

## Northern Illinois Bottlecap Balloon Brigade

We Build and Launch Pico Balloons

### Technical Page

We use a program called WSPR (pronounced Whisper) written by Joe Taylor, K1JT. WSPR is a acronym for Weak Signal Propogation Reporter and is used by Amateur Radio operators as a means to test their radios and antennas. Amateur Radio Operators can see on the WSPRnet program how far their signals can reach either by sending or receiving their callsigns.

The data packets that are sent by our balloon trackers are reported by the receiving station. Without their reports, we are unable to track our locations. these reporting stations are unaware that we're a Pico Balloon unless we send them an email thanking them for receiving our signal report. Some of these reporting stations have become NIBBB followers, receiving emails when our posts are published and in turn help us to track our balloons.

We track our balloons using primarily two programs; <http://wspr.rocks/> (<http://wspr.rocks/>) and the [WSPR Spot Database](https://www.wsprnet.org/olddb?mode=html&band=20&limit=200&findcall=&findreporter=&sort=date) (<https://www.wsprnet.org/olddb?mode=html&band=20&limit=200&findcall=&findreporter=&sort=date>)

In the WSPR Spot Database we enter the callsign of the balloon we're following to receive 1st packet information. The 1st packet information gives us our location in a 4 grid maidenhead or 7,000 square mile area and a general altitude in meters; 10,000, 11,000, 12,000, etc.

In WSPR Rocks we enter our Pico Trackers telemetry code in the Tx call box either a "Q" "0" or "1" and a number between 0 and 9 for example Q\_7%

With the code Q\_7%, we are asking WSPR Rocks to give us all the information on balloons transmiting with the Q as the 1st symbol and 7 as the 3rd symbol. If a report is near our 1st packet location and, if it's 2 minutes later than our 1st report the likleyhood is high that it's our balloon.

WSPR Rocks provides us with the 2nd packet information providing a more accurate location of a 6 grid maidenhead or 15 square mile grid and the additional altitude in groups of 60 meters. We need to receive both the 1st packet and 2nd packet to get an accurate location and altitude.

Once we know the altitude and location, we can track our projected path accurately over an 84 hour period using NOAA.gov for tracking balloons [NOAA Hysplit Model](https://www.ready.noaa.gov/hypub-bin/trajsrc.pl?trjtype=4) (<https://www.ready.noaa.gov/hypub-bin/trajsrc.pl?trjtype=4>). We can also see the projected speed and direction of the jetstream and weather patterns using [Ventusky](https://www.ventusky.com/) (<https://www.ventusky.com/>).

Our [Locate and Track](https://nibbb.org/links-to-locate-and-track/) (<https://nibbb.org/links-to-locate-and-track/>) page on our website will provide information for our balloons in flight and tracking other Pico Balloons around the world.

### Calculating the Altitude

The WSPR Spot Database provides the altitude in both dBm and Watts (shown as **Power**), WSPR Rocks is shown in Watts (shown as **W**). The formula used to calculate the altitude in watts to convert to dBm is  $10\log(\text{Watts}/.001)$  Adding the data from (WSPR Spots + WSPR Rocks) will provide the accurate or true altitude. The 1st packet (WSPR Spot) gives us the altitude in thousands of meters, the 2nd packet (WSPR Rocks) in hundreds of meters, when added together, we get our true altitude.

Index	dBm	in Meters Thousands	In Meters Hundreds	In Feet Thousands	In Feet Hundreds
0	0	0	0	0	0
1	3	1000	60	3280	197
2	7	2000	120	6560	394
3	10	3000	180	9840	590
4	13	4000	240	13120	787
5	17	5000	300	16400	984
6	20	6000	360	19680	1181
7	23	7000	420	22960	1378
8	27	8000	480	26240	1574
9	30	9000	540	29520	1771
10	33	10000	600	32800	1968
11	37	11000	660	36080	2165
12	40	12000	720	39360	2362
13	43	13000	780	42640	2558
14	47	14000	840	45920	2755
15	50	15000	900	49200	2952
16	53	16000	960	52480	3149
17	57	17000	1020	55760	3346
18	60	18000	1080	59040	3542

## Code of Federal Regulations 14 CFR Part 101

This is the section of the Code of Federal Regulations that allows us to fly Amateur Radio Pico Balloons [14 CFR Part 101](https://www.ecfr.gov/current/title-14/chapter-I/subchapter-F/part-101) (<https://www.ecfr.gov/current/title-14/chapter-I/subchapter-F/part-101>).

## Finding the Right Balloons, and the Right Gas

All of our balloons are advertised as a party balloon, so if you're planning a wedding these will work nicely as a dual purpose balloon.

Before we get too far into what works and what hasn't, I'd like to recognize the Pico Balloon io group where we receive support on anything you want to know about our hobby, I would recommend joining <https://groups.io/g/picoballoon> (<https://groups.io/g/picoballoon>)

It was through the io group that we found the 36" Chinese made balloon. That's the best way we can describe this, it's made in China, and it's a couple of bucks, available in groups of 10 at a discount. [36" clear party balloon, Aliexpress Party World Store 10 lot](https://www.aliexpress.com/item/32803586452.html?ug_edm_item_id=32803586452&ug_edm_click_module=item_detail&tracelog=rowan&rowan_id1=aeug_edm_24687_1_en_US_2021-12-25&rowan_msg_id=0970biz_search_product:0:0_5728544$7204b14c954f4fac82c5a87a4791cc66&ck=in_edm_other) ([https://www.aliexpress.com/item/32803586452.html?ug\\_edm\\_item\\_id=32803586452&ug\\_edm\\_click\\_module=item\\_detail&tracelog=rowan&rowan\\_id1=aeug\\_edm\\_24687\\_1\\_en\\_US\\_2021-12-25&rowan\\_msg\\_id=0970biz\\_search\\_product:0:0\\_5728544\\$7204b14c954f4fac82c5a87a4791cc66&ck=in\\_edm\\_other](https://www.aliexpress.com/item/32803586452.html?ug_edm_item_id=32803586452&ug_edm_click_module=item_detail&tracelog=rowan&rowan_id1=aeug_edm_24687_1_en_US_2021-12-25&rowan_msg_id=0970biz_search_product:0:0_5728544$7204b14c954f4fac82c5a87a4791cc66&ck=in_edm_other)) It takes a while to receive these so plan ahead.

The 36" Chinese made balloon is round and flatter, we call it a pillow or pancake style. We flew this balloon for many long flights, it only needs to be heat sealed to secure. The issue is that we were limited in altitude to 32,000 feet. The balloon has stamina, we flew it on December 22nd for 19 days, spending 8 days touring the Marshall Islands.

To get to that magic altitude of 47,000 feet, we needed a round also known as a sphere balloon. We became aware of two different manufactured 32" sphere's and bought them both.

The 32" Orbs Silver Balloon is manufactured by SAG, available at BalloonsOnline for around \$16. If you buy 10 balloons, shipping is free, at least here in the U.S. [Balloons Online 32" Orbs Silver](https://balloons.online/orbs-32-silver/) (<https://balloons.online/orbs-32-silver/>)

As of April of 2023, The Yokohama balloon is \$150 for 10, in addition they charge \$100 for freight [Yokohama 32" Transparent Sphere](https://yokohamaballoon.com/products/sphere-balloon32inch?variant=41763086729369) (<https://yokohamaballoon.com/products/sphere-balloon32inch?variant=41763086729369>)

The key to all of these balloons is they perform better if they're pre-stretched, and there's a science to that as well, another

reason to join the io group.

The best place for information on the steps and video on how to pre-stretch a balloon can be found here [Everything about Flying a Pico Balloon by K9YO](https://sites.google.com/view/picoballoonsbyk9yo/home) (<https://sites.google.com/view/picoballoonsbyk9yo/home>)

Ken Daniel, K9YO, a member of the NIBBB, one of our key advisors and the reason for our success. Pico Balloon K9YO-15 had recently flew for 123 days, preparing for the 8th time around the world before we lost track of his balloon flying over Canada. Ken uses the Silver SAG Balloon (32" Orbs Silver) and Helium Gas for his flights. His YouTube Video on stretching balloons is found here [Stretching and Filling Balloons](https://sites.google.com/view/picoballoonsbyk9yo/balloon) (<https://sites.google.com/view/picoballoonsbyk9yo/balloon>)

We found that our balloons will lose about 1/2 gram of gas overnight for each day before launch, so it's critical on the proper gas fill, and not to delay the launch.

Both the SAG and the Yokohama balloons are bargains for what we're able to achieve.

We started using Helium gas in the beginning of our program and found the gas to be reliable but very expensive. We started using Hydrogen in December of 2021.

Not everyone is keen on storing a Hydrogen tank so we use both Helium and Hydrogen. Our last fill cost for our small 55 cubic foot Helium tank in March of 2023 was around \$100, compared to the cost of filling a 240 cubic foot Hydrogen tank is about \$80. We can expect to fill over 20, 32" Sphere balloons with the 55 cubic foot Helium tank which we also use for the occasional birthday party. We only use the Hydrogen for our Pico Balloon program.

## Pico Balloon Trackers

We use our own Pico Balloon Tracker designed and tested with some of our partners. Our 2nd version tracker weighs approximately 1.4 grams. We are in the process of designing and building our 3rd version tracker.

For those interested in getting into our hobby you can visit Ken Daniel's site [Pico Balloons by K9YO](https://sites.google.com/view/picoballoonsbyk9yo/home) (<https://sites.google.com/view/picoballoonsbyk9yo/home>) for commercially available trackers.

The NIBBB had used both the Zachtek and QRP Labs trackers with much success.

Zachtek sells a Pico Tracker complete with solar panels for around \$100 with two versions of tracker packages, and offers discounts for multi-pack orders [WSPR-TX Pico Transmitter](https://www.zachtek.com/product-page/wspr-tx-pico-transmitter) (<https://www.zachtek.com/product-page/wspr-tx-pico-transmitter>) and [WSPR-TX Pico Transmitter with large solar cells](https://www.zachtek.com/product-page/wspr-tx-pico-transmitter-with-large-solar-cells) (<https://www.zachtek.com/product-page/wspr-tx-pico-transmitter-with-large-solar-cells>)

QRP Labs sells their Pico Tracker for under \$60 but you have to add your own solar panels. Luckily here at the NIBBB, we teach you how to build solar panel packages. The QRP Labs U4B is about the same size and weight as our tracker and uses their own software for tracking balloons on their site.

While we're limited to 30 possible telemetry codes for tracking our balloons, QRP labs software is capable of supporting 600 different telemetry channels making it much easier to track a specific balloon. Click here for information and ordering the [U4B - Balloon Tracker](http://qrp-labs.com/u4b) (<http://qrp-labs.com/u4b>)

## Antenna and Monofilament Fishing Line

Now that you have your tracker, balloon and solar panels figured out, you now need your antenna and a way to attach the package to the balloon. Ken Daniel, K9YO has created a YouTube video on how to build the antenna and for that, click here [Launching, What else do I need?](https://sites.google.com/view/picoballoonsbyk9yo/launching) (<https://sites.google.com/view/picoballoonsbyk9yo/launching>)

## Antennas, Storage, Transport and Rigging

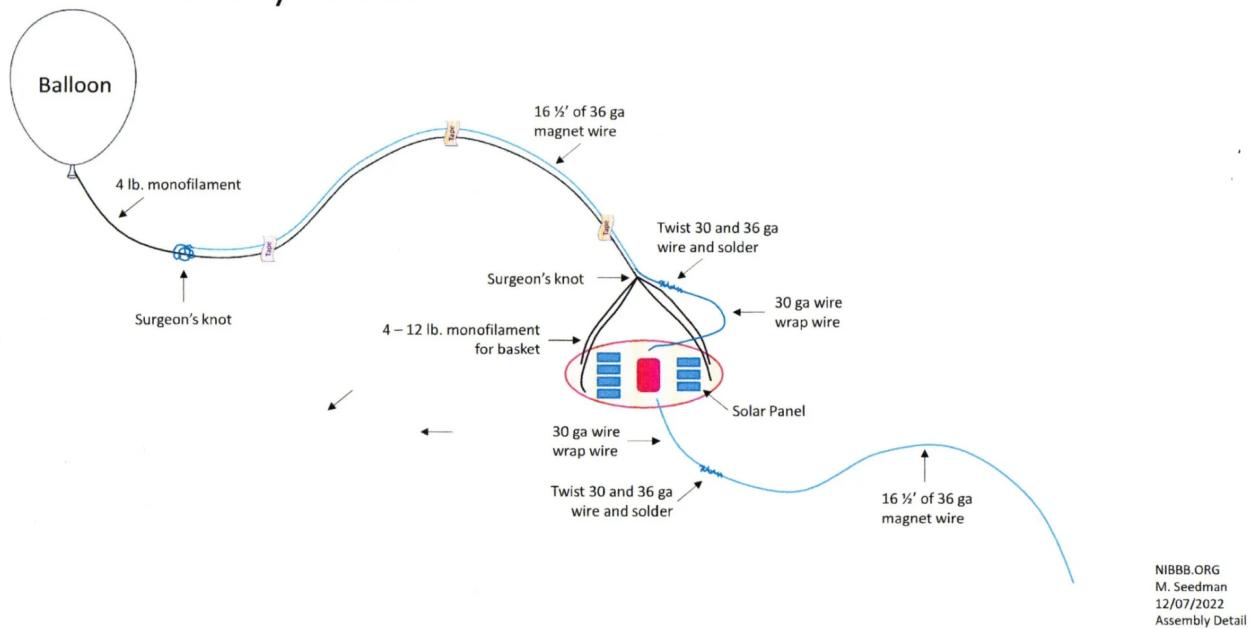
We use 36 gauge magnet wire for our antennas and 30 gauge magnet wire for the rigging. If we use the Polycrystalline Solar Panel package, we use a 4 lb. monofilament fishing line to connect the balloon to the 10 gram package. The High Power, Low Sun Angle solar panel package weighs about 20 grams and uses a 20 lb monofilament fishing line.

The Code of Federal Regulations relating to Pico Balloons require an impact force of less than 50 lbs to separate the balloon from

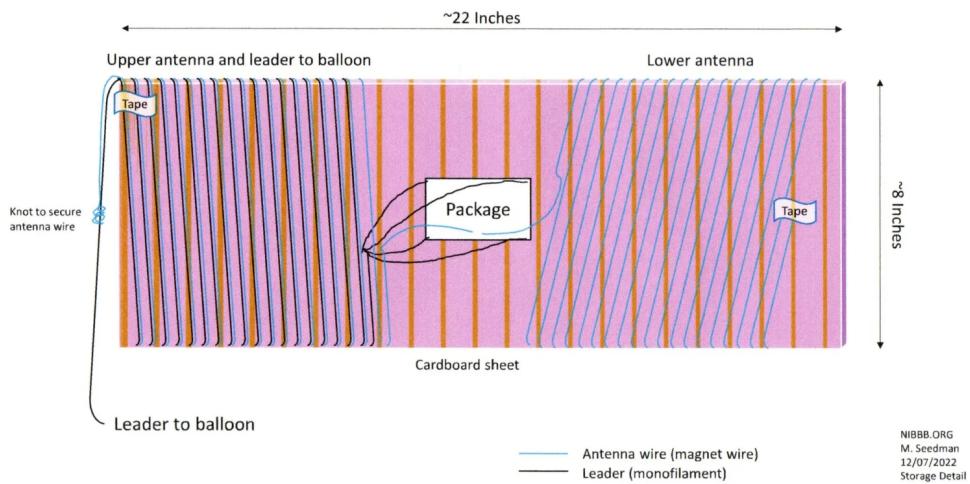
the suspended payload.

Below is the Assembly Detail of our package for a tracker transmitting on 14.097 Mhz on the 20 Meter Band.

## Assembly Detail

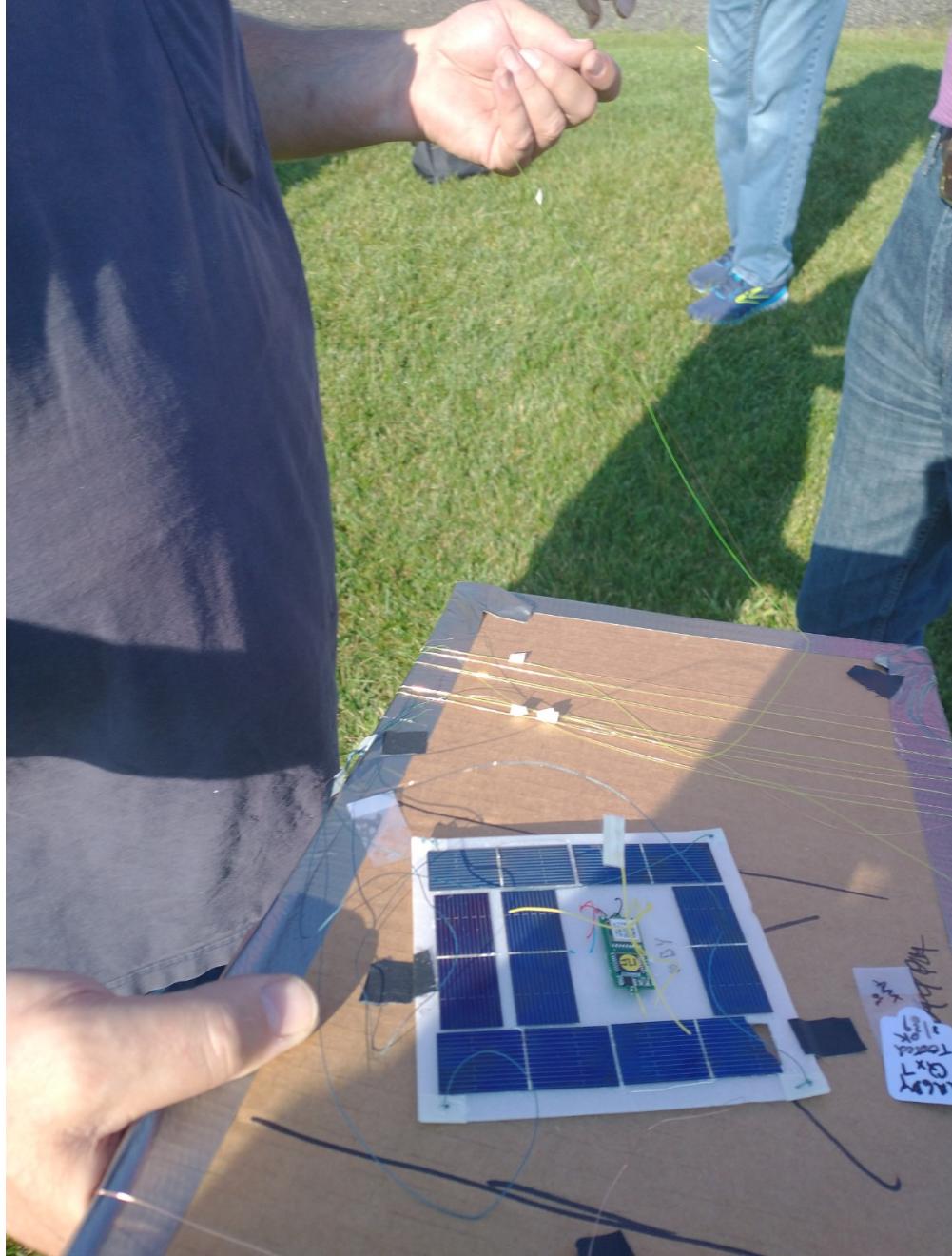


## Storage & Transport Detail

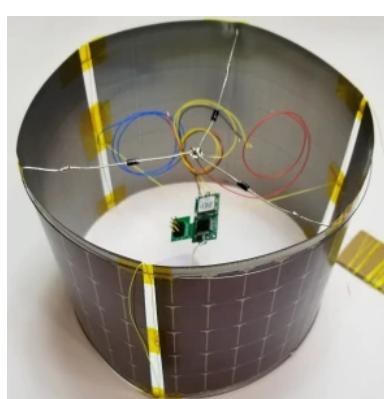


Our package of tracker, polycrystalline solar panels and dipole antenna weigh 9.2 grams, we add about 8 grams of additional gas before sealing the balloon.

Below is pictured our tracker, 7 panel polycrystalline solar panel package and antenna package transported to the launch site on September 3rd 2022, for Pico Balloon AA6DY.



Below is our Low Sun Angle – High Power Solar Panel and Tracker used for Pico Balloon KD9UQB, launched from Neumayer Station III, Antarctica, November 24th 2022.



Information on building our solar panel packages are on the menu at the top of this page.

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