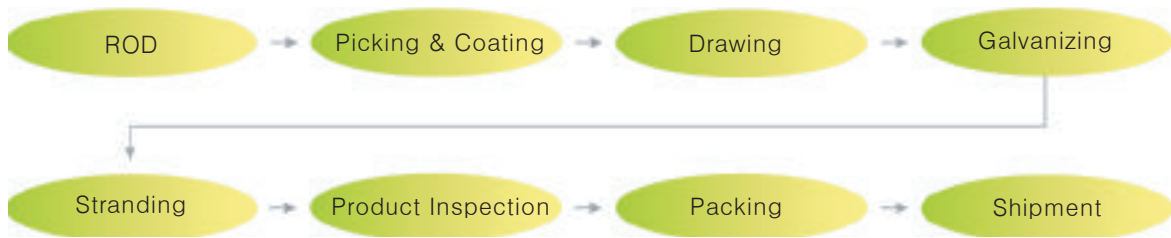




GALVANIZED STEEL WIRE STRAND & STEEL WIRE FOR ACSR



1. Production Flow Chart



2. Superiority of Manho Products

① Manho Products can be produced in accordance with these international specifications:

- | | |
|--------------|---|
| · KS D 7007 | Galvanized Steel Wire Strand |
| · KS C 3113 | Aluminum Stranded Conductors Steel Reinforced |
| · JIS G 3537 | Galvanized Steel Wire Strand |
| · ASTM A 363 | Zinc-Coated(Galvanized) Steel Overhead Ground Wire Strnad |
| · ASTM A475 | Zinc-Coated Steel Wire Strnad |
| · ASTM B 498 | Zinc-Coated(Galvanized) Steel Core Wire for Aluminum Conductors, Steel Reinforced(ACSR) |
| · DIN 48200 | Wire for Stranded Conductors |
| · AS 1220 | Galvanized Steel Reinforced |
| · BS 215 | Aluminum Conductors and A.C.S.R. for overhead power transmission |
| · BS 4565 | Galvanized Steel Wire for Aluminum Conductors Steel Reinforced |

② Manho products are being produced with the laster equipments and facilities under the start quality control, so superb quality is quaranteed. Weight of zinc coating and its uniformity ate also quaranteed to meet your requirements.

③ They can be used for various application with their own mechanical properties and superiority of stain resistance.

- Power transmission
- Fishing
- Supporting Telecommunication cable
- Out-Casting



3. Kinds of the product

1 Galvanized Steel Wire Strand

A. JIS G 3537 (KS D 7007)

Number of Wires in Strand	Nominal Diameter of Coated Wire in Strand (mm)	Approx. Wt of Strand (kg/km)	Physical Properties								
			Minimum Breaking Strength of Strand, KN(t)			Weight of Zinc Coating, min, g/m of Uncoated Wire Surface			Elongation min %, 250mm		
			Grade 1	Grade 1	Grade 3	Class ExA	Class A	Class B	Grade 1	Grade 2	Grade 3
3	2.90	156	22.4(2.28)	16.1(1.64)	12.6(1.28)	-	230	160	3.0	4.0	4.0
3	3.20	190	27.4(2.79)	19.6(2.00)	15.2(1.55)	-	"	"	4.0	5.0	5.0
3	3.50	228	32.5(3.31)	23.4(2.39)	18.2(1.86)	-	250	175	"	"	"
3	4.00	297	42.5(4.33)	30.6(3.12)	23.8(2.43)	-	"	"	"	"	"
3	4.30	344	49.2(5.02)	35.5(3.62)	27.7(2.82)	-	270	190	"	"	"
3	4.50	376	53.8(5.49)	38.7(3.95)	30.0(3.06)	-	"	"	"	"	"
7	1.00	43.5	6.19(0.631)	4.48(0.457)	3.47(0.354)	160	110	80	2.0	2.0	2.0
7	1.20	62.7	8.90(0.908)	6.44(0.657)	4.99(0.509)	"	"	"	"	"	"
7	1.40	85.3	12.2(1.24)	8.78(0.895)	6.83(0.696)	"	130	90	"	"	"
7	1.60	111	15.9(1.62)	11.5(1.17)	8.90(0.908)	180	"	"	"	"	"
7	1.80	141	20.1(2.05)	14.4(1.47)	11.3(1.15)	"	160	110	3.0	3.0	3.0
7	2.00	174	24.8(2.53)	17.8(1.82)	13.9(1.42)	200	"	"	"	4.0	4.0
7	2.30	230	32.8(3.34)	23.6(2.41)	18.3(1.87)	220	200	140	"	"	"
7	2.60	294	42.0(4.28)	30.2(3.08)	23.5(2.40)	"	"	"	"	"	"
7	2.90	366	52.2(5.32)	37.6(3.83)	29.2(2.98)	-	230	160	"	"	"
7	3.20	446	63.7(6.50)	45.7(4.66)	35.6(3.63)	-	"	"	4.0	5.0	5.0
7	3.50	533	75.8(7.73)	54.7(5.58)	42.5(4.33)	-	250	175	"	"	"
7	3.80	628	89.6(9.14)	64.4(6.57)	50.1(5.11)	-	"	"	"	"	"
7	4.00	696	99.1(10.1)	71.4(7.28)	55.6(5.67)	-	"	"	"	"	"
7	4.30	805	115(11.7)	82.8(8.44)	64.4(6.57)	-	270	190	"	"	"
7	4.50	881	126(12.8)	90.3(9.21)	70.1(7.15)	-	"	"	"	"	"
7	5.00	1,090	155(15.8)	112(11.4)	86.5(8.82)	-	"	"	"	"	"

Permissible Variations in Diameter of Individual zinc Coated Wires			
Nominal Diameter of Coated Wires in the Strand (mm)	Tolerance on Diameter (mm)	Nominal Diameter of Coated Wires in the Strand (mm)	Tolerance on Diameter (mm)
1.00	±0.05	2.90	±0.08
1.20	"	3.20	"
1.40	"	3.50	±0.10
1.60	"	3.80	"
1.80	±0.06	4.00	"
2.00	"	4.30	"
2.30	"	4.50	"
2.60	±0.08	5.00	"

Minimum number of forsons in 100d					
Nominal Diameter of Coated Wires in the Strand (mm)	Grade 1	Grade 2	Nominal Diameter of Coated Wires in the Strand (mm)	Grade 1	Grade 2
1.00	18	14	2.90	14	10
1.20	"	"	3.20	"	"
1.40	"	"	3.50	"	"
1.60	"	"	3.80	"	"
1.80	16	12	4.00	"	"
2.00	"	"	4.30	12	"
2.30	"	"	4.50	"	"
2.50	"	"	5.00	"	"



B. ASTM A 475

Nominal Diameter of Strand, in.	Number of Wire in Strand	Nominal Diameter of Coated Wire in Strand, in.	Approx. W't of Strand, lb/1000ft	Physical Properties				
				Minimum Breaking Strength of Strand, lbf				
				Utilities Grade	Common Grade	Siemens-Martin Grade	High Strength Grade	Extra-High Strength Grade
1/8	7	0.041	32	-	540	910	1,330	1,830
5/32	7	0.052	51	-	870	1,470	2,140	2,940
3/16	7	0.062	73	-	1,150	1,900	2,850	3,990
3/16	7	0.065	80	2,400(1)b	-	-	-	-
7/32	7	0.072	98	-	1,540	2,560	3,850	5,400
1/4	3	0.120	117	3,150(2)b	1,860	3,040	4,730	6,740
1/4	3	0.120	117	4,500(3)b	-	-	-	-
1/4	7	0.080	121	-	1,900	3,150	4,750	6,650
9/32	7	0.093	164	4,600(1)b	2,570	4,250	6,400	8,950
5/16	3	0.145	171	6,500(3)b	2,490	4,090	6,350	9,100
5/16	7	0.104	205	-	3,200	5,350	8,000	11,200
5/16	7	0.109	225	6,000(1)b	-	-	-	-
3/8	3	0.165	220	8,500(3)b	3,330	5,560	8,360	11,800
3/8	7	0.120	273	11,500(4)b	4,250	6,950	10,800	15,400
7/16	7	0.145	399	18,000(4)b	5,700	9,350	14,500	20,800
1/2	7	0.165	517	25,000(4)b	7,400	12,100	18,800	26,900
1/2	19	0.100	504	-	7,620	12,700	19,100	26,700
9/16	7	0.188	671	-	9,600	15,700	24,500	35,000
9/16	19	0.113	637	-	9,640	16,100	24,100	33,700
5/8	7	0.207	813	-	11,600	19,100	29,600	42,400
5/8	19	0.125	796	-	11,000	18,100	28,100	40,200
3/4	19	0.150	1,155	-	16,000	26,200	40,800	58,300
7/8	19	0.177	1,581	-	21,900	35,900	55,800	79,700
1	19	0.200	2,073	-	28,700	47,000	73,200	104,500
1	37	0.143	2,057	-	28,300	46,200	71,900	102,700
11/8	37	0.161	2,691	-	36,000	58,900	91,600	130,800
11/4	37	0.179	3,248	-	44,600	73,000	113,600	162,200

The Utilities Grade is being used principally in the fields of communication and power and light industries.

Elongation Requirements for Grades of Strand	
Grade of Strand	Elongation in 24 in (640mm), min, percent
Utilities Grade (1) and Common Strand	10
Utilities Grade (2) and Siemens-Martin	8
Utilities Grade (3) and High-Strength	5
Utilities Grade (4) and Extra-High Strength	4

Permissible Variations in Diameter of Individual Zinc Coated Wire	
Nominal Diameter of Coated Wire in the Strand, in, (mm)	Permissible Variations, plus and minus, in, (mm)
0.041 to 0.060 (1.04 to 1.52)	0.002(0.05)
0.061 to 0.090 (1.55 to 2.29)	0.003(0.08)
0.091 to 0.120 (2.31 to 3.05)	0.004(0.10)
0.121 and over (3.07 and over)	0.005(0.13)



2 Galvanized Steel Wire For ACSR

A. JIS C 3110 (KS C 3113)

Nominal Diameter (mm)	Cross Sectional Area of Stranded Diameter Wire (mm ²)	Approx Wt of Strand (kg/km)	Physical Properties				
			Ultimate Tensile Strength (min, kg/mm ²)	Elongation min % 250mm	Weight of Zinc Coating min, g/m ² of Uncoated Wire Surface	Uniformity of Coating	Mandrel Size for Adherence Test
2.0	3.142	24.51	135	4.0	215	2 ↑	15 × Wire Diameter
2.3	4.155	32.41	"	"	230	"	
2.6	5.309	41.41	"	"	"	3 ↑	
2.9	6.605	51.52	"	"	245	4 ↑	
3.1	7.548	58.87	130	4.5	"	"	
3.2	8.042	62.73	"	"	"	"	
3.5	9.621	75.04	"	"	260	"	
3.8	11.34	88.45	"	"	"	"	
4.2	13.85	108.0	125	5.0	275	"	
4.5	15.90	124.0	"	"	"	"	

Permissible Variation in Diameter of Individual Zinc Coated Wires			
Nominal Diameter of Coated Wires (mm)	Tolerance on Diameter (mm)	Nominal Diameter of Coated Wires (mm)	Tolerance on Diameter (mm)
2.0	±0.04	3.2	±0.06
2.3	±0.05	3.5	±0.07
2.6	"	3.8	"
2.9	±0.06	4.2	±0.08
3.1	"	4.5	"

Nominal Diameter of Coated Wires (mm)	Minimum Number of Torsions in 100d	Nominal Diameter of Coated Wires (mm)	Minimum Number of Torsions in 100d
2.0	20	3.2	16
2.3	"	3.5	"
2.6	"	3.8	"
2.9	16	4.2	"
3.1	"	4.5	"



B. ASTM B 498

Physical Properties													
Nominal Diameter	Stress at 1% Extension, min PSI(kgf/mm ²)			Ultimate Tensile Strength, min PSI(kgf/mm ²)			Elongation min% in 10 in, (250mm)			Permissible Variation	Initial Settings for Determining Stress at 1% Extension		Mandrel Size for Adherence Test
	inch (mm)	Class A	Class B	Class C	Class A	Class B	Class C	Class A	Class B		Class C	in, (mm) plus minus	
0.0500-0.0899 (1.270-2.283)	190,000 (134)	180,000 (127)	170,000 (120)	210,000 (148)	200,000 (141)	190,000 (134)	3.0	3.0	3.0	0.0015 0.001 (0.038 0.025)	14,000 (9.84)	0.0005 (0.05% Extension)	3
0.0900-0.1199 (2.286-3.045)	185,000 (130)	175,000 (123)	165,000 (116)	205,000 (144)	195,000 (137)	185,000 (130)	3.5	3.0	3.0	0.002 0.002 (0.051 0.051)	28,000 (19.7)	0.0010 (0.10% Extension)	4
0.1200-0.1399 (3.048-3.553)	180,000 (127)	170,000 (120)	160,000 (112)	205,000 (144)	195,000 (137)	185,000 (130)	4.0	3.0	3.0	0.003 0.002 (0.076 0.051)	42,000 (29.5)	0.0015 (0.15% Extension)	4
0.1400-0.1900 (3.556-4.822)	170,000 (120)	160,000 (112)	155,000 (109)	200,000 (141)	185,000 (130)	180,000 (127)	4.0	4.0	4.0	0.004 0.003 (0.102 0.076)	42,000 (29.5)	0.0015 (0.15% Extension)	5

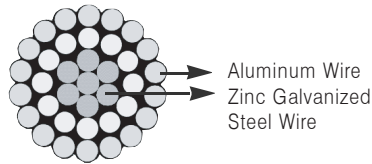
Minimum Weight of coating								
Nomininal Diameter of Coated Wire		Weight of Zinc Coating, min, oz/ft ² of Uncoated Wire Surface			Weight of Zinc Coating, min, g/m ² of Uncoated Wire Surface			
in.	mm	Coating			Coating			
		Class A	Class B	Class C	Class A	Class B	Class C	
0.0500 to 0.0599, incl	1.270 to 1.521, incl	0.60	1.20	1.80	183	366	549	
0.0600 to 0.0749, incl	1.524 to 1.902, incl	0.65	1.30	1.95	198	396	550	
0.0750 to 0.0899, incl	1.905 to 2.283, incl	0.70	1.40	2.10	214	437	610	
0.0900 to 0.1039, incl	2.286 to 2.639, incl	0.75	1.50	2.25	229	458	686	
0.1040 to 0.1199, incl	2.642 to 3.045, incl	0.80	1.60	2.40	244	488	732	
0.1200 to 0.1399, incl	3.048 to 3.553, incl	0.85	1.70	2.55	259	518	778	
0.1400 to 0.1799, incl	3.556 to 4.569, incl	0.90	1.80	2.70	274	549	824	
0.1800 to 0.1900, incl	4.572 to 4.822, incl	1.00	2.00	3.00	305	610	915	



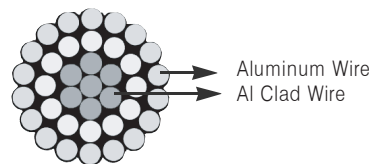
3. AS Wire (Aluminum Clading Steel Wire)

① AS WIRE ?

Existing ACSR uses the zinc galvanized steel wire by itself, or with Al wire stranded around it to ensure the high degree of strength by the core zinc galvanized steel wire or zinc galvanized steel wire strand, and high degree of electricity flow through the stranded Al wire. However, this technology faces frequent disconnection due to the corrosion by the contact of two different materials, zinc and Al. To solve this problem, AS WIRE was developed to replace zinc galvanized steel wire. AS WIRE is the hard drawn steel wire covered with aluminum cladding. When ACSR is made by AS WIRE itself, or with aluminum wire stranded around it, almost no corrosion is observed because the contacting two surfaces consist of the same material, i.e., aluminum. This results in strikingly low occurrences of disconnection. It is for this reason that ACSR using AS WIRE has been more widely used in the highly polluted areas and seashore areas where the air is very salty.

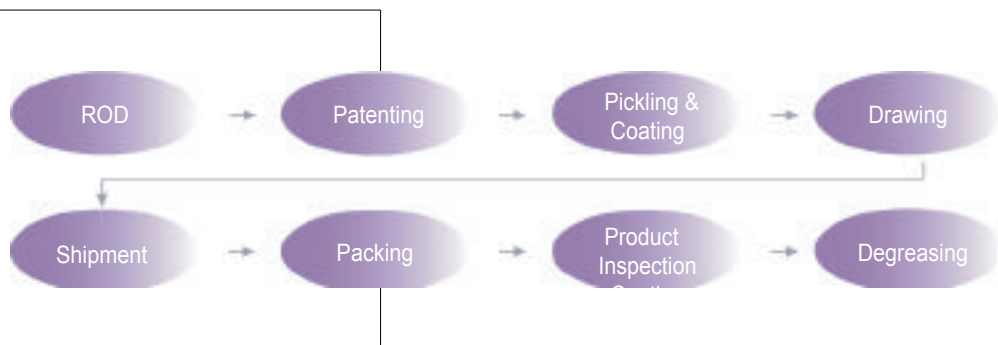


· Existing ACSR



· ACSR AL, using the Clad cable

② Production Procedure



③ Required Product Characteristics

- When cladding Al wire around AS WIRE, high bonding quality is very important.
- The tensile strength and tensile elongation should be within the standard range, because the required tensile strength and tensile elongation must be attested to after the wire drawing, following the Al cladding.
- Winding condition should be excellent.
- Excellent wrapping condition is very important.