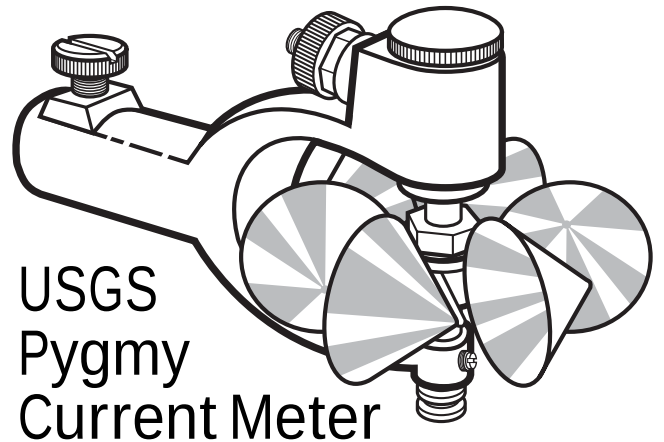


USER MANUAL



USGS Pygmy Current Meter

Open Channel Flow Measurement Instrument



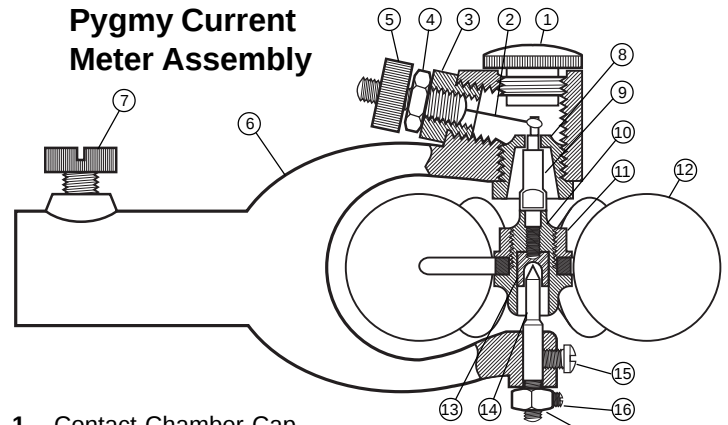
geo scientific ltd.
watershed monitoring instrumentation

Unit 247 - 2628 Granville St. Vancouver, BC V6H 4B4
Tel 604-731-4944 Fax 604-731-9445 Geoscientific.com

EQUATION: $V = (0.9604 R + 0.0312) \times 3048$ (R = Revolutions per second)

TIME MIN SECS	REVOLUTIONS																		
	3	5	7	10	15	20	25	30	40	50	60	80	100	150	200	300	400	500	600
40	0.031	0.046	0.061	0.083	0.119	0.156	0.192	0.229	0.302	0.375	0.449	0.595	0.741	1.107	1.473				
41	0.031	0.045	0.059	0.081	0.117	0.152	0.188	0.224	0.295	0.368	0.443	0.581	0.723	1.080	1.437				
42	0.030	0.044	0.058	0.079	0.114	0.149	0.184	0.219	0.288	0.358	0.433	0.567	0.706	1.055	1.403				
43	0.030	0.044	0.057	0.078	0.112	0.146	0.180	0.214	0.282	0.350	0.418	0.554	0.690	1.031	1.371				
44	0.029	0.043	0.056	0.076	0.109	0.143	0.176	0.209	0.276	0.342	0.409	0.542	0.675	1.007	1.340				
45	0.029	0.042	0.055	0.075	0.107	0.140	0.172	0.205	0.270	0.335	0.400	0.530	0.660	0.985	1.311				
46	0.029	0.041	0.054	0.073	0.105	0.137	0.169	0.200	0.264	0.328	0.391	0.519	0.646	0.964	1.282				
47	0.028	0.041	0.053	0.072	0.103	0.134	0.165	0.196	0.259	0.321	0.383	0.508	0.632	0.944	1.255				
48	0.028	0.040	0.052	0.070	0.101	0.131	0.162	0.192	0.253	0.314	0.375	0.497	0.619	0.924	1.229				
49	0.027	0.039	0.051	0.069	0.099	0.129	0.159	0.189	0.248	0.308	0.368	0.487	0.607	0.906	1.204				
50	0.027	0.039	0.050	0.068	0.097	0.127	0.156	0.185	0.244	0.302	0.361	0.478	0.595	0.888	1.180				
51	0.027	0.038	0.050	0.067	0.096	0.124	0.153	0.182	0.239	0.296	0.354	0.469	0.583	0.870	1.157				
52	0.026	0.038	0.049	0.066	0.094	0.122	0.150	0.178	0.235	0.291	0.347	0.460	0.572	0.854	1.135				
53	0.026	0.037	0.048	0.065	0.092	0.120	0.148	0.175	0.230	0.286	0.341	0.451	0.562	0.838	1.114				
54	0.026	0.037	0.047	0.064	0.091	0.118	0.145	0.172	0.226	0.281	0.335	0.443	0.552	0.823	1.094				
55	0.025	0.036	0.047	0.063	0.089	0.116	0.143	0.169	0.222	0.276	0.329	0.435	0.542	0.808	1.074				
56	0.025	0.036	0.046	0.062	0.088	0.114	0.140	0.166	0.219	0.271	0.323	0.428	0.532	0.794	1.055				
57	0.025	0.035	0.045	0.061	0.087	0.112	0.138	0.164	0.215	0.266	0.318	0.420	0.523	0.780	1.037				
58	0.025	0.035	0.045	0.060	0.085	0.110	0.136	0.161	0.211	0.262	0.312	0.413	0.514	0.767	1.019				
59	0.024	0.034	0.044	0.059	0.084	0.109	0.134	0.158	0.208	0.258	0.307	0.406	0.506	0.754	1.002				
60	0.024	0.034	0.044	0.058	0.083	0.107	0.131	0.156	0.205	0.253	0.302	0.400	0.497	0.741	0.985				
61	0.024	0.034	0.043	0.057	0.081	0.105	0.129	0.153	0.201	0.249	0.297	0.393	0.489	0.729	0.969				
62	0.024	0.033	0.043	0.057	0.080	0.104	0.128	0.151	0.198	0.246	0.293	0.387	0.482	0.718	0.954				
63	0.023	0.033	0.042	0.056	0.079	0.102	0.126	0.149	0.195	0.242	0.288	0.381	0.474	0.706	0.939				
64	0.023	0.032	0.042	0.055	0.078	0.101	0.124	0.147	0.192	0.238	0.284	0.375	0.467	0.696	0.924				
65	0.023	0.032	0.041	0.055	0.077	0.100	0.122	0.145	0.190	0.235	0.280	0.370	0.460	0.685	0.910				
66	0.023	0.032	0.041	0.054	0.076	0.098	0.120	0.143	0.187	0.231	0.276	0.364	0.453	0.675	0.897				
67	0.022	0.031	0.040	0.053	0.075	0.097	0.119	0.141	0.184	0.228	0.272	0.359	0.446	0.665	0.883				
68	0.022	0.031	0.040	0.053	0.074	0.096	0.117	0.139	0.182	0.225	0.268	0.354	0.440	0.655	0.870				
69	0.022	0.031	0.039	0.052	0.073	0.094	0.116	0.137	0.179	0.222	0.264	0.349	0.434	0.646	0.858				
70	0.022	0.030	0.039	0.051	0.072	0.093	0.114	0.135	0.177	0.219	0.260	0.344	0.428	0.637	0.846				

Pygmy Current Meter Assembly



1. Contact Chamber Cap
2. Binding Post Wire
3. Binding Post Insulator
4. Binding Post
5. Binding Post Nut
6. Yoke
7. Rod Mount Set Screw
8. Upper Bearing
9. Shaft
10. Bucket Wheel Hub
11. Bucket Wheel Hub Nut
12. Bucket Wheel
13. Pivot Bearing
14. Pivot
15. Pivot Set Screw
16. Pivot Adjustment Nut Set Screw
17. Pivot Adjustment Nut

INTRODUCTION

The Pygmy Current Meter is a versatile instrument with a long history of accuracy, reliability, and durability. The precisely balanced Bucket Wheel mounts on a vertical pivot inside a yoke and rotates by water flow. Each rotation of the Bucket Wheel produces an audible click which users monitor either manually with a headset or with digital equipment. Rotation rate is

WARRANTY

Rickly Hydrological warrants that its products are free from defects in material and workmanship under normal use and service for a period of one year from date of shipment from the factory.

Rickly Hydrological's obligations under this warranty are limited to, at Rickly Hydrological's option: (I) replacing or (II) repairing any products determined to be defective. In no case shall Rickly Hydrological's liability exceed the product original purchase price. This warranty does not apply to any equipment that has been repaired or altered, except by Rickly Hydrological, or which has been subject to misuse, negligence or accident. It is expressly agreed that this warranty will be in lieu of all warranties of fitness and in lieu of the warranty of merchantability. The warranty begins on the date of the invoice.

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proportional to water velocity. The user compares the number of rotations over a period of time to a rating chart (provided in back of this manual, and separately with each meter) which determines water velocity. The meter measures streamflow velocities from 0.1 to 25 feet per second (0.03 to 7.6 meters per second).

Users suspend the meter by a wading rod while wading a stream. Use a Pygmy Current Meter for shallow, slow, wading survey applications.

This manual is by no means exhaustive on the care and use of the Pygmy Current Meter. However, it provides a firm foundation. For a detailed treatment of different uses of the meter and technical explanations behind water resource investigations, visit <http://pubs.usgs.gov/twri/> which contains nearly all the Techniques of Water-Resources Investigations reports.

PYGMY CURRENT METER MAINTENANCE

Monitor the meter for wear, damage, and fouling before, during, and after measurements. A timed spin test before a measurement does not protect the meter from damage or fouling during a measurement. To guarantee acceptable meter performance, diligently follow procedures for meter protection, cleaning, and lubrication in this manual.

Visual meter inspection is vital. Bent cups often cause meter inaccuracy, something a timed spin test is unlikely to reveal. Users must also determine if the meter rotor moves freely and does not stop abruptly. A full spin test demonstrates this, but a much quicker observation of the rotor as it comes to rest does as well. The full timed spin test should be an office procedure between field trips, when meter performance is suspect, and before and after repairs. It is no substitute for continual meter care and inspection.

STANDARD RATING TABLE NO. 2 FOR PYGMY CURRENT METERS (6/90) - VELOCITY IN FEET PER SECOND																
TIME IN SECS	REVOLUTIONS															
	3	5	7	10	15	20	25	30	40	50	60	80	100	150	200	
40	0.103	0.151	0.199	0.271	0.391	0.511	0.631	0.752	0.992	1.23	1.47	1.95	2.43	3.63	4.83	
41	0.101	0.148	0.195	0.265	0.383	0.503	0.617	0.734	0.968	1.20	1.44	1.91	2.37	3.54	4.72	
42	0.100	0.146	0.191	0.260	0.374	0.489	0.603	0.717	0.946	1.17	1.40	1.86	2.32	3.46	4.60	
43	0.098	0.143	0.188	0.255	0.366	0.478	0.590	0.701	0.925	1.15	1.37	1.82	2.26	3.38	4.50	
44	0.097	0.140	0.184	0.249	0.359	0.468	0.577	0.686	0.904	1.12	1.34	1.78	2.21	3.31	4.40	
45	0.095	0.138	0.181	0.245	0.351	0.458	0.565	0.671	0.885	1.10	1.31	1.74	2.17	3.23	4.30	
46	0.094	0.136	0.177	0.240	0.344	0.449	0.553	0.658	0.866	1.08	1.28	1.70	2.12	3.16	4.21	
47	0.093	0.133	0.174	0.236	0.338	0.440	0.542	0.644	0.849	1.05	1.26	1.67	2.07	3.10	4.12	
48	0.091	0.131	0.171	0.231	0.331	0.431	0.531	0.631	0.832	1.03	1.23	1.63	2.03	3.03	4.03	
49	0.090	0.129	0.168	0.227	0.326	0.423	0.521	0.619	0.815	1.01	1.21	1.60	1.99	2.97	3.95	
50	0.089	0.127	0.166	0.223	0.319	0.415	0.511	0.607	0.800	0.992	1.18	1.57	1.95	2.91	3.87	
51	0.088	0.125	0.163	0.220	0.314	0.408	0.502	0.596	0.784	0.973	1.16	1.54	1.91	2.86	3.80	
52	0.087	0.124	0.160	0.216	0.308	0.401	0.493	0.585	0.770	0.955	1.14	1.51	1.88	2.80	3.73	
53	0.086	0.122	0.158	0.212	0.303	0.394	0.484	0.575	0.756	0.937	1.12	1.48	1.84	2.75	3.66	
54	0.084	0.120	0.156	0.209	0.298	0.387	0.476	0.565	0.743	0.920	1.10	1.45	1.81	2.70	3.59	
55	0.084	0.119	0.153	0.206	0.293	0.380	0.468	0.555	0.730	0.904	1.08	1.43	1.78	2.65	3.52	
56	0.083	0.117	0.151	0.203	0.288	0.374	0.460	0.546	0.717	0.889	1.06	1.40	1.75	2.60	3.46	
57	0.082	0.115	0.149	0.200	0.284	0.368	0.452	0.537	0.705	0.874	1.04	1.38	1.72	2.56	3.40	
58	0.081	0.114	0.147	0.197	0.280	0.362	0.445	0.528	0.694	0.859	1.02	1.36	1.69	2.51	3.34	
59	0.080	0.113	0.145	0.194	0.275	0.357	0.438	0.520	0.682	0.845	1.01	1.33	1.66	2.47	3.29	
60	0.079	0.111	0.143	0.191	0.271	0.351	0.431	0.511	0.671	0.832	0.992	1.31	1.63	2.43	3.23	
61	0.078	0.110	0.141	0.189	0.267	0.346	0.425	0.504	0.661	0.818	0.976	1.29	1.61	2.39	3.18	
62	0.078	0.109	0.140	0.186	0.264	0.341	0.418	0.496	0.651	0.806	0.961	1.27	1.58	2.35	3.13	
63	0.077	0.107	0.138	0.184	0.260	0.336	0.412	0.489	0.641	0.793	0.946	1.25	1.56	2.32	3.08	
64	0.076	0.106	0.136	0.181	0.256	0.331	0.406	0.481	0.631	0.782	0.932	1.23	1.53	2.28	3.03	
65	0.076	0.105	0.135	0.179	0.253	0.327	0.401	0.474	0.622	0.770	0.918	1.21	1.51	2.25	2.99	
66	0.075	0.104	0.133	0.177	0.249	0.322	0.395	0.468	0.613	0.759	0.904	1.20	1.49	2.21	2.94	
67	0.074	0.103	0.132	0.175	0.246	0.318	0.390	0.461	0.605	0.748	0.891	1.18	1.46	2.18	2.90	
68	0.074	0.102	0.130	0.172	0.243	0.314	0.384	0.455	0.596	0.737	0.879	1.16	1.44	2.15	2.86	
69	0.073	0.101	0.129	0.170	0.240	0.310	0.379	0.449	0.588	0.727	0.866	1.14	1.42	2.12	2.81	
70	0.072	0.100	0.127	0.168	0.237	0.306	0.374	0.443	0.580	0.717	0.854	1.13	1.40	2.09	2.78	

EQUATION: $V = 0.9604 R + 0.0312$ (R = Revolutions per second)

9. Remove Shipping Pin and install Pivot Pin.
10. Adjust Bucket Wheel end-play to 1/8 turn instead of the normal 1/4 turn.
11. Spin test the meter. Acceptable spins last between two and four minutes. If it spins less than 90 seconds, clean, lubricate, and re-adjust the meter.
12. Turn **Sensor Head** to adjust the air gap between the magnet on the **Magnet Assembly** and the end of the **Sensor Head** until a signal is received. Rotate Bucket Wheel to insure it moves freely.
13. Install new modified **Contact Chamber Cap with O-ring**. This modified cap is shorter than the original chamber cap.
14. Replace Pivot Pin with Shipping Pin to store or transport the meter. The retrofit is now complete and the Pygmy MagHead is ready for field use.

Use care during installation. The Sensor Head Assembly is made of brass, but severe treatment may damage the glass Reed Switch. In case of mishaps in the field, carry a spare pygmy meter or parts needed to convert the meter back to Binding Post Wire contact. Use care when removing the Contact Chamber Cap in case the Magnet Assembly is loose. The Magnet Assembly is very small, sticks to metal and is easily lost.

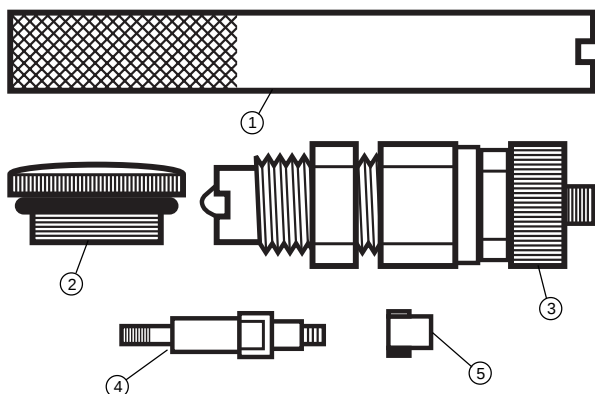
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PYGMY MAGHEAD

The Pygmy MagHead is an electronic replacement for the Pygmy Current Meter Binding Post Wire contact. Use this Pygmy MagHead with headphones and any of our digital counters, current meter digitizers, or flow computers.

Pygmy MagHead Installation

The Pygmy MagHead is designed for field installation and removal. However, initial installation requires current meter disassembly, removal of Binding Post assembly, and installation and adjustment of the Pygmy MagHead assembly. **Tools needed:** small pliers, screwdriver, and adjustable wrench.



Pygmy Current Meter Maghead Kit

1. Installation Tool
2. Contact Chamber Cap
3. Sensor Head
4. Upper Mag Shaft
5. Magnet Assembly

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Timed spin tests indicate bearing surface wear or damage. Keep a current meter log on file that includes the meter user, checker, repairs, and timed test dates and results.

1. Remove Shipping Plug and insert Pivot. **NOTE:** If existing Pivot is burred, use a new Pivot for meter checkup.
2. Visually inspect Pivot alignment. The Pivot should align with the Shaft. Pivot/Shaft misalignment indicates Yoke misalignment. (See Yoke Alignment below.)
3. Rotate Bucket Wheel and check for wobble. Wobble indicates either a bent Bucket Wheel Frame, a bent bucket, or a worn Pivot Bearing. Replace the Bucket Wheel if the frame or one of the buckets is bent. To determine Pivot Bearing wear, check the lower section of the Bucket Wheel Hub for wobble as the Bucket Wheel slowly rotates. If the hub wobbles, replace it.
4. Check the Upper Bearing and Shaft for excessive wear. Remove Contact Chamber Cap and observe the Shaft as the Bucket Wheel rotates slowly. As the Binding Post Wire slides over the Shaft contact lobe, there should be no discernible movement of the Shaft away from the Cat Whisker. If there is movement, replace the Upper Bearing. Remove a worn Upper Bearing, with small pliers.
5. Visually check Shaft for warp. Rotate Bucket Wheel slowly to see if the upper section of the Shaft in the Contact Chamber wobbles (not associated with a worn upper bearing). If it wobbles, replace it.
6. Visually inspect Binding Post Wire. Replace if kinked, twisted, or coated with oil film (oil film interferes with the signal from electronic counters).
7. To remove/replace the Binding Post Assembly, use a thin

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11. Clean Pivot Bearing. A cotton swab is too large to fit into the Pivot Bearing. Remove some cotton on the sides of the swab, then twirl the cotton into a point to reach into the bottom of the Pivot Bearing. A clean Pivot Bearing usually shines when clean. If there is hardened material in the Pivot Bearing, leave a drop or two of meter oil on it for a couple minutes to help remove it. Sometimes, a small piece of lint-free industrial wipe wrapped around the end of a small Allen wrench is helpful, but be very careful that the wipe fully covers the wrench end so it will not scratch the Pivot Bearing or its carrier.
12. Oil Pivot Bearing with just one drop of meter oil; too much oil attracts sediment. Dip the end of a straightened paper clip into meter oil and transfer the drop that accumulates to the Pivot Bearing. Do not use vegetable-based oils (like 3-in-1) which emulsify too easily, or silicon-based oils which hold sediment and are difficult to clean off.
13. Clean the Shaft and Upper Bearing.
14. Clean Pivot and check the point. Replace Pivot if point is rounded or burred. Test Pivot for magnetization. Touch a paper clip with the Pivot. A magnetized Pivot lifts the paper clip. Either demagnetize it with a bulk magnetic tape eraser or tape player head demagnetizer, or replace it.
15. Thread the Shaft into the top of the Hub Assembly with a small adjustable wrench.
16. To install an Upper Bearing, gently thread a new bearing into the underside of the upper yoke arm with a small pair of pliers. **WARNING: DO NOT crush the bearing with excessive force.** It is better to let pliers slip than to crush or deform the Upper Bearing. The bearing is fully inserted when the lower lip of the bearing contacts the lower surface

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wrench to unscrew the Binding Post Assembly. Use a pair of pliers to remove the Binding Post Insulator if it does not come off with the assembly. Install new Binding Post Assembly, and Insulator and tighten until snug.

8. Remove Bucket Wheel Assembly (Bucket Wheel, Hub, and Shaft). Loosen Pivot Set Screw, remove Pivot, then the Bucket Wheel Assembly. **NOTE: Do not force assembly.** Some older pygmy meter yokes allow limited clearance between the yoke arms. Subsequently, the Bucket Wheel Assembly comes out in only one position. Rotate assembly to find the position that allows removal.
9. To remove the Bucket Wheel from the Hub, unscrew and remove the shaft with a small adjustable wrench, then use a standard 5/16" socket to loosen the Bucket Wheel Hub Nut. The Bucket Wheel should slide off of the Hub. **Hint:** If the Bucket Wheel will not easily slide off the Hub, rethread the Hub Nut only a couple threads to insure a gap between the bottom of the Nut and the top of the Bucket Wheel, place the socket on the nut, flip upside down and gently hit the back of the socket on a hard surface while cradling the Bucket Wheel in your hand.
10. To install a new Bucket Wheel, insert the Hub Assembly into the bottom of the Bucket Wheel center hole. The top of the Bucket Wheel is marked with an "Sxx" on top of the Bucket Wheel frame, where "S" indicates Standard Rated and xx is the year of manufacture. If there are no markings, install the Bucket Wheel so it rotates counterclockwise when looking down on it. A Bucket Wheel without an "Sxx" MUST have an individual rating; the standard rating DOES NOT apply. Tighten the Bucket Wheel Retaining Nut snugly. DO NOT overtighten.

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of the upper yoke arm.

17. Yoke alignment check. **NOTE:** To insert the Pygmy Yoke Alignment Tool, remove both the Upper Bearing and the Binding Post Wire. **WARNING: DO NOT crush the Upper Bearing when attempting to remove!!**

Thread the alignment tool into the top of the yoke until the lower pin is about to enter the lower yoke arm pivot hole. Visually check if the lower pin slides into the pivot hole. DO NOT thread the alignment tool all the way down to force the lower pin into the pivot hole without first visually checking alignment. If the lower yoke arm is moderately to grossly misaligned, forcing the alignment tool into the pivot hole will either bend the tool or deform the pivot hole and destroy the yoke. Align the yoke as needed with a rubber hammer. When alignment is correct or only slightly misaligned, gently thread the alignment tool down until the lower pin completely inserts into the pivot hole. **WARNING: On the Pygmy Alignment Tool, there is no machined stop similar to the AA Alignment Tool.** Stop threading the alignment tool when the lower pin fully inserts into the pivot hole. Threading the alignment tool beyond this point or forcibly threading it into the lower yoke arm destroys the yoke.

18. Insert the Bucket Wheel assembly shaft into the Yoke Upper Bearing hole and wiggle it until the assembly slides into place. **NOTE: Do not force the assembly.** Some older pygmy meter yokes allow limited clearance between the yoke arms. The Bucket Wheel assembly inserts in only one position; rotate it to find the position that allows insertion.
19. Insert Pivot and adjust as needed. To adjust the pivot:
 - a. Verify meter is properly oiled, then hold meter in an inverted position with the Pivot up.

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Meter Disassembly and Binding Post Assembly Removal

1. Remove Contact Chamber Cap.
2. Remove Shipping Pin or Pivot Pin, whichever is currently installed. Unscrew Pivot Set Screw. Inspect Pivot Pin for wear or damage and replace if necessary.
3. Unscrew and remove Upper Shaft from Bucket Wheel.
4. Remove Bucket Wheel.
5. Unscrew and remove Binding Post Assembly.

Pygmy MagHead Component Installation

1. Apply only one drop of oil to **Upper Yoke Bushing** bearing surface.
2. Thread replacement **Upper Mag Shaft** into Bucket Wheel.
3. Install Bucket Wheel into Yoke.
4. Apply only one drop of oil into Bucket Wheel Cup Bearing.
5. Insert Shipping Pin into yoke, secure Bucket Wheel and tighten retaining screw.
6. Thread square base of **Sensor Head** into Binding Post Hole until it begins to protrude into chamber.
7. Insert **Magnet Assembly** into the included **Installation Tool**, then carefully thread it onto the threaded **Upper Mag Shaft**. Tighten gently.
8. Connect the assembled Pygmy MagHead to a digital readout. Start a measurement on the readout, and then spin the Bucket Wheel to verify that the readout counts properly. If it counts incorrectly, adjust **Sensor Head** 1/8 turn in or out as needed and retest. When adjusted properly, turn the **Jam Nut** to lock Sensor Head against Yoke.

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- b. Release Pivot Adjustment Nut Set Screw and unscrew the nut a few turns.
- c. Release Pivot Set Screw and advance Pivot until all vertical play of the Hub assembly is eliminated.
- d. Tighten Set Screw temporarily and advance Pivot Adjustment Nut until it touches the Yoke.
- e. Release Set Screw further (not too far; Pivot should not rotate) and advance the Pivot Adjustment Nut one-fourth turn. Then tighten the Set Screw.
Push Pivot inward as far as possible and tighten Pivot Set Screw.

20. Adjust Binding Post Wire as needed to obtain a strong click. For electronic counters, OSW Hydraulics Laboratory recommends setting the wire to make contact for about the rotational distance of one bucket (about 60 degrees) for a good, clean signal.
21. Oil Upper Bearing and shaft contact point with only one drop of oil.
22. Replace Contact Chamber Cap.
23. Spin test the meter. Conduct all timed spin tests with the meter level, the shaft vertical, and in a location with NO air currents. Minimum spin time is 45 seconds; optimum spin time is more than 90 seconds. **NOTE:** Bucket Wheel "chatter" when spun hard indicates a worn Pivot Bearing. Replace Hub if chatter occurs.
24. Replace Pivot with Shipping Plug during meter storage or transport.

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