

# LABORATORY



4-13-87

**astro**

A Division of THERMAL TECHNOLOGY INC

606 North Olive Street, Santa Barbara, CA 93101  
(805) 963-3461 • Telex 658441 • FAX (805) 966-0126

# TUBULAR FURNACES

Astro Industries pioneered in the design and manufacture of high-temperature and controlled atmosphere furnaces, and now also manufactures laboratory tubular furnace systems for operation at temperatures to 1700°C in air. There are over two hundred single-zone models in six temperature ranges. Accessories include furnace support stands, temperature controls, and power supplies. A complete furnace system can be selected from this catalogue. Please refer to the last page. Numerous custom options and accessories are also available and will be quoted on request.

Astro tubular furnaces are designed to provide good temperature stability and efficient steady state power consumption. Typical heat up time to maximum temperature is approximately two hours.

Other outstanding performance features include:

■ **TEMPERATURE PROFILES**

Shunt tapped heating elements permit adjustment of the temperature profile.

■ **TEMPERATURE UNIFORMITIES**

Uniform temperature zones with tolerances of  $\pm 1^\circ\text{C}$  and better are possible.

■ **COVERED SHUNT PANELS**

The completely covered shunt panel is sized to afford ample space for shunt wires. No shunts or power connections are exposed during operation.

■ **HORIZONTAL OR VERTICAL OPERATION**

All models can be operated either vertically or horizontally.



# TUBULAR FURNACES

## TEMPERATURE CAPABILITIES

- **A100 SERIES** — 1100° C (2000° F)  
Heating element is nickel-chromium wire, wound on a high-purity, fused aluminum oxide tube.
- **A200 SERIES** — 1200° C (2200° F)  
Iron-chromium-aluminum wire, wound on a high-purity fused aluminum oxide tube.
- **A300 SERIES** — 1315° C (2400° F)  
Internally exposed iron-chromium-aluminum ribbon heating element, supported and separated by aluminum oxide spacers.
- **A400 SERIES** — 1430° C (2600° F)  
Four-strand platinum 50% rhodium wire, wound on a high-purity, fused aluminum oxide tube.
- **A500 SERIES** — 1550° C (2800° F)  
Four-strand platinum 50% rhodium wire, wound on a recrystallized 99.8% aluminum oxide tube.
- **A700 SERIES** — 1700° C (3100° F)  
Nine-strand platinum 50% rhodium wire wound on a recrystallized 99.8% aluminum oxide tube.

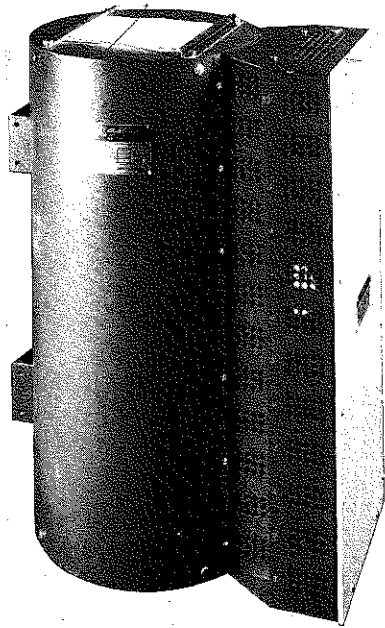


### A100 SERIES TUBULAR FURNACES

MODEL	DIMENSIONS <sup>1</sup>	SHUNT TAPS	VOLTAGE	WATTS	RECOMMENDED TEMPERATURE CONTROLLER	E-Z PROFILE <sup>2</sup>
A101	1" x 10" x 7" x 9"	4	55	300	12K25	N/A
A102	1" x 10" x 11" x 13"	6	55	400	12K25	5
A103	1" x 10" x 15" x 17"	8	55	565	12K25	7
A104	1" x 10" x 17" x 19"	8	55	590	12K25	7
A105	1" x 10" x 19" x 21"	10	115	690	12K25	9
A111	1½" x 10" x 7" x 9"	4	55	345	12K25	N/A
A112	1½" x 10" x 11" x 13"	6	115	655	12K25	5
A113	1½" x 10" x 15" x 17"	8	115	755	12K25	7
A114	1½" x 10" x 17" x 19"	8	115	865	12K25	7
A115	1½" x 10" x 19" x 21"	10	115	940	12K25	9
A117	1½" x 10" x 23" x 25"	10	115	1205	12K25	9
A118	1½" x 10" x 29" x 31"	18	230	1500	12K25	17
A122	2" x 10" x 11" x 13"	4	115	715	12K25	3
A123	2" x 10" x 15" x 17"	6	115	970	12K25	5
A124	2" x 10" x 17" x 19"	8	115	1120	12K25	7
A125	2" x 10" x 19" x 21"	8	115	1290	12K25	7
A127	2" x 10" x 23" x 25"	14	230	1490	12K25	13
A128	2" x 10" x 29" x 31"	14	230	1880	12K25	13
A129	2" x 10" x 35" x 37"	18	230	2330	12K25	17
A132	2½" x 10" x 11" x 13"	4	115	955	12K25	3
A133	2½" x 10" x 15" x 17"	6	115	1305	12K25	5
A134	2½" x 10" x 17" x 19"	8	230	1570	12K25	7
A135	2½" x 10" x 19" x 21"	8	230	1650	12K25	7
A137	2½" x 10" x 23" x 25"	10	230	1930	12K25	9
A138	2½" x 10" x 29" x 31"	12	230	2400	12K25	11
A139	2½" x 10" x 35" x 37"	14	230	2890	12K25	13
A142	3" x 12" x 11" x 13"	4	115	1095	12K25	3
A143	3" x 12" x 15" x 17"	6	230	1500	12K25	5
A144	3" x 12" x 17" x 19"	8	230	1690	12K25	7
A145	3" x 12" x 19" x 21"	8	230	1975	12K25	7
A147	3" x 12" x 23" x 25"	8	230	2230	12K25	7
A148	3" x 12" x 29" x 31"	10	230	2920	12K25	9
A149	3" x 12" x 35" x 37"	14	230	3350	12K25	13
A153	3½" x 12" x 15" x 17"	4	230	1835	12K25	3
A154	3½" x 12" x 17" x 19"	6	230	2035	12K25	5
A155	3½" x 12" x 19" x 21"	6	230	2275	12K25	5
A157	3½" x 12" x 23" x 25"	10	230	2720	12K25	9
A158	3½" x 12" x 29" x 31"	12	230	3500	12K25	11
A159	3½" x 12" x 35" x 37"	14	230	4280	12K25	13
A163	4" x 12" x 15" x 17"	4	230	2010	12K25	3
A164	4" x 12" x 17" x 19"	6	230	2260	12K25	N/A
A165	4" x 12" x 19" x 21"	6	230	2550	12K25	N/A
A167	4" x 12" x 23" x 25"	8	230	2920	12K25	N/A
A168	4" x 12" x 29" x 31"	10	230	3780	12K25	N/A
A169	4" x 12" x 35" x 37"	12	230	4720	12K25	N/A
A175	5" x 14" x 19" x 21"	6	230	3200	12K25	N/A
A177	5" x 14" x 23" x 25"	6	230	4060	12K25	N/A
A178	5" x 14" x 29" x 31"	10	230	4720	12K25	N/A
A179	5" x 14" x 35" x 37"	14	230	5500	12K40	N/A
A187	6" x 14" x 23" x 25"	6	230	4590	12K25	N/A
A188	6" x 14" x 29" x 31"	10	230	5500	12K40	N/A
A189	6" x 14" x 35" x 37"	8	230	6000	12K40	N/A

<sup>1</sup>I.D. x O.D. x heated length x overall length  
<sup>2</sup>Number of resistors

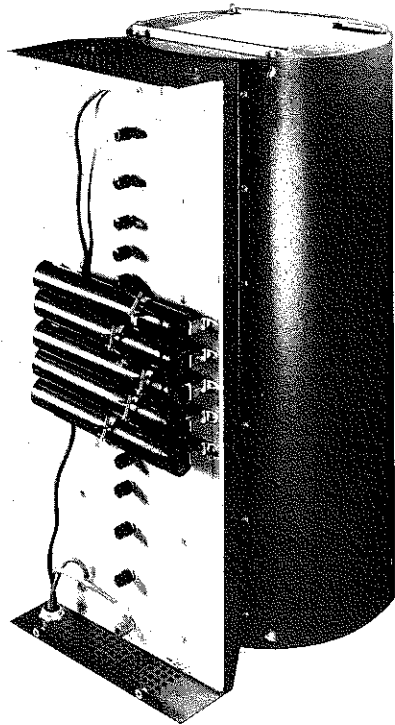




Model A127 Tubular Furnace.

A400 SERIES TUBULAR FURNACES							
MODEL	DIMENSIONS <sup>1</sup>	SHUNT TAPS	HOT VOLTAGE <sup>2</sup>	WATTS	LINE VOLTAGE	TRANSFORMER	RECOMMENDED TEMPERATURE CONTROLLER
A410	1" x 10" x 6" x 10"	4	27	430	115/230	10SDT	45S25
A411	1" x 10" x 8" x 12"	6	34	538	115/230	11SDT	45S25
A412	1" x 10" x 10" x 14"	8	42	680	115/230	10SDT	45S25
A413	1" x 10" x 12" x 16"	10	49	785	115/230	11SDT	45S25
A414	1" x 10" x 14" x 18"	10	56	895	115/230	11SDT	45S25
A415	1" x 10" x 16" x 20"	12	63	1000	115/230	11SDT	45S25
A420	1 1/2" x 10" x 6" x 10"	4	37	583	115/230	10SDT	45S25
A421	1 1/2" x 10" x 8" x 12"	4	48	772	115/230	11SDT	45S25
A422	1 1/2" x 10" x 10" x 14"	6	59	965	115/230	11SDT	45S25
A423	1 1/2" x 10" x 12" x 16"	6	71	1150	115/230	11SDT	45S25
A424	1 1/2" x 10" x 14" x 18"	8	82	1340	115/230	11SDT	45S25
A425	1 1/2" x 10" x 16" x 20"	10	92	1500	115/230	12SDT	45S25
A431	2" x 12" x 8" x 12"	4	70	1100	115/230	11SDT	45S25
A432	2" x 12" x 10" x 14"	4	85	1366	115/230	11SDT	45S25
A433	2" x 12" x 12" x 16"	4	92	1525	115/230	12SDT	45S25
A434	2" x 12" x 14" x 18"	6	105	1775	115/230	12SDT	45S25
A435	2" x 12" x 16" x 20"	6	118	2055	230	12SDT	45S25
A436	2" x 12" x 18" x 22"	8	131	2270	230	12SDT	45S25
A437	2" x 12" x 20" x 24"	8	146	2525	230	13SDT	45S25
A438	2" x 12" x 24" x 28"	10	172	3025	230	13SDT	45S25
A442	2 1/2" x 12" x 10" x 14"	4	96	1575	115/230	12SDT	45S25
A443	2 1/2" x 12" x 12" x 16"	4	113	1919	115/230	12SDT	45S25
A444	2 1/2" x 12" x 14" x 18"	6	128	2200	230	12SDT	45S25
A445	2 1/2" x 12" x 16" x 20"	6	144	2520	230	13SDT	45S25
A446	2 1/2" x 12" x 18" x 22"	8	160	2835	230	13SDT	45S25
A447	2 1/2" x 12" x 20" x 24"	8	176	3140	230	13SDT	45S25
A448	2 1/2" x 12" x 24" x 28"	10	208	3780	230	13SDT	45S25
A449	2 1/2" x 12" x 28" x 32"	10	208CT	4410	230	15SDT	45S25
A453	3" x 12" x 12" x 16"	4	133	2285	230	12SDT	45S25
A454	3" x 12" x 14" x 18"	4	152	2675	230	13SDT	45S25
A455	3" x 12" x 16" x 20"	6	172	3080	230	13SDT	45S25
A456	3" x 12" x 18" x 22"	6	190	3440	230	14SDT	45S25
A457	3" x 12" x 20" x 24"	6	208	3780	230	15SDT	45S25
A458	3" x 12" x 24" x 28"	8	250CT	4600	230	15SDT	45S25
A459	3" x 12" x 28" x 32"	8	147CT	5370	230	16SDT	45S40
A464	3 1/2" x 12" x 14" x 18"	4	180	3160	230	13SDT	45S25
A465	3 1/2" x 12" x 16" x 20"	4	202	3550	230	—	45S25
A466	3 1/2" x 12" x 18" x 22"	4	111CT	4000	230	14SDT	45S25
A467	3 1/2" x 12" x 20" x 24"	6	124CT	4470	230	15SDT	45S25
A468	3 1/2" x 12" x 24" x 28"	6	145CT	5300	230	16SDT	45S40
A469	3 1/2" x 12" x 28" x 32"	8	167CT	6200	230	17SDT	45S40
A475	4" x 14" x 16" x 20"	4	113CT	4120	230	15SDT	45S25
A476	4" x 14" x 18" x 22"	4	124CT	4550	230	15SDT	45S25
A477	4" x 14" x 20" x 24"	4	137CT	5100	230	16SDT	45S25
A478	4" x 14" x 24" x 28"	6	161CT	6075	230	17SDT	45S40
A479	4" x 14" x 28" x 32"	6	186CT	7100	230	18SDT	45S40

<sup>1</sup>I.D. x O.D. x heated length x overall length  
<sup>2</sup>"CT" indicates center power tap

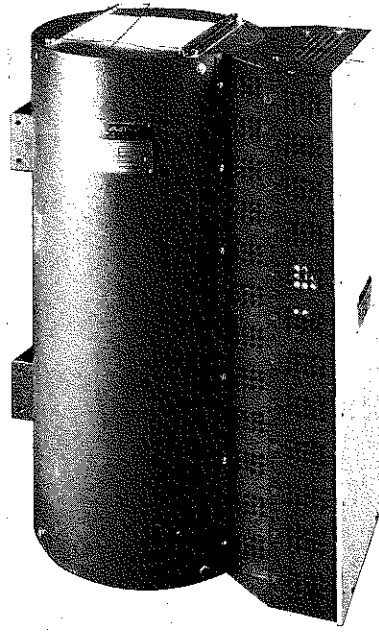


Tubular Furnace, with shunt panel cover removed, showing E-Z-PROFILE option.

A500 SERIES TUBULAR FURNACES							
MODEL	DIMENSIONS <sup>1</sup>	SHUNT TAPS	HOT VOLTAGE <sup>2</sup>	WATTS	LINE VOLTAGE	TRANSFORMER	RECOMMENDED TEMPERATURE CONTROLLER
A510	1" x 12" x 6" x 10"	4	30	508	115/230	10SDT	45S25
A511	1" x 12" x 8" x 12"	6	38	645	115/230	10SDT	45S25
A512	1" x 12" x 10" x 14"	8	47	815	115/230	11SDT	45S25
A513	1" x 12" x 12" x 16"	10	55	950	115/230	11SDT	45S25
A514	1" x 12" x 14" x 18"	10	65	1120	115/230	11SDT	45S25
A515	1" x 12" x 16" x 20"	12	74	1290	115/230	11SDT	45S25
A520	1 1/2" x 12" x 6" x 10"	4	42	723	115/230	11SDT	45S25
A521	1 1/2" x 12" x 8" x 12"	4	56	962	115/230	11SDT	45S25
A522	1 1/2" x 12" x 10" x 14"	6	68	1182	115/230	11SDT	45S25
A523	1 1/2" x 12" x 12" x 16"	6	82	1425	115/230	12SDT	45S25
A524	1 1/2" x 12" x 14" x 18"	8	95	1676	115/230	12SDT	45S25
A525	1 1/2" x 12" x 16" x 20"	10	109	1919	115/230	12SDT	45S25
A531	2" x 12" x 8" x 12"	4	73	1288	115/230	11SDT	45S25
A532	2" x 12" x 10" x 14"	4	92	1575	115/230	12SDT	45S25
A533	2" x 12" x 12" x 16"	4	108	1875	115/230	12SDT	45S25
A534	2" x 12" x 14" x 18"	6	125	2212	230	12SDT	45S25
A535	2" x 12" x 16" x 20"	6	141	2520	230	13SDT	45S25
A536	2" x 12" x 18" x 22"	8	159	2830	230	13SDT	45S25
A537	2" x 12" x 20" x 24"	8	175	3140	230	13SDT	45S25
A538	2" x 12" x 24" x 28"	10	212	3800	230	—	45S25
A542	2 1/2" x 14" x 10" x 18"	4	112	1995	230	12SDT	45S25
A543	2 1/2" x 14" x 12" x 20"	4	132	2380	230	13SDT	45S25
A544	2 1/2" x 14" x 14" x 22"	6	154	2770	230	13SDT	45S25
A545	2 1/2" x 14" x 16" x 24"	6	176	3142	230	13SDT	45S25
A546	2 1/2" x 14" x 18" x 26"	8	198	3540	230	14SDT	45S25
A547	2 1/2" x 14" x 20" x 28"	8	110CT	3930	230	14SDT	45S25
A548	2 1/2" x 14" x 24" x 32"	8	133CT	4750	230	15SDT	45S25
A549	2 1/2" x 14" x 28" x 36"	8	155CT	5530	230	16SDT	45S40
A553	3 1/2" x 14" x 12" x 20"	4	160	2855	230	13SDT	45S25
A554	3 1/2" x 14" x 14" x 22"	4	184	3300	230	14SDT	45S25
A555	3 1/2" x 14" x 16" x 24"	6	212	3790	230	—	45S25
A556	3 1/2" x 14" x 18" x 26"	6	120CT	4280	230	15SDT	45S25
A557	3 1/2" x 14" x 20" x 28"	6	132CT	4740	230	15SDT	45S25
A558	3 1/2" x 14" x 24" x 32"	8	160CT	5710	230	16SDT	45S40
A559	3 1/2" x 14" x 28" x 36"	8	185CT	6600	230	17SDT	45S40
A564	3 3/4" x 14" x 14" x 22"	4	216	3875	230	—	45S25
A565	3 3/4" x 14" x 16" x 24"	4	124CT	4400	230	15SDT	45S25
A566	3 3/4" x 14" x 18" x 26"	4	140CT	4990	230	15SDT	45S25
A567	3 3/4" x 14" x 20" x 28"	6	154CT	5530	230	16SDT	45S40
A568	3 3/4" x 14" x 24" x 32"	6	186CT	6650	230	17SDT	45S40
A569	3 3/4" x 14" x 28" x 36"	8	216CT	7720	230	—	45S40
A575	4 1/2" x 14" x 16" x 24"	4	140CT	5020	230	16SDT	45S40
A576	4 1/2" x 14" x 18" x 26"	4	158CT	5655	230	16SDT	45S40
A577	4 1/2" x 14" x 20" x 28"	4	176CT	6280	230	17SDT	45S40
A578	4 1/2" x 14" x 24" x 32"	6	212CT	7535	230	—	45S40

<sup>1</sup>I.D. x O.D. x heated length x overall length  
<sup>2</sup>"CT" indicates center power tap





Model A127 Tubular Furnace.

A400 SERIES TUBULAR FURNACES							
MODEL	DIMENSIONS <sup>1</sup>	SHUNT TAPS	HOT VOLTAGE <sup>2</sup>	WATTS	LINE VOLTAGE	TRANS-FORMER	RECOMMENDED TEMPERATURE CONTROLLER
A410	1" x 10" x 6" x 10"	4	27	430	115/230	10SDT	45S25
A411	1" x 10" x 8" x 12"	6	34	538	115/230	10SDT	45S25
A412	1" x 10" x 10" x 14"	8	42	680	115/230	10SDT	45S25
A413	1" x 10" x 12" x 16"	10	49	785	115/230	11SDT	45S25
A414	1" x 10" x 14" x 18"	10	56	895	115/230	11SDT	45S25
A415	1" x 10" x 16" x 20"	12	63	1000	115/230	11SDT	45S25
A420	1 1/2" x 10" x 6" x 10"	4	37	583	115/230	10SDT	45S25
A421	1 1/2" x 10" x 8" x 12"	4	48	772	115/230	11SDT	45S25
A422	1 1/2" x 10" x 10" x 14"	6	59	965	115/230	11SDT	45S25
A423	1 1/2" x 10" x 12" x 16"	6	71	1150	115/230	11SDT	45S25
A424	1 1/2" x 10" x 14" x 18"	8	82	1340	115/230	11SDT	45S25
A425	1 1/2" x 10" x 16" x 20"	10	92	1500	115/230	12SDT	45S25
A431	2" x 12" x 8" x 12"	4	70	1100	115/230	11SDT	45S25
A432	2" x 12" x 10" x 14"	4	85	1356	115/230	11SDT	45S25
A433	2" x 12" x 12" x 16"	4	92	1525	115/230	12SDT	45S25
A434	2" x 12" x 14" x 18"	6	105	1775	115/230	12SDT	45S25
A435	2" x 12" x 16" x 20"	6	118	2055	230	12SDT	45S25
A436	2" x 12" x 18" x 22"	8	131	2270	230	12SDT	45S25
A437	2" x 12" x 20" x 24"	8	146	2525	230	13SDT	45S25
A438	2" x 12" x 24" x 28"	10	172	3025	230	13SDT	45S25
A442	2 1/2" x 12" x 10" x 14"	4	96	1575	115/230	12SDT	45S25
A443	2 1/2" x 12" x 12" x 16"	4	113	1919	115/230	12SDT	45S25
A444	2 1/2" x 12" x 14" x 18"	6	128	2200	230	12SDT	45S25
A445	2 1/2" x 12" x 16" x 20"	6	144	2520	230	13SDT	45S25
A446	2 1/2" x 12" x 18" x 22"	8	160	2835	230	13SDT	45S25
A447	2 1/2" x 12" x 20" x 24"	8	176	3140	230	13SDT	45S25
A448	2 1/2" x 12" x 24" x 28"	10	208	3780	230	15SDT	45S25
A449	2 1/2" x 12" x 28" x 32"	10	120CT	4410	230	15SDT	45S25
A453	3" x 12" x 12" x 16"	4	133	2285	230	12SDT	45S25
A454	3" x 12" x 14" x 18"	4	152	2675	230	13SDT	45S25
A455	3" x 12" x 16" x 20"	6	172	3080	230	13SDT	45S25
A456	3" x 12" x 18" x 22"	6	190	3440	230	14SDT	45S25
A457	3" x 12" x 20" x 24"	6	208	3780	230	14SDT	45S25
A458	3" x 12" x 24" x 28"	8	236	4600	230	15SDT	45S25
A459	3" x 12" x 28" x 32"	8	147CT	5370	230	16SDT	45S40
A464	3 1/2" x 12" x 14" x 18"	4	180	3160	230	13SDT	45S25
A465	3 1/2" x 12" x 16" x 20"	4	202	3550	230	—	45S25
A466	3 1/2" x 12" x 18" x 22"	4	111CT	4000	230	14SDT	45S25
A467	3 1/2" x 12" x 20" x 24"	6	124CT	4470	230	15SDT	45S25
A468	3 1/2" x 12" x 24" x 28"	6	145CT	5300	230	16SDT	45S40
A469	3 1/2" x 12" x 28" x 32"	8	167CT	6200	230	17SDT	45S40
A475	4" x 14" x 16" x 20"	4	113CT	4120	230	15SDT	45S25
A476	4" x 14" x 18" x 22"	4	124CT	4550	230	15SDT	45S25
A477	4" x 14" x 20" x 24"	4	137CT	5100	230	16SDT	45S25
A478	4" x 14" x 24" x 28"	6	161CT	6075	230	17SDT	45S40
A479	4" x 14" x 28" x 32"	6	186CT	7100	230	18SDT	45S40

<sup>1</sup>I.D. x O.D. x heated length x overall length  
<sup>2</sup>"CT" indicates center power tap

A500 SERIES TUBULAR FURNACES							
MODEL	DIMENSIONS <sup>1</sup>	SHUNT TAPS	HOT VOLTAGE <sup>2</sup>	WATTS	LINE VOLTAGE	TRANS-FORMER	RECOMMENDED TEMPERATURE CONTROLLER
A510	1" x 12" x 6" x 10"	4	30	508	115/230	10SDT	45S25
A511	1" x 12" x 8" x 12"	6	38	645	115/230	10SDT	45S25
A512	1" x 12" x 10" x 14"	8	47	815	115/230	11SDT	45S25
A513	1" x 12" x 12" x 16"	10	55	950	115/230	11SDT	45S25
A514	1" x 12" x 14" x 18"	10	65	1120	115/230	11SDT	45S25
A515	1" x 12" x 16" x 20"	12	74	1290	115/230	11SDT	45S25
A520	1 1/2" x 12" x 6" x 10"	4	42	723	115/230	11SDT	45S25
A521	1 1/2" x 12" x 8" x 12"	4	56	962	115/230	11SDT	45S25
A522	1 1/2" x 12" x 10" x 14"	6	68	1182	115/230	11SDT	45S25
A523	1 1/2" x 12" x 12" x 16"	6	82	1425	115/230	12SDT	45S25
A524	1 1/2" x 12" x 14" x 18"	8	95	1676	115/230	12SDT	45S25
A525	1 1/2" x 12" x 16" x 20"	10	109	1919	115/230	12SDT	45S25
A531	2" x 12" x 8" x 12"	4	73	1288	115/230	11SDT	45S25
A532	2" x 12" x 10" x 14"	4	92	1575	115/230	12SDT	45S25
A533	2" x 12" x 12" x 16"	4	108	1875	115/230	12SDT	45S25
A534	2" x 12" x 14" x 18"	6	125	2212	230	12SDT	45S25
A535	2" x 12" x 16" x 20"	6	141	2520	230	13SDT	45S25
A536	2" x 12" x 18" x 22"	8	159	2830	230	13SDT	45S25
A537	2" x 12" x 20" x 24"	8	175	3140	230	13SDT	45S25
A538	2" x 12" x 24" x 28"	10	212	3800	230	—	45S25
A542	2 1/2" x 14" x 10" x 14"	4	112	1995	230	12SDT	45S25
A543	2 1/2" x 14" x 12" x 16"	4	132	2380	230	13SDT	45S25
A544	2 1/2" x 14" x 14" x 18"	6	154	2770	230	13SDT	45S25
A545	2 1/2" x 14" x 16" x 20"	6	176	3142	230	13SDT	45S25
A546	2 1/2" x 14" x 18" x 22"	8	198	3540	230	14SDT	45S25
A547	2 1/2" x 14" x 20" x 24"	8	110CT	3930	230	14SDT	45S25
A548	2 1/2" x 14" x 24" x 28"	8	133CT	4750	230	15SDT	45S25
A549	2 1/2" x 14" x 28" x 32"	8	155CT	5530	230	16SDT	45S40
A553	3 1/2" x 14" x 12" x 16"	4	180	2855	230	13SDT	45S25
A554	3 1/2" x 14" x 14" x 18"	4	184	3300	230	14SDT	45S25
A555	3 1/2" x 14" x 16" x 20"	6	212	3790	230	—	45S25
A556	3 1/2" x 14" x 18" x 22"	6	120CT	4280	230	15SDT	45S25
A557	3 1/2" x 14" x 20" x 24"	6	132CT	4740	230	15SDT	45S25
A558	3 1/2" x 14" x 24" x 28"	8	160CT	5710	230	16SDT	45S40
A559	3 1/2" x 14" x 28" x 32"	8	185CT	6600	230	17SDT	45S40
A564	3 1/2" x 14" x 14" x 18"	4	216	3875	230	—	45S25
A565	3 1/2" x 14" x 16" x 20"	4	124CT	4400	230	15SDT	45S25
A566	3 1/2" x 14" x 18" x 22"	4	140CT	4990	230	15SDT	45S25
A567	3 1/2" x 14" x 20" x 24"	6	154CT	5530	230	16SDT	45S40
A568	3 1/2" x 14" x 24" x 28"	6	186CT	6650	230	17SDT	45S40
A569	3 1/2" x 14" x 28" x 32"	8	216CT	7720	230	—	45S40
A575	4 1/2" x 14" x 16" x 20"	4	140CT	5020	230	16SDT	45S40
A576	4 1/2" x 14" x 18" x 22"	4	158CT	5655	230	16SDT	45S40
A577	4 1/2" x 14" x 20" x 24"	4	176CT	6280	230	17SDT	45S40
A578	4 1/2" x 14" x 24" x 28"	6	212CT	7535	230	—	45S40

<sup>1</sup>I.D. x O.D. x heated length x overall length  
<sup>2</sup>"CT" indicates center power tap

## CONSTRUCTION

Construction features in all standard furnaces include: full-length thermocouple well immediately adjacent to the heating element and accessible from either end; external mounting blocks located 180° from the shunt panel; sliding covers on both ends of the furnace; durable texture painted shell; and a 10-foot long power cord. Insulation is either aluminum oxide wool (A100 through A400 Series) or a combination of aluminum oxide bubble and wool. The shunt panel can be removed easily to facilitate maintenance and element replacement. The platinum furnaces have a fuse to safeguard the element against high current inrush.

In the A400, A500, and A700 Series, where a heating element would require in excess of 230 volts, the continuous element winding has a center power lead to permit operation of the furnace at less than 230 volts. A "CT" in the Hot Voltage column of the Furnace Model Tables indicates a center power lead.

## OPTIONS

### ■ E-Z-PROFILE SHUNT PANEL

Variable resistors located in the enclosed shunt panel provide low-cost shortcuts to furnace profiling. E-Z-PROFILE is available for most models in the A100 and A200 Series. Refer to Furnace Model Tables.

### ■ RECRYSTALLIZED ALUMINA ELEMENT TUBES

If quartz is to be used at temperatures above 850° C in an A100, A200, or A400 Series furnace, it is recommended that a recrystallized 99.8% aluminum oxide element tube be substituted for the standard alumund tube to reduce devitrification of the quartz.

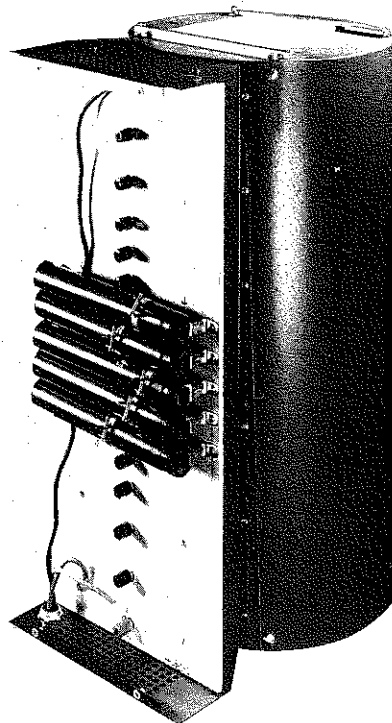
### ■ OTHER CUSTOM OPTIONS

Radial thermocouple ports, installed thermocouples, multi-zone elements, non-inductively wound heating elements, and radial viewing windows. Consult the factory.

## FURNACE SUPPORT STANDS

Model VS-1 universal furnace positioning mount and support stand permits positioning a furnace vertically or horizontally. A swivel mounting bracket on a vertical column attaches to the furnace mounting blocks.

For horizontal bench top operation, support pads attach to furnace mounting blocks. Specify HF-1.



Tubular Furnace, with shunt panel cover removed, showing E-Z-PROFILE option.

A700 SERIES TUBULAR FURNACES							
MODEL	DIMENSIONS <sup>1</sup>	SHUNT TAPS	HOT VOLTAGE <sup>2</sup>	WATTS	LINE VOLTAGE	TRANS-FORMER	RECOMMENDED TEMPERATURE CONTROLLER
A710	1" x 14" x 6" x 10"	4	18	587	115/230	10SDT	47B25
A711	1" x 14" x 8" x 12"	4	24	802	115/230	11SDT	47B25
A712	1" x 14" x 10" x 14"	6	29	952	115/230	11SDT	47B25
A713	1" x 14" x 12" x 16"	6	35	1169	115/230	11SDT	47B25
A714	1" x 14" x 14" x 18"	8	41	1385	115/230	12SDT	47B25
A715	1" x 14" x 16" x 20"	10	46	1535	115/230	12SDT	47B25
A720	1 1/2" x 14" x 6" x 10"	2	27	910	115/230	11SDT	47B25
A721	1 1/2" x 14" x 8" x 12"	4	35	1190	115/230	11SDT	47B25
A722	1 1/2" x 14" x 10" x 14"	6	43	1470	115/230	12SDT	47B25
A723	1 1/2" x 14" x 12" x 16"	6	51	1750	115/230	12SDT	47B25
A724	1 1/2" x 14" x 14" x 18"	8	59	2020	115/230	12SDT	47B25
A725	1 1/2" x 14" x 16" x 20"	8	67	2300	230	13SDT	47B25
A731	2" x 14" x 8" x 12"	2	46	1554	115/230	12SDT	47B25
A732	2" x 14" x 10" x 14"	4	56	1894	115/230	12SDT	47B25
A733	2" x 14" x 12" x 16"	4	67	2300	230	13SDT	47B25
A734	2" x 14" x 14" x 18"	6	79	2670	230	13SDT	47B25
A735	2" x 14" x 16" x 20"	6	89	3010	230	13SDT	47B25
A736	2" x 14" x 18" x 22"	6	100	3420	230	14SDT	47B25
A737	2" x 14" x 20" x 24"	8	110	3755	230	14SDT	47B25
A738	2" x 14" x 24" x 28"	8	131	4515	230	15SDT	47B25
A742	2 1/2" x 14" x 10" x 14"	4	69	2370	230	13SDT	47B25
A743	2 1/2" x 14" x 12" x 16"	4	84	2840	230	13SDT	47B25
A744	2 1/2" x 14" x 14" x 18"	4	97	3310	230	14SDT	47B25
A745	2 1/2" x 14" x 16" x 20"	6	110	3780	230	14SDT	47B25
A746	2 1/2" x 14" x 18" x 22"	6	125	4250	230	15SDT	47B25
A747	2 1/2" x 14" x 20" x 24"	6	141	4790	230	15SDT	47B25
A748	2 1/2" x 14" x 24" x 28"	8	166	5665	230	16SDT	47B40
A749	2 1/2" x 14" x 28" x 36"	8	193	6610	230	17SDT	47B40
A753	3 1/2" x 16" x 12" x 16"	4	104	3430	230	14SDT	47B25
A754	3 1/2" x 16" x 14" x 18"	4	120	3980	230	14SDT	47B25
A755	3 1/2" x 16" x 16" x 20"						

# TEMPERATURE CONTROLS

Astro temperature control systems feature a solid-state, 3-mode current proportioning, potentiometric control instrument and silicon controlled rectifier power regulator. Twelve single-zone models are available for use with the six Series of tubular furnaces.

The digital set point control instruments have millivolt scales and thumb-wheel setters. The combination provides superior setting accuracy since, with thumb-wheel switches and a matched resistor bank calibrated in millivolts, a thermocouple curve can be followed in a series of small steps, all within 1° C of the curve.

Three-mode control consists of adjustable proportional band and automatic reset and rate actions factory selected specifically for tubular furnace control requirements. Calibration and indicator accuracy are better than 0.5% of full scale. Control stability of furnace temperature is possible to within 1.0° C. All control instruments have a deviation meter, overshoot inhibition, voltage drop compensation, reference-junction compensation, upscale thermocouple break protection, and manual 0-100% power adjustment.

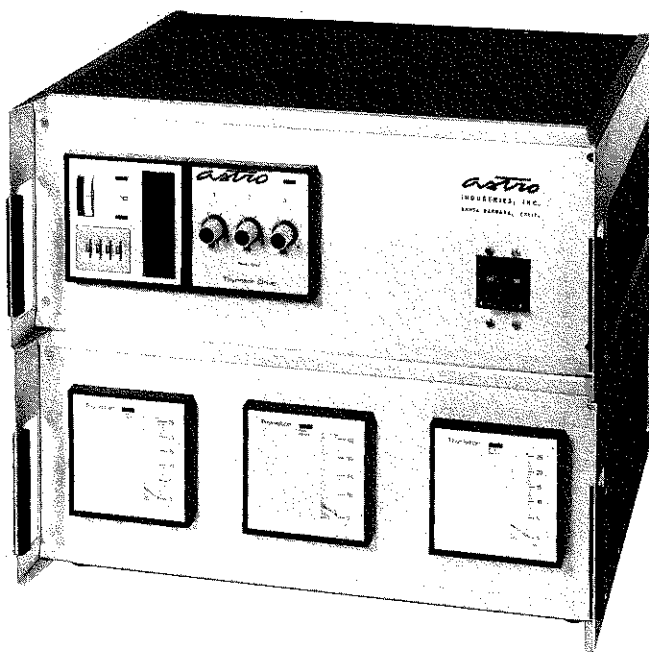
The silicon controlled rectifier, for resistive, inductive, or transformer-coupled loads, has an integral panel ammeter and fuse failure indicating lamp. Phase-angle firing is standard on all models and zero-firing can be optionally specified for straight resistive load applications. Current limit is included on the models recommended for platinum furnaces.

The models with 25 and 40-ampere SCR's have components installed in a compact cabinet 7" high x 15" deep x 17" wide with attractive anodized blue and clear aluminum panels. The 60-ampere models are in a 10" high cabinet. All systems are completely wired and ready for operation from specified 115/208/230 volt, 50/60 Hz, single-phase power service, and include a front panel main power circuit breaker, back panel thermocouple jack, power output connection, and power input cord. Lugs for 19" rack mounting are optionally available.

The Furnace Model Tables indicate the recommended temperature control models for each furnace.



Model 12K25 temperature control.



Typical three-zone temperature control.

# TEMPERATURE CONTROLS

Astro temperature control systems feature a solid-state, 3-mode current proportioning, potentiometric control instrument and silicon controlled rectifier power regulator. Twelve single-zone models are available for use with the six Series of tubular furnaces.

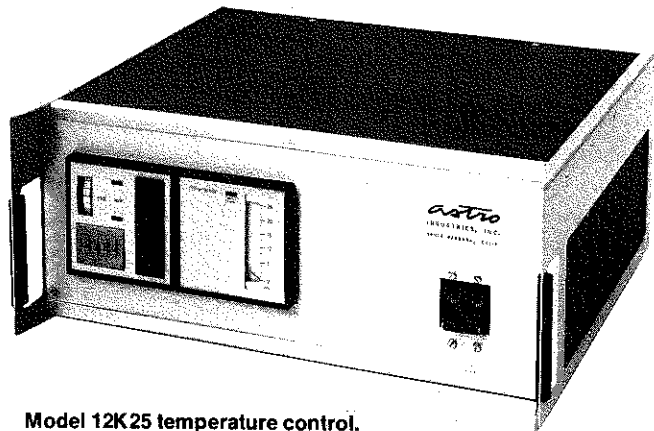
The digital set point control instruments have millivolt scales and thumb-wheel setters. The combination provides superior setting accuracy since, with thumb-wheel switches and a matched resistor bank calibrated in millivolts, a thermocouple curve can be followed in a series of small steps, all within 1°C of the curve.

Three-mode control consists of adjustable proportional band and automatic reset and rate actions factory selected specifically for tubular furnace control requirements. Calibration and indicator accuracy are better than 0.5% of full scale. Control stability of furnace temperature is possible to within 1.0°C. All control instruments have a deviation meter, overshoot inhibition, voltage drop compensation, reference-junction compensation, upscale thermocouple break protection, and manual 0-100% power adjustment.

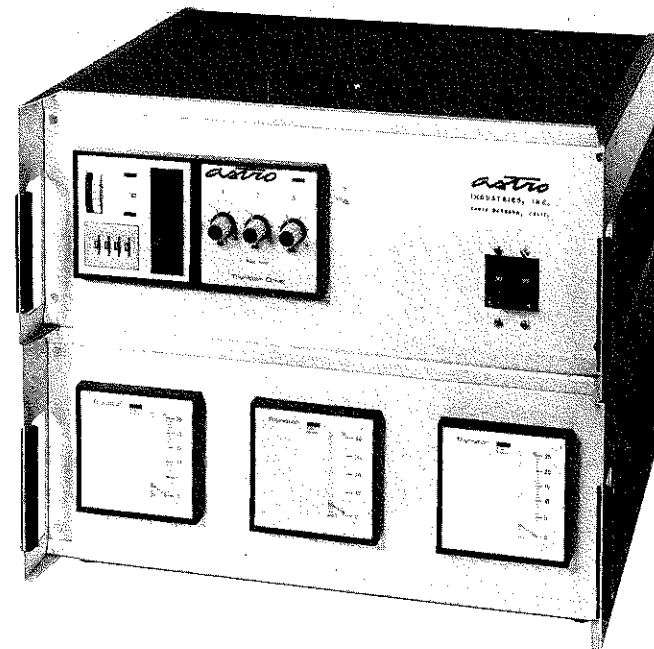
The silicon controlled rectifier, for resistive, inductive, or transformer-coupled loads, has an integral panel ammeter and fuse failure indicating lamp. Phase-angle firing is standard on all models and zero-firing can be optionally specified for straight resistive load applications. Current limit is included on the models recommended for platinum furnaces.

The models with 25 and 40-ampere SCR's have components installed in a compact cabinet 7" high x 15" deep x 17" wide with attractive anodized blue and clear aluminum panels. The 60-ampere models are in a 10" high cabinet. All systems are completely wired and ready for operation from specified 115/208/230 volt, 50/60 Hz, single-phase power service, and include a front panel main power circuit breaker, back panel thermocouple jack, power output connection, and power input cord. Lugs for 19" rack mounting are optionally available.

The Furnace Model Tables indicate the recommended temperature control models for each furnace.



Model 12K25 temperature control.



Typical three-zone temperature control.

## OPTIONS

Several control and power supply options are offered.

- **SCALE RANGES**  
Additional digital scales include 0-19.99 mv for Type R thermocouples, and °C and °F scales for standard thermocouples.
- **ALARMS**  
Integral high limit, low limit, or out of limit alarms are available for all control instruments.
- **HIGH STABILITY CONTROL**  
High stability controllers can be substituted for standard instrumentation. The calibration and indicator accuracy of such controllers is better than  $\pm 0.1^\circ\text{C}$ . Such instrumentation can provide control stability of a few tenths of  $1^\circ\text{C}$  with careful design and normal laboratory conditions.
- **POWER SUPPLIES**  
Zero-firing silicon controlled rectifiers can be specified for those designated models when the load is to be resistive only, and there are no current limit requirements.

## ACCESSORIES AND SPECIAL SYSTEMS

- **OVER TEMPERATURE PROTECTION**  
Over temperature instruments are available to monitor element or specimen temperatures. Relay outputs will activate audio and visual alarms and/or shut off furnace power.
- **TEMPERATURE PROGRAMMERS**  
Linear ramp and curve following programmers are available for requirements ranging from the simple to the complex.
- **TEMPERATURE RECORDERS**  
Recorders are available in single and multi-pen, single and multi-point models with several chart widths and speeds.
- **MULTI-ZONE CONTROL**  
Various configurations of multi-zone temperature control are available.

Please consult the factory for complete information on all options, accessories, and special systems.

## TRANSFORMERS

Most Astro A300, A400, A500, and A700 Series furnaces require step-down load transformers to match element and power supply voltages. Separately enclosed, Class H ( $150^\circ\text{C}$  rise) transformers with capacities from .75 to 14.0 KVA are available. Furnace Model Tables indicate the transformer models required.

Also available for use with A300 Series furnaces are the Tri-One Series of transformers. The Tri-One transformers have multiple secondary taps permitting higher power input to the ends of the furnace than to the center, compen-

TEMPERATURE CONTROL/POWER SUPPLIES						
MODEL	CONTROL INSTRUMENT		SCR POWER SUPPLY		POWER SERVICE	USE
	SCALE RANGE	CALIBRATION	CAPACITY	MODE		
12K25	0-49.99 mv	Type K	25 amperes	Phase-Angle*	115/208/230	A100 and
12K40	0-49.99 mv	Type K	40 amperes	Phase-Angle*	208/230	A200 Series
12K60	0-49.99 mv	Type K	60 amperes	Phase-Angle*	208/230	Furnaces
13S25	0-19.99 mv	Type S	25 amperes	Phase-Angle	115/208/230	A300 Series
13S40	0-19.99 mv	Type S	40 amperes	Phase-Angle	208/230	Furnaces
13S60	0-19.99 mv	Type S	60 amperes	Phase-Angle	208/230	
45S25	0-19.99 mv	Type S	25 amperes	Phase-Angle Current Limit	115/208/230	A400 and A500 Series Furnaces
45S40	0-19.99 mv	Type S	40 amperes			
45S60	0-19.99 mv	Type S	60 amperes			
47B25	0-19.99 mv	Type B	25 amperes	Phase-Angle Current Limit	115/208/230	A400, A500 and A700 Series Furnaces
47B40	0-19.99 mv	Type B	40 amperes			
47B60	0-19.99 mv	Type B	60 amperes			

\*A Zero-firing SCR can be specified for straight resistive loads.

sating for end losses. The heated length:bore diameter ratio required to achieve given uniformities in A300 Series furnaces can be reduced by using a Tri-One transformer. Specify Tri-One.

The recommended temperature controls shown on the Furnace Model Tables are the same with either type transformer.

## THERMOCOUPLES

Standard Astro control systems are calibrated for Type K (chromel-alumel), Type S (platinum vs platinum 10% rhodium), or Type B (platinum 6% vs platinum 30% rhodium) thermocouples. Maximum recommended use temperatures are: Type K -  $1250^\circ\text{C}$ ; Type S -  $1550^\circ\text{C}$ ; Type B -  $1750^\circ\text{C}$ .

Bare-junction thermocouple assemblies are in double-bore, high purity aluminum oxide insulating tubes and include 10 feet of compensating lead wire. Thermocouples for use in the furnace bore or thermocouple well should be long enough to extend at least one-inch beyond the center of the furnace. Standard thermocouple lengths start at 12 inches, increasing in 6-inch increments.



Temperature control with linear ramp programmer.

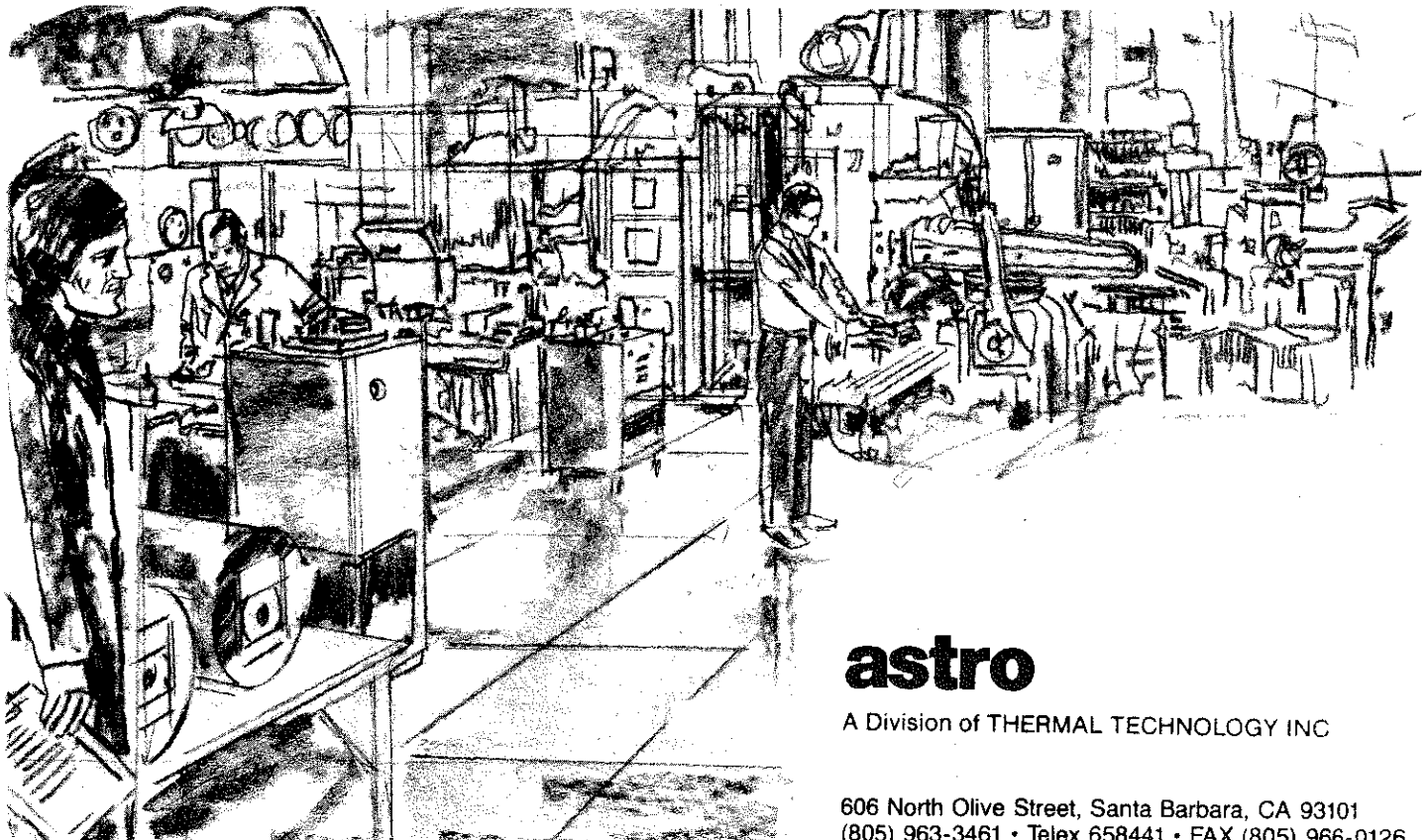
## HOW TO SELECT AN ASTRO TUBULAR FURNACE SYSTEM

1. Determine the maximum and working temperatures required. (If uniformities of  $\pm 1^{\circ}\text{C}$  or better are required, the maximum working temperature will be approximately  $100^{\circ}\text{C}$  below the maximum rated temperature of any furnace.) Select the furnace Series.
2. Determine furnace inside (hot zone) diameter.
3. Is furnace to be operated vertically or horizontally?
4. Determine uniformity requirements and calculate heated length necessary, using the guidelines given on page 3. Select a furnace model from one of the six tables.
5. The recommended temperature controller is shown on the Furnace Model Tables.
6. If required, the step-down load transformer model is shown on the Furnace Model Tables. On A300 Series furnaces a Tri-One Series transformer can be specified in lieu of the standard model transformer.
7. Specify line voltage available, checking compatibility with furnace voltage.
8. Determine thermocouple type and length.
9. Select a furnace support.

Please consult the factory if the operating requirements are not such that a furnace system can be selected as outlined above.

The factory can also offer assistance on custom systems and accessories for special applications. Astro tubular furnace systems can be designed for such applications as crystal growing, crystal pulling, tensile and creep testing, TGA, DTA, zone refining, and hot pressing.

Work tubes, vacuum/atmosphere retorts, motorized support systems for Bridgman and epitaxial crystal growing and zone refining, gas control and safety systems, and vacuum pumping systems are among the other accessories available.



**astro**

A Division of THERMAL TECHNOLOGY INC

606 North Olive Street, Santa Barbara, CA 93101  
(805) 963-3461 • Telex 658441 • FAX (805) 966-0126