PASSING ABILITY OF SELF-CONSOLIDATING CONCRETE (SCC) BY J-RING FOP FOR AASHTO T 345

Scope

This procedure provides instruction for determining the passing ability of self-consolidating concrete (SCC) by the J-Ring method, in accordance with AASHTO T 345-12, both in the laboratory and in the field. SCC is defined as a highly workable concrete that can flow through densely reinforced or complex structural elements under its own weight without vibration and adequately fill voids without segregation or excessive bleeding.

Passing ability and J-Ring test value are an indication of the ability of the SCC to flow around and between reinforcement without blocking.

To determine the passing ability of the mix the slump flow must be determined according to the FOP for AASHTO T 347/T 351. A difference between the J-Ring flow and the slump flow of less than 25 mm (1 in.) indicates good passing ability, and a difference greater than 50 mm (2 in.) indicates poor passing ability.

A J-Ring test value less than 15 mm (½ in.) indicates satisfactory passing ability without blockage.

Apparatus

- J-Ring Apparatus: a rigid ring made of steel or some other nonabsorbent material connecting 100 mm (4 in.) vertical smooth bars with the dimensions shown in Figure 1, with Table 1 tolerances. The 16 mm (5/8 in.) diameter vertical round bars are connected to the ring and spaced as shown in Figure 1. Do not use an apparatus with out-of-plumb bars or incorrect clear spacing.
- Mold: meeting the requirements of the FOP for AASHTO T 119.
- Base plate: made of stiff nonabsorbent material, at least 820 mm (32 in.) square, marked with a circle indicating the central location for the mold, and a concentric circle with a diameter of 500 mm (20 in.).
- Pouring vessel or scoop: a water-tight container large enough so each amount of concrete obtained from the sampling receptacle is representative and small enough, so it is not spilled during placement in the mold.
- Strike-off bar: a straight bar of steel or other suitable metal.
- Tape measure or ruler with 5 mm (¼ in.) increments

Figure 1 - J-Ring Dimensions

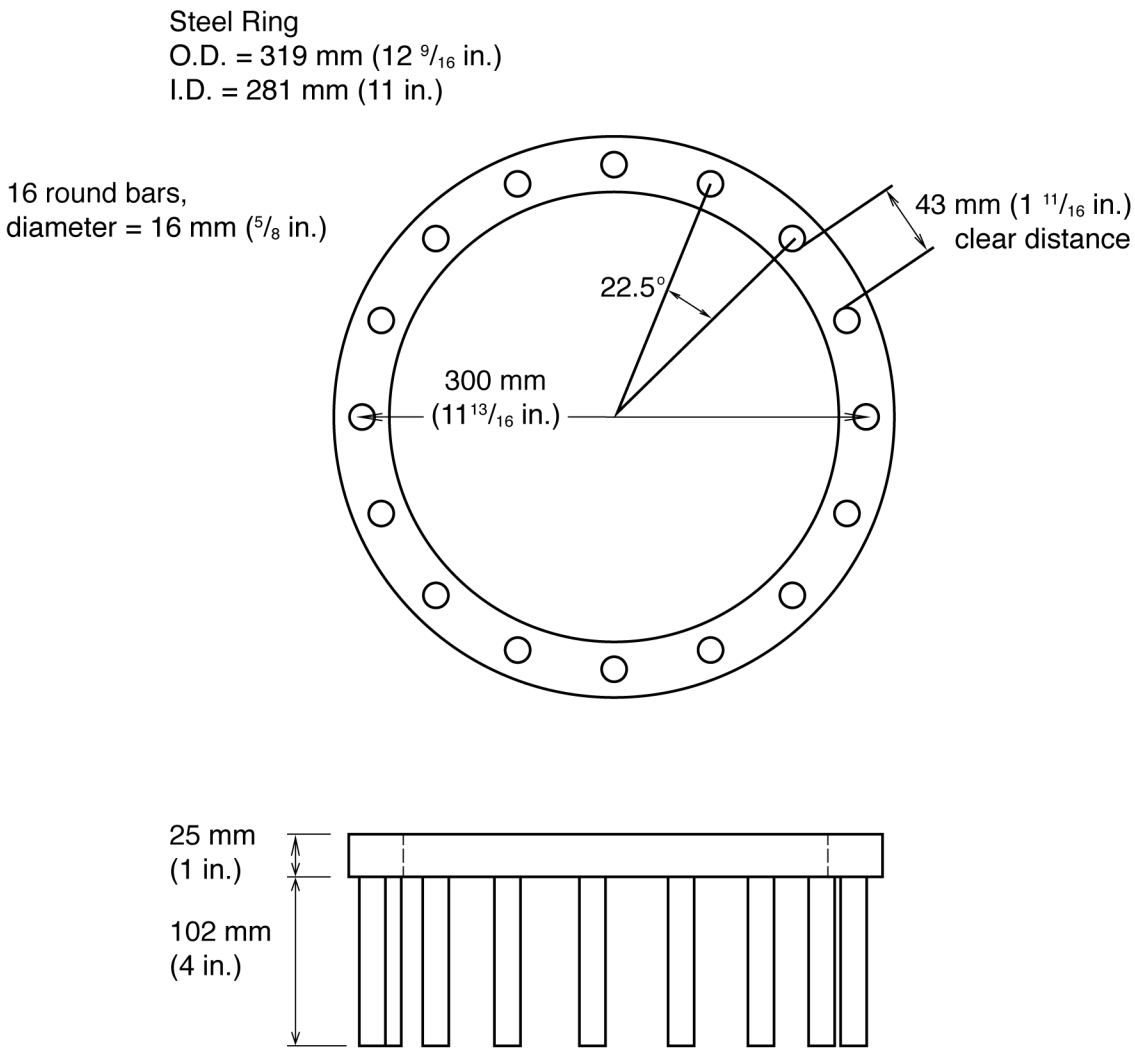


Table 1
J-Ring Dimensions and Tolerances

Dimension	mm	in.
Ring diameter (centerline)	30 ± 3.3	11 13/16 ± 1/8
Ring width	38 ± 1.5	1 9/16 ± 1/16
Bar diameter	16 ± 3.3	5/8 ± 1/32
Bar spacing (clear distance)	43 ± 1.0	1 11/16 ± 1/32
Ring thickness	25 ± 1.5	1 ± 1/16
Bar length	102 ± 6.0	4 ± 1/4

Procedure

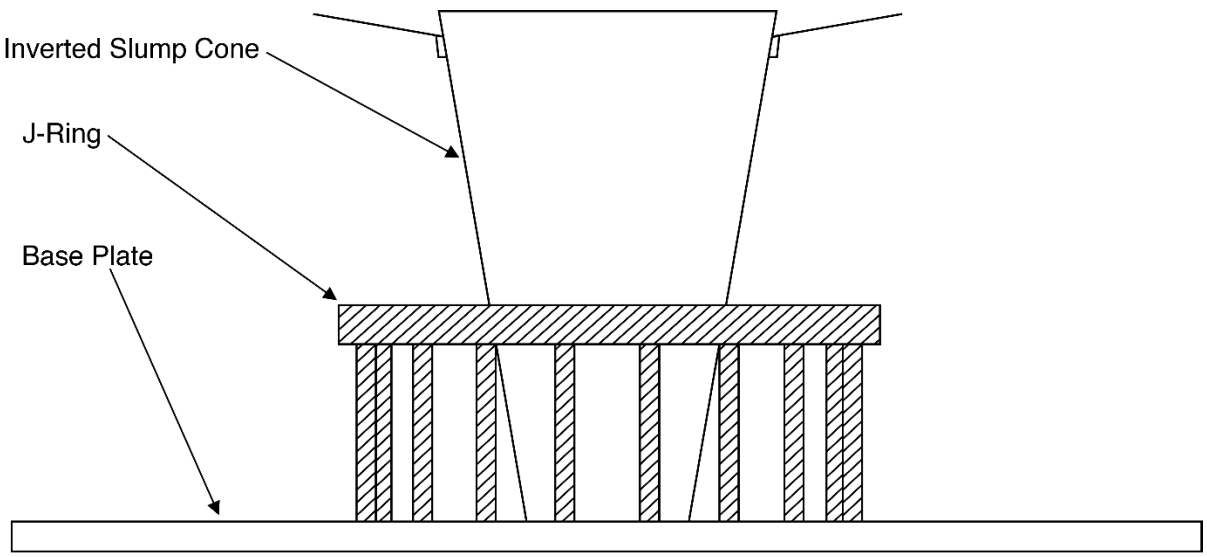
Using SCC from the same sample, determine the J-Ring flow and the slump flow (FOP for AASHTO T 347). The two results are used to indicate the passing ability.

1. Obtain the sample according to the FOP for WAQTC TM 2.

Note 1: Approximately 6 L (0.2 ft^3) of SCC is needed to perform the slump flow and VSI tests.

2. Dampen the inside of the mold and the base plate
3. Place the base plate on a level, stable surface.
4. Place the J-Ring in the center of the base plate, invert the mold and place inside the J-Ring. Hold down firmly.

Figure 2 – J-Ring, Mold (Inverted), and Base Plate



5. Use the pouring vessel or scoop to slightly overfill the mold. Do not rod or tamp the SCC. Do not tap or vibrate the mold.
6. Use the strike-off bar to strike off the SCC level with the top of the mold.
7. Clean off all SCC from around the base of the mold to prevent interference with the flowing SCC.
8. Raise the mold vertically 230 ± 75 mm (9 ± 3 in.) above the base plate with no lateral or torsional motion in 3 ± 1 second, allowing the SCC to flow out freely from within.

   Complete the entire operation within 2 ½ minutes from the start of the filling through removal of the mold without interruption.
9. After the concrete flow has stopped, measure the diameter of the SCC in two directions, the largest diameter (j_1) and the diameter perpendicular to the largest diameter (j_2), to the nearest 5 mm (¼ in.). Include any border without coarse aggregate or a bleed water 'halo' in the diameter measurements.

If the two measured diameters differ by more than 50 mm (2 in.), the test is invalid and must be repeated.

Note 2: A difference in the measured diameter more than 50 mm (2 in.) is likely due to the mold being raised with lateral motion.

10. Lay the strike-off bar across the J-Ring.
11. Measure from the bottom of the bar to the top of the SCC in the center of the J-Ring to the nearest 5 mm (¼ in.), designate as C.
12. Measure from the bottom of the bar to the top of the SCC in two locations just inside the J-Ring to the nearest 5 mm (¼ in.), designate the measured heights as I_1 and I_2.
13. Measure from the bottom of bar to the top of the SCC in two locations just outside the J-Ring to the nearest 5 mm (¼ in.), designate as E_1 and E_2.

Note 3: With the bar in place across the J-Ring, take measurements in the center, and outside and just inside the J-Ring at each end of the bar, rotate the bar around the J-Ring and repeat measurements outside and just inside the J-Ring.

14. Lay the strike-off bar across the J-Ring in a different location.
15. Measure from the bottom of the bar to the top of the SCC in two locations just inside the J-Ring to the nearest 5 mm (¼ in.), designate the measured heights as I_3 and I_4.
16. Measure from the bottom of bar to the top of the SCC in two locations just outside the J-Ring to the nearest 5 mm (¼ in.), designate as E_3 and E_4.
17. Calculate the J-Ring flow by averaging the two measured diameters.
18. Calculate the passing ability by subtracting the J-Ring flow from the slump flow determined according to the FOP for AASHTO T 347/T 351.
19. Calculate the height of the SCC in the center of the J-Ring, subtract C from 127 mm (5 in.), designate as h_c.
20. Calculate the average height of SCC just inside the J-Ring to the nearest 5 mm (¼ in.), average I_1 through I_4 and subtract from 125 mm (5 in.), designate as h_{am}.
21. Calculate the average height of SCC outside the J-Ring to the nearest 5 mm (¼ in.), average E_1 through E_4 and subtract from 125 mm (5 in.), designate as h_{bm}.
22. Calculate the difference in average heights inside the J-Ring and outside the J-Ring, subtract h_{bm} from h_{am}, designate as h_{ab}.
23. Calculate the difference between the height of the SCC at the center of the J-Ring, and the average height of the SCC inside the J-Ring, subtract h_{am} from h_c, designate as h_{ac}.
24. Calculate the J-Ring test value, subtract h_{ac} from 2 times h_{ab}, designate as J.

Calculations

J-ring Flow

$$J\_ring\ flow = \frac{(j_1 + j_2)}{2}$$

Where:

j_1 = the largest diameter of the circular spread of SCC

j_2 = the diameter perpendicular to the largest diameter (j_1)

Passing ability

$$passing\ ability = slump\ flow - J_{-ring} flow$$

Where:

passing ability = the difference between the J-Ring flow and the slump flow

slump flow = determined according to the FOP for AASHTO T 347/T 351

Average height inside the J-Ring

$$h_{am} = 125\ mm\ (5\ in.) - \left(\frac{I_1 + I_2 + I_3 + I_4}{4}\right)$$

Where:

h_{am} = average height of SCC inside the J-Ring to the nearest 5 mm (¼ in.)

I_1 through I_4 = measurements from the bottom of the strike-off bar to the top of the SCC inside the J-Ring

Average height outside the J-Ring

$$h_{bm} = 125\ mm\ (5\ in.) - \left(\frac{E_1 + E_2 + E_3 + E_4}{4}\right)$$

Where:

h_{bm} = average height of SCC outside the J-Ring to the nearest 5 mm (¼ in.)

E_1 through E_4 = measurements from the bottom of the strike-off bar to the top of the SCC outside the J-Ring

Difference of the average heights

$$h_{ab} = h_{am} - h_{bm}$$

Where:

h_{ab} = difference between the average height of SCC inside the J-Ring and outside the J-Ring

Difference between the center and the inside average heights

$$h_{ac} = h_c - h_{am}$$

Where:

h_{ac} = difference between the average height inside the J-Ring and the height at the center

J-Ring test value

$$J = (2 \times h_{ab}) - h_{ac}$$

Where:

J = J-Ring test value

Example

J-ring Flow

$$J_{ring}flow = \frac{615\ mm\ \left(24\frac{1}{4}\ in.\right) + 590\ mm\ (23\frac{1}{4}\ in.)}{2} = 605\ mm\ (23\frac{3}{4}\ in.)$$

Given:

j_1 = 615 mm (24 ¼ in)

j_2 = 590 mm (23 ¼ in.)

Passing ability

$$passing\ ability = 635\ mm\ (25\ in.) - 605\ mm\ \left(23\frac{3}{4}\ in.\right) = 30\ mm\ \left(1\frac{1}{4}\ in.\right)$$

Given:

slump flow = 635 mm (25 in.) (determined according to the FOP for AASHTO T 347/T 351)

Average height inside the J-Ring

$$h_{am} = 125\ mm - \left(\frac{100\ mm + 110\ mm + 110\ mm + 110\ mm}{4}\right) = 20\ mm$$

$$h_{am} = 5\ in. - \left(\frac{4\ in. + 4\frac{1}{4}\ in. + 4\frac{1}{4}\ in. + 4\frac{1}{4}\ in.}{4}\right) = \frac{3}{4}\ in.$$

Given:

I_1 = 100 mm (4 in.)

I_2 = 110 mm (4 ¼ in.)

I_3 = 110 mm (4 ¼ in.)

I_4 = 110 mm (4 ¼ in.)

Average height outside the J-Ring

$$h_{bm} = 125\ mm - \left(\frac{110\ mm + 115\ mm + 115\ mm + 115\ mm}{4}\right) = 10\ mm$$

$$h_{bm} = 5\ in. - \left(\frac{4\frac{1}{4}\ in. + 4\frac{1}{2}\ in. + 4\frac{1}{4}\ in. + 4\frac{1}{2}\ in.}{4}\right) = \frac{1}{2}\ in.$$

Given:

E_1 = 110 mm (4 ¼ in.)

E_2 = 115 mm (4 ½ in.)

E_3 = 115 mm (4 ½ in.)

E_4 = 115 mm (4 ½ in.)

Difference of the average heights

$$h_{ab} = 20\ mm\ \left(\frac{3}{4}\ in.\right) - 10\ mm\ \left(\frac{1}{2}\ in.\right) = 10\ mm\ \left(\frac{1}{4}\ in.\right)$$

Difference between the center and the inside average

$$h_{ac} = 25\ mm\ (1\ in.) - 20\ mm\ \left(\frac{3}{4}\ in.\right) = 5\ mm\ \left(\frac{1}{4}\ in.\right)$$

J-Ring test value

$$J = \left(2 \times 10\ mm\ \left(\frac{1}{4}\ in.\right)\right) - 5\ mm\ \left(\frac{1}{4}\ in.\right) = 15\ mm\ \left(\frac{1}{4}\ in.\right)$$

Report

- On forms approved by the agency
- Sample ID
- J-Ring flow to the nearest 5 mm (¼ in.)
- Slump flow from the FOP for AASHTO T 347
- Passing ability to the nearest 5 mm (¼ in.)
- The difference between the average heights inside and outside the J-Ring (h_{ab}) to the nearest 5 mm (¼ in.)
- The difference between the height at the center of the SCC and the average height inside the J-Ring (h_{ac}) to the nearest 5 mm (¼ in.)
- J-Ring test value to the nearest 5 mm (¼ in.)