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Load testing of PP
Itip™ wheelbarrow handles

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Job No: J4921

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Introduction

Testing and validation of wheelbarrow handles was requested. No current standard was found for wheelbarrows in the UK. Manufacturers in the UK advise that their commercial trade wheelbarrows are load tested and certified up to 150KG. Below is an extract from RAPP tool from HSE.

*Small with one or two wheels: eg wheelbarrows, wheelie bins or sack trucks.
With this equipment the worker supports some of the load.*



Less than 50 kg	Low G/0
50 kg to 100 kg	Medium A/2
100 kg to 200 kg	High R/4
More than 200 kg	Very high R/8
Load exceeds equipment's rated capacity (manufacturer's recommended maximum weight)	Unacceptable P

Based on this information it was decided that load testing of the handles should be carried out to find the maximum load before failure. Our clients aim was to exceed 200KG.

Sample List

The samples delivered consisted of 5 of articulated wheelbarrow handles. Each of the samples were initially inspected for any evidence of defects. No difference between any of the handles was observed apart from the presence of a clip on 2 handles and not on the other 3. An example image of the delivered samples is shown below. In each case the handle element was manufactured from PP whilst the support stub was manufactured from POM.



Image 1: Samples as received

Method

In the absence of a published standard, a bespoke load test was agreed with the client. Load testing was conducted in 1 orientation on the 5 samples. A steel mandrel used for mounting and testing the handles. An image of the final test setup is shown below. For this testing a tensile tester was used with a crosshead speed of 12mm per minute, and the load on the handle was recorded digitally. The load was increased in approximately 250N steps and then held for 10 seconds at each interval.



Image 2: Test setup showing vertical loading

Results

Table 1: Load Test Results

Load (N)	Test piece				
	1	2	3	4	5
250					
500					
750					
1000					
1250					
1500					
1750					
2000					
Peak load	1785	1554	1440	1579	1355

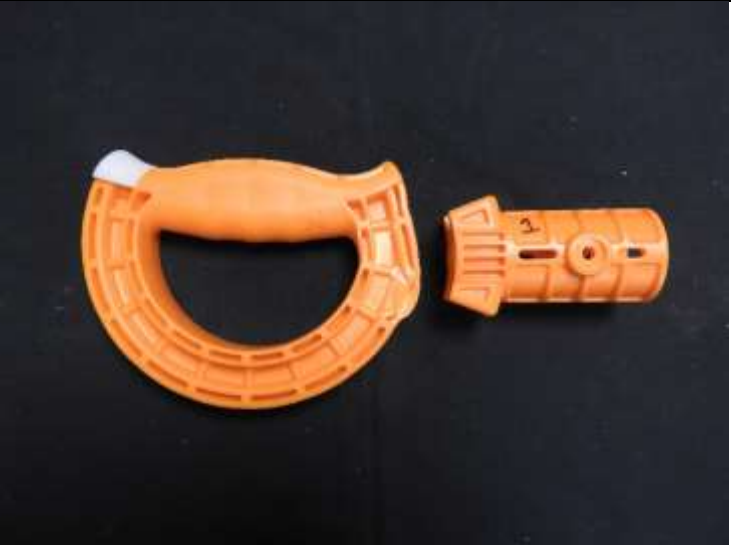

The table above shows the results of the tensile loading. For each sample a green square indicates a satisfactory hold of the applied load. Red indicates that the sample failed at that specific load.

Table 2: Summary of Load Results

Average peak load (N)	1543
Load equivalent mass (Kg)	157.2

The above table shows the summary of the loading results. The average failure load of the handles was 1543 N which is equivalent to 157.2 Kg. when used in pairs that would total slightly over 300kg of load before failure.

Table 3: Failure description of samples

Sample	Failure description	Image
1	Failed following deformation of the handle allowing it to slip out of the joint.	
2	Failed following deformation of the handle allowing it to partially slip out of the joint.	




3	Failed following deformation of the handle allowing it to partially slip out of the joint.	
4	Failed following deformation of the handle allowing it to partially slip out of the joint.	
5	Failed following deformation of the handle allowing it to partially slip out of the joint.	

Table 3 shows images and descriptions of how each sample failed during testing. All samples failed due to deformation of the handles that allowed the sample to slip out of the top of the joint. Image 3 (below) shows sample 2 just prior to failure.

In each case, visible deformation of the handle began to occur between 1000 and 1200N. Some stress whitening was visible on the inner radius of the handle (see image 3).

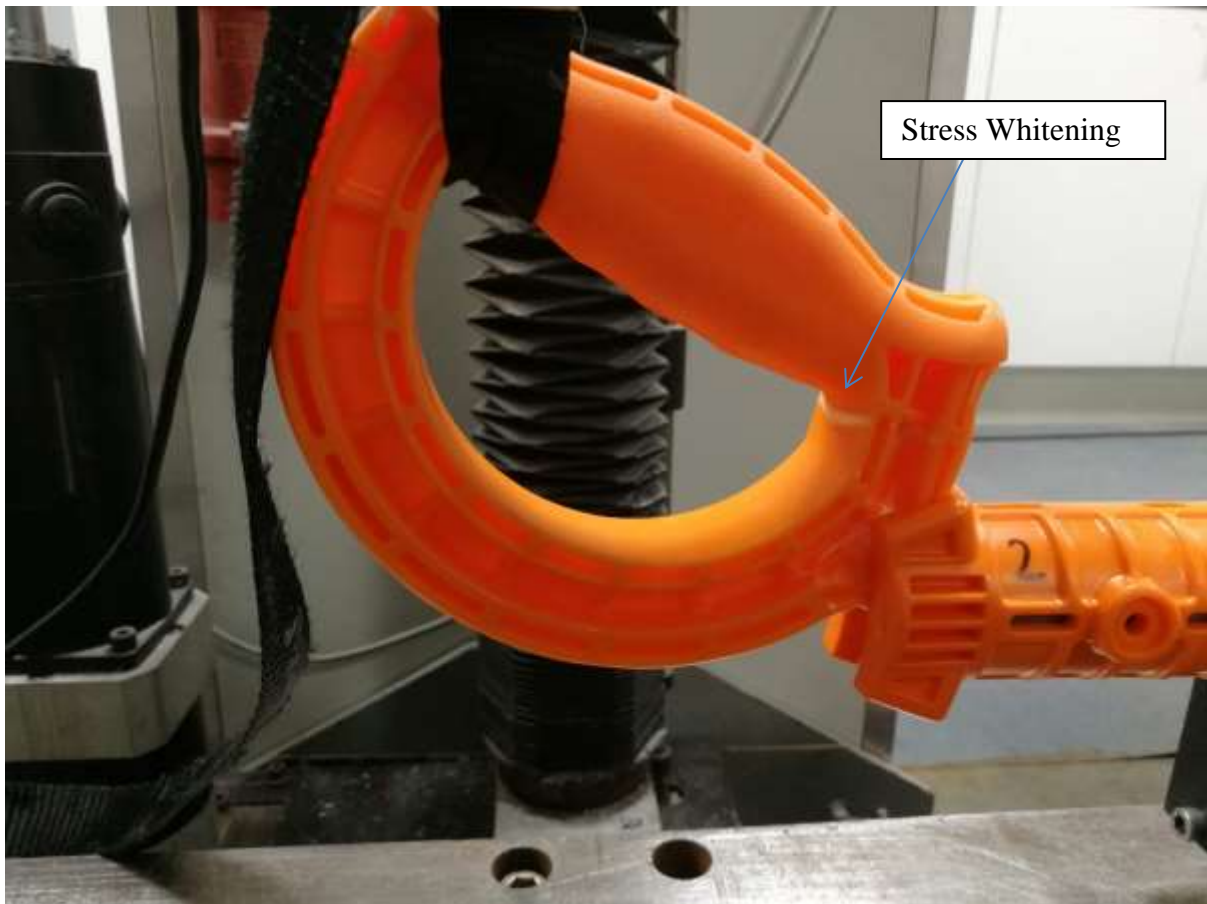
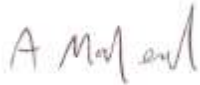


Image 3: Image of sample at failure

Conclusion

The following conclusions can be made from this work;

1. Load testing of the PP/POM variant shows a different failure mode to the POM variant.
2. No cracking or fracturing of the components occurred with the PP/POM variant.
3. Deformation of the handle begins to occur at around 1000 to 1200N.
4. Final failure occurs 1543N. The final failure mode is deformation of the PP track causing the handle to slip out of the POM retainer.



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