

## **Proposed structure for a fair trade standard for recycled filament.**

### **AN ETHICAL FILAMENT STANDARD FOR 3-D PRINTING**

Note: In addition to the standards outlined below, producers must comply with national legislation and also other recognised standards and conventions such as the International Labour Organisation (ILO).<sup>i</sup>

#### **The rationale for an Ethical Filament Standard**

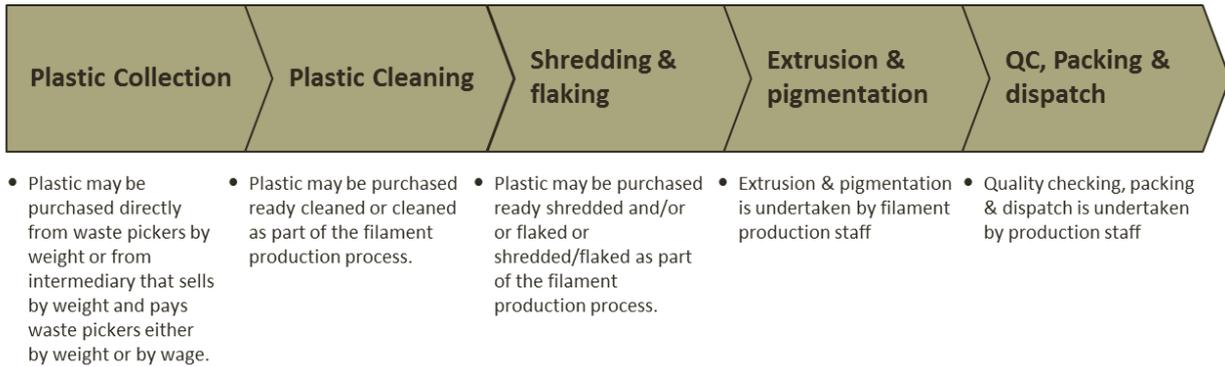
A main goal of fair trade is to provide opportunities and stable trading partners to economically disadvantaged producers and to open up new markets (WFTO, 2013). Fair trade filament has the potential to benefit some of the world's most disadvantaged – the millions of people, predominantly in developing countries,<sup>ii</sup> whose livelihood and income come from picking waste on dumps through the possibility of some income stability, access to the plastic value chain and further job creation without a large startup cost or difficult job training. Pickers can be employed to collect and process the plastic through all the steps shown below. As well as plastic collection and sale, through the acquisition of a recycling machine, such as a RecycleBot (Baechler, et al., 2013), pickers will have the ability to enter the value chain and turn their plastic into filament themselves to provide a higher value return and diversify their income. This filament could then be sold to make useful products for local and national communities that could be in turn sold.

In addition, a picker or other local workers could buy or build an open-source RepRap 3-D printer<sup>iii</sup> and begin making finished products from the waste plastic filament. These finished products can have substantial value (Wittbrodt, et al., 2013) and can either be used to offset household costs or again sold on the market for profit. This process could be especially beneficial in rural areas where markets are not as varied as in cities and consumers simply lack access to many products.

The main goals for a fair trade standard for filament are:

- To provide an environmentally friendly and ethically produced filament alternative to meet market need.
- To open up a new market for value added products that can be produced by waste pickers.
- To ensure that a transparent minimum price is paid to waste pickers for the plastic used to make ethical filament. This will ensure that waste pickers are able to earn a wage that meets or exceeds sector regulations, collective bargaining agreements and regional average minimum wage (where these exist).
- To provide the opportunity for waste pickers to further their position and improve their income by engaging in the plastic value chain through access to filament recycling roles and the creation of value added products.
- To provide an additional premium to waste picker communities, which may be invested in further projects that enhance social, economic and environmental conditions within their communities.
- To contribute towards a general improvement in standards in trading relationships with waste pickers by influencing industry standards.

## The Ethical Filament Value Chain<sup>iv</sup>



For the purposes of this document it is assumed that the value chain for ethical filament starts at the point that waste plastic is collected by waste pickers and ends at the point of despatch of the filament to a customer. The value chain could be extended to include community production of 3-D printed objects/products using the same filament in which case it is assumed that those standards that relate to the shredding, flaking and extrusion of filament will extend to its use for the production of a final object/product.

### The Proposed Structure of the Standard

This standard adopts a similar approach to other fair trade standards in that requirements are broken down into 'Minimum Requirements' which are those required as a minimum to meet the 'Ethical Filament' accreditation, and those defined as 'Progress Requirements' which are additional desirable requirements that producers might be expected to work towards over time.

Requirements are structured under three categories: Social, Economic and Environmental. Requirements relating to pickers of plastic are separated from those relating to workers in the rest of the value chain.

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More research needs to be done into existing initiatives currently being deployed with waste pickers by NGO's governments or unions.

ii In 1988, the World Bank estimated that 1–2% of the global population subsists by waste picking. A more recent study from 2010 estimates that there are 1.5 million waste pickers in India alone. Brazil, the country that collects the most robust official statistics on waste pickers, estimates that nearly a quarter million of its citizens engage in waste picking ([http://en.wikipedia.org/wiki/Waste\\_picker](http://en.wikipedia.org/wiki/Waste_picker))

iii A RepRap is an open source design self replicating 3D printer. See <http://www.reprap.org/wiki/RepRap>

iv This still needs to be tested

## Requirements for Fair Trade Standards for plastic collection for Ethical Filament

### Social Criteria

	Minimum	Progress
<p><b>Labour</b></p>	<p><b>CHILD LABOUR</b> No child labor is to be used. Child labour is defined by the International Labour Organization (ILO) as work that is physically, socially or morally damaging to children, or interferes with their attendance of school (ILO, 2013). The Fair Labor Association (FLA) states no one under the age of 15 or the age of compulsory education, whichever is higher, is to be employed (FLA, 2013).</p> <p>See Fairtrade standard for Hired Labour requirement 1.3.1.2 <a href="http://www.fairtrade.net/hired-labour-standards.html">http://www.fairtrade.net/hired-labour-standards.html</a></p> <p><b>WORKING TIME</b> The regular work week of a full time worker is not to exceed 48 hours and the regular work week plus over time is not to exceed 60 hours (FLA, 2013). Overtime is to be paid at a premium rate.</p> <p><b>FORCED OR COMPULSORY LABOUR</b> No forced or compulsory labor of any kind is to be used including prison labor, indentured labor, or bonded labor. Workers must receive compensation for their work, so no unpaid internships are permissible. Waste picker compensation should be at least the minimum wage or the appropriate prevailing wage, whichever is higher. Migrant, temporary, seasonal, and subcontracted workers are to be paid on a basis of equal pay for equal work performed. Labor standards are to be followed as stated by the Fair Labor Association (FLA, 2013).</p>	
<p><b>Health &amp; Safety</b></p>	<p>Employers must safeguard workers' rights under national and international labor and social security laws and regulations (FLA, 2013).</p> <p><b>HEALTH &amp; SAFETY POLICY</b> A written health and safety policy should be implemented and in areas where the workers are not literate, an image-based safety system should be used. The company ensures that Personal Protective Equipment is provided to workers appropriate to their tasks, free of charge, and that they are instructed and monitored in its proper use.</p>	<p>Establish testing procedures and mitigation techniques for potentially harmful fumes resulting from filament production.</p> <p><b>HEALTH &amp; SAFETY POLICY</b> The company has appointed a Medical Officer that maintains complete and updated records on workers' illnesses, accidents, first aid health care and other health care provided, and actions taken for improvements. Records are kept of all work accidents and related first aid response.</p>

	<b>Minimum</b>	<b>Progress</b>
	<p><b>SANITARY FACILITIES</b> The sanitary facilities are clean and hand washing facilities are next to the sanitary facilities. Potable drinking water is clearly labeled and easily accessible to all workers during their working period (Fair Trade USA, 2012).</p>	<p><b>SANITARY FACILITIES</b> Setting up programs to sort the waste before it enters the dump increases the amount of waste being recycled as well as makes it safer and more sanitary for the workers as scavenging from open dumps is considered to be the most damaging to health (Wilson, Velis and Cheeseman, 2006).</p>
<b>Discrimination &amp; Harassment</b>	<p><b>DISCRIMINATION</b> Following protocols for other fair trade products, no person shall be discriminated against for hiring, compensation, advancement, discipline, termination or retirement, on the basis of gender, race, religion, age, disability, sexual orientation, nationality, political opinion, social group or ethnic origin.</p> <p><b>HARASSMENT</b> No physical, sexual, psychological or verbal harassment or abuse will be tolerated (FLA, 2013).</p>	
<b>Freedom of Association &amp; Collective Bargaining</b>	<p>Employees have the right to establish or join an independent union, collectively bargain for better working conditions, elect their advisors and design their own programs (Fair Trade USA, 2012).</p>	
<b>Discipline</b>	<p>No form of corporal punishment is to be used. Wages may not be withheld as a disciplinary tool (Fair Trade USA, 2012).</p>	

## Economic Criteria

	Minimum	Progress
<b>Price paid for recycled plastic</b>	Where recycled plastic is purchased by weight or volume, either as raw plastic or as cleaned, shredded or extruded plastic, a fair minimum price must be paid to the group that is collecting the plastic. If the minimum price is lower than the market price, the market price prevails <sup>v</sup> (Fair Trade USA, 2013; WFTO, 2013; FLA, 2013; Fairtrade Foundation, 2013a).	
<b>Minimum Wage</b>	<p>Plastic collectors should be paid the minimum wage stipulated by the government or earn the relevant industry average (whichever is higher). For the purposes of this standard, waste pickers are regarded as Piece Workers. Piece-rate workers receive a rate that is calculated on the assumption that an average worker working 'normal hours' per month will be able to earn the minimum wage.</p> <p><b>Guidance:</b> Minimum wages are not subject to change on the basis of the quality of work done. They are applicable to piece-rate workers in that the piece-rate is calculated to ensure that at the end of the month/day the worker receives at least the minimum wage on a normal working hour basis. This means that the total sum paid to a worker can be less than the minimum wage only if the worker works on average less than 8 hours a day. No deductions for quality, disciplinary or other reasons can bring the actual wage received below the minimum. If the money earned from piece-rate work is higher than the minimum wage, workers will get the higher amount.</p>	
<b>Fair trade Premium</b>	<p><b>PREMIUM CALCULATION</b></p> <p>In addition to a minimum price for recycled plastic and a fair wage for waste pickers, a fair trade premium should be established which may be a percentage of the final sale price of the finished filament product.<sup>vi</sup></p> <p><b>PREMIUM DISTRIBUTION</b></p> <p>This premium is to be invested in projects for the direct social, economic, and environmental benefit of the waste picking community that has gathered the recycled plastic. Notwithstanding the structure of the decision making body it is a compulsory requirement that decision making with regards to how the premium is spent is fully democratic and transparent and adequately represents the waste picking community.</p>	

**Environmental Criteria<sup>vii</sup>**

	<b>Minimum</b>	<b>Progress</b>
<b>Insulation</b>		The company will undertake and publish findings of further work to improve the insulation and extruder design of equipment to improve their efficiency.
<b>Use of chemicals</b>	<p>Toxic chemicals are not to be used at all and should not be necessary for all standard ethical filament production operations. Measures should be in place to ensure that improper use of equipment is minimized as improper use of a can cause combustion of the plastic and the concomitant toxic smoke.</p> <p>Chemicals are to be used safely and in accordance with published handling guidelines. (Fair Trade USA, 2012).</p>	The company will undertake and publish findings of further work to develop filament additives that improve printability, bed adhesion, colour fastness, etc. that are non-toxic.
<b>Water &amp; Conservation</b>	<p>Procedures should be implemented to make efficient and rational use of water sources, which are necessary for the washing of the plastic containers. Protection of soil, water and biodiversity is important and as such the ethical filament company should document its involvement in local and regional environmental projects related to supporting the biodiversity of the region</p>	The company will undertake and publish findings of further work to improve practices for water recycling and water use minimization for the washing of plastic containers.
<b>Toxins</b>	<p>Care needs to be taken to ensure no plastic that may contain BPA is recycled into containers or utensils for holding or serving food (The National Toxicology Program, 2008). Plastics coded 3 and 7 may contain BPA and should not be used in these situations (National Institute for Environmental Health Sciences, 2013).</p>	The company will undertake and publish findings of further work to development of a low-cost open-source hardware tool for characterizing the chemical composition of unknown plastics. For example, PLA, which is already known as a premium 3-D printer filament, is marked with recycle code 7 the “other” category along with many other types of plastics that may not be suitable for printing.
<b>Alternative energy sources</b>		Where possible the electricity used for the recycling operation should be from renewable and sustainable sources of energy. There has already been some technical development of solar-powered 3-D printers (King, et al. 2014) and further work could produce solar photovoltaic powered RecycleBots.

## References

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v For the purpose of this document, can we consider market price to be the average price at which a commercial recycler in that region would sell plastic on the commercial market to a business wishing to use recycled plastic for manufacturing?

vi More work needs to be done to establish what would constitute a fair premium.

vii The environmental criteria relate to protection of natural environment and how this goes over and above standard filament supply chains. The background on standard filament production in the original paper would be helpful here.