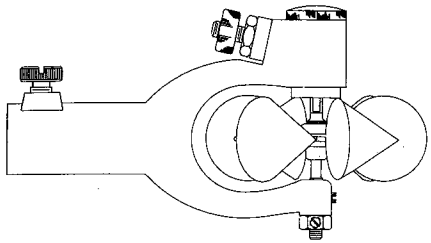
MODELS
1205 & 1206
PRICE TYPE "MINI" CURRENT METERS

INSTRUCTION AND
CARE MANUAL



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Part No. 1205-66 & 1206

MODELS 1205 & 1206 "MINI" CURRENT METERS

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INTRODUCTION

GENERAL

The Scientific Instruments Model 1205 Price-type "Mini" Current Meter (sometimes referred to as "Pygmy"), in combination with other equipment, is used for measuring flow velocity in bodies of water such as rivers, lakes and streams. The meter is capable of measuring velocity from .25 to 3 feet per second (.075 to .914 meters per second).

Price-type meters have been in use in the U.S. since the early part of the 20th century. Due to their relatively low cost, ease of use, accuracy in the presence of sediment-laden water, reliability and serviceability, they continue to be an industry standard.

THEORY OF OPERATION

Price-type current meters (also referred to in this manual as instruments or meters) operate essentially the same way regardless of size, method of measurement, suspension means or data collection methods. A precisely balanced "Bucket Wheel" is mounted on a vertical pivot and is turned by flowing water. Water velocity is determined by counting the number of revolutions of the "Bucket Wheel" over a given period of time. A "Cat Whisker Switch" produces a signal that is either manually counted or recorded by a counting instrument. This value, or count, is then compared on a cross-reference chart, or rating chart, to yield water flow velocity.

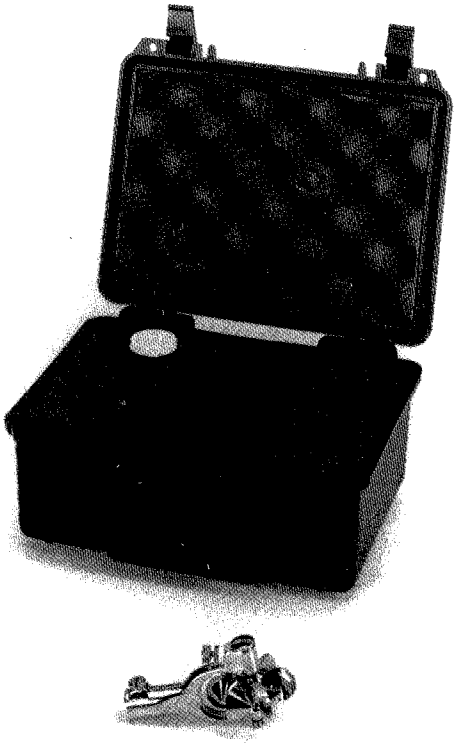
SPECIFICATIONS

MODEL 1205

FLOW VELOCITY - feet per second (meters per second)
— Minimum .25 fps (.075 mps)
— Maximum 3 fps (.914 mps)

WEIGHT - pounds (kilograms) .25 lb (.11 kg)

SUSPENSION MEANS Wading Rod



1. Current Meter with Shipping Plug Installed
2. Parts Container - With:
   - Pivot Assembly
   - Binding Post Assembly
   - Pivot Set Screw
   - Screwdriver
3. Rating Charts (Not Shown)
4. Operator Manual (Not Shown)
5. Instrument Oil (1/4 oz.)
6. Carrying Case
7. Pivot Assembly (Not Shown)

Figure 1. Model 1205 Mini Current Meter

USING THE CURRENT METER

PREPARING THE CURRENT METER

Inspect the Current Meter to ensure that it is in good operating condition. Refer to Figure 2 and check the following:

- Loosen the Pivot Set Screw and remove the shipping plug. Install the Pivot Assembly. Refer to page 12 for adjustments.
- Check that the "Bucket Wheel" is free of defects and spins freely.
- Remove the Contact Chamber Cap and inspect the Cat Whisker.*
- Perform a spin test. (See MAINTENANCE AND SERVICING section.)

*Not necessary on Model 1206

CAUTION

Do not turn the "Bucket Wheel" in the wrong direction as this can damage the contact wires and cause inaccurate readings. The correct direction of rotation is counterclockwise as viewed from above. See Figure 3.

The Current Meter is now ready for mounting on a wading rod. Please see instructions furnished with the wading rod.

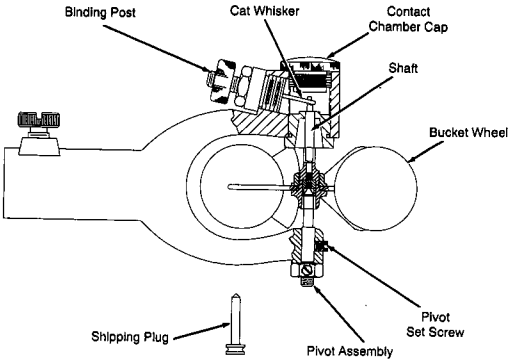


Figure 2. Preparing Model 1205 Meter for Use

COLLECTING DATA

1. Lower the Current Meter into the water. Position it for the method to be used (see TOTAL DISCHARGE CALCULATION METHODS).

2. Ensure that the Meter is positioned to the "Bucket Wheel" is facing into the current or into the direction of water flow. See Figure 3.

3. Collect and record data. Listen for the pulses from the Meter through the headset and, using a stopwatch, count the pulses over a period of 40 to 70 seconds. This data is then used to determine the water velocity using the rating chart.

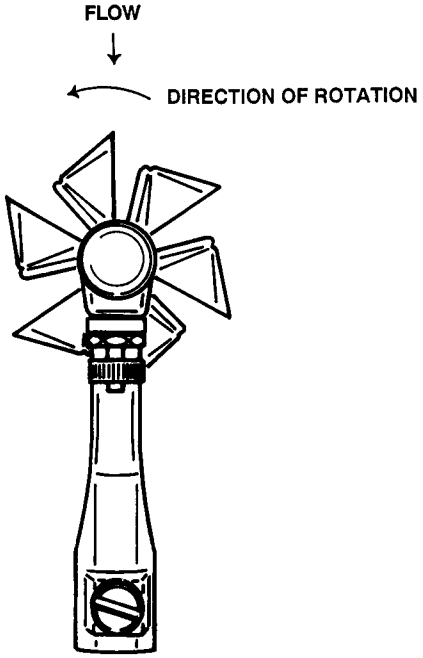


Figure 3. Positioning Meter

TOTAL DISCHARGE VOLUME

THEORY

The data collected with the Current Meter is used to determine the total discharge volume of a stream or a river.

Total discharge is the sum of the products of the partial areas (vertical cross-sections) and their respective average velocities. As such, total discharge of a river can be expressed by the following formula:

Total Discharge Formula

$$Q = \Sigma(a\,v)$$

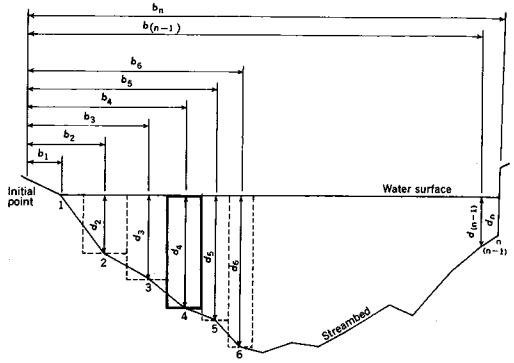
Q = total discharge

a = individual partial cross-sectional area

v = corresponding mean velocity of the flow normal to the partial area

Velocity measurements can be taken at many points in the cross-section of a river or stream and totaled to equal the total discharge. Each measured point represents a vertical cross-section. The flow of water in any vertical cross-section can be described as a point on a non-linear curve. That is, the water moves fastest at the surface and slowest at the bottom.

It can be assumed that the velocity sample at each point represents the mean velocity in a partial rectangular area. This rectangular area extends laterally halfway the distance from the preceding sample location and halfway the distance to the next sample location. It extends vertically from the water surface to the bottom. The cross-section is defined by depths at locations 1,2,3, ...n. Refer to Figure 4.



EXPLANATION

1, 2, 3, ...n	Observation points
b_1, b_2, b_3, ...b_n	Distance, in feet, from the initial point to the observation point
d_1, d_2, d_3, ...d_n	Depth of water, in feet, at the observation point
Dashed lines	Boundary of partial sections; one heavily outlined discussed in text

Figure 4. Cross-Sectional Area of a River or Stream

The velocities are sampled at each point to obtain the mean of the velocity distribution. To compute the partial discharge for any partial section at any given location, use the following formula:

Partial Discharge Formula

$$q_x = v_x\left[\frac{(b_x - b_{(x-1)})}{2} + \frac{(b_{(x+1)} - b_x)}{2}\right] d_x$$

$$= v_x\left[\frac{b_{(x+1)} - b_{(x-1)}}{2}\right] d_x$$

where

q_x = discharge through partial section x,

v_x = mean velocity at location x,

b_x = distance from initial point to location x,

$b_{(x-1)}$ = distance from initial point to preceding location,

$b_{(x+1)}$ = distance from initial point to next location,

d_x = depth of water at location x.

Using the example shown in Figure 4, the discharge through the partial section 4 would be expressed as follows:

Partial Section 4 Discharge

$$q_4 = v_4\left[\frac{b_5 - b_3}{2}\right] d_4$$

The procedure is similar when X is at an end section. The preceding location at the beginning of the cross-section is designated Location 1; the next location at the end of the cross-section is designated Location n. Discharge through the end section would be expressed as follows:

End Section Discharge

$$q_1 = v_1\left[\frac{b_2 - b_1}{2}\right] d_1 \quad \textit{and}$$

$$q_n = v_n\left[\frac{b_n - b_{(n-1)}}{2}\right] d_n$$

TOTAL DISCHARGE CALCULATION METHODS

GENERAL

There are three commonly used methods of calculating total discharge. The Velocity Curve method is the most accurate, the slowest and the most complicated. The Two-Point and the Six-Tenths methods are the most commonly used. Of the three, the Two-Point method should be used wherever possible because of its favorable balance of accuracy and speed.

VELOCITY CURVE METHOD

This method involves taking as many readings as possible at as many different depths as possible along the entire vertical cross-section and averaging all the readings to determine the mean velocity. This method can be quite complex and can require literally hundreds of readings for larger bodies of water. The Velocity Curve Method should only be used when absolute accuracy is required and time is of no concern.

TWO-POINT METHOD

When using the Two-Point method, measurements are taken at two pre-determined points to find the mean velocity. Measurements are taken at 20% and 80% of the water surface-to-bottom distance. The average of these two readings is taken as the mean velocity of the vertical cross-section.

Experience has shown that this method renders more accurate results than any other method except the Velocity Curve method.

Note: The Two-Point method should not be used in water less than 2.5 feet (.762 meter) deep.

SIX-TENTHS METHOD

The velocity of water at a point six-tenths of the distance from the surface to the bottom very closely approximates the mean velocity of the entire vertical cross-section, making it possible to gather relatively accurate data by taking only one measurement in a particular vertical cross-section.

Position the Current Meter at six-tenths of the total water depth (four-tenths up from the bottom). For a stream 2.2 feet (.67 meter) deep, this position would be 1.2 feet (.40 meter) below the surface. This is most easily accomplished with the use of a Top Setting wading rod.

The Six-Tenths method gives reliable results under several conditions:

- When the water depth is between .3 and 2.5 feet (.091 and .762 meter)
- When large volumes of slush, ice, debris or flotsam make the Two-Point method impossible
- When quick measurements are required

CONVERTING CURRENT METER DATA TO FLOW VELOCITY

Use the English or Metric table furnished with the Current Meter to convert raw data to water velocity. (See Rating Tables on page 10 & 11)

As an example:

- 100 pulses (revolutions of the "Bucket Wheel") are counted in 60 seconds.
- Using the English Rating Table, locate 100 (revolutions) on the top line and 60 (seconds) in the vertical column.
- These two values intersect at a water velocity of 1.66 fps.

English Rating Chart for "Mini" Current Meter

(Table #2, Effective 06/99)

Time In Secs	Revolutions 3	5	7	10	15	20	25	30	40	50	60	80	150	200	Time In Secs
40	.103	.151	.199	.271	.391	.511	.631	.752	.992	1.23	1.47	1.95	3.63	4.83	40
41	.101	.148	.195	.265	.383	.500	.617	.734	.968	1.20	1.44	1.91	3.54	4.72	41
42	.100	.146	.191	.260	.374	.489	.603	.717	.946	1.17	1.40	1.86	3.46	4.60	42
43	.098	.143	.188	.255	.366	.478	.590	.701	.925	1.15	1.37	1.82	3.38	4.50	43
44	.097	.140	.184	.249	.359	.468	.577	.686	.904	1.12	1.34	1.78	3.31	4.40	44
45	.095	.138	.181	.245	.351	.458	.565	.671	.885	1.10	1.31	1.74	3.23	4.30	45
46	.094	.136	.177	.240	.344	.449	.553	.658	.866	1.08	1.28	1.70	3.16	4.21	46
47	.093	.133	.174	.236	.338	.440	.542	.644	.849	1.05	1.26	1.67	3.10	4.12	47
48	.091	.131	.171	.231	.331	.431	.531	.631	.832	1.03	1.23	1.63	3.03	4.03	48
49	.090	.129	.168	.227	.325	.423	.521	.619	.815	1.01	1.21	1.60	2.97	3.95	49
50	.089	.127	.166	.223	.319	.415	.511	.607	.800	.992	1.18	1.57	2.91	3.87	50
51	.088	.125	.163	.220	.314	.408	.502	.596	.784	.973	1.16	1.54	2.86	3.80	51
52	.087	.124	.160	.216	.308	.401	.493	.585	.770	.955	1.14	1.51	2.80	3.73	52
53	.086	.122	.158	.212	.303	.394	.484	.575	.756	.937	1.12	1.48	2.75	3.66	53
54	.085	.120	.156	.209	.298	.387	.476	.565	.743	.920	1.10	1.45	2.70	3.59	54
55	.084	.119	.153	.206	.293	.380	.468	.555	.730	.904	1.08	1.43	2.65	3.52	55
56	.083	.117	.151	.203	.288	.374	.460	.546	.717	.889	1.06	1.40	2.60	3.46	56
57	.082	.115	.149	.200	.284	.368	.452	.537	.705	.874	1.04	1.38	2.56	3.40	57
58	.081	.114	.147	.197	.280	.362	.445	.528	.694	.859	1.02	1.36	2.51	3.34	58
59	.080	.113	.145	.194	.275	.357	.438	.520	.682	.845	1.01	1.33	2.47	3.29	59
60	.079	.111	.143	.191	.271	.351	.431	.511	.671	.832	.992	1.31	2.43	3.23	60
61	.078	.110	.141	.189	.267	.346	.425	.504	.661	.818	.976	1.29	2.39	3.18	61
62	.078	.109	.140	.186	.264	.341	.418	.496	.651	.806	.961	1.27	2.35	3.13	62
63	.077	.107	.138	.184	.260	.336	.412	.489	.641	.793	.946	1.25	2.32	3.08	63
64	.076	.106	.136	.181	.256	.331	.406	.481	.631	.782	.932	1.23	2.28	3.03	64
65	.076	.105	.135	.179	.253	.327	.401	.474	.622	.770	.918	1.21	2.25	2.99	65
66	.075	.104	.133	.177	.249	.322	.395	.468	.613	.759	.904	1.20	2.21	2.94	66
67	.074	.103	.132	.175	.246	.318	.390	.461	.605	.748	.891	1.18	2.18	2.90	67
68	.074	.102	.130	.172	.243	.314	.384	.455	.596	.737	.879	1.16	2.15	2.86	68
69	.073	.101	.129	.170	.240	.310	.379	.449	.588	.727	.866	1.14	2.12	2.81	69
70	.072	.100	.127	.168	.237	.306	.374	.443	.580	.717	.854	1.13	2.09	2.78	70

Equation: Velocity = $^{Rev}/_{Time}$ X .9604 + .0312

Rating Limits: .25ft/sec to 3ft/sec

Metric Rating Chart for "Mini" Current Meter

(Table #2, Effective 06/99)

Time In Secs	Revolutions 3	5	7	10	15	20	25	30	40	50	60	80	150	200	Time In Secs
40	.031	.046	.061	.083	.119	.156	.192	.229	.302	.375	.449	.595	1.107	1.473	40
41	.031	.045	.059	.081	.117	.152	.188	.224	.295	.366	.438	.581	1.080	1.437	41
42	.030	.044	.058	.079	.114	.149	.184	.219	.288	.358	.428	.567	1.055	1.403	42
43	.030	.044	.057	.078	.112	.146	.180	.214	.282	.350	.418	.554	1.031	1.371	43
44	.029	.043	.056	.076	.109	.143	.176	.209	.276	.342	.409	.542	1.007	1.340	44
45	.029	.042	.055	.075	.107	.140	.172	.205	.270	.335	.400	.530	.985	1.311	45
46	.029	.041	.054	.073	.105	.137	.169	.200	.264	.328	.391	.519	.964	1.282	46
47	.028	.041	.053	.072	.103	.134	.165	.196	.259	.321	.383	.508	.944	1.255	47
48	.028	.040	.052	.070	.101	.131	.162	.192	.253	.314	.375	.497	.924	1.229	48
49	.027	.039	.051	.069	.099	.129	.159	.189	.248	.308	.368	.487	.906	1.204	49
50	.027	.039	.050	.068	.097	.127	.156	.185	.244	.302	.361	.478	.888	1.180	50
51	.027	.038	.050	.067	.096	.124	.153	.182	.239	.296	.354	.469	.870	1.157	51
52	.026	.038	.049	.066	.094	.122	.150	.178	.235	.291	.347	.460	.854	1.135	52
53	.026	.037	.048	.065	.092	.120	.148	.175	.230	.286	.341	.451	.838	1.114	53
54	.026	.037	.047	.064	.091	.118	.145	.172	.226	.281	.335	.443	.823	1.094	54
55	.025	.036	.047	.063	.089	.116	.143	.169	.222	.276	.329	.435	.808	1.074	55
56	.025	.036	.046	.062	.088	.114	.140	.166	.219	.271	.323	.428	.794	1.055	56
57	.025	.035	.045	.061	.087	.112	.138	.164	.215	.266	.318	.420	.780	1.037	57
58	.025	.035	.045	.060	.085	.110	.136	.161	.211	.262	.312	.413	.767	1.019	58
59	.024	.034	.044	.059	.084	.109	.134	.158	.208	.258	.307	.406	.754	1.002	59
60	.024	.034	.044	.058	.083	.107	.131	.156	.205	.253	.302	.400	.741	.985	60
61	.024	.034	.043	.057	.081	.105	.129	.153	.201	.249	.297	.393	.729	.969	61
62	.024	.033	.043	.057	.080	.104	.128	.151	.198	.246	.293	.387	.718	.954	62
63	.023	.033	.042	.056	.079	.102	.126	.149	.195	.242	.288	.381	.706	.939	63
64	.023	.032	.042	.055	.078	.101	.124	.147	.192	.238	.284	.375	.696	.924	64
65	.023	.032	.041	.055	.077	.100	.122	.145	.190	.235	.280	.370	.685	.910	65
66	.023	.032	.041	.054	.076	.098	.120	.143	.187	.231	.276	.364	.675	.897	66
67	.023	.031	.040	.053	.075	.097	.119	.141	.184	.228	.272	.359	.665	.883	67
68	.022	.031	.040	.053	.074	.096	.117	.139	.182	.225	.268	.354	.655	.870	68
69	.022	.031	.039	.052	.073	.094	.116	.137	.179	.222	.264	.349	.646	.858	69
70	.022	.030	.039	.051	.072	.093	.114	.135	.177	.219	.260	.344	.637	.846	70

Equation: Velocity = $^{Rev}/_{Time}$ X .9604 +.0312 X .3048

Rating Limits: .077M/sec to 1M/sec

MAINTENANCE AND SERVICING

CLEANING AND INSPECTION (Refer to Figure 6)

CAUTION

Do not attempt to perform major repairs of the Current Meter, such as "Bucket Wheel" repair, balancing or yoke repairs. Repairs other than those outlined here may adversely affect performance and/or void the manufacturer's warranty.

- Wash the Current Meter in clean water after each use and dry with a soft cloth.
- Lubricate the Pivot Assembly (12) and lubricate the Pivot Bearing (10) located inside the Hub (9).
- Remove the Cap (1) and lubricate the upper Bearing (3).
- Replace the Pivot Assembly (12) with the Shipping Plug (13) when the meter is not in use.

CAUTION

Do not use excessive force to disassemble the Current Meter. Excessive force could damage some parts.

- Replace the Binding Post Assembly (2) if the Cat Whisker is broken or bent excessively.
- Replace any screws that have excessively worn heads or threads.
- Replace th Pivot Assembly (12) if it shows signs of wear or damage.
- Put a drop of oil on all threads to prevent seizing during periods of prolonged storage.

PIVOT ASSEMBLY ADJUSTMENT

1. See Figure 5. Loosen the Pivot Nut Set Screw and turn the Adjusting Nut counterclockwise two turns as viewed from below.

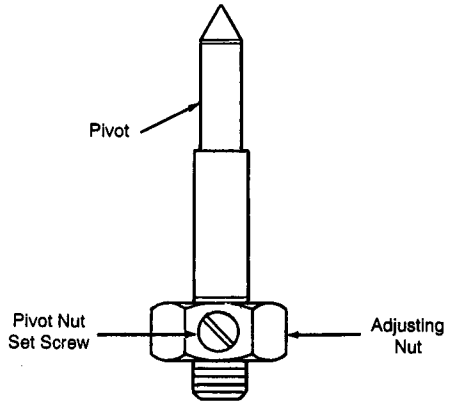


Figure 5. Pivot Assembly

2. Slightly loosen the Pivot Set Screw. Refer to Figure 2. The Pivot has a flat under this Set Screw. Make sure the flat area of the Pivot remains under the Set Screw.
3. Push the Pivot into the Yoke until all vertical "Bucket Wheel" play is eliminated and tighten the Pivot Set Screw.
4. Turn the Pivot Adjusting Nut clockwise as viewed from below until it touches the yoke, then slightly loosen the Pivot Set Screw.
5. Turn the Pivot Adjusting Nut 1/8 turn clockwise. This correctly positions the pivot in relation to the bearing. Tighten the Pivot Nut Set Screw.
6. Tighten the Pivot Set Screw.

Note: There will be a small amount of lateral play in the "Bucket Wheel." This ensures that the "Bucket Wheel" is not impaired by the pivot while taking measurements.

LUBRICATION

Repeated immersion in water followed by exposure to air enhances metal corrosion. Although the Current Meter is constructed of corrosion resistant materials to prevent corrosion, perform the following:

- Apply a drop of instrument oil (supplied with Meter) to each bearing surface and threaded hole.
- Apply a drop of oil to the Shaft and Bearings.

SPIN TEST

CAUTION

Do not turn "Bucket Wheel" in the wrong direction as this can damage the contact wire and cause inaccurate readings. The correct direction of rotation is counter-clockwise as viewed from above.

A spin test should be performed after adjustment and lubrication to ensure that the Model 1205 Current Meter is in good working order.

Check that the shipping plug has been replaced with a Pivot Assembly. Make sure that it is free of burrs and other defects. Mount the meter on a Wading Rod making sure that the "Bucket Wheel" is in as true a horizontal plane as possible and attach the Headset in preparation for performing a Cat Whisker adjustment.

Refer to Figure 2. Remove the Contact Chamber Cap. Spin the "Bucket Wheel" in a counterclockwise direction as viewed from above while listening for contact through the headset. A momentary contact should be heard each revolution. If no contact is heard, carefully bend the Cat Whisker to achieve one contact per revolution. Contact pressure should be as light as possible. Excessive contact pressure between the Shaft and Cat Whisker may adversely affect test results.

Spin the "Bucket Wheel" briskly, counterclockwise as viewed from above, by snapping it with a thumb or finger. The "Bucket Wheel" should spin freely for a minimum of one (1) minute in air and come slowly to a stop. (The "Bucket Wheel" may reverse direction after stopping. This is normal and does not affect the Current Meter accuracy.)

If the "Bucket Wheel" does not spin for a minimum of one minute or if it comes to an abrupt stop, refer to PIVOT ASSEMBLY ADJUSTMENT in this section for proper adjustment procedures. If, after adjustment, the Current Meter still will not pass the spin test, factory service may be required.

1205 SERVICE PARTS

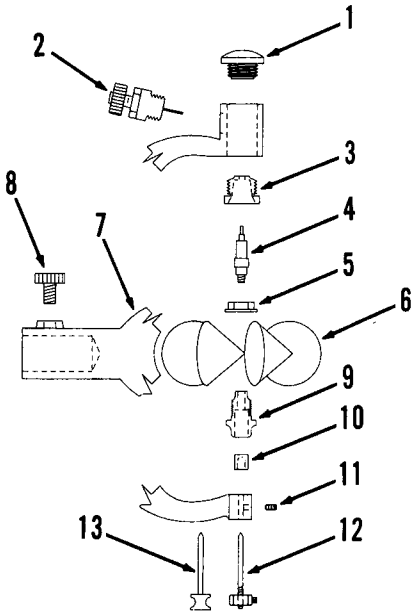


Figure 6

ITEM	PART NO.	DESCRIPTION
1	1205-1	Contac Chamber Cap
2	1205-310	Binding Post Assembly
3	1205-355-8	Upper Bearing
4	1205-9	Shaft
5	1205-325-11	Hub Nut
6	1205-320	Bucket Wheel Assembly
7	*1205-6	Yoke
8	1205-355-7	Mounting Screw
9	*1205-325-10	Hub
10	*1205-370	Pivot Bearing
11	1205-355-17	Pivot Set Screw
12	1205-330	Pivot Assembly
13	1205-18	Shipping Plug

*Can be purchased only as part of the associated assembly

ASSEMBLIES

ITEMS	PART NO.	DESCRIPTION
5, 9, 10	1205-325	Hub Assembly
3, 7, 8, 11	1205-355	Yoke Assembly

Figure 6. Model 1205 Current Meter Service Parts

MODEL 1206, MAGNETIC HEAD "MINI" CURRENT METER

The model 1206 Magnetic Head Current Meter is a variation of the standard "Cat Whisker" contact "Mini" Current Meter, model 1205. The Magnetic Head contact is available as a complete current meter by the stock number 1206, or as an easily installed retrofit kit as stock number 1206R. The Magnetic Head version generates a "cleaner" signal than the cat whisker making it more compatible with electronic counting devices such as the model 9000 Digimeter.

In use, a magnet embedded in a shaft rotates along with the Bucket Wheel. Once each revolution it passes and closes a proximity switch, which closes a circuit and registers as one revolution.

Addition of the Magnetic Head does not affect the physical characteristics of the meter. Therefore it fits the standard rating for Mini Current Meters.

The Magnetic Head pickup does not require the occasional adjustment needed by the "Cat Whisker". Its use and general maintenance i.e. lubrication, pivot adjustment..etc. are the same as the standard version as found in this manual.

MODEL 1206, MAGNETIC HEAD MINI METER SERVICE PART

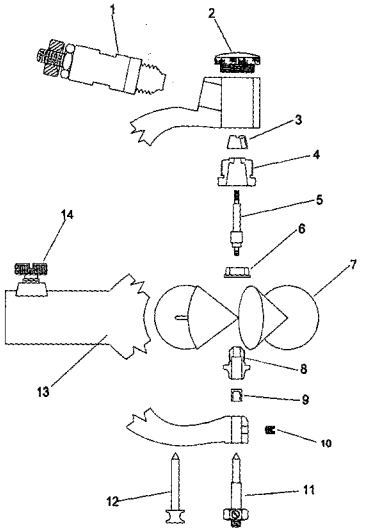


Figure 7

Item #	Part #	Description
1	1206-310	Binding Post Assembly
2	1206-6	Cap
3	1206-315	Rotor
4	1205-355-8	Upper Bearing
5	1206-9	Shaft
6	1206-325-11	Hub Nut
7	1205-320	Bucket Wheel Assembly
8	1206-325-10	Hub
9	1205-370	Pivot Bearing
10	1205-355-17	Set Screw
11	1205-330	Pivot Assembly
12	1205-375-18	Shipping Plug
13	1205-355	Yoke Assembly
14	1206-355-7	Thumb Screw

ACCESSORIES

WADING RODS

A wading rod is used to position a Current Meter at a desired depth in water that is shallow enough for wading. Refer to instructions included with the Wading Rod for mounting and operating procedures.

BIBLIOGRAPHY

Thomas J. Buchanan and William P. Somers; "Techniques of Water Resources Investigations of the United States Geological Survey, Chapter A8, Discharge Measurements at Gaging Stations, Book 3 Applications of Hydraulics." 1969 by the U.S. Government Printing Office, Washington, DC.