TESTING PORTABLES

Illustrations on Pages 17 and 25

Typical Full Size Scales on Pages 16 and 24

DIRECT CURRENT PORTABLES

Voltmeters . . . Ammeters . . . Milliammeters

Model	Accuracy Within	Scale Length	Ranges and Prices
1	¼ of 1%	5.18″ (132 mm)	Page 18
622	½ of 1%	6.1″ (155 mm)	19
45	½ of 1%	5.18″ (132 mm)	20
430	½ of 1%	4.04″ (103 mm)	20
280	1%	2.76″ (70 mm)	22
489	2%	2.36″ (60 mm)	21

Millivoltmeters

1	¼ of 1%	5.18″ (132 mm)	18
622	½ of 1%	6.1″ (155 mm)	19
280	1%	2.76″ (70 mm)	22

Volt-Millivoltmeters

1	¼ of 1%	5.18″ (132 mm)	18
56	½ of 1%	5.18″ (132 mm)	22
622	½ of 1%	6.1″ (155 mm)	19

Volt-Ammeters

Model	Accuracy Within	Scale Length	Ranges and Prices
280	1%	2.76″ (70 mm)	Page 22
540	1%	2.7″ (68.5 mm)	23

Microammeters

1	¼ of 1%	5.18″ (132 mm)	18
622	½ of 1%	6.1″ (155 mm)	19
430	½ of 1%	5.18″ (132 mm)	21
440		2.36″ (60 mm)	23

Galvanometers

440	.....	2.36″ (60 mm)	23
375	.....	2.36″ (60 mm)	21
699	.....	2.36″ (60 mm)	21

ALTERNATING CURRENT PORTABLES

Voltmeters

Model	Accuracy Within	Scale Length	Ranges and Prices
155	½ of 1%	5.18″ (132 mm)	Page 28
433	¾ of 1%	4.04″ (103 mm)	26
330	1% at 60 cycles		
	2% at 50 to 100 cycles	2.67″ (69 mm)	29
528	2%	2.03″ (52 mm)	29

Ammeters

155	½ of 1%	5.18″ (132 mm)	28
433	¾ of 1%	4.04″ (103 mm)	26
330	1% at 60 cycles		
	2% at 50 to 100 cycles	2.67″ (69 mm)	29
528	2%	2.03″ (52 mm)	29
633	3% overall	2.36″ (60 mm)	82

Milliammeters

155	½ of 1%	5.18″ (132 mm)	28
433	¾ of 1%	4.04″ (103 mm)	26
528	2%	2.03″ (52 mm)	29

Wattmeter

432	½ of 1%	4.04″ (103 mm)	27

Millivoltmeter—Rectifier Type

Model	Accuracy Within	Scale Length	Ranges and Prices
430	4%	4.04″ (103 mm)	Page 27

Inrush or Coded Current Ammeter

433	¾ of 1%	4.04″ (103 mm)	27

A-C and D-C Voltmeter

455	½ of 1%	4.04″ (103 mm)	27

THERMO-INSTRUMENTS

Ammeter . . . Milliammeter . . . Voltmeter

622	½ of 1% on a-c 1% on d-c	6.1″ (155 mm)	30

Clamp-Ammeter

633	3% overall	2.36″ (60 mm)	82

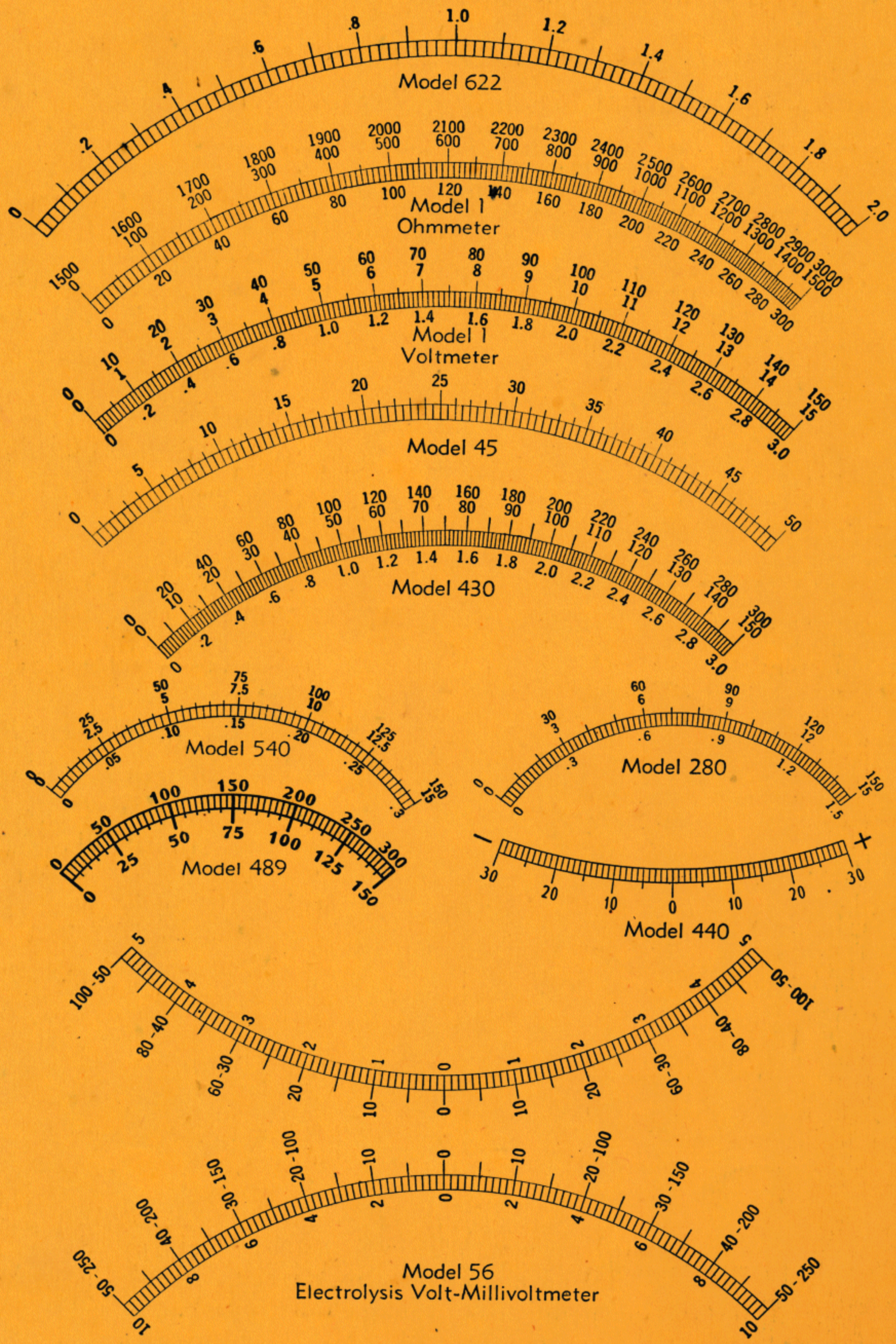
Industrial Analyzer

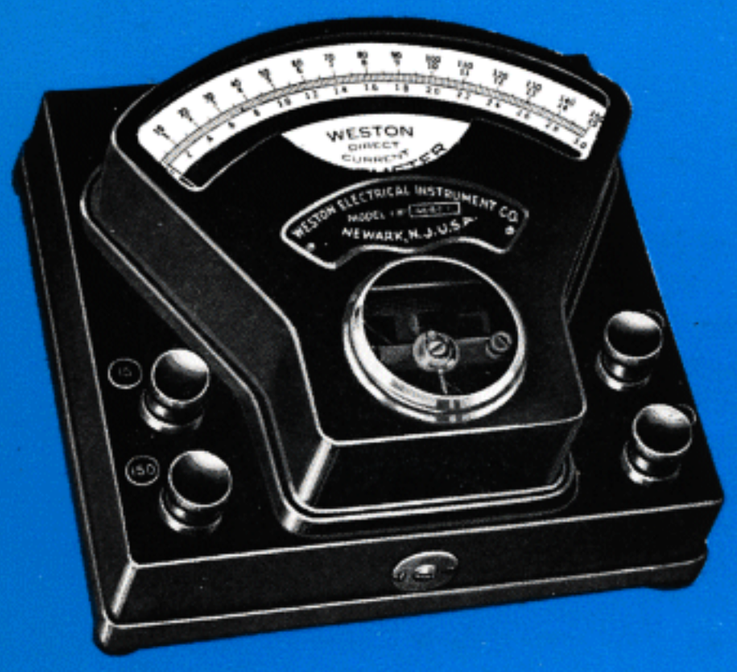
639	1 and 2%	3.5″ (89 mm)	81

FOR GENERAL INDEX SEE PAGE 117

DIRECT CURRENT PORTABLES

TYPICAL FULL SIZE SCALES





Model 1—Scale 5.18″

Model 489—Scale 2.36″

Model 622—Scale 6.1″

Model 280—Scale 2.76″

Model 45—Scale 5.18″

Model 430—Scale 4.04″

Model 375—Scale 2.36″

Model 540—Scale 2.7″

Model 56—Scale 5.18″

Model 440—Scale 2.36″

DIRECT CURRENT PORTABLES

MODEL 1 D-C INSTRUMENTS

Accuracy ¼ of 1%.....Scale 5.18" (132 mm)

Permanent Magnet Moving Coil Type

Approx. Dimensions { 6⅝ x 6 x 3½" / 170 x 152 x 89 mm }..Average Wgt. { 7½ lbs. / 3.4 kgs.

Model 1 instruments are portable reference standards of unequalled popularity in electrical laboratories and in the field. Each instrument is regularly supplied in a sturdy leather carrying case with a convenient handle.

Scales are hand calibrated by direct comparison with accurate reference standards . . . they have knife-edged pointers and mirror scales to eliminate parallax errors . . . zero corrector for adjusting the zero position of the pointer . . . very responsive to slight or rapid electrical changes in the circuit under test . . . excellent damping to facilitate rapid readings . . . may be left in circuit continuously or subjected to wide ranges in temperature without serious effect upon the guaranteed accuracy . . . all parts designed and selected to insure long life and sustained accuracy . . . handsome appearance with bases of black bakelite and cases finished in dull black to match.

D-C VOLTMETERS—MODEL 1

Resistance 100 ohms per volt. For higher sensitivities we recommend Model 622, listed on page 19.

Range		Scale Div.	Price
150/15/3	s	150	$106.00
300/150/3	s	150	110.00
750/300/150	s	150	122.00
750/300/150/15/3	s	150	132.00

Self-contained up to 750 volts inclusive. For higher ranges see multipliers listed on page 72.

D-C MILLIVOLTMETERS—MODEL 1

Ranges	Resistance Ohms	Scale Divisions	Price
*10-0-10 / 100-0-100	4 / 40	100	$102.50
** 20 / 200	4 / 40	100	102.50

*Equipped with contact key for range changing.

**Three binding post instrument.

Millivoltmeters are supplied with one pair of 5 ft. leads, having fork terminals. If fork terminals are desired at one end, and pin tips at the other, please specify.

ELECTROLYSIS VOLT-AMMETER AND VOLT-MILLIVOLTMETER—MODEL 1

Dimensions { 9 5/16 x 11 x 4¾" / 237 x 279 x 121 mm }.....Approx. Weight { 13 lbs. / 5.9 kgs.

Especially designed for locating and measuring stray currents in pipes, cables, steel structures, etc. Supplied mounted in wooden carrying case.

VOLT-AMMETER—MODEL 1

Ranges	Scale Divisions	Price
50-0-100 Volts 5-0-10 Volts 0.5-0-1 Volt 0.05-0-0.10 Volt 0.005-0-0.01 Volt 50-0-100 Amps. 5-0-10 Amps.	150	$216.00 s

(Sensitivity:—300 ohms per volt.)

VOLT-MILLIVOLTMETER—MODEL 1

Ranges	Scale Divisions	Price
50-0-50 Volts 5-0-5 Volts 0.5-0-0.5 Volt 0.05-0-0.05 Volt 0.005-0-0.005 Volt	100	$200.00

(Sensitivity:—400 ohms per volt.)

D-C AMMETERS—MODEL 1

(Self-contained)

Range	Scale Div.	Price	Range	Scale Div.	Price
1	100	$101.50	50	100	$110.00
1.5	150	101.50	100	100	115.00
5	100	101.50	150	150	120.00
10	100	101.50	300	150	130.00
15	150	101.50	500	100	140.00

Regularly supplied self-contained up to and including 500 amperes. Ammeters up to and including 150 amperes have a drop of 50 mv ± 5% and between 200 and 500 amperes a drop of 40 mv ± 5%.

(External Shunt Type)

100 millivolts for use with portable precision shunts, shown on page 76. Instrument resistance 20 ohms. Price (Instrument only) $96.00

50 millivolts for use with portable multiple range rotary switch type shunts shown on page 73. Instrument resistance 10 ohms. Price (Instrument only).....$96.00

External shunt ammeters are calibrated with scales to suit the shunts selected. One pair of 5 ft. leads is supplied with each instrument.

D-C MILLIAMMETERS—MODEL 1

Range	Scale Div.	Approx. Res.	Price
150/15	150	0.34/2.24	$109.00
500/50	100	0.1/0.9	109.00
1500/150	150	0.033/0.322	114.50
500/50/10	100	0.1/0.9/2.47	122.00
1500/150/15	150	0.033/0.322/2.22	127.50

For microammeters and multi-range milliammeters other than those listed above, we recommend Model 622 listed on page 19.

DIRECT-READING OHMMETERS—MODEL 1

Dimensions { 6⅝ x 8⅜ x 3½" / 170 x 213 x 89 mm }.....Approx. Weight { 8.8 lbs. / 4 kgs.

For resistance measurements where speed and accuracy are essential. Operated on ordinary dry cells, the changes in voltage being compensated for by means of an adjustable magnetic shunt.

Ohm Ranges	Scale Divisions	Volts Necessary to Operate	Milliamperes Low Range	Milliamperes Higher Ranges	Price
0-2.5, 0-25, 25-50	125	1.5	200	36	$141.50
0-10, 0-50, 50-100	100	1.5	65	30	141.50

Ranges up to 10,000 ohms, of the same order of accuracy, are available. Correspondence invited. For still higher ranges, at somewhat lower accuracy, we recommend Models 564 and 663 listed on pages 83 and 84.

Only the most commonly used ranges are listed—*any* practical range can be supplied.

s *Denotes instrument normally carried in stock.*

Typical scales page 16

MODEL 622 D-C INSTRUMENTS

Accuracy ½ of 1%.....Scale length 6.1″ (155 mm)

Permanent Magnet Moving Coil Type
Statically and Magnetically Shielded

Dimensions { 8¾ x 7¾ x 4 1/16″ / 222 x 197 x 103 mm } .....Approx. Weight { 8½ lbs. / 4 kgs.

Broad flexibility and high sensitivity have been combined to make Model 622 the ideal instrument for accurate measurement of current and potential, such as encountered in the fields of telephony, design and manufacture of radio sets and tubes, temperature measurements, experimental and development work, etc. Large rectangular scale opening insures good readability of the long, hand calibrated mirror scale. Zero corrector provided for adjusting knife edged pointer.

Model 622 instruments are of the double pivot type, eliminating the necessity of leveling when used in a horizontal position. Magnetically and statically shielded for all ranges other than 5 microamperes wherein magnetic shielding is omitted in favor of improved torque.

Ultra-sensitive instruments are provided with an automatic switch which short circuits the moving coil when the cover of the case is closed. This feature provides additional damping, guarding against possible damage during shipment and in handling. All Model 622 instruments are supplied in molded bakelite cases. Model 622 Thermo Instrument is described on page 30.

Model 622 instruments can be supplied with multi-range voltage and current combinations. For example, ranges from 100 microamperes to 2 amperes and from 2 millivolts to 1000 volts can be obtained in one instrument. Any suitable combination up to 14 ranges can be included in a single instrument having one selector switch. Ranges can be increased by adding another switch. This feature permits overlapping of ranges, and measurements of practically any value can be made in the best portion of the scale. Correspondence is invited.

VOLTMETERS—MODEL 622

1000 Ohms Per Volt

Ranges	Scale Div.	Price
75/30/7.5	150	$115.00
150/15/3	150	115.00
300/150/3	150	119.00
750/300/150	150	131.00

Multi-Range
(With range changing switch)

Ranges	Scale Divs.	Price
300/150/75/30/15/7.5/3/1.5	150	$159.00
500/200/100/50/20/10/5/2	100	163.00
750/300/150/75/30/15/7.5/3/1.5	150	176.00
1000/500/200/100/50/20/10/5/2	100	184.00

MILLIVOLTMETERS—MODEL 622

Multi-Range
(With range changing switch)

Ranges	Resistance Ohms	Scale Divisions	Price
50/20/10/5/2	250/100/50/25/10	100	$145.00
100/50/20/5/1	500/250/100/25/5	100	145.00
500/100/50/20/1	2500/500/250/100/5	100	145.00
1000/100/50/10/1	5000/500/250/50/5	100	145.00
2000/200/50/20/2	10000/1000/250/100/10	100	145.00

Adjusted flexible leads, five feet long, are supplied with each Model 622 Millivoltmeter. Each set of leads has a resistance of 0.026 ohm. Each instrument is adjusted and calibrated with these leads and therefore the resistances shown in the above table include the leads.

MILLIAMMETERS—MODEL 622

Multi-Range
(With range changing switch)

Ranges	Approximate Resis. Ohms	Scale Divisions	Price
30/3/0.3/0.03 s	3.4/33.2/306/556	150	$145.00
100/10/1/0.1	0.20/1.98/18.4/40.0	100	145.00
200/20/2/0.2	0.099/0.99/9.1/10	100	140.00
200/20/2/0.2	(10 ohms for all ranges)	100	160.00
500/50/5/0.5	0.10/1.0/9.8/80	100	130.00

MICROAMMETERS—MODEL 622

Single Range

Range	Scale Divs.	Low Resis. Type—Approx. Resis. Ohms	Price	High Resis. Type—Approx. Resis. Ohms	Price
* 5	100	4000	$150.00	.....	.....
*10	100	3900	145.00	.....	.....
*15	150	2600	140.00	.....	.....
20	100	280	130.00	2600	$120.00
30	150	150	125.00	1800	115.00
50	100	90 s	120.00	1100	110.00
100	100	45	120.00	600	110.00
150	150	30	120.00	240	110.00
200	100	10	120.00	175	110.00

Multi-Range
(With range changing switch)

Ranges	Resistance Ohms	Scale Divisions	Price
1000/500/200/100/50† s	100 for all ranges	100	$165.00

*These instruments have a scale length of 5.2″.

†This instrument is recommended for telephone and PHOTRONIC photoelectric cell circuits.

Model 622 Microammeters, low resistance type, are designed to function on the lowest amount of energy consistent with reasonable performance. They should be used in circuits when but little energy may be abstracted by the instrument as in the output of vacuum thermocouples.

High resistance microammeters will stand more severe service and, in general, are more rapid in indication than low resistance instruments. High resistance instruments are recommended for use wherever circuit conditions will permit.

ELECTROLYSIS VOLT-MILLIVOLTMETER—MODEL 622

High Resistance Type

This instrument is ideal for electrolysis surveys where extreme sensitivity is desired. Ranges listed are zero center and are typical of those that can be supplied. Correspondence is invited relative to special applications.

Range (Zero Center)	Sensitivity	Scale Div.	Price
.025/.1/.5/1/5 volts	200,000 ohms per volt	100	$200.00
1/10/100 mv., 1/10/100 volts	10,000 ohms per volt	100	165.00

Measurements of stray currents in pipes, cables, steel structures, etc, can be made by using a 100 millivolt external shunt with either of the above instruments.

Leather case for Model 622 instruments.....$12.00 s

Only the most commonly used ranges are listed—*any* practical range can be supplied.

s ***Denotes instrument normally carried in stock.***

Typical scales page 16

DIRECT CURRENT PORTABLES

MODEL 45 D-C INSTRUMENTS

Accuracy ½ of 1%.....Scale 5.18" (132 mm)

Permanent Magnet Moving Coil Type
Shielded from External Magnetic Fields

Dimensions { 8 x 8 x 4¾" / 203 x 203 x 121 mm } .....Approx. Weight { 9.9 lbs. / 4.5 kgs.

For general test work requiring an exceptionally rugged instrument. Made as voltmeters, ammeters, and milliammeters in a wide variety of ranges and range combinations.

Enclosed in lacquer finished oak case having hinged cover and carrying handle. Scales are hand calibrated by direct comparison with accurate reference standards . . . knife edged pointers and mirror scales eliminate parallax errors . . . zero corrector. Very responsive to slight or rapid electrical changes but adequately damped to facilitate rapid readings. May be left in circuit continuously or subjected to wide changes in temperature without serious effect on guaranteed accuracy.

D-C VOLTMETERS—MODEL 45

Regularly made in two sensitivities, 100 ohms per volt and 1000 ohms per volt. Other sensitivities supplied on special order. Self-contained to 750 volts inclusive.

Range	Divisions		PRICE 100 Ohms Per Volt	PRICE 1000 Ohms Per Volt
*0.2/0/2.8	150	s	$ 60.00	$ 70.00
1.5	150		60.00	70.00
3	150		60.00	70.00
5	100		60.00	70.00
15	150		60.00	70.00
150	150	s	60.00	70.00
300	150	s	64.00	74.00
750	150		76.00	91.00
15/3	150		65.00	75.00
150/3	150		65.00	75.00
150/15	150	s	65.00	75.00
150/75	150	s	65.00	75.00
300/150	150	s	69.00	79.00
600/300	150		77.00	92.00
750/150	150		81.00	96.00
150/15/3	150	s	70.00	80.00
300/150/3	150	s	74.00	84.00
750/300/150	150	s	86.00	101.00

*Scale adapted for use in connection with Cadmium Test on storage batteries.

Leather case for any self contained instrument.....$13.00

D-C AMMETERS—MODEL 45

Self-contained up to and including 25 amperes, above 25 amperes they are supplied with external 50 mv shunts and 5 ft. leads. Ranges from 1.5 to 25 amperes can be had with external shunts if desired, at the base price of $60.00 plus the price of the shunt selected, as shown on page 76.

The Model 45 for use with external shunts is regularly supplied with a resistance of 5 ohms. When a Weston Rotary Shunt is to be used with a Model 45, it should be so specified. An instrument having a resistance of 10 ohms and a sensitivity of 5 milliamperes must be supplied for this purpose. There is no extra charge for this instrument.

Range	Scale Div.	Price	Range	Scale Div.	Price
1.5	150	$67.00	50 s	100	$67.00
3	150	67.00	100 s	100	67.00
5 s	100	67.00	150	150	67.00
10 s	100	67.00	300 s	150	68.25
15	150	67.00	500 s	100	71.75
25 s	125	67.00	750	150	74.00

D-C MILLIAMMETERS—MODEL 45

Range	Scale Divisions	Approx. Res. Ohms	Price
1.5	150	360	$61.00
15	150	3.3	60.00
100	100	0.50	60.00
150	150	0.35	60.00
300	150	0.17	60.00
750	150	0.07	62.50

A-C RECTIFIER TYPE VOLTMETER—MODEL 45

(For Flux Measurements)

In the magnetic testing of iron samples, as in the Epstein test, the maximum flux values are represented by the average, rather than the rms values of the induced voltage. Rectifier type instruments inherently indicate average values, although calibrated in terms of the rms values of a sine wave.

For such requirements, Model 45 is available as a three-range voltmeter with ranges of 75/150/300 volts, having a sensitivity of 400 ohms per volt. Well compensated for temperature changes from 15° C. to 35° C. These instruments will read true average values within 1.5% of full scale value.

Price $109.00

MODEL 430 D-C INSTRUMENTS

Accuracy ½ of 1%.....Scale 4.04" (103 mm)

Permanent Magnet Moving Coil Type
Unshielded from External Magnetic Fields

Dimensions { 5 1/16 x 6 1/32 x 3½" / 129 x 153 x 89 mm } .....Approx. Weight { 3½ lbs. / 1.6 kgs.

Model 430 d-c instruments, together with Models 432, 433 and 455, constitute a very popular group of portable test instruments. An unusually large scale opening permits good visibility of the long, hand calibrated scales. They are calibrated by direct comparison with accurate reference standards and are contained in molded bakelite cases provided with a leather carrying strap.

D-C VOLTMETERS—MODEL 430

Regularly made in two sensitivities, 1000 ohms per volt and 5000 ohms per volt.

Range	Scale Div.		1000 Ohms Per Volt	5000 Ohms Per Volt
3	150		$43.00	$53.00
15	150		43.00	53.00
50	100		43.00	53.00
150	150		43.00 s	53.00
300	150		47.00 s	60.00
30/7.5/3	150		53.00	63.00
75/30/7.5	150		53.00 s	63.00
150/15/3	150		53.00 s	63.00
300/150/3	150		57.00 s	70.00
500/100/10	100		63.00	79.50
750/300/150	150		69.00 s	89.00

Leather case for single range voltmeter, $7.50 s; and triple range voltmeters, $8.00 s.

Only the most commonly used ranges are listed—*any* practical range can be supplied.

s *Denotes instrument normally carried in stock.*

Typical scales page 16

D-C AMMETERS—MODEL 430

Self-contained up to 50 amperes inclusive, but can be supplied with external 50 mv shunts and 5 ft. leads. When external shunt instruments are desired, add price of shunt, listed on page 76, to the instrument price of $43.00.

Range	Scale Div.	Price	Range	Scale Div.	Price
1	100	$43.00	10/5/1	100	$53.00
1.5	150	43.00	15/3/0.15	150	53.00
3	150	43.00	15/3/1.5	150	53.00
5	100	43.00	25/2.5/0.5	100	53.00
7.5	150	43.00	25/10/2.5	100	53.00
15	150	43.00	30/15/3	150	53.00
30	150	43.00	50/5/0.5	100	53.00
50	100	43.00	50/10/2	100	53.00
5/0.5/0.05	100	53.00	50/20/5	100	53.00
5/2.5/0.5	100	53.00	50/25/10	100	53.00
10/1/0.1	100	53.00			

D-C MILLIAMMETERS—MODEL 430

Range	Approx. Res. Ohms	Scale Divisions	Price
1	92	100	$44.00
15	1.4	150	43.00
150	.....	150	43.00
3/0.3/0.03	.....	150	70.00
15/1.5/0.15	.....	150	65.00
150/15/1.5	.....	150	54.00
1500/150/15	.....	150	53.00
3000/300/30	.....	150	53.00

Single range milliammeters with ranges above 30 ma. are shunted and have a drop of 50 mv ± 5%.

D-C MICROAMMETERS—MODEL 430

		High Resistance		Low Resistance	
Range	Scale Div.	Approx. Res. Ohms	Price	Res. Ohms	Price
30	150	3300	$60.00	150	$70.00
100	100	1650	55.00	45	65.00
200	100	560	48.25	10	59.25

The Model 430 microammeter high resistance type having high torque, their service life will be greater than the low torque instruments, and they should be used wherever sufficient energy is available for their operation.

The low resistance type is designed to function on the lowest amount of energy consistent with reasonable performance.

Leather case for single range ammeter, milliammeter or microammeter, $7.50 s.

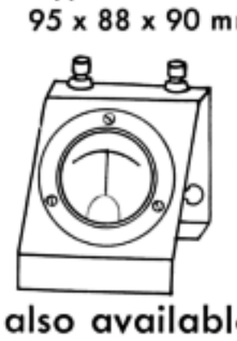
STUDENT GALVANOMETER—MODEL 375

Permanent Magnet Moving Coil Type.....Scale 2.36" (60 mm)

Dimensions:

With Mounting Base
3¾ x 3 15/32 x 3 17/32"
95 x 88 x 90 mm

Without Mounting Base
Case: 3¼" 83 mm Body: 2 9/16" 65 mm



Especially designed for student use in school laboratories, and wherever a d-c galvanometer of extreme sensitivity is not essential, but where great durability and moderate cost are factors. It is usually supplied in the 45° angle base, but it is also available without the base for mounting on apparatus or on panels.

It has a sensitivity of approximately 22 microamperes per division which is the equivalent of one millimeter and a resistance of about 23 ohms. The scale is zero-center, calibrated 30-0-30 in millimeter divisions.

Model 375 with Style A Mounting Base s.....$12.00
Model 375 without Mounting Base s..... 10.00

MODEL 489 D-C INSTRUMENTS

Accuracy 2%.....Scale 2.36" (60 mm)

Permanent Magnet Moving Coil Type

Dimensions { 3 27/32 x 3 5/32 x 1 29/32" / 98 x80 x 48 mm } .....Approx. Weight { 11 ounces / 0.3 kg. }

The Model 489 d-c instrument is the companion to the Model 528 a-c instrument. It is a small, rugged and serviceable instrument for all-around checking purposes where the accuracy of a precision portable is not required. It is enclosed in a black molded bakelite case.

All single and double range instruments have binding posts, while the triple range instruments are equipped with pin jacks to receive standard pin-tipped leads.

D-C VOLTMETERS—MODEL 489

Made in double and triple range combinations having sensitivities of 125 and 1000 ohms per volt. All voltmeters are supplied with 30 inch test leads—pin tipped for triple range instruments.

125 Ohms Per Volt				1000 Ohms Per Volt			
Range		Scale Divisions	Price	Range		Scale Divisions	Price
150/7.5	s	75	$13.50	200/8	s	40	$16.25
200/8	s	40	15.25	250/50	s	50	16.75
				150/7.5/3	s	75	18.25
				300/7.5/3	s	75/60	22.25
				750/250/10	s	75/50	23.50

D-C AMMETERS—MODEL 489

Range	Scale Divisions	Price	Range	Scale Divisions	Price
1 s	50	$13.50	10/1 s	50	$15.50
10 s	50	13.50	15/3 s	75/60	15.50
30 s	60	13.50	30/3 s	60	15.50

D-C MILLIAMMETERS—MODEL 489

Ranges	Approximate Res. Ohms	Scale Divisions	Price
150/15 s	0.7/4.1	75	$13.50
150/30 s	0.7/2.6	60	13.50

Leather case for Model 489, $2.50.

GALVANOMETER—MODEL 699

Permanent Magnet Moving Coil Type.....Scale 2.36" (60 mm)

Dimensions:

With Mounting Base
3¾ x 3½ x 4"
95 x 89 x 90 mm

Without Mounting Base
Case: 3½" 89 mm Body: 2 13/16" 74 mm

Model 699 Galvanometer has a sensitivity of approximately 2 microamperes per division, making it most suitable for many applications where medium sensitivity is desired. It has a resistance of approximately 125 ohms and the scale is calibrated 30-0-30. The external critical resistance is about 450 ohms so that the instrument is suitable for low resistance bridges, as well as applications where the circuit resistance is high.

Model 699 With Mounting Base s.....$23.00
Model 699 Without Mounting Base in 3½" Round Flush Bakelite Case. s..... 21.00

Only the most commonly used ranges are listed—*any* practical range can be supplied.

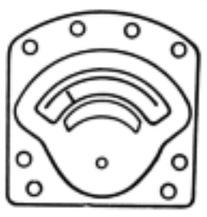
s ***Denotes instrument normally carried in stock.***

Typical scales page 16

DIRECT CURRENT PORTABLES

MINIATURE PRECISION D-C INSTRUMENTS—MODEL 280

Accuracy 1%.....Scale 2.76" (70 mm)
Permanent Magnet Moving Coil Type
Shielded from external magnetic fields
Dimensions { 4⅖ x 4⅗ x 1½" / 112 x 117 x 38 mm }.....Approx. Weight { 1.1 lbs. / 0.5 kg.



Model 280 instruments are widely used in educational institutions and wherever miniature precision portable instruments are required for d-c testing. Scales are hand calibrated and are provided with knife edged pointers and mirrors to eliminate parallax errors. These instruments are truly precision built throughout.

D-C VOLTMETERS—MODEL 280

Resistance of approx. 100 ohms per volt.

Range		Scale Div.	Price	Range		Scale Div.	Price
1.5	s	75	$25.00	25/10/2.5	s	50	$29.00
3	s	60	25.00	30/3/1.5	s	60	29.00
5		50	25.00	30/15/3	s	60	29.00
7.5	s	75	25.00	50/5/2.5	s	50	29.00
10	s	50	25.00	50/25/5		50	29.00
15	s	75	25.00	100/25/2.5		50	29.00
30	s	60	25.00	100/50/5		50	29.00
50	s	50	25.00	150/15/1.5	s	75	29.00
75		75	25.00	150/15/3	s	60	29.00
100		50	25.00	150/30/3	s	60	29.00
150	s	75	25.00	150/60/3	s	60	29.00
400/40		40	40.00	150/75/3	s	75	29.00
†500/50		50	45.00				

All listed voltmeters are self-contained, multipliers for Model 280 Voltmeters, see page 72.

†Push button for low range. Sensitivity 500 ohms per volt.

D-C MILLIVOLTMETERS—MODEL 280

Range		Scale Div.	Price	Range		Scale Div.	Price
50	s	50	$25.00	250		50	$25.00
100	s	50	25.00	500		50	25.00
150		75	25.00	750		75	25.00

D-C AMMETERS—MODEL 280

Range		Scale Div.	Price	Range		Scale Div.	Price
1	s	50	$25.00	10/1/0.1	s	50	$29.00
1.5	s	75	25.00	10/1/0.5		50	29.00
3	s	60	25.00	10/5/0.5	s	50	29.00
5	s	50	25.00	10/2.5/1	s	50	29.00
10	s	50	25.00	15/3/0.15	s	60	29.00
15	s	75	25.00	15/3/1.5	s	60	29.00
30	s	60	25.00	25/2.5/0.5	s	50	29.00
*50	s	50	32.00	25/5/2.5	s	50	29.00
*100	s	50	32.00	25/10/5		50	29.00
*150		75	32.00	30/3/1.5	s	60	29.00
5/2.5/0.25	s	50	29.00	30/15/3	s	60	29.00

*Provided with external shunt having a drop of 50 mv. For ranges higher than those listed, add price of shunt (listed on page 76) to the instrument base price of $25.00.

D-C MILLIAMMETERS—MODEL 280

Range		Approx. Res.	Scale Div.	Price
1.5		27	75	$26.00
5		10.6	50	25.00
10	s	5.4	50	25.00
25		1.2	50	25.00
50	s	2.0	50	25.00
75		1.33	75	25.00
100	s	1.00	50	25.00
150	s	0.66	75	25.00
250		0.4	50	25.00
300		0.33	60	25.00
500	s	0.2	50	25.00
750		0.13	75	25.00
30/15/3	s	.....	60	30.00
50/10/1	s	.....	50	30.00
125/25/5	s	.....	50	29.00
150/15/1.5	s	.....	75	30.00
600/120/30		.....	60	29.00

Milliammeters with ranges above 30 milliamperes are shunted and have a drop of approximately 100 mv.

D-C VOLT-AMMETERS—MODEL 280

Ranges			Scale Divisions	Price
Volts	Amperes			
30/3/1.5	30/3/1.5	s	60	$43.00
30/15/3	15/3/0.15		60	43.00
30/3/1.5	30/3/0.3	s	60	43.00
50/5/2.5	10/1/0.1		50	43.00
50/25/2.5	25/2.5/0.5		50	43.00
*60/30/6	6/0.6/0.03	s	60	43.00
150/15/1.5	15/1.5/0.15	s	75	43.00
150/15/1.5	30/3/1.5		60	43.00
150/15/1.5	30/15/1.5	s	60	43.00
*150/15/3	15/1.5/0.15	s	60	43.00
150/15/3	30/3/1.5		60	43.00
150/15/3	30/15/3	s	60	43.00
150/30/3	30/15/1.5	s	60	43.00
150/30/3	30/0.6/0.06	s	60	43.00
150/60/3	30/0.6/0.06	s	60	43.00
**30/3/.05	300/30/3	s	60	48.25

*This instrument is particularly adapted for railway signal and automatic train control testing.

**Recommended for testing automotive starting, lighting, ignition and battery charging equipment. External shunts and leads supplied for use with 50 mv. instrument range. A leather carrying case for instrument, 3 shunts and leads is priced at $8.50. An external multiplier for 150 volts can be supplied at $6.00.

Leather case for other Model 280 instruments—$3.00 s.

ELECTROLYSIS VOLT-MILLIVOLTMETER—MODEL 56

Accuracy ½ of 1%.....Scale 5.18" (132 mm)
Permanent Magnet Moving Coil Type
Not Shielded from External Magnetic Fields
Dimensions { 13⅜ x 7 5/16 x 4 9/16" / 340 x 186 x 116 mm }.....Approx. Weight { 10½ lbs. / 4.8 kgs.

This instrument consists of a voltmeter and millivoltmeter, each zero-center, mounted in a strongly reinforced dust-proof case. Despite the extreme sensitivities, it is designed to withstand the severe service encountered in electrolysis work around city streets, in manholes, etc.

Two binding posts and a dial switch are provided at each end of the case for the selection of ranges. The voltmeter and millivoltmeter have sensitivities of 1000 and 300 ohms per volt respectively.

Ranges	Scale Divisions		Price
250/50/10/5/1 Volts	100	s	$300.00
5 Volts/100/50/10/5 Millivolts	100		

Only the most commonly used ranges are listed—*any* practical range can be supplied.

s *Denotes instrument normally carried in stock.*

Typical scales page 16

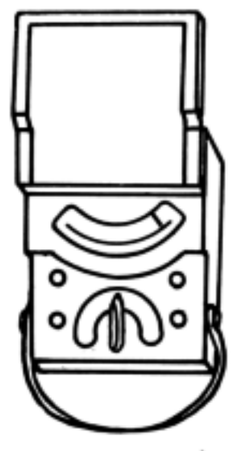
DIRECT CURRENT PORTABLES

D-C FUSED SIX RANGE VOLT-AMMETER—MODEL 540

Accuracy 1%.....Scale 2.7" (68.5 mm)

Permanent Magnet Moving Coil Type

Dimensions { 3 5/16 x 4 7/8 x 2 1/2" / 84 x 124 x 64 mm } .....Approx. Weight { 2 lbs. / 0.9 kg.



All ranges fused for protection from overloads. Voltage ranges (sensitivity 100 ohms per volt) are all protected by a single fuse located in a cap marked "Vm. Fuse" on front of case. Each current range is protected by a separate fuse mounted in a special compartment covered by a hinged back. Compartment also contains spare fuses for each range.

Ranges are brought out through a selector switch to three binding posts; a common +, a current and a potential post. This arrangement facilitates connections so that both current and voltage readings can be taken by turning the switch without changing connections. The line is closed at all times when connected to ammeter binding post, regardless of position of range selector switch. This feature makes it possible to test railway signal devices without opening the relay circuit.

Model 540 is especially useful for railway signal testing, for use in schools and for general industrial work. Supplied in molded bakelite case with hinged cover and leather carrying strap.

Ranges			Scale Divisions	Price
Volts	Amperes			
30/3	15/1.5/0.15/0.03	s	60	$60.00
30/3/1.5	30/3/0.03		60	60.00
30/3/1.5	30/3/0.3	s	60	60.00
60/30/6	6/0.6/0.03	s	60	60.00
150/15/1.5	15/1.5/0.15	s	75	60.00
150/15/3	15/1.5/0.15	s	60	60.00
150/15/3	15/1.5/0.3		60	60.00
150/15/3	30/3/0.3	s	60	60.00
150/15/3	30/15/3	s	60	60.00
150/30/3	30/3/0.3	s	60	60.00
150/30/3	30/0.6/0.06		60	60.00

Extra Fuses:—Weston replacement fuses should be used to give full protection and insure the accuracy of the instrument. All voltage fuses and current fuses up to and including 60 milliamperes may be obtained for $0.50 each. All current fuses from 100 milliamperes up to and including 30 amperes are $0.15 each. Minimum charge on any order, $0.75 NET.

When ordering, it is important that the range of the instrument and the quantity of fuses desired for each range be clearly specified.

Leather case for Model 540.....$4.00 s

GALVANOMETER AND MICROAMMETER—MODEL 440

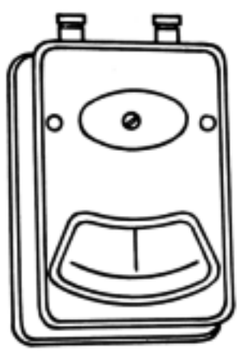
Permanent Magnet Moving Coil Type.....Scale 2.36" (60 mm)

Flush Type

Dimensions { 6 1/4 x 4 1/2 x 2 7/8" / 159 x 114 x 73 mm } .....Approx. Weight { 2 3/4 lbs. / 1.25 kgs.

Surface or Portable

Dimensions { 6 3/4 x 4 1/4 x 2 3/8" / 172 x 108 x 60 mm } .....Approx. Weight { 2 3/4 lbs. / 1.25 kgs.



An exceedingly sensitive, double pivoted, moving coil type instrument. May be used to considerable advantage in place of the suspended coil, reflecting type of galvanometer. Made in two types of case: surface type for use as a portable instrument; and flush type for insertion into equipment such as potentiometers and bridges. Both types have aluminum cases finished in dull black. Regularly supplied surface type; if flush type is desired, please specify on order.

GALVANOMETERS—MODEL 440

May be used for many kinds of service; with a Wheatstone Bridge, a potentiometer, for insulation or high resistance testing, and in vacuum tube work. Portable (surface type) is provided with two contact keys controlled by push buttons. One key closes the galvanometer through a high resistance, thus preventing damage to the movement in the event of a badly unbalanced circuit. Other key connects galvanometer circuit directly to binding posts for maximum sensitivity. Contact keys and protective resistances are omitted in the flush type.

Scale calibrated 30/0/30 in millimeter divisions.

Approx. Microamps. Per Div.	Approx. Res. of Mov. Coil in Ohms	Ext. Critical Resistance in Ohms	Approx. Period in Seconds	Price
*0.25 s	150	1000	2.7	$46.00
*0.5 s	50	150	2.5	40.00
**2.2 s	3.5	10	2.3	40.00

*Carried in stock in both portable and flush types.

**Carried in stock in portable type only.

MICROAMMETERS—MODEL 440

Can be used wherever measurements must be made in low energy circuits, as in thermocouple and Photronic Cell applications.

Range Microamps.	Approx. Res. Ohms	Approx. Ext. Critical Res. Ohms	Scale Divisions	Price
*15 s	100,000	.....	75	$65.00
†15 s	150	1000	75	65.00
30 s	50	150	60	60.00
150 s	3.5	10	75	58.50

Accurate within 1½%.

*Used by radio tube manufacturers in production tube testing for gas content. Instrument is self-protected against shorted tubes.

Ranges marked s are carried in stock in the portable type.

†Carried in stock in both portable and flush types.

Leather case for Model 440, $7.25 s.

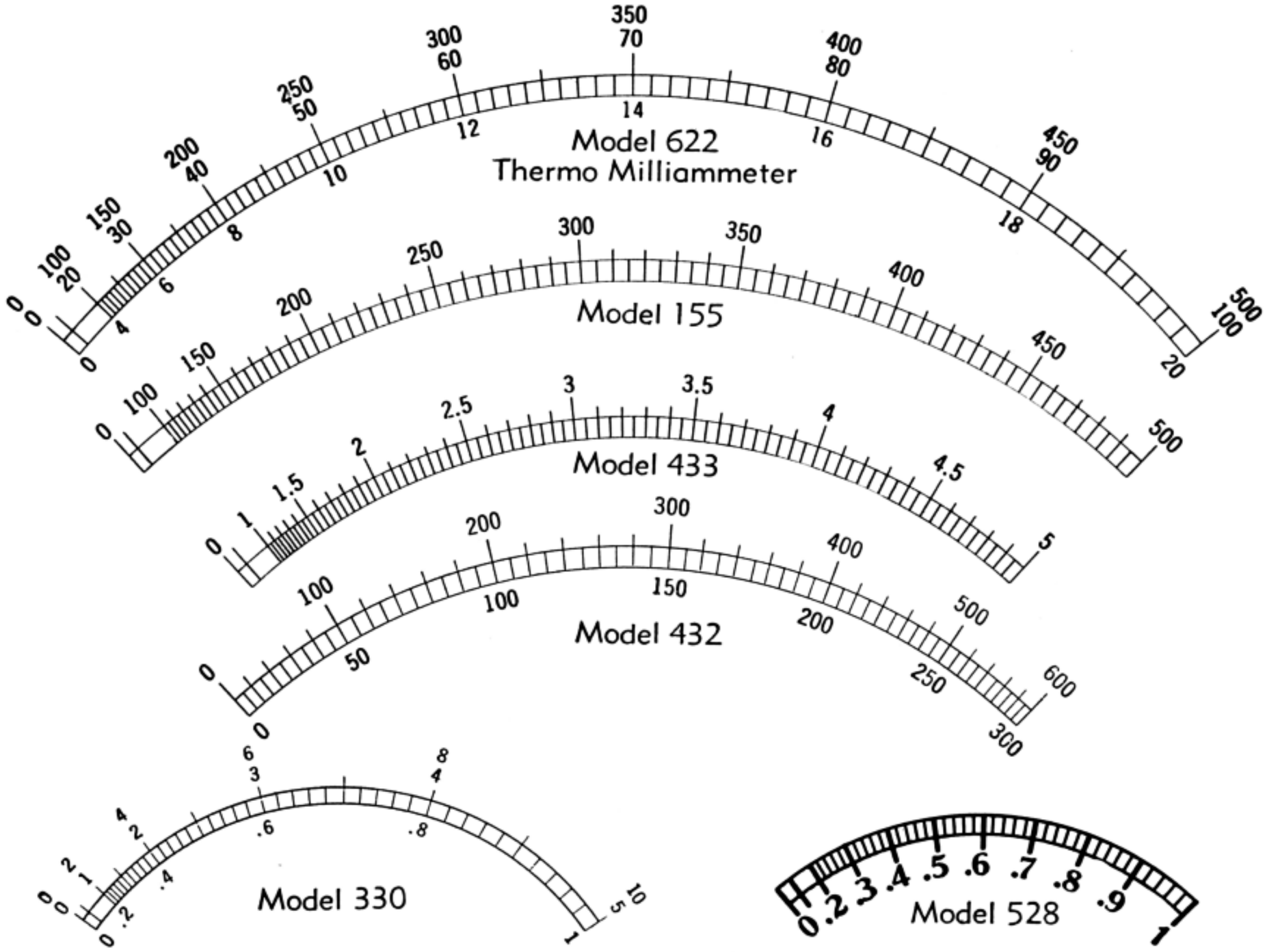
Only the most commonly used ranges are listed—*any* practical range can be supplied.

s *Denotes instrument normally carried in stock.*

Typical scales page 16

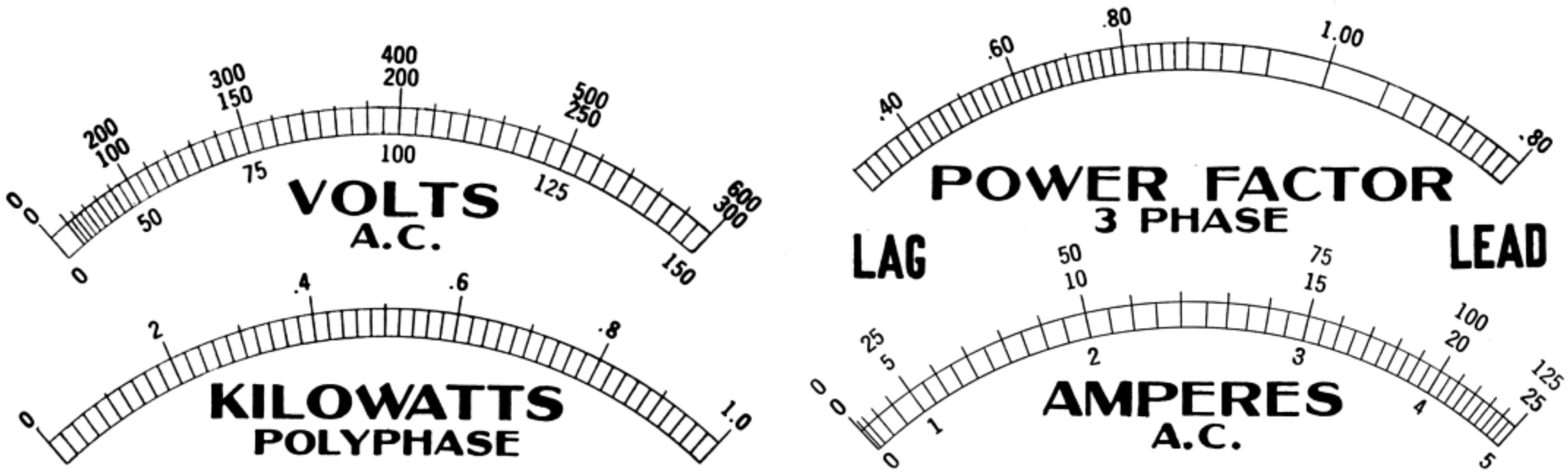
ALTERNATING CURRENT PORTABLES

FULL SIZE TYPICAL SCALES



MODEL 639 TYPE 2 INDUSTRIAL ANALYZER

(Described in Service Instrument Section)



Model 433—Scale 4.04″

Model 528—Scale 2.03″

Model 622—Scale 6.1″

Model 155—Scale 5.18″

Model 330—Scale 2.67″

Model 432—Scale 4.04″

Only the most commonly used ranges are listed — Any practical range can be supplied

Model 639—Scales 3.5″

(Described in Service Instruments Section)

Model 633—Scale 2.36″

(Described in Service Instruments Section)

ALTERNATING CURRENT PORTABLES

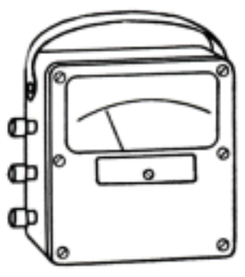
MODEL 433 A-C INSTRUMENTS

Accuracy ¾ of 1%.....Scale 4.04" (103 mm)

Movable Iron Type

Shielded from external magnetic fields

Dimensions { 5 1/16 x 6 1/32 x 3½" / 129 x 153 x 89 mm } .....Approx. Weight { 2½ lbs. / 1.1 kgs. }



Model 433 a-c instruments, together with Models 430, 432, and 455, constitute a very popular group of portable test instruments. An unusually large scale opening permits good visibility of the long, hand calibrated mirror scales. They are calibrated by direct comparison with accurate reference standards. These instruments may be left in circuit continuously without overheating. Contained in molded bakelite cases provided with a leather carrying strap.

A-C VOLTMETERS—MODEL 433

Power Consumption: 150 volt range at 115 volts, 2.5 watts; at 25 or 60 cycles, 2.5 volt-amperes.

Made with single, double and triple ranges. For use on frequencies from 25 to 125 cycles.

Range		Scale Div.	Approx. Res. Ohms	Price
10		100	80	$41.00
15		150	168	41.00
30		150	425	41.00
50		100	1140	41.00
75		150	2680	41.00
125		125	4400	41.00
150	s	150	5300	41.00
250	s	125	18,200	44.00
300	s	150	22,000	45.00
10/5	s	100	40/20	46.00
20/10	s	100	160/80	46.00
30/15	s	150	336/168	46.00
60/30	s	150	850/425	46.00
*150/15	s	150	5300/530	46.00
150/75	s	150	5300/2680	46.00
300/150	s	150	22,000/11,000	50.00
450/300/150	s	150	33,000/22,000/11,000	60.00
600/300/150	s	150	44,000/22,000/11,000	63.00
750/300/150	s	150	55,000/22,000/11,000	68.00

*The low range of this combination has an accuracy of 3%.

Triple range voltmeters have an extension on the case to accommodate the additional resistance necessary.

Voltmeters are available, at a nominal surcharge, compensated to be within the normal accuracy of ¾% for higher frequencies up to 1000 cycles.

For a coverage of 25 to 1000 cycles as many as 3 ranges can be supplied self-contained providing that the ratio of the highest to lowest range is not greater than 4. The lowest practical range is 15 volts, the highest 750 volts. A minimum of approximately 3.3 watts is required to operate single range instruments or the low range of multi-range units.

Coverage up to 2500 cycles, is possible in single range voltmeter only, with an accuracy of within 1¼%. Single ranges from 20 to 750 volts are practical. Approximately 10 watts are required for operation of the instrument. Correspondence is required.

It is not practical to combine all low and high ranges because of variation in current requirements. Correspondence is necessary for requirements other than listed above.

Instruments listed are all self-contained. Higher ranges are obtained by use of multipliers listed on page 72, or by using Model 311 Potential Transformer (page 71) in connection with a 150 volt range.

Leather case for single or double range, $7.50 s; for triple range, $8.00 s.

A-C AMMETERS—MODEL 433

Power Consumption: 5 ampere range at 5 amperes, 0.49 watt at 25 cycles, 0.5 volt-ampere and at 60 cycles, 0.51 volt-ampere.

Made in single, double and triple ranges, for use on frequencies of 25 to 500 cycles. All instruments have two binding posts, double and triple range instruments are provided with range selector switch.

Single and double range instruments can, subject to a nominal surcharge be adjusted to cover a frequency span, from 25 to 1000 cycles, at the normal ¾% accuracy.

These instruments can also be specially compensated to cover a frequency span of 25 to 2500 cycles, within the guaranteed ¾% accuracy, at a higher surcharge. Correspondence regarding this special instrument is necessary.

Range		Scale Div.	Approx. Res. Ohms	Inductance Henries	Price
1	s	100	0.48	0.00035	$39.00
1.5		150	0.20	0.000155	39.00
2		100	0.119	0.000085	39.00
3		150	0.053	0.000030	39.00
5	s	100	0.0197	0.0000135	39.00
10	s	100	0.007	0.0000029	39.00
15	s	150	0.0038	0.0000014	43.00
25	s	125	0.00155	0.00000062	43.00
30	s	150	0.00063	0.00000039	43.00
50	s	100	0.00038	0.00000013	45.00
2/1	s	100	0.12/0.48	.....	52.00
5/2.5	s	100	0.02/0.08	.....	52.00
10/5	s	100	0.0083/0.028	.....	52.00
20/10	s	100	0.004/0.0108	.....	56.00
3/1.5/0.75	s	150	.....	.....	88.00
5/2.5/1		100	.....	.....	88.00
10/5/1	s	100	.....	.....	88.00
10/5/2.5		100	.....	.....	88.00
15/7.5/1.5	s	150	.....	.....	88.00
20/5/2	s	100	.....	.....	88.00
30/7.5/3		150	.....	.....	88.00
50/20/5	s	100	.....	.....	88.00
50/20/10		100	.....	.....	88.00

Current transformers listed on page 70 can be used for extending these ranges; Model 461 in conjunction with a 5 ampere instrument, and Model 539 with a 1 ampere instrument.

A-C MILLIAMMETERS—MODEL 433

Made in single and double ranges only, for use on frequencies from 25 to 500 cycles. Double range instruments have range selector switch.

Subject to a nominal surcharge, these instruments can be adjusted to cover a frequency span of from 25 to 1000 cycles at the normal ¾% accuracy.

At a higher surcharge adjustment can be made to cover a frequency span of from 25 to 2500 cycles, within guaranteed ¾% accuracy. Correspondence regarding this special instrument is necessary.

Range		Scale Div.	Approx. Res. Ohms	Price
15		150	1850	$39.00
30	s	150	460	39.00
75		150	78	39.00
100	s	100	49	39.00
150	s	150	13	39.00
200		100	8.75	39.00
250		125	6.0	39.00
300		150	3.85	39.00
400		80	2.5	39.00
500	s	100	2.0	39.00
600		120	1.13	39.00
750		150	0.75	39.00
100/50		100	50/200	57.00
150/75		150	20/80	57.00
300/150		150	4/16	57.00
500/250		100	1.1/4.4	57.00

Leather case for ammeters or milliammeters.....$7.50 s

Only the most commonly used ranges are listed—*any* practical range can be supplied.

s *Denotes instrument normally carried in stock.*

Typical scales page 24

ALTERNATING CURRENT PORTABLES

A-C RECTIFIER TYPE MILLIVOLTMETER—MODEL 430

Model 430 a-c rectifier type millivoltmeter is basically a sensitive d-c instrument adapted for use on alternating current by the addition of a self-contained rectifier and transformer. Its accuracy is approximately 4% when used on 60 cycle sinusoidal wave forms. It is regularly supplied with ranges of 250/25 millivolts. Price, complete with 5 ft. leads, $130.00. For additional data on Weston rectifier type instruments, see page 65.

INRUSH OR CODED CURRENT AMMETERS—MODEL 433

The ammeters and milliammeters listed on page 26 may be provided with a special attachment for pointer adjustment which facilitates accurate readings of starting currents of motors, coded currents in railway signal circuits or other similar loads of short duration. For this special feature add $5.00 to the prices shown.

D-C AND SINGLE PHASE A-C WATTMETERS—MODEL 432

Accuracy ½ of 1%.....Scale 4.04" (103 mm)
Electrodynamometer Type
Shielded from external magnetic fields
Dimensions { 6 12/32 x 5¼ x 3½" / 168 x 133 x 89 mm }.....Approx. Weight { 3¼ lbs. / 1.5 kgs.

Power Consumption: Potential circuit at 115 volts, 1.2 watts; at 25 or 60 cycles, 1.2 volt-amperes. Current circuit at 5 amperes, 0.67 watt; at 25 cycles, 0.73 volt-ampere and at 60 cycles, 0.98 volt-ampere.

Model 432 wattmeter is another popular unit in the well-known group of portable test instruments which includes Weston Models 430, 433 and 455. An unusually large scale opening permits good visibility of the long, hand calibrated mirror scale. It is calibrated by direct comparison with accurate reference standards and is contained in a molded bakelite case provided with a leather carrying strap.

For use on direct or alternating current at frequencies from 25 to 125 cycles. The phase angle is negligible on such frequencies. The temperature error is less than 1% for 25° C. change in temperature. As the working error is negligible, they may be left in circuit continuously without appreciable effect upon the accuracy.

Model 432 is made with double voltage and single or double current ranges, self-contained up to 300 volts and 50 amperes. Potential ranges up to 750 volts are obtained by using external multipliers, listed on page 72. Higher ranges require the use of potential transformers such as the Model 311 shown on page 71. Current ranges may be extended beyond 50 amperes by using a 5 ampere instrument in conjunction with the Model 461 Current Transformer, listed on page 70.

Current ranges have an overload capacity of 50%, and potential ranges an overload capacity of 33%.

Watt ranges listed are based on the product of normal volts and normal amperes. Low power factor instruments having watt ranges based on 20% of the product of maximum volts and maximum amperes are also available on special order.

All Model 432 Wattmeters can be especially compensated to cover a frequency span up to 1000 cycles. A surcharge will be required. Correspondence is essential.

Normal Volts	Normal Amps.	Watts Low Range	Watts High Range	Scale Div.	Price
75/150	1 s	75	150	75	$70.00
	2 s	150	300	75	70.00
	5 s	375	750	75	70.00
	10 s	0.75 KW	1.5 KW	75	70.00
	20	1.5 KW	3.0 KW	75	73.00
	50	3.75 KW	7.5 KW	75	76.00
150/300	1 s	150	300	75	74.00
	2 s	300	600	60	74.00
	5 s	0.75 KW	1.5 KW	75	74.00
	10 s	1.5 KW	3.0 KW	75	74.00
	20 s	3.0 KW	6.0 KW	60	77.00
	50	7.5 KW	15.0 KW	75	80.00
Double Current Ranges					
150/75	10/5	375	1500	75	90.00
150/75	5/2.5	200	800	80	90.00
300/150	10/5	750	3000	75	94.00
300/150	5/2.5	375	1500	75	94.00

Leather case for Model 432, $7.50 s.

Y-BOXES FOR MODEL 432 WATTMETERS

For Use on Balanced 3 Phase, 3 Wire Circuits

Power in balanced 3 phase, 3 wire systems can be measured with a single-phase wattmeter used in conjunction with a Y-Box. The Y-Box is essestially a center tapped resistor through which the meter is connected to the 3 phase line.

To use a Y-Box, the load must be balanced in both phase angle and magnitude and the potential range of the wattmeter should not be lower than the voltage of line to neutral.

Normal Voltage of Instrument	Y-Box Multiplying Constant	Normal Line Voltage With Y-Box	Maximum Voltage With Y-Box	Box Type	Box No.	Price
75	3	150	170	5	1	$24.00
150	3	300	340	5	2	24.00
150	4	400	450	5	2	24.00
150	5	500	550	5	3	24.00
150	6	600	650	5	3	24.00

All orders for 'Y' boxes must give the instrument potential range with which the box will be used and the line voltage of the 3 phase system to be measured.

All orders for 'Y' boxes to be used with meters already in possession of the purchaser must give the serial number of the instrument, since the box is for use with a specific instrument only.

A-C & D-C VOLTMETER—MODEL 455

Accurate within ½ of 1%.....Scale 4.04" (103 mm)
Electrodynamometer Type

Exactly similar in size and appearance to the Model 433 voltmeters described on the preceding page. These instruments are equally accurate on d-c and a-c, and are preferable to the iron vane instruments where both types of power are involved. Model 455 voltmeters are available in most of the ranges listed for the Model 433. The resistance of these ranges however, may not correspond with those of the Model 433.

For equivalent ranges the price of Model 455 is $30.00 higher than Model 433. Model 455 voltmeters can be used on d-c and a-c of frequencies from 25 to 125 cycles. For higher frequencies correspondence is requested.

Model 455 Voltmeters are available, at a surcharge, compensated to be within the normal accuracy of ½% for higher frequencies up to 2500 cycles.

For a coverage of d-c and a-c frequencies of 25 to 1000 cycles, single and double range instruments can be provided. Double range voltmeter ranges must have a ratio not greater than 2 to 1. Range coverage from 10 to 750 volts is practical. A minimum of approximately 3.5 watts is required to operate a single range instrument or the low range of a double range unit.

Coverage up to 2500 cycles is possible in single range instruments only within the normal ½% guarantee by special compensation. Ranges from 20 to 750 volts are practical. A minimum of approximately 8 watts is required for the instrument operation. A surcharge is necessary. Correspondence is required.

Only the most commonly used ranges are listed—*any* practical range can be supplied.

s ***Denotes instrument normally carried in stock.***

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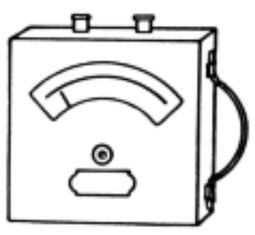
ALTERNATING CURRENT PORTABLES

MODEL 155 A-C INSTRUMENTS

Accuracy ½ of 1%.....Scale 5.18" (132 mm)

Movable Iron Type

Dimensions	To 300 Volt Range	Approx. Wgt.
7 x 7⅛ x 3¼"		4 lbs.
178 x 181 x 83 mm		1.8 kgs.
	Above 300 Volt Range	
7¾ x 8¾ x 4"		5 lbs.
197 x 222 x 102 mm		2.3 kgs.



Model 155 instruments are extensively used for general laboratory testing as well as field work. Hand calibrated mirror scales facilitate accurate reading. They are contained in dust-proof polished black walnut cases without covers and are provided with a convenient leather carrying handle.

A-C VOLTMETERS—MODEL 155

Power Consumption: 150 volt range at 115 volts, 6.5 watts; at 25 or 60 cycles, 6.5 volt-amperes.

For use on frequencies from 25 to 125 cycles. Correspondence invited regarding requirements for special instruments for use on frequencies up to 1,000 or 2500 cycle service. Because of the variation in the current required for the various voltage ranges, it is impractical to combine all low and high ranges. Therefore the multi-range combinations listed should be adhered to when making selections.

All voltmeters listed below are provided with a non-locking contact key to insure against overheating. They are not recommended for continuous service.

Single Range

Range		Approx. Res. Ohms	Scale Divisions	Price
30		150	150	$58.00
50		415	100	58.00
125		2075	125	58.00
150	s	2500	150	58.00
250		4150	125	61.00
300	s	5000	150	62.00
500		8333	100	67.00
600	s	10,000	120	70.00
Double Range				
150/75	s	1250/625	150	63.00
300/150	s	5000/2500	150	67.00
600/150		10000/2500	150	75.00
600/300	s	10000/5000	150	75.00
750/150		12500/2500	150	79.00
Triple Range				
600/300/150	s	10000/5000/2500	150	80.00
750/300/150	s	12500/5000/2500	150	84.00

Voltmeters are self-contained up to and including 750 volts. Higher ranges may be obtained by using Model 311 Potential Transformer listed on page 71 in conjunction with a 150 volt instrument, or external resistors shown on page 72.

Correspondence is invited relative to voltmeters for use at higher frequencies. Please indicate the normal frequency and the maximum probable deviation. At higher frequencies the power dissipation of the instrument is a function of the frequency span to be covered, often necessitating external resistance units. Instruments can more readily be made for single frequency use.

Leather cases for voltmeters up to 300 volts, single, double or triple ranges, $11.00 s. Above 300 volts, single, double or triple ranges, $14.00 s.

A-C VOLTMETERS—MODEL 155

Six Range

For use on 60 cycles

Seven binding post instrument equipped with a transformer—al self-contained, size 7¾ x 8¾ x 4 inches (197 x 222 x 102 millimeters). Approximate weight, 5 pounds (2.3 kilograms). The transformer is used to reduce the current required for operation. Current consumption on 3 and 15 ranges, 0.3 ampere; on 75 range, 0.2 ampere; 150 range, 0.1 ampere; 300 range, 0.05 ampere and on 750 range, 0.02 ampere at 60 cycles.

750/300/150/75/15/3 Volts, scale figured 750/300/150—150 divisions. Price $140.00 s.

A-C AMMETERS—MODEL 155

Power Consumption: 5 ampere range at 5 amperes, 1.1 watts. At 25 cycles, 1.1 volt-amperes and at 60 cycles, 1.4 volt-amperes.

For use on frequencies from 25 to 500 cycles. Self-contained up to and including 500 amperes.

Single Range

Range		Approx. Res. Ohms	Inductance Henries	Scale Div.	Price
1	s	1.15	0.00244	100	$56.00
2		0.287	0.00057	100	56.00
3		0.128	0.00027	150	56.00
5	s	0.0435	0.000091	100	56.00
10	s	0.0127	0.000023	100	56.00
15		0.0066	0.000011	150	60.00
25	s	0.0032	0.0000033	125	60.00
50	s	0.00117	.....	100	62.00
75		0.00085	.....	150	62.00
100	s	0.00047	.....	100	65.00
150	s	0.00034	.....	150	68.00
200		0.00034	.....	100	71.00
300		0.000172	.....	150	77.00
500		0.000054	.....	100	85.00

Double Range

Range		Approx. Res. Ohms	Scale Divisions	Price
1/.5	s	1.15/4.6	100	$71.00
2/1	s	0.34/1.36	100	71.00
5/2.5	s	0.052/0.218	100	71.00
10/5	s	0.012/0.045	100	71.00

Higher ranges are obtained by using Model 461 Current Transformer listed on page 70 in conjunction with a 5 ampere instrument.

Leather cases for Ammeters up to and including 300 amperes, $11.00 s; above 300 amperes, $12.00 s.

A-C MILLIAMMETERS—MODEL 155

Range		Approx. Res. Ohms	Inductance Henries	Scale Div.	Price
50		433	0.61	100	$56.00
75		123	0.28	150	56.00
150		33	0.067	150	56.00
250		12	0.022	125	56.00
500	s	2.25	0.006	100	56.00
750		1.10	0.002	150	56.00
150/75		31/125	.....	150	74.00
300/150		6.5/25	.....	150	74.00

Leather cases for milliammeters, all listed ranges $11.00 s.

Only the most commonly used ranges are listed—*any* practical range can be supplied.

s *Denotes instrument normally carried in stock.*

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ALTERNATING CURRENT PORTABLES

MODEL 528 A-C INSTRUMENTS

Accuracy 2%.....Scale 2.03" (52 mm)

Movable Iron Type

Dimensions { $3\frac{27}{32}$ x $3\frac{5}{32}$ x 2⅛" / 98 x 80 x 54 mm } .....Approx. Weight { 11 ounces / 0.3 kg.

The Model 528 a-c instrument is the companion to the Model 489 d-c instrument. It is contained in a black bakelite case. Due to their small size, ready portability and dependable performance, they are very desirable for checking small electrical products during manufacture and for servicing them in the field —for use in research and educational laboratories— and for general testing purposes.

All single and double range instruments have binding posts for connections, while the triple range voltmeters are equipped with pin jacks.

A-C VOLTMETERS—MODEL 528

For use on all commercial frequencies. Made in double and triple range combinations, having exceptionally high internal resistance with correspondingly low current consumption. Self-contained for all listed ranges. All voltmeters are supplied with 30 inch test leads —pin tipped for triple range instruments. Correspondence invited regarding requirements for special instruments for use on frequencies up to 1,000 or 2500 cycle service.

For use on frequencies from 25 to 125 cycles

Range		Approximate Res. Ohms	Scale Divisions	Price
150/15	s	7,350/735	30	$13.50
300/150	s	31,600/15,800	30	18.75
600/150	s	100,000/25,000	30	23.25
600/300	s	100,000/50,000	30	23.25
150/15/3	s	8,700/150/30	30/30	16.50
150/8/4		10,000/80/40	30/40	16.50
300/8/4	s	43,000/80/40	30/40	21.75

AC-AMMETERS—MODEL 528

For use on frequencies from 25 to 500 cycles

1	s	0.204	50	$13.50
3	s	0.0249	30	13.50
5	s	0.0108	50	13.50
10	s	0.0067	50	13.50
15	s	0.003	30	13.50
30	s	0.0016	30	15.50
50	s	0.0014	50	15.50
15/3	s	.....	30	21.00
15/5		.....	30/50	21.00
30/3	s	.....	30	23.00
30/5	s	.....	30/50	23.00

Higher ranges are obtained by using Model 539 Current Transformer (Page 71) in conjunction with a 1 ampere instrument.

A-C MILLIAMMETERS—MODEL 528

For use on frequencies from 25 to 500 cycles

15	s	2000	30	$13.50
50	s	175	50	13.50
100	s	28	50	13.50
500	s	1.1	50	13.50

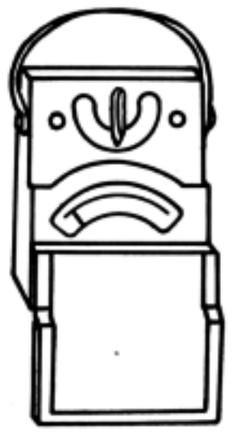
Leather Case for Model 528 instruments, $2.50 s.

A-C VOLTMETER—MODEL 330

Accuracy { 1% at 60 Cycles / 2% at 25 to 100 Cycles } .....Scale 2.67" (69 mm)

Iron Core Dynamometer Type

Dimensions { $3\frac{15}{16}$ x 4⅞ x $1\frac{13}{16}$" / 100 x 124 x 49 mm } .....Approx. Weight { 1¾ lbs. / 0.8 kg.



All ranges of this compact, multi-range a-c voltmeter are fused for protection against overloads. A range changing switch is incorporated for selecting ranges. To eliminate parallax errors a knife edged pointer and mirror scale are used. It is contained in a mottled red and black molded bakelite case with a hinged cover and leather carrying handle.

In this type of a-c voltmeter, low ranges combined with an unusually high sensitivity are possible. It is recommended for use wherever the current drain of the instrument must be limited to a low value, as in testing a-c railway signal circuits, etc. Although the high sensitivities of the copper oxide type of voltmeter are not possible with this instrument, nevertheless its accuracy is unaffected by wave form and variations in frequency over relatively wide limits.

Range		Sensitivity Ohms per Volt	Scale Divisions	Price
125/25/12.5	s	20	50	$60.00
250/25/5	s	42	50	75.00
*125/25/5/1	s	20	50	60.00
150/30/15/1.5	s	20	75	60.00
150/50/10/1	s	20	50	60.00

*Conforms with A.R.A. specifications.

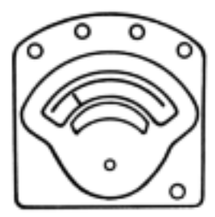
Leather case for Model 330, $4.00.

A-C SELECTIVE AMMETER—MODEL 330

Accuracy { 1% at 60 Cycles / 2% at 50 to 100 Cycles } .....Scale 2.67" (69 mm)

Iron Core Dynamometer Type

Dimensions { $4\frac{13}{32}$ x $4\frac{19}{32}$ x 3" / 112 x 117 x 76 mm } .....Approx. Weight { 2½ lbs. / 1.1 kgs.



Especially designed for measuring a-c current only in circuits where direct current is also present, as in train control track circuits or where an a-c ammeter of unusually low impedance is required. Its indications are not appreciably affected by the presence of a d-c component of 3 or 5 times the full scale value of any range.

This instrument has a transformer housed in the base, connected between the ammeter and the line to prevent the d-c component from entering the movement. It is similar in appearance to the well-known Model 280 d-c instrument, except for the increased depth necessary to accommodate the self-contained transformer.

Range	D-C Res. Ohms	Effective Res. Ohms on 100 Cycles	Impedance Ohms on 100 Cycles	Scale Divisions	Price
1	0.031	0.060	0.070	50	$125.00 s
2	0.015	0.021	0.024		
5	0.0062	0.0072	0.0076		
10	0.0042	0.0044	0.0046		

Leather case for Model 330, $4.00.

Only the most commonly used ranges are listed—*any* practical range can be supplied.

s *Denotes instrument normally carried in stock.*

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ALTERNATING CURRENT PORTABLES

THERMO INSTRUMENTS—MODEL 622

Accurate within ½ of 1% on a-c of frequencies stated and within 1% on d-c at 25° C.; within 1.5% on a-c of frequency stated and 2% on d-c from 20° C. to 30° C. Scale length: 6.1" (155 mm).

Thermocouple Type

Dimensions { 8¾ x 7¾ x 4 1/16" / 222 x 197 x 103 mm } ..... Approx. Weight { 8½ lbs. / 4 kgs.

Model 622 thermo instruments are basically the ultra-sensitive d-c instruments described on page 19; with the addition of a replaceable, precalibrated, thermo element. Thermal instruments, because of their limited overload capacity, are subject to the hazards of laboratory experimentation and occasionally burn out. This ordinarily necessitates the return of the instrument to the factory for thermo couple replacement and recalibration. With the Model 622, it is not necessary to return the instrument for replacement of the thermo couple and recalibration, as a new precalibrated thermo element can be obtained. If additional spares are available the instrument can be kept continually in service.

Thermo milliammeters and voltmeters are supplied with a single plug-in, precalibrated, replaceable thermo element. As originally shipped, the instrument scale is direct reading, having been drawn exactly for the original plug-in element. Replacement elements are supplied with a correction chart so that the guaranteed accuracy of ½ of 1% can be maintained with the original instruments scale calibration. A correction chart is necessary, as a maximum deviation of 3 per cent in the thermo couple characteristics is possible between the original instrument scale calibration and the replacement, or spare thermo element. The chart shows the necessary correction to be applied to the instrument indications to maintain the initial instrument guarantee.

Thermo milliammeters are made in two types; single or multiple range, where an individual plug-in element of the desired range can be plugged into the socket; and the shunted type, where the ranges are selected by means of a range changing switch. The single range type is accurate on d-c and a-c of any frequency up to 2000 KC. For frequencies greater than 2000 KC, a high frequency adapter* is recommended. The multiple range shunted type is accurate on d-c and a-c of any frequency up to 15 KC.

Thermo ammeters are of the external precalibrated thermo element type, and like the single range milliammeters, the scales are directly calibrated to the original thermo element.

Multiple range milliammeters and ammeters made up of separate precalibrated thermo elements (external or plug-in) will have an average scale, and a correction chart will be supplied with each thermo element.

Special Model 622 plug-in type thermo instruments can be supplied with a wide selection of voltage and current combinations. Correspondence is invited.

*To reduce the capacitive effect between the internal connecting wires and the wires to the shield, for frequency measurements greater than 2000 KC, a high frequency adapter is recommended. The high frequency adapter is a combined plug and socket, arranged so that the plug-in thermo element plugs into the socket of the adapter and the adapter plugs into the instrument socket. Connections are brought directly to the small binding posts on the adapter, thereby making the connection short and direct. List Price $25.00.

THERMO AMMETERS—MODEL 622

Thermo ammeters are of the external precalibrated thermo element type. They are provided with one thermo element of range desired and five foot shielded leads for connecting to the instrument. These ammeters are accurate on d-c and a-c for ranges up to 20 amperes; ranges higher than 20 amperes are for a-c only. Frequency errors are less than 1% up to 50 megacycles, see page 64 for details.

Multiple ranges are made available by obtaining thermo elements of the desired range, maintaining the frequency coverage. External precalibrated thermo elements are available of any range listed on page 64.

Range	Scale Div.	Price
3	150	$134.50
5	100	134.50
10	100	134.50
25	125	137.00

THERMO MILLIAMMETERS—MODEL 622

Single range milliammeters are provided with a single plug-in thermo element of range desired. These milliammeters are accurate on d-c and a-c of any frequency up to 2000 kilocycles. For frequencies greater than 2000 KC a high frequency adapter* is recommended. Multiple ranges are made available by obtaining additional plug-in thermo elements of the desired range, without sacrificing frequency coverage. Plug-in thermo elements are available with ranges from 1.5 to 500 ma. inclusive, and are listed on page 64.

Single Range

Range	Scale Div.	Approx. MV. Drop	Price
1.5 Ma.	150	2050	$160.00
2 Ma.	100	1650	160.00
7.5	150	310	160.00
10	100	265	160.00
50	100	195	160.00

Quadruple Range

Multiple range milliammeters of the shunted type, have 2 binding posts, a range changing switch, and are equipped with a plug-in thermo element. They are accurate on d-c and a-c of any frequency up to 15 kilocycles.

Range MA.	Scale Div.	Approx. Res. Ohms	Price
100/50/10/5	100	19.8/37/120/80	$180.00
200/100/20/10	100	3.3/6.5/26.8/40	180.00
500/100/20/5	100	4/19.3/80/80	180.00

THERMO VOLTMETERS—MODEL 622

Thermo voltmeters can be made self contained with single and multiple ranges from 0.3 to 500 volts. They are accurate on d-c and a-c of any frequency up to 5000 cycles. On special order, voltmeters for use on frequencies up to 15 kilocycles can be obtained. Correspondence is invited.

Single range voltmeters have two binding posts and a single plug-in thermo element. Multiple range voltmeters have two binding posts, range changing switch and a single plug-in thermo element.

Range	Scale Div.	Sensitivity in Ohms per Volt	Price
10	100	100	$160.00
10	100	500	185.00
20/5/2/0.5	100	50	185.00
50/10/5/1	100	100	185.00
100/20/10/2	100	100	185.00
100/50/10/5	100	500	210.00

Only the most commonly used ranges are listed—any practical range can be supplied.

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