

Guide of the BrickIt balloon system for LEGO® Blimps

Balloons for LEGO Blimps



Introduction

At LEGO WORLD Zwolle 2010 we saw the blades on the LEGO Education Renewable Energy Add-On Set 9688 for the first time (See Figure 1). We immediately got the idea of making a flying NXT! We wanted to use standard LEGO elements for everything on the blimp, except for the balloons, because we knew that we would not be able to get enough lifting power from any combinations of LEGO Motors and the new wings from the education set to lift a LEGO model by itself. What we needed was to achieve neutral buoyancy! A good inspiration for this method is the GOODYEAR Blimp that is illustrated in Figure 2. It uses a large balloon filled with a gas, called helium. Helium is lighter than air, which results in lifting power that can give us neutral buoyancy. So if our model had neutral buoyancy we would only need a small amount of power from the propellers to make it controllable.

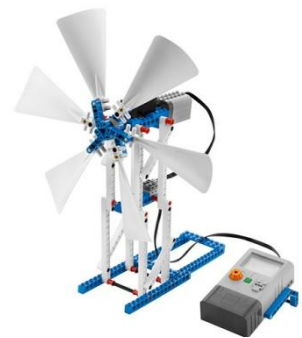


Figure 1 - LEGO 9688 Renewable energy set.



Figure 2- The GOODYEAR Blimp.

At this point we had discovered that 1 litre of helium was able to lift approximately 1 gram, so we needed very large balloons. We found some large round balloons at a web shop from a Danish company called Viborg Ballon (<http://www.viborg-ballon.dk/>). They had the balloons in the sizes that could contain the amount of helium we needed, in order to get enough lifting power. After talking to Viborg Ballon, we learned that instead of helium, we should use a gas called balloon gas. Balloon gas is not purely helium, which makes it less expensive and easier to get. We then had the balloon and the balloon gas in place, so all we needed was a way to mount the balloons to our LEGO Model, and a way to fill the balloons. The problem with the gas that we would use to inflate the balloons with was that it would slowly pass through the rubber of the balloon, resulting in reduction of lifting power over time. So we needed an inflating system that allowed us to easily put extra helium into the balloons when they need more lifting power. Therefore we would need a balloon mount with an easy accessible inflation valve.

In this guide we will show you how we created the balloon system for the various LEGO MINDSTORMS® Blimps that we have created.

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The balloon mount

In this section we will show you how the balloon mount for our blimps is created. On the left picture in Figure 3 shows the LEGO construction that the balloon mount will be attached to, and on the right you can see the two parts are put together.

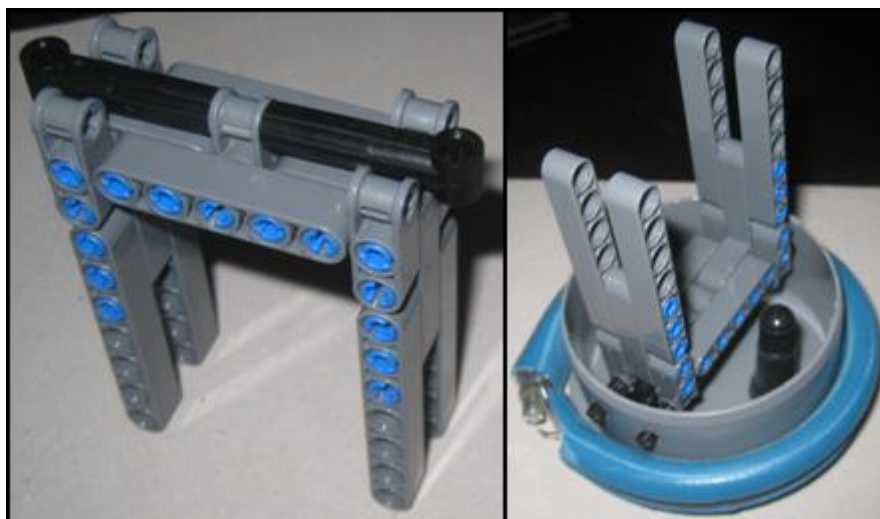


Figure 3 – Left picture: The LEGO construction that the balloon mount gets attached to. Right picture: The balloon mount attached to the LEGO construction.

The balloon mount is based on, what we in Danish call an end plug for drain pipes, which was bought in a local hardware store. Figure 4 shows three pictures of this plug from different angles.



Figure 4 – End plug for drain pipes from different angles.

The first modification we will do to the end plug, is to drill the holes for the LEGO mount. The easiest way to drill the holes in the correct positions on the plug is to build a LEGO guide frame for the drilling. Figure 5 shows this guide frame in action. Please note that you might damage the LEGO parts that you drill through if you are not careful. We used a 4.5mm drill for this, to minimize the damage on the LEGO elements. When one hole is drilled, you place a technic pin long in the hole in order to keep the plug in place while drilling the next hole (See Figure 6).

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Figure 5 - The drill guiding construction in action.

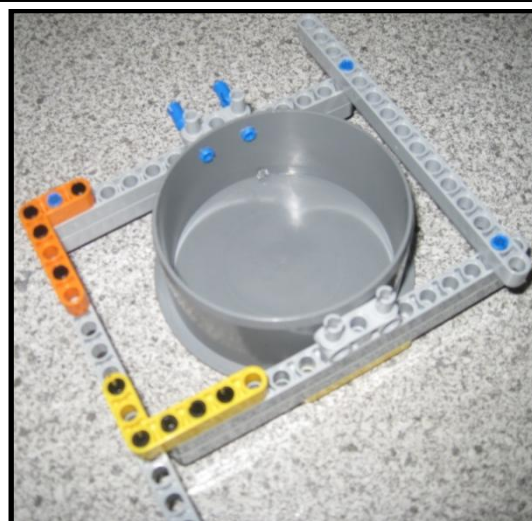


Figure 6 - The plug locked in place by long pins.

When all the holes are drilled with the 4.5mm drill, we enlarge the holes further with a 5mm drill, so the LEGO parts will have an easier fit. When that is done, we take an 8mm drill to remove the sharp edges of the hole (use your hands, and not an electrical drill, see Figure 7).



Figure 7 - Removal of sharp edges around the holes.

Now, it is time to fit the valve onto the balloon mount. In order to do that we need to drill a hole that the valve will fit into. We use a rim valve for a car tyre, bought at the local mechanic. The valve that we use is shown in Figure 8. The hole that we will be drilling needs to be a bit smaller than the diameter of the valve indicated with the orange arrow. The indicated diameter was subtracted with 1mm to find the used drill diameter.



Figure 8 - Rim valve for car tyres.

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Before drilling the hole, you need to make sure that you place the hole so it is free of the LEGO construction that the balloon mount will be attached to, and thereby making the valve accessible when it is all put together. In Figure 9 you see our placement of the hole for the valve.



Figure 9 - Placement of the valve.

When the hole has been drilled, we remove the sharp edges around the hole. We did not have a drill that was larger than the hole, so we used a knife instead (be careful not to cut yourself!). When the sharp edges have been removed, we placed the valve in the hole. Do not push the valve all the way through yet! Before pushing it all the way through we need to apply some glue to make sure it is completely airtight. In Figure 11 you can see the glue that we used. The glue is applied around the edge of the hole, as shown in Figure 10. After the glue has been applied, the valve is pulled all the way through (if you are using fast hardening glue as we were, you need to do this quickly after applying the glue). Afterwards, we applied some more glue around the edges of the valve, to be certain that it would be completely airtight (Se Figure 12).



Figure 10 - Applying the glue before pulling the valve through the hole.



Figure 11 - The glue we used.



Figure 12 - Applying the glue after pulling the valve through the hole.

We need to take care of the last sharp edges on the plug, as they might burst the balloon. In order to do this, we apply some electrical tape around the edge of the plug, as illustrated in Figure 13. You might also note that we have drilled an extra hole in the plug (indicated with the orange arrow in Figure 13). This hole is used to attach a safety wire to, which is used when we are moving around with the balloons, or filling them. This is to make sure that we do not lose them.

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Figure 13 - Applying electrical tape to the plug.

To keep the balloon mounted on the balloon mount, we use a clamping band. In order to protect the balloon from the sharp edges of the clamping band, we use a rubber hose, which we have cut such that it fits around the clamping band (See Figure 14).



Figure 14 - Clamping band with protective rubber hose.

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Now it is time to attach the balloon to the balloon mount. Figure 15 shows the parts that we will be putting together.



Figure 15 - Balloon with the balloon mount and the clamping band.

First we put the balloon mount into the balloon, as shown in Figure 16. We pull the balloon all the way down such that the balloon mount is placed at the top of the balloon nozzle. This will make the mount of the balloon more stable, because if we place the mount lower in the balloon nozzle, the balloon will become more wobbly.



Figure 16 - Mounting the balloon on the balloon mount.

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After this, it is time to attach the clamping band. We place it at the top of the balloon mount (on top of the balloon), as shown in Figure 17. We then tighten the clamping band, to make sure that the balloon is safely attached to the balloon mount.



Figure 17 - Attaching the clamping band on the balloon mount.

After tightening the clamping band, we pull the bottom part of the balloon nozzle back up over the clamping band, such that it covers the clamping band up as shown in Figure 18. Finally we have a balloon with a balloon mount ready to fit onto your LEGO model. In the next section, we will show you how we fill the balloons with balloon gas.



Figure 18 - The finished balloon with its balloon mount.

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Filling the balloons with balloon gas



Warning!

Working with high pressure gas cylinders can be very dangerous! We strongly recommend that you consult with professionals before doing anything yourself!



We now have a balloon, that is ready to be filled with balloon gas. The balloon gas comes in high pressure gas cylinders and therefore you need to be very careful when working with it. Usually when you order a cylinder of balloon gas, they ask you if you want to borrow a valve that is used to fill normal party balloons. This valve is not able to be used for filling the balloons using the balloon mount that we just created, but we need to use a part of it. Figure 19 shows you see the balloon valve that usually is included with a balloon gas cylinder. The left side (A) of the valve is the fitting that fits onto the gas cylinder (This gas cylinder fitting varies from country to country!). On the right side in Figure 19 is a valve that opens when you bend it (C). The part in the middle (B) is a pressure reduction valve. This is a very important part for your safety. The reduction valve ensures that the pressure on the right side of it never exceeds 8 bar (for our valve, it might be different for other valves)



Figure 19 - The standard balloon valve.

We will now remove part C from Figure 19 and attach a pneumatic quick coupling instead. This allows us to attach standard pneumatic hoses and tools to the pressurized gas cylinder. In Figure 20 you can see how we will mount the pneumatic quick coupling onto the pressure reduction valve. When we assemble the two parts, it is important to use sealing tape (See Figure 21), which ensures an airtight seal.



Figure 20 - The pressure reduction valve and the pneumatic quick coupling.

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Figure 21 - Use sealing tape when assembling the two valves.

Now we can attach a standard pneumatic hose to the quick coupling as shown in Figure 22. And on the end of that hose, we can attach a tyre inflating gun that match the type of rim valve we used for the balloon mount. In Figure 23 you see how we connect the tyre inflating gun to the balloon mount. When inflating the balloon, be careful not to inflate it too quickly. We have blown some balloons as a result of inflating the balloon too quickly.



Figure 22 - Attaching a standard pneumatic hose to the quick coupling.



Figure 23 – Using the tyre inflating gun allows us to fill the balloon through the valve we fitted onto the balloon mount.