

Welding test report of CP-40 with the changed raw material

Product Development Division, on May 10, 2019

1. Purpose of the test

Currently, the raw material Kaolin for ceramic tabs is produced in Hebei Province, but it is going to be changed to the one produced in Fujian Province in the future. This test was conducted to investigate the product dimensional accuracy and weldability of samples made by using the raw material Kaolin produced in Fujian Province. We have used CP-40 samples, made with the amount of clay reduced compared to the sample (FM) of the previous welding test.

2. Test methods

2.1. Test materials

Fig. 1 shows the dimensions and shape of CP-40. Use 4 specimens and 4 conventional items, which totals eight pieces.

Fig. 2 shows the two welding test pieces used.

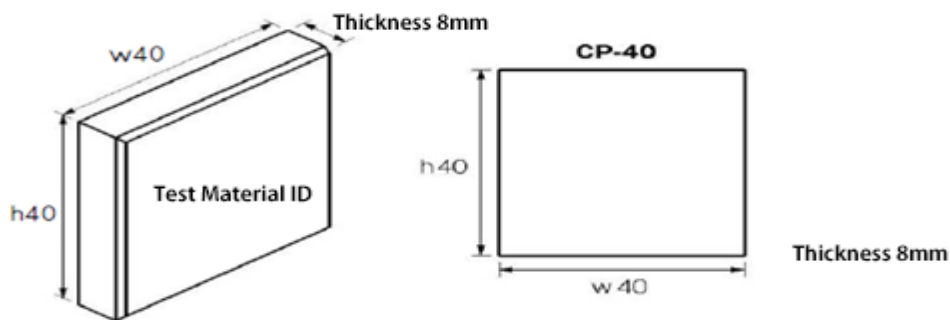


Fig. 1: Dimensions and shape of CP-40

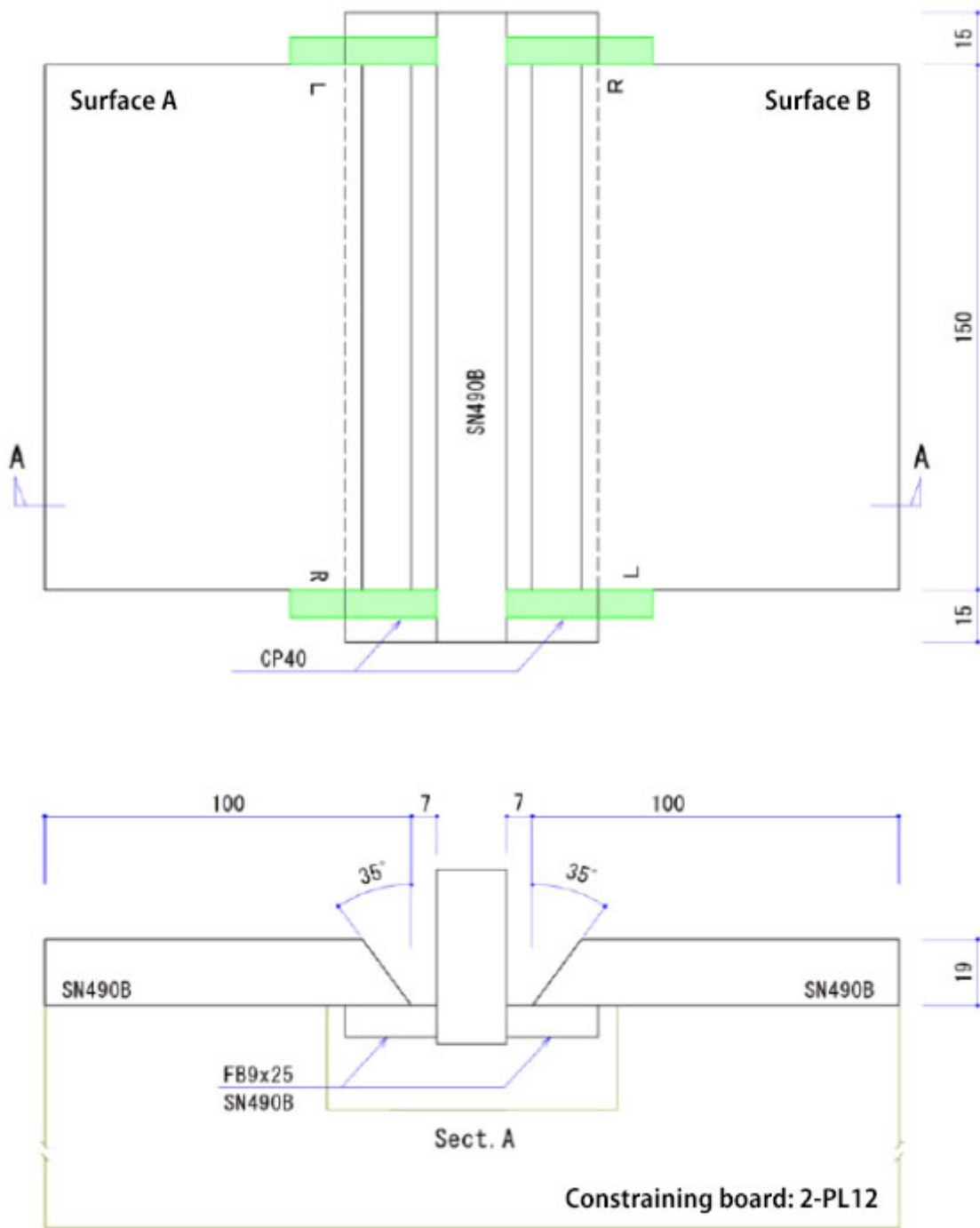


Fig. 2: Shape of the welding test piece

2.2 Measurement of product dimensions

Measured the height, width, and thickness of the CP-40 in Fig. 1 to check the product accuracy.

2.3 Measurement in welding

Measure the cracking (breakage), peel property, and welding appearance (defects and bead glossiness) of CP-40 during welding.

Record the welding procedure conditions.

2.4 Welding procedures

Perform (semi-automatic) CO₂ arc welding. The welding material should be YM-55C (Φ1.2), and the aim of welding electric current would be 300 to 320 A. Perform the backward method from left to right for the entire layers.

3. Test records

3.1 Results of measurement of product dimensions

Photograph 1 shows the results of comparing the color tone difference between the specimen and the conventional item in parallel.

The specimen is found brighter.

Photograph 1: Comparison of color tone

Specimen

Conventional item

Dimensional measurements were performed with a digital caliper for the specimen and the conventional item. Table 1 shows the results of dimensional measurement.

There is little variation in all measurement items.

Photograph 1:
Comparison of color tone



Dimensional measurements were performed with a digital caliper for the specimen and the

conventional item. Table 1 shows the results of dimensional measurement. There is little variation in all measurement items.

Table 1: Results of dimensional measurement

CP- 40 ID	Measurement item			Remarks
	Height (h) (mm)	Width(w) (mm)	Thickness (mm)	
2A-L	40.0	40.0	7.6	Specimen
2A-R	40.0	40.0	7.6	
28- L	40 .0	40.0	7.6	
28- R	40.0	40.0	7.6	
Average	40.0	40.0	7.6	
3A-L	40.3	40.4	8.0	Conventional item
3A- R	40 .3	40.4	8.2	
38-L	40.3	40.4	8.2	
38 - R	40 .3	40.4	8.1	
Average	40.3	40.4	8.1	

3.2 Results of welding test

Table 2-1 shows the welding procedure records and weldability of the specimens, and Table 2-2 shows those of the conventional items. Photographs 2 to 14 show the appearance and test conditions of the test materials. There seemed to be no problem with the important welding performance of avoiding bead irregularities, undercuts, and pits. Gloss and peel properties of the specimens were considered to be equivalent to those of the conventional items.

Table 2-1: List of welding procedure records and test results for specimens

Weld length = 150 mm Performed on April 26, 2019

Specimen ID	Pass No.	Electric Current (A)	Voltage (V)	Welding time (sec.)	Welding speed (cm/min)	Heat input (kJ/cm)	Breakage during and after welding	Peel property of CP-40*	Weld surface of the wooden end **				
									Gloss	No bead required	UC	Pit	
2A	1	306	37.0	26	35	20	○	L side					
	2	323	35.4	37	24	28	○	△ Adhesion to 1st to 3rd layers	L side △	L side △	L side 0.3	L side, None	
	3	325	35.5	41	22	32	○						
	4	323	35.5	44	20	34	○	R side △	R side △	R side, None	R side, None	R side, None	
	5	300	36.0	24	38	17	○	△ Adhesion to 1st to 3rd layers					
	6	311	36.2	28	32	21	○						
2B	1	305	37.3	28	32	21	○	L side	L side				
	2	325	35.5	36	25	28	○	△ Adhesion to 1st to 3rd layers	L side △	L side, None	L side, None	L side, None	
	3	326	35.5	39	23	30	○						
	4	325	35.3	40	23	31	○	R side △	R side △	R side, None	R side, None	R side, None	
	5	310	36.0	27	33	20	○	△ Adhesion to 1st to 4th layers					
	6	308	36.7	29	31	22	○						
Lamination diagram													

Settings: Electric Current of 350 A, Voltage of 33.5 V, CO₂: 25 ℓ/min, Welding machine: M500

○: Good, △: Slightly poor, ×: Poor

*Peeling without using a tool 120 minutes after completion of welding.

**Bead irregularity: Not exceeding 2.5 mm, Undercut: Not exceeding 0.5 mm

Table 2-2: List of welding procedure records and test results for specimens

Weld length = 150 mm Performed on April 26, 2019

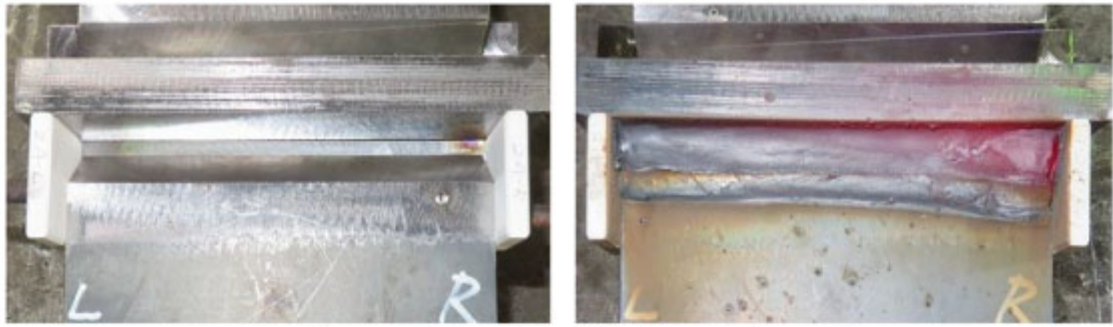
Specimen ID	Pass No.	Electric Current (A)	Voltage (V)	Welding time (sec.)	Welding speed (cm/min)	Heat input (kJ/cm)	Breakage during and after welding	Peel property of CP-40*	Weld surface of the wooden end **			
									Gloss	No bead required	UC	Pit
3A	1	310	36.4	27	33	20	○	L side				
	2	325	35.0	39	23	30	○	△	L side	L side,	L side	L side, None
	3	320	36.0	40	23	31	○		△	△	0.3	
	4	330	35.2	40	23	31	○	Adhesion to 1st R side	R side	R side, None	R side, None	R side, None
	5	305	36.8	28	32	21	○	Adhesion to 1st to 3rd layers	△			
	6	312	36.7	26	35	20	○					
3B	1	306	36.7	27	33	20	○	L side				
	2	330	34.8	36	25	28	○	△	L side	L side, None	L side, 0.3	L side, None
	3	330	35.5	36	25	28	○	Adhesion to 1st to 2nd layers	△			
	4	323	35.5	43	21	33	○	R side	R side	R side, None	R side, None	R side, None
	5	310	36.4	33	27	25	○	△				
	6	310	36.0	28	32	21	○	Adhesion to 1st to 4th layers	△			
Lamination diagram												

Settings: Electric Current of 350 A, Voltage of 33.5 V, CO₂: 25 ℓ/min, Welding machine: M500

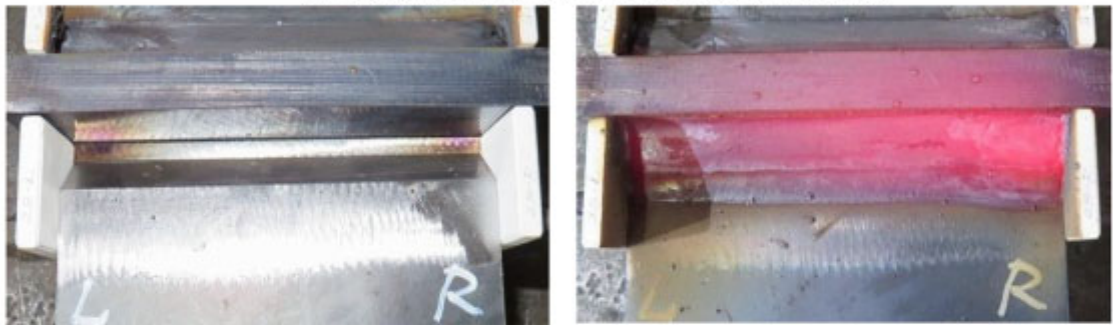
○: Good, △: Slightly poor, ×: Poor

*Peeling without using a tool 120 minutes after completion of welding.

**Bead irregularity: Not exceeding 2.5 mm, Undercut: Not exceeding 0.5 mm



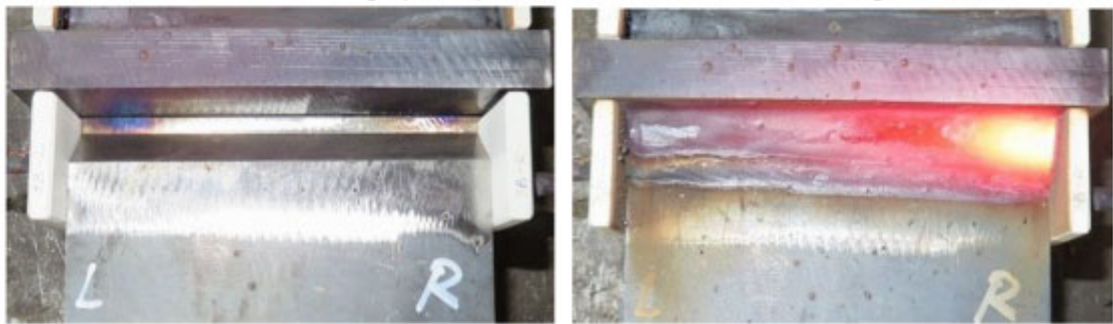
Photograph 2: Specimen 2A before and after welding



Photograph 3: Specimen 2B before and after welding



Photograph 4: Specimen 3A before and after welding



Photograph 5: Specimen 3B before and after welding



Photograph 6: Appearance of the specimen 2AL after welding (at the starting side)



Photograph 7: Appearance of the specimen 2AR after welding (at the ending side)



Photograph 8: Appearance of the specimen 2BL after welding (at the starting side)



Photograph 9: Appearance of the specimen 2BR after welding (at the ending side)



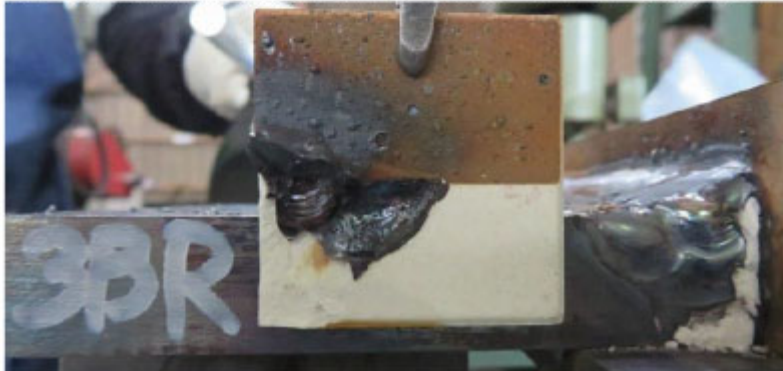
Photograph 10: Appearance of the specimen 3AL after welding (at the starting side)



Photograph 11: Appearance of the specimen 3AR after welding (at the ending side)



Photograph 12: Appearance of the specimen 3BL after welding (at the starting side)



Photograph 13: Appearance of the specimen 3BR after welding (at the ending side)



**Photograph 14:
Welding being performed**



4. Summary

Based on the test results mentioned above, the product dimensional accuracy and weldability of the specimens were summarized as follows.

- ① The dimensions of each part were of good accuracy with less variation, but the thickness was, on average, 0.4 mm thinner than the reference value.
- ② It was considered that the specimen could withstand the thermal shock of welding because no cracks or breakage occurred during or after welding.
- ③ There seemed no problem with the most important welding performance of avoiding welding defects such as bead irregularities, undercuts, and pits.
- ④ Gloss was considered equivalent to conventional items.
- ⑤ The peel properties of the specimens were considered equivalent to those of the conventional items.