

(CK15)

(AISI 316L)

2007/1/8:

2007/8/2:

(AISI 316L)
(CK15) (AISI316L) (DIN1654)
(Retort)
(/ 2-1)
AWSRB Cu Zn-) , (AWSRB CuZn-C), (DINL-Ag20Cd)
(10 , 5) (D
(Double shear) (Single shear)
(Tensile shear)
(316L)
(RBCuZn-D)
(10 5)

Abstract

Similar Plates of stainless steel (AISI 316L) and dissimilar plates of stainless steel (AISI 316L) and low carbon steel (Ck15) are welded by brazing using copper base non- active filler metal alloys in furnaces with inert gas atmospheres. The specimens were inserted in special container called (Retort) filled by inert gas (argon) during brazing process with flow rate (1-2 liter / min). Three types of filler metal alloys DINL- Ag20Cd , AWSRB CuZn-C , AWS RB Cu Zn – D were used with changing the brazing time (5 , 10) min at given temperature suitable for each filler metal alloy . Many or various mechanical and metallurgical tests were carried out including single shear test, double shear test and tensile shear test, in addition to the microstructure and x-ray diffraction inspection for each similar and dissimilar welds. It was shown that single and double butt joints of the

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similar metals of stainless steel (316L) showed higher shear strength than that of dissimilar weld of stainless steel (316L) and Low carbon steel(CK15) . The brazed joints by filler metal alloy (RBCu Zn-D) showed the best shear strength for similar and dissimilar metal of stainless steel (316L) and low carbon steel (CK15) in comparison with joints brazed by other filler metal alloys at (5, 10) min .

Recrystallization)
 (Temperature
 (HAZ)
 . [7]

Capillary)
 (Attraction
 (Joint Clearance)
 . [2,1]

(450C°)
 (Brazing)
)
 . [5,4,3](Soldering)(

(Wetting)
 . [6]
 (Fluxes)

(Superalloys)

. [1]

Lugscheider , Cosack
 [8](1988)
 (BNi)
 (316L)

(CK15)

(AISI 316L)

.(RB Cu Zn-D

. (AISI 321)

(3) (Foils)

(2004) **Stephenl Feldbauer**
[9]

. [11,10]
()

. [1]

(Foil)

(Foil)

(Brazing)

(180)

(Rod)

(Copper spacers wire)

.(Joint Clearance)

3 -2

Fluxes Applying

Experimental Works
Base Metals

1 -2

(AISI 316L)

(Ck15)

(DIN1654)

(2) (1)

(316L)

(Ck15)

Spectro Anolgtical)

Instruments Boschstrobe 10,D-

(4190KLEVE

2-2

Brazing Filler Metals

(Borax)

(Boric Acid)

(DINL – Ag20Cd)

AWS) (AWS RB Cu Zn-C)

(CK15)

(AISI 316L)

(1b)

(Holding furnace)

4 -2

(K)

(AISI 316L)

(± 5) C°

(1200 C°)

)

(300 C°

(

(Retort)

.(100,180)

(10 , 5)

5-2

. (300 C°)

(Fixtures)

(

3

(Screw M4)

. (Mt M4)

7-2

Brazing Tests

1-7-2

Micro Structure Inspection

6 -2

Brazing by Retort

()

(Single – Butt Joint)

(Mounting)

(Retort)

Grinding)

(Screw Flange)

(Wet

(AISI 316L)

(1200-100)

, **(1a)**

(Polishing)

/

(%15)			
.(Fluidity)			
	1-1-3	Tensile Shear Test	3-2-7-2
5 min	780C°		
	(Braze Metal)		
Base)	(Interface)	(316L)	
	.(Metal		
		(2mm)	
		()	
Copper- Rich Dendrites in a)		(10 , 5)	
matrix of Silver-Copper-Zinc-			
(Cadmium Eutectic			
Columnnar)			
(Intermediate Compound		(4)	
		(JIS)	
	(Welding Seam)	(Overlap)	[13]
			12-15 mm)
		-3	.(
.(5)			
	2-1-3	and Discussion	
10min	780C°		Results
			1-3
	(10min)	(L-Ag20Cd)	
	)		
(		(316L)	
(DINL-Ag20Cd)		(316L)	
		(Ck15DIN1654)	
5min		DINL-	
		(Ag20Cd)	
		(10 5)	780C°
.(6)			
	2-3		
AWS "			
	"RB CuZn-C	(5)	
		(10)	
(955C°)			
		(Intermediate compounds)	

(CK15)

(AISI 316L)

. (5, 10) min

1-3-3

980C°

5 min

β-Brass)

α-)

(Grains

(Brass

Peritectic)

(Reaction

.(α-Phase and the melt)

.(9)

2-3-3

10 min

980C

(10)

10min

.(FCC)

1-2-3

5 min

955C°

-β

(RB CuZn-C)

1-4

(DIN L-Ag20Cd)

Single Butt)

(Joints

(Double Butt Joints)

(Tensile Shear)

(β -Brass)

(α-Brass)

.(7)

(AISI 316L)

2-2-3

(316L)

. (CK15)

10 min

955C°

(8)

10 min

DINL-)

(5min)

.(Ag20Cd

(10min)

3-3

AWS RB CuZn-D

[14]

(Single Shear)

%11-9

(0.05-0.18)mm

(CK15)

(AISI 316L)

()
 (Brazing Cycle)
 .[15] (0.12mm) (Gap)
 (0.05-0.18) mm
 5 min (Rod)
 0.1 mm (Double Shear)
 (0.08 mm)
 (Foil)
 (5)
 Tensile)
 (316L) (Shear
 (0.1mm)
 .(CK15) (4)
 3-4
 (RBCuZn-D)
 (316L)
 .(Ck15)
 2-4
 (AWS RB C u Zn-C)
 (316L)
 CK15
 10 min
 RBCuZn-D
 (Single Butt Joints)
 Double)
 (Butt Joints
 (Tensile Shear)
 %11-9
 CrNi
 (A) (XRD)
 (AISI316L)
 (316L)
 .(CK15)
 0.04-)
 (0.25%Si
 5 min
 (AWS RB Cu Zn-C)
 10 min
 .[14]
 [16](2005) (Ali)

(CK15)

(AISI 316L)

-5

(Ta)

(Retort Furnace)

(6)

(CK15) (316 L)

(316L)

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(C K15)

. RBCuZn-D

(11)

(10 5)

: -5

-1

DINL-Ag20Cd,)

AWSRBCuZn-C , RBCuZn-D

(

()

(RBCuZn-D)

- 2

316L

(345 MPa)

(338 MPa)

(280 MPa)

.(10 min)

-3

(316L)

(Ck15)

-4

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of Tension and Shear

(CK15)

(AISI 316L)

AISI(316L)

(1)

Elements wt%	C	Si	Mn	P	S	Cr	Mo	Ni
Nominal Value	< 0.03	< 1.00	< 2.00	≤ 0.04	≤ 0.03	17.00	2.25	12.00
Actual Value	0.063	0.93	2.73	0.03	0.03	16.8	1.77	9.74

(Ck15)

(2)

Elements wt%	C	Si	Mn	P	S	Cr	Mo	Ni
Nominal Value	0.14-0.22	0.15-0.35	0.5-0.8	≤0.035	≤0.035	0.2-0.4	0.8-1	≤0.3
Actual Value	0.144	0.17	0.38	0.03	0.013	0.55	0.87	0.059

.[4]

(3)

Brazing Filler metal	Nominal composition wt-%	Melting range °C		Brazing temperature °C		properties
		Tsol	Tliqu			
Alloy1 (DIN) L-Ag 20Cd	20Ag,40Cu, 25Zn,15Cd	605	765	775	785	Tensile strength (DIN8525)N/mm ² Tensile strength on { St37=350 St50=430
Alloy2 (AWS) RBCuZn-C	46-50 Cu, Zn rem,0.8-1.1Sn,Mn 0.01-0.5, pb 0.05,Al 0.01, Si 0.04 -0.15, 0.5 Other element	866	888	910	954	
Alloy3 (AWS) RBCuZn-D	46-50Cu,Zn rem ,Ni 9-11 P 0.25 ,pb 0.5, Al 0.01, Si 0.04 -0.25, 0.5 Other element	921	935	938	982	Tensile strength of brazed joint (N/mm ²)0.5mm gap=285, Hv=> 280

(CK15)

(AISI 316L)

(4)

Brazing Conditions		Max. Shear Strength (MPa)			Joint Clearance(mm)		
		Single Shear	Double Shear	Tension Shear	Single	Double	Tension
Similar welds	780C°/5min	313	316	240	0.12	0.08	0.1
	780C°/10min	307	295	232	0.12	0.08	0.1
Dissimilar welds	780C°/5min	290	282	234	0.12	0.08	0.1
	780C°/10min	276	275	226	0.12	0.08	.0.1

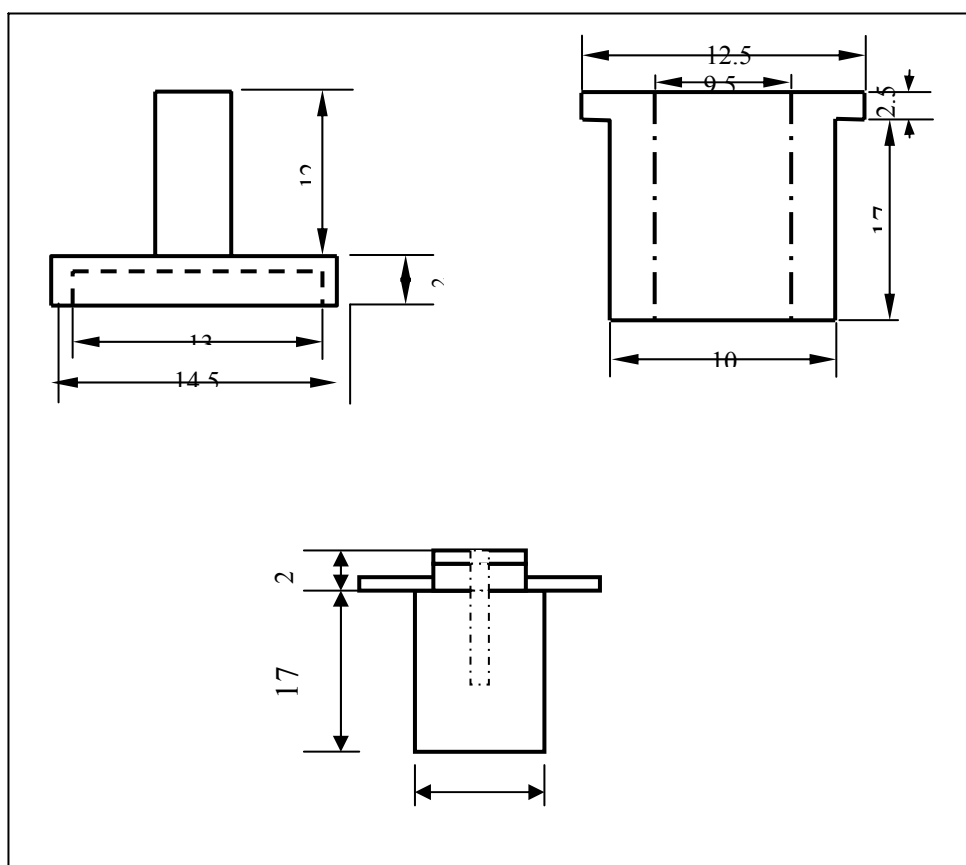
(5)

Brazing Conditions		Max. Shear Strength (MPa)		
		Single Shear	Double Shear	Tension Shear
Similar welds	955C°/5min	326	311	256
	955C°/10min	288	291	248
Dissimilar welds	955C°/5min	310	298	245
	955C°/10min	276	279	237

(6)

Brazing Conditions		Max. Shear Strength (MPa)		
		Single Shear	Double Shear	Tension Shear
Similar	980C°/5min	332	325	261

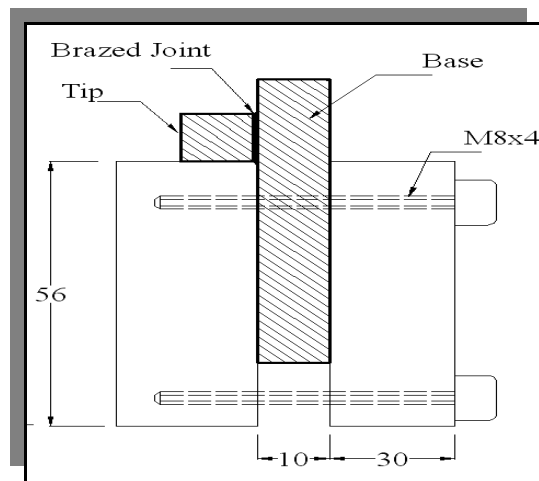
welds	980C°/10min	345	338	280
Dissimilar welds	980C°/5min	318	310	251
	980C°/10min	336	331	268



10

b

(1)

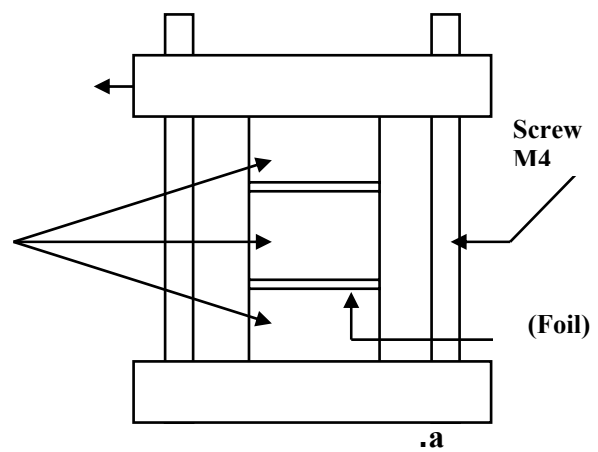
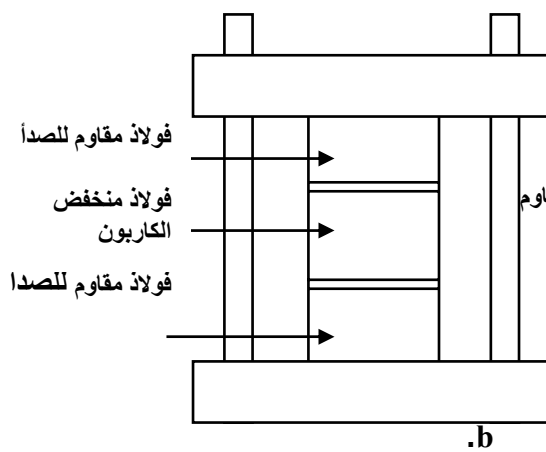


(2)

(AWS)

(

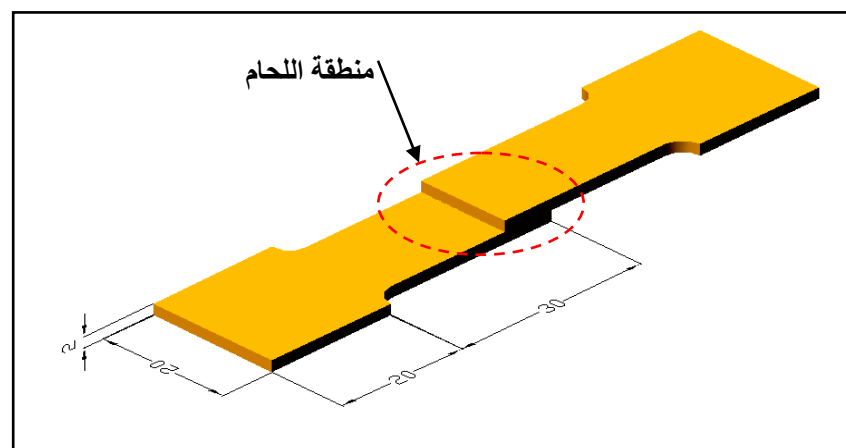
) (Single Shear)



(

)

(3)



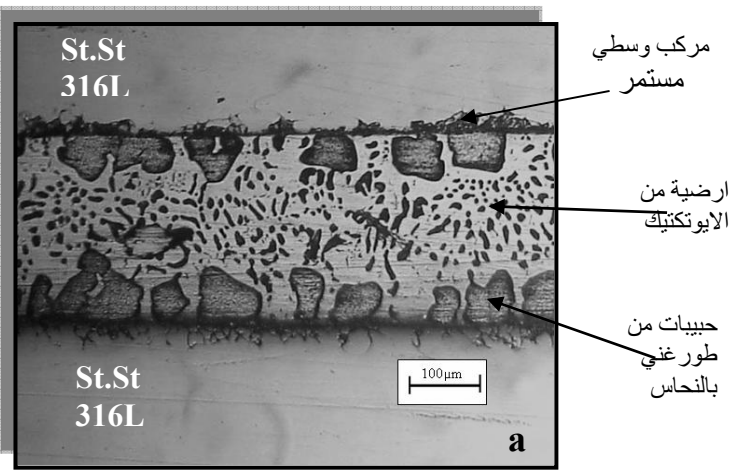
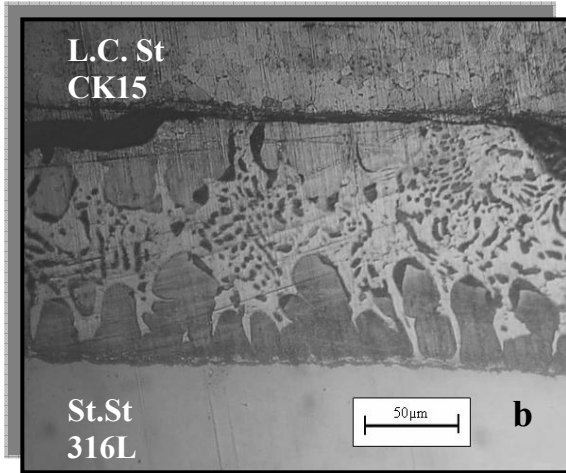
(CK15)

(AISI 316L)

(JIS)

(Tensile Shear)

(4)



780C°

(5)

(DINL-Ag20Cd)

5 min

0.18mm

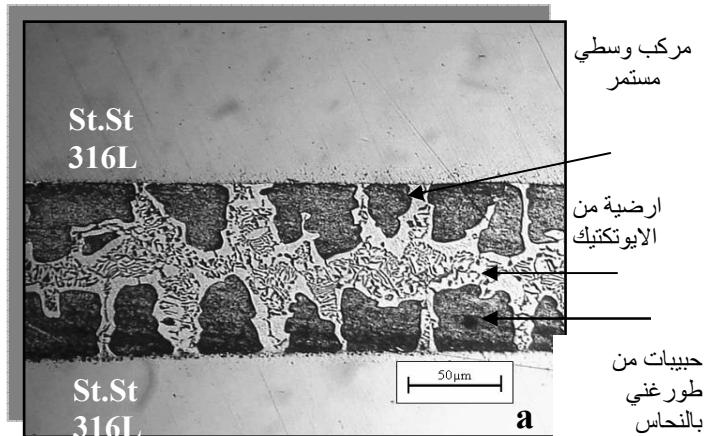
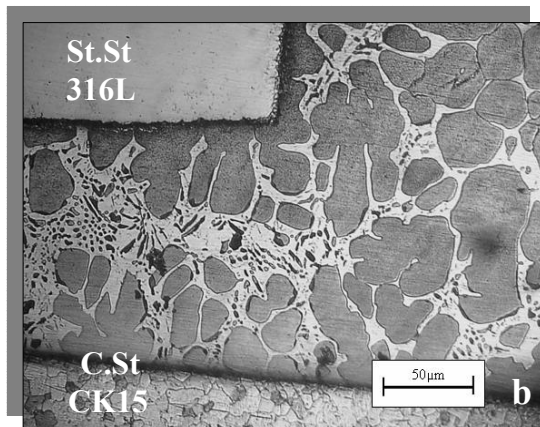
a - وصلة لحام متشابهة من الفولاذ مقاوم الصدأ (316L) وسماح

(316L)

-b

() 0.125mm

(CK15)



(CK15)

(AISI 316L)

780 C°

(6)

(DINL-Ag20Cd)

10 min

.(0.12 mm)

(316L)

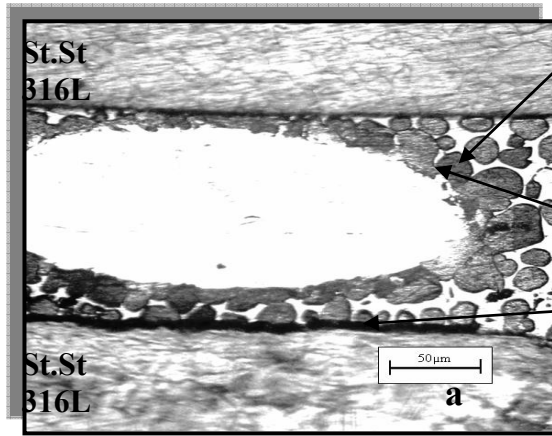
- a

(316L)

- b

0.12mm

(CK15)



طور الفا -
براص
 α - Brass
طور بيتا - براص
 β - Brass
مركب وسطي
مستمر

955C°

(7)

(RB CuZN-C)

5min

.(0.12 mm)

(316L)

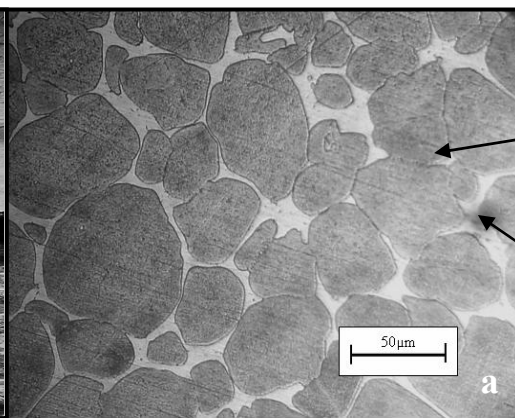
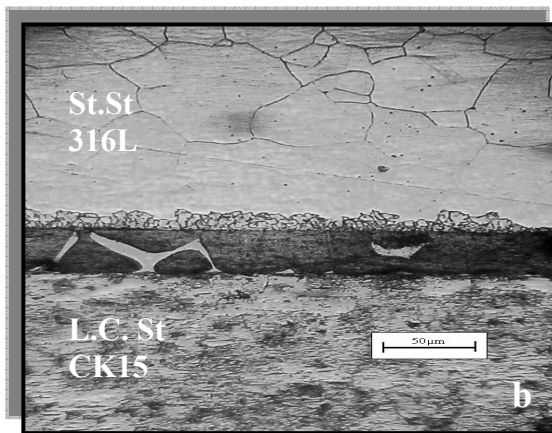
- a

(316L)

- b

0.05 mm

(CK15)



طور بيتا - براص
 β - Brass
طور الفا - براص
 α - Brass

955C°

(8)

(RB CuZN-C)

10 min

0.12 mm.

(316L)

/

- a

(CK15)

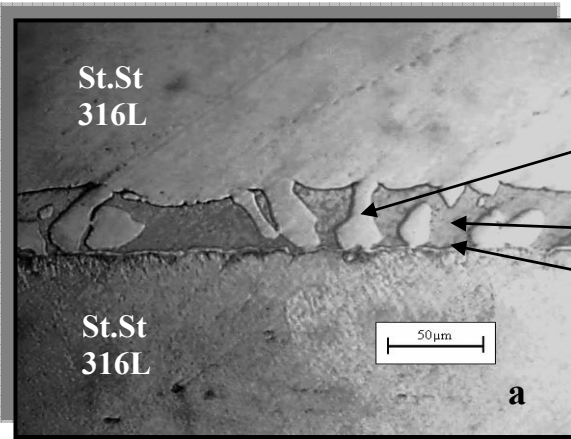
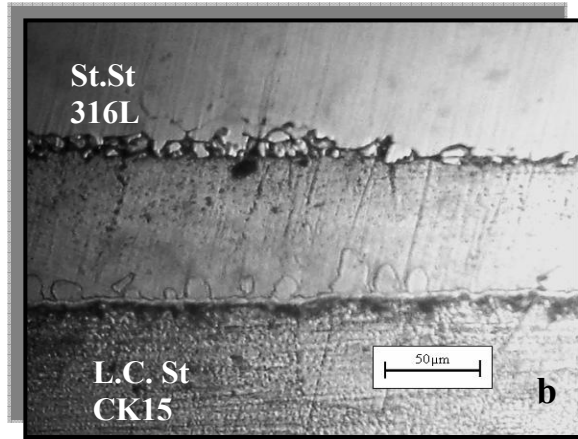
(316L)

- b

0.05 mm

(CK15)

(AISI 316L)



980C°

(9)

(RBCuZn-D)

5min

0.08 mm.

(316L)

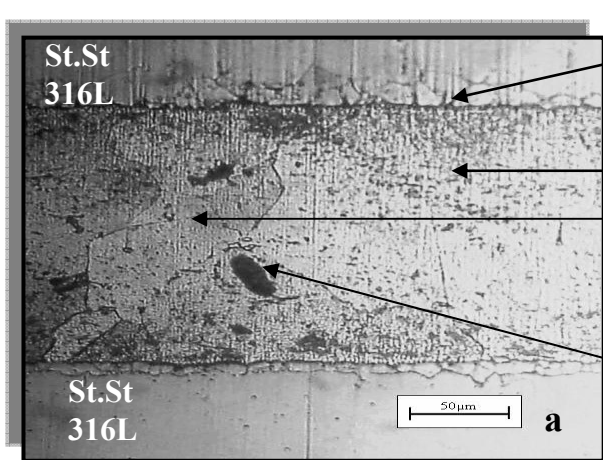
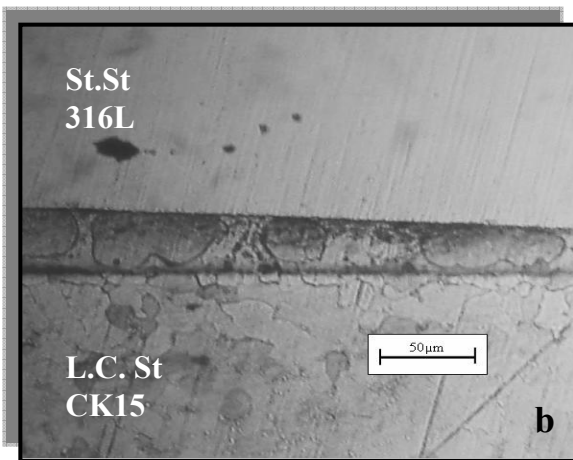
- a

(CK15)

(316L)

- b

0.08 mm



980C°

(10)

(RBCuZn-D)

10 min

0.18 mm.

(316L)

- a

(316L)

- b

0.05 mm

(CK15)



(316L)

(RBCuZn-D)