

SMIC

Contact

SENJU METAL INDUSTRY CO., LTD.

HEADQUARTERS
Senju Hashido-cho 23, Adachi-ku, Tokyo 120-8555, Japan
Phone +81-3-3888-5151
URL www.senju.com/en

Attention to counterfeit products.
Counterfeit flux cored and other inauthentic SMIC solder products have been distributed abroad.
Please purchase genuine SMIC products from SMIC subsidiaries or authorized distributors.



SMIC Lead-free Flux Cored Solder Product Catalogue

ECO SOLDER CORED

ECO SOLDER CORED

SMIC is keenly aware of its social responsibility to help protect the global environment. We contribute to society by continuously offering products that create new values in our ECO SOLDER products. In addition, we have declared "Conflict-Free Sourcing" and developed procurement satisfying CSR (Corporate Social Responsibility) through efforts such as checking the origins of smelters of tin ores. Since 1955, when we introduced the first flux cored solder in Japan under the brand of "Sparkle Solder," we have continued to develop a number of flux cored solders with various alloys for a wide range of applications. This has contributed significantly to progress in the electronic and automotive markets as well as in other areas of the industry.

As the leading company in the industry, we continue to suggest "Smart Connection Realized by Advanced Solder," through the development of flux cored solder products that can accommodate various requests in many markets that continue to evolve environmentally-friendly, high-reliability, inexpensive and wearable products for the next generation.

Contents

SEN Series	3	EFC Series	13
GAO Series	5	ALS Series	15
CBF Series	7	RK Series Solder Alloys	17
MACROS Series	9	List of Lead-Free Solder Alloys	18
LEO Series	11		

Please select from our product lineup according to the applications or purposes of the next-generation products that continue to evolve.

SEN Series NEW

Complete suppress of splash of flux solder

GAO Series

Flux shows superb wettability that realizes high thermal resistance and low fumes

CBF Series

Enables fine connection with halogen-free flux cored ultra-thin wire on mobile devices, etc

MACROS Series

Optimal for harsh environments such as automotive applications

LEO Series

Sn-Bi low melting temperature alloy as our L20 enables low temperature soldering

Lead-free flux cored solder that continues to take on further challenges and evolve

● Workability-oriented (wettability, fume, odor countermeasure) JIS A Class



● Reliability-oriented (high insulation of flux residue) JIS AA Class



● Soft flux residue (migration countermeasure) JIS AA Class



● Halogen-free flux (JIS AA Class equiv.)



● Low temperature soldering JIS A Class

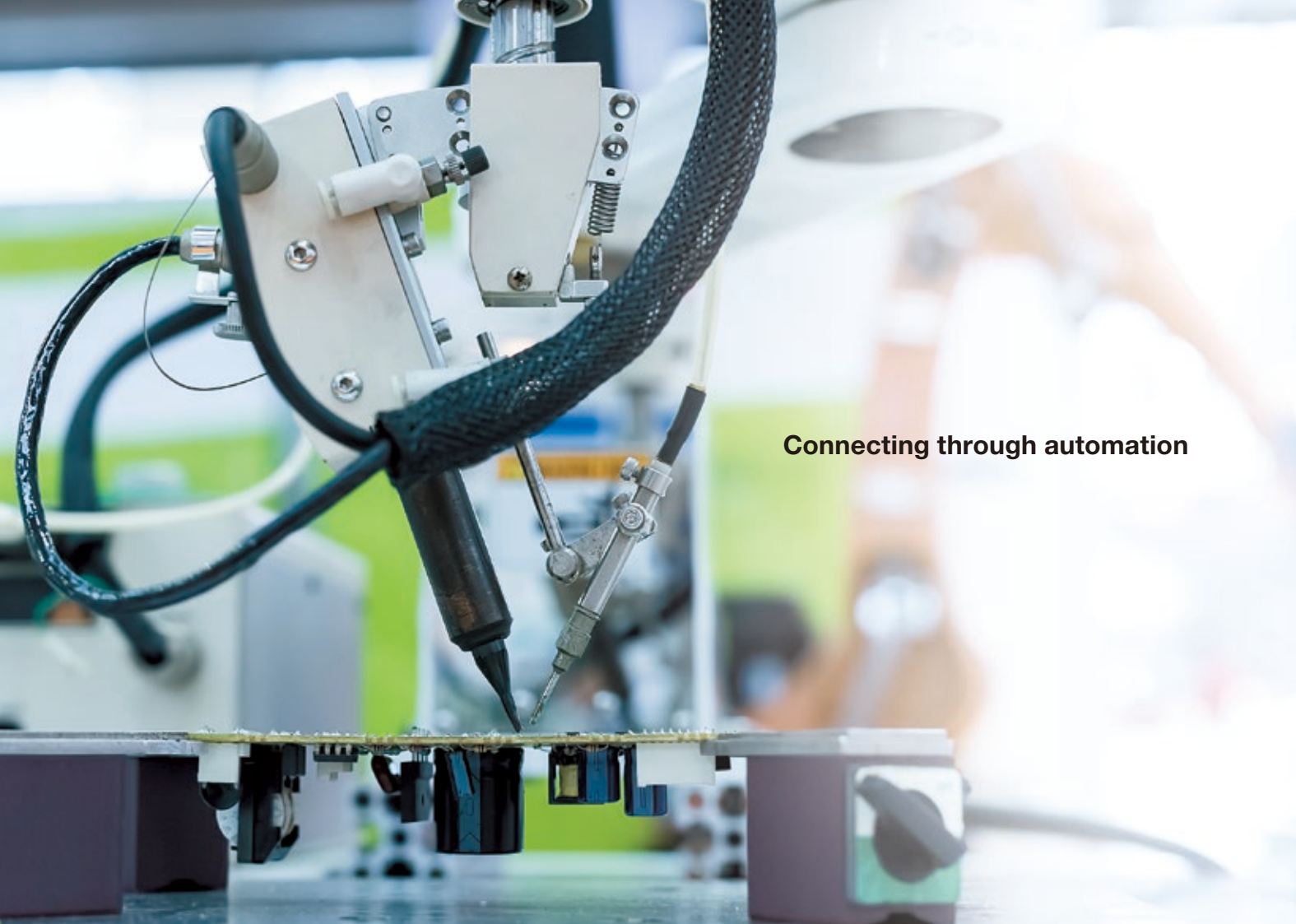


2000

Performance
enhancement

2015

0% Ag alloys have been added to the product lineup



Connecting through automation

SEN Series NEW

Splash-free, high insulation product that is applicable to laser soldering.

The electronics industry has advanced with higher density and higher precision, and the environment with splash of solder and flux is inducing malfunction. In addition that, solder and flux splash may adhere to the hands and body of workers and be burned concern. The “SEN Series” is newly developed for complete the reduction of solder and flux splash. Besides using at high temperature, the flux splash was also suppressed for robotics and laser soldering. In addition, flux and fumes, which are concerned about adverse effects on the human body, were suppressed and the achieved Eco-friendly work environment. The “SEN Series” connects to the future with automation. Rosin Mildly Activated type with high insulation and no corrosion materials are ideal for optical products such as automotive and OA applications.

Available Alloys

M705

M705RK

M20RK



Basic Specifications

Flux type	JIS AA Class RMA Type ROL1
Containing halogen elements	Yes
Flux content	3 mass%, 4 mass%
Halide content [mass%]	0.1 mass% or less
Copper corrosion test	Pass
Dryness test	Pass
Insulation Resistance (85°C/85% RH)	1.0E + 09 Ω
Humidity test under DC voltage	No ion migration
Spreadability	75 % or higher
Supported wire diameters	φ 0.3 to 1.6 mm
Available Alloys	M705, M705RK, M20RK
Recommended solder iron tip temperature	320 to 400 °C

Features

● Non-splash of flux & solder through exclusive control

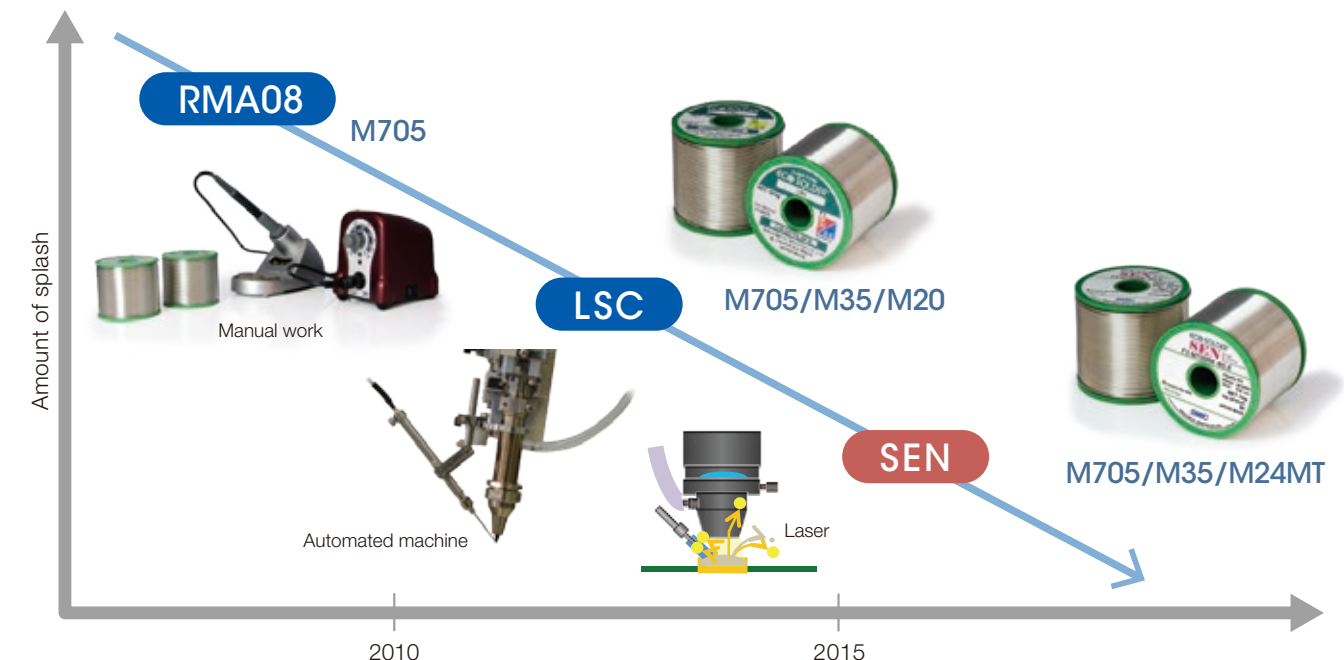
- Splash control in a wide working temperature range.
- Non-splash soldering even in laser soldering with rapid heating.
- Splash control even in high-speed operation with various alloys.

● Recommended Applications

- Not dependent on soldering work conditions, and suitable for automation using robotics.
- Suitable for laser soldering as well as solder iron operation.
- Suitable for sleeve soldering robotics supplying molten solder from ceramic sleeve, as it does not cause scorching in the ceramic sleeve part.



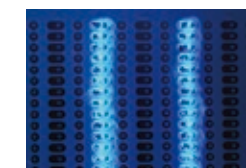
● Non-splash flux-cored solder SEN meeting new soldering requirements



● Splash when the solder is directly put on a soldering iron



Conventional product



SEN

● Splash in laser soldering



Conventional product

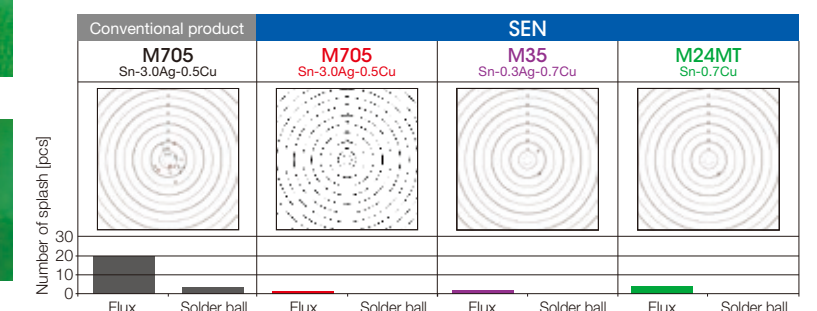


SEN

● Splash of various alloys

Product	Composition	Solidus line - Liquidus line
M705	Sn-3Ag-0.5Cu	217-220
M35	Sn-0.3Ag-0.7Cu	217-227
M24MT	Sn-Cu-Ni-P-Ge	228-230

- When the difference between the solidus and the liquidus is large, the number of splash is more likely to increase
- When an alloy has a high melting point, the number of splash is more likely to increase





Connecting healthy work environments

GAO Series

We pursued a comfortable work environment and beautiful appearance after soldering.

When performing soldering work, adverse health effects due to the flux fume is a concern. The “GAO Series” was developed taking into consideration the health of workers. The “GAO Series” demonstrates low fumes and odor even under high temperatures, and achieves a beautiful appearance after soldering as it does not cause scorching or air bubbles. It facilitates appearance check, and is friendly to the health of workers. To be specific, it suppresses the flux fumes and odor to the extent possible to promise a comfortable soldering environment. In addition, scorching of the flux does not occur even at a high solder iron tip temperature of 400°C or higher. The “GAO Series,” which connects a healthy work environment to the future, is perfect for customers who use high solder iron tip temperatures for soldering in a short amount of time.



Basic Specifications	
Flux type	JIS A Class, MIL RA, ROM1
Containing halogen elements	Yes
Flux content	3 mass%
Halide content [mass%]	0.1 to 0.5 mass%
Copper corrosion test	Pass
Dryness test	Pass
Insulation Resistance (85°C/85% RH)	1.0E + 08 Ω
Humidity test under DC voltage	No ion migration
Spreadability	75 % or higher
Supported wire diameters	φ 0.3 to 1.6 mm
Available Alloys	M24AP, M24MT
Recommended solder iron tip temperature	350 to 450 °C

Features

Worker-friendly solder that withstands high temperatures

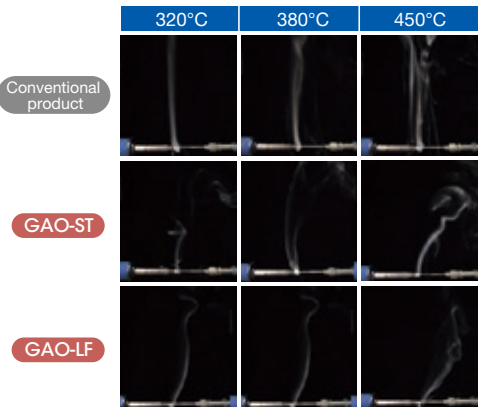
- The flux does not burn even under high temperatures.
- The reduction of fumes and odor.
- Equipped with workability and reliability, while realizing a comfortable work environment.



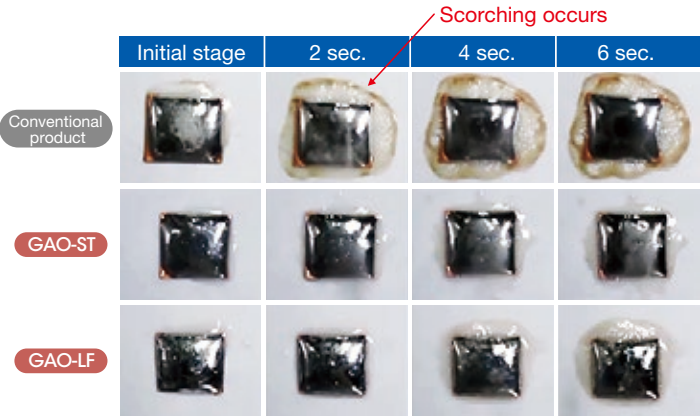
Recommended Applications

- Suitable for solder iron work as flux does not easily burn even under direct heating.
- Suitable for soldering of components with a large heat capacity.

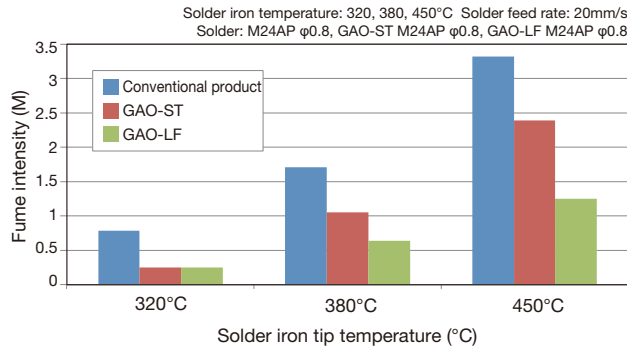
Comparison of fume amount at each temperature



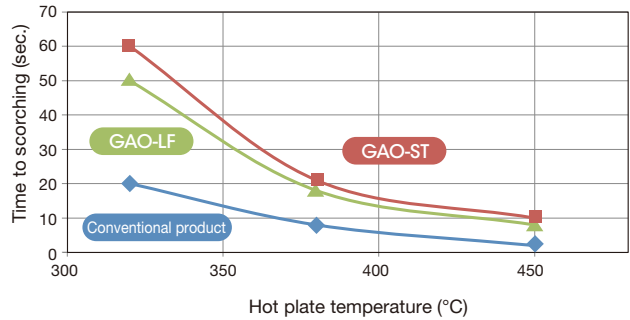
Comparison of scorching degree at 450 °C



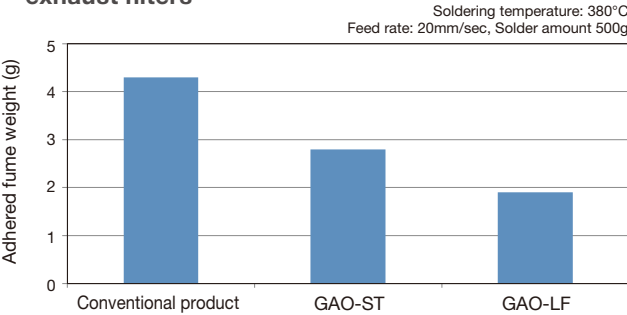
Comparison of fume intensity



Comparison of scorching temperatures



Comparison of the weight of fume adhered to local exhaust filters



Comparison of remaining air bubble amounts





Connecting high-density packaging

CBF Series

Optimal for high-density printed circuit boards, with a product lineup including ultra-fine wires with halogen free flux.

Halogen is a collective name for the group of elements such as fluorine, chlorine, bromine, and iodine (group 17 of the periodic table). Some materials containing these halogen elements generate dioxins when burned. Generally, a slight amount of halogen is added as an activator of flux. SMIC, however, offers various halogen-free flux products. The “CBF Series” consists of halogen-free flux cored solder products that satisfy the industry standard. Having excellent wettability and being a halogen-free flux, it is suitable for laser soldering or drag soldering for fine pitch leads. The “CBF Series” is optimal for the production of environmentally friendly products, and connects high-density packaging to the future.

Available Alloys

- M705
- M35
- M24MT



Basic Specifications

Flux type	JIS AA Class equiv., MIL RMA equiv., ROL1
Containing halogen elements	Free (Halogen content: compliant with the industry standard)
Flux content	3 mass%
Halide content [mass%]	0.1 mass% or less
Copper corrosion test	Pass
Dryness test	Pass
Insulation Resistance (85°C/85% RH)	1.0E + 09 Ω
Humidity test under DC voltage	No ion migration
Spreadability	70 % or higher
Supported wire diameters	φ 0.15 to 1.6 mm
Available Alloys	M705, M35, M24MT
Recommended solder iron tip temperature	320 to 380 °C

Features

● Excellent wettability despite being halogen-free flux

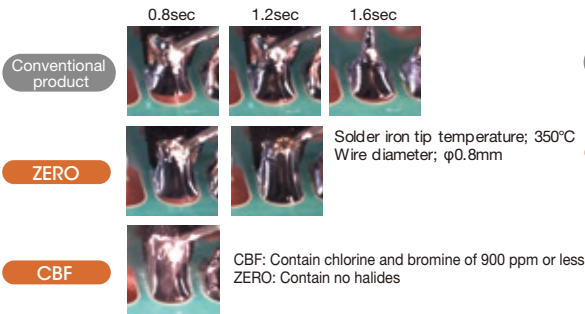
- Contains amounts of chlorine and bromine that satisfy the halogen-free standard.
- Improves wettability and suppresses bridge generation in drag soldering.
- Suitable for processes in which heat is applied for a long period with low splash and high thermal resistance.



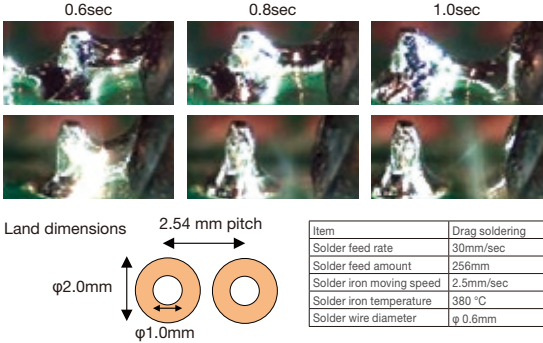
● Recommended Applications

- Suitable for solder iron work and CBF series is also suitable for laser soldering.
- The CBF Series is suitable for drag soldering or fine-pitch soldering due to its exceptional fluidity.
- The ZERO Series features a superb insulation characteristic of flux and is suitable for products requiring high reliability.

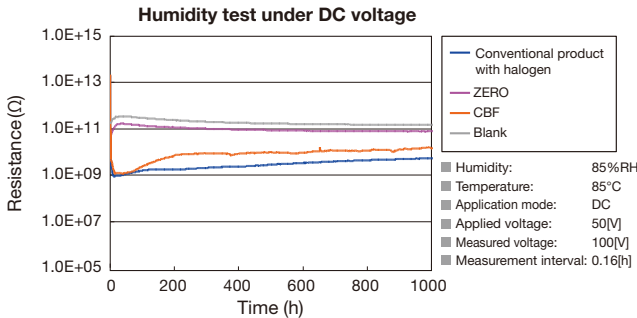
● Excellent wettability despite being halogen-free flux



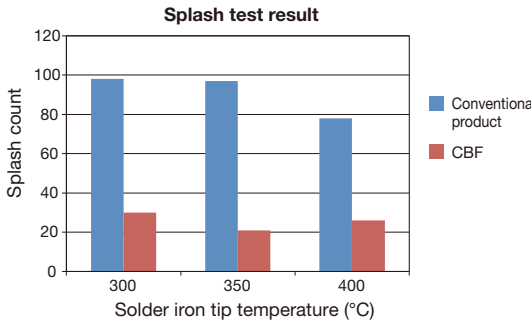
● CBF series does not cause bridge even in drag soldering



● Flux used in ZERO series features excellent insulation characteristic



● Flux used in CBF series features low splash and excellent thermal resistance



ZERO Series

Available Alloys

- M705

Basic Specifications

Flux type	JIS AA Class equiv., MIL RMA equiv. ROL0
Containing halogen elements	No (100% halogen-free)
Flux content	3 mass%, 4 mass%
Halide content [mass%]	0.02 mass% or less
Copper corrosion test	Pass
Dryness test	Pass
Insulation Resistance	1.0E+09 Ω
Humidity test under DC voltage	No ion migration
Spreadability	70 % or higher
Supported wire diameters	φ0.3 mm to φ1.6 mm
Available Alloys	M705
Recommended solder iron tip temperature	320 to 360 °C

With 0% halogen content in the flux, a groundbreaking product focusing on its insulation characteristic

“ZERO Series” is lead-free solder and a “completely halogen-free flux product” that does not contain any halides in the flux. Since flux contain ZERO halogen, it exhibits an extremely high insulation resistance value, which leads to excellent reliability of the flux residue after soldering. In addition, since it uses a clear flux, its residue has a clear appearance that is easy for appearance check, etc. It is optimal for all types of environmentally-friendly products.

Connecting automotives



MACROS Series

Available Alloys

M705

Soft residue of flux is optimal for automotive applications with a high condensation risk.

Flux cored solder may experience cracking in the flux residue under harsh environments such as in automotive applications. In automotive applications, where the temperature difference between the daytime and nighttime is large, condensed water enters into these cracks, which easily cause ion migration when applying current. The “MACROS Series” is soft flux residue type products featuring flux residue that does not crack even under mechanical bending or thermal stress, thus preventing ion migration due to condensation. In addition, it is suitable for laser soldering due to low splashing even under rapid heating, and the flux exhibits high water repellency and insulation resistance that lead to high reliability. The “MACROS Series” is optimal for automotive applications that require high reliability, safety and security and connects the future of automotive.



Basic Specifications

Flux type	JIS AA Class, MIL RMA, ROL1
Containing halogen elements	Yes
Flux content	3.5 mass%
Halide content [mass%]	0.1 mass% or less
Copper corrosion test	Pass
Dryness test	Pass
Insulation Resistance (85°C/85% RH)	1.0E+09 Ω
Humidity test under DC voltage	No ion migration
Spreadability	75 % or higher
Supported wire diameters	φ 0.5 to 1.6 mm
Available Alloys	M705
Recommended solder iron tip temperature	320 to 380 °C

Features

● Prevents flux residue cracking, and is optimal for automotive applications

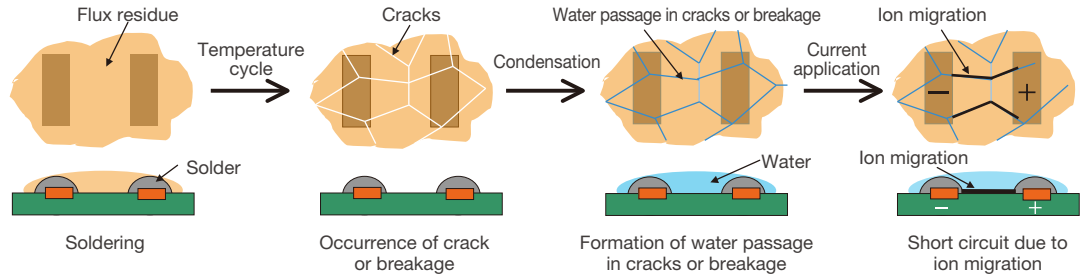
- Features flux residue that does not crack even under mechanical bending or thermal stress.
- Flux exhibits high adhesive force to PCB and high water repellency, as well as anti-corrosion effect and high insulation resistance.
- Suppresses flux splashing inherent to laser soldering.



● Recommended Applications

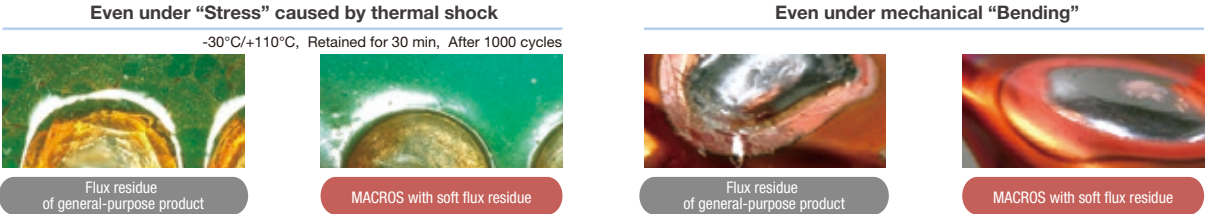
- Optimal for laser soldering due to low splashing of flux even under rapid heating.
- Optimal for automotive applications that require high reliability.
- Suitable for drag soldering due to its exceptional fluidity.

● If flux residue cracks, it will become the cause of ion migration

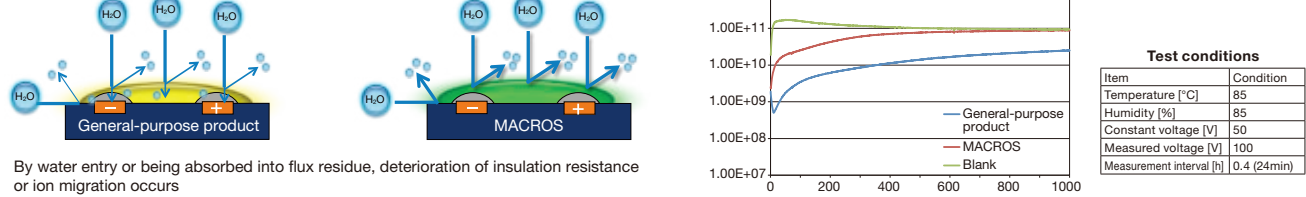


● MACROS series features flux residue that does not crack even under mechanical bending or thermal stress

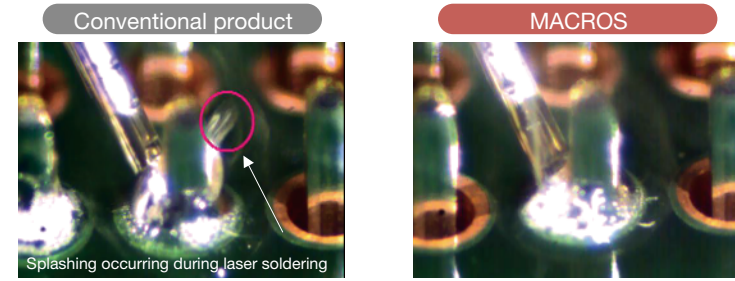
Flux residue does not crack and ion migration due to condensation does not occur



● Flux residue with high water repellency and adhesion force exhibits high insulation characteristic, preventing corrosion or ion migration



● Suppresses flux splashing inherent to laser soldering



● Promises excellent soldering work with outstanding fluidity



Connecting future packaging

LEO Series

Available Alloys
L20

Enable soldering at 200°C, which leads the industry.

Conventionally, Sn-Bi (tin-bismuth) solder alloys could not be used in flux cored solder products, since its hardness and low ductility. SMIC has succeeded in developing The “LEO Series” of Sn-Bi low-temperature flux cored solder, which leads the industry, by fully utilizing our propitiatory processing technologies. The series uses an alloy with a low melting point, which enables soldering at 200°C, and also makes it possible to reduce energy use or solder iron tip wear, as well as to use inexpensive materials; as a result, material and production costs can be reduced. Moreover, the rework materials will accelerate low-temperature soldering using Sn-Bi solder in reflow oven. The “LEO Series,” which connects future of packaging, is optimal for packaging of low heat-resistant components or substrates.

Basic Specifications

Flux type	JIS A Class equiv., MIL RA, ROM1
Containing halogen elements	Yes
Flux content	2 mass%
Halide content [mass%]	0.1 to 0.5 mass%
Copper corrosion test	Pass
Dryness test	Pass
Insulation Resistance (85°C/85% RH)	1.0E+08 Ω
Humidity test under DC voltage	No ion migration
Spreadability	75 % or higher
Supported wire diameters	φ 0.8 mm, φ 1.0 mm
Available Alloys	L20
Recommended solder iron tip temperature	200 to 300 °C

Features

Enabled low-temperature soldering, which is leading the industry, through proprietary processing technologies

- Low melting point alloy has been successfully turned into a product, realizing low-temperature soldering.
- Splashing is suppressed due to low temperature soldering.
- Energy consumption and solder iron tip wear can be reduced, which contributes to cost reduction.

Recommended Applications

- Recommended for use in solder iron soldering.
- Optimal for soldering of low heat-resistant components due to the low melting point.
- Suitable for repairs, due to its characteristic that the melting point drops when mixed in the SAC305 products.

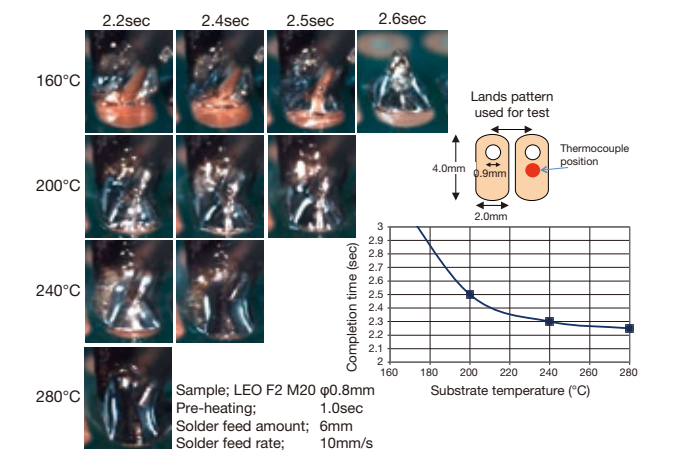


Succeeded in the development of Sn-Bi flux cored solder, which is leading the industry

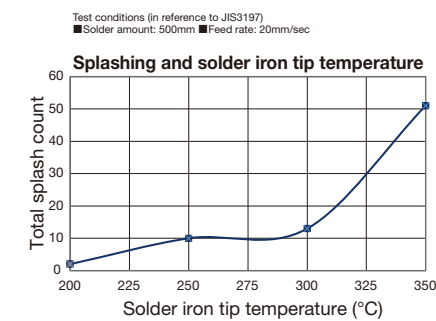


It was difficult to turn Sn-Bi alloys into flux cored solder products due to their hardness and low ductility. However, SMIC has successfully made Sn-Bi alloy into a flux cored solder product through the utilization of our proprietary processing technologies and has become the first in the industry to realize low-temperature soldering

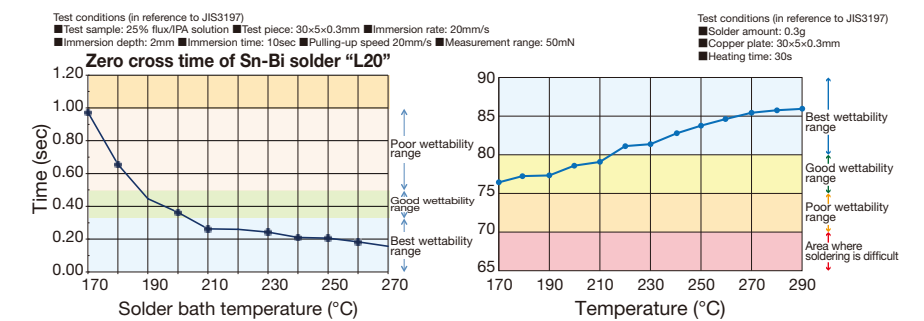
Enable soldering at substrate temperature at 200 °C



Flux developed exclusively for low temperature soldering that features improved wettability and suppresses splashing at low temperature

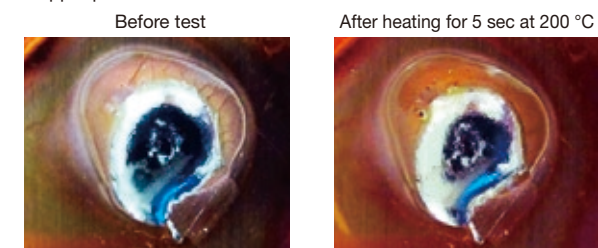


Enables good soldering work even with a solder iron tip temperature of 210 °C

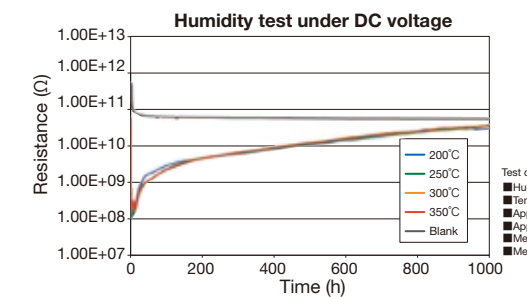


Good corrosion resistance of flux can be achieved even in low-temperature soldering by the LEO Series

Copper plate corrosion test



Good insulation characteristic of flux can be achieved even in low-temperature soldering by the LEO Series





Connecting narrow pitches

EFC Series

Flux cored solder for micro-fine connections realizes fine-pitch soldering.

In electronic devices that are becoming increasingly sophisticated and multifunctional, such as wearable devices and smartphones, the demand for size reduction and integration of components is constantly growing. Therefore, there is a strong demand for high-density packaging with a fine pitch. The “EFC Series” is flux cored solder exclusively for ultra-fine connections developed through the utilization of our proprietary elongate wire-drawing technology; in which flux is contained in the middle of ultra-fine wire with a diameter of 80 μm. The series features low splashing, good wettability, and good solder fluidity, and realizes ultra-fine connections with narrow pitches. In addition, the series comes in packaging designed so as to prevent oxidation, which causes deterioration of wettability. The “EFC Series,” which connects the future of fine pitch packaging, is optimal for soldering of fine pitch or micro-pattern soldering using solder irons.



Available Alloys
M705

Basic Specifications	
Flux type	JIS AA Class, MIL RMA, ROL1
Containing halogen elements	Yes
Flux content	3 mass%
Halide content [mass%]	0.1 mass% or less
Copper corrosion test	Pass
Dryness test	Pass
Insulation Resistance (85°C/85% RH)	1.0E+09 Ω
Humidity test under DC voltage	No ion migration
Spreadability	75 % or higher
Supported wire diameters	φ 0.08 mm to 0.2 mm
Available Alloys	M705
Recommended solder iron tip temperature	320 to 380 °C

Features

● Realizes fine-pitch soldering with ultra-thin wires

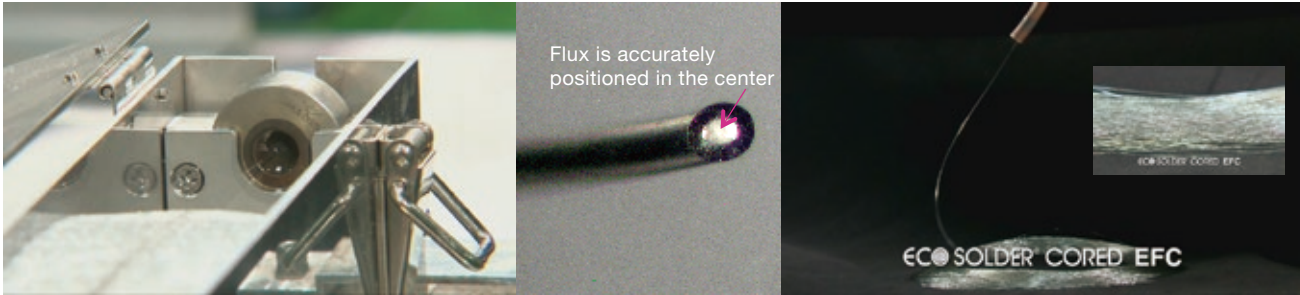
- Advanced wire drawing technology has resolved issues peculiar to ultra-thin wires, including strength.
- Low splashing has been realized through the development of flux designed for ultra-thin wires.
- Bridge formation is suppressed through the development of flux designed for ultra-thin wires.



● Recommended Applications

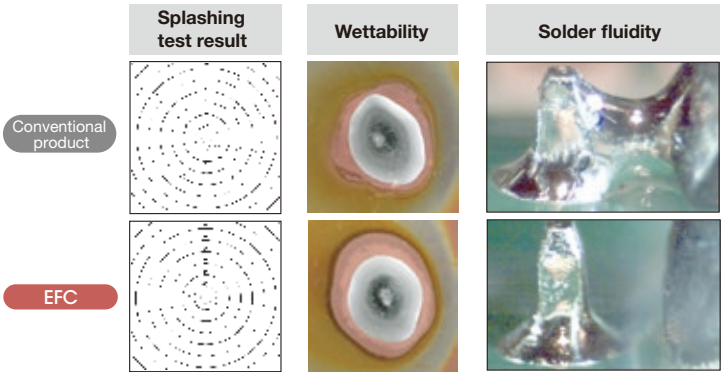
- Features high insulation resistance flux and is optimal for soldering narrow-pitch, multi-pin structures.
- Optimal for soldering micro or fine pitch components since it is ultra-fine wire.
- Optimal for soldering micro or fine pitch components due to low splashing.

- Fewer disconnections and constrictions during wire drawing and high-quality extra-fine lines made possible with our own wire drawing technology

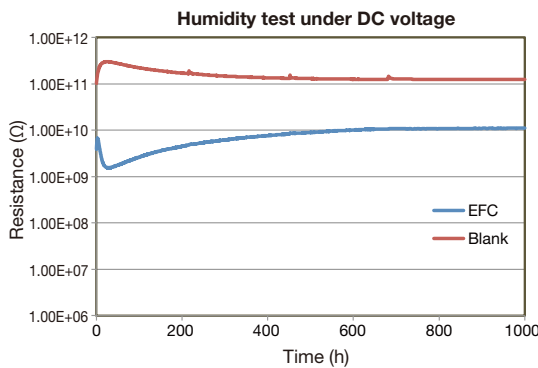


φ 0.1mm flux cored solder

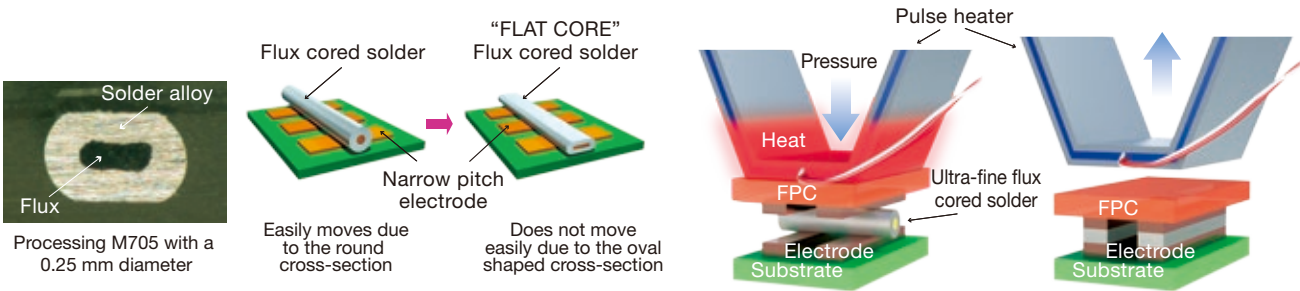
- Ultra-fine connections achieved with lower splashing, good wettability, and good solder fluidity



- Flux exhibits high insulation resistance



- Narrow-pitch soldering in reflow oven using the ultra-fine flux cored solder “FLAT CORE”



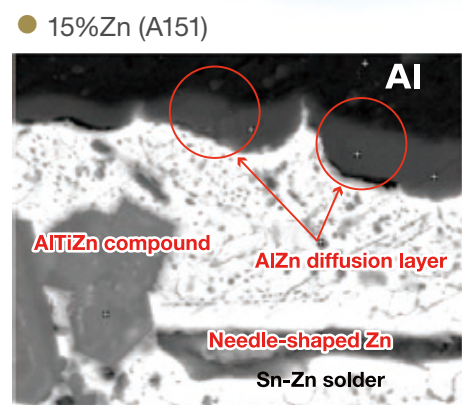
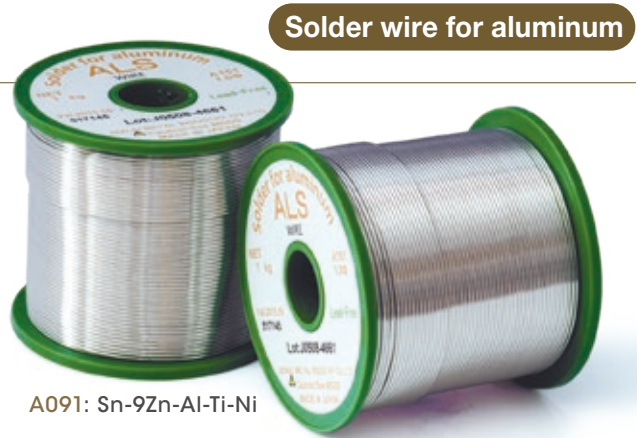


Connecting aluminum

ALS Series

Next-generation solder products that enable soldering of light and inexpensive aluminum.

Currently, heavy and expensive copper wires are mainly used for electric wires used in coils or motors. However, use of light and inexpensive aluminum is considered for applications that require weight reduction, such as electric vehicles. If soldering is performed on aluminum by using conventional soldering materials, however, a phenomenon called “galvanic corrosion” occurs and causes joint failure. The “ALS Series” solder is mainly composed of zinc, which has standard potential close to that of aluminum, and therefore suppresses electrolytic corrosion and exhibits high reliability. In order to suppress aluminum corrosion, Al was added to Sn-Zn solder. The “ALS Series” is optimal for soldering of components using light and inexpensive aluminum for energy conservation or price lowering, and connects aluminum to the future.



Features

High-quality solder material that suppresses electrolytic corrosion

- Electrolytic corrosion has been suppressed through the development of Sn-Zn material.
- Flux is not required for ultrasonic soldering.
- Aluminum corrosion has been significantly suppressed.



GLS solder for glass #6084 #9087

Recommended Applications

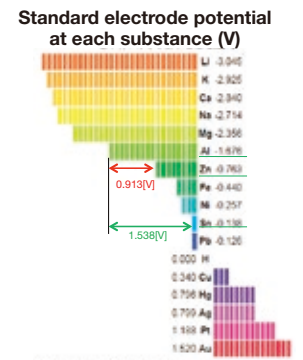
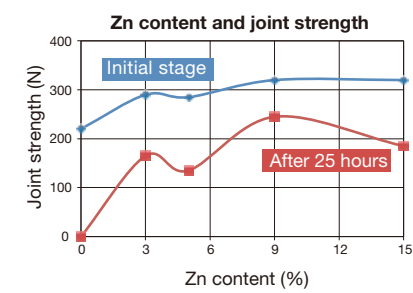
- ALS series is exclusively for aluminum, and ultrasonic soldering is recommended for this series.
- GLS series is exclusively for glass, and ultrasonic soldering is recommended for this series.

Zn solder with small standard potential difference from that of aluminum suppresses electrolytic corrosion

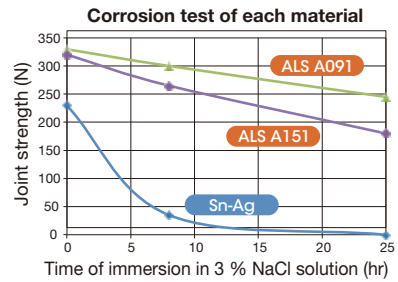


Sn-Zn solder
Zn
Al
Standard electrode potential difference 0.913[V]

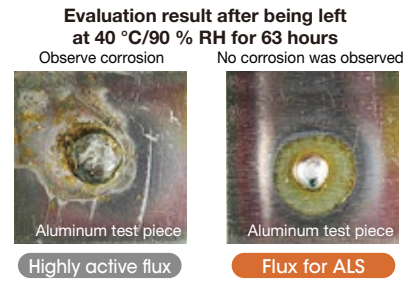
Sn-Ag solder
Sn
Al
Standard electrode potential difference 1.538[V]



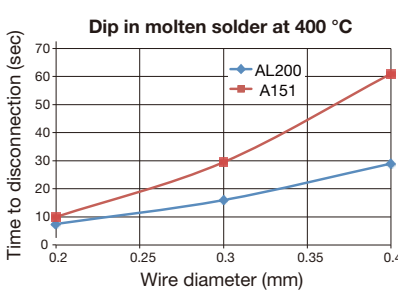
Exhibits good corrosion resistance



Flux for ALS series features low corrosiveness



Prevents aluminum corrosion



GLS Series

Solder for glass

Products that allow for direct soldering on insulators including glass.

The “GLS Series” makes it possible to directly form electrodes using solder material by ultrasonic soldering on insulators including glass, without metalizing them. It is electrode formation material rather than soldering material, which allows for the formation of flat electrodes without becoming rounded due to surface tension. It is used for antennas of rear windows of automobiles or electrode formation for photovoltaic cells, and its application is expanding.

Application is expanded for flat displays, etc.

- Joint strength can be enhanced by ultrasonic soldering
- Exhibits high electrical conductivity due to metal joint
- Enables soldering on ITO (Indium Tin Oxide) films



RK Series Solder Alloys

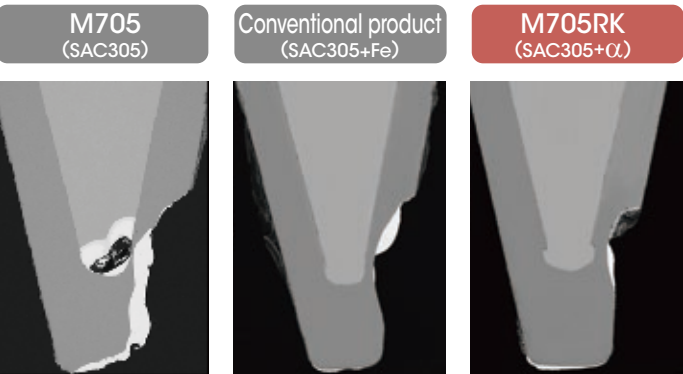
● RK Series solder alloys reduce erosion and contamination at solder iron chip

RK Series suppresses contamination of solder iron chip to improve productivity. Also, lowered erosion at iron chip induces reduction of production cost. 3Ag type M705RK and Ag-free M20RK are lineuiped and best for automatic soldering process.



Initial

● Iron tip erosion



Reached the heater component in 20,000 shots
No reach to heater component even after 60,000 shots
No reach to heater component even after 60,000 shots

● Iron tip contamination after 5000 shots



Carbides are increased
Carbides are reduced

	M705RK	Conventional product	M705
Anti-erosion	○	○	×
Anti-carbonization	○	△	○
Equipment Maintenance	○	△	○

List of Lead-Free Solder Alloys

ECO SOLDER	Alloy composition (wt%)	Melting temp. (°C)			Product Form				
		Solidus line	Peak temp.	Liquidus line	BAR	CORE	BALL	PASTE	PREFORM
M-series: Melting temperature 200 °C to 250 °C									
M705	Sn-3.0Ag-0.5Cu	217	219	220	●	●	●	●	●
M705RK	Sn-3.0Ag-0.5Cu-x	219	221	221		●			
M30	Sn-3.5Ag	221	223	223	●	●	●	●	●
M31	Sn-3.5Ag-0.75Cu	217	219	219	●	●	●	●	●
M714	Sn-3.8Ag-0.7Cu	217	219	220	●	●	●	●	●
M715	Sn-3.9Ag-0.6Cu	217	219	226	●	●	●	●	●
M710	Sn-4.0Ag-0.5Cu	217	219	229	●	●	●	●	●
M770	Sn-2.0Ag-0.75Cu-Ni	218	220	224	●	●	●	●	●
M34	Sn-1.0Ag-0.5Cu	217	219	227	●	●	●	●	●
M771	Sn-1.0Ag-0.7Cu	217	219	224	●	●	●	●	●
M40	Sn-1.0Ag-0.7Cu-Bi-In	211	222	222		●	●	●	●
M35	Sn-0.3Ag-0.7Cu	217	219	227	●	●	●	●	●
M35RK	Sn-0.3Ag-0.7Cu-x	217	219	227		●			
M47	Sn-0.3Ag-0.7Cu-0.5Bi-Ni	216	228	228	●	●	●	●	●
M20	Sn-0.75Cu	227	229	229	●	●	●	●	●
M20RK	Sn-0.75Cu-x	227	229	229		●			
M24MT	Sn-0.7Cu-Ni-P-Ge	228	230	230	●	●	●	●	●
M24AP	Sn-0.6Cu-Ni-P-Ge	227	228	228	●	●	●	●	●
M805E	Sn-0.3Bi-0.7Cu-P	225	229	229	●	●	●	●	●
M725	Sn-0.7Cu-Ni-P	228	230	230	●	●	●	●	●
M823	Sn-0.75Cu-1.5Bi-Ni-x	224	229	229			●		
M773	Sn-0.7Cu-0.5Bi-Ni	225	229	229	●	●	●	●	●
M794	Sn-3.4Ag-0.7Cu-Bi-Sb-Ni-x	210	221	221		●	●	●	●
M731	Sn-3.9Ag-0.6Cu-3.0Sb	221	224	226	●	●	●	●	●
M716	Sn-3.5Ag-0.5Bi-8.0In	196	208	214		●		●	●
M758	Sn-3.0Ag-0.8Cu-Bi-Ni	205	215	215		●	●	●	●
M806	Sn-3.5Ag-0.8Cu-Bi-Ni	203	214	214		●	●	●	●
M807	Sn-3.5Ag-0.8Cu-Bi-Ni	214	219	219		●	●	●	●
M709	Sn-0.5Ag-6.0Cu	217	226	378	●				
M760HT	Sn-5.0Cu-0.15Ni-x	228	229	365	●				
M711	Sn-0.5Ag-4.0Cu	217	226	344	●				
M10	Sn-5.0Sb	240	243	243	●	●	●	●	●
M14	Sn-10Sb	245	248	266	●	●	●	●	●
L-series: Melting temperature: 200 °C or lower									
L20	Sn-58Bi	139	141	141	●	●	●	●	●
L29	Sn-58Bi-Sb-Ni	140	145	145				●	

Peak temp.: Max. endothermic reaction point on DSC curve
Some alloy compositions may not be available in certain forms with special product sizes and grades.
For alloy compositions not listed above, please contact our sales representative or contact us via e-mail (web@senju.com).

● Features of the main flux cored solder products

	Workability	Flux heat resistance	Suppression of flux scattering	Suppression of fumes/odor	Insulation characteristic	Laser compatibility soldering	Robot compatibility soldering	Fine pitch connectivity	Suppression of flux residue cracking	Low-temperature soldering
SEN	★★★★★	★★★★	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★	—	—
GAO-ST	★★★★★	★★★★★	★★★★	★★★★★	★★★★	★★★★	★★★★★	★★★★	—	—
GAO-LF	★★★★★	★★★★	★★★★★	★★★★★	★★★★	★★★★	★★★★★	★★★★	—	—
CBF	★★★★	★★★★	★★★★	★★★★	★★★★★	★★★★★	★★★★★	★★★★★	—	—
MACROS	★★★★	★★★★	★★★★★	★★★★★	★★★★★	★★★★★	★★★★	★★	★★★★★	—
LEO	★★★★★	—	★★★★★	★★★★	★★★★	★★★★	★★	★★	—	★★★★★