c)  $\alpha_{\rm c}$  — Annular flow — Pipe

$$\alpha_{c} = \frac{3}{4} \frac{\left[ \left( 2 \times 290\ 580 \right) / 24\ 500 + 3/4 \right] - \sqrt{\left[ \left( 2 \times 290\ 580 \right) / 24\ 500 + 3/4 \right]^{2} - 4\left( 290\ 580 / 24\ 500 \right)^{2}}}{2\left( 290\ 580 / 24\ 500 \right)} = 0,583\ 600$$

d)  $\alpha_{\rm c}$  — Annular flow — Slot

$$\alpha_{c} = \frac{3}{4} \frac{\left[ (2 \times 129\ 150) / 24\ 500 + 3/4 \right] - \sqrt{\left[ (2 \times 129\ 150) / 24\ 500 + 3/4 \right]^{2} - 4\left(129\ 150 / 24\ 500\right)^{2}}}{2\left(129\ 150 / 24\ 500\right)} = 0,515\ 4$$

e) Critical Bingham Reynolds number Re<sub>BP2</sub> — Annular flow — Pipe

$$Re_{\mathsf{BP2}} = \frac{290\ 580 \times \left[0,968\ 774 - 1,362\ 439 \times 0,583\ 6 + 0,160\ 082\ 2 \times \left(0,583\ 6\right)^4\right]}{8 \times 0,583\ 6} = 11\ 964$$

f) Critical Bingham Reynolds number  $Re_{BP2}$  — Annular flow — Slot

$$Re_{\mathsf{BP2}} = \frac{129\,150 \times \left[0,968\,774 - 1,362\,439 \times 0,515\,4 + 0,160\,082\,2 \times \left(0,515\,4\right)^4\right]}{12 \times 0,510\,2} = 7\,040$$

g) Critical fluid mean velocity for turbulent flow — Annular flow — Pipe

$$v_{\rm c} = \frac{\left(5,586 \times 10^{-3}\right) \times 11964}{1560 \times \left(0,2159 - 0,1778\right)} = 1,12 \,{\rm m/s}$$

h) Critical fluid mean velocity for turbulent flow — Annular flow — Slot

$$v_{\rm c} = \frac{1,5 \times (5,586 \times 10^{-3}) \times 7\ 040}{1560 \times (0,215\ 9-0,177\ 8)} = 0,99\ {\rm m/s}$$

i) Critical flowrate — Annular flow — Pipe

$$q_{\rm c} = \frac{\pi \times (0,215.9^2 - 0,177.8^2) \times 1,12}{4} = 0,013 \,{\rm m}^3/{\rm s}$$

j) Critical flowrate — Annular flow — Slot

$$q_{\rm c} = \frac{\pi \times \left(0,215 \ 9^2 - 0,177 \ 8^2\right) \times 1,12}{4} = 0,013 \ {\rm m}^3/{\rm s}$$

# 13.4.2.4 Example 4

What is the friction pressure, in pascals, over 500 m for the same fluid flowing at 0,015 m<sup>3</sup>/s?

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Its velocity is:

$$v = \frac{4 \times 0.15}{\pi (0.215 9^2 - 0.177 8^2)} = 1,27 \text{ m/s}$$

#### a) Reynolds number — Annular flow — Pipe

$$Re_{\rm BP} = \frac{1,27 \times 1560 \times (0,2159 - 0,1778)}{5,5862 \times 10^{-3}} = 13520$$

#### b) Reynolds number — Annular flow — Slot

$$Re_{\rm BP} = \frac{1,27 \times 1560 \times (0,2159 - 0,1778)}{1,5 \times 5,5862 \times 10^{-3}} = 9008$$

Since *Re*<sub>BP</sub> is greater than *Re*<sub>BP2</sub> in both pipe and slot models, the flow regime is turbulent.

#### c) Pipe-flow model

For the pipe-flow model, the Hedstrom number, He, is greater than  $1,575 \times 10^5$ . So the friction factor, f, is given by:

$$f = 0,205 \ 21 \times 13 \ 520^{-0,355 \ 79} = 6,96 \times 10^{-3}$$

Thus the friction pressure gradient is given by:

$$\frac{\Delta p}{L} = \frac{2 \times 1560 \times 1,27^2 \times (6,96 \times 10^{-3}) \times 1}{(0,2159 - 0,1778)} = 919,28 \text{ Pa/m}$$

which gives a friction pressure of:

$$\Delta p = 919,28 \times 500 = 459\ 640\ Pa$$

#### Slot-flow model

For the slot-flow model, the Hedstrom number, *He*, is such that  $0.75 \times 10^5 < He < 1.575 \times 10^5$ . So the friction factor, *f*, is given by:

$$f = 0,263\ 651 \times 9\ 008^{-0,389\ 31} = 7,61 \times 10^{-3}$$

So the friction pressure gradient is given by:

$$\frac{\Delta p}{L} = \frac{2 \times 1560 \times 1,27^2 \times (7,61 \times 10^{-3}) \times 1}{(0,2159 - 0,1778)} = 1005 \,\text{Pa/m}$$

which gives a friction pressure of:

$$\Delta p = 1005 \times 500 = 502500$$
 Pa

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SI unit	to be multiplied by	to get value in USC units
Pa	1 × 10 <sup>-5</sup>	bar
m <sup>3</sup>	6,29	bbl
m <sup>3</sup> /s	6,29 × 60	bbl/min
Pa∙s	1 000	cP
m	3,28	ft
m <sup>3</sup> /s	264,19 × 60	gal/min
m	39,37	in
m <sup>3</sup>	1 000	I
m <sup>3</sup> /s	1 000 × 60	l/min
kg/m <sup>3</sup>	$2,2 \times (3,785 \ 2 \times 10^3)$	lbm/gal
kg/m <sup>3</sup>	$2,2 \times 0,304 \ 8^3$	lbm/ft <sup>3</sup>
Pa	2,09	lbf/100 ft <sup>2</sup>
Pa·s <sup>n</sup>	0,020 9	lbf·s <sup>n</sup> /ft <sup>2</sup>
Pa	6 894,65	psi

# **13.5 Conversion factors**

# 14 Test procedure for arctic cementing slurries

# 14.1 General

This procedure is intended for the testing of cement slurries that are to be placed in areas known to contain permafrost. The conditioning temperature for the test equipment, materials to be tested and the test temperatures shall be controlled to  $\pm$  1 °C ( $\pm$  2 °F).

# 14.2 Preparation of cement slurry

Test samples shall be prepared according to Clause 5, except that the cement blend and mixing equipment shall be preconditioned at  $-7 \degree C$  (20 °F). Mix water shall be pre-chilled to 1 °C (34 °F), and the slurry temperature shall be recorded immediately after mixing; ~ 4 °C (40 °F) is typical. Each of the above temperatures shall be measured and reported on all tests.

# 14.3 Fluid fraction

The fluid fraction shall be expressed as percent by mass of basic dry blend (not including any additives needed for placement).

# 14.4 Thickening time

A thickening-time test shall be performed in a consistometer at 4 °C (40 °F) at atmospheric pressure.

# 14.5 Compressive strength

Specimens shall be cured at –7 °C (20 °F) and 4 °C (40 °F) for the desired testing period, i.e. 1 d, 3 d or 7 d.

The moulds shall be preconditioned by cooling to the temperature of the curing bath, i.e.  $-7 \degree C (20 \degree F)$  or  $4 \degree C (40 \degree F)$ .

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Stir the selected cementing compositions for 90 min in a consistometer at 4 °C (40 °F) before pouring into the preconditioned moulds for curing. For curing at temperatures below 0 °C (32 °F), seal the test specimens in a container of fresh water at test temperature or 2 °C (35 °F), whichever is higher. Submerge the sealed container in a mineral oil or glycol bath at test temperature in a manner consistent with avoiding contamination of the fresh water and specimens.

EXAMPLE For 24-h compressive strengths:

- a) Stir cement slurry for 90 minutes at 4 °C (40 °F) and atmospheric pressure.
- Quickly pour slurry into preconditioned moulds, seal in a suitable container filled with fresh water [for tests below 0 °C (32 °F)], and submerge in curing bath.
- c) Cure slurry for 22 h at  $-7 \circ C$  (20  $\circ F$ ) or 4  $\circ C$  (40  $\circ F$ ), and monitor temperature.
- d) Remove cubes from moulds 30 min before the test and place them in 4 °C (40 °F) water. Crush the specimens at the loading rates described in 7.5.6 a).

# 14.6 Freeze-thaw cycling at atmospheric pressure

Prepare slurry as in 14.2 (do not precondition the slurry as in 14.5) and cure under the following sequence (it is suggested that the cycle begin on a Monday):

- a) 48 h at 4 °C (40 °F) Monday
- b) 24 h at -7 °C (20 °F) Wednesday
- c) 24 h at 4 °C (40 °F) Thursday
- d) 72 h at 38 °C (100 °F) Friday
- e) 72 h at 77 °C (170 °F) Monday
- f) 24 h at 38 °C (100 °F) Thursday
- g) 72 h at -7 °C (20 °F) Friday
- h) Raise to 4 °C (40 °F) and repeat cycle on Monday.

#### 14.7 Compressive strength cyclic testing

Examine the cement cubes and break them after 1 and 3 cycles under these conditions (14 d and 42 d). Cure all compressive-strength test cubes under water and in moulds during cycles with top of cement column exposed to water. Break control specimens after 48 h at 4  $^{\circ}$ C (40  $^{\circ}$ F) for reference.

# 15 Well-simulation slurry stability tests

# **15.1 Introduction**

The purpose of this test is to determine the static (quiescent) stability of a cement slurry. The cement slurry is conditioned to simulate dynamic placement in a wellbore. The slurry is then left static to determine if free fluid separates from the slurry or to determine if the cement slurry experiences particle sedimentation. Both the free fluid result and the sedimentation result are required in order to understand the static stability of the slurry under downhole conditions. Free fluid can be formed with minimal sedimentation, and sedimentation can take place without free fluid being formed. Therefore, both results must be evaluated to determine slurry stability. Excessive free fluid and settling are normally considered detrimental to cement sheath quality. The amount of free fluid or settling that is acceptable varies with the application.

# 15.2 Slurry mixing

Prepare the cement slurry according to Clause 5. If performing the sedimentation test described in 15.6, immediately after mixing the slurry, measure the density of the slurry using a pressurized fluid density balance.

# 15.3 Slurry conditioning

Any consistometer referenced in Clause 9 may be used. The following procedure applies to the most commonly used equipment.

Place the slurry in the container of the pressurized consistometer and begin a thickening-time test in accordance with Clause 9. Apply pressure and heat or cool according to the thickening-time schedule which most closely simulates actual field conditions. If desired, the slurry may be held at the specified temperature and pressure for 30 min  $\pm$  30 s or other desired conditioning period before proceeding to the next step. If the conditioning temperature is greater than 88 °C (190 °F), cool the slurry to approximately 88 °C (190 °F) for safety. If the boiling point of water in your area is less than 100 °C (212 °F), adjust test temperatures accordingly.

Release the pressure slowly [about 1 380 kPa/s (200 psi/s)]. Remove the slurry container from the consistometer, keeping the container upright so oil does not mix with the slurry. Remove the top locking ring, drive bar and collar from the shaft and the diaphragm cover. Syringe and blot any oil from the top of the diaphragm. Remove the diaphragm and the support ring. Syringe and blot any remaining oil from the top of the slurry. If the contamination is severe, discard the slurry and begin the test again. Remove the paddle and stir the slurry briskly with a spatula to ensure a uniform slurry.

At this point, proceed with either 15.4 or 15.5 for a free-fluid test. For a sedimentation test, proceed to 15.6.

NOTE The 88 °C (190 °F) safety temperature assumes a boiling point for water of 100 °C (212 °F).

# **15.4 Free-fluid test with heated static period**

#### 15.4.1 General

Pour the slurry into a clear graduated tube. The ratio of the slurry-filled length to the inside tube diameter shall be greater than 6:1 and less than 8:1. The clear tube shall be inert to well cements and shall not deform during the test. The clear tube shall be graduated such that the slurry volume placed in the tube can be visually determined with a precision of  $\pm 2$  ml. The free-fluid test slurry volume shall be between 100 ml and 250 ml, inclusive. Document the slurry volume placed in the tube dimensions as well.

Preheat (or precool) a test chamber for curing the slurry during the static period to  $T_{BHC}$  or 88 °C (190 °F), whichever is cooler. To minimize the effects of condensation on the test results, a test temperature of 88 °C (190 °F) was chosen, and a boiling point for water of 100 °C (212 °F) assumed. If the boiling point of water in your area is less than 100 °C (212 °F), adjust the 88 °C (190 °F) test temperature accordingly. This chamber may be an atmospheric heating or cooling bath/oven/jacket/chamber, or a suitable pressurized heating/cooling chamber that uses hydrocarbon oil to transmit heating/cooling to the slurry.

A bath/oven/jacket/chamber or pressurized chamber is designated hereafter in this clause as a chamber. When hydrocarbon oil is used, the oil shall have a flash point that satisfactorily meets the safety requirements of the organization performing the test.

#### 15.4.2 Free-fluid tests at temperatures less than 88 °C (190 °F)

Immediately place the graduated tube in a heating or cooling chamber that is preheated or precooled to  $T_{BHC}$ . Cover the opening of the graduated tube to prevent evaporation. The chamber must be able to heat or cool the entire slurry. The tube can be tilted to simulate hole angle, if desired. Appropriate precautions shall be taken to ensure the static curing is performed at essentially vibration free conditions.

The temperature is maintained at  $T_{BHC}$  for the remainder of the test. The test duration is 2 h, starting from the time the slurry is poured into the clear tube. After the 2 h test period, the volume of free fluid (clear or coloured fluid on top of the cement slurry inside of the clear tube) shall be measured, with a precision of ± 0,2 ml.

The volume fraction,  $\varphi$ , of free fluid, expressed as a percent, is then calculated.

$$\varphi = \frac{V_{\mathsf{F}}(100)}{V_{\mathsf{S}}} \tag{110}$$

where

- $V_{\mathsf{F}}$  is the volume, in millilitres, of free fluid;
- $V_{\rm S}$  is the volume in millilitres, of slurry.

### 15.4.3 Free-fluid test at temperatures greater than or equal to 88 °C (190 °F)

Place the graduated tube in a preheated 88 °C (190 °F) oil-filled heating chamber. Optionally, tilt the tube to simulate hole angle. Further heat the slurry to  $T_{BHC}$  in the time required to take the slurry from a depth with 88 °C (190 °F) circulating temperature to  $T_{BHC}$ . Some heating chambers may not be able to heat fast enough; in that case heat as fast as possible but minimize overshooting the  $T_{BHC}$ . Maintain the slurry at  $T_{BHC}$  until it is time to start cooling the chamber back down to 88 °C (190 °F). The time required to cool various pieces of equipment from elevated temperatures back to 88 °C (190 °F) will vary. Maintain the pressure on the curing chamber high enough throughout the test so the slurry cannot boil (Table 4). The pressure applied can simulate bottom-hole conditions, if desired. Avoid constant pump cycling, in order to prevent vibration. The schedules found in Clause 9 can be used to aid in selecting pressure- and temperature-change rates. Take appropriate precautions to ensure that the static curing is performed in essentially vibration-free conditions.

The 2 h test period is initiated when the conditioned slurry is poured into the graduated tube. Slurries need to be cooled to 88 °C (190 °F) before the free fluid can be measured. This cooling time is part of the 2 h test period. After the 2 h test period, the volume of free fluid (clear or coloured fluid on top of the cement slurry inside of the clear tube) shall be measured. Free fluid for slurries immersed in hydrocarbon oil collects above the cement but below the oil. Measure the volume of the free fluid with a precision of  $\pm$  0,2 ml.

The volume fraction of free fluid is then calculated, as a percent, in accordance with Equation (110) above.

# 15.5 Free-fluid test with ambient temperature static period

Pour 250 ml of the slurry from 15.3 into a 250 ml graduated glass cylinder. The zero-to-250 ml graduated portion of the cylinder shall be no less that 232 mm (9 in) nor more than 250 mm (9,8 in) in length, graduated in 2 ml increments or less. Stir the slurry by hand with a spatula during pouring to ensure a uniform sample of the slurry. The 2 h test period is initiated when the conditioned slurry is poured into the graduated tube. Seal the graduated cylinder with plastic film wrap or equivalent material to prevent evaporation. The graduated glass cylinder may be inclined at an angle to simulate wellbore deviation. Take appropriate precautions to ensure that static curing is performed in essentially vibration-free conditions.

After the 2-h test period, measure the volume of free fluid (clear or coloured fluid on top of the cement slurry inside the clear tube) with a precision of  $\pm$  0,2 ml.

The volume fraction of free fluid is then calculated, as a percent, in accordance with Equation (110) above.

# **15.6 Sedimentation test**

Pour slurry from 15.3 into a sedimentation tube until it is approximately 20 mm  $({}^{3}/_{4}$  in) from the top. The sedimentation tube shall have an inner diameter of 25 mm ± 5 mm (0,98 in ± 0,02 in). The tube length shall be a minimum of 100 mm (3,94 in). The most common tube length is approximately 200 mm (7,9 in) (see Figure 17). Lightly grease the inside of the tube, and all joints, to ensure that it is leak-tight and so that the set

cement can be removed without damage. The tube shall be inert to well cements and shall not deform during the course of the test. Puddle the slurry in the filled tube to dislodge any air bubbles, then fill the tube completely. A top closure which allows pressure communication may be used to prevent spillage of the slurry. Place the filled tube in a water-filled preheated/precooled heating/cooling chamber in a vertical position. Preheat or precool the chamber to  $T_{BHC}$  or 88 °C (190 °F) whichever is cooler (see safety note in 15.3).

Dimensions in millimetres



Key

- 1 vent hole
- 2 lid
- 3 split in tube
- 4 base

### Figure 17 — Typical sedimentation tube

Adjust the slurry temperature further to simulate temperature changes in the wellbore. Maintain sufficient pressure to prevent boiling of the slurry (see Table 4). The pressure applied may simulate bottom-hole conditions, if desired. Avoid constant-pump cycling in order to minimize vibration. The schedules in Annex E and Clause 7 can be used to aid in selecting the temperature and pressure.

Allow the slurry to cure for 24 h or until set before removing it from the heating/cooling chamber.

Cool the chamber to 88 °C (190 °F), if required (see safety note in 15.3). Release pressure from the chamber, if required. Remove the tube from the heating/cooling chamber and bring the tube to 27 °C (80 °F)  $\pm$  6 °C (10 °F) by placing it in a water bath. Once the tube has cooled, remove the cement from the tube. Keep the cement sample immersed in water, as much as possible, to prevent it from drying out. Measure the length of the set cement specimen. Mark the specimen approximately 20 mm (3/4 in) from the bottom and from the top of the sample. Then divide the middle section, between the marks, by further marks into roughly equal pieces with a minimum of two segments. Break or cut the sample at these marks, keeping the sections in order. Keep the sections immersed in water until each is weighed. A balance with a precision of 0,01 g is necessary, a precision of 0,001 g is preferred.

The preferred method for determining the density of each section is as follows. Place a beaker containing water on the balance and tare the balance to zero. Remove a section to be measured from the water bath and gently dry it with a paper towel. Place this section on the balance beside the beaker. Record the mass and remove the section from the balance. Retare the balance to zero. Next place a noose of thin line around the section. Pick up the section by the line and suspend the section in the water in the beaker such that the sample is totally surrounded by water. The sample shall not touch the bottom or sides of the beaker. Air bubbles shall not be clinging to the section. Obtain the mass with the sample suspended in water. Remove the sample from the water and retare the balance. Repeat the procedure for each set cement section.

By applying the Archimedes Principle, calculate the relative density of each cement core section.

$$d_{\text{rel}} = \frac{m_{\text{air}}}{m_{\text{water}}}$$
(111)

The results are used to construct a density profile for the entire sample.

NOTE It is normal for cement slurries to experience a small density increase upon setting.

The liquid slurry density was measured prior to curing to permit the calculation of the percent density difference between the liquid sample and the set sample.

$$\% \Delta \rho = \frac{\rho_{\text{set}}}{\rho_{\text{sl}}} (100) \tag{112}$$

where

 $\Delta \rho$  is the density difference;

 $\rho_{set}$  is the density of the set cement segment;

 $\rho_{sl}$  is the density of the cement slurry.

The density differences between slurry and set well cements can vary greatly and depend on many factors. The amount of density difference that is acceptable varies with the application. The heating/cooling, pressurizing, and cooling information that is requested in the results-Report form (Table 6) will allow other laboratories to reproduce the test. The information requested is sufficient only if the heating/cooling rate, pressurizing rate, and cool-down rate are linear. If the rates are not linear, specify the exact heating/cooling, pressurizing, and cool-down schedules on the form.

# Table 6 — Free fluid and sedimentation results-Report form

# Slurry mixing and conditioning

Cement temperature:\_\_\_\_\_ Mix water temperature:\_\_\_\_\_

Slurry initial temperature:

Slurry final temperature:

Time to final temperature:

Optional additional conditioning period:

Pressure profile:

Initial pressure: \_\_\_\_\_

Final pressure: \_\_\_\_\_

Time to final pressure: \_\_\_\_\_

# Free fluid test

Length of graduated tube section:

Graduated tube inner diameter:

Test at less than 88 °C (190 °F)

Slurry volume:\_\_\_\_\_

Test temperature:

Test angle:\_\_\_\_\_

Measured free fluid volume:\_\_\_\_\_ ml

Vol. fraction (%) free fluid :\_\_\_\_\_

Test at greater than or equal to 88 °C (190 °F)

Slurry volume:\_\_\_\_\_

Final temperature: \_\_\_\_\_

Time to final temperature: \_\_\_\_\_ minutes

Initial test pressure:\_\_\_\_\_

Final test pressure:\_\_\_\_\_

Time to final test pressure:\_\_\_\_\_

Test angle:\_\_\_\_\_

Time to cool the slurry to 88 °C (190 °F):\_\_\_\_\_

Measured free-fluid volume: \_\_\_\_\_ ml

Vol. fraction (%) free fluid:

Clause 7 schedules employed: \_\_\_\_\_ Yes or \_\_\_\_\_ No

If Yes, schedule number: \_\_\_\_\_

Ambient static period

Test angle: \_\_\_\_\_

Measured free fluid volume: \_\_\_\_\_ ml

Vol. fraction (%) free fluid:

#### Sedimentation test

Preheated or precooled chamber temperature:\_\_\_\_\_

*T*<sub>BHC</sub>:\_\_\_\_\_

Time to T<sub>BHC</sub>:\_\_\_\_\_

*T*<sub>BHS</sub>:\_\_\_\_\_

Time to T<sub>BHS</sub>:\_\_\_\_\_

Initial test pressure: \_\_\_\_\_

Pressure at T<sub>BHC</sub>:\_\_\_\_\_

Time to pressure at T<sub>BHC</sub>:\_\_\_\_\_

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Pressure at T<sub>BHS</sub>:\_\_\_\_\_

Time to pressure at T<sub>BHS</sub>:\_\_\_\_\_

Time at *T*<sub>BHS</sub>:\_\_\_\_\_hours

Time to cool the chamber to 88 °C (190 °F):\_\_\_\_\_

Length of sedimentation tube: \_\_\_\_\_

Length of set specimen: \_\_\_\_\_

Annex E schedules employed: \_\_\_\_\_Yes or \_\_\_\_\_No

If Yes, schedule number: \_\_\_\_\_

Clause 7 schedules employed: \_\_\_\_\_Yes or \_\_\_\_\_No

If Yes, schedule number: \_\_\_\_\_

Slurry density:\_\_\_\_\_

Density profile:

Top sample density: \_\_\_\_\_; % density diff:\_\_\_\_\_\_ Next sample density: \_\_\_\_\_; % density diff:\_\_\_\_\_

- Next sample density: \_\_\_\_; % density diff:\_\_\_\_\_
- Next sample density: \_\_\_\_\_; % density diff:\_\_\_\_\_\_

Next sample density: \_\_\_\_\_; % density diff:

Bottom sample density: \_\_\_\_\_; % density diff:\_\_\_\_\_

# 16 Compatibility of wellbore fluids

# 16.1 General

This procedure is intended for determining the degree of compatibility of wellbore fluids in cementing operations, and includes examination of rheology, static gel strength, thickening time, compressive strength, fluid loss and solids suspension. By the use of this procedure, the selection of proper preflushes and/or spacers can be made when required. User discretion shall be exercised in the selection of the portion(s) of the procedure needed.

The following test procedures are the same for preflushes and spacers. Therefore, the term spacer is used hereafter to refer to both fluids.

# 16.2 Preparation of test fluids

# 16.2.1 Preparation of spacer

The spacer shall be freshly prepared and aged in accordance with the supplier's instructions.

# 16.2.2 Preparation of mud

Use representative field mud. Thoroughly mix mud samples prior to testing.

# 16.2.3 Preparation of cementing slurries

Prepare the cement slurries according to Clause 5 or Annex A. Prepare a fresh quantity of cementing slurry for each test.

# 16.2.4 Preparation of fluid mixtures

Mixtures prepared in this clause shall be used for rheological, static gel strength, solids suspension, thickening time, compressive strength and fluid loss testing. Data for base fluids shall be obtained before mixtures are prepared. All fluid mixtures in this clause are expressed as volume fraction  $\varphi$  (percent) of the total mixture. The mixture for each test procedure shall be prepared by stirring the proper ratio of base fluids with a spatula until homogeneous. The volume of the mixture shall be sufficient to perform the desired test procedure.