Introduction

There are many factors determining the final quality of the print. Among this roughness, or rather, the degree of smoothness is one of the most important. There are many methods and devices to determine the roughness; however, they all have their limitations.
The determination of roughness described in this leaflet is a dynamic method, which is executed while maintaining the conditions of the printing process as closely as possible.
This method has been standardized in the Dutch standard NEN 1839.

Principle

On the IGT printability tester a small drop of water (with an accurately determined volume) is rolled out between two identical paper surfaces at high speed. Due to the high speed only the surface recesses of the paper will be filled. The area of the resulting blot on the paper is measured and the roughness of the paper is calculated as the volume of water per square meter of paper (cm^3/m^2). The speed in this test is high, so that the time of contact between the water and the paper is very short and the water cannot penetrate into the paper pores. To prevent initial penetration of the coloured water into the paper, the spot of application is closed using lacquer. The amount of water needed to carry out the test depends on the roughness of the paper to be tested: with very smooth papers 1 mm^3 may be sufficient, while for very rough papers a volume of up to 6 mm^3 may be necessary.

Method of operation

- It is recommended to execute the test in the standard atmosphere; to most standards it is 23,0 ± 1,0 °C and 50 ± 2% rh.
- For the operation of the AIC2-5T2000 and Global Standard Tester follow the instructions of the manuals, IGT information leaflet W100 and the displays accurately.
- Handle the samples carefully.

Preparation

1. Condition the papers, the test liquid and the equipment during >6 hours in the standard atmosphere.
2. Cut the paper strips and mark them with top and/or bottom side, machine and/or cross direction and a code for the type of material.
3. Mount the packing on the sector. See W100.
4. For the syringe 705 N only: Mount the syringe into the dispenser/adaptor.
5. For AIC2-5T2000 only:
   5.1. Adjust the printing force of the top printing disc shaft to 1000 N and pay attention for the right backlash. See W100.
   5.2. Adjust the printing speed to 3 m/s in the increasing speed mode (◢).
6. For GST 1/1W only:
   6.1. Select the menu "Roughness" in the display.
   6.2. Slide the mounting ring with the ring opening horizontal on the pin of the mounting plate.
   6.3. Fix the white or black tube connection of the adapter at the white or black dose air connection of the instrument by rotating or pressing and rotating for only 90 degrees (dependent to the type of connection).

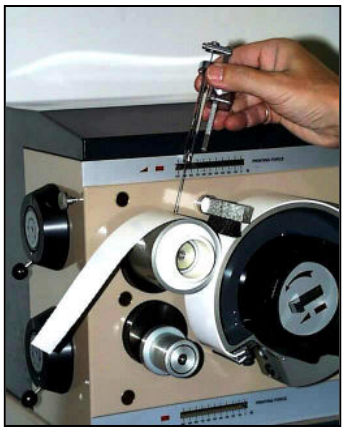


Fig.1: Roughness on AIC2-5T2000

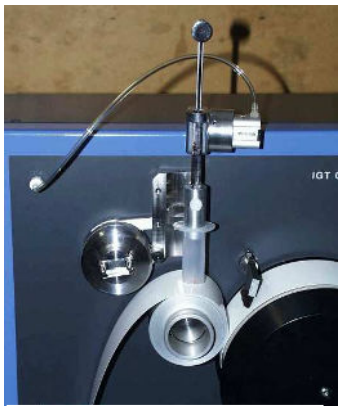


Fig. 2: Roughness on GST 1

Materials / Testing conditions		
1	IGT AIC2-5T2000 or IGT Global Standard Tester 1 or IGT Global Standard Tester 1-W ********** For AIC2-5T2000 only:	710.000.000 410.000.000 415.000.000
2	Syringe 705N 50 mm^3	409.010.705.414
3	Dispenser BP.600/1	409.006
4	Printing disc, aluminium, 50 mm	402.331
5	IGT roughness solution	409.004.000
6	Lacquer	409.005.000
7	Nomogram	409.007
8	Packing, rubber, 55 mm ********** For GST 1/1W only:	404.001.006
9	Syringe holder complete	409.041.000
10	Micro syringe 705N 50 mm^3	409.010.705.410
11	Printing disc, aluminium, 50 mm	402.331
12	IGT roughness solution	409.004.000
13	Lacquer	409.005.000
14	Nomogram	409.007
15	Packing, rubber, 55 mm	404.001.006
Strips of paper to be tested, preferable 55*340 mm^2, 10 strips per sample Ruler Lint free rags and ethanol		
Printing force	1000 N	
Printing speed	Increasing, end speed 3 m/s	
Quantity of test liquid	1 - 6 mm^3	
► The numbers 1 thru 15 are available at IGT Testing Systems.		

7. Fill the syringe:
   7.1. Insert the needle of the syringe with the plunger downwards into the trypan blue solution and fill the syringe with the liquid by moving the plunger upwards, downwards and upwards for several times.
   7.2. Clean the outside of the needle with rags and ethanol.

Execution

1. Place the printing disc on the top printing disc shaft.
2. Attach two test strips of the same paper with the sides to be tested facing one another into the front clamp of the sector.
3. Turn the sector into starting position.
4. Take care that the one strip is placed over the printing disc and the other strip on the sector.
5. For AIC2-5T2000only:
   5.1. Move the printing disc into printing position against the test strips.
   5.2. Apply with the brush a spot of lacquer onto the strip of paper on the printing disc at the place where the drop of test liquid will fall and allow the lacquer to dry. (This place will be at a distance of 100 - 105 mm from the beginning in the middle of the strip).
   5.3. Apply 1 to 6 mm^3 trypan blue solution on the lacquered spot by means of the micro syringe (see fig.1).
6. For GST only:
   6.1. Select "Make print" in the display.
   6.2. Press the side buttons to move the sector into the starting position, to move the printing disc into printing position and to move the syringe downwards. After these movements release the side buttons.
   6.3. Press the button "Enter" to move the syringe upwards. Also the printing disc will release from the paper.
   6.4. With the brush apply a spot of lacquer onto the strip of paper on the printing disc at the place where the drop of test liquid will fall on the paper and allow the lacquer to dry. (This place will be at a distance of 100 - 105 mm from the beginning in the middle of the strip).
   6.5. Select "Make print" in the display.
   6.6. Press the side buttons to move the printing disc into the printing position and to move the syringe downwards.
   6.7. Release the side buttons.

►►

6.8. Press button 1, 2, 3 or 4 to apply a drop of the test liquid of 1, 2, 3 or 4 mm^3 on the spot of lacquer of the paper strip. These buttons can be pressed more than once for bigger volumes. It is advised not to use more than 6 mm^3.

7. Make a "print": de drop of water will be spread into a spot between the papers strips.
8. Remove the test strips from the sector.
9. Calculate the roughness as described in the chapter "Assessment".
10. If necessary fill the syringe with the trypan blue solution.
11. Repeat the points 1 thru 10 for every test strip. It is recommended to perform the test at least 5 times per sample.
12. After having finished the test clean and store all parts as described in the manual.
13. Make an accurate record of the conditions and the results of the test and refer to W28.

Assessment

1. Measure the length (l) of the stain to the nearest 0.5 mm.
2. Measure the width (b) in the centre of the length of the stain to the nearest 0.5 mm.
3. Find the corresponding positions (l) and (b) in the nomogram and connect the two points with a straight line. See fig. 4. The intersection with the R-axis gives the roughness in 0.01 cm^3/m^2 for a drop volume of only 1 mm^3.
4. Multiply the value of the R-axis with the number of mm^3 of the drop volume used and divide this value by 100. The dimension of the roughness is cm^3/m^2.
5. Repeat the points 1 thru 4 for every test strip and calculate the average and if desired the standard deviation. In some cases it may be useful to mention the highest and lowest values as well.

Notes:

1. Example of calculation for the use of the nomogram:

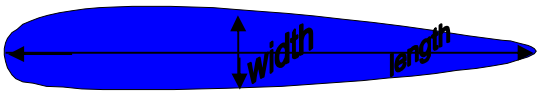
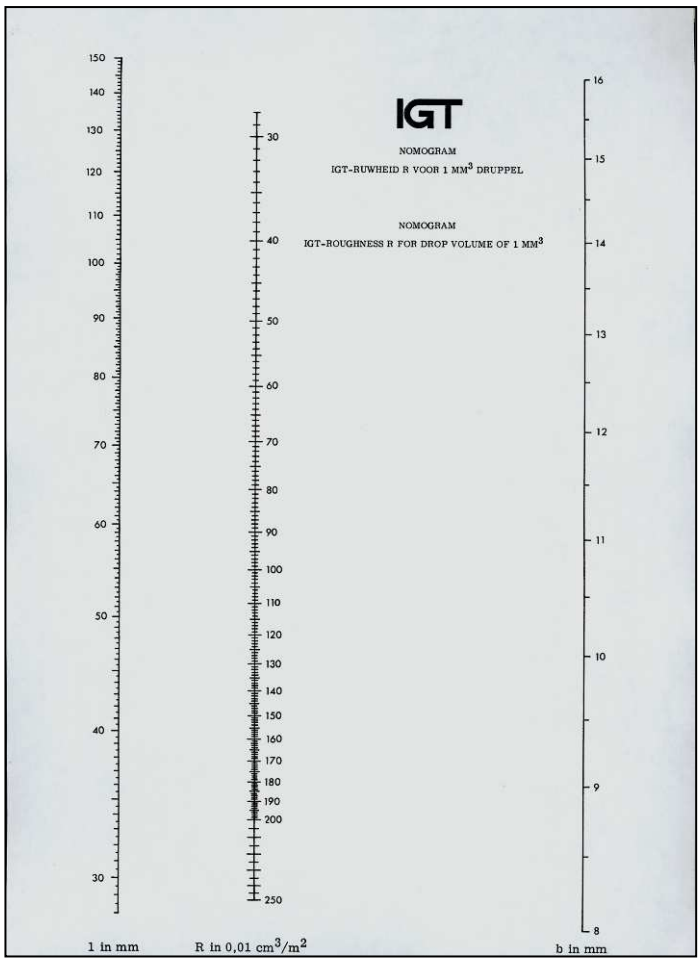


Fig. 3: Test result

- Assume a certain paper is tested with a volume V = 2 mm3.
- Assume the resulting stain has a length (l) = 70 mm, and a width, measured in the middle of the length, (b) = 13 mm.
- From the nomogram the value for 100 R at 1 mm3 = 65 is found.
- The roughness R is:
  R = (V x 65):100 = (2 x 65):100 = 1,3 cm^3/m^2
- The area of the stain may be approximated using the formula:
  A = 0,85 x l x b
  - Herein is:
    A = area of the stain in mm^3
    l = length of the stain in mm
    b = width of the stain in mm
- The roughness is calculated with the formula:
  R = (V x 1000) : 2 A
  - Herein is:
    V = volume in mm^3 of trypan blue used
    A = area in mm^2 of stain



Length mm | Roughness 0,01 cm^3/m^2 | Width mm

Fig. 4: Nomogram

►2006: In comparison to older IGT leaflets, this leaflet is valid for the AIC2-5T2000 and Global Standard Testers as mentioned
►2012: This leaflet is valid for the AMSTERDAM as well and contains some small text corrections
►2017: This leaflet is valid for the AIC2-5T2000 and GST1/1W and contains some small text corrections.