About finishes

The finishing touches

When you're making an engineered product and you've decided on the materials you're going to use, you then have to think about **finishes**.

Imagine you were building a footbridge. You may decide to make it from metal and concrete. When the structure is complete, you need to apply finishes. For example, you don't want a really **slippery** surface, and you will want a structure that doesn't **rust**. You wouldn't want any **sharp edges** where people might be holding on to things for support.

Other products will require different finishes. For example, sometimes things need to be **water resistant**, **scratch resistant** or **temperature resistant**. Perhaps you'll decide to add a finish to make your product look good. If you make things a certain colour by spraying or painting them, you don't want that surface to crack under a slight impact or blister in hot sunshine.

CT 0005:2003 Methods of testing finishes -

Part 1: Measuring the static coefficient of friction between steel and different surface finishes

Part 2: Testing the scratch resistance of finishes

Part 3: Testing the resistance of finishes to organic chemicals

Part 4: Testing the resistance of finishes to solutions of chemicals in water

COMPARATIVE TEST CT 0005-1:2003

Methods of testing finishes -

Part 1: Measuring the static coefficient of friction between steel and different surface finishes

1 Scope

This Comparative Test provides a method of measuring the static coefficient of friction between a polished steel block and a surface finish under test.

2 Principle

Static friction is the force that holds back a stationary object up to the point that it just starts moving. Thus, the static coefficient of friction is the force restricting the movement of an object that is stationary on a surface.

An object on an incline can be used to determine the static coefficient of friction by finding the angle at which the force of gravity overcomes the static friction.

3 Apparatus

- Protractor
- Ramp made from the finished material, approximately 30 cm long
- Highly polished steel block, 5 cm x 5 cm x 5 cm

4 Test specimens

The test specimen is the ramp. The finished surface should be facing upwards.

5 Procedure

- set up apparatus as shown in figure 1
- slowly lift the left edge on the ramp until the steel block slides down the surface
- record the angle, *a*, at which the block just starts to move
- repeat the experiment three times

6 Expression of Results

Calculate the static coefficient of friction, *u*, between the steel block and the surface finish under test using the equation:

$u = \tan(a)$

where

u is the static coefficient of friction (no units)

tan(*a*) is the tangent of the angle, *a*

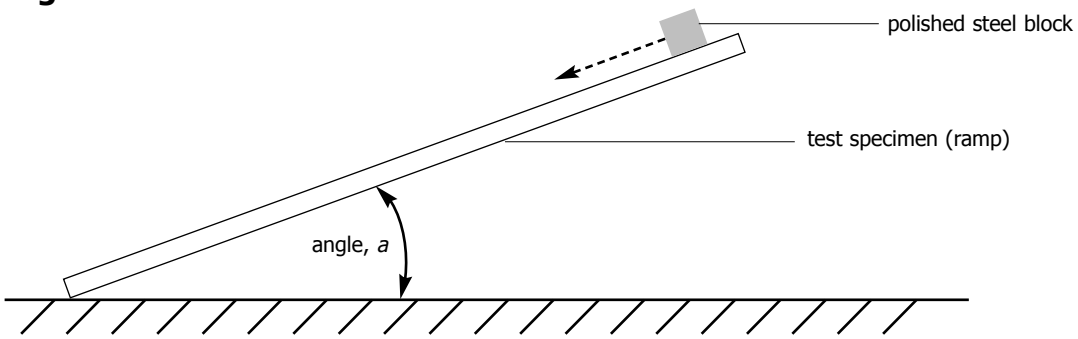
7 Test Report

Your test report should include:

(a) reference to this Comparative Test

(b) the static coefficient of friction between the steel block and the surface finish under test

figure 1



COMPARATIVE TEST CT 0005-2:2003

Methods of testing finishes - Part 2: Testing the scratch resistance of finishes

1 Scope

This Comparative Test estimates the scratch resistance of surface finishes.

2 Principle

Materials that can withstand scratching have the property of hardness. A hard material will not be scratched by a less hard material.

By scratching a surface finish with objects with a range of known hardness, the hardnesses (or scratch resistance) of the surface finishes can be estimated.

3 Apparatus

- Rectangular reference samples of materials of known relative hardness. Materials from the Mohs scale could be used:

Mineral	Hardness
Talc	1
Rock Salt	2
Calcspur	3
Flourspar	4
Apatite	5
Felspar	6
Quartz	7
Topaz	8
Corundum	9
Diamond	10

- Marker to identify corner points on reference samples used for scratching

4 Test specimens

The surface finish should be applied to the material it would be applied to in its intended engineered product. Three specimens should be prepared.

5 Procedure

- Scratch the surface of the test specimen with a corner point of the softest reference sample. Note whether a scratch is visible. Mark the corner point used to make sure a fresh point is used for each test (see figure 1).
- Repeat with reference samples of increasing hardness until a scratch is visible on the test specimen.
- repeat the procedure twice more, using different corner points of the reference samples each time.

6 Expression of Results

Record the softest object that scratched the surface finish, and the hardest object that did not scratch the surface finish. It can be assumed that the hardness of the surface finish lies between these values.

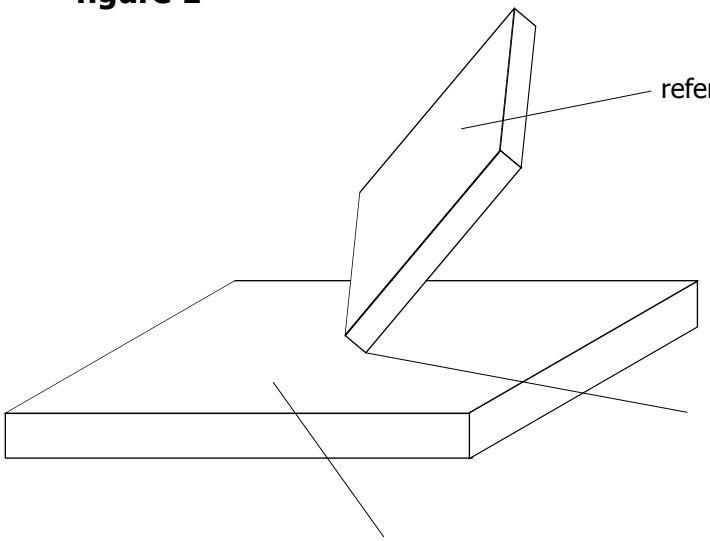
7 Test Report

Your test report should include:

(a) reference to this Comparative Test

(b) the approximate hardness (scratch resistance) of the surface finish under test.

figure 1


reference sample
one corner point of reference sample - mark each corner point with a pen when it has been used. Each corner point should only be used once.
test specimen

COMPARATIVE TEST CT 0005-3:2003

Methods of testing finishes - Part 3: Testing the resistance of finishes to organic chemicals

1 Scope

This procedure tests the effect of various organic solvents on a particular finish applied to a material.

This procedure can be customised and used for other organic solvents, provided safety checks and a risk assessment are carried out before starting work.

2 Principle

Finishes are usually applied to a material to improve its appearance and to make it last longer in a particular environment. They often protect a material or object from chemical attack. By following this procedure it is possible to note the effect on a surface finish when exposed to commonly used organic solvents. The solvents used are ethanol, propanone and petrol.

3 Apparatus

- three boiling tubes
- organic solvents:
  - ethanol (HIGHLY FLAMMABLE)
  - propanone (FLAMMABLE)
  - petrol (FLAMMABLE)
- cotton thread
- three glass rods
- stopwatch or other timing device
- fume cupboard
- clingfilm

4 Test specimens

Three test specimens, of a standard size, finished on all sides. The standard size must be decided upon (for example, 1 cm^3 block, a rod or a thin sheet) and then used for all specimens being compared.

Each specimen must be made from the same material and finished in the same way as it would be in its intended engineered product.

5 Procedure

- Set up the apparatus as in figure 1
- Cover each boiling tube with clingfilm to prevent evaporation
- Use the glass rods to lift each specimen from its boiling tube and note any change to its surface finish. Use a table like the one shown in figure 2 for the results.
- Place the specimens back in the boiling tubes and check again after 30 mins and again after one hour.
- Place the boiling tubes in a fume cupboard for 24 hours.
- Check the surface finishes and record the final observations.

6 Expression of Results

Copy and complete the table as shown in figure 2.

7 Test Report

Your test report should include:

(a) reference to this Comparative Test

(b) a copy of the completed table

figure 1

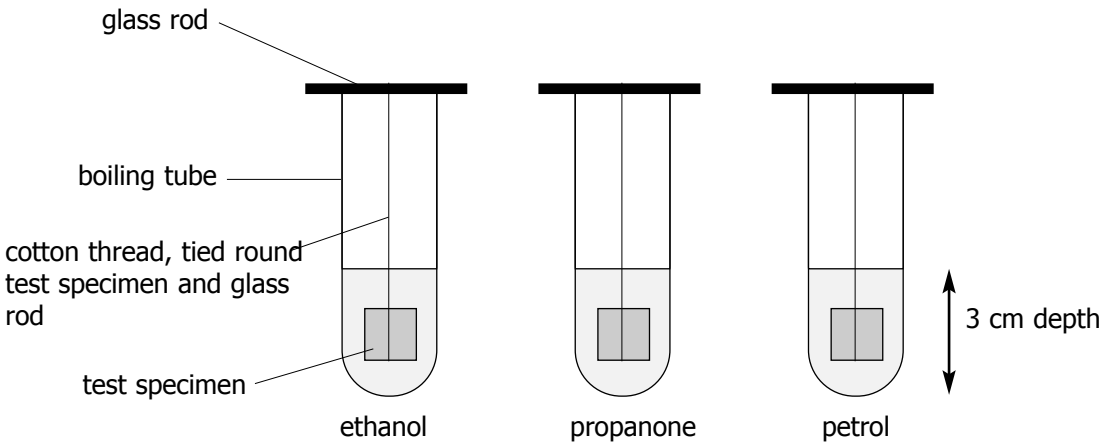


figure 2

	Organic solvent		
Observation	Ethanol	Propanone	Petrol
Immediate			
After 30 mins			
After one hour			
After 24 hours			

Methods of testing finishes -
Part 4: Testing the resistance of finishes to solutions of chemicals in water

1 Scope

This procedure tests the effect of solutions of chemicals in water on a particular finish applied to a material.

This procedure can be customised and used for other solutions of chemicals in water, provided safety checks and a risk assessment are carried out before starting work.

2 Principle

Finishes are usually applied to a material to improve its appearance and to make it last longer in a particular environment. They often protect a material or object from chemical attack. By following this procedure it is possible to note the effect on a surface finish when exposed to commonly used solutions of chemicals in water. The chemical solutions used are ethanoic acid, hydrochloric acid, sodium carbonate, ammonia, sodium hydroxide and sodium chlorate(I).

NOTE: there is a difference between the strength and concentration of acids and alkalis.

3 Apparatus

- six boiling tubes
- water
- solutions of chemicals in water:
  - 1 mol dm^{-3} ethanoic acid
  - 1 mol dm^{-3} hydrochloric acid
  - 1 mol dm^{-3} sodium carbonate
  - 1 mol dm^{-3} ammonia
  - 1 mol dm^{-3} sodium hydroxide [corrosive]
  - 1 mol dm^{-3} sodium chlorate(I)
- nylon fishing line
- six glass rods
- cling-film
- stopwatch or other timing device
- fume cupboard
- 250 cm^3 beaker
- Bunsen burner, stand and gauze

4 Test specimens

Six test specimens, of a standard size, finished on all sides. The standard size must be decided upon (for example, 1 cm^3 block, a rod or a thin sheet) and then used for all specimens being compared.

Each specimen must be made from the same material and finished in the same way as it would be in its intended engineered product.

5 Procedure

- Set up the apparatus as in figure 1
- cover each boiling tube with clingfilm to prevent evaporation
- Use the glass rods to lift each specimen from its boiling tube and note any change to its surface finish. Use a table like the one shown in figure 2 for the results.
- Place the specimens back in the boiling tubes and check again after 30 mins and again after one hour.
- Place the boiling tubes in a fume cupboard for 24 hours.
- Check the surface finishes and record the observations
- Set up apparatus as shown in figure 3
- For each boiling tube:
  - heat water until boiling and allow to simmer gently
  - place boiling tube in the water, start stopwatch

- record any changes to the surface finish over a ten minute period. Record results in a table like the one shown in figure 4
- repeat for the remaining boiling tubes

- NOTE: this procedure can also be used to determine the effects of water by submerging the test specimen in distilled water, tap water or salt water and following the same steps.

6 Expression of Results

Copy and complete the table as shown in figure 2.

For each chemical solution, copy and complete the table as shown in figure 4.

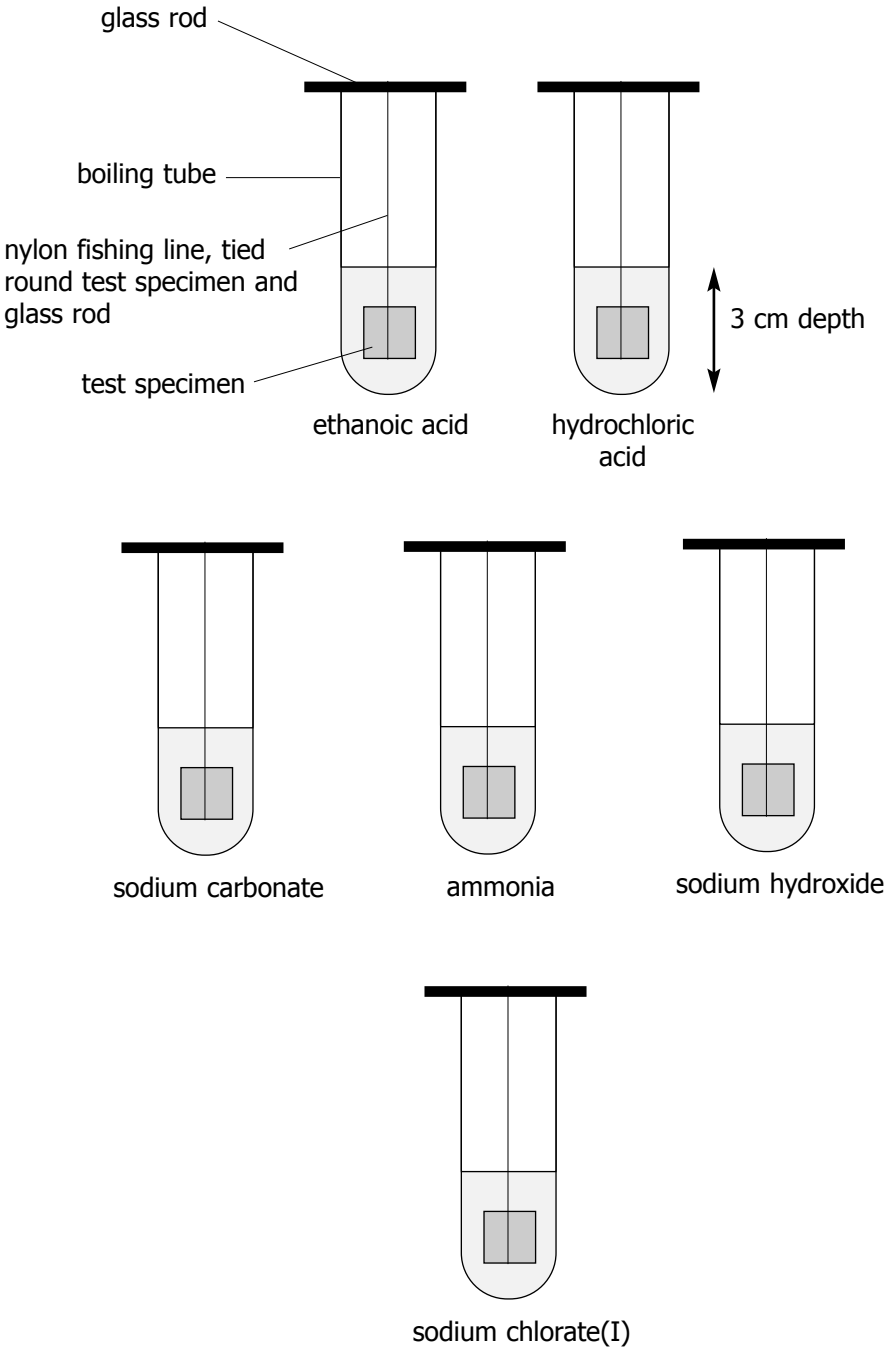
7 Test Report

Your test report should include:

(a) reference to this Comparative Test

(b) A copy of the two completed tables.

figure 1



NOTE: all solutions are 1 mol dm^{-3}

figure 2

	Solutions of chemicals in water					
Observation	1 mol dm^{-3} ethanoic acid	1 mol dm^{-3} hydrochloric acid	1 mol dm^{-3} sodium carbonate	1 mol dm^{-3} ammonia	1 mol dm^{-3} sodium hydroxide	1 mol dm^{-3} sodium chlorate(I)
Immediate						
After 30 mins						
After one hour						
After 24 hours						

figure 3

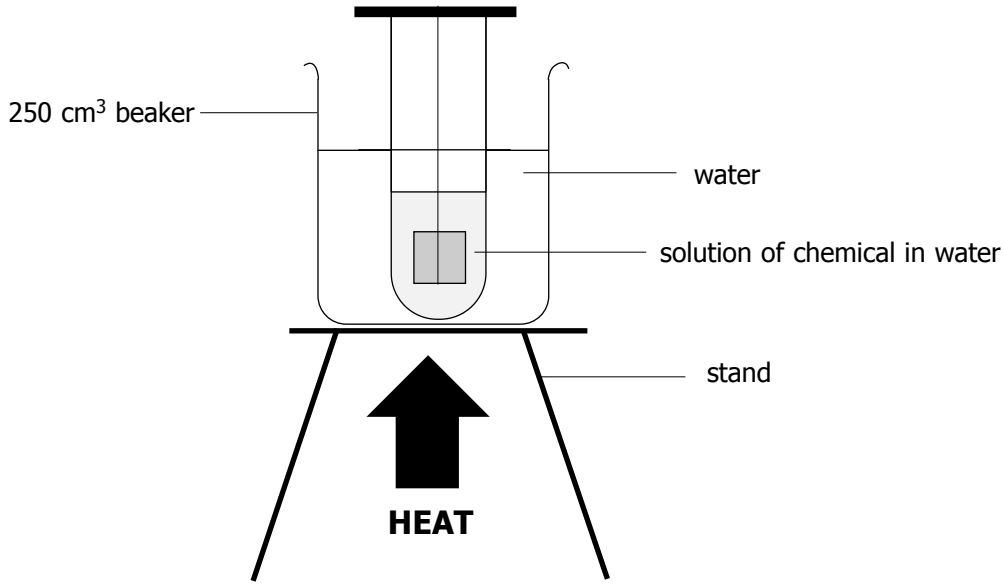


figure 4

Name of chemical solution =	
Time / mins	Observation
1.0	
2.0	
3.0	
4.0	
5.0	
6.0	
7.0	
8.0	
9.0	
10.0	