	48	30.6	84	N
GRS-42-60	056805	GRT-42-60	057525	42	60	38.0	105	N
GRS-42-72	056813	GRT-42-72	057533	42	72	45.4	114	N
GRS-42-84	056821	GRT-42-84	057541	42	84	52.8	132	N
GRS-42-96	056830	GRT-42-96	057550	42	96	60.2	151	N
GRS-42-108	056848	GRT-42-108	057568	42	108	67.6	169	N
GRS-42-120	056856	GRT-42-120	057576	42	120	75.0	188	N
GRS-42-132	056864	GRT-42-132	057584	42	132	82.4	206	N
GRS-42-144	056872	GRT-42-144	057592	42	144	89.8	225	N

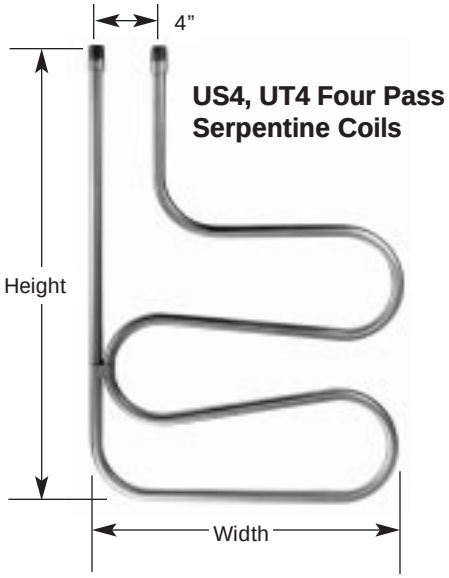
To Order: Specify quantity, catalog number, PCN, steam or water, and surface area.

- Heat transfer coefficient steam= 150 BTU/HR/FT^2/°F
- Heat transfer coefficient liquid= 90 BTU/HR/FT^2/°F

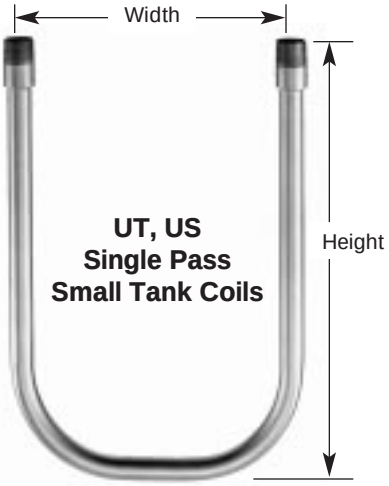
UT, US Metal Heat Exchangers
Titanium or SS Heat/Cool Coils

Features

- Low profile for minimal space consumption
- Standoffs, hooks and hanger straps, sold separately
- 1" NPT standard. Other sizes available depending on flow requirements.
- Fully pressure tested (100 psi max.)
- Highest quality construction
- Custom sizes and shapes available



US4, UT4 Four Pass Serpentine Coils



UT, US Single Pass Small Tank Coils

Specifications

316SS Catalog #	316SS PCN	Titanium Catalog #	Titanium PCN	Height (in.)	Width (in.)	Surf. Area (ft^2)	Weight (lbs.)	Stock Status
SINGLE PASS U-COILS								
US1-12-18	055765	UT1-12-18	055968	18	12	0.8	3	N
US1-12-24	055773	UT1-12-24	055976	24	12	1	4	N
US1-12-30	055781	UT1-12-30	055984	30	12	1.3	5	N
US1-12-36	055790	UT1-12-36	055992	36	12	1.6	6	N
US1-12-42	055802	UT1-12-42	056004	42	12	1.8	7	N
US1-12-48	055810	UT1-12-48	056012	48	12	2.1	8	N
US1-12-54	055829	UT1-12-54	056020	54	12	2.4	9	N
US1-12-60	055837	UT1-12-60	056039	60	12	2.6	10	N
4 PASS UNITS								
US4-24-36	055845	UT4-24-36	056047	36	24	2.7	11	N
US4-36-36	055853	UT4-36-36	056055	36	36	3.7	12	N
US4-48-36	055861	UT4-48-36	056063	36	48	4.7	14	N
US4-60-36	055870	UT4-60-36	056071	36	60	5.7	16	N
US4-78-36	055888	UT4-78-36	056080	36	78	7.3	20	N
US4-96-36	055896	UT4-96-36	056098	36	96	8.8	25	N
6 PASS UNITS								
US6-20-48	055909	UT6-20-48	056100	48	20	3.7	12	N
US6-30-48	055917	UT6-30-48	056119	48	30	5	14	N
US6-40-48	055925	UT6-40-48	056127	48	40	6.3	17	N
US6-50-48	055933	UT6-50-48	056135	48	50	7.5	20	N
US6-60-48	055941	UT6-60-48	056143	48	60	8.7	25	N
US6-70-48	055950	UT6-70-48	056151	48	70	10	28	N

To Order: Specify quantity, catalog number, PCN, steam or water, and surface area.

•Heat transfer coefficient steam = 150 BTU/HR/FT^2/°F
•Heat transfer coefficient liquid = 90 BTU/HR/FT^2/°F

NEW PRODUCTS
ENGINEERED SPECIFICALLY FOR CORROSIVE SOLUTIONS

CMX Circulating Water* Temperature Controllers

Features

- Heat/Cool capabilities
- Chromalox 2104 microprocessor control
- 4.5 to 24 kW heating
- 250˚F max. output temperature**
- Compact rugged design
- 3/4 HP, 30 gpm pump standard
- Other ratings, pump sizes and features optional. Consult representative

Options

- Alternate voltages 208, 575
- Solid state power control
- Surge reduction valve
- Digital communications
- 1.5, 3, 5, 7.5 HP pumps

Specifications

Model	PCN	Volts	kW	Stock Status
Open Loop Cooling				
CMX-250-4	214017	240	4.5	A
CMX-250-4	214025	480	4.5	A
CMX-250-9	214033	240	9	**S**
CMX-250-9	214041	480	9	**S**
CMX-250-12	214050	240	12	A
CMX-250-12	214068	480	12	A
CMX-250-18	214076	240	18	**S**
CMX-250-18	214084	480	18	**S**
CMX-250-24	214092	240	24	A
CMX-250-24	214105	480	24	A
Closed Loop Cooling				
CMX-250-4C	214113	240	4.5	A
CMX-250-4C	214121	480	4.5	A
CMX-250-9C	214130	240	9	**S**
CMX-250-9C	214148	480	9	**S**
CMX-250-12C	214156	240	12	A
CMX-250-12C	214164	480	12	A
CMX-250-18C	214172	240	18	**S**
CMX-250-18C	214180	480	18	**S**
CMX-250-24C	214199	240	24	A
CMX-250-24C	214201	480	24	A

Standard 3/4 HP Pump

Pump Size (HP)	Nominal Flow (gpm)	Process Connections (in. dia.)	Drain/Supply (in. dia.)
3/4	30	1-1/4 NPT	1/2 NPT

Optional Pump Sizes

Optional Pump Sizes (HP)	Nominal Flow (gpm)
1.5	40
3	50
5	60
7.5	80

To Order: Specify quantity, catalog number, PCN, volts, watts, and phase.
S - Units in stock, subject to prior sale.
A - Shipment 10 days.
* Hot oil units available, consult representative.
** 275˚F unit optional, consult representative.

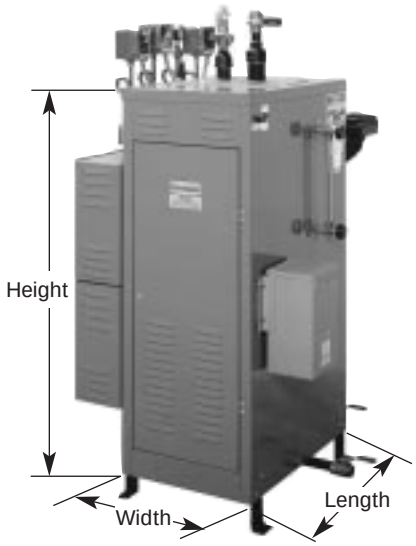
NEW PRODUCTS
ENGINEERED SPECIFICALLY FOR CORROSIVE SOLUTIONS

QUICK SHIPMENT FROM STOCK

CES Industrial Steam Boilers

Features

- Low water cut-off
- Integral electrical control
- Rugged industrial construction
- ASME Section 1 Code M



Specifications

Catalog #	PCN	Bhp	Lbs† Steam/hr.	Dimensions (in.) W	L	H	kW	3 Phase* Volts	Total Draw Amps	Std. Trfr. Kva	Weight (lbs.)	Stock Status
With one operating pressure control ‡												
CES-18B	025734	1.73	51.2	23	24	35	17	208	48	1	240	**S**
CES-18B	086545	1.73	51.2	23	24	35	17	240	42	1	240	**S**
CES-24B	086561	2.45	72.3	28	29	44	24	480	29	1	300	**S**
CES-36B	086588	3.47	102.5	28	29	44	34	240	82	1	310	**S**
CES-36B	086596	3.47	102.5	28	29	44	34	480	41	1	310	**S**
CES-48B	086617	4.69	138.7	28	29	44	46	240	111	1	315	**S**
CES-48B	086625	4.69	138.7	28	29	44	46	480	56	1	315	**S**
CES-60B	086641	5.91	174.8	28	29	44	58	480	70	1	380	**S**
CES-72B	086650	6.93	205	28	29	44	68	480	82	1	390	**S**
With two operating pressure controls ‡												
CES-100B	086668	10.4	307	30	32	58	102	480	123	1-1/2	625	**S**
CES-180B	025750	18.4	543	30	32	64	180	480	217	1-1/2	790	**S**

Accessories

PCN	Feed Water or Condensation System Required with each Boiler	Stock Status
109359	Low Pressure Feed	**S**
109364	High Pressure Feed Water Pump CES-18 thru CES-72	**S**
109380	High Pressure Feed Water Pump CES-100 thru CES-180	**S**
109372	Condensate Return/Feed System CES-18 thru CES-72	**S**
109399	Condensate Return/Feed System CES-100 thru CES-180	**S**
109250	Blowdown Separator	**S**

† At 212˚F with 50˚F feedwater
* Single phase and other voltages available.
‡ All boilers have 120V/1/60Hz control circuits;

All the above units are in stock subject to prior sale. Other ratings from 3 to 1000 kW are available. Contact factory for details.

To Order: Specify quantity, catalog number, PCN, volts, watts, and phase.

CES PRODUCTS
ENGINEERED SPECIFICALLY FOR CORROSIVE SOLUTIONS

QUICK SHIPMENT FROM STOCK

GNIT Non Indicating Thermostats in Moisture-Resistant Enclosure and Teflon® Covered Sensor

Specifications

Catalog #	PCN	Temperature Range (˚F)	Volts	Max. Amps	Sensor Length (ft.)	Stock Status
GNIT-5	360946	30 to 220	120/240	25	5	**S**
GNIT-12	360954	30 to 220	120/240	25	12	**S**

Higher temperature units and other sensor lengths available. Consult local representative.

GIT Indicating Thermostats with 7' Teflon® Covered Capillary

Specifications

Catalog #	PCN	Temperature Range (˚F)	Volts	Max. Amps	Set Points	Stock Status
GIT-7LS	360962	0 to 250	120/240	20	Single	**S**
GIT-7HS	360970	100 to 500	120/240	20	Single	**S**
GIT-7LD	360989	0 to 250	120/240	20	Double	N
GIT-7HD	360997	100 to 500	120/240	20	Double	N

Longer sensor lengths available. Consult local Representative.

116 - 1/8 DIN Digital Indicating Temperature Indicators, 120 VAC

Specifications

Catalog #	PCN	Temperature Range	Input* Type	Stock Status
116-JF1	306114	-364 to 1400˚F	J	**S**
116-JC1	306106	-210 to 760˚C	J	**S**
116-MF1	306190	-199 to 199˚F	RTD	**S**
116-MC1	306181	-128 to 93˚C	RTD	**S**

* Sensor sold separately.

QUICK SHIPMENT FROM STOCK

1604 - 1/16 DIN Digital Indicating Temperature Controllers

Specifications

Catalog #	PCN	Display*	Supply Voltage	Max. Amps	Heat/Cool Capability	Stock Status
1601-11030	306464	Single 3 Character	100-240 Vac	3	No	S
1603-11030	306253	Dual 3 Character	100-240 Vac	3	Yes	S
1604-11030	306270	Dual 4 Character	100-240 Vac	3	Yes	S

Other options available. Please consult local representative.
* NEMA 4X Faceplate

2104 - 1/4 DIN Digital Indicating Temperature Controllers

Specifications

Catalog #	PCN	Display*	Supply Voltage	Max. Amps	Heat/Cool Capability	Stock Status
2104-R0100	306528	Dual 4 Character	100-240 Vac	3	No	S
2104-RR100	306616	Dual 4 Character	100-240 Vac	3	Yes	S

Other options available. Please consult local representative.
* NEMA 4X Faceplate

GSEN Temperature Sensors

Specifications

Catalog #	PCN	Sensor Type*	Sensor Sheath	Temperature Range (˚F)	Status
GSEN-RTD-10	360911	RTD	Teflon Covered	Up to 300	S
GSEN-JT-10	360920	J Thermocouple	Teflon Covered	Up to 300	S
GSEN-RTD-10B	360890	RTD	304 SS	Up to 500	S
GSEN-JT-10B	360903	J Thermocouple	304 SS	Up to 500	S

Sensors ends are 1.5” in length, 0.156” in diameter (0.2” With Teflon cover)
10 foot Teflon lead wires standard
100 ohm platinum standard

QUICK SHIPMENT FROM STOCK

4468 - Combination Temperature and Power Control Panel
Fully NEMA 4X Rated Single or Three Phase

Specifications

Catalog #	PCN	Controller Type	Max. Amps	Supply Voltage	Heat/Cool Capability	Stock Status
4468-30000	360014	None	40	120/240/480	No	N
4468-30100	360022	1601	40	120/240/480	No	**S**
4468-30200	360030	1603	40	120/240/480	Yes	N
4468-30300	360049	1604	40	120/240/480	Yes	N
4468-30400	360057	2104	40	120/240/480	Yes	**S**
4468-60000	360065	None	75	120/240/480	No	N
4468-60100	360073	1601	75	120/240/480	No	**S**
4468-60200	360081	1603	75	120/240/480	Yes	N
4468-60300	360090	1604	75	120/240/480	Yes	**S**
4468-60400	360102	2104	75	120/240/480	Yes	N
4468-90000	360110	None	110	120/240/480	No	N
4468-90100	360129	1601	110	120/240/480	No	**S**
4468-90200	360137	1603	110	120/240/480	Yes	N
4468-90300	360145	1604	110	120/240/480	Yes	N
4468-90400	360153	2104	110	120/240/480	Yes	N

Consult local representative for other optional features.

Ordering Information — NEMA 4X Control Panel

4468 Series Mini Contactor Temperature Control Panel

UL Listed
3-Phase or Single Phase Magnetic Contactor Panels
Optional Temperature Controllers
480/240/120 Vac-Fused Control Power Transformer
LED Indication of Power On, Heater On
Remote Shutdown Interlock Terminals (Flow, Level and Thermal Fuse)

Enclosure Description

NEMA 4X Fiberglass Enclosure with Hinged Screw Cover -
16"H x 14"W x 8"D - Door Mounted Temperature Controller

Code	***Amperes (Resistive Rating)***
30	40 Amp Contactor
60	75 Amp Contactor
90	110 Amp Contactor

Code Digital Indicating Temperature Controller

0	None
1	1601-11030, 3-Digit Single Display 1/16 DIN Process Controller
2	1603-11030, 3-Digit Dual Display 1/16 DIN Process Controller
3	1604-11030, 4-Digit Dual Display 1/16 DIN Process Controller
4	2104-RR100, 4-Digit Dual Display 1/4 DIN Process Controller

Code

00	Add to complete model number

4468 - 30 2 00

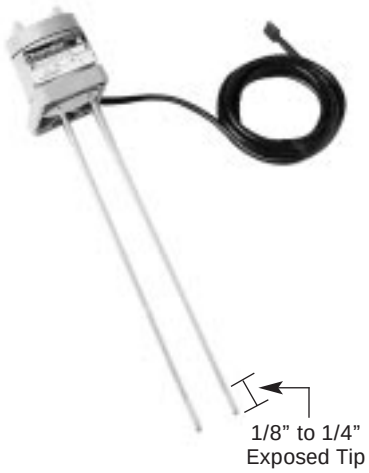
QUICK SHIPMENT FROM STOCK

SFT General Purpose Time Switch Controls

Specifications

Catalog #	PCN	Display	Supply Voltage	Max. Amps	Battery Back-up	Stock Status
SFTU	315440	24 Hour	120	10	No	S
SFWU	315459	7 Day	120	10	No	S
QFRTU	315467	24 Hour	120	10	Yes	S
QFRWU	315475	7 Day	120	10	Yes	S

LLC2 Conductive Type Liquid Level Control



Specifications

PROBES+						
2 Probe Catalog #	2 Probe PCN	3 Probe Catalog	3 Probe PCN	Probe* Material	Probe** Length (in.)	Stock Status
LLC2-12S	360778	LLC3-12S	360815	316 SS	12	S
LLC2-12T	360786	LLC3-12T	360823	Titanium	12	S
LLC2-24S	360794	LLC3-24S	360831	316 SS	24	S
LLC2-24T	360807	LLC3-24T	360840	Titanium	24	S

ELECTRONIC CONTROL CIRCUITRY AND BOX					
2 Probe Catalog #	2 Probe PCN	3 Probe Catalog	3 Probe PCN	Box Dimensions (H x W x D in.)	Stock Status
LLC2-CIR	360858	LLC3-CIR	360866	6 x 3-1/2 x 3-1/2	S

+ Replacement probes only. Must order electronic control to complete unit.
* Probes are Teflon covered except for probe tip
** Other lengths available. Probes can be cut to length.
All units 120V. 240V units available upon request.

LLC Capacitive Liquid Level Control

Specifications

Catalog #	PCN	Volts*	Switching	Head Style	Stock Status
LLC-1S	360268	90-250	Normally Open	Straight	S
LLC-1N	360276	90-250	Normally Open	90 Degree	S
LLC-1R	360284	90-250	Normally Open	Remote	S
LLC-2S	360292	90-250	Normally Closed	Straight	S
LLC-2N	360305	90-250	Normally Closed	90 Degree	S
LLC-2R	360313	90-250	Normally Closed	Remote	S

Unit 1.4” in diameter by 5” long.
* Low voltage systems available, consult factory.
Mounting bracket included (not shown).

QUICK SHIPMENT FROM STOCK

Replacement Fuses, Resettable Fuse and Resettable Fuse Circuitry

Specifications

Single Use Fuse				Resettable Fuse**					
Catalog #	PCN	Temp. Rating ˚F	Stock Status	**Catalog #	PCN	Temp. Rating ˚F	Stock Status	Use With	Lead Length (in.)
F	360330	219	S	RF	360436	219	S	GS, GT, 3GS, 3GT	18
FM*	360348	260	S	RFM	360444	260	S	GS, GT, 3GS, 3GT	18
FH	360356	330	S	RFH	360452	330	S	GS, GT, 3GS, 3GT	18
FT	360364	219	S	RFT	360460	219	S	GTF, GTFN,	18
FTM*	360372	260	S	RFTM	360479	260	S	GTF6, GTF9,	18
FTH	360380	330	S	RFTH	360487	330	S	QM, QM3	18
FL	360399	219	S	RFL	360495	219	S	GSL, GTL,	86
FLM*	360401	260	S	RFLM	360508	260	S	GSL3, GTL3,	86
FLH	360410	330	S	RFLH	360516	330	S	GSV3, GTV3	86
FLTM*	360428	260	S	RFLTM	360524	260	S	GTFL, GTFNL, GTFL3	86

Resettable Fuse System Circuitry**

Catalog #	PCN	Temp.	Products Used on
RFM-EC	360321	All	All

* Standard fuse from factory for use with product types listed in specifications.
** Bi-metal switch only. Resettable fuse system circuitry includes manual reset, audible alarm and relay, and is ordered separately. Use PCN 360321, catalog # RFM-EC to order
Single fuse rated to 240V, 25A cold. Resettable fuse rated to 240V, 5A cold.

Thermowells For Use With Metal, Teflon and Quartz Heaters

Specifications

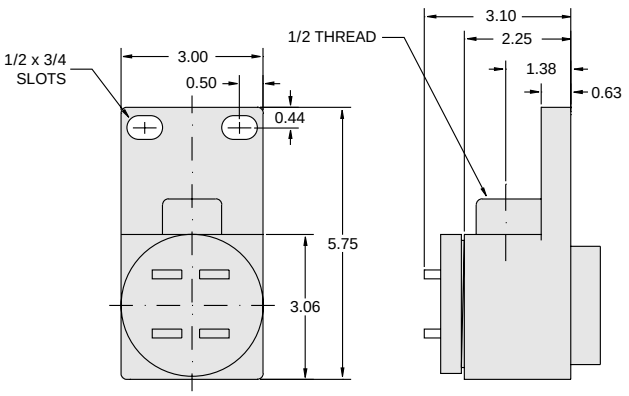
	Diameter (in.)	12" Length		24" Length		36" Length	
Material	O.D./I.D.	Catalog #	PCN	Catalog #	PCN	Catalog #	PCN
316 SS	1/2 / 0.43	GSTW-12	360575	GSTW-24	360612	GSTW-36	360655
Titanium	1/2 / 0.43	GTTW-12	360583	GTTW-24	360620	GTTW-36	360663
Teflon*	1/2 / 0.44	GTFTW-12	360591	GTFTW-24	360639	GTFTW-36	360671
Quartz*	5/8 / 0.50	GQTW-12	360604	GQTW-24	360647	GQTW-36	360680
THERMOWELL GUARDS							
Teflon Guard		GTFTW-12G	360698	GTFTW-24G	360719	GTFTW-36G	360735
Quartz Guard		GQTW-12G	360700	GQTW-24G	360727	GQTW-36G	360743

Flange dimensions: 1" wide x 4" long. 3/8" mounting hole centered 3/16" from end.
* Guards recommended. Specify Thermowell and Guard PCN when ordering.
* Guards made of Polypropylene, other materials available.
Other lengths, diameters, and sheath materials available. Please consult factory.

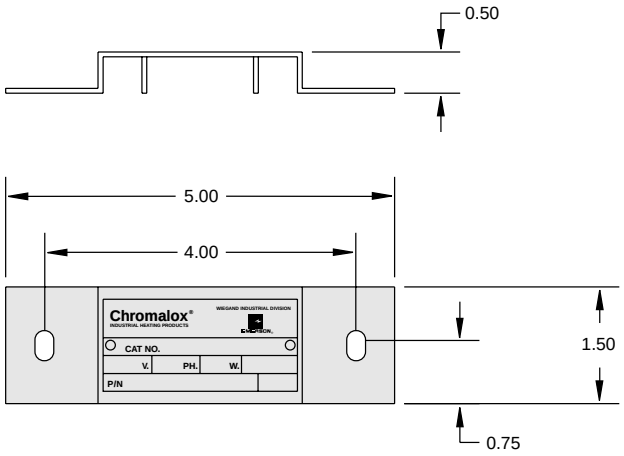
QUICK SHIPMENT FROM STOCK

Terminal Housing Dimensions

(All Dimensions in Inches)



Style A



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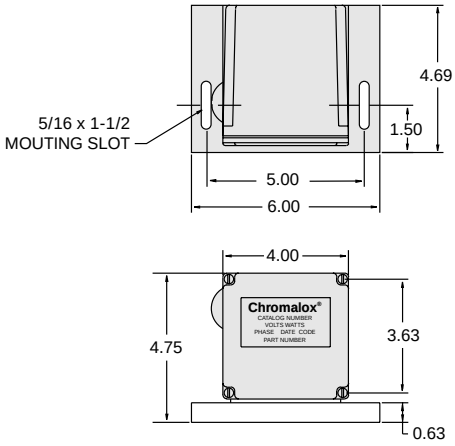

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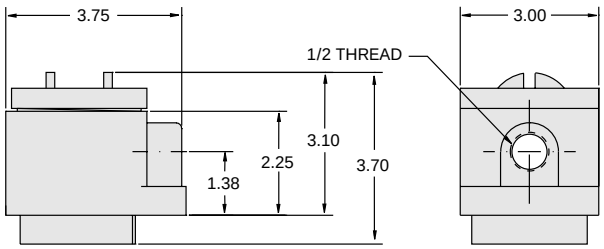

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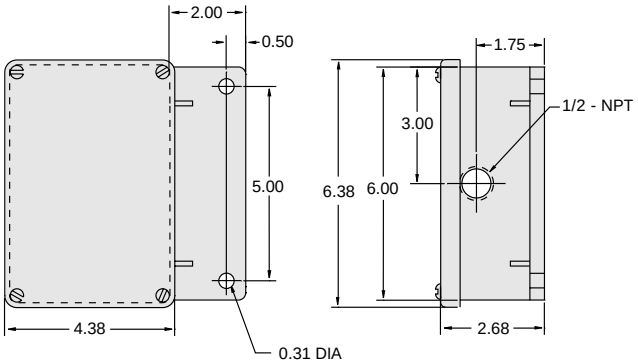

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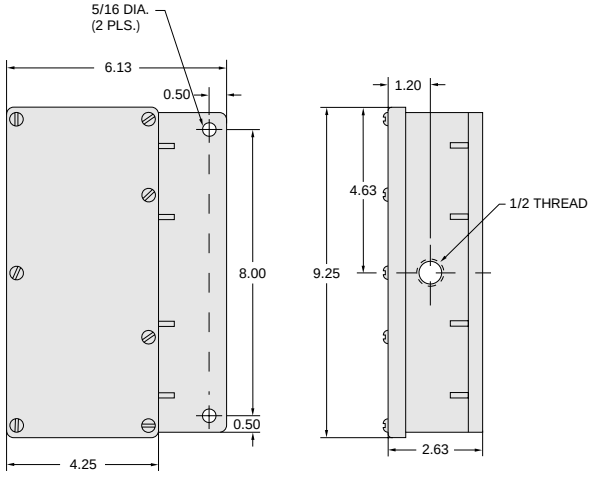


Style F

Introduction

This technical section presents basic problems and solutions along with data, charts and graphs to aid in solving heating applications with electric resistance type heaters and heating/cooling coils.

There are three basic requirements, when met, leave only the selection of type and number of electric heaters best suited for the application.

1. Final temperature desired - Electric resistance heaters of the enclosed sheath type normally operate from the cryogenic ranges of -300˚F or lower to approximately 1500˚F.

2. Sheath material required - This catalog gives considerable help in choosing the proper sheath material for many common materials. For additional help, check with the nearest Chromalox application engineering sales office or factory.

3. Watt density permitted - Watt density is the watts emanating from each square inch of heated surface area of the heater. Some materials such as water, vegetable oils and salt baths can take a high watt density, while others such as petroleum oils or Corrosive Applications must use lower watt densities, as these solutions will not readily absorb the heat being generated. If the watt density is too high, carbonization, overheating or sheath failure will result with damage to the heating equipment or material being heated. All heaters in the catalogs have the watt density specified for standard ratings. Recommended allowable ratings for various materials and temperature conditions are included.

After resolving the above points, choose the type of heater best desired for the application. For example, a tank may be heated by direct immersion heaters or by clamping strip, ring or tubular heaters to the outside of the tank.

Calculating heat requirements

Most heating problems involve only three steps:

1. Determine required kW capacity for bringing application up to operating temperature in the desired time.
2. Calculate the kW capacity required to maintain the operating temperature.
3. Select the number and type of heaters required to supply the required kW of the greater of factors 1 or 2.
4. The kW to be installed will be the larger of steps 1 and 2 plus a safety factor of 20% for contingencies.

Calculations of initial and operating kW capacity requirements should take into consideration the following:

1. Specified heat-up time.
2. Heat losses to surrounding medium.
3. Thermal properties of (a) material being heated and (b) insulation.
4. Make up material per hour.
5. Surface loss of material and/or container.
6. Dimensions and weight of container and material being heated.
7. Heat carried away by products being processed through heated area.

Initial Heating kW Requirements

$$kWH = \frac{Qmc}{3412} + \frac{Ls}{2000} \times \text{htg.hrs}$$

Where:

Qmc = Btu absorbed by material and container (wt in lbs x spec. ht of material + wt in lbs x spec. ht of container x temp. difference (final temp. - initial temp.)

Ls = Exposed surface area (ft^2) x W/ft^2 loss at final temp. (See curves G-114S or G-126S).

Note: In case specific heat of the material varies during the process due to melting the material, calculate absorbed Btu up to the melting point add heat of fusion, then add Btu required to raise the molten material to final temperature.

$$\text{kWH capacity for operating reqmts.} = \frac{Qmc}{3412} + \frac{Ls}{1000}$$

Operating kW Requirements

$$\text{kWH capacity for initial htg.} = \frac{\text{kWh}}{\text{hrs allowed for heat-up}}$$

Where:

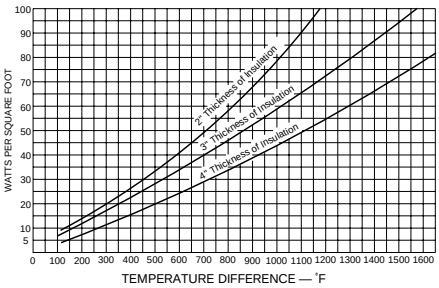
Qmc = Btu absorbed by the material added per hr. (Wt. in Lbs. x Temp. Rise in ˚F). Heat of fusion if the product is being melted.

Ls = Surface losses from curves G-114S OR G-126S

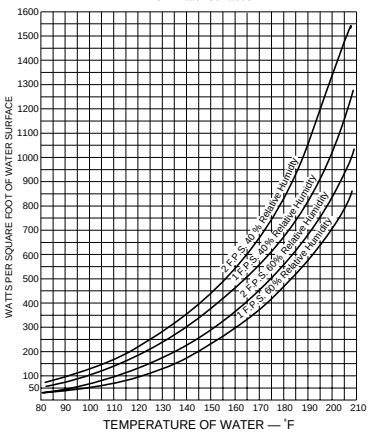
Heat loss curves

Technical Information / Reference Data

CURVE G126S — HEAT LOSS
From Walls of Insulated Ovens
Pipes, Tanks, etc.



CURVE G114S — HEAT LOSS
From Water Surfaces



Heating/Cooling

1. Formula for Steam Heating Media

$$\frac{\text{Gallons to be heated} \times \text{Temperature Rise Required} \times \text{Steam Pressure Factor}}{1000} = \text{Ft}^2 \text{ of area required for one hr. heat up}$$

Calculation Process:

A. Determine gallons in tank. (A) = in Formula.

B. Subtract the temperature of the solution to be heated from the temperature to which it must be heated. (B) = in Formula.

C. Locate your useable steam pressure in the Steam Pressure Factor (see Chart A) and find the factor. C = in Formula.

D. $\frac{(A) \times (B) \times (C)}{1000} = \text{Ft}^2$ of area required for one hr. heat up

Chart A

Steam Pressure Available/PSI	5#	10#	15#	20#	25#	30#	Above 30#
(TEFLON) Steam Pressure Factor	2.2	2	1.7	1.5	1.3	1.1	Consult Factory
(METAL) Steam Pressure Factor	.55	.50	.42	.37	.30	.27	Consult Factory

2. Formula for Hot Water Heating Media

$$\frac{\text{Gallons to be heated} \times \text{Temperature Rise Required} \times 8.33}{(U) \times (\text{Hot Water Temp.}) - (\text{Required Tank Temp.})} = \text{Ft}^2 \text{ of area required for one hr. heat up}$$

U Factor for Metal Coils = 90
U Factor for Teflon Coils = 40

$$\frac{(A) \times (B) \times 8.33}{(U) \times (D)} = \frac{(C)}{(E)} = \text{Ft}^2 \text{ of area required for one hr. heat up}$$

A. Determine gallons in tank. (A) = in Formula.

B. Subtract temperature of solution to be heated from the temperature to which it is to be heated. (B) = in Formula.

C. (A) * (B) * 8.33 = (C)

D. Subtract the required tank temperature from the temperature of your hot water supply. (D) = in Formula.

E. (D) * U = (E)

F. C/E = square feet of area required.*

If more time is available, coil surface area may be reduced by dividing the square foot area by the heat-up time available, up to 4 hours, maximum.

*Heat loss for open tank must be added.

3. Formula for Cooling

$$\frac{\text{Volts} \times \text{Amps} \times 3.412}{(U) \times (\text{Required Tank Temp.}) - (\text{Cooling liquid Temp.})} = \text{Ft}^2 \text{ of surface area required}$$

$$\frac{(A)}{(U) \times (B)} = \frac{(A)}{(C)} = \text{Ft}^2 \text{ of surface area required}$$

A. Determine watts by multiplying voltage times amperage delivered by the tank rectifier. Multiply this product times 3.412 to determine BTUs. (A) = in Formula.

B. Subtract cooling liquid tempera ture from required tank temperature. (B) = in Formula. **Caution:** If this number is less than 15, consult factory for assistance in determining proper coil size.

C. (B) * (U) = (C).

D. (A)/(C) = square feet of surface area required.

Check solution guide for proper sheath material selection.

Allowable Watt Densities

Liquid Heating

(Suggested Watt Density for Heating Liquids)

Materials heated	Max.Operating Max.Temp. °F	Max. being W/in2
Acid solution or electro-plating tanks	180	40
Alkali & Oakite cleaning solution	212	40
Asphalt, tar, heavy compounds, etc.	200	10
	300	8
	400	7
	500	6
Bunker C fuel oil	160	10
Caustic soda 2%	210	45
10%	210	25
75%	180	25
Dowtherm A		
Liquid phase	750	22
Vaporizing	750	10
Dowtherm J liquid	575	22
Ethylene glycol	300	30
Freon	300	3
Fuel oil pre-heating	180	9
Gasoline, kerosene	300	20
Lead-stereotype pot	600	35 on casting
Liquid ammonia plating baths	50	25
Machine oil, SAE-30	250	18
Metal melting pot	500 to 900	20-27
Mineral oil	200	20
	400	16
Molasses	100	4-5
Molten salt bath	800 to 950	25-30
Molten tin	600	20

Materials heated	Max.Operating Max.Temp. °F	Max. being W/in2
Oil draw bath	600	20
	400	16
Sodium cyanide	140	40
Steel tubing cast into aluminum	500 to 750	50
Steel tubing cast into iron	750 to 1000	55
Socony vacuum type transfer oil	600	22
Therminols and heat transfer oils	500	22
	600	22
Therminol 66	650	22
Trichlorethylene	150	20
Vapor degreasing solutions	275	20
Vegetable oil (fry kettle)	400	30
Water (process)	212	50
Water (washroom)	140	80-90

These watt densities may be adjusted when heat takeaway or flow velocity rates are increased or when operating temperatures are altered. Be aware of significant differences in composition that may exist in different baths of the same type of material being heated. At times, extended heater life will be obtained by using a lower watt density.

$$kW = \frac{kW \text{ (std)} \times \text{suggested W/in}^2 \text{ (from table)}}{\text{W/in}^2 \text{ (std)}}$$

Corrosion guide for electric immersion heaters

The following Corrosion Guide recommendations must not be interpreted as a positive recommendation for your choice of sheath material for electric immersion heaters. Use this information as a guide in your investigation of your heating process, and arrive at the proper choice based upon your knowledge and testing of the conditions.

Be very selective in your consideration of heater sheath material. Remember that recommended materials of construction for your tank may not survive as sheathing for the immersion heater. The sheath of an immersion heater functions as a heat transfer surface, and thus is operating at temperatures above the control temperature of the process. Such temperatures and fluid movement impose severe corrosion conditions on the metal surface.

1. Control the chemistry of the solution.
   - **a.** Avoid carry-over from other processes.
   - **b.** Control depletion of bath chemistry.
   - **c.** Filter or remove accumulating sludge. Sludge impedes flow of heat from heaters and accelerates corrosion.
2. Control process temperature.
   - **a.** Temperature accelerates all corrosion processes. Excess temperatures mean shorter heater life.
3. Avoid contacts between dissimilar metals which could initiate galvanic type corrosion.
4. For safety to personnel against electrical shock, metal sheath heaters must be grounded to the tank and, in turn, to earth. Consider the use of a ground fault circuit interrupter for optimum safety.
5. For processes involving electroplating, immersion heaters must be kept out of the space between anode and cathode where the effects of plating current may damage the heater surface.
6. The immersion heaters should be examined periodically for corrosion so that corrective action can be taken to maintain continuity of operation.

Legend
A - Good
B - Fair
C - Depends upon conditions
X - Not suitable
Blank - Data not available

Solution	Sheath Material - Comments														
	Iron-Steel	Cast Iron	Aluminum	Copper	Lead	Monel-400	304, 321, 347, S.S	316 S.S.	Carpenter Stainless #20	Incoloy 800	Inconel 600	Titanium	Quartz	Teflon	Notes
Acetic Acid	X	X	C	X	X	B	C	B	A	C	C	A	A	A	2
Acetone	X	X	B	A	A	A	B	B	B	A	A	A	A	A	1
Actane 70														A	1
Actane 80														A	1
Actane Salt														A	1
Alco Bright Dip R5														A	
Alcohol	B	B	B	A	A	A	B	A	A	A	A	A	A		1
Alcorite													A	A	1, 9
Alkaline Cleaners							B							X	1
Alkaline Soaking Cleaners	B														1
Alodine								A							1
Aluminum Bright dip													A	A	
Aluminum Chloride	X	X	X	X	X	X	X	X	X	X	X	C	A	A	1
Aluminum Cleaners	C	C	X	X	X	A	A	A	B	A	A	B	X	A	1
Aluminum Sulphate	X	X	X	X	B	X	A	A	A	X	X	A	A		1
Alum	X	X	X	X	X	X	X	X	B	X	X	X	A		1
Ammonia	X	X	C	X	C	X	X	X	X	C	B	A	A	A	
Ammonium Bifluoride	X	X	X	X	X	X	X	X	B	X	X	X	X	A	
Ammonium Chloride	X	X	X	X	X	C	C	C	C	C	C	A	A	A	
Ammonium Hydroxide	A	A	X	X	X	X	A	A	A	A	A	A	X	A	
Ammonium Nitrate	A	X	C	X	X	X	A	A	A	X	X	X	A		
Ammonium Persulphate	X	X	X	X	C	X	C	B	B	C	C		A	A	
Ammonium Sulphate	X	X	X	X	B	B	C	B	B	B	B	A	A	A	
Amyl Alcohol	A	B	C	A		B	B	B	B	B	B	A	A		2
Aniline	B	B	B	X	B	B	A	A	A	B	B	A	A		
Anodizing	X	X	X	X	A	X	X	X	A	X	X	X	A	A	
ARP-28														A	1
ARP-80 Blackening Salt													A		1
Arsenic Acid	X	X	X	X	X	X	C	B	B	X	X	X	A	A	
Asphalt	A	A	X	X	X	X	A	A	A	A	A	A	A		2
Barium Hydroxide	B	B	X	X	X	B	B	A	A	B	B	X	A	A	
Barium Sulphate	B	B	B	B	B	B	B	B	B	B	B	A	A		
Black Nickel													A	A	5
Black Oxide							A								5

Legend
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Solution	Iron-Steel	Cast Iron	Aluminum	Copper	Lead	Monel-400	304, 321, 347, S.S	316 S.S.	Carpenter Stainless #20	Incoloy 800	Inconel 600	Titanium	Quartz	Teflon	Notes
	Sheath Material - Comments														
Bonderizing	SEE ZINC PHOSPHATE														
Boric Acid	X	X	X	C	C	C	C	C	C	C	C	A	A	A	
Brass Cyanide							A								1
Bright Copper-Acid													A	A	1
Bright Copper-Cyanide	A						A								1
Bright Nickel												A	A	A	1, 5
Bronze Plating	A						A							A	1
Butanol	A	A	B	A	A	A	A	A	A	A	A	A	A	A	2
Cadmium Black													A	A	1
Cadmium Fluoborate														A	1
Cadmium Plating							A								1
Calcium Chlorate	B	B	B	C	C	B	B	B	B	B	B				
Calcium Chloride	B	B	A	B	X	B	B	B	B	B	B	A	A	A	
Carbon Dioxide-Dry Gas	X	X	A	A	B	A	A	A	A	A	A	X	A	X	
Carbon Dioxide-Wet Gas	X	X	A	X	B	A	A	A	A	A	A	X	A	X	
Carbonic Acid	C	C	B	C	X	C	B	B	A	B	A	A	A	A	
Carbon Tetrachloride	X	X	X	A	A	A	A	A	A	A	A	A	A		
Castor Oil	A	A	A	A	A	A	A	A	A	A	A	A	A	A	
Caustic Etch	A	A	X	C	X	A	A	A	A	A	A	A	X	A	6
Caustic Soda	SEE SODIUM HYDROXIDE														
Chlorine Gas-Dry	X	X	X	X	X	C	C	C	B	C	B	B	A	B	
Chlorine Gas-Wet	X	X	X	X	X	X	X	X	X	X	X	X	A	X	
Chloracetic Acid	X	X	X	X	X	C	X	X		C	C	A	A	A	
Chromium Plating	X	X	X	X	B	X	X	X	X	X	X	A	A	A	
Chromic Acetate													A	A	1
Chromic Acid	X	X	X	X	B	X	X	X	X	X	X	A	A	A	
Chromic Anodizing													A	A	1
Chromylite													A	A	1
Citric Acid	X	X	X	X	X	B	B	A	A	B	B	A	A	A	
Clear Chromate								A					A	A	1
Cobalt Nickel													A	A	1, 6
Cobalt Plating							A						A	A	1
Cod Liver Oil							A	A	A	A	A				
Copper Acid												A	A	A	1
Copper Bright							A								1
Copper Bright-Acid													A	A	1
Copper Chloride	X	X	X	X	X	X	X	X	X	X	X	A	A	A	
Copper Cyanide	A	A	X	X		C	B	B	B	X	X		A	A	
Copper Fluoborate						B	B	B	B	B	B			A	
Copper Nitrate	X	X	X	X		X	B	B	B	C	X		A	A	
Copper Pyrophosphate							A								1
Copper Strike	A	A					A								1
Copper Sulphate	X	X	X	C	A	X	B	B	A	C	X	A	A	A	
Creosote	A	A	C	B	X	B	B	B	B	B	B		A		2
Cresylic Acid	C	C	C	C	X	C	B	A	B	C	C	B	A	A	2
Deionized Water	SEE WATER														
Deoxidizer (Etching)													A		1
Deoxidizer (3AL-13)							A	A						A	1, Non-chromate
Dichromic Seal	X	X												A	
Diethylene Glycol	B	A	B	B	A	B	A	A	A	B	B	A	A	A	
Diversey - DS9333													A	A	1
Diversey - 511													A	A	1, 5
Diversey - 514														A	1
Dur-Nu												A	A	A	1, 5
Electro Cleaner	A						A								1
Electro Polishing													A		1
Electroless Nickel												A	A		1
Electroless Tin (Acid)													A		1
Electroless Tin (Alkaline)								A				A			1
Ether	B	B	B	B	B	B	B	B	A	B	B	A	A		2
Enthone Acid-80														A	1
Ethyl Chloride	B	B	B	A	B	B	B	A	A	B	A	A	A	A	2
Ethylene Glycol	A	B	A	B	X	B	B	B	B	B	B	A	A	A	5
Fatty Acids	X	X	A	X	X	B	B	A	A	B	B	A	A		
Ferric Chloride	X	X	X	X	X	X	X	X	X	X	X	A	A	A	

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	Sheath Material - Comments														
Ferric Nitrate	X	X	X	X		X	B	B	A	X	X		A	A	
Ferric Sulphate	X	X	X	X	A	X	B	B	B	C	C	A	A	A	
Fluoborate														A	1
Fluoborate (high speed)													A	A	1
Fluorine Gas. Dry	C	X	X	X	X	A	C	C	C	C	A	A	C		
Formaldehyde	X	X	B	B	X	B	A	A	A	B	B	A	A		
Formic Acid	X	X	B	B	X	B	A	X	A	B	B	C	A	A	
Fuel Oil-Normal	A	A	A	A	A	B	A	A	A	B	B	A			2, 3, 7
Fuel Oil-Acid	X	X	X	X	A	C	C	B	A	C	C	A			2, 3, 7
Gasoline-Refined	A	A	A	A	A	B	A	A	A	B	B		A		2, 5
Gasoline-Sour	C	C	C	C	A	X	B	B	A	X	X		A		2, 3, 5
Glycerin, Glycerol	B	B	A	B	B	A	A	A	A	A	A		A		
Gold-Acid	A											A	A	A	1
Gold-Cyanide							A	A						A	1
Grey Nickel												A	A	A	1, 5
Hot Seal Sodium Dichromate								A							1
Hydrocarbons-Aliphatic	A	A	A	A		A	A	A	A	A	A		A		2
Hydrocarbons-Aromatic	A	A	A	A		A	A	A	A	A	A		A		2
Hydrochloric Acid	X	X	X	X	X	X	X	X	X	X	X	X	X	A	
Hydrocyanic Acid	X	X	B	X	X	B	B	B	B	B	B		A		
Hydrofluoric Acid	X	X	X	X	X	X	X	X	X	X	X	X	X	A	5
Hydrogen Peroxide	X	X	A	X	X	B	B	B	B	B	B	A	A	A	
Indium													A	A	1
Iridite - #4.75, #4.73								A							
#14, #14-2, #14-2, #14-9, #18-P															1
Indrite - #1, #2, #3, #4-C															
#4PC&S, #4P-4, #4-80															
#4L-1, #4-2, #4-2A, #4-2P															
#5P-1, #7, #7-P, #8, #8-P															
#8-2, #12-P, #15, #17P, #18P													A	A	1
Indite Dyes - #12L-2, #40, #80													A	A	1
Irilac													A	A	1
Iron Fluoborate														A	1
Iron Phosphate								A							
Isoprep Deoxidizer #187, #188								A							1
Cleaner #186								A							1
Isoprep #191 Acid Salts														A	1
Jetal							A								1
Kerosene	A	A	A		A	A	A	A	A	A					2
Lacquer Solvent	A	A	A	A	A	B	A	A	A	B	B	A	A		2
Lead Acetate	X	X	X	X	X	A	A	A	A	A	A	A	A	A	
Lead Acid Salts							A								1
Lime Saturated Water	B	B	X	B	X	B	B	A	B	B	B		X	A	
Linseed Oil	A	A	B	B	B	B	A	A	A	B	B		A		2
Magnesium Chloride	X	X	X	B	X	B	C	B	A	B	A	A	A		
Magnesium Hydroxide	A	A	B	A	A	B	A	A	A	A	A		A	A	
Magnesium Nitrate	B	B	B	B	X	B	B	B	B	B	X	B	A	A	
Magnesium Sulphate	B	B	B	B	A	A	B	B	B	B	A	A	A		
McDermid #629														A	1
Mercuric Chloride	X	X	X	X	X	X	X	X	X	X	X	A	A	A	
Mercury	A	A	X	X	X	B	A	A	A	A	B	A	A		
Methyl Alcohol Methanol	B	B	C	B	B	A	B	B	B	B	A	A	A		2
Methyl Bromide	C	C	X	B	B	B	A	A	A	B	B	A	A		
Methyl Chloride	X	C	X	A	C	C	C	C	A	C	C	A	A		
Methylene Chloride	X	C	C	C	B	C	C	C	A	C	B	A	A		
Mineral Oil	A	A	A	A	A	A	A	A	A	A	A	A	A		
Muriatic Acid	SEE HYDROCHLORIDE ACID														
Muriato													A	A	1
Naptha	A	B	A	A	A	A	A	A	A	A	A	A	A	A	2
Nickel Acetate Seal								A							1
Nickel Chloride	X	X	X	X	C	C	X	C	B	C	B	C	A	A	1, 5
Nickel Plate-Bright												A	A	A	1, 5
Nickel Plate-Dull													A	A	1, 5
Nickel Plate-Watts Sol.												A	A	A	1, 5
Nickel Sulphate	X	X	X	C	B	C	B	B	B	C	C		A	A	

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Solution	Sheath Material - Comments: Iron-Steel	Cast Iron	Aluminum	Copper	Lead	Monel-400	304, 321, 347, S.S	316 S.S.	Carpenter Stainless #20	Incoloy 800	Inconel 600	Titanium	Quartz	Teflon	Notes
Nickel Copper Stride (CN Free)							A								1
Nitric Acid	X	X	X	X	X	X	C	C	B	X	X	A	A	A	
Nitric Hydochloric Acid	X	X	X	X	X	X	X	X	X	X	X	X	A	A	
Nitric 6% Phosphoric Acid								A					A	A	1
Nitric Sodium Chromate								A					A	A	1
Nitrobenzene	A	B	B	B	X	B	B	B	A	B	B	A	A		2
Oakite #67							A							A	1
Oil	A	A	A	A	A	A	A	A	A	A	A	A	A	A	7
Oleic Acid	C	C	C	C	X	B	C	B	B	B	A	B	A	A	
Oxalic Acid	X	X	X	B	X	B	X	X	B	X	B	X	A	A	
Paint Stripper (High Alkaline Type)	A														1
Paint Stripper (Solvent Type)									A						1, 2
Pariffin	A	A	A	A		B	A	A	A						2, 7
Parkerizing	SEE IRON PHOSPHATE														
Perchloroethylene	A	A	B	B	B	A	A	A	A	A	A	A	A		
Petroleum-Crude	B	B	A			A	A	A	A				A		2, 3, 7
Phenol	B	B	B	A	X	B	C	B	B	B	B	A	A		
Phosphate								A						X	1, 5, 9
Phosphate Cleaner							A							X	1, 5, 9
Phosphatizing								A						X	1, 5, 9
Phosphoric Acid	X	X	X	C	C	C	X	B	B	C	C	X	A	A	5, 9
Picric Acid	X	X	X	X	X	X	B	B	B	C	C		A	A	
Potassium Acid Sulphate													A	A	1
Potassium Bichromate	C	C	B		B	B	B	B	B	B		A	A	A	
Potassium Chloride	X	X	X	C	C	B	C	A	A	C	C	A	A		
Potassium Cyanide	C	X	X	X	X	C	B	B	B	B	B	X	A	A	
Potassium Hydrochloric													A	A	1
Potassium Hydroxide	X	X	X	X	X	B	C	C	C	C	B	C	X	A	
Potassium Nitrate	B	B	A	B	B	B	B	B	B	B	B	A	A		
Potassium Sulphate	C	X	A	B	A	A	A	A	A	B	B		A	A	
Reynolds Brightener													A	A	1
Rhodium Hydroide													A	A	
Rochelle Salt Cyanide	A						A							A	1
Ruthenium Plating													A	A	1
Salt (Actine)														A	1
Silver Bromide	X	X	X	X		C	X	X	C			A	A	A	
Silver Cyanide	C	C	X	X		B	A	A	A	A			A	A	
Silver Lume							A								1
Silver Nitrate	X	X	X	X	X	X	C	C	B	C	C	A	A		
Soap Solutions	A	A	X				A	A	A						3
Sodium-Liquid Metal	C	X	X	X	X	B	A			A	A		X		
Sodium Bisulphate	X	X	C		C	C	X	X	B		C	C	A		
Sodium Bromide	B	X	X	B	B	B	X	B	B	B	B		A	A	
Sodium Carbonate	C	C	X	A	X	B	B	B	B	B	B	A	C	A	
Sodium Chlorate	X	X	B	A	B	A	B	B	B	B	A	A	A	A	
Sodium Chloride	X	X	X	B	B	A	X	X	C	B	A	C	A		
Sodium Citrate	X	X	X	X	X		B	B	B				A	A	
Sodium Cyanide	X	B	X	X	C	X	A	A	A	A	A	C	A		
Sodium Dichromate (Sodium Bichromate)	A	A	C	X			B	B	B			C	A		
Sodium Hydroxide	C	C	X	X	X	C	X	C	C	B	B	C	X	A	8, 6
Sodium Hypochlorite	X	X	X	X	X	X	X	X	B	X	X	A	A	A	
Sodium Nitrate	B	B	X	C	B	B	A	A	A	A	A	A	A	A	5
Sodium Peroxide	B	A	B	X	X	B	B								
Sodium Phosphate	B	B	X	B	B	B	B	B	B	B	B	A	A	A	
Sodium Salicylate	B	C				B	B	B	B	B	B		A	A	
Sodium Silicate	B	B	X	B	X	B	B	B	B	B	B	A	A	A	4
Sodium Sulphate	B	X	A	B	B	B	X	B	B	B	B	C	A	A	
Sodium Sulphide	X	X	X	X	A	B	X	C	C	B	C	C	C	A	
Solder Bath	X	B	X	X	X	X	X	X	X	X	X	X	X	X	
Sodium Stannate	C	C				B	B	B	B	B	B		A	A	
Stanostar													A	A	1
Stearic Acid	C	C	B	X	X	X	C	A	B	B	A	A	A		
Sugar Solution	A	A	A	A	A	A	A	A	A	A	A	A	A	A	7
Sulfamate Nickel												A	A	A	1

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Sulfuric Acid	X	X	X	X	A	X	X	X	B	X	X	X	A	A	
Sulfurous Acid	X	X	C	X	A	X	X	X	A	X	X	A	A	A	
Sulphamic Acid	X	X	X				X	X					A	A	
Sulphur	X	X	A	X	X	B	A	A	A	A	A	A	A		
Sulphur Chloride	X	X	X	X	C	C	C	C	C	C	B		A	A	
Sulphur Dioxide	C	C	C	C	B	X	C	B	B	C	C	A	A		
Tannic Acid	X	X	C	X	X	C	B	B	B	C	C	A	A		
Tin (Molten)			X	X	X	X	X	X	X		X			X	4
Tin-Nickel Plating													A	A	1
Tin Plating-Acid														A	1
Tin Plating-Alkaline	A						A								1
Trichloroethane	A	A	A	A	A	A	A	A	A	A	A	A	A		
Trichlorethylene	A	A	A	B	X	B	A	A	A	A	A	A	A	A	
Triethylene Glycol	A	A	A	A	A	A	A	A	A	A	A	A	A		
Trisodium Phosphate	A	A	X	C	X	C	C	C	C				X	X	
Trioxide (Pickle)													A	A	1
Turco 4181 (Alk. Cleaner)								A							1
Turco 4008 (Descaler)								A						A	1, 5
Turco 4338 (Oxidizer)								A						A	1, 7
Turco Ultrasonic Solution								A						A	1
Ubec													A	A	1
Udylite #66												A	A	A	1, 5
Unichroma CR-110													A	A	1
Unichroma 5RHS													A	A	1
Water Deionized	X	X	X	X		A	A	A	A	A	A			A	11
Water Demineralized	X	X	X	X		A	A	A	A	A	A			A	11
Water Pure	X	X	X	X		A	A	A	A	A	A			A	11
Water Potable	X	C	C	B	A	A	C	B	A	A	A	A	A	A	
Water Sea	X	X		X		A	C	C	A	B	B	A	A	A	
Watt's Nickel Strike													A	A	1
Whiskey				A		A	A	A	A						2
Wood's Nickel Strike													A	A	1
Yellow Dichromate								A					A	A	1
Zinc (Molten)			X	X	X	X	X	X	X	X	X	X		X	
Zinc Chloride	X	X	X	X	X	B	X	X	B	X	B	B	A	A	
Zinc Plating Acid													A	A	1
Zinc Plating Cyanide	A						A							A	1
Zinc Phosphate								A						X	1, 5
Zincate	A						A								1

Notes and Legend to Corrosion Guide

1. This solution involves a mixture of various chemical compounds whose identity and proportions are unknown or subject to change without our knowledge. Check supplier to confirm choice of sheath material plus alternate sheath materials that may be used.
2. Caution - Flammable material.
3. Chemical composition varies widely. Check supplier for specific recommendations.
4. Direct immersion heaters not practical. Use clamp-on heaters on outside surface of cast iron pot.
5. Element surface loading should not exceed 20 watts per sq. inch.
6. For concentrations greater than 15%, element surface loading should not exceed 20 watts per sq. inch.
7. See suggested watt density chart.
8. Remove crusts at liquid level.
9. Clean often.
10. Do not exceed 12 wpsi.
11. Passivate stainless steel, Inconel and Incoloy.

Because so many factors are beyond our power to control, the Emerson Electric Company cannot be responsible for any electric immersion heater failure that can be attributed to corrosion. This is in lieu of any warranties, written or verbal, relative to heater performance in a corrosive environment.

Saturated steam

Saturated steam is pure steam in direct contact with the liquid water from which it was generated and at a temperature of water at the existing pressure. For example, saturated steam at 50 psig has a temperature of 298˚F.

Pressure is commonly expressed either (a) psia - pounds per square inch absolute (above perfect vacuum) or, (b) psig - pounds per square inch gauge above standard atmospheric pressure of 14.7 psia, thus psig is equal to psia minus 14.7 psi.

Latent heat, expressed in Btu per pound, is the amount of heat needed (absorbed) to convert a pound of boiling water to a pound of steam. The same amount of heat is liberated when a pound of steam condenses back to a pound of water. Latent heat varies with temperature (see Table).

*Heat content is the number of Btu/lb needed to reach the condition indicated starting with water at 32˚F.

Thermodynamic properties/saturated steam (values to nearest even digits)

		Btu/lb.			Spec. vol.			Btu/lb.			Spec. vol.
psig	˚F	Ht. Liquid*	Latent Ht. Evap.	Total Ht. Steam	Ft.3/lb. Sat. Vapor	psig	˚F	Ht. Liquid*	Latent Ht. Evap.	Total Ht. Steam	Ft.3/lb. Sat. Vapor
0	212	180	970	1150	27.0	65	312	282	901	1183	5.5
1	216	183	968	1151	25.0	70	316	286	898	1184	5.2
2	219	187	965	1152	24.0	75	320	290	895	1185	4.9
3	222	190	964	1154	22.5	80	324	294	892	1186	4.7
4	224	193	962	1155	21.0	85	328	298	889	1187	4.4
5	227	195	961	1156	20.0	90	331	302	886	1188	4.2
6	230	198	959	1157	19.5	95	335	306	883	1189	4.0
7	232	201	957	1158	18.5	100	338	309	881	1190	3.9
8	235	203	956	1159	18.0	110	344	316	876	1192	3.6
9	237	206	954	1160	17.0	120	350	322	871	1193	3.3
10	240	208	952	1160	16.5	125	353	325	868	1193	3.2
15	250	218	945	1163	14.0	130	356	328	866	1194	3.1
20	259	227	940	1167	12.0	140	361	334	861	1195	2.9
25	267	236	934	1170	10.5	150	366	339	857	1196	2.7
30	274	243	929	1172	9.5	160	371	344	853	1197	2.6
35	281	250	924	1174	8.5	170	375	348	849	1197	2.5
40	287	256	920	1176	8.0	180	380	353	845	1198	2.3
45	292	262	915	1177	7.0	190	384	358	841	1199	2.2
50	298	267	912	1179	6.7	200	388	362	837	1199	2.1
55	303	272	908	1180	6.2	220	395	370	830	1200	2.0
60	307	277	905	1182	5.8	240	403	378	823	1201	1.8
						250	406	381	820	1201	1.75

*Heat content is the number of Btu/lb needed to reach the condition indicated starting with water at 32˚F.

kW Boiler rating using known steam load and feedwater temperatures.

kW/lb. steam											
˚F Feed	Working Pressure (psig)										
Water	0	2	10	15	25	40	50	75	100	125	150
40	.3347	.3355	.3375	.3388	.3406	.3422	.3431	.3447	.3458	.3464	.3470
50	.3318	.3326	.3345	.3359	.3376	.3392	.3401	.3417	.3429	.3435	.3441
60	.3288	.3296	.3316	.3329	.3347	.3363	.3372	.3388	.3400	.3407	.3411
70	.3259	.3267	.3287	.3300	.3318	.3334	.3343	.3359	.3370	.3376	.3382
80	.3229	.3238	.3278	.3271	.3288	.3305	.3313	.3329	.3341	.3347	.3353
90	.3200	.3208	.3238	.3242	.3259	.3275	.3284	.3300	.3312	.3318	.3324
100	.3171	.3179	.3199	.3212	.3229	.3246	.3255	.3271	.3283	.3288	.3294
110	.3142	.3150	.3170	.3183	.3200	.3217	.3225	.3242	.3253	.3259	.3265
120	.3112	.3210	.3140	.3154	.3171	.3187	.3196	.3212	.3224	.3230	.3236
130	.3083	.3091	.3111	.3124	.3142	.3160	.3167	.3183	.3195	.3200	.3206
140	.3054	.3062	.3082	.3095	.3113	.3129	.3137	.3154	.3165	.3171	.3177
150	.3025	.3032	.3052	.3066	.3083	.3099	.3108	.3124	.3136	.3142	.3148
160	.2995	.3003	.3029	.3036	.3054	.3070	.3079	.3095	.3107	.3113	.3118
170	.2966	.2974	.2994	.3001	.3025	.3041	.3050	.3066	.3077	.3083	.3089
180	.2937	.2945	.2964	.2978	.2995	.3011	.3020	.3036	.3048	.3054	.3060
190	.2907	.2915	.2935	.2948	.2966	.2982	.2981	.3007	.3019	.3025	.3030
200	.2878	.2886	.2906	.2919	.2937	.2953	.2962	.2978	.2989	.2995	.3001

Example: Need a boiler to produce 450 lbs steam/hr at 75 psig with the available feedwater temperature 50˚F.

From the above chart, find 0.3417 kW/lb of steam.

450 lbs steam/hr x .3417 = 153.8 kW boiler required.

Suggested wiring practices for electric heaters

When selecting wiring for electric heater circuits, it should be recognized that wiring may be operating at temperatures above room ambient. These temperatures may be the result of conducted heat from heater terminals, radiation from heated surfaces, or due to high ambient temperatures.

In the high temperature areas wiring must employ high-temperature insulation and/or nickel plated copper or high temperature nickel alloy conductors. Outside the heated zone, conventional wiring methods and materials are generally used.

The recommendations which follow are only suggestions for minimum good wiring practice and are not to conflict with the National Electric code or local codes.

Selecting Type of Wire

Table I lists some of the more common code wire constructions according to their temperature capabilities. A more complete listing may be found in current issues of the National Electric Code on good wiring practice.

Explosion-proof Wiring

Where hazardous conditions exist, approved explosion-proof terminal and junction boxes should be used. MI cable or rigid conduit is mandatory and thread joints should be wrench tight but need not be sealed (Refer to NEC).

Selecting Wire Size

Size of the electrical conductor will depend upon the current which the heating load will draw from the power source. Table II permits determination of heating load current.

Wire size may be selected from Table III for the calculated load current.

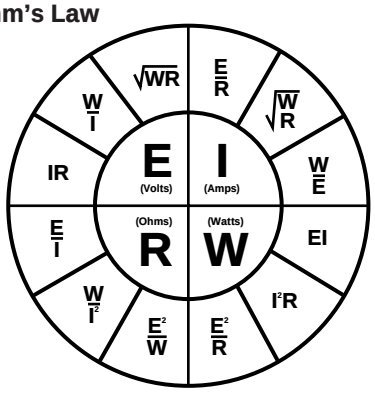
Table III lists the high-temperature conductors. The recommended current carrying capacities are valid if conductor temperatures do not exceed 104˚F (40˚C).

The wire size thus selected may be used in the heating circuit and enclosed in rigid or flexible conduit to protect the wiring. If more than 3 conductors are encased in the same conduit, another current correction factor must be used. When 4 to 6 conductors are enclosed in a single conduit, use 80% of the recommended current-carrying capacity. The correction for 7 to 24 conductors is 70% of the rated capacity.

Miscellaneous Wiring Hints

1. All heater terminal connections should be wrench or screwdriver tight with maximum torque consistent with terminal strength.
2. Where heater terminal connections may be affected by movement of wire stranded wire is preferred.
3. Under extreme temperature or vibration conditions, soldering, or brazing should be used to make electrical connections to heating elements.
4. It is good practice to provide separate conduit for thermocouple circuit wiring.
5. Thermostat capillary tubing and thermocouple wiring should be kept clear of heater terminals.
6. Use wiring suitable for the temperatures involved. For terminal wiring, alloy wire is recommended unless the instruction sheet with the equipment specifically states copper or low-temperature wire may be used. Always check local electrical codes for wiring requirements.

Ohm's Law



For special applications, contact the nearest Chromalox sales and application engineering office for assistance. He is listed on the back cover of this Full Line Catalog.

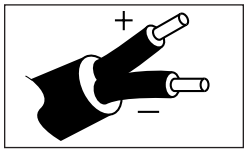
Table I

Max. Conductor Operating Temps.		Wire Choice		
		Line Voltages up to 300V	Line Voltages up to 600V	
˚C	˚F	Type Wire	Type Wire	Construction
60	140	Use 600V wire	T	Thermoplastic over copper.
			TW	Moisture-resistant thermoplastic over copper.
75	167	Use 600V wire	RHW	Moisture & heat-resist. rubber over copper.
			THWN	Moisture & heat-resist. thermoplastic over copper.
90	194	Use 600V wire	RHH	Heat-resistant rubber over copper.
			THHN	Heat-resistant thermoplastic over copper.
200	392	Use 600V wire	FEP	Teflon over copper.
		Use 600V wire	SRG	Silicone rubber & glass braid over copper.
Special construction for high temperature application				
250	482	Use 600V wire	TGT	Teflon tape with teflon impregnated glass braid over nickel plated copper.
		Use 600V wire	TGS	Teflon tape with silicone impregnated glass braid over nickel plated copper.
450	842	Use 600V wire	MGS	Mica tape with silicone impregnated glass braid over nickel plated copper.
		Use 600V wire	MGT	Mica tape with silicone impregnated glass braid over nickel plated copper.
594	1100	Bare Maganese nickel wire or bus wire or bus bar with ceramic tube or bead insulation.		Mica tape with teflon impregnated glass braid over nickel plated copper.

Suggested wiring practices continued

Thermocouple Wire and Cable

Thermocouples and extension wires are color coded to aid in identification and to avoid inadvertent cross wiring.



All negative (-) conductors have red color coded insulation.

Thermocouples

Positive (+) conductor	Insulation color code	Alloy
J	White	Iron/Constantan
K	Yellow	Chromel/Alumel
T	Blue	Copper/Constantan
E	Purple	Chromal/Constantan
R	Black	Platinum/Platinum w/13% Rhodium
S	Black	Platinum/Platinum w/6% Rhodium
N	Orange	Nicrosil/Nisil

Thermocouple Extension Wire

Wire			Color	
Type	Pos.	Neg.	Overall	Positive
T	TPX	TNX	Blue	Blue
J	JPX	JNX	Black	White
E	EPX	ENX	Purple	Purple
K	KPX	KNX	Yellow	Yellow
R or S	SPX	SNX	Green	Black
B	BPX	BNX	Gray	Gray

Note: All negative conductors are color red.

Table II — Currents for Resistance Heating Loads

Single Phase							Three Phase				
kW	120	208	240	440	480	600	208	240	440	480	600
0.5	4.2	2.4	2.1		1.1	0.8	1.4	1.2		0.6	0.5
1	8.4	4.8	4.2	2.3	2.1	1.7	2.8	2.5	1.4	1.3	1.0
2	16.7	9.7	8.4	4.6	4.2	3.3	5.6	4.9	2.7	2.5	1.9
3	25	14.5	12.5	6.9	6.3	5	8.4	7.3	4	3.7	2.9
4	33.4	19.3	16.7	9.1	8.4	6.7	11.2	9.7	5.3	4.9	3.9
5	41.7	24.1	20.9	11.4	10.5	8.3	13.9	12.1	6.6	6.1	4.8
6	50	28.9	25	13.7	12.5	10	16.7	14.5	7.9	7.3	5.8
7	58.3	33.7	29.2		14.6	11.7	19.5	16.9		8.4	6.7
7.5	62.5	36.1	31.3	17.1	15.7		20.9	18.1	9.9	9.1	
8	66.7	38.5	33.4		16.7	13.3	22.3	19.3		9.7	7.7
9	75	43.3	37.5		18.8	15	25.1	21.7		10.9	8.7
10	83.4	48.1	41.7	22.8	20.9	16.7	27.8	24.1	13.2	12.1	9.6
12	100	57.7	50	27.3	25	20	33.4	29	15.8	14.5	11.6
15	125	72.2	62.5	34.1	31.2	25	41.7	36.2	19.7	18.1	14.5
18	150	86.6	75		37.5	30	50.1	43.4		21.7	17.3
20	167	96.2	83.4	45.5	41.7		55.6	48.2	26.3	24.1	
21	175	101	87.5		43.8	35	58.3	50.6		25.3	20.2
24	200	115.4	100		50	40	66.7	57.8		28.9	23.1
25	209	121	105	56.9	52.1		69.5	60.3	32.9	30.1	
27	225	129.9	112.5		56.3	45	75.1	65.1		32.6	26
30	250	145	125	68.2	62.5		83.4	72.3	39.4	36.2	
36	300	173.1	150		75	60	100.1	86.8		43.4	34.7
50	417	241	209	114	105		139	121	65.7	60.3	
75	625	361	313	171	157		209	181	98.6	90.4	
100	834	481	417	228	209		278	241	132	121	

Table III — Insulated Wire Current Carrying Capacity - Amperes in 104˚F Ambient

Type Insulation Max. wire temp	Copper or Nickel Silicon-glass 200˚C/392˚F	Nickel-plated copper TGT, Teflon-glass 250˚C/482˚F	Nickel-plated copper MGT*, Mica-glass 450˚C/842˚F
16	27	-	33
14	36	39	44
12	45	54	58
10	60	73	77
8	83	93	100
6	110	117	-

*Amperes based on single conductor in free air with 400˚C conductor temperature and 200˚C ambient temperature.

Equivalents and conversions

Heating elements are frequently used at voltages other than those shown in our catalog. The percentages shown above are used to determine the resulting wattage. To use a heater on a voltage not shown, you may calculate the resultant wattage with this formula:

$$\text{Actual Wattage} = \text{Rated Wattage} \times \frac{\text{Applied Voltage}^2}{\text{Rated Voltage}^2} \qquad W1 = W2 * \left(\frac{V1^2}{V2^2}\right)$$

Conversion of ˚F and ˚C
˚F -(9/5) ˚C + 32
˚C = (˚F-32) x 5/9

Percent of Rated Wattage for various Applied Voltages

Applied Voltage	Rated Voltage 110	115	120	208	220	230	240	277	380	415	440	460	480	550
110	100%	91%	84%	28%	25%	23%	21%	16%	8.4%	7%	6.2%	5.7%	5.2%	4%
115	109%	100%	92%	31%	27%	25%	23%	17%	9.0%	7.6%	6.7%	6.2%	5.7%	4.3%
120	119%	109%	100%	33%	30%	27%	25%	19%	10%	8.4%	7.4%	6.8%	6.3%	4.8%
208			300%	100%	89%	82%	75%	56%	30%	25%	22%	20%	19%	14%
220				112%	100%	91%	84%	63%	34%	28%	25%	23%	21%	16%
230				122%	109%	100%	92%	69%	37%	31%	27%	25%	23%	17%
240				133%	119%	109%	100%	75%	40%	33%	30%	27%	25%	19%
277							133%	100%	53%	45%	40%	36%	33%	25%
380								188%	100%	84%	74%	68%	63%	47%
415									119%	100%	89%	81%	75%	57%
440										112%	100%	91%	84%	64%
460										123%	109%	100%	92%	70%
480											119%	109%	100%	76%
550											156%	143%	131%	100%

Metric System Length

Unit			Metric Equivalent			U.S. Equivalent	
millimeter	(mm)	=	0.001	meter	=	0.0.937	inch
centimeter	(cm)	=	0.01	meter	=	0.3937	inch
decimeter	(dm)	=	0.1	meter	=	3.937	inches
METER	(m)	=	1.0	meter	=	39.37	inches
dekameter	(dkm)	=	10.0	meters	=	10.93	yards
hectometer	(hm)	=	100.0	meters	=	328.08	feet
kilometer	(km)	=	1000.0	meters	=	0.6214	mile

Metric System / Weight or Mass

Unit			Metric Equivalent			U.S. Equivalent	
Milligram	(mg)	=	0.001	gram	=	0.0154	grain
centrigram	(cg)	=	0.01	gram	=	0.1543	grain
decigram	(dg)	=	0.1	gram	=	1.543	grains
GRAM	(g)	=	1.0	gram	=	15.43	grains
dekagram	(dkg)	=	10.0	grams	=	0.3527	ounce avoidrdupois
hectogram	(hg)	=	100.0	grams	=	3.527	ounces avoidrdupois
kilogram	(kg)	=	1000.0	grams	=	2.2	pounds avoidrdupois

Metric System / Capacity

Unit			Metric Equivalent			U.S. Equivalent	
milliliter	(ml)	=	0.001	liter	=	0.034	flud ounce
centiliter	(cl)	=	0.01	liter	=	0.338	fluid ounce
deciliter	(dl)	=	0.1	liter	=	3.38	fluid ounces
LITER	(l)	=	1.0	liter	=	1.05	liquid quarts
dekaliter	(dkl)	=	10.0	liters	=	0.284	bushel
hectoliter	(hl)	=	100.0	liters	=	2.837	bushels
kiloliter	(kl)	=	1000.0	liters	=	264.18	gallons

Multiply Number of . . .	By . . .	To Obtain . . .
bar	0.987	atmosphere
bar	100,000	pascal
barrel (42 US gal.)	0.159	cu. meters
calorie	4.184	Joule
Joule	0.00095	BTU
Kilojoule	3,600	kilowatt-hour
Kilograms/sq. cm.	14.2	lbs./sq. in.

Metric System / Area

Unit			Metric Equivalent			U.S. Equivalent	
square millimeter	(mm2)	=	0.000001	centare	=	0.00155	square inch
square centimeter	(cm2)	=	0.0001	centare	=	0.155	square inch
square decimeter	(dm2)	=	0.01	centare	=	15.5	square inches
CENTARE also square meter	(ca) (m2)	=	1.0	centare	=	10.76	square feet
are also square dekameter	(a) (dkm2)	=	100.0	centares	=	0.0247	acre
hecatre also square hectometer	(ha) (hm2)	=	10,000.0	centares	=	2.47	acres
square kilometer	(km2)	=	1,000,000.0	cantares	=	0.386	square mile

Metric System / Volume

Unit			Metric Equivalent			U.S. Equivalent	
cubic millimeter	(mm3)	=	0.001	cubic cm	=	0.016	minim
cubic centimeter	(cc, cm3)	=	0.001	cubic dm	=	0.061	cubic inch
cubic decimeter	(dm3)	=	0.001	cubic meter	=	61.023	cubic inches
STERE also cubic meter	(s) (m3)	=	1.0	cubic meter	=	1.308	cubic yards
cubic dekameter	(dkm3)	=	1000.0	cubic meters	=	1307.943	cubic yards
cubic hectometer	(hm3)	=	1 (million)	cubic meters	=	1,307,942.8	cubic yards
cubic kilometer	(km3)	=	1 (billion)	cubic meters	=	0.25	cubic mile

Conversion Factors

Length
1 in. = 2.54 cm
1 ft. = 0.3048 m
1 yd. = 0.9144 m
1 m = 39.37 in.

Area
1 sq. in. = 6.452 cm^2
1 sq. ft. = 0.0929 m^2

Horsepower
1 hp. = 0.746 kW
1 boiler hp. = 9.8 kW

Weight
1 kg. = 2.205 lb.

Volume
1 cu. in. = 16.39 cm^3
1 cu. ft. = 0.02832 m^3
1 cu. ft. = 62.43 lb. water
1 cu. ft. = 7.5 gal water
1 cu. ft. = 28.32 liters
1 US gal. = 0.1337 cu. ft.
1 US gal. = 231 cu. in.
1 US gal. = 8.345 lb. water
1 US gal. = 3.785 liters

Equivalents and conversions

Pressure

Unit	Atm.	kg./cm.²	lb./in.²	bar	mm. Hg. (0˚C)	in. Hg. (32˚F)	ft. H_2O (60˚F)
1 Atmosphere	1*	1.033228	14.6959	1.013250	760*	29.921	33.934
1 kg/cm2	0.967841	1*	14.2233	0.980665*	735.559	28.959	32.843
10 lb/in2	0.68046	0.70307	10*	0.689476	517.149	20.360	23.091
1 bar	0.986923	1.019716	14.5038	1*	750.062	29.530	33.490
1 meter Hg. (˚C)	1.31579	1.35951	19.3368	1.333224	1000*	39.370	44.65
10 in. Hg. (32˚F)	0.33421	0.34532	4.9115	0.33864	254*	10*	11.341
100 ft. H_2O (60˚F)	2.9469	3.0448	43.308	2.9859	2239.6	88.175	100*

Note: 1 inch of Hg (mercury) = 13.6 inch H_2O
1 PSI = 2.31 inches of H_2O
1 BTU = 251.996 Calories

Conversion Table

Multiply Number of . . .	By . . .	To Obtain . . .
British Thermal Units	778.3	Foot-pounds
	3.929×10^{-4}	Horsepower-hours
	2.930×10^{-4}	Kilowatt-hours
	0.2930	Watts-hours
Foot-pounds	1.285×10^{-3}	British thermal units
	5.05×10^{-7}	Horsepower-hours
	3.766×10^{-7}	Kilowatt-hours
	3.766×10^{-4}	Watt-hours
Horsepower-hours	2545	British thermal units
	1.98×10^{4}	Foot-pounds
	0.7457	Kilowatt-hours
	745.7	Watt-hours
Kilowatt-hours	3413	British thermal units
	2.655×10^{6}	Foot-pounds
	1.341	Horsepower-hours
	1000	Watt-hours
Watt-hours	3.413	British thermal units
	2655	Foot-pounds
	1.341×10^{-3}	Horsepower-hours
	0.001	Kilowatt-hours

Heater sizing estimation

Heater Wattage Sizing Formulas+
Gallons vs Operating Temp in ˚F (Table in kW*)

Gallons	100˚F	110˚F	120˚F	130˚F	140˚F	150˚F	160˚F	170˚F	180˚F	190˚F	200˚F	210˚F
50	1	1	1	2	2	2	2	2	3	3	3	3
100	2	2	3	3	3	4	4	4	5	5	6	6
150	3	3	4	4	5	5	6	7	8	8	9	10
200	4	4	5	6	6	7	8	9	10	11	12	14
250	5	5	6	7	8	9	10	12	13	14	15	16
300	6	6	7	8	9	10	12	14	15	16	18	20
350	7	7	8	10	11	13	14	16	18	20	21	22
400	8	8	9	10	12	14	16	19	20	21	24	26
450	9	9	11	12	14	16	18	21	23	24	27	29
500	9	10	12	13	15	18	20	24	24	27	30	32
550	10	11	14	15	18	20	24	25	27	29	32	35
600	11	12	15	16	18	21	24	28	30	32	36	38
650	12	13	16	18	21	24	27	29	32	35	38	41
700	13	14	17	18	21	24	28	32	36	38	42	44
750	14	15	18	21	24	27	31	34	37	41	44	47
800	15	16	19	21	24	28	32	36	40	44	48	52
850	16	17	20	23	27	31	35	38	42	46	50	54
900	17	18	21	24	27	32	36	40	44	48	54	58
950	18	20	23	26	30	34	39	43	47	52	56	60
1000	18	21	24	27	30	36	40	44	48	54	58	64

+ Based on 6 hour tank heat-up time.
* Add surface heat losses.

Surface Losses in Kilowatts from Open Hot Water Tank with Mild Air Agitation or Ventilation (120 FPM)

80˚F 0.03	130˚F 0.30	180˚F 1.1
85˚F 0.05	135˚F 0.35	185˚F 1.3
90˚F 0.07	140˚F 0.41	190˚F 1.6
95˚F 0.09	145˚F 0.45	195˚F 1.95
100˚F 0.11	150˚F 0.51	200˚F 2.35
105˚F 0.13	155˚F 0.58	205˚F 2.80
110˚F 0.15	160˚F 0.65	210˚F 3.25
115˚F 0.18	165˚F 0.73	215˚F 3.75
120˚F 0.21	170˚F 0.83	
125˚F 0.25	175˚F 0.95	

Surface Losses in Kilowatts from Open Hot Water Tank (little mixing)

80˚F -	130˚F 0.16	180˚F 0.50
85˚F 0.01	135˚F 0.18	185˚F 0.55
90˚F 0.02	140˚F 0.21	190˚F 0.60
95˚F 0.04	145˚F 0.24	195˚F 0.66
100˚F 0.05	150˚F 0.27	200˚F 0.72
105˚F 0.07	155˚F 0.30	205˚F 0.80
110˚F 0.09	160˚F 0.34	210˚F 0.87
115˚F 0.10	165˚F 0.37	215˚F 0.95
120˚F 0.12	170˚F 0.41	220˚F 1.04
125˚F 0.14	175˚F 0.45	

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General Information and Warranty

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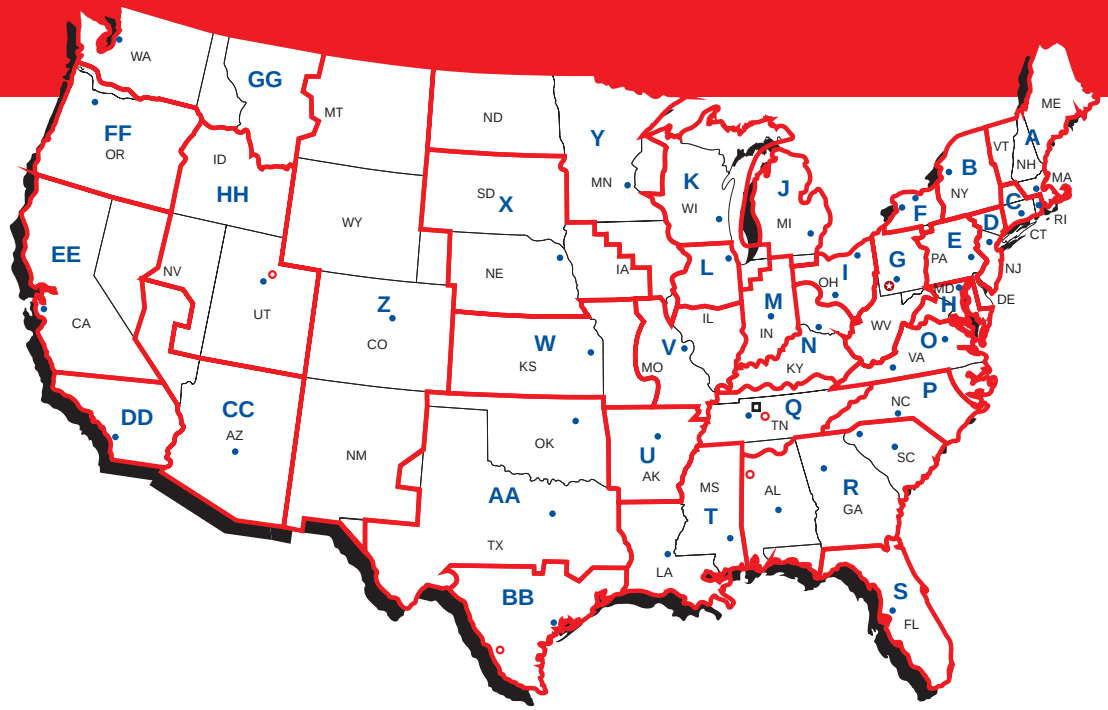

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