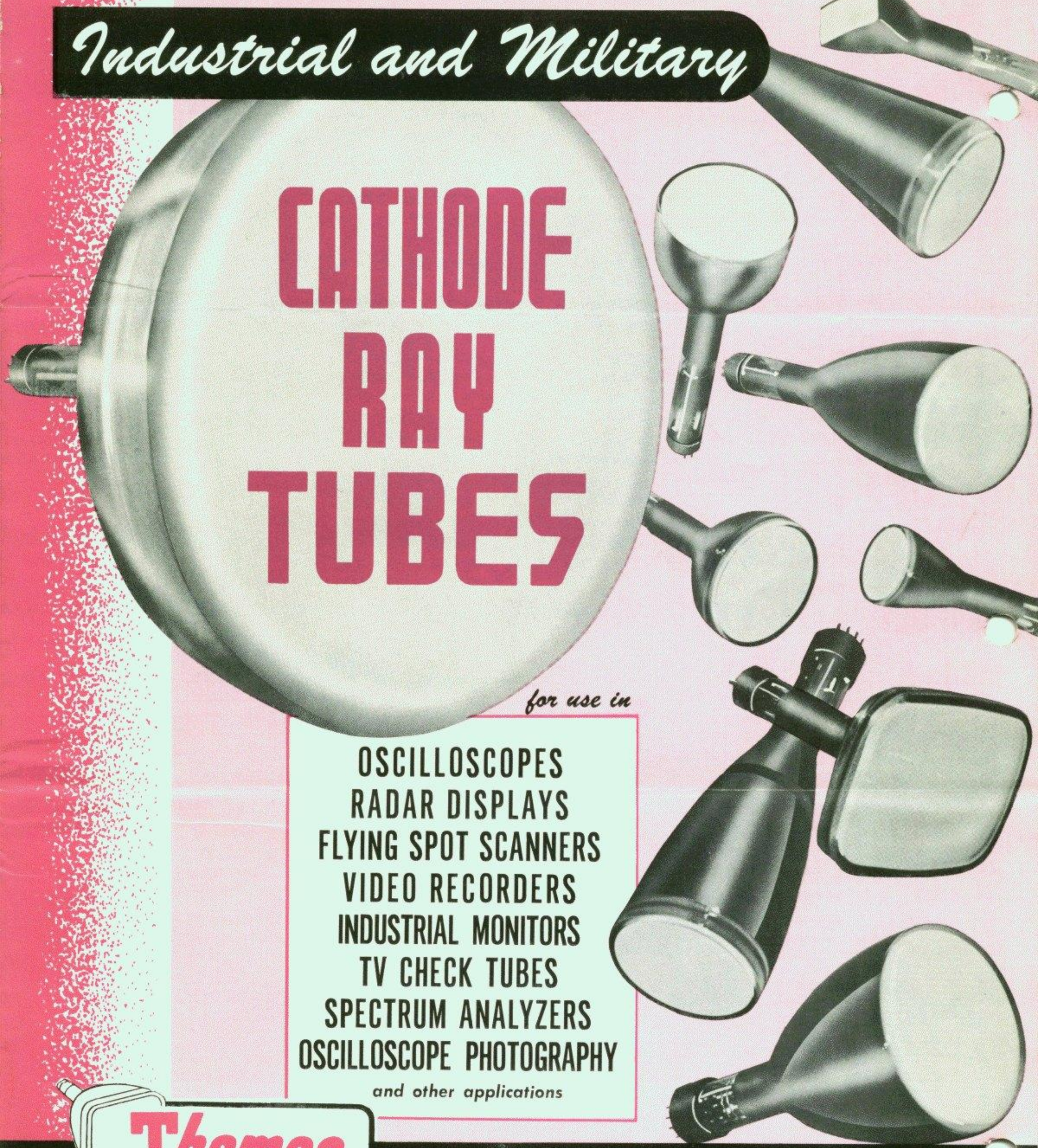
Industrial and Military

CATHODE RAY TUBES



for use in

OSCILLOSCOPES
RADAR DISPLAYS
FLYING SPOT SCANNERS
VIDEO RECORDERS
INDUSTRIAL MONITORS
TV CHECK TUBES
SPECTRUM ANALYZERS
OSCILLOSCOPE PHOTOGRAPHY

and other applications

Thomas ELECTRONICS Inc.

118 NINTH ST.
PASSAIC, N. J.

Thomas

CHART OF INDUSTRIAL-MILITARY CATHODE-RAY TUBE CHARACTERISTICS

Thomas

MAGNETIC DEFLECTION TYPES

JEDEC TYPE NO.	OVERALL LENGTH (Inches)	FACEPLATE AND SCREEN (See * below)	DEFLECTION ANGLE (Degrees)	OUTSIDE CAPACITANCE (mmf)	FOCUSING METHOD	ION TRAP	JEDEC BASING	JEDEC BASE NO.	TYPICAL OPERATING CONDITIONS			
									ANODE VOLTAGE (KV DC)	ACCELERATOR GRID VOLTAGE (V DC)	NEGATIVE CUT-OFF VOLTAGE (V DC)	FOCUSING VOLTAGE (V DC) or CURRENT (MA DC)
3AKP__	6-3/8	CA	36° Offset	None	ES	No	Spec. Coded	Molded	7	300	45-95	-50 to 350 V
3HP__	9-13/16	C	55	None	M	No	5AN	B8-65	5	150	15-45	——
4BP__	13-1/8	C	50	100-500	M	No	8ET	B8-65	25	No Grid	75-175	——
4CP__	11-1/4	C	50	100-500	M	No	12G	B5-57	20	——	70-140	——
5ACP__	11-1/8	CA Rd	53	None	ES	No	8EQ	B8-65	12	250	27-63	-50 to 350 V
5AEP__	11-1/8	C Rd	53	None	ES	No	8EQ	B8-65	7	250	25-70	-50 to 350 V
5AHP__	11-1/8	C Rd	53	None	ES	No	8EF	B8-65	7	300	28-72	-50 to 350 V
5AHP__A	11-1/8	CA Rd	53	None	ES	No	8EF	B8-65	7	300	28-72	-50 to 350 V
5AKP__	12-9/16	A Rd	50	100-500	M	No	12G	B5-57	30	——	80 to 140	250 MA
5ALP__	7-1/4	C Rd	53	None	M	No	9DF	——	8	No Grid	50	——
5AUP__	12-1/2	CA Rd	40	100-500	ES	No	12C	B6-63	25	200	40-100	5200 V
5AXP__	10-5/8	C Rd	53	None	ES	No	12S	B5-57	14	300	28-72	AUTO
5BCP__	7	C Rd	70	None	M	No	9DF	E9-37	8	——	25-75	56-84 MA
5BNP__	10-5/8	CA Rd	53	None	ES	No	12M	B6-63	14	300	28-72	-50 to 350 V
5CKP__	16-5/8	C Rd	42	None	M	No	12AM	B7-51	20	1000	35 to 110	135 MA
5FP__A	11-1/8	C Rd	53	None	M	No	5AN	B8-65	6	250	25-70	75-102 MA
5QP__A	11-1/8	CA Rd	53	None	M	No	5AN	B8-65	10	300	28 to 72	137 MA
5TP__	11-3/4	CA Rd	50	100-500	ES	No	12C	B7-51	27	200	40-100	——
5WP__	11-7/16	CA Rd	50	100-500	ES	No	12C	B7-51	27	200	42-98	6600 V MAX.
5ZP__	14-3/8	CA Rd	40	100-500	ES	No	12C	B7-51	20	200	42-98	4700 V
7ABP__	13-1/4	C Rd	50	None	ES	No	12M	B6-63	7	300	33-77	-50 to 350 V
7ABP__A	13-1/4	CA Rd	50	None	ES	No	12M	B6-63	7	300	28-72	0 to 250 V
7AJP__	19	CA	40	None	M	No	12D	B6-63	14	550	75-150	77 MA
7BP__	13-1/4	C Rd	53	None	M	No	5AN	B8-65	7	250	50	99-135 MA
7BP__B	13-1/4	C Rd	53	None	M	No	5AN	B8-65	7	250	25-70	99-135 MA
7CP__	13-7/16	C Rd	55	None	ES	No	8BQ	B8-65	6	250	25-68	1200 V
7DP__	14-1/16	C Rd	50	400-1500	ES	Double	12C	B7-51	6	250	25-65	——
7HP__	13	C Rd	50	500 Max.	M	No	12N	B5-57	6	250	28-72	——
7LP__	13-1/4	CA Rd	53	None	ES	No	8EQ	B8-65	12	250	27-63	0 to 250 V
7MP__	12-3/4	C Rd	50	None	M	No	12D	B5-57	7	250	27-63	105-140 MA
7QP__	12-7/8	C Rd	52	None	M	Single	12D	B5-57	8	300	28-72	80 MA
7RP__	14-1/16	CA Rd	50	None	M	No	12D	B5-57	9	250	27-63	80 MA
7SP__	14-1/16	C Rd	50	100-500	M	No	12G	B5-57	20	——	63-147	195 MA
7TP__	13-1/8	CA Rd	50	None	ES	No	12Q	B6-63	10	200	23-53	2200 V MAX.
8DP__	10-7/16	G Re	90	250-350	ES	Single	12AB	B6-158	8	200	22-51	-50 to 350 V
8FP__	11-7/16	GA Re	90		M	Single	12D	B5-57	16	300	35 to 72	125 MA
9LP__	14-31/32	C Rd	55	None	M	No	5AN	B8-65	7	250	60-100	——
9MP__	17-1/2	C Rd	55	None	M	No	5AN	B8-65	6	250	25-75	——
10KP__A	17-5/8	G Rd	50	None	M	No	12D	B7-51•B5-57	9	250	27-63	105 MA (Approx.)
10NP__A	17-5/8	GA Rd	52	500-1500	M	No	12G	B5-57	18	No Grid	62-125	110 MA (Approx.)
10QP__	17-9/16	C Rd	50	100-500	M	No	12G	B5-57	20	——	63-147	190 MA
10SP__	16-5/8	GA Rd	50	None	ES	No	12Q	B6-63	14	200	18-48	1900 V
10UP__	17-5/8	C Rd	50	None	ES	No	12M	B6-63	10	300	38-72	0 to 350 V
10UP__A	17-5/8	CA Rd	50	None	ES	No	12M	B6-63	10	300	28-72	0 to 350 V
10VP__	17-5/8	CA Rd	50	500-2500	M	No	12N	B5-57	11	250	28-72	110 MA (Approx.)
10WP__	16-15/16	G Rd	50	None	ES	No	12M	B6-63	10	300	28-72	0 to 350 V
10WP__A	16-15/16	GA Rd	50	None	ES	No	12M	B6-63	10	300	28-72	0 to 350 V
12ABP__	18	G Rd	55	None	ES	No	12M	B6-63	10	300	28-72	0 to 350 V

12ABP__A	18	GA Rd	55	None	ES	No	12M	B6-63	10	300	28-72	0 to 350 V
12AFP__A	18-5/16	G Rd	54	None	M	No	12D	B5-57	12	500	28-72	110 MA (Approx.)
12AGP__A	18-5/16	GA Rd	54	None	ES	No	12M	B6-63	12	500	28-72	0 to 350 V
12DP__	20-3/4	C Rd	55	None	M	No	5AN	B8-65	7	250	22-66	75-102 MA
12DP__A	19-5/8	G Rd	50	None	M	No	5AN	B8-65	7	250	22-66	99-135 MA
12DP__C	19-5/8	GA Rd	50	None	M	No	5AN	B8-65	7	250	22-66	75-102 MA
12KP__A	17-5/8	GA Rd	54	500-2500	M	No	12N	B5-57	11	250	27-63	110 MA (Approx.)
12SP__	18-3/4	C Rd	55	None	M	No	12D	B5-57	9	250	27-63	105 MA (Approx.)
12SP__B	18-3/4	GA Rd	55	None	M	No	12D	B5-57	9	250	27-63	105 MA (Approx.)
12SP__D	18-3/4	GA Rd	55	None	M	No	12D	B5-57	9	250	27-63	105 MA (Approx.)
14WP__	13-3/16	GA Re	90	80-1200	ES	No	12L	B6-63	12	300	28-72	0 to 350 V
16AFP__	19-5/32	CA Re	70	None	ES	No	12L	B6-63	12	250	27-63	0 to 350 V
16AKP__	22-1/16	GA Rd	53	None	ES	No	12M	B6-63	12	300	32 to 70	100 to 200 V
16LP__	22-1/4	C Rd	52	750-2000	M	Double	12N	B5-57	12	300	38-72	95 MA
16WP__	17-3/4	G Rd	70	None	M	Double	12D	B5-57	12	250	27-63	95 MA
16WP__A	17-3/4	G Rd	70	750-1500	M	Double	12N	B5-57	12	250	27-63	95 MA
17ADP__	19-3/16	GA Re	70	None	M	No	12D	B5-57	12	300	27-63	92 MA
17BCP__	19-1/4	GA Re	70	None	ES	No	12M	B6-63	12	250	27-63	0 to 350 V
17LP__	19-3/16	G Cy Re	70	750-1500	ES	Single	12L	B6-63	14	300	33-77	0 to 350 V
17QP__	19-3/16	G Cy Re	70	750-1500	M	Single	12N	B5-57	14	300	28-72	95 MA (Approx.)
21AMP__A	20	GA Re	90	2000-2500	M	Single	12N	B5-57	16	300	28-72	105 MA (Approx.)
21EP__	23	G Cy Re	70	None	M	Single	12D	B5-57	16	300	28-72	95 MA (Approx.)
21FP__	23	G Cy Re	70	None	ES	Single	12D	B6-63	16	300	28-72	0 to 350 V
22CP__	22-1/16	C Rd M	70	None	M	No	12D	B5-57	12	300	33-77	105 MA (Approx.)
22DP__	22-1/16	C Rd M	70	None	ES	No	12N	B6-63	12	300	33-77	-50 to 350 V
27EP__	23-1/16	GA Re	90	None	M	Single	12M	B5-57	16	300	38-72	105 MA

ELECTROSTATIC DEFLECTION TYPES

JEDEC TYPE NO.	OVERALL LENGTH (Inches)	FACEPLATE AND SCREEN (See * below)	JEDEC BASING	JEDEC BASE NO.	NO. OF GUNS	DEFLECTION FACTOR		TYPICAL OPERATING CONDITIONS			
						D1 D2 (V DC/Inch)	D3 D4 (V DC/Inch)	POST ACCELERATOR VOLTAGE (KV DC)	ACCELERATOR GRID VOLTAGE (V DC)	FOCUSING VOLTAGE (V DC)	NEGATIVE CUT-OFF (V DC)
1BP__	3	C FL	9CU	Min. 9 Pin	1	350	300	None	600	150	100 Max.
1EP__	4-1/16	C FL	11V	E11-22	1	210-310	240-350	None	1000	100-300	14-42
2AP__	7-7/16	C8	11B	Magnal 11 Pin	1	115	98	None	500	125	15-45
2AP__A	7-7/16	C8	11L	Sm. Shell Mag.	1	230	196	None	1000	250	30-90
2BP__	7-5/8	C8	12E	B12-43	1	230-310	148-200	None	2000	300-560	135 Max.
3AP__	11-1/2	C8	7AN	Med. 7 Pin	1	47	45	None	600	170	14-40
3AP__A	11-1/2	C8	7CE	Med. 7 Pin	1	114	109	None	1500	430	25-75
3ABP__	10-3/4	C FL	14T	B14-38	2	164-198	148-181	4	2000	480	45-75
3ACP__	10	C FL	14J	B12-37	1	180-220	133-163	4	2000	545	45-75
3ADP__	10	C FL	12Z	B12-43	1	140-160	61-70	4	2000	320-470	52-87
3AHP__	9-1/8	C15 Re	12E	B12-43	1	146-198	52-70	None	2000	330-620	58-135
3AQP__	9-1/8	C8	12E	B12-43	1	146-198	52-70	None	2000	330-620	58-135
3BP__	10	C8	14A	B12-37	1	168	123	None	1500	430	22.5-67.5
3BP__A	10	C8	14G	B12-37	1	200	148	None	2000	575	30-90
3CP__	10-3/8	C8	11C	Med. Mag. 11 Pin	1	124	165	None	2000	575	30-90
3DP__	10-7/16	C8	14C	B12-37	1	166	123	None	1500	430	22.5-67.5
3DP__A	10-7/16	C8	14H	B12-37	1	220	148	None	2000	575	30-90
3EP__	9-15/16	C8	11N	Wafer Mag. 11 Pin	1	221	165	None	2000	575	30-90
3FP__	10	C8	14B	B12-37	1	221	164	2	2000	575	30-90
3FP__A	10	C8	14J	B12-37	1	250	180	4	2000	575	30-90
3GP__	11-1/2	C8	11N	B11-66	1	64-96	56-84	None	1000	163-291	16.5-49.5
3JP__	10	C8	14J	B12-37	1	170-230	125-270	4	2000	400-690	30-90
3JP__A	10	C8	14J	B12-37	1	180-220	133-163	4	2000	400-690	45-75
3KP__	11-1/2	C8	11M	B11-66	1	50-68	38-52	None	1000	160-300	45 Max.
3MP__	8	C8	12F	B12-43	1	286-380	260-360	None	2000	400-700	126 Max.
3QP__	6-1/8		9D	European 9 Pin	1	214-290	133-181	None	1200	240-480	31-74
3RP__A	9-1/8	C8	12E	B12-43	1	146-198	104-140	None	2000	330-620	45 to 135
3SP__	9-1/8	C15 Re	12E	B12-43	1	73-99	52-70	None	1000	165-310	28.5-67.5
3UP__	7-1/2	C FL Re	12F	B12-43	1	246-310	232-296	None	2000	330-620	126 Max.
3WP__	11-1/2	C FL	12T	B12-43	1	83-101	57-70	None	2000	330-620	60-100
3XP__	8-7/8	C15 Re	Spec.	D8-1	1	68-92	25-38	None	2000	370-650	28.5-67.5
4DP__	12-1/4	C FL	14Y	B12-37	2	115-140	90-115	4	2000	335-615	52-87
5AP__	13	C9	11A	Large Magnal	1	93	90	None	1500	430	21-57
5ABP__	16-3/4	C FL	14J	B12-37	1	53-72	36-48	4	2000	400-690	52-87
5ADP__	16-3/4	C FL	14J	B12-37	1	46-50	30.5-37.5	3	1500	300-515	34-56

5AJP__	9-7/8	C7-1	Spec.		1	230	230	6	750	400-900	30-60
5AMP__	17-5/8	C FL	14U	B12-37	1	40-50	20-25	None	2500	0-300	34-56
5AQP__	16-3/4	C FL	14G	B12-37	1	40-50	31.5-38.5	None	2500	0-300	34-56
5AQP__A	16-3/4	C FL	14G	B12-37	1	40-50	31.5-38.5	None	2500	0-300	34-56
5ARP__	18-1/2	C FL	Spec.	B12-37	2	45-55	31.5-38.5	None	2500	0-300	34-56
5ATP__	17-5/8	C FL A	14V	B12-37	1	94-116	34-42	None	6000	0-700	34-56
5AWP__	16-3/4	C FL A	14P	B12-37	1	113-128	113-128	10.3	2300	500-730	33-55
5BP__	16-3/4	C8	11A	Wafer Mag.	1	63	57	None	1500	310	20-60
5BP__A	16-3/4	C8	11N	Med. Mag. 11 Pin	1	84	76	None	2000	450	20-60
5BDP__	18-1/4	C FL A	14AB	B12-37	2	130-160	111-133	14	2000	400-630	45-75
5BFP__	18-5/16	C FL A		B12-37	2	130-160	110-138	13.25	2750	600-900	35-65
5BGP__	17-1/2	C FL A	14AF	B12-37	1	70-86	28.4-34.8	10	1670	180-590	50-80
5BHP__	18-1/4	C FL A	14AF	B12-37	1	70-86	15-18.3	10	1670	180-590	50-80
5CBP__	18-1/4	C FL	14AG	B12-37	1	48.3-58.5	15.5-19	4	1900	190-565	62-85
5CP__	16-3/4	C8	14B	B12-37	1	92	74	4	2000	575	30-90
5CP__A	16-3/4	C8	14J	B12-37	1	92	78	4	2000	575	30-90
5CP__B	16-3/4	C8	14J	B12-37	1	83-101	70-86	4	2000	400-690	45-75
5CAP__	17-1/2	C FL	14AF	B12-37	1	48.3-61	22.6-28	6	1850	225-670	60-85
5GP__	16-3/4	C8	11A	11 Pin Sleeve	1	36	72	None	2000	425	24-56
5HP__	16-3/4	C8	11A	11 Pin Sleeve	1	63.5	57.8	None	1500	310	15-45
5HP__A	16-3/4	C8	11N	Med. Mag.	1	84	76	None	2000	450	20-60
5JP__	16-3/4	C10	11E	11 Pin Mag.	1	96	96	2	1000	260	22.2-51.8
5JP__A	16-3/4	C10	11S	Med. Mag.	1	77-115	77-115	4	2000	333-630	45-105
5LP__	16-3/4	C10	11F	Med. Mag.	1	103	90	4	2000	500	30-90
5LP__A	16-3/4	C10	11T	Med. Mag.	1	83-124	72-108	4	2000	376-633	30-90
5MP__	15-7/8	C10	7AN	Large 7 Pin	1	66	60	None	1000	250	16.5-49.5
5NP__	16-3/4	C	11A	11 Pin Sleeve	1	84	76	None	1500	337	15-45
5RP__	16-3/4	C FL	14F	B12-37	1	140-210	131-197	20	2000	528	30-90
5RP__A	16-3/4	C FL	14F	B12-37	1	140-210	131-197	20	2000	363-695	30-90
5SP__	18-1/2	C FL	14K	B12-37	2	74-110	62-94	4	2000	363-695	30-90
5SP__A	18-1/4	C FL	14K	B12-37	2	83-101	70-86	4	2000	363-695	45-75
5UP__	14-3/4	C20	12E	B12-43	1	56-77	46-62	None	2000	340-640	90 Max.
5VP__	16-3/4	C8	11N	Med. Mag.	1	70-98	63-89	None	2000	315-562	20-60
5XP__	17-5/8	C FL	14P	B12-37	1	140-210	46-68	20	2000	362-695	30-90
5XP__A	17-5/8	C FL	14P	B12-37	1	130-159	42-52	12	2000	362-695	45-75
5XP__B	17-5/8	C FL A	14P	B12-37	1	130-159	42-52	12	2000	362-695	45-75
5YP__	17-5/8	C8	14Q	B12-37	1	108-162	36-54	6	3000	541-1040	45-135
6DP__	20-1/16	FL A	Spec.	B25-139	3	112-138	105-130	12	4000	950-1225	75-124
7ACP__	17-3/4	C30 A Re	Spec.	B25-139	3	86-130	84-126	9	3000	595-1020	87-112
7AEP__	15-1/2	C FL	14J	B12-37	1	81-101	67-83	4	2000	380-620	45-75
7AGP__	18-7/8	G30 A	Spec.	22 Pin Collar	1	175-195	170-186	None	8000	2000-2950	105-175
7GP__	14-1/2	C	14G	B12-37	1	93-123	75-102	None	3000	810-1200	36-84
7JP__	14-1/2	C20	14R	B12-37	1	186-246	150-204	None	6000	1620-2400	72-168
7VP__	14-1/2	C20	14R	B12-37	1	93-123	75-102	None	3000	800-1200	84 Max.
7XP__	18-5/8	C24	Spec.	22 Pin Collar	5	63-105	59-94	4	2000	440-750	22.5-67.5
7YP__	18-1/2	C40 Sq	Spec.	B25-139	5	60-90	28-45	4	2000	450-700	50-90
8CP__	16-1/2	C20	14J	B12-37	1	58-81	49-68	4	2000	540-800	24-56
10GP__	18-1/2	C	14A	B12-37	1	125-165	100-135	None	5000	1250-1850	60-140
10HP__	19-1/4	C	14G	B12-37	1	110-150	85-115	None	5000	1200-1800	60-140
12ACP__	24-7/8	C40 A		B12-37	2	140-190	130-180	None	7500	1750-2500	150-225
12FP__	24	C	14E	B12-37	1	110	125	8	4000	1250	30-90
12GP__	22	C	14S	B12-37	1	108	101	6	4000	1143	65-195
12HP__	23-1/2	C	11J	11 Pin Sleeve	1	95	125	None	5000	1150	45-135
14AP__	24-1/4	C	12A	12 Pin Per.	1	130	130	8	4000	1000	40-120
20AP__	27-7/8	C	12A	12 Pin Per.	1	110	110	8	4000	1000	40-120

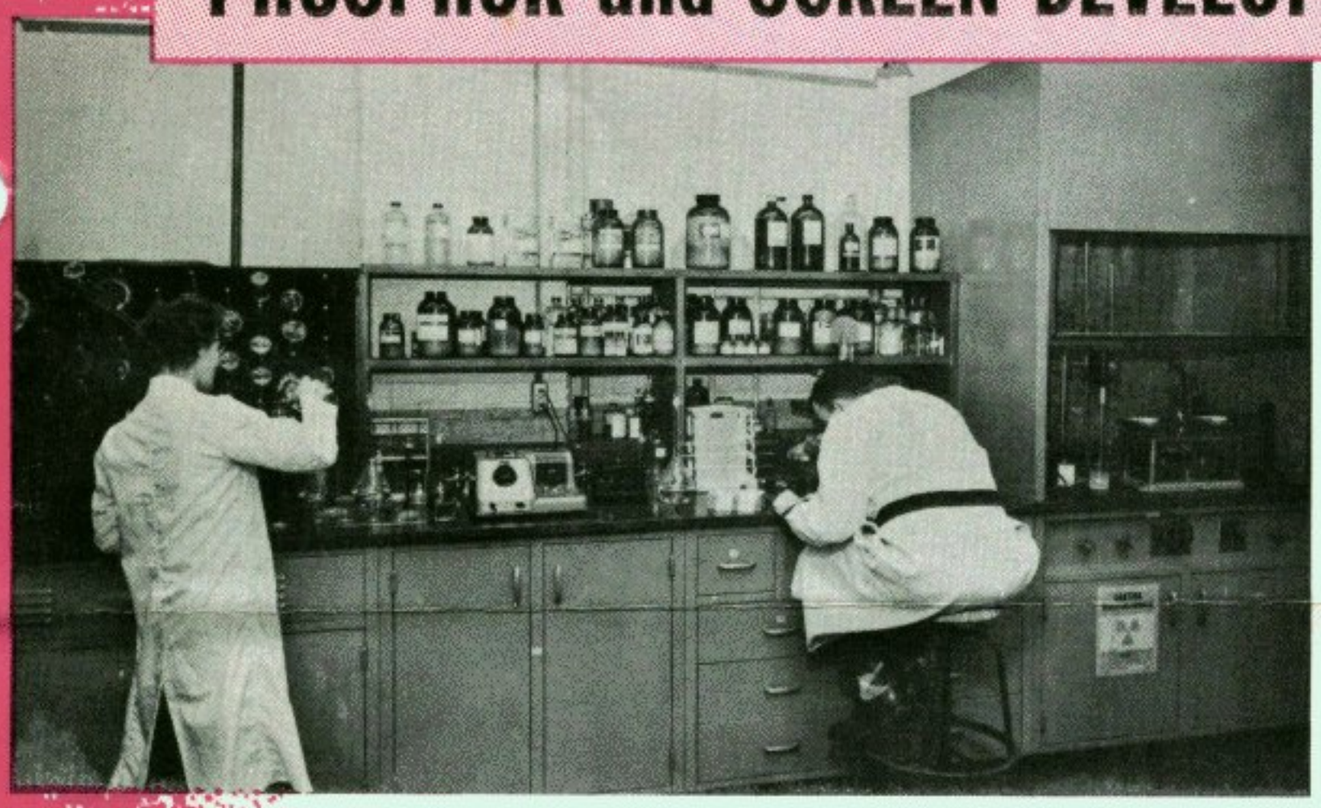
* A=Aluminized, C=Clear, Cy=Cylindrical, G=Gray, M=Metal, Rd=Round, Re=Rectangular, FL=Flat, Sq=Square, Digit=Radius of curvature given in inches

TESTING EQUIPMENT

Depicted at the left is a section of the Industrial-Military cathode-ray tube Test Department showing one of Thomas' test sets and a composite video signal generator. The test set was designed and built by Thomas Electronics for evaluating the electrical characteristics of electrostatic deflection cathode-ray tubes over a very wide range of operating conditions. Close-tolerance precision components, well-regulated power supplies and large-scale meters (accurate to within 0.5%) ensure precise measurements. The test set is capable of testing tubes according to MIL-E specifications. Similar test sets, employing advanced circuit design, are used by Thomas Electronics for testing magnetic deflection tubes. Test sets like the one shown on the left, and supplementary test equipment, are checked by Thomas' calibration laboratory in accordance with rigorous quality control schedules.

Cathode-Ray Tube Test Set

PHOSPHOR and SCREEN DEVELOPMENT



This is a section of Thomas' chemical laboratory showing a chemist and technician engaged in a phosphor screen development project. The lab is well equipped with up-to-date apparatus for complete analysis of tube and tube process materials, the formulation of materials and the preparation and evaluation of phosphors, phosphor screens and other tube coatings. While the main function of the laboratory is research as well as material and process development, it also works closely with production departments by chemically testing raw materials, issuing specifications for developmental tube type processes and troubleshooting shop problems.

Corner Section of One of Thomas' Laboratories

This brief summary of the **THOMAS ELECTRONICS** *organization will acquaint you with our personnel, plant facilities and operation.*

We welcome the opportunity to discuss your prototype and production requirements in greater detail.

Address all inquiries to: Jess E. Dines, Manager of Sales, Industrial and Military Tube Division of
THOMAS ELECTRONICS, Inc., 118 NINTH STREET, PASSAIC, N. J., U.S.A.

PRINTED IN U.S.A.

NO. TI60-10M

ABOUT THOMAS ELECTRONICS

Thomas Electronics, Inc., founded in 1949, was engaged initially in the design and manufacture of television picture tubes. In subsequent years, other product lines were added including cathode-ray tube component parts, industrial-military cathode-ray tubes and electronic equipment and cable assemblies. Advancements in automated production techniques (together with effective management, engineering, research and quality control facilities) have enabled Thomas Electronics to become one of the leading manufacturers of television cathode-ray tubes in the nation. Production capacity is presently in excess of 6,000 tubes a day. Headquarters in Passaic, New Jersey comprise a quarter-million-square-foot plant as well as manufacturing and warehouse facilities in St. Charles, Illinois; Cedartown, Georgia and Fort Worth, Texas. Overseas operations include manufacturing facilities in Australia and Italy.

In the laboratories, research and development groups are engaged in advanced product development and the study of new material and design concepts. A substantial portion of the laboratory and industrial-military area is air-conditioned and humidity-controlled for critical processing operations. The necessary facilities for fabrication and testing of experimental electron guns and tubes are available, as well as equipment for development work on metal and phosphor film evaporation techniques. Research groups are supplemented by efficient production engineers, equipment design specialists and industrial and application engineers to bring new developments into full scale production with minimum delays. At the present time, particular emphasis is being placed on the enhancement of light output of cathode-ray tubes when operating on low voltages and high precision, high resolution, tube and electron gun designs.

KEY PERSONNEL

KENNETH A. HOAGLAND *Director of Engineering*

Mr. Hoagland holds the degrees of B.S. and M.S. in electrical engineering from Newark College of Engineering and has done graduate work in physics and mathematics at the Polytechnic Institute of Brooklyn and Stevens Institute of Technology. He is a Senior Member of the I.R.E., a member of the American Physical Society, A.I.E.E. and Tau Beta Pi. From 1941 to 1959 Mr. Hoagland was associated with the Allen B. DuMont Laboratories in various engineering capacities including Chief Engineer, Cathode-Ray Tube Division; Director of Color Tube Research and Development; and Director of Engineering, Tube Operations. He is responsible for a number of innovations in cathode-ray tube design, such as high sensitivity tubes for wide-band oscillography, precision mono-accelerator instrument tubes and an electron beam focusing lens presently in general use for television picture tubes. Mr. Hoagland is a former Chairman of the JEDEC Committee on Cathod-Ray Tubes, Electronic Industries Association.

PETER SEATS *Manager, Research and Development*

Mr. Seats was educated in Europe and Australia, joining Thomas Electronics in 1954 after serving six years as Chief Chemist in the Cathode-Ray Tube Division of E.M.I. Ltd., England. In the past ten years, he has been responsible for a number of significant improvements in cathode-ray tube efficiencies, particularly in the areas of screen applications and aluminizing. Mr. Seats' experience and original approach to design and development problems concerning cathode-ray tubes are exemplified by a recently concluded project involving the use of radioactive tracers. He holds 18 patents in the cathode-ray tube field.

EDWARD LISOVICZ *Manager, Industrial and Military Tube Division*

Mr. Lisovicz has a B.S. degree in electrical engineering from the Newark College of Engineering and is a member of Tau Beta Pi. He has been associated with Thomas Electronics since its inception in 1949 and has made a number of significant contributions to the company's growth in the areas of production and processing engineering. His diversified experience includes plant production supervision, cathode-ray tube manufacturing processes; development of electron gun production techniques, gun design, and control of plant shrinkage, using statistical inspection and quality control procedures. He holds several electron gun design patents.

NICHOLAS E. BRODERICK *Director of Quality Control and Field Engineering*

Mr. Broderick holds a B.S. degree in physics from Fordham University. He has done graduate work at both Fordham and Syracuse Universities in the fields of electronics, mathematics and nuclear physics. He is a Senior Member of the I.R.E., a former chairman of the engineering section of the Cathode-Ray Tube Manufacturers' Association, a member of the Joint Electron Devices Engineering Council and the American Physical Society. Before joining Thomas Electronics, Mr. Broderick was connected with Sylvania Electronics Products where his duties included the design and development of optical systems and electron guns. He holds several cathode-ray tube patents.