



Survey documenting Stakeholder expectation of the transition to lead-free electronics in Aerospace and high performance electronics

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Developed By:

AIA – GEIA- AMC Lead-free Electronics in Aerospace Working Group

The Lead-free Electronics in Aerospace Project Working Group (LEAP WG) is a joint activity of the Aerospace Industries Association (AIA), the Avionics Maintenance Conference (AMC), and the Government Engineering and Information Technology Association (GEIA).

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Executive Summary

In an effort to better understand the technical and business impacts of the transition to lead-free electronics, the AIA LEAP standards working group conducted a survey to better understand the timeline. A key result was unexpected: aerospace products that are partially and fully lead-free are a reality today! An expected response was received “we will be required to produce and support both tin-lead and lead-free products indefinitely”. It is recommended that this survey be repeated on a two year timeframe. The results dramatically reinforce the immediate need for complying with the standards and implementing control plans. Managing the transition and the risks to aerospace is not an option for the future but necessary now.

Introduction/Background

There is an apparent lack of industry information or consensus as to when major lead-free events will occur in the global electronics industry, for example, when can we expect significant unavailability of lead-bearing components for use in aerospace systems, or, when will avionics assembly facilities face significant pressure to implement lead-free assembly alloys? Although there are certainly many qualifications and uncertainties regarding the available information, it may be worthwhile for the LEAP WG to make an effort to develop a lead-free timeline. The “timeline team” was convened by the AIA LEAP Working Group and after several meetings established an approach which took the form of a survey. This approach would address key issues and questions framed in a time period of the next one to two years, then out to five and finally ten years and beyond.

The Survey Methodology consisted of 14 key questions implemented in a “Zoomerang”™ web format with the following introduction and instructions for the respondents . . .

The AIA-GEIA-AMC LEAP-WG invites you to participate in a survey regarding expectations of the transition to Lead-free electronics. The purpose of this survey is to assemble a time-line indicating how and when the transition to lead-free electronic assemblies may occur in the aerospace and high reliability electronics industries.

We are interested in obtaining opinions from as wide a cross-section of individuals as possible. It is **not** the purpose of this survey to determine the precise plans of any particular organization. Therefore, **responses from multiple employees from a single organization are encouraged.** (In fact, multiple responses from single individuals may also be appropriate)

AIA-GEIA-AMC Lead-free electronics WG Team members are acknowledged here: Bob Gregory (Rolls-Royce), Dave Pinsky (Raytheon), Dan Kaspari (Rockwell Collins), Bob Bondaruk (USAF), Paul Hacker, Sean McQuillan and Robin Powell (MBDA Missile Systems), Jürgen Heyn (EADS Astrium

Satellites), Pat Amick and Anduin Touw (Boeing), Barrie Dunn (ESA-ESTEC-QM), Rusty Rentsch (AIA) and Dave Humphrey (Honeywell) Leader

Conclusions

First some demographics, two thirds of our responses were from our own technical community, while space, military and commercial craft systems accounted for 75%. Nearly half were from customers/integrators, and one third from avionics/electronics system suppliers and a surprising and important 10% from the electronic component industry.

The survey, meant to increase our common knowledge, revealed both expected and unexpected answers to our questions. A sample of the most significant ones follow: **Over 90% responded “already”** to these two questions ...

When do you anticipate routinely using components that incorporate pure tin finish in deliverable hardware? (Not including components that are embedded into COTS assemblies or have been reprocessed to replace the tin.)

Do you currently have any components that incorporate pure tin finishes reprocessed using a qualified process to replace the tin finish with tin-lead? If no, how soon do you anticipate having such reprocessing performed?

When do you anticipate routinely using components that incorporate pure tin finish in deliverable hardware? Nearly all indicate **that it has already happened**. Given the well known aerospace concern about risks from tin whiskers and increasing tin control measures, over 90% from the survey responses, this was an expected answer.

When will aerospace begin to deliver fully lead-free products? 23% are **already delivering partially lead-free** (usually meaning a sub-assembly or module) and 37% will in the next 1 to 2 years. **Fully lead-free products** break down 25% in the **next 2-5 years**, 25% in 5-10 years and 25% 10 and beyond. Most respondents indicated some military and many space programs are expected to continue to be conventional tin-lead out to 30 years and beyond?

When do you anticipate attaching Lead-Free ball grid array packages using a tin-lead SMT solder process for deliverable hardware?

Many are doing today and will continue for several years

Do you currently have any Lead-Free ball grid array packages reprocessed to replace the solder spheres with tin-lead alloy solder spheres? If no, how soon do you anticipate having such reprocessing performed?

Already doing 13%, 2 to 5 years 21% and >10 years 14%

When do you anticipate the cost of lead-bearing components will average twice the cost of lead-free components?

20% already and about the same say within 2-5 years

Recommendations

1) Implement a Lead-free Control Plan (LFCP) plan per the standards ...NOW.

Note: A LFCP will take effort to generate, implement, and maintain and it will be necessary for several years because of uncertainty and ongoing changes.

The responses predicted that several important milestone and events will occur in next two years

2) In the months since the survey, many of the responses interpreted as predictions have begun to occur more frequently. There are more subsystem fully lead-free modules and components, parts costs continue to increase and manufacturing supply base is increasing the manufacturing cost delta for tin-lead vs. lead-free assembly.

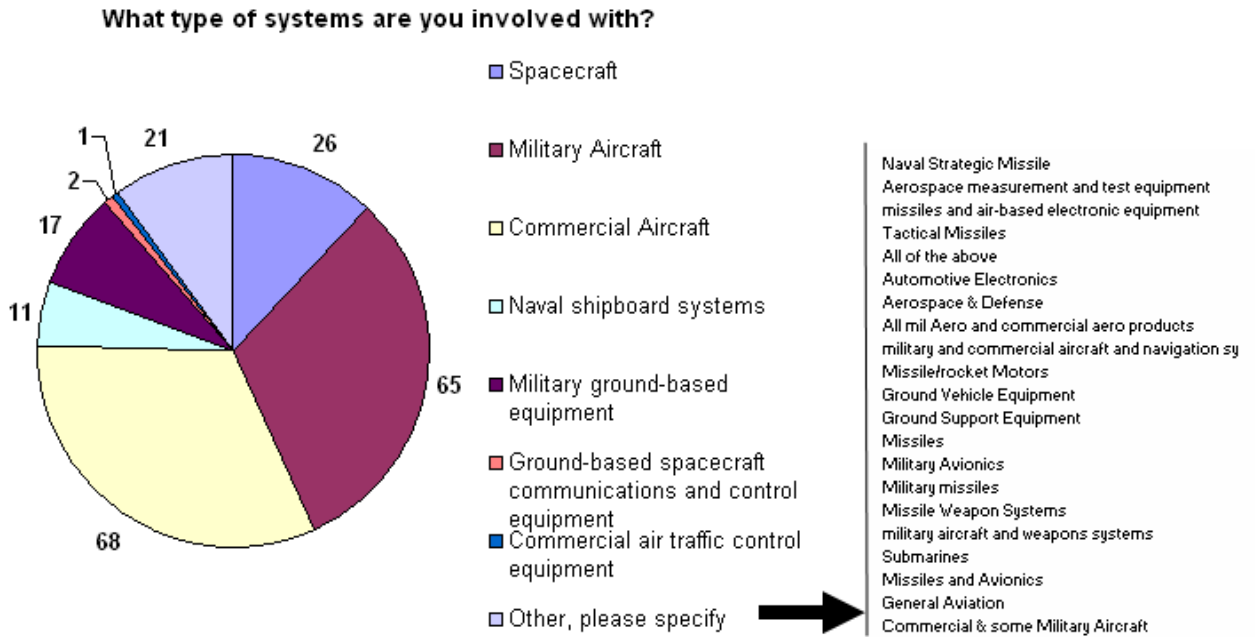
3) An ongoing coherent picture of the aerospace product shift should be maintained. This information could help the supply chain to stabilize the industry during the transition and beyond.

Appendix A: Aggregated Results and Summary Findings

The results of the data was compiled, analyzed and then formulated in both pie and bar chart format . It was also summarized in table format including both number of responses and related percentages. The results begin on the next full page of the report to maintain integrity of the information.

Special Thanks to Jürgen Heyn (EADS Astrium Satellites) and his team for the results analysis and summary that follows and to Dave Pinsky and Rusty Rentsch for preparing and executing the actual survey.

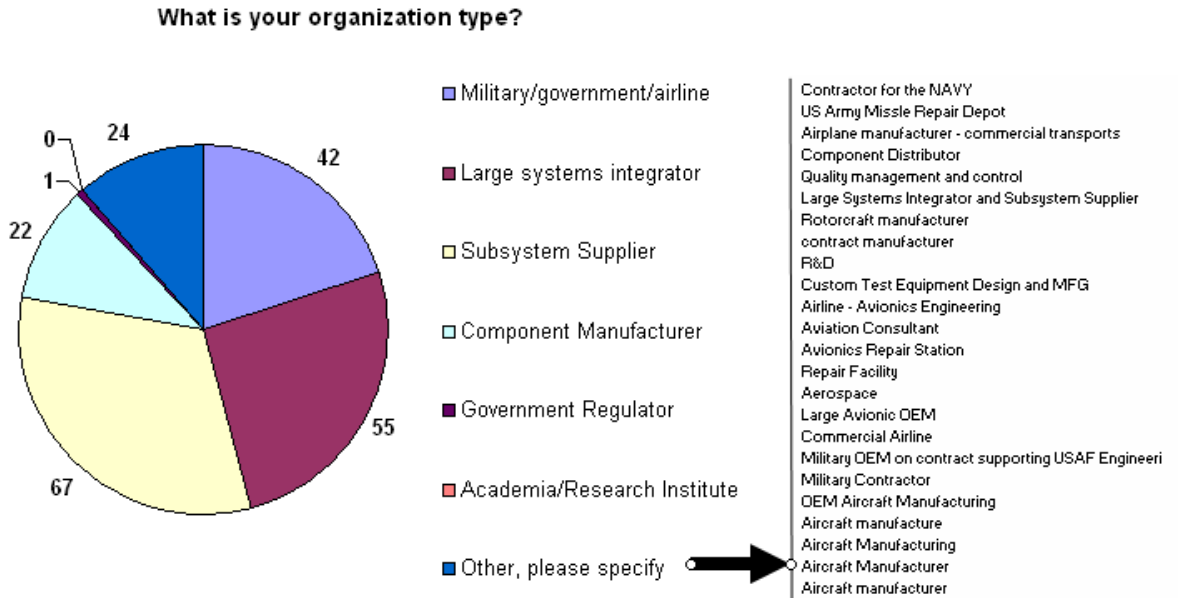
1. What type of systems are you involved with?



1. What type of systems are you involved with? Please check the one that best describes your activities. All subsequent answers should relate to this class of equipment. If you have substantial involvement with multiple system types, please take the survey more than once.

Spacecraft	26	12%
Military Aircraft	65	31%
Commercial Aircraft	68	32%
Naval shipboard systems	11	5%
Military ground-based equipment	17	8%
Ground-based spacecraft communications and control equipment	2	1%
Commercial air traffic control equipment	1	0%
Other, please specify	21	10%
Total	211	100%

2 What is your organization type?

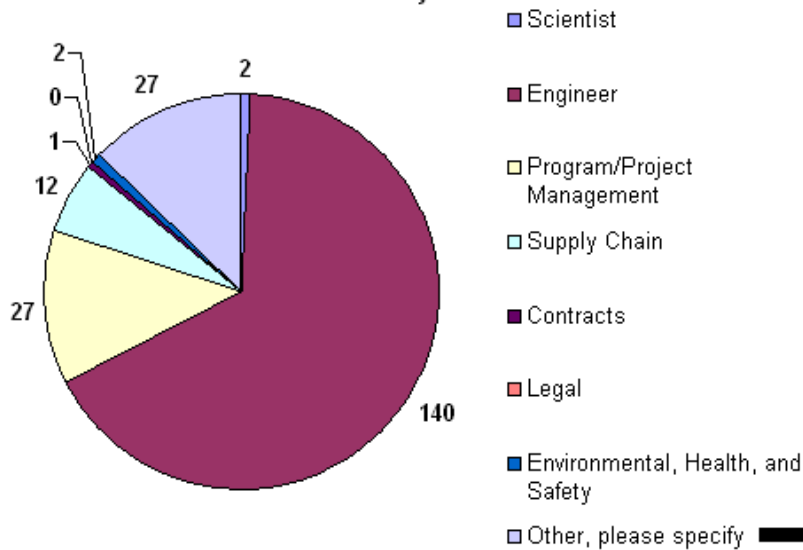


2. What is your organization type?

Military/government/airline	42	20%
Large systems integrator	55	26%
Subsystem Supplier	67	32%
Component Manufacturer	22	10%
Government Regulator	1	0%
Academia/Research Institute	0	0%
Other, please specify	24	11%
Total	211	100%

3 Which of the following terms best describes your role in the industry?

Which of the following terms best describes your role in the industry?

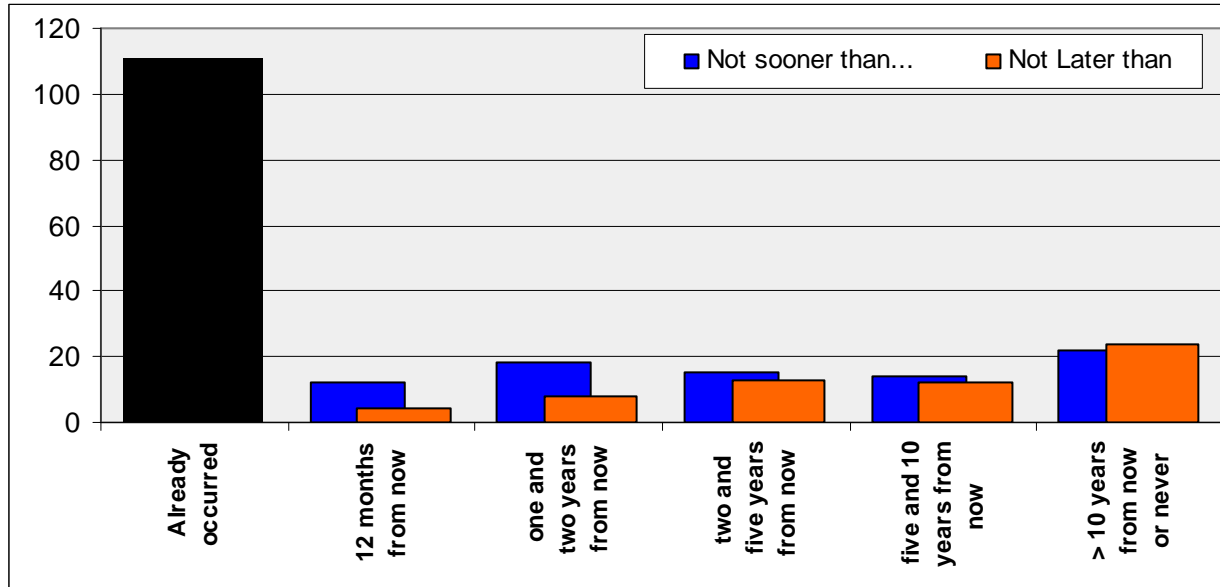


- V.P. Quality
- Safety and Airworthiness
- Manufacturing Engineering including supply chain m
- Contract Development & Manufacturing
- Plant Management
- Technical Director
- Quality
- Quality
- Manufacturing & Supply Chain director
- Engineering management
- Product Stewardship
- sales
- Mission Assurance
- Senior Management
- Shop manager
- Quality Assurance
- Mission Assurance (Quality)
- Continued operation of existing components
- Engineering standards management
- Tech./IPC Trainer
- maintnenace
- Product Integrity/Quality
- Product Integrity/Quality
- Quality
- Skills Training Supervisor
- Quality Assurance & Process Improvement
- GM, Manufacturing

3. Which of the following terms best describes your role in the industry?

Scientist	2	1%
Engineer	140	66%
Program/Project Management	27	13%
Supply Chain	12	6%
Contracts	1	0%
Legal	0	0%
Environmental, Health, and Safety	2	1%
Other, please specify	27	13%
Total	211	100%

4 When do you anticipate routinely using components that incorporate pure tin finish in deliverable hardware? (Not including components that are embedded into COTS assemblies or have been reprocessed to replace the tin.)



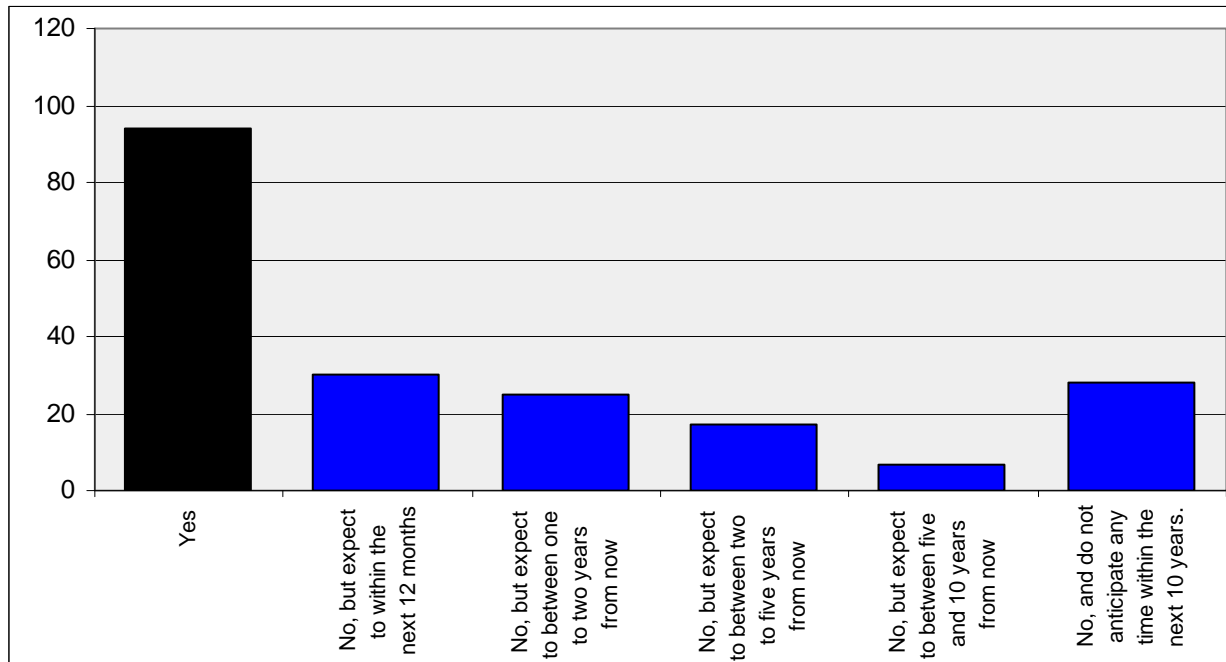
4. When do you anticipate routinely using components that incorporate pure tin finish in deliverable hardware? (Not including components that are embedded into COTS assemblies or have been

If this has not already occurred, please select one choice for "not sooner than" and a second choice for "not later than" to indicate your estimate on the range of time over which this event may occur.

Already occurred	111	53%
Not sooner than 12 months from now	12	6%
Not sooner than one and two years from now	18	9%
Not sooner than two and five years from now	15	7%
Not sooner than five and 10 years from now	14	7%
Not sooner than > 10 years from now or never	22	11%
Not later than 12 months from now	4	2%
Not later than one and two years from now	8	4%
Not later than two and five years from now	13	6%
Not later than five and 10 years from now	12	6%
Not later than > 10 years from now or never	24	11%

5 Do you currently have any components that incorporate pure tin finishes reprocessed using a qualified process to replace

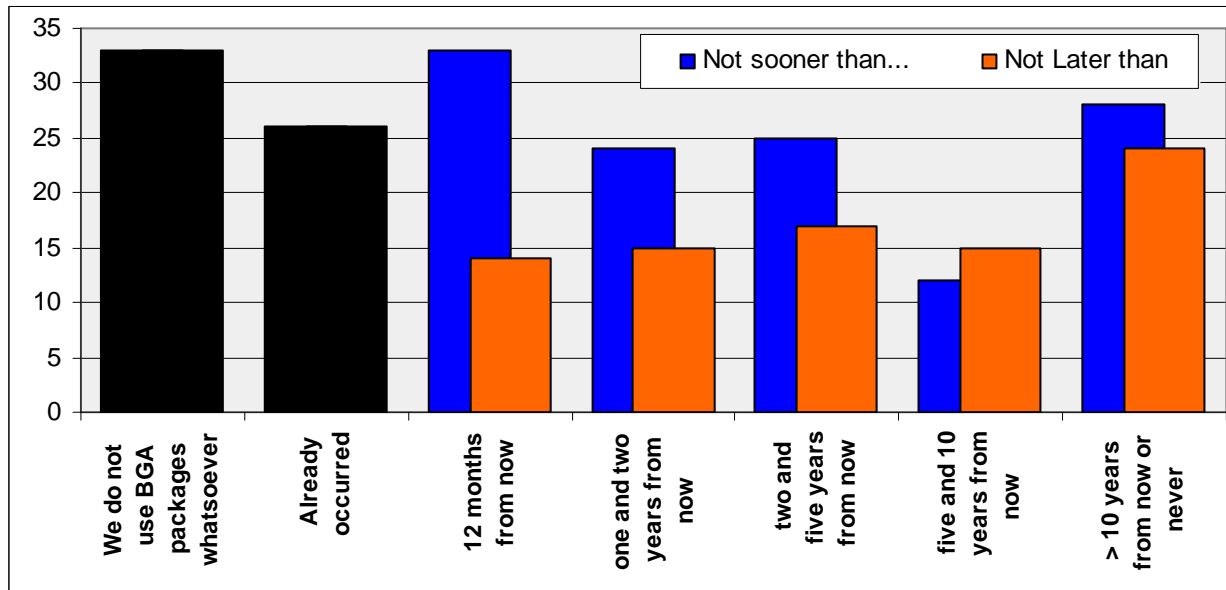
the tin finish with tin-lead? If no, how soon do you anticipate having such reprocessing performed?



5. Do you currently have any components that incorporate pure tin finishes reprocessed using a qualified process to replace the tin finish with tin-lead? If no, how soon do you anticipate having such reprocessing performed?

Yes	94	47%
No, but expect to within the next 12 months	30	15%
No, but expect to between one to two years from now	25	12%
No, but expect to between two to five years from now	17	8%
No, but expect to between five and 10 years from now	7	3%
No, and do not anticipate any time within the next 10 years.	28	14%
Total	201	100%

6. When do you anticipate attaching Lead-Free ball grid array packages using a tin lead SMT solder process for deliverable hardware?

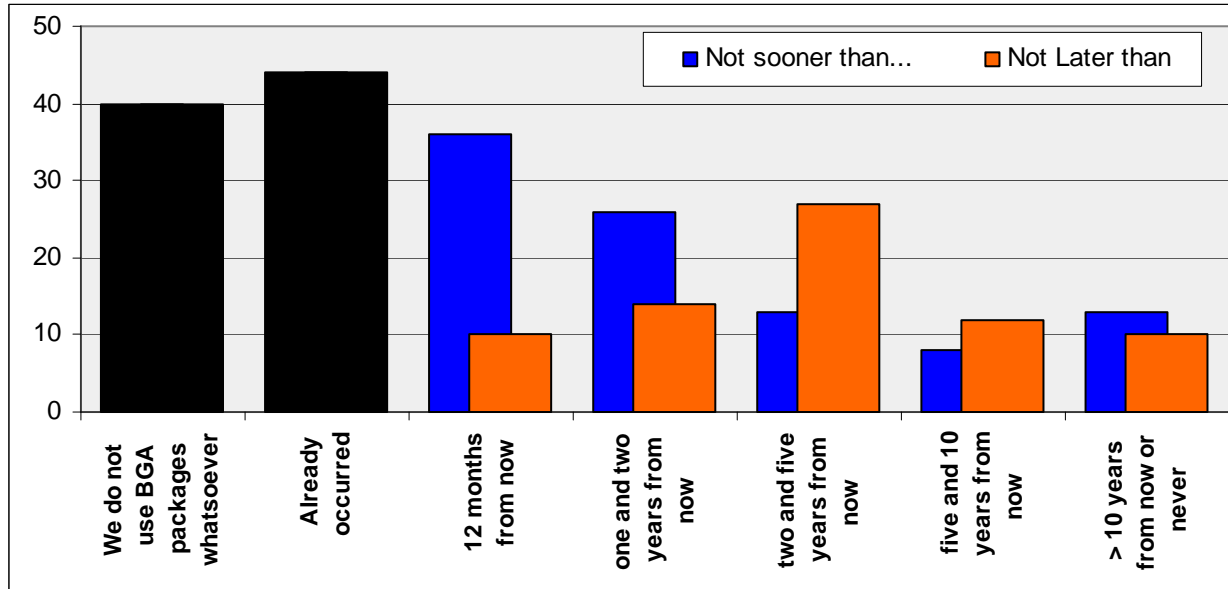


6. When do you anticipate attaching Lead-Free ball grid array packages using a tin lead SMT solder process for deliverable hardware?

If this has not already occurred, please select one choice for "not sooner than" and a second choice for "not later than" to indicate your estimate on the range of time over which this event may occur.

We do not use BGA packages whatsoever	33	17%
Already occurred	26	13%
Not sooner than 12 months from now	33	17%
Not sooner than one and two years from now	24	12%
Not sooner than two and five years from now	25	13%
Not sooner than five and 10 years from now	12	6%
Not sooner than > 10 years from now or never	28	14%
Not later than 12 months from now	14	7%
Not later than one and two years from now	15	8%
Not later than two and five years from now	17	9%
Not later than five and 10 years from now	15	8%
Not later than > 10 years from now or never	24	12%

7. Do you currently have any Lead-Free ball grid array packages reprocessed to replace the solder spheres with tin-lead alloy solder spheres? If no, how soon do you anticipate having such reprocessing performed?

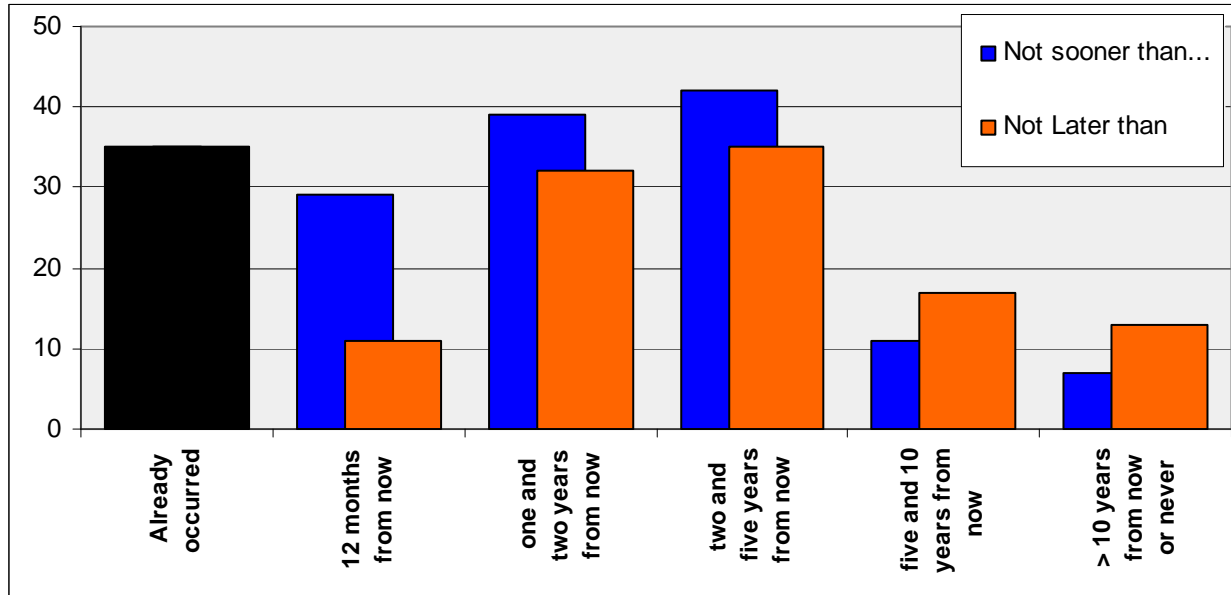


7. Do you currently have any Lead-Free ball grid array packages reprocessed to replace the solder spheres with tin-lead alloy solder spheres? If no, how soon do you anticipate having such reprocessing

If this has not already occurred, please select one choice for "not sooner than" and a second choice for "not later than" to indicate your estimate on the range of time over which this event may occur.

We do not use BGA packages whatsoever	40	21%
Already occurred	44	23%
Not sooner than 12 months from now	36	19%
Not sooner than one and two years from now	26	13%
Not sooner than two and five years from now	13	7%
Not sooner than five and 10 years from now	8	4%
Not sooner than > 10 years from now or never	13	7%
Not later than 12 months from now	10	5%
Not later than one and two years from now	14	7%
Not later than two and five years from now	27	14%
Not later than five and 10 years from now	12	6%
Not later than > 10 years from now or never	10	5%

8. When do you anticipate the cost of lead-bearing components will average twice the cost of lead-free components?

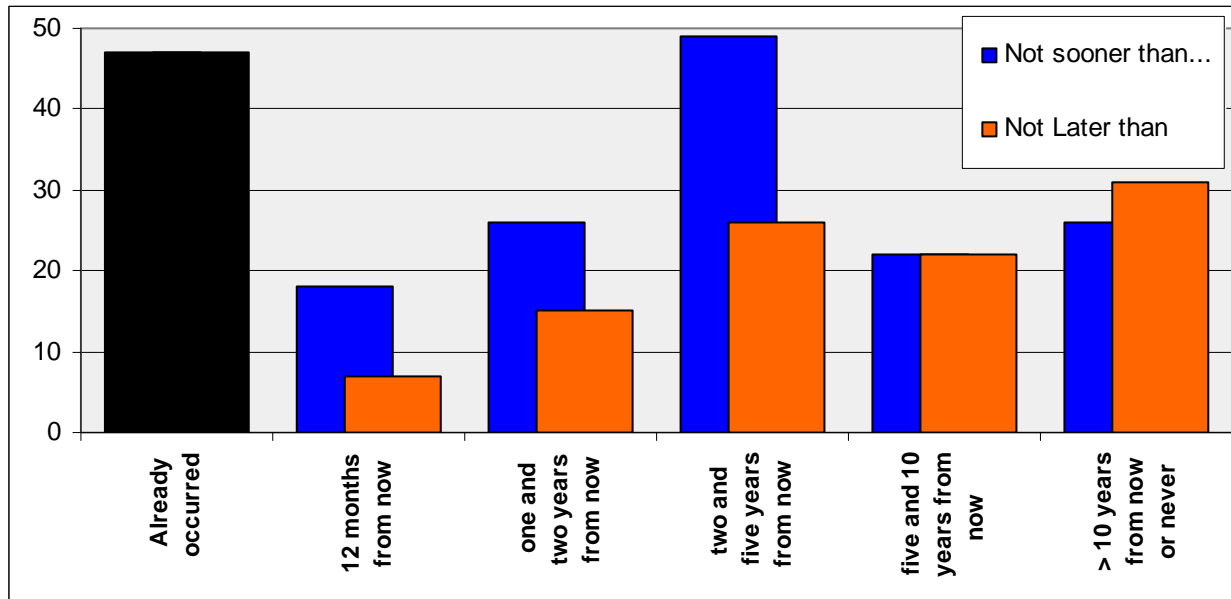


8. When do you anticipate the cost of lead-bearing components will average twice the cost of lead-free components?

If this has not already occurred, please select one choice for "not sooner than" and a second choice for "not later than" to indicate your estimate on the range of time over which this event may occur.

Already occurred	35	18%
Not sooner than 12 months from now	29	15%
Not sooner than one and two years from now	39	20%
Not sooner than two and five years from now	42	22%
Not sooner than five and 10 years from now	11	6%
Not sooner than > 10 years from now or never	7	4%
Not later than 12 months from now	11	6%
Not later than one and two years from now	32	17%
Not later than two and five years from now	35	18%
Not later than five and 10 years from now	17	9%
Not later than > 10 years from now or never	13	7%

9. When do you anticipate delivering systems some portion of which is assembled using lead-free solder (exclusive of COTS assemblies)?

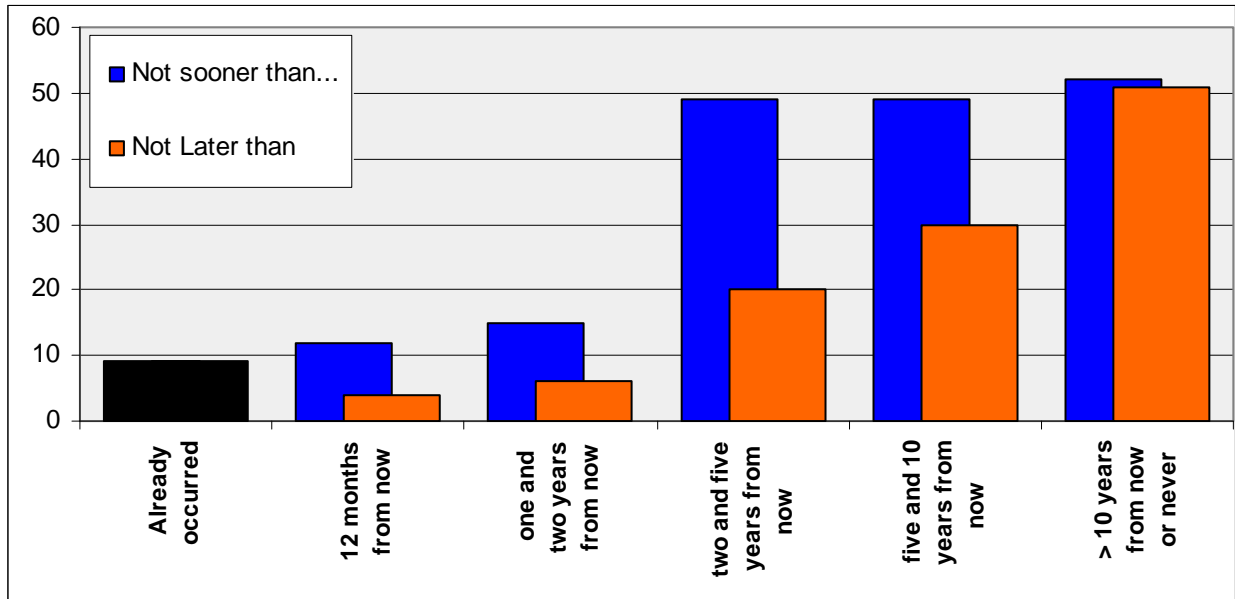


9. When do you anticipate delivering systems some portion of which is assembled using lead-free solder (exclusive of COTS assemblies)?

If this has not already occurred, please select one choice for "not sooner than" and a second choice for "not later than" to indicate your estimate on the range of time over which this event may occur.

Already occurred	47	23%
Not sooner than 12 months from now	18	9%
Not sooner than one and two years from now	26	13%
Not sooner than two and five years from now	49	24%
Not sooner than five and 10 years from now	22	11%
Not sooner than > 10 years from now or never	26	13%
Not later than 12 months from now	7	3%
Not later than one and two years from now	15	7%
Not later than two and five years from now	26	13%
Not later than five and 10 years from now	22	11%
Not later than > 10 years from now or never	31	15%

10. When do you anticipate delivering systems assembled exclusively using lead-free solder?

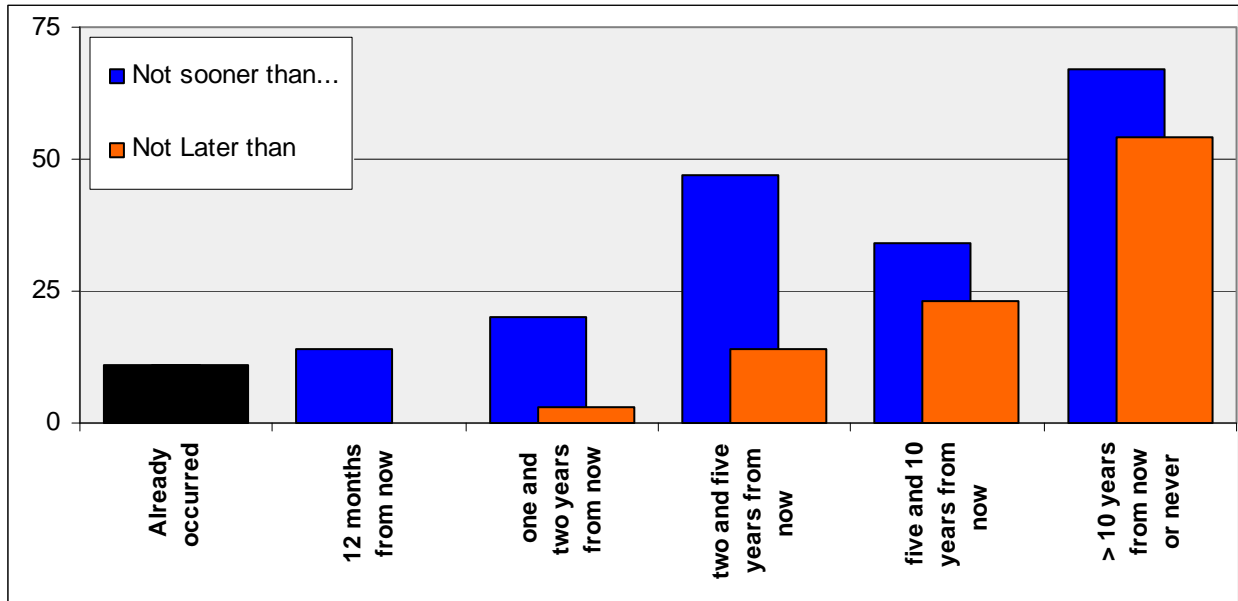


10. When do you anticipate delivering systems assembled exclusively using lead-free solder?

If this has not already occurred, please select one choice for "not sooner than" and a second choice for "not later than" to indicate your estimate on the range of time over which this event may occur.

Already occurred	9	4%
Not sooner than 12 months from now	12	6%
Not sooner than one and two years from now	15	7%
Not sooner than two and five years from now	49	24%
Not sooner than five and 10 years from now	49	24%
Not sooner than > 10 years from now or never	52	26%
Not later than 12 months from now	4	2%
Not later than one and two years from now	6	3%
Not later than two and five years from now	20	10%
Not later than five and 10 years from now	30	15%
Not later than > 10 years from now or never	51	25%

11. When do you anticipate government regulations restricting the use of lead will become applicable to your product line?

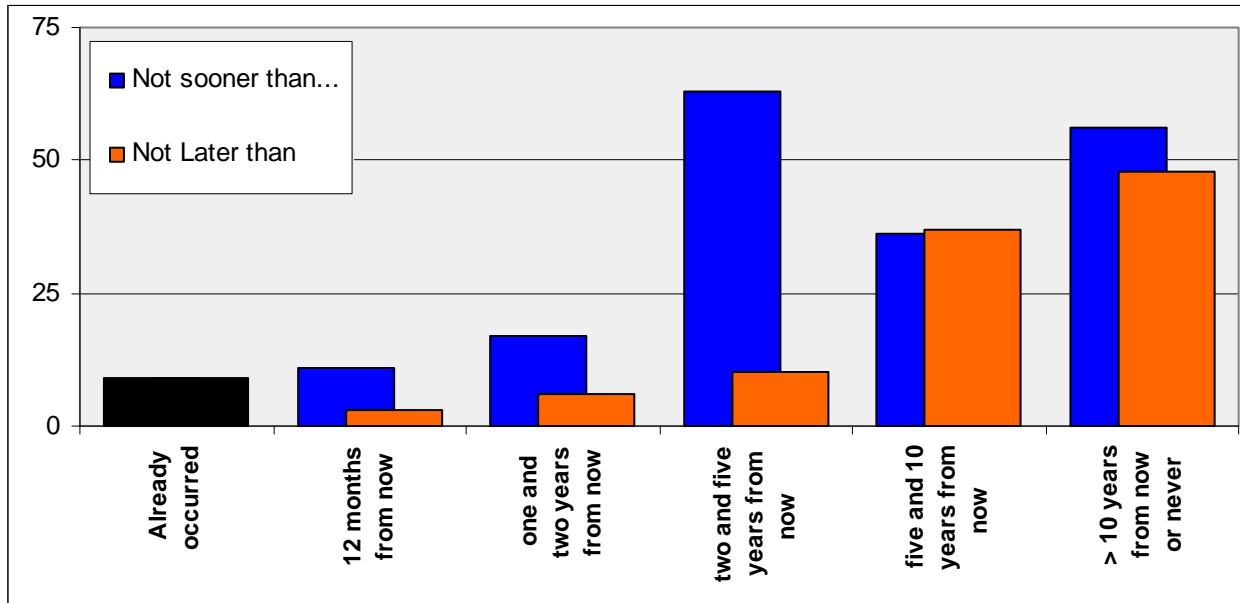


11. When do you anticipate government regulations restricting the use of lead will become applicable to your product line?

If this has not already occurred, please select one choice for "not sooner than" and a second choice for "not later than" to indicate your estimate on the range of time over which this event may occur.

Already occurred	11	5%
Not sooner than 12 months from now	14	7%
Not sooner than one and two years from now	20	10%
Not sooner than two and five years from now	47	23%
Not sooner than five and 10 years from now	34	17%
Not sooner than > 10 years from now or never	67	33%
Not later than 12 months from now	0	0%
Not later than one and two years from now	3	1%
Not later than two and five years from now	14	7%
Not later than five and 10 years from now	23	11%
Not later than > 10 years from now or never	54	26%

12. When do you anticipate when your new designs will be exclusively lead-free?

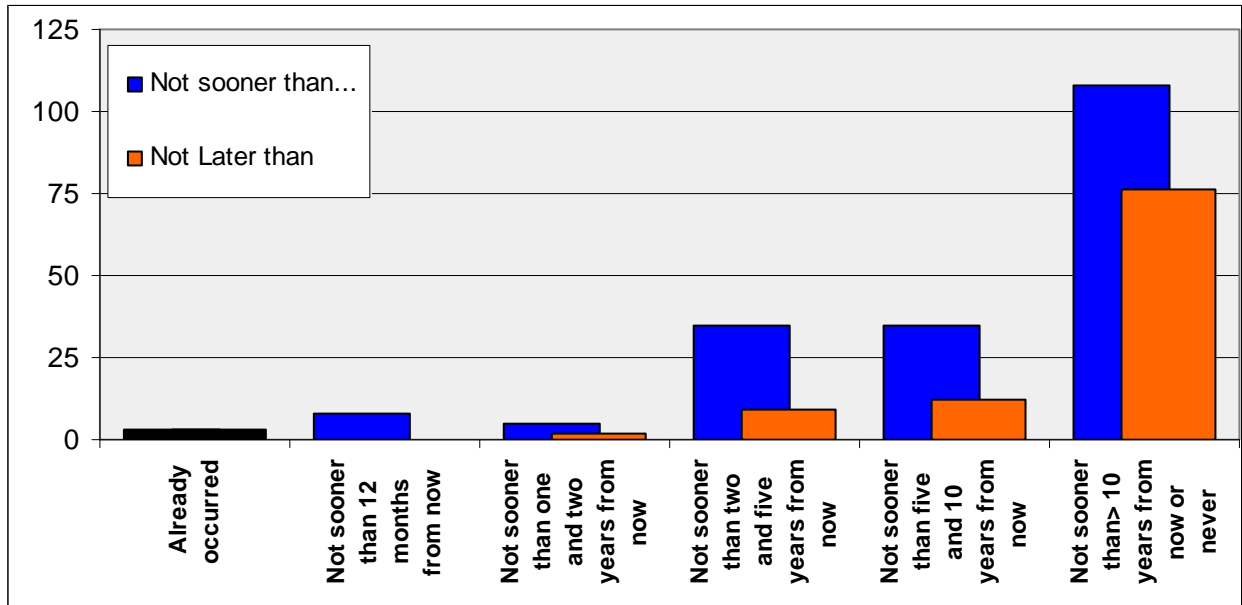


12. When do you anticipate when your new designs will be exclusively lead-free?

If this has not already occurred, please select one choice for "not sooner than" and a second choice for "not later than" to indicate your estimate on the range of time over which this event may occur.

Already occurred	9	4%
Not sooner than 12 months from now	11	5%
Not sooner than one and two years from now	17	8%
Not sooner than two and five years from now	63	31%
Not sooner than five and 10 years from now	36	18%
Not sooner than > 10 years from now or never	56	27%
Not later than 12 months from now	3	1%
Not later than one and two years from now	6	3%
Not later than two and five years from now	10	5%
Not later than five and 10 years from now	37	18%
Not later than > 10 years from now or never	48	24%

13. When do you anticipate ceasing to supply product assembled using any tin-lead solder?

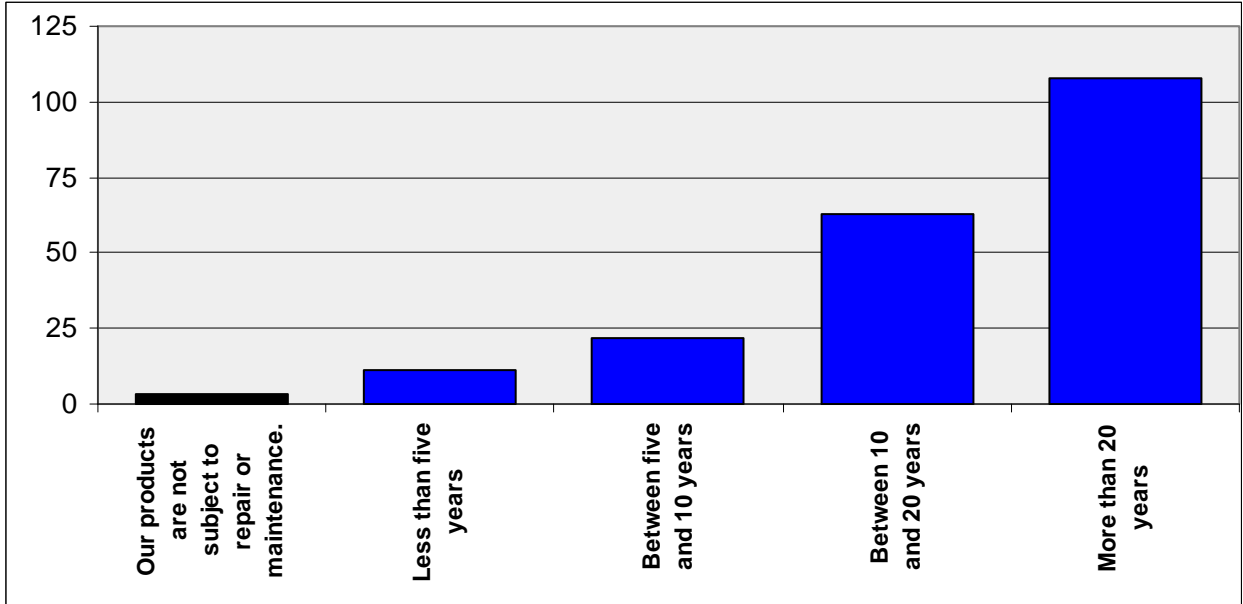


13. When do you anticipate ceasing to supply product assembled using any tin-lead solder.

If this has not already occurred, please select one choice for "not sooner than" and a second choice for "not later than" to indicate your estimate on the range of time over which this event may occur.

Already occurred	3	1%
Not sooner than 12 months from now	8	4%
Not sooner than one and two years from now	5	2%
Not sooner than two and five years from now	35	17%
Not sooner than five and 10 years from now	35	17%
Not sooner than > 10 years from now or never	108	53%
Not later than 12 months from now	0	0%
Not later than one and two years from now	2	1%
Not later than two and five years from now	9	4%
Not later than five and 10 years from now	12	6%
Not later than > 10 years from now or never	76	37%

14. For how many years do you anticipate a requirement to maintain legacy tin-lead in the field?



14. For how many years do you anticipate a requirement to maintain legacy tin-lead in the field?		
Our products are not subject to repair or maintenance.	3	1%
Less than five years	11	5%
Between five and 10 years	22	11%
Between 10 and 20 years	63	30%
More than 20 years	108	52%
Total	207	100%