PTS TEST REPORT
AB.0001917-K2

Client	Nefab Bijl B.V. Baron van Nagellstraat 64 3781 AT Voorthuizen NIEDERLANDE
Order dated	8th January 2020
Sample received	17th December 2019 Sample 1: Mix of strawboard+kraft (30%) and cardboard (70%)
Order processed	21st January 2020 Assessment of the recyclability of packaging products made of paper and board according to PTS-RH:021/97 (Draft Oct 2019) – Category I: Paper and board for Recycling (PfR) that are predominantly used in the manufacture of graphic papers, tissue papers and white top packaging papers.

Heidenau, 17th March 2020

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Contents

1 SUMMARY OF THE RESULTS

Based on the tests and analyses performed, and in accordance with the criteria laid down in the PTS method PTS-RH:021/97 (Draft Oct 2019) Category II 'PfR that are predominantly used in the manufacture of packaging papers', the analyzed samples are rated as follows:

Sample code		**Mix of strawboard+kraft (30%) and cardboard (70%)**
Disinte-gratability	Non-paper constituents[1]	No information
	Total reject[2]	9.3 %
	Recyclable percentage[3]	90.7 %
Sheet formation	Adhesive impurities	None.
	Optical inhomogeneities	None.
OVERALL RATING Recyclability		**Recyclable.**

An assessment of potential impacts on circuit waters or effluents is not part of this method. This could be analysed separately upon request.

[1] This information either is provided directly by the manufacturer or is an estimate derived from the percentage of any removed-dry non-paper constituents and of any visually assessable non-paper constituents in the reject of a 0.7-mm hole plate fractionator (Brecht-Holl) and in the accept sheets after screening in a 0.15 mm slot plate fractionator (Haindl).

[2] This corresponds to the reject of a 0.7-mm hole plate fractionator (Brecht-Holl) and to the percentage of any removed-dry non-paper constituents

[3] Recyclable percentage (Fibre yield) means the percentage suitable for recycling or usable in papermaking. It corresponds to total mass of the sample (50g oven-dry ≙ 100%) less total reject

2 TASK DEFINITION

Task definition

Category II

PTS were commissioned to analyse the provided samples in terms of their recyclability (material recycling in papermaking).

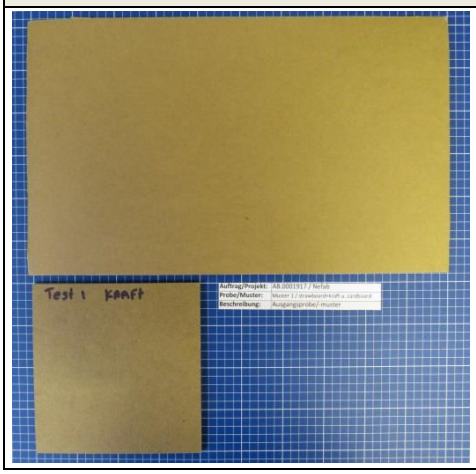
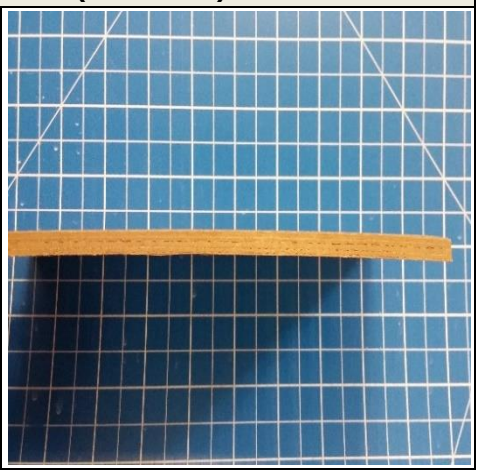
PTS classified the samples as semi-finished packaging products.

The testing of recyclability was carried out according to PTS-method PTS-RH:021/97 (Draft Oct 2019) 'Identification of the recyclability of paper and board packages and of graphic print products' – Category II: Paper and board for Recycling (PfR) that are predominantly used in the manufacture of packaging papers.

Sample material

The client provided the following sample material for the analysis:

Sample 1: Mix of Strawboard (20x20 cm, 0.5 cm thick) +kraft and cardboard (50x30 cm)

Strawboard (20x20 cm, 0.5 cm thick) +kraft and cardboard (50x30 cm)	
	

3 METHODOLOGY OF THE ANALYSIS – CATEGORY II

Tests performed

The analysis is carried out in accordance with the PTS method PTS-RH:021/97 (Draft Oct 2019) 'Identification of the recyclability of paper and board packages and of graphic print products'.

For the purpose of said test method, 'recyclability' is a post-consumer or pre-consumer paper or board product's ability to be treated in a recovered paper treatment plant according to recognised rules of engineering so as to ensure that the secondary fibre furnish allows the undisturbed and cost-effective manufacture of a recycled fibre-based new paper of acceptable quality.

The criteria used in the assessment of the recyclability are:

- **Disintegratability**
  Mass percentage of the constituents not usable in papermaking (removed-dry non-paper constituents and reject of non-defibrated fibre constituents after 0.7-mm hole-plate fractionation (Brecht-Holl))
- **Undisturbed sheet formation (absence of stickies or optical inhomogeneities)**
  Purity of the furnish mass percentage usable in papermaking

An assessment of potential impacts on circuit waters or effluents is not part of this method.

Category II

Packaging products as well as paper and board for the manufacture of packaging products (semi-finished products) are assigned to product Category II under PTS-RH:021/97 (Draft Oct 2019). This category covers recovered paper that is mainly used for the manufacture of packaging papers. The recovered paper treatment process for packaging papers does not include a deinking step for the removal of printing inks. Therefore, the test method (Category II) does not provide for a deinking test for such Paper and board for Recycling (PfR).

All partial tests were carried out by at least double determination. The values shown are the averages of the results so obtained.

Assessment

Disintegratability

The disintegratability criterion and the related yield in recyclable fibre is evaluated on the basis of the following tests:

- *Reject after Brecht-Holl fractionation*: This may include both non-disintegrated fibre agglomerates, coating and adhesive particles, as well as any non-paper constituents such as flat particles from coatings and laminations. Disintegratability is rated by means of the mass percentage of the reject and additionally described in qualitative terms.
- *Percentage of non-paper constituents*: This percentage is either based on the manufacturer's statements or is estimated. For estimates, the following percentages and assessments are taken into account:
    - Non-paper constituents eliminated by manual dry removal during specimen preparation, such as closures, grips, windows etc.
    - Polymer and other non-paper coatings, laminations and liners that can be evaluated based on the reject content after Brecht-Holl fractionation and can be detected during a visual inspection of the accept sheets after Haindl screening. Ink particles and adhesive applications are not included.
- *Total reject*: This percentage is the total of the percentage of the reject from Brecht-Holl fractionation and of the percentage of removed-dry non-paper constituents
- *Recyclable percentage (Fibre yield)*: This value results from the mass of initial material less the mass of total reject. It is based on the oven-dry total mass of the initial material.

Evaluation

Undisturbed sheet formation

The criterion of undisturbed sheet formation is assessed on the basis of the following two tests:

(1) Sheet adhesion test on handsheets made of the obtained stock (both total stock and accept from screening) to detect adhesive impurities (stickies) caused by e.g.

- Glued side wall and bottom panels
- Coating binders
- Polymer and other non-paper coatings, laminations and liners
- Adhesive labels and tapes
- Adhesive contaminants (stickies) in paper and board made of recycled fibre

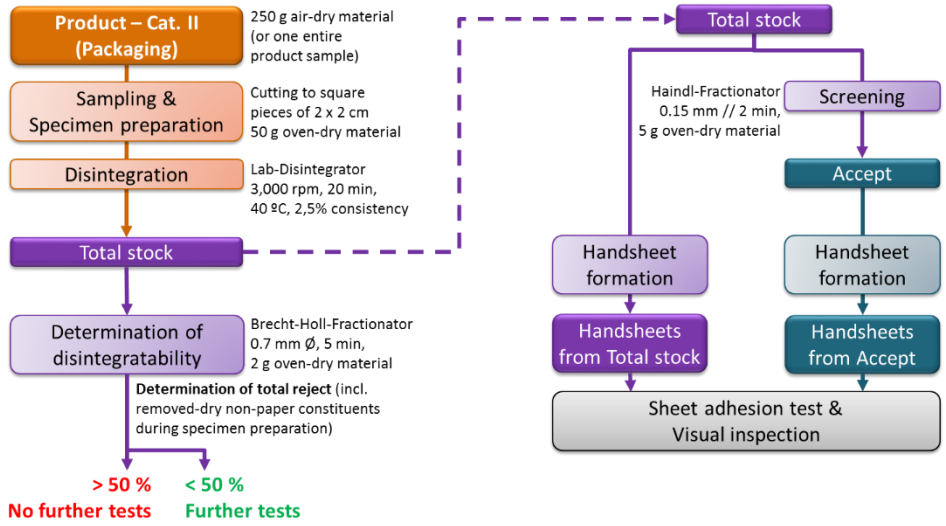
(2) Visual inspection for optical inhomogeneities such as:

- Dirt specks due to ink, coating, metal, paint, glue etc. particles.
- Transparent or white spots or flaws due to stickies, plastic particles, coating particles, etc.
- Through-coloured conspicuous fibres and significant stain of the handsheet due to colorants

General workflow

PTS-RH:021/97 (Draft Oct 2019)

Category II



Preparation of specimens

Category II

The testing of products (finished) as well as paper and board (semi-finished) samples according to **Category II** is each time carried out with a representative amount of at least 250 g of air-dry material (or at least one entire product sample).

For entire packaging product samples, the first step is a gravimetric determination of the different constituents such as glue on side and bottom panels, transparent windows, handles, etc.

Non-paper constituents (such as plastic closures, textile handles, etc.) are removed dry, where possible.

Prior to weighing the specimens, part of the specimens are subjected to a moisture test according to DIN ISO 287.

For weighing the required test quantity of 50 ± 1 g of oven-dry material, the mass-weighted proportional ratio between the remaining constituents is taken into account.

The test material is reduced to pieces of about 2 cm x 2 cm with a guillotine-type cutter or by means of a punch with an appropriate die.

Disintegration and homo-genisation

Category II

The size-reduced test material is disintegrated in a procedure after DIN EN ISO 5263. For this purpose, a total volume of 2,000 ml of the specimen is defibrated in a standard disintegrator without prior swelling at a consistency of 2.5%. The disintegration time is 20 minutes, the speed is 3,000 rpm, and the temperature of the tap water is 40°C.

Then, the fibre suspension such obtained is homogenized according to ZM V/6/61. For this purpose, the specimen is transferred into a distributor, diluted with tap water to a consistency of 0.5%, and homogenized for about 5 minutes.

In the following, the diluted stock to be used for further testing is referred to as ‘total stock’.

Disintegratability

Disintegratability is tested after the Zellcheming method ZM V/18/62.

For this purpose, the total stock is screened for 5 minutes without any further chemical additive by means of a Brecht-Holl fractionator using a perforated plate with a hole diameter of 0.7 mm. This is followed by a visual inspection and gravimetric determination of the reject on the perforated plate. As well as the reject content, the proportion of removed-dry non-paper constituents is included in the test.

Fibre yield can be derived from the difference between the (oven-dry, 100%) initial material and the total reject.

Rating of total reject (incl. of removed-dry non-paper constituents)		
< 20%	**20 – 50%**	**> 50%**
Recyclable	The product is recyclable, but worthy of product design improvement.	Not reasonably usable in paper recycling.

Screening and sheet formation

For evaluating the undisturbed sheet formation criterion, the total stock is first screened in a procedure after the Zellcheming method ZM V/1.4/86.

For this purpose, the total stock is fractionated for 2 minutes by means of a Haindl fractionator using a slot plate with a slot width of 0.15 mm. The passing fraction, which is hereinafter referred to as 'accept', is collected.

Then, the accept is used to form a sheet on a Rapid Köthen sheet former after DIN EN ISO 5269. The grammage of the handsheets is about 60 g/m², the drying temperature is about 96°C.

For the sheet adhesion test, the dried handsheets together with a couch carrier board and a cover sheet are sandwiched between two brass plates and placed in a drying oven where a full-surface pressure of 1.18 kPa is applied for 2 minutes. Next, the specimens are placed in an exsiccator where they are allowed to cool down for 10 minutes, then they undergo the sheet adhesion test and the visual inspection for any optical inhomogeneities.

For a qualitative assessment of the screening effect and the separation of contaminants, handsheets are formed also from the total stock and then tested for adhesive impurities (stickies) and optical inhomogeneities.

Sheet adhesion test

The carrier board and the cover sheet are one by one and slowly peeled off the handsheets. While doing so, the test operator will check for potential adhesion effects. Also, the surfaces of the handsheet, cover sheet and carrier board are inspected for any damage or adhesions to the handsheet.

Rating of sheet adhesion test (handsheets from accept)		
No adhesion effect	**Little adhesion effect with slight damage**	**Adhesion effect with damage**
Recyclable	**Limitedly** recyclable due to tackiness in the prepared fibre stock.*	**Not** recyclable due to tackiness in the prepared fibre stock.

* Not reasonably usable as a mono-material or only when using additional measures.

Visual inspection

The handsheets are inspected under transmitted light for the presence of any flaws, transparent and white spots, or dirt specks from inks, coating, paint, lamination and adhesive particles. In addition, the sheets are evaluated for stain from any dark colorants.

Rating of visual inspection for optical inhomogeneities (handsheets from accept)		
No or non-disturbing optical inhomogeneities	**Disturbing optical inhomogeneities**	**Unacceptable optical inhomogeneities**
Recyclable	**Limitedly** recyclable due to optical inhomo-geneities in the prepared fibre stock.*	**Not** recyclable due to optical inhomo-geneities in the prepared fibre stock.

* Not reasonably usable as a mono-material or only when using additional measures.

4 RESULTS FOR SAMPLE 1 – MIX OF STRAWBOARD & KRAFT (30%) AND CARDBOARD (70%)

Sample

Mix of strawboard+kraft (30%) and cardboard (70%)

Total mass (an entire packaging product sample) **52.77 g**

Packaging constituents	Mass [g]	Percentage [%]
strawboard+kraft	15.19 g	29.5 %
cardboard	37.58 g	70.5 %

Percentage of non-paper constituents

The semi-finished packaging product sample **Mix of strawboard+kraft (30%) and cardboard (70%)** is a mix of

- 30 % Strawboard with a kraftliner made of unbleached virgin fibres
- 70 % Cardboard which is a single wall corrugated board made of testliner and medium (secondary fibres)

There is no information about any non-paper constituents. The gravimetric percentage was not quantified.

Disintegratability

The reject content from Brecht-Holl fractionation is **9.3 %** on average.

The reject contains fibre flakes and long fibres. A picture of a reject sample can be found in the Annex.

The recyclable content is **90.7 %**.

Rating of total reject (incl. of removed-dry non-paper constituents)		
< 20%	**20 – 50%**	**> 50%**
Recyclable	The product is recyclable, but worthy of product design improvement.	Not reasonably usable in paper recycling.

Adhesive impurities

The handsheets made from total stock showed little adhesion to the carrier board and cover sheet. There was damage to the cover sheet and carrier board in form of single fibre tears all over the surface.

The handsheets made from accept showed no adhesion to the carrier board and cover sheet.

Pictures of a reject sample on the perforated plate (0.15mm slot) of the Haindl-screening and of the adhesion test can be found in the Annex.

Rating of sheet adhesion test (handsheets from accept)		
No adhesion effect	**Little adhesion effect with slight damage**	**Adhesion effect with damage**
Recyclable	**Limitedly** recyclable due to tackiness in the prepared fibre stock.	**Not** recyclable due to tackiness in the prepared fibre stock.

Optical inhomogeneities

The handsheets made from accept showed no optical inhomogeneities.

The Annex contains comparative images of handsheets made from the total stock and from accept, respectively.

Rating of visual inspection for optical inhomogeneities (handsheets from accept)		
No or non-disturbing optical inhomogeneities	**Disturbing optical inhomogeneities**	**Unacceptable optical inhomogeneities**
Recyclable	**Limitedly** recyclable due to optical inhomo-geneities in the prepared fibre stock.	**Not** recyclable due to optical inhomo-geneities in the prepared fibre stock.

Overall rating

Based on the tests performed, and in accordance with the criteria laid down in the PTS Method PTS-RH:021/97 (Draft Oct 2019), the analysed sample **Mix of strawboard+kraft (30%) and cardboard (70%)** is rated:

"Recyclable".

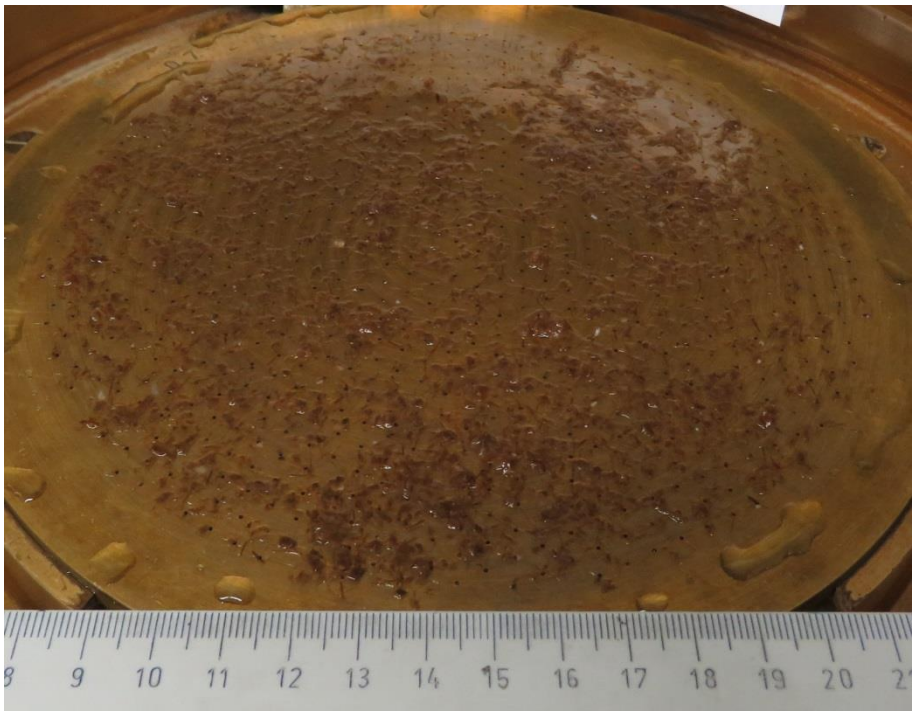
5 ANNEX FOR SAMPLE 1 – MIX OF STRAWBOARD+KRAFT (30%) AND CARDBOARD (70%)

Reject

Brecht-Holl-fractionation

Reject on perforated plate with a hole diameter of 0.7 mm

(sample weight 2 g oven dry)

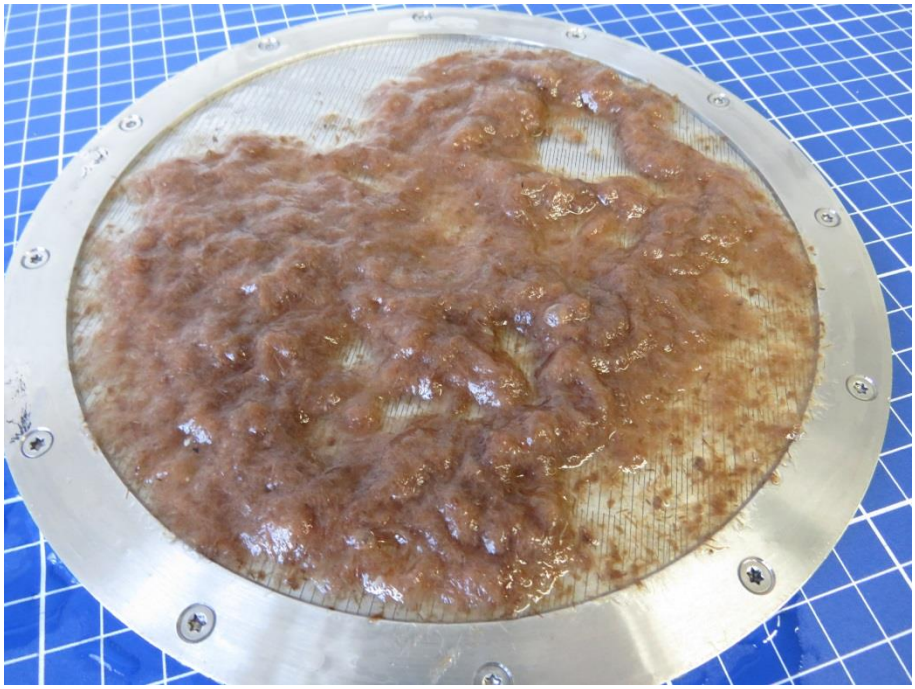


Reject

Haindl-screening

Reject on slot plate with a slot width of 0.15 mm

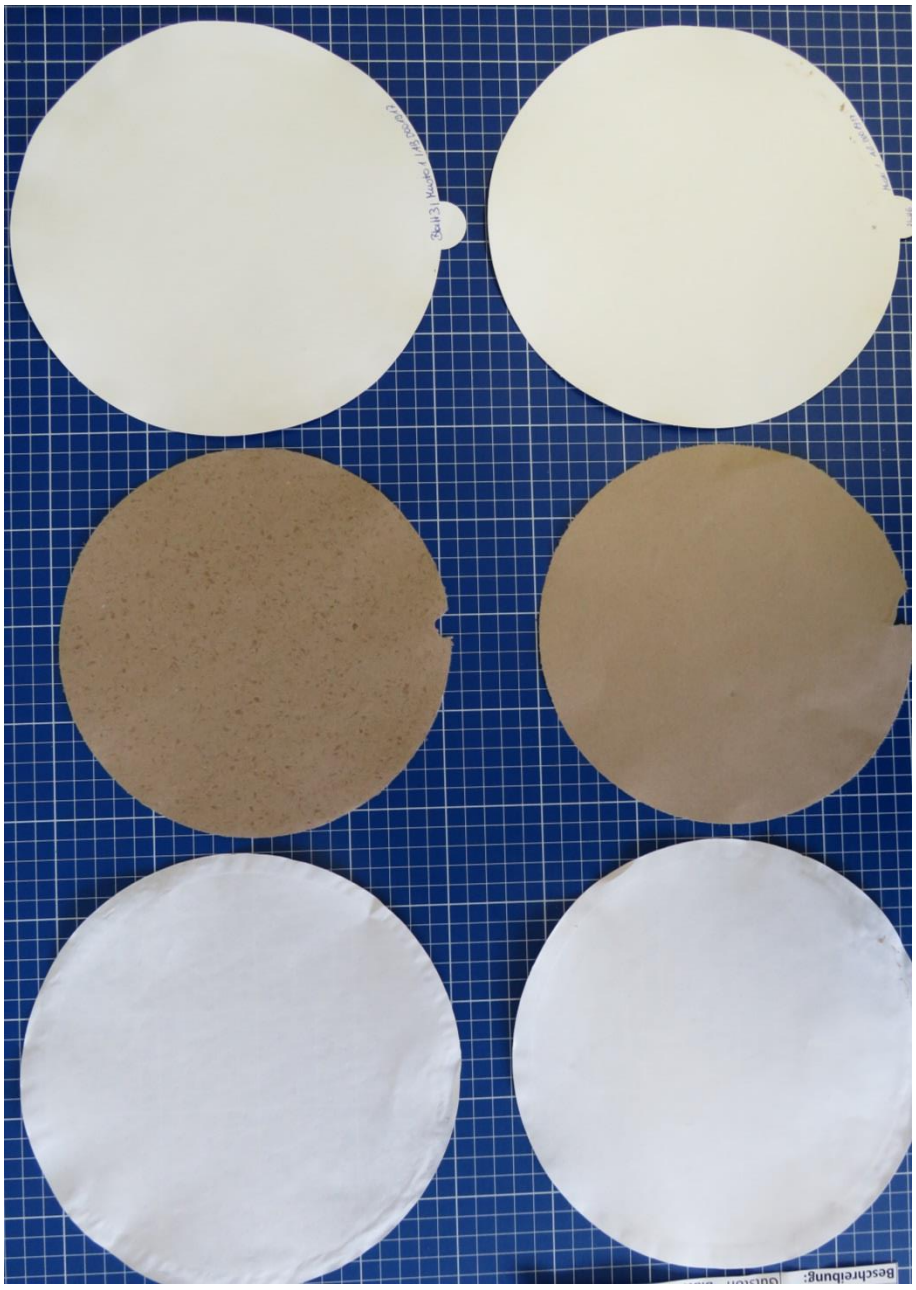
(sample weight 5 g oven dry)



Sheet adhesion test

Total stock (left)

Accept (right)



Handsheets

Total stock (above)

Accept (below)