Senju Metal Industry Co., Ltd.
Senju Manufacturing (Europe) Ltd.

ECO SOLDER®

High-Reliability Lead-Free Solder Paste

M31-GRN360-K-V

Manufacturer	European Facility
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M31-GRN360-K V-Type

Lead-Free solder paste ECOSOLDER M31-GRN360-K V-Type is a further development of the GRN360 K-series and especially designed to meet higher preheat temperatures. This means users will not only benefit from

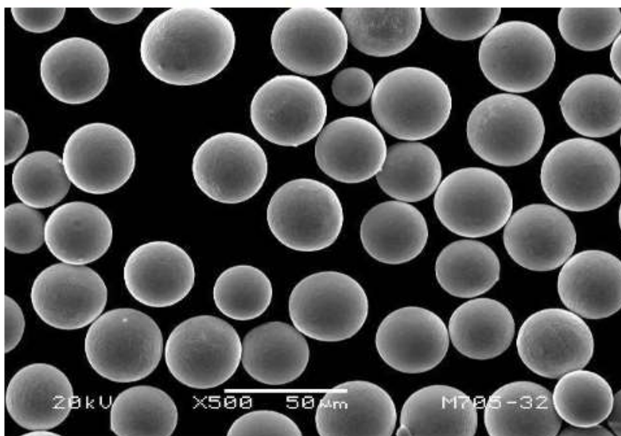
Very stable solder paste viscosity — Excellent wettability
Clear flux residue combined — Reduced flux residue cracking
Excellent joint cosmetics — Reduced occurrence of side ball

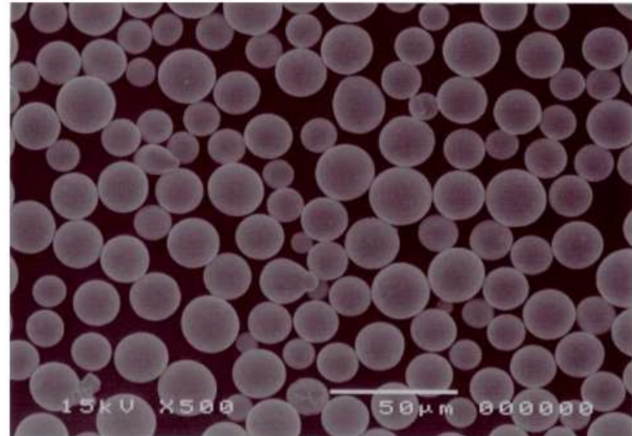
that are the features of the GRN360-K series but also from a wide application range due to the improved thermal properties. This includes also high density applications with BGAs, CSPs etc.

Characteristic of M31 alloy compared to eutectic tin-lead alloy

		M31	63Sn-Pb
Alloy Composition(%)		Sn95.75-Ag3.5-Cu0.75	Sn63-Pb37
Specific gravity		7.4	8.4
Melting temperature ©	Solidus	217	183
	Peak	219	
	Liquidus	219	
Tensile strength (Mpa)		53.0	56.0
Elongation(%)		47	59
Young's module (Gpa)		45.1	26.3
0.2% Yield point (Mpa)		39.4	45.8
Coefficient of linear expansion (ppm/C)		21.3	23.5
Vickers Hardness (Hv)		17.9	16.6

SEM Photo of M31 powder





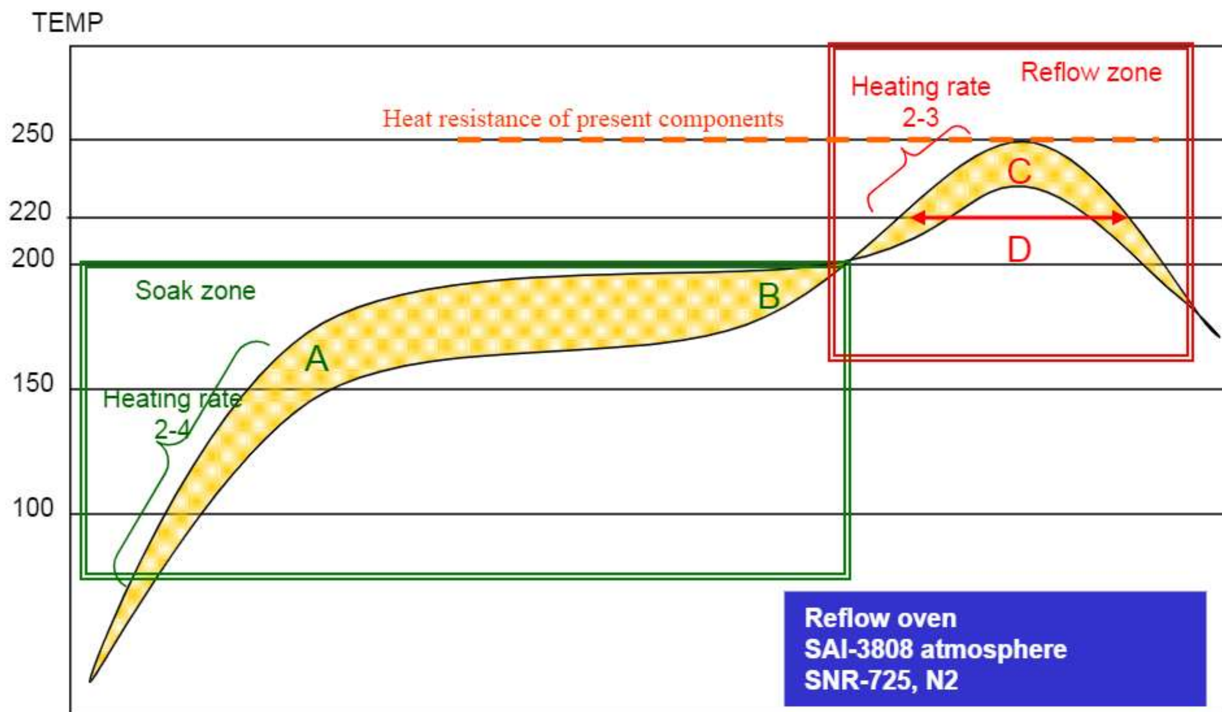
No surface oxidation, spherical lead-free powder is used in all Senju ECOSOLDER paste products .
(The photograph shows type-4 (25-36um) and type-5 (15-25um)

M31-GRN360-K V-Type characteristics

Items	M31-GRN360-K-V (Type 4)	M31-GRN360-K MK-V (Type 3)	Test method /Remarks
Solder Powder			
Alloy Composition	Sn95.75-Ag3.5-Cu0.75		---
Melting Temperature	217 ~ 219 C		DSC
Powder Shape	Spherical		SEM
Powder size/distribution	25 ~ 36um	25-45 um	SEM & Laser method
FLUX			
Type	RO		J-STD-004
Activity	L0		J-STD-004
Halide	0.0%/Flux		Titration method
Surface Insulation Resistance (40C90%RH,168hr)	Over 1.0E+12		ISO 9445-1 & 94554-1
Electro-migration Resistance (85C85%RH Bias DC45V, 1000hr)	Over 1.0E+9 No migration		ISO 9445-1 & 94554-1
Water resistance	750Ωm		ISO 9455
Copper mirror test	PASS		ISO 9455
Fluoride Test	PASS		ISO 9455
Solder Paste			
Viscosity	K1:180 Pa.s K2:200 Pa.s		ISO 9445-1 & 94554-1
Thixotropic Index	0.6		ISO 9445-1 & 94554-1
Flux Content	11.5%		ISO 9455
Hot Slump	0.4mm Max.		ISO 9445-1 & 94554-1
Tackiness	1.3N		ISO 9445-1 & 94554-1
Tackiness Time	Over 24h/1.0N		ISO 9445-1 & 94554-1
Spreading	77%		ISO 9455
Wetting and dewetting	Rank 1-2		ISO 9445-1 & 94554-1
Solder balls	Rank 1-2		ISO 9445-1 & 94554-1
Copper plate corrosion test	PASS		ISO 9455
Validity (unopened, keep at 0 ~ 10˚C)	6 months		---

Recommended Reflow Temperature Profile M31-GRN360-K-V

Recommended reflow temperature profile for M31-GRN360-K-V is shown below.
During reflow not all temperatures on PCB are the same, there will be a variation due to the different thermal mass.
However, all soldering points on the PCB showed go into the following recommendation for the thermal profile.



Recommendation

A: soak start:	150 - 180	C: Peak temp:	230 - 250
B: soak end:	170 - 200	D: time above 220; (solidus line)	30 - 60sec
A - B: soak time:	90 ±30sec		

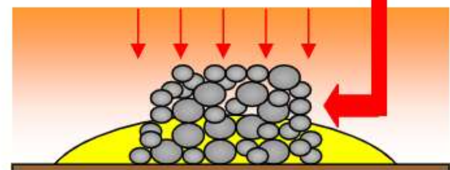
Reflowability GRN360-K-V

,,,,,, behavior Aperture; 280um Thickness; 120umt Preheat; 180-200 / 120sec Peak; 240 (above 220, 45sec)	Standard Paste (25 - 36um)	GRN360-K -V
	Standard Paste (25 - 45um)	GRN360-K MK-V

Heat resistance

During reflow in atmosphere the oxidation layer is removed by the flux when oxidation increases in the high temperature atmosphere attacking the top surface of the solder powder. If the flux fails to remove the oxidation layer, powder can be left on the surface.

At the soak zone, the Flux is down to the bottom. Then solder powder is easy to oxidize.



Preheat temp. and time

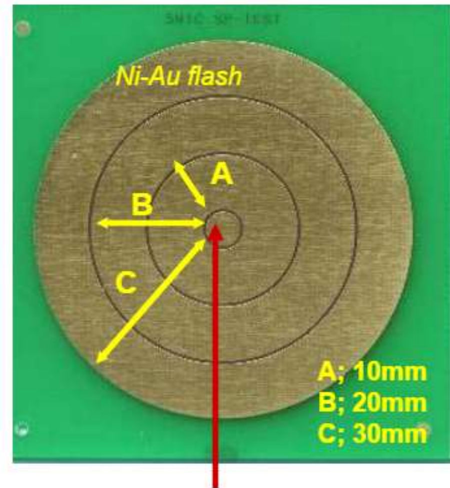
The smaller the surface, grain size and openings the more likely this is to happen and therefore the heat resistance of a solder paste is a very important item.

Solder / Flux spattering –GRN360-K-V

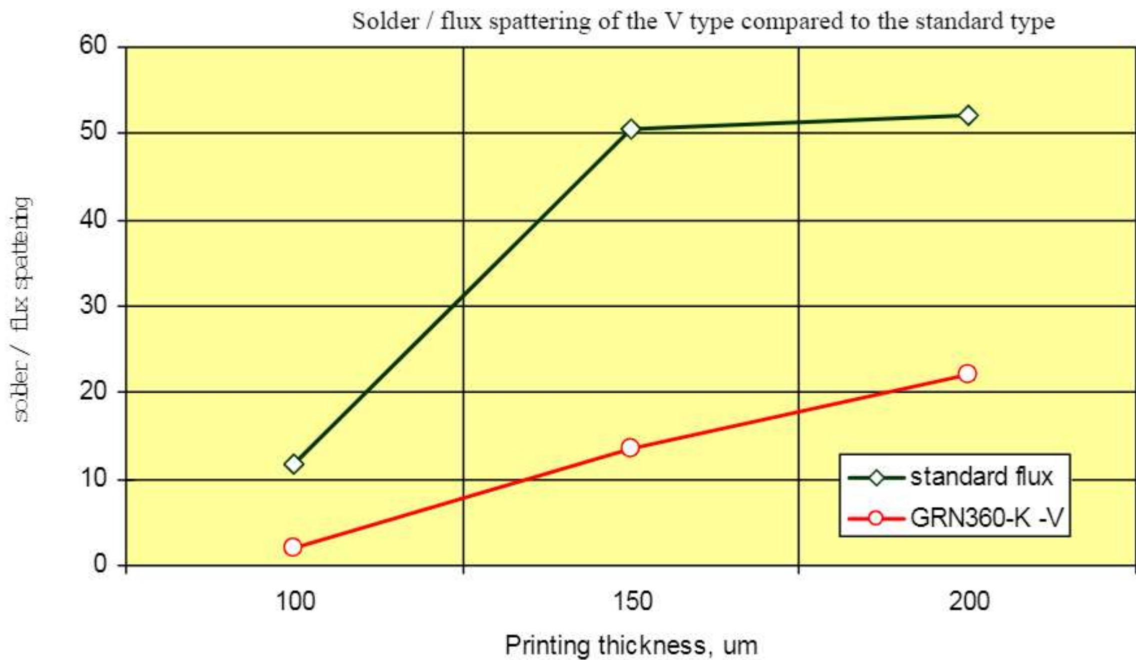
Solder / Flux spattering - GRN360-K -V

Test conditions:
Test board: Ni-Au flash
Printing; 6.5mmφ thickness, 100,150,200um
Preheat; 180-200 / 120sec
Peak temp; 240 (above: 220, 45sec)
Test method, counting of solder / flux spattering points on the reflowed board.

Test board / SMIC SP-TEST



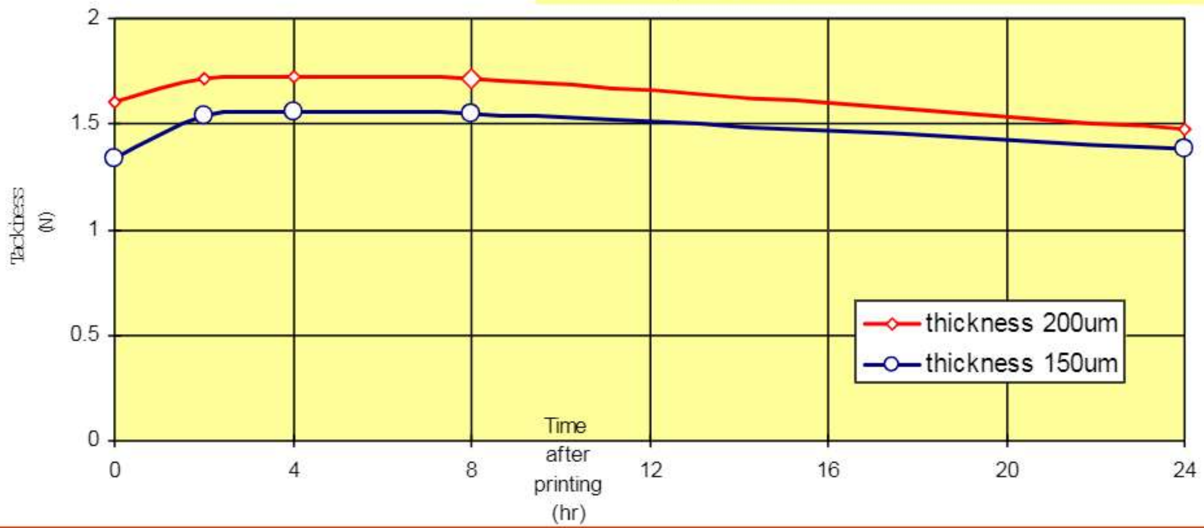
Printed paste: 6.5mmφ



Solder or flux spattering during reflow affects the connections when sticking to gold fingers or other components.
Compared to the standard type GRN360-K-V shows less solder / flux spattering. At a printing thickness of 100 ~ 150um it can be reduced up to a fifth. Solder / flux spattering is however also very much influenced by the quality of the PC boards and therefore this side should be also checked carefully.

GRN360-K-V Tackiness and Tackiness time

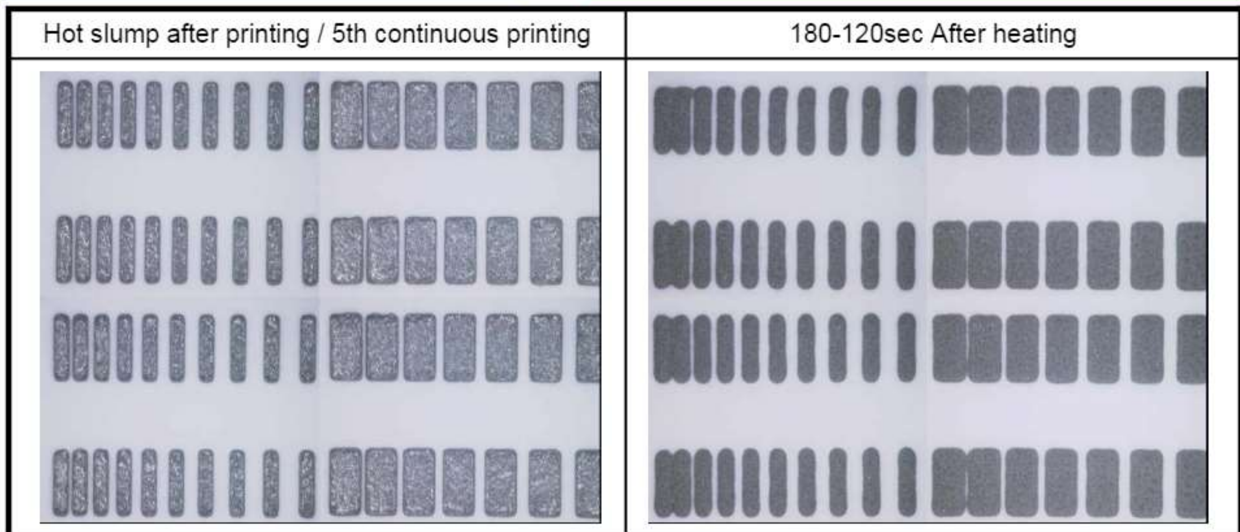
Tackiness and Tackiness time
GRN360-K -V
Test conditions:
Equipment; Rhesca, Tackiness tester
Immersion speed; 2.0mm/s
Press time; 0.2s
Press load; 0.49N
Test speed; 10.0mm/s
Environment; 25-50%RH



Tackiness force and the tack time of Solder Paste are important characteristics when related to the performance of high speed placement equipment. Tack time affects the defect rate (missing component, tombstone etc.) after machine stops and maintenance.
GRN360-K-V has higher initial tackiness and longer tackiness after printing.

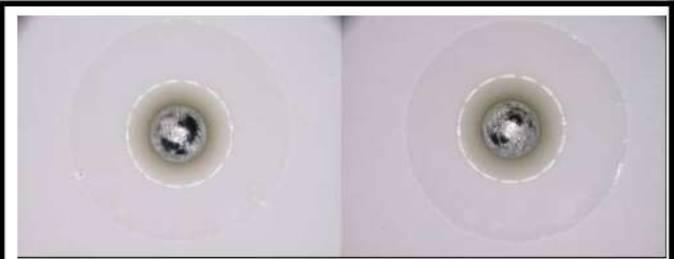
Printing; Hot Slumping
GRN360-K -V
Test conditions;
Stencil thickness; 150um, JIS Z 3284
Heating; 180-120sec

The paste slump correlates with solder balling and bridging for fine pitch applications.
GRN360-K-V has no slump and the characteristic also has a big effect in controlling side-ball.



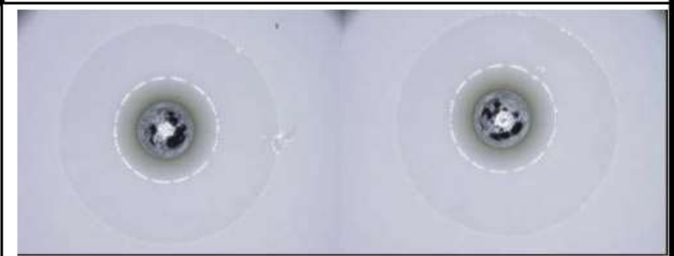
Solder ball test; GRN360-K -V

(JIS Z 3284)
Stencil thickness; 150um
Preheat; 180-120sec
Peak temp; : 235 above 220, 40sec)

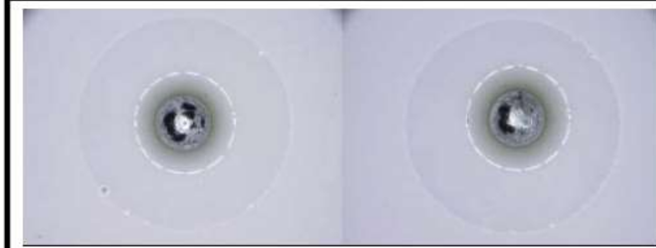


After 4hrs

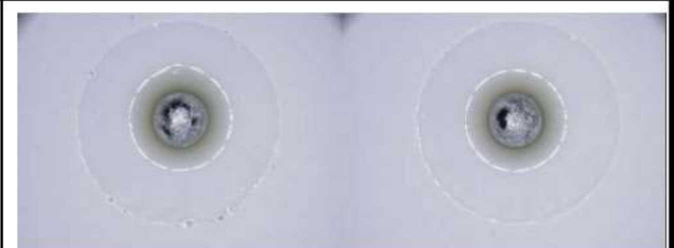
Initial



After 8hrs



After 2hrs



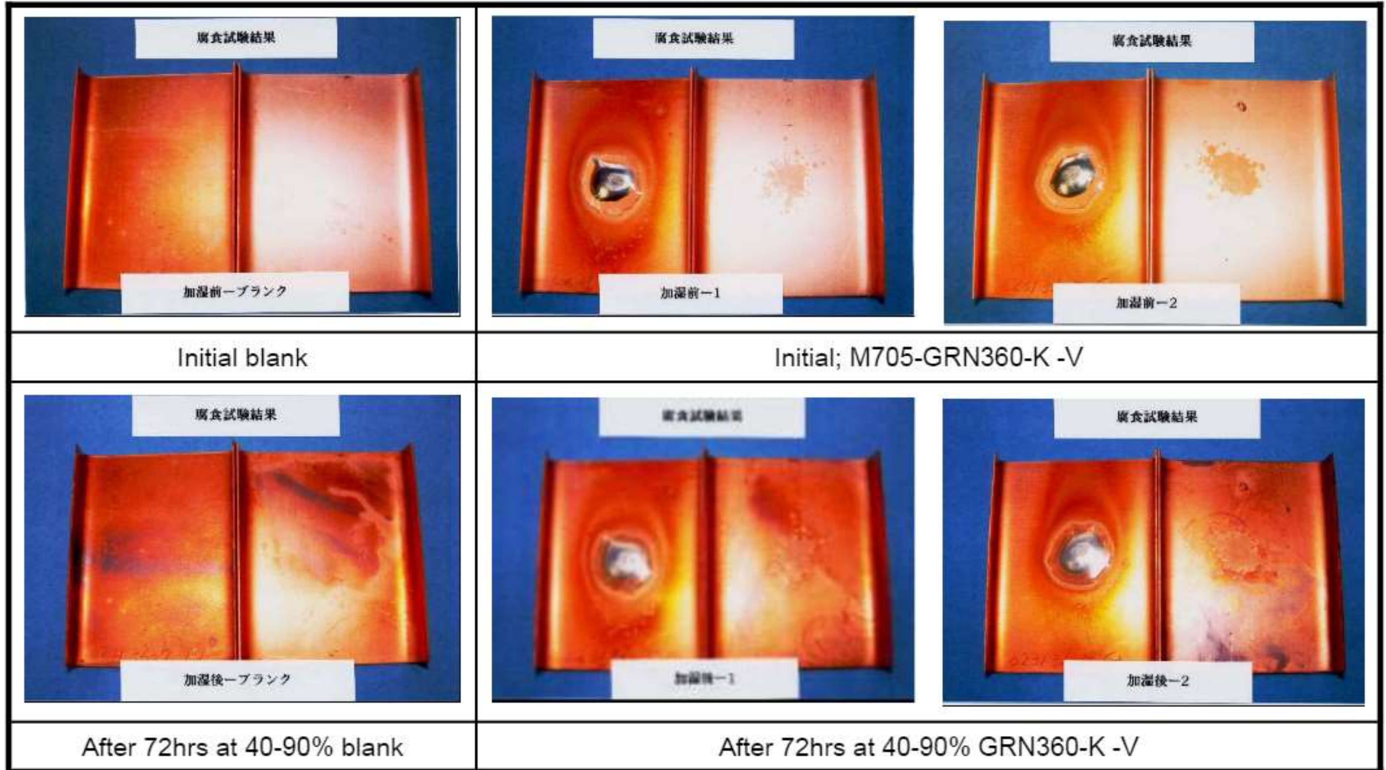
After 24hrs

Wetting and Dewetting
GRN360-K -V

(JIS Z 3284)
Stencil thickness; 150um
Preheat; 180-120sec
Peak temp; 235 above 220, 40sec

GRN360-K-V Reliability

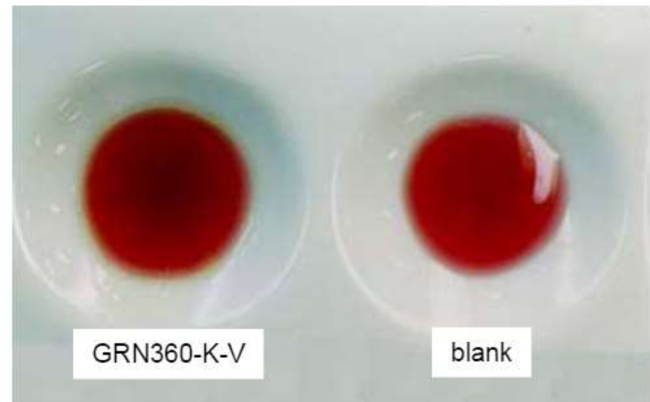
Copper Corrosion Test
GRN360-K -V
(JIS Z 3197)



Initial blank	Initial; M705-GRN360-K -V
After 72hrs at 40-90% blank	After 72hrs at 40-90% GRN360-K -V

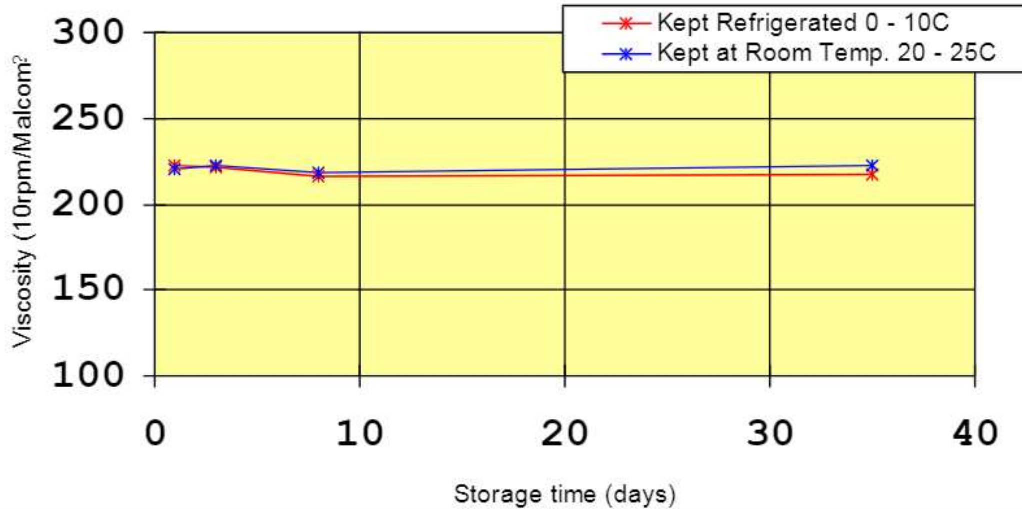
Copper Mirror Test
GRN360-K -V
(JIS Z 3197)

Fluoride Test
GRN360-K -V
(JIS Z 3197)



GRN360-K V Storage stability

Viscosity monitoring results with Storage time (Initial ~ 35 days)



GRN K V-series is very stable paste when stored in a fridge and also room temperature.

Long term stability of the solder paste is a key feature required for stabile production, especially for irregular or low volume production. As shown by the above graph GRN360-K V is very stable at room temperature and so it performs exceptionally well during production.

The paste life is six months when the paste in kept unopened and in refrigerated storage (0-10 degrees C).