

Remodeling 3-Pin Plug Design to Improve Product Sustainability

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Abstract

3-pin plugs are devices that connect electricity to devices and imply safety of humans and electrical appliances. A 3-pin plug consists of three pins (hence the name). Each pin must be correctly connected to the three wires in the electrical cable. Each wire has its own specified color so as it can be easily identified. Plastic wastage is one of the major problems now a days. Properties of plastic is the main reason why it is used so frequently, it is light weight, versatile, flexible, moisture resistant, strong and relatively inexpensive. A normal plastic product like bottles, straws which is one time use it takes about 450 years to biodegradable. The main objective of this paper is to reduce the plastic content of the plug, which is useless, because sooner or later the world must unite to fight against plastic problem. If there a way to make a plug with less plastic content than there is no need to put extra plastic. As a result, it also takes less space which also reduce the transportation cost and the overall cost of the plug will also decrease. Solid works (3d simulation software) has been used to make the 3d model of the design, the idea is to make the design on it and then go for the prototype and then do the testing. The result shows some amount of success, but the problem is the design is to complex which is difficult to make with the 3D printer and plastic.

Keywords: *biodegradable, moisture resistant, Solid works, versatile.*

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Introduction

First attempts to redesign plugs and sockets

In the mid-1930s, IEC were made mindful of institutionalization in Europe by the Internationale Fragens-Kommission - International Questions Commission. The association involved agents from power providers just as electrical test houses in 12 nations, including a few delegates of IEC NCs (National Committees). It concentrated principally on the field of electrical power dissemination. (Iec.ch, 2019)

The IEC at its gathering in Paris in January 1933 chose that its CA (Committee of Action) should contact the IFK to connect with joint effort in issues of common intrigue. In 1934 an IEC/IFK co-activity understanding was agreed upon.

Subsequently, the new TC (Technical Committee) 23 was made to manage the institutionalization needs of electrical fittings. (Iec.ch, 2019)

Crafted by TC 23 set aside a long effort to start. The IEC CA, at its gathering in Torquay, UK in June 1938 and again in Paris, France in June 1939 encouraged the specialists taking an interest in TC 23 to at long last calendar their first gathering and to offer need to the subject of fittings and attachments. At that point World War II broke out and for quite a while people stop thinking about plugs, because there were bigger problems at that time. (Iec.ch, 2019)

National Electrical Manufacturers Association had established in 1926. During the 1940s NEMA characterized measures for plugs. Even though these guidelines are not necessary, they advance compatibility between items made by different makers and are frequently marked as "the US standards". (Plugsocketmuseum.nl, 2019)

NEMA wiring gadgets are made in current evaluations from 15 to 60 Amp with voltage ratings from 125 to 600 V (single-, split-or potentially three-stage). In excess of 70 distinctive

connector types have been characterized. Some of them are eliminated. (Plugsocketmuseum.nl, 2019)



Figure 1 Harvey Hubbell's "Separable Attachment Plug" (patented in 1904) - allowed for non-bulb devices to be plugged into a light socket for power (Iec.ch, 2019)

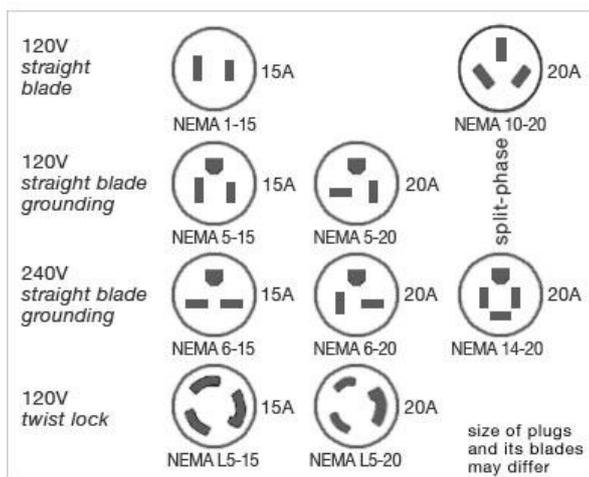


Figure 2: Examples of NEMA plug configurations (Plugsocketmuseum.nl, 2019)

Plastic wastage is one of the major problems in our environment, it's not only affected the sea life, but it is also contributing to the global warming. When plastic is burn it release some harmful gases which later goes into the environment and cause global warming.

Terrible for the atmosphere and seas, Plastic is an oil-based material, and when consumed it resembles some other petroleum product: it discharges atmosphere contamination. This thus prompts rising ocean levels, expanded sea and air harmfulness, and devastation of coral reefs and

other marine life. As indicated by the U.S. Natural Protection Agency, consuming plastics is strikingly the most noticeably awful conceivable finish of-life the board approach for plastics from an atmosphere point of view. Gasification, pyrolysis, and plasma incinerators are even less proficient at creating power than mass consume incinerators, and frequently supplement squander with coal and other petroleum products to deliver vitality. Environmental change is a significant danger to our seas and marine wellbeing. (Global Alliance for Incinerator Alternatives, 2019)

While plastic pack enactment may help diminish use and contamination on a nearby level, the master gathering's advising report features an absence of consistency in U.S. plastic sack enactment. Furthermore, a few states have executed or endeavored to actualize decides that restrict enactment managing plastic packs and other harmful plastic buyer items, which is the reason defenders of plastic sacks are pushing government activity. (Cirino et al., 2019)

Plastic is everywhere, even on those things you may not envision that it ought to be. Milk compartments are fixed with plastic, water bottles are disseminated everywhere, and a couple of things may even contain minor plastic spots. Each time one of these things escapes or washed down a sink, the noxious defilements have to a more noteworthy degree a chance to enter nature and do hurt. (Conserve Energy Future, 2019)

Reject dumps and landfills are dreadful difficult issues, as they empower poisons to enter the ground and impact untamed life and groundwater for an impressive time allotment to come. (Conserve Energy Future, 2019)

As plastic is progressively moderate, it is one of the most extensively available and manhandled things on the planet today. Exactly when disposed of, it doesn't deteriorate adequately and taints the land or air close by when break down in air. (Conserve Energy Future, 2019)

Business calculating is a budgetary requirement for certain bits of the world, and enormous measures of people eat fish for their ordinary

perseverance. In any case, this industry has added to the issue of plastics pollution in the oceans in a couple of various ways. The nets used for certain immense scale trolling exercises are ordinarily made of plastic.

In any case, these spend long events submerged in water, spilling harms deliberately, anyway they moreover normally get isolated or lost, left to stay wherever they fall. This killings and harms close by natural life, yet also ensures that defilements enter the water and fish of the region. (Conserve Energy Future, 2019)

Since it comes in sizes gigantic and small, contaminating plastics even impact the world's most unobtrusive living creatures, for instance, minute fish. Exactly when these animals become hurt in view of plastic ingestion, this wrecks up the greater animals that depend upon them for sustenance. This can cause a whole slew of issues, each well beyond along the common lifestyle. Furthermore, it infers that plastic is accessible in the fish that various people eat every day. (Conserve Energy Future, 2019)

Water preservation is now a worry in places extending from California to parts of India, yet the world's water is in incredible threat in light of spilling plastics and waste. In the event that you've at any point seen a landfill, envision what happens each time it downpours – at that point envision that being in your drinking water. Groundwater and supplies are powerless to releasing ecological poisons. (Conserve Energy Future, 2019)

The vast majority of the litter and contamination influencing the world's seas additionally gets from plastics. This has had awful results on numerous marine species, which can prompt ramifications for those that eat fish and marine life for supplements – including individuals. (Conserve Energy Future, 2019)

At the point when plastic is dumped in landfills, it interfaces with water and structure perilous synthetic concoctions. At the point when these synthetic concoctions leak underground, they corrupt the water quality. Wind conveys and

stores plastic starting with one spot then onto the next, expanding the land litter. It can likewise stall out on posts, traffic lights, trees, wall, tower and so forth and creatures that may come in the region and might choke out them to death. (Conserve Energy Future, 2019)

Consuming of plastic in the outside, prompts ecological contamination because of the arrival of toxic synthetic compounds. The dirtied air when breathed in by people and creatures influence their wellbeing and can cause respiratory issues.

Despite endless TV advertisements throughout the years demonstrating ducks or dolphins caught in six-ring plastic can holders, these things are yet utilized and disposed of end masse every day. Regardless of whether on the grounds that the mass of plastic has dislodged creatures, or the related poisons have harmed them, plastic contamination does a great deal of harm to the world's biological systems. (Conserve Energy Future, 2019)

So, it will be good if we star doing something to reduce the useless plastic now before it's too late.

Methodology

First different hand sketch has been drawn to find out which one is best, from different design best one is chosen and made on the solid works. The only challenge is that the distance between the pings should be kept constant because the socket size is remained same. The whole idea come from the flower how it is open and closed and it shape somehow looks like same.

The below pictures show the design of the plug, the drawing pictures are taken from the solidworks.

Previous Design:



Figure 3: old design (Wilko.com, 2019)

New Design

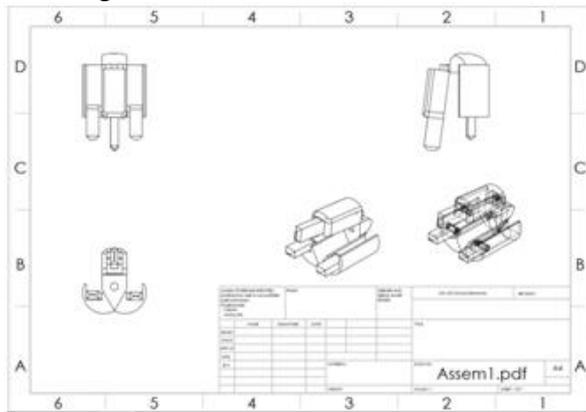


Figure 4 new design

Results

Total Mass = 21.77 grams
 Total Volume = 10237.91 cubic millimeters
 Surface area = 9253.97 square millimeters
 Center of mass: (millimeters)
 X = 2.75
 Y = 15.88
 Z = 44.82

Principal axes of inertia and principal moments of inertia: (grams * square millimeters)
 Taken at the center of mass.

$I_x = (0.03, 0.71, 0.71)$	P_x	=
3707.93		
$I_y = (-0.03, -0.71, 0.71)$	P_y	=
5175.70		
$I_z = (1.00, -0.04, 0.00)$	P_z	=
5760.93		

Moments of inertia: (grams * square millimeters)
 Taken at the center of mass and aligned with the output coordinate system.

$L_{xx} = 5758.25$	$L_{xy} = 59.23$	$L_{xz} = 35.64$	
$L_{yx} = 59.23$	$L_{yy} = 4443.48$	$L_{yz} =$	=
733.02			
$L_{zx} = 35.64$	$L_{zy} = 733.02$	$L_{zz} =$	=
4442.82			

Moments of inertia: (grams * square millimeters)
 Taken at the output coordinate system.

$I_{xx} = 54965.65$	$I_{xy} = 1010.31$	$I_{xz} =$	=
2719.14			
$I_{yx} = 1010.31$	$I_{yy} = 48324.31$	$I_{yz} =$	=
16226.81			
$I_{zx} = 2719.14$	$I_{zy} = 16226.81$	$I_{zz} =$	=
10098.83			

Discussion

The idea is to reduce the size of the plug to reduce the plastic content in the plug. This will automatically reduce all the other things like it will cover less space which reduce the transportation cost because more pieces can send at one time which reduces the overall cost of the plug material type polyvinyl chloride is keep same plus the current rating of 13A amperes is also constant with the 12v fuse in it. The only thing is, it is not the stronger as the old one but can be used thousand times before break. At the end of the day if the cost is lower and plastic content is lower it is a good compensation on the strength of the model.

Size can be reduced more but the strength can be more compromise, so this stands out to be the most effective design among all which reduce the plastic amount plus enough strength to reuse for about more than thousand times.

Conclusion

If somehow strength able to remain same than the size of the plug can be reduce more. It can be made automatic because we only need pins, so if there is a way that pins are presented only than there is no need of plastic.

The success in lower down the plastic content its not that much but the able to reduce the surface area which will reduce the over all cost of the plug. On estimation it will reduce 0.5\$-1\$ on per piece due to lower down the price on the transportation and packing. If a company has a production of 1 million pieces on a year they are able to save around 1 million to half a million dollars per year and if they continue to do so for five years than multiply this number in to five which is end of the day is not a bad idea to do so.

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