



AC series $\pm 5\%, \pm 1\%, \pm 0.5\%$ Sizes 0201/0402/0603/0805/1206/ 1210/1218/2010/2512 1101

2R20

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100

221

RoHS compliant & Halogen free



Product specification – January 04, 2023 V.10

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SCOPE

This specification describes AC0201 to AC2512 chip resistors with leadfree terminations made by thick film process.

APPLICATIONS

- All general purpose applications
- Car electronics, industrial application

FEATURES

- AEC-Q200 gualified
- Moisture sensitivity level: MSL I
- AC series soldering is compliant with J-STD-020D
- Halogen free epoxy
- RoHS compliant
 - Products with lead-free terminations meet RoHS requirements
 - Pb-glass contained in electrodes, resistor element and glass are exempted by RoHS
- Reduce environmentally hazardous waste
- High component and equipment reliability
- The resistors are 100% performed by automatic optical inspection prior to taping.

ORDERING INFORMATION - GLOBAL PART NUMBER

Part number is identified by the series name, size, tolerance, packaging type, temperature coefficient, taping reel and resistance value.

GLOBAL PART NUMBER

AC XXXX X X X XX XXXX L

(1)	(2)	(3)	(4)	(5)	(6)	(7)
-----	-----	-----	-----	-----	-----	-----

(I) SIZE

0201/0402/0603/0805/1206/1210/1218/2010/2512

(2) TOLERANCE

D	$= \pm 0.5\%$	
F	$= \pm 1\%$	

 $J = \pm 5\%$ (for Jumper ordering, use code of J)

(3) PACKAGING TYPE

R = Paper taping reelK = Embossed taping reel

(4) TEMPERATURE COEFFICIENT OF RESISTANCE

- = Base on spec

(5) TAPING REEL

07 = 7 inch dia. Reel & Standard power 13 = 13 inch dia, Reel

7W = 7 inch dia. Reel & 2 x standard power

3W = 13 inch dia. Reel & 2 x standard power

(6) RESISTANCE VALUE

$I\,\Omega$ to 22 $M\Omega$

There are 2~4 digits indicated the resistance value. Letter R/K/M is decimal point, no need to mention the last zero after R/K/M, e.g. I K2, not I K20.

Detailed coding rules of resistance are shown in the table of "Resistance rule of global part number".

(7) DEFAULT CODE

Letter L is the system default code for ordering only. ^(Note)

Resistance rule number Resistance coding rule	of global part Example
XRXX (I to 9.76Ω)	R = Ω R5 = .5Ω 9R76 = 9.76Ω
XXRX	10R = 10Ω
(10 to 97.6Ω)	97R6 = 97.6Ω
XXXR	100R = 100Ω
(100 to 976Ω)	976R = 976Ω
XKXX	K = 1,000Ω
(Ι to 9.76 K Ω)	9K76 = 9760Ω
XMXX	$IM = I,000,000\Omega$
(I to 9.76 MΩ)	9M76= 9,760,000 Ω
XXMX (10 MΩ)	10M = 10,000,000Ω

ORDERING EXAMPLE

The ordering code for an AC0402 chip resistor, value 100 K Ω with ±1% tolerance, supplied in 7-inch tape reel is: AC0402FR-07100KL.

NOTE

- I. All our R-Chip products are RoHS compliant and Halogen free. "LFP" of the internal 2D reel label states "Lead-Free Process"
- 2. On customized label, "LFP" or specific symbol can be printed.
- 3. AC series with $\pm 0.5\%$ tolerance is also available. For further information, please contact sales.

- 10 = 10 inch dia. Reel

MARKING

AC0201	/ AC0402	
Fig. I		No marking
AC0603	/ AC0805 / AC1206 / A	ACI2I0 / AC2010 / AC25I2
Fig. 2		E-24 series: 3 digits, ±5% First two digits for significant figure and 3rd digit for number of zeros
AC0603		
Fig. 3	2<u>4</u>0 Value = 24 Ω	E-24 series: 3 digits, ±1% & ±0.5% One short bar under marking letter
Fig. 4	Value = 12.4 K Ω	E-96 series: 3 digits, $\pm 1\% \& \pm 0.5\%$ First two digits for E-96 marking rule and 3rd letter for number of zeros
AC0805	/ AC1206 / AC1210 / A	AC2010 / AC2512
Fig. 5	1002 Value = 10 KΩ	Both E-24 and E-96 series: 4 digits, $\pm 1\% \& \pm 0.5\%$ First three digits for significant figure and 4th digit for number of zeros
<u>ACI2I8</u>		
Fig. 6	Value = 10 KΩ	E-24 series: 3 digits, ±5% First two digits for significant figure and 3rd digit for number of zeros
Fig. 7	1002 Value = 10 KΩ	Both E-24 and E-96 series: 4 digits, $\pm 1\% \& \pm 0.5\%$ First three digits for significant figure and 4th digit for number of zeros

ΝΟΤΕ

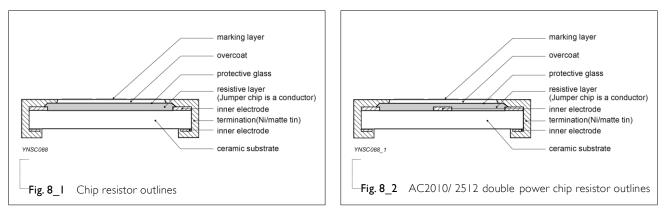
For further marking information, please refer to data sheet "Chip resistors marking". Marking of AC series is the same as RC series.



CONSTRUCTION

The resistors are constructed on top of an automotive grade ceramic body. Internal metal electrodes are added at each end and connected by a resistive glaze. The resistive glaze is covered by a protective glass. The composition of the glaze is adjusted to give the approximately required resistance value and laser trimming of this resistive glaze achieves the value within tolerance. The whole element is covered by a protective overcoat. Size 0603 and bigger is marked with the resistance value on top. Finally, the two external terminations (Ni / matte tin) are added, as shown in Fig.8.

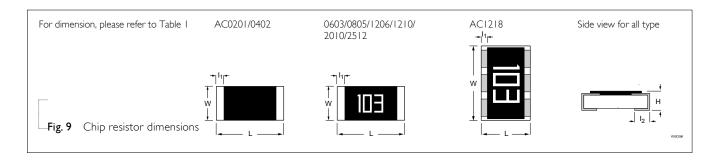
OUTLINES



DIMENSIONS

Table I For outlines, please refer to Fig. 9

ТҮРЕ	L (mm)	W (mm)	H (mm)	l₁ (mm)	l ₂ (mm)
AC0201	0.60 ±0.03	0.30 ±0.03	0.23 ±0.03	0.12 ±0.05	0.15 ±0.05
AC0402	1.00 ±0.05	0.50 ±0.05	0.32 ±0.05	0.20 ±0.10	0.25 ±0.10
AC0603	1.60 ±0.10	0.80 ±0.10	0.45 ±0.10	0.25 ±0.15	0.25 ±0.15
AC0805	2.00 ±0.10	1.25 ±0.10	0.50 ±0.10	0.35 ±0.20	0.35 ±0.20
AC1206	3.10 ±0.10	1.60 ±0.10	0.55 ±0.10	0.45 ±0.20	0.45 ±0.20
AC1210	3.10 ±0.10	2.60 ±0.15	0.55 ±0.10	0.45 ±0.15	0.50 ±0.20
AC1218	3.10 ±0.10	4.60 ±0.10	0.55 ±0.10	0.45 ±0.20	0.40 ±0.20
AC2010	5.00 ±0.10	2.50 ±0.15	0.55 ±0.10	0.55 ±0.15	0.55 ±0.20
AC2512	6.35 ±0.10	3.10 ±0.15	0.55 ±0.10	0.60 ±0.20	0.60 ±0.20



ELECTRICAL CHARACTERISTICS

Table 2	2							
					CHARACT	ERISTICS		
TYPE	POWER	Operating Temperature Range	Max. Working Voltage	Max. Overload Voltage	Dielectric Withstanding Voltage	Resistance Range	Temperature Coefficient	Jumper Criteria
						5% (E24)	$ \Omega \le R \le 0\Omega $	Rated Current
						$ \Omega \le R \le 0M\Omega $	-100/+350ppm°C	0.5A
						1% (E24/E96)	$10\Omega < R \le 10M$	Maximum
AC0201	1/20 W	-55 °C to 155 °C	25V	50V	50V	$ \Omega \le R \le 0M\Omega $	±200ppm°C	Current
						0.5% (E24/E96)		1.0A
						$10\Omega \le R \le 1M\Omega$		
						Jumper $\!<\!50\mathrm{m}\Omega$		
						5% (E24)	$ \Omega \le R \le 0\Omega $	Rated Current
						$ \Omega \leq R \leq 22M\Omega$	±200ppm°C	IA
			50) (0.5%, 1% (E24/E96)	$10\Omega < R \le 10M\Omega$	Maximum
	1/16 VV	√ -55 °C to 155 °C	50V	100V	100V 100V	$I\Omega \leq R \leq I0M\Omega$	±100ppm°C	Current
						Jumper<50m Ω	$10M\Omega < R \le 22M\Omega$	2A
AC0402						5	±200ppm°C	
						5% (E24)	$ \Omega \leq R < 0\Omega $	
						$ \Omega \leq R \leq 0M\Omega $	±200 ppm°C	
	1/8W	-55 °C to 155 °C	75V	100V	100V	0.5%, 1% (E24/E96)	$10\Omega \le R \le 10M\Omega$	
						$ \Omega \leq R \leq 10M\Omega$	±100 ppm°C	
								Rated Current
						5% (E24) I $\Omega \le R \le 22M\Omega$	$ \Omega \leq R < 0\Omega $	IA
							± 200 ppm°C $10\Omega \le R \le 10M\Omega$	Maximum
	1/10 W	-55 °C to 155 °C	75V	150V	150V	0.5%, 1% (E24/E96) $1\Omega \le R \le 10M\Omega$		Current
							± 100 ppm°C $10M\Omega < R \le 22M\Omega$	2A
AC0603						Jumper - Jumsz	±200ppm°C	273
						5% (E24)	$ \Omega \le R < 0\Omega $	
	1/5 W	-55 °C to 155 °C	75V	150V	150V	$ \Omega \le R \le 0M\Omega $	±200 ppm°C	
						0.5%, 1% (E24/E96)	$10\Omega \le R \le 10M\Omega$	
						$ \Omega \le R \le 0M\Omega $	±100 ppm°C	

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TYPE	POWER	Operating Temperature Range	Max. Working Voltage	Max. Overload V Voltage	Dielectric Vithstanding Voltage	Resistance Range	Temperature Coefficient	Jumper Criteria
						5% (E24)	$ \Omega \le R < 0\Omega $	Rated Current
						$ \Omega \leq R \leq 22 M\Omega$	±200ppm°C	2A
	1/0\\/		150V	300V	300V	0.5%, 1% (E24/E96)	$10\Omega \le R \le 10M\Omega$	Maximum
	1/0 VV	-55 °C to 155 °C	1500	2004	2004	$ \Omega \le R \le 0M\Omega $	±100ppm°C	Current
						Jumper < 50m Ω	$10M\Omega < R \le 22M\Omega$	5A
AC0805							±200ppm°C	
						5% (E24)	$ \Omega \le R < 0\Omega $	
				2001	2001	$ \Omega \le R \le 0M\Omega $	±200 ppm°C	
	1/4 VV	-55 °C to 155 °C	150V	300V	300V	0.5%, 1% (E24/E96)	$10\Omega \le R \le 10M\Omega$	
						$ \Omega \le R \le 0M\Omega $	±100 ppm°C	
						5% (E24)	$ \Omega \le R < 0\Omega $	Rated Current
			200∨			$ \Omega \le R \le 22M\Omega$	±200ppm°C	2A
						0.5%, 1% (E24/E96)	$10\Omega \le R \le 10M\Omega$	Maximum
	1/4 W	-55 °C to 155 °C		400V	500V	$ \Omega \le R \le 0M\Omega $	±100ppm°C	Current
						Jumper<50m Ω	$10M\Omega < R \le 22M\Omega$	10A
AC1206							±200ppm°C	
						5% (E24)	$ \Omega \leq R < 0\Omega $	
					= = = = =	$I\Omega \le R \le I0M\Omega$	±200 ppm°C	
	1/2 W	-55 °C to 155 °C	200V	400V	500V	0.5%, 1% (E24/E96)	$10\Omega \le R \le 10M\Omega$	
						$ \Omega \leq R \leq 0M\Omega $	±100 ppm°C	
						5% (E24)	$ \Omega \le R < 0\Omega $	Rated Current
						$ \Omega \le R \le 22M\Omega$	±200ppm°C	2A
				= = = = /	= = = = =	0.5%, 1% (E24/E96)	$10\Omega \le R \le 10M\Omega$	Maximum
	1/2 VV	-55 °C to 155 °C	200V	500V	500V	$ \Omega \le R \le 0M\Omega $	±100ppm°C	Current
						Jumper<50m Ω	$10M\Omega < R \le 22M\Omega$	10A
AC1210							±200ppm°C	
						5% (E24)	$ \Omega \leq R < 0\Omega $	
						$ \Omega \le R \le 0M\Omega $	±200 ppm°C	
	IW	-55 °C to 155 °C	200V	500V	500V	0.5%, 1% (E24/E96)	$10\Omega \le R \le 10M\Omega$	
						$ \Omega \le R \le 0M\Omega $	±100 ppm°C	

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		CHARACTERISTICS									
TYPE	POWER	Operating Temperature Range	Max. Working Voltage	Max. Overload V Voltage	Dielectric Vithstanding Voltage	Resistance Range	Temperature Coefficient	Jumper Criteria			
						5% (E24)	$ \Omega \le R < 0\Omega $	Rated Current			
						$ \Omega \le R \le M\Omega $	±200ppm°C	6A			
	IW	-55 °C to 155 °C	200V	500V	500V	0.5%, 1% (E24/E96)	$10\Omega \le R \le 1M\Omega$	Maximum			
						$ \Omega \leq R \leq M\Omega $	±100ppm°C	Current			
AC1218						Jumper<50m Ω		10A			
						5% (E24)	$ \Omega \leq R < 0\Omega $				
			2001	5001	5001	$ \Omega \leq R \leq M\Omega $	±200 ppm°C				
	1.500	-55 °C to 155 °C	200V	500V	500V	0.5%, 1% (E24/E96)	$10\Omega \le R \le 1M\Omega$				
						$ \Omega \le R \le M\Omega $	±100 ppm°C				
						5% (E24)	$ \Omega \leq R < 0\Omega $	Rated Current			
	3/4 W	-55 ℃ to 155 ℃	200V	500V	500V	$I\Omega \le R \le 22M\Omega$	±200ppm°C	2A			
						0.5%, 1% (E24/E96)	$10\Omega \le R \le 10M\Omega$	Maximum			
						$ \Omega \le R \le 0M\Omega $	±100ppm°C	Current			
						Jumper<50m Ω	$10M\Omega < R \le 22M\Omega$	10A			
AC2010							±200ppm°C				
						5% (E24)	$ \Omega \leq R < 0\Omega $				
						$ \Omega \le R \le 0M\Omega $	±200 ppm°C				
	1.25W	-55 °C to 155 °C	200V	500V	500V	0.5%, 1% (E24/E96)	$10\Omega \le R \le 10M\Omega$				
						$ \Omega \le R \le 0M\Omega $	±100 ppm°C				
	<u>.</u>					5% (E24)	$ \Omega \leq R < 0\Omega $	Rated Current			
						$I\Omega \leq R \leq 22M\Omega$	±200ppm°C	2A			
						0.5%, 1% (E24/E96)	$10\Omega \le R \le 10M\Omega$	Maximum			
	IW	-55 °C to 155 °C	200V	500V	500V	$ \Omega \leq R \leq 0M\Omega $	±100ppm°C	Current			
						Jumper<50m Ω	$10M\Omega < R \le 22M\Omega$	10A			
AC2512							±200ppm°C				
						5% (E24)	$ \Omega \leq R < 0\Omega $				
						$I\Omega \leq R \leq I0M\Omega$	±200 ppm°C				
	2 W	-55 °C to 155 °C	200V	500V	500V	0.5%, 1% (E24/E96)	$10\Omega \le R \le 10M\Omega$				
						$I\Omega \le R \le 10M\Omega$	±100 ppm°C				

FOOTPRINT AND SOLDERING PROFILES

Recommended footprint and soldering profiles of AC-series is the same as RC-series. Please refer to data sheet "Chip resistors mounting".

PACKING STYLE AND PACKAGING QUANTITY

Table 3 Packing style and packaging quantity

PACKING STYLE	reel Dimension	AC0201	AC0402	AC0603	AC0805	AC1206	AC1210	AC1218	AC2010	AC2512
Paper taping reel (R)	7" (178 mm)	10,000	10,000	5,000	5,000	5,000	5,000			
	10" (254 mm)	20,000	20,000	10,000	10,000	10,000	10,000			
	13" (330 mm)	50,000	50,000	20,000	20,000	20,000	20,000			
Embossed taping reel (K)	7" (178 mm)							4,000	4,000	4,000
	13" (330 mm)								16,000	

NOTE

I. For paper/embossed tape and reel specifications/dimensions, please refer to data sheet "Chip resistors packing".

FUNCTIONAL DESCRIPTION

OPERATING TEMPERATURE RANGE

Range: -55 °C to +155 °C

POWER RATING

Each type rated power at 70 °C: AC0201=1/20W (0.05W) AC0402=1/16W (0.0625W); 1/8W (0.125W) AC0603=1/10W (0.1W); 1/5W (0.2W) AC0805=1/8W (0.125W); 1/4 W(0.25 W) AC1206=1/4W (0.25W); 1/2 W (0.5 W) AC1210=1/2W (0.5W); 1/2 W (0.5 W) AC1218=1W; 1.5W AC2010=3/4W (0.75W); 1.25W AC2512=1 W; 2W

RATED VOLTAGE

The DC or AC (rms) continuous working voltage corresponding to the rated power is determined by the following formula:

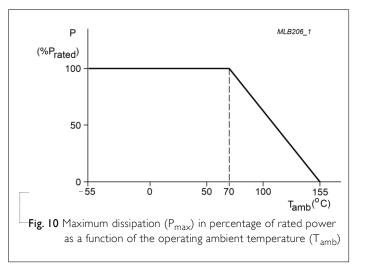
$$V = \sqrt{(P \times R)}$$

Or Maximum working voltage whichever is less

Where

V = Continuous rated DC or AC (rms) working voltage (V) P = Rated power (W)

 $R = Resistance value (\Omega)$



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TESTS AND REQUIREMENTS

Table 4 Test condition, procedure and requirements

TEST	TEST METHOD	PROCEDURE	REQUIREMENTS
High Temperature Exposure	AEC-Q200 Test 3 MIL-STD-202 Method 108	1,000 hours at T _A = 155 °C, unpowered	\pm (1.0%+0.05Ω) for D/F tol \pm (2.0%+0.05Ω) for J tol <50 mΩ for Jumper
Moisture Resistance	AEC-Q200 Test 6 MIL-STD-202 Method 106	Each temperature / humidity cycle is defined at 8 hours (method 106F), 3 cycles / 24 hours for 10d. with 25 °C / 65 °C 95% R.H, without steps 7a & 7b, unpowered	$\pm (0.5\% + 0.05\Omega)$ for D/F tol $\pm (2.0\% + 0.05\Omega)$ for J tol <100 m Ω for Jumper
Biased Humidity	AEC-Q200 Test 7 MIL-STD-202 Method 103	1,000 hours; 85 °C / 85% RH 10% of operating power Measurement at 24±4 hours after test conclusion.	±(1.0%+0.05Ω) for D/F tol ±(3.0%+0.05Ω) for J tol <100 mΩ for Jumper
Operational Life	AEC-Q200 Test 8 MIL-STD-202 Method 108	1,000 hours at 125 °C, derated voltage applied for 1.5 hours on, 0.5 hour off, still-air required	±(1.0%+0.05Ω) for D/F tol ±(3.0%+0.05Ω) for J tol <100 mΩ for Jumper
Resistance to Soldering Heat	AEC-Q200 Test 15 MIL-STD-202 Method 210	Condition B, no pre-heat of samples Lead-free solder, 260±5 °C, 10±1 seconds immersion time Procedure 2 for SMD: devices fluxed and cleaned with isopropanol	\pm (0.5%+0.05 Ω) for D/F tol \pm (1.0%+0.05 Ω) for J tol <50 m Ω for Jumper No visible damage
Thermal Shock	AEC-Q200 Test 16 MIL-STD-202 Method 107	-55/+125 °C Number of cycles is 300. Devices mounted Maximum transfer time is 20 seconds. Dwell time is 15 minutes. Air – Air	\pm (0.5%+0.05Ω) for D/F tol \pm (1.0%+0.05Ω) for J tol <50 mΩ for Jumper
ESD	AEC-Q200 Test 17 AEC-Q200-002	Human Body Model, I _{pos.} + I _{neg.} discharges 0201: 500V 0402/0603: IKV 0805 and above: 2KV	±(3.0%+0.05Ω) <50 mΩ for Jumper



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TEST	TEST METHOD	PROCEDURE	REQUIREMENTS	
Solderability - Wetting	AEC-Q200 Test 18 J-STD-002	Electrical Test not required Magnification 50X SMD conditions:	Well tinned (≥95% covered) No visible damage	
		(a) Method B, aging 4 hours at 155 °C dry heat, dipping at 235±3 °C for 5±0.5 seconds.		
		(b) Method B, steam aging 8 hours, dipping at 215±3 ℃ for 5±0.5 seconds.		
		(c) Method D, steam aging 8 hours, dipping at 260±3 ℃ for 30±0.5 seconds.		
Board Flex	AEC-Q200 Test 21	Chips mounted on a 90mm glass epoxy resin	±(1.0%+0.05Ω) <50 mΩ for Jumper	
	AEC-Q200-005	PCB (FR4) Bending for 0201/0402: 5 mm 0603/0805: 3 mm 1206 and above: 2 mm		
		Holding time: minimum 60 seconds		
Temperature Coefficient of	MIL-STD-202 Method 304	At +25/–55 °C and +25/+125 °C	Refer to table 2	
Resistance (T.C.R.)		Formula:		
		T.C.R= $\frac{R_2-R_1}{R_1(t_2-t_1)} \times 10^6 \text{ (ppm/°C)}$		
		Where t ₁ =+25 °C or specified room temperature		
		t_2 =–55 °C or +125 °C test temperature		
		R_1 =resistance at reference temperature in ohms		
		R_2 =resistance at test temperature in ohms		
Short Time Overload	IEC60115-14.13	2.5 times of rated voltage or maximum overload voltage whichever is less for 5 sec at room temperature	\pm (1.0%+0.05Ω) for D/F tol \pm (2.0%+0.05Ω) for J tol <50 mΩ for Jumper	
FOS	ASTM-B-809-95	Sulfur (saturated vapor) 500 hours, 60±2°C, unpowered	±(1.0%+0.05Ω)	

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Chip Resistor Surface Mount	AC	SERIES	0201 to 2512
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REVISION HISTORY

REVISION	DATE	CHANGE NOTIFICATION	DESCRIPTION
Version 10	Jan. 04, 2023	-	- 10ohm TCR upgrade to 100ppm, for 0603~2512 normal power and 0402~2512 double power.
Version 9	Aug. 02, 2022	-	- 12 dimension updated, for size 1206, size 2010, size 2512.
Version 8	Mar. 19, 2021	-	- Upgrade the working voltage of 0402 double power to 75V
Version 7	July 10, 2017	-	- Add "3W" part number coding for 13" Reel & double power
Version 6	May 31, 2017	-	- Add 10" packing
Version 5	Dec. 07, 2015	-	- Add in AC double power
Version 4	May 25, 2015	-	- Remove 7D packing - Extend resistance range - Add in AC0201 - Update FOS test and requirements
Version 3	Feb 13, 2014	-	- Feature description updated - add ±0.5% - delete 10" taping reel
Version 2	Feb. 10, 2012	-	- Jumper criteria added - ACI2I8 marking and outline figure updated
Version I	Feb. 01, 2011	-	- Case size 1210, 1218, 2010, 2512 extended - Test method and procedure updated - Packing style of 7D added
Version 0	Nov. 10, 2010	-	- First issue of this specification

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