General Aviation Joint Steering Committee (GAJSC)

System Component Failure – Powerplant Report

June 23, 2016

This report provides an overview of the work of the General Aviation Joint Steering Committee (GAJSC) since the FAA-Industry program was reestablished in January 2011 with a specific focus on System Component Failure–Powerplant accidents.

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I. Background

General Aviation Joint Steering Committee

The General Aviation Joint Steering Committee (GAJSC) is a public-private partnership working to improve general aviation (GA) safety through data-driven risk reduction efforts focused on education, training, and enabling new equipment in GA aircraft. It was reestablished in January 2011 after several years of being mostly dormant. The GAJSC was originally created in the mid-1990s to parallel the Commercial Aviation Safety Team (CAST) under the Federal Aviation Administration's (FAA) Safer Skies initiative. The GAJSC had many successes through the mid-2000s, including the FAA's annual General Aviation and Air Taxi Activity Survey, which provided the FAA and industry with credible data on flight hours, from which meaningful accident rates could be computed. The committee also helped advance risk mitigations to address Controlled Flight Into Terrain (CFIT). However, industry and FAA involvement subsided and the committee was mostly inactive by 2010.

The impetus for reforming the GAJSC came from the Secretary of Transportation and the Future of Aviation Advisory Committee (FAAC). In its final report, the FAAC Safety Subcommittee identified the need to refocus joint FAA-industry work[1] on proactive and cooperative safety analysis to reduce the fatal accident rate in GA. The FAAC Safety Subcommittee also determined it was necessary to emphasize the FAA's strategic plan, also referred to as the "Flight Plan."

The GAJSC sought to avoid previous problems by adopting a structured, strategic process and making its work data driven. Additionally, this restructuring ensures analytical credibility and allows the FAA and industry to plan for implementation activities. The GAJSC noted it was essential to keep any ongoing projects from the previous incarnations of the committee and therefore directed the Safety Analysis Team (SAT), a subgroup that uses working groups consisting of subject matter experts (SME) from industry and Government to identify future areas of study and develop a safety plan, to inventory ongoing activities. In the spring of 2011, the GAJSC also tasked the SAT to conduct a review of GA accidents to determine the priorities for joint FAA-industry analysis of risks leading to fatal GA accidents.

The GA fatal accident rate is one of the metrics the FAA's Aviation Safety organization monitors. Although the FAA established a GA safety metric under the Safer Skies initiative based on the number of annual fatal accidents that occurred,[2] the industry and the FAA jointly transitioned to a rate-based metric in 2007. The FAA and industry agreed to base the new metric on the 3 safest years in GA (2006−2008)[3] and plan for an annual improvement of a 1 percent reduction in the fatal accident rate. Meeting this rate would result in no more than 1 fatal accident per 100,000 hours flown by 2018.

[1] FAAC, Safety Recommendation, #3 "Voluntary Safety Data" and #5 "Identification of Safety Priorities."
[2] The FAA and industry jointly established a safety metric in the mid-1990s based on the number of fatal accidents in 1 year. At that time, the industry and the FAA were reluctant to establish a rate-based metric because of limitations in the exposure data from GA. Through joint work under the GAJSC GA Data Improvement Team, the exposure data (hours flown) was improved and currently has an accuracy of approximately 1.6 percent Standard Error, which was deemed acceptable for transitioning to a rate-based metric and goal for GA safety for 2007–2018.
[3] The 3 years with the fewest fatal accidents since World War II were 2006–2008. Converted to a rate, these years experienced 1.12 fatal accidents per 100,000 hours flown.

System Component Failure–Powerplant

Following the Loss of Control (LOC) Working Group, the GAJSC decided to focus on the available System Component Failure−Powerplant (SCF−PP) fatal accident set. Although CFIT remains a high-risk area (see figure 1), the SAT determined that because of the steady decline of CFIT accidents (see figure 2), this category did not require a working group to be established at the time of this report. This decision stems from the widespread adoption of synthetic vision and terrain databases being offered on both panel-mount and portable Global Positioning System (GPS) equipment and electronic flight bags (EFB). Although the GAJSC may elect to review CFIT accidents in the future, it was determined that SCF−PP accidents would be the focus of the next working group formed, as SCF−PP is the third highest category[4] in a study the FAA conducted of fatal accidents from 2001 to 2010. The GAJSC plans to conduct future work in other accident categories.

For the SCF−PP Working Group, the SAT decided to focus on fatal accidents operating under Title 14, Code of Federal Regulations (14 CFR) part 91 GA operations, 14 CFR part 125 operations, 14 CFR part 135 on-demand operations, and 14 CFR part 137 aerial application operations, or operations categorized as "public use" or "unknown." Although FAA safety efforts in commercial air carrier operations have moved from analysis of fatal accident data to more proactive work analyzing incidents and non-fatal accidents, the SAT determined such preventive work was not yet appropriate for GA because of the number of fatal accidents in GA. Instead, the SAT recommended that the FAA and the GA industry undertake root cause analysis of fatal GA accidents, an undertaking not conducted since the early 2000s.

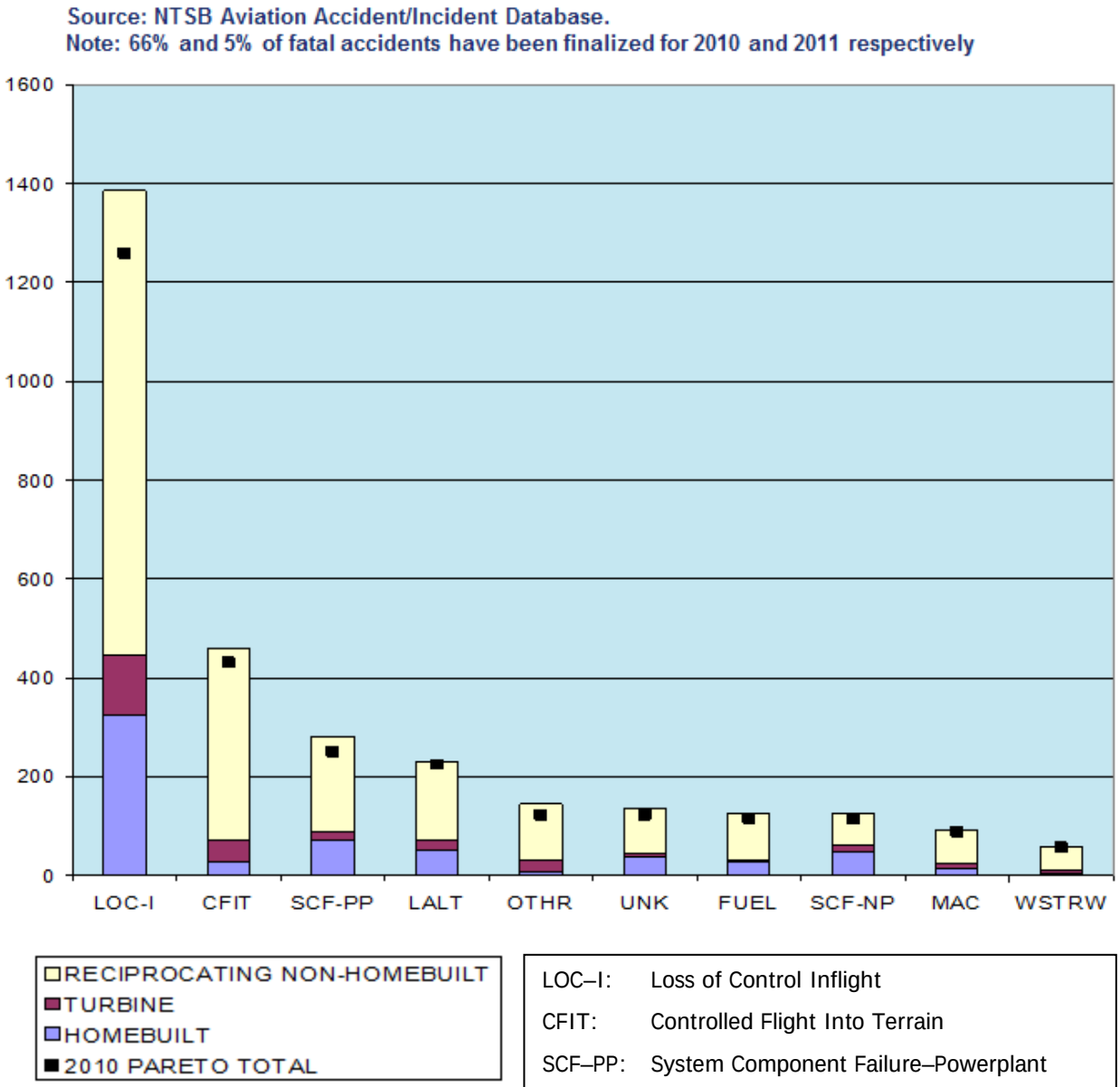
The ability to accurately measure failures and impending failures for GA reciprocating engines is limited at this time. Much of the information has come from accidents, which by definition does not allow the GAJSC to be proactive. Furthermore, there is little statistical data available from original equipment manufacturers (OEM), engine manufacturers, or repair stations or individual mechanics. A more robust and comprehensive system to capture component failures would be a valuable predictor of areas where additional emphasis is needed.

This critical need for data is identified in Safety Enhancement (SE) 44, Maintenance Data Exchange (see section IV).[5]

[4] Using the CAST−International Civil Aviation Organization (ICAO) Common Taxonomy. The CAST–ICAO Common Taxonomy Team (CICTT) was formed in the late 1990s to standardize accident analysis taxonomy in aviation.

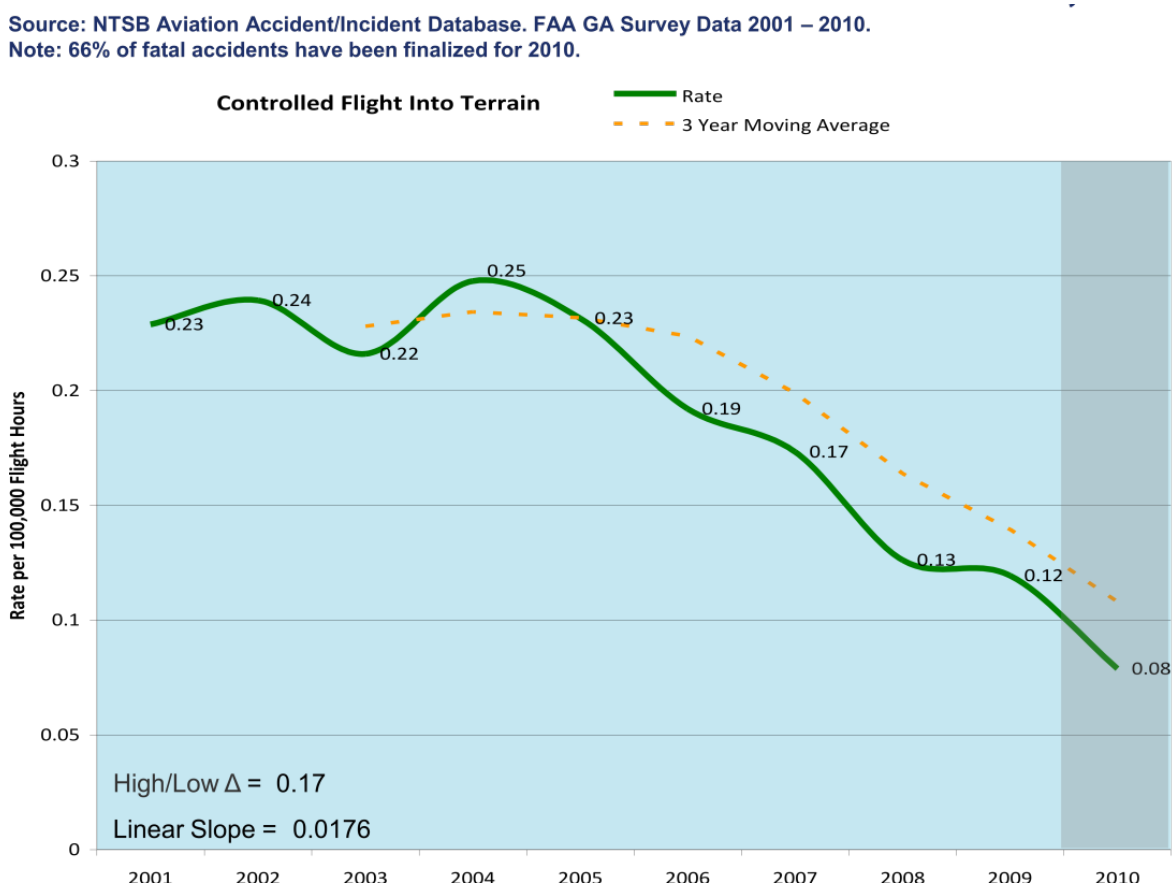
[5] An SE is a plan containing one or more intervention strategies to prevent or mitigate a problem associated with the cause of an accident.

Figure 1. GAJSC Pareto CY2001–CY2011



LOC–I:	Loss of Control Inflight
CFIT:	Controlled Flight Into Terrain
SCF–PP:	System Component Failure–Powerplant
LALT:	Low Altitude Operations
UNK:	Unknown or Undetermined
OTHR:	Other
FUEL:	Fuel Related
SCF–NP:	System Component Failure–Non-Powerplant
MAC:	Midair Collisions
WSTRW:	Windshear or Thunderstorm

Figure 2. GAJSC GA Accident Rate CY2001–CY2010, CFIT



Organization of the Working Group

At its April 24, 2014, meeting, the GAJSC approved the charter of the SCF–PP Working Group (see appendix A) to examine accidents categorized as having an SCF–PP factor in the outcome. The SCF–PP Working Group formed two subteams to examine the accident dataset and propose intervention strategies.

The SCF–PP Working Group was co-chaired by representatives from the FAA and the General Aviation Manufacturers Association (GAMA), with technical support and process guidance provided by the FAA's Office of Accident Investigation and Prevention (AVP). The group's membership consisted of appropriate Government and industry powerplant SMEs to support and lend expertise to the project. Appendix B to this report contains a list of working group members and their credentials, and appendix C contains a list of the working group meetings.

II. Scope of This Report

This report is organized to outline the SCF–PP Working Group's processes, including accident selection, review of previous SCF–PP work, technical briefings, and the processes of intervention and SE development (section III). Additionally, this report contains SEs approved by the GAJSC (section IV), SEs reserved for future implementation (section V), and other areas the SCF–PP Working Group members found to be relevant to their work (section VI).

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III. SCF–PP Working Group Process

Accident Selection

The SCF–PP Working Group conducted an indepth analysis and review of the SCF−PP accidents provided by the SAT. The SAT established a statistically acceptable process to reduce the 282 SCF−PP accidents that occurred from 2001 to 2010 into a dataset that could be practically reviewed by the working group within the timeframe provided by the group's charter.

The GAJSC members initially selected 90 SCF−PP accidents for the group to review. Upon further review, 20 of those accidents were deemed unsuitable because they did not meet the selection criteria due to errors in classification. However, the SAT deemed the remaining 70 randomly selected accidents still maintained statistical viability, so the SCF−PP Working Group used this number of accidents for analysis. Additionally, the National Transportation Safety Board (NTSB) assisted by compiling the accident dockets containing additional information about the accident sequence and pilot data, including post mortem information from the medical examination, to facilitate the root cause analysis. The detailed process for accident selection is included in appendix D to this report.

Technical Briefings

The SCF−PP Working Group used the expertise of its individual members and invited SMEs to present briefings on issues relevant to the group. The SMEs provided briefings about—

- The FAA's Monitor Safety/Analyze Data (MSAD) program,[6]
- Predictive maintenance,
- Aviation Data Exchange (AVDEX) information sharing,
- Experimental amateur-built aircraft and repairman certificate requirements,
- An update on the LOC Working Group's efforts to implement its recommended SEs,
- The FAA's efforts to standardize intervention strategies,
- Smart co-pilot technology in development, and
- Human factors related to powerplant and maintenance accidents.

The SCF−PP Working Group considered the input from these presentations when designing its intervention strategies and recommendations. When appropriate to the SCF−PP risks identified in this study, the group incorporated presenters' ideas into the final SEs.

[6] FAA Order 8110.107A, Monitor Safety/Analyze Data: http://www.faa.gov/documentLibrary/media/Order/Order%208110.107A.pdf

Intervention Development

The working group developed and prioritized safety intervention strategies that aim to reduce the potential for SCF−PP accidents occurring in the future. In addition to documenting its analysis, results, and recommended intervention strategies, the working group documented its assumptions regarding the analysis (see appendix G to this report).

The SCF−PP Working Group, with assistance from the SAT, identified prospective interventions for implementation and presented them to the GAJSC for review and approval. The analysis and rationale for how the GAJSC dispensed with the intervention strategies is included in appendix F to this report.

SE Development

Following the GAJSC's approval of the proposed interventions, the SCF−PP Working Group subteams developed an SE for each intervention (see appendix E to this report).

Each SE contains—

- Prioritized implementation strategies,
- Parties responsible for action,
- Major implementation milestones,
- Metrics to monitor progress in meeting these milestones, and
- Metrics for tracking success of the interventions after they are implemented.

The SCF−PP Working Group, with help from the SAT, presented each proposed SE to the GAJSC for review and approval. The approved SEs are contained in section V of this report and the SEs reserved for possible future implementation are contained in section VI of this report.

Feedback Loop and Lessons Learned

The SCF−PP Working Group will provide feedback to the GAJSC about which aspects of its process worked and which did not work to aid future working groups in this process.

Because this was the third working group under the GAJSC, the process it used is substantially more established than the first LOC Working Group. However, there were still lessons learned.

Number of accidents: Because of the complexity of the SCF–PP accident reports (most accident reports contained engine teardowns with large amounts of technical data), the group chose to reduce the accident set from 90 to 70 accidents. The SAT determined this was still statistically viable. Additionally, a large portion of the SCF−PP Working Group members were new participants and therefore unfamiliar with the GAJSC process, so reducing the number of accident reports was a necessary step to ensure the group remained on schedule.

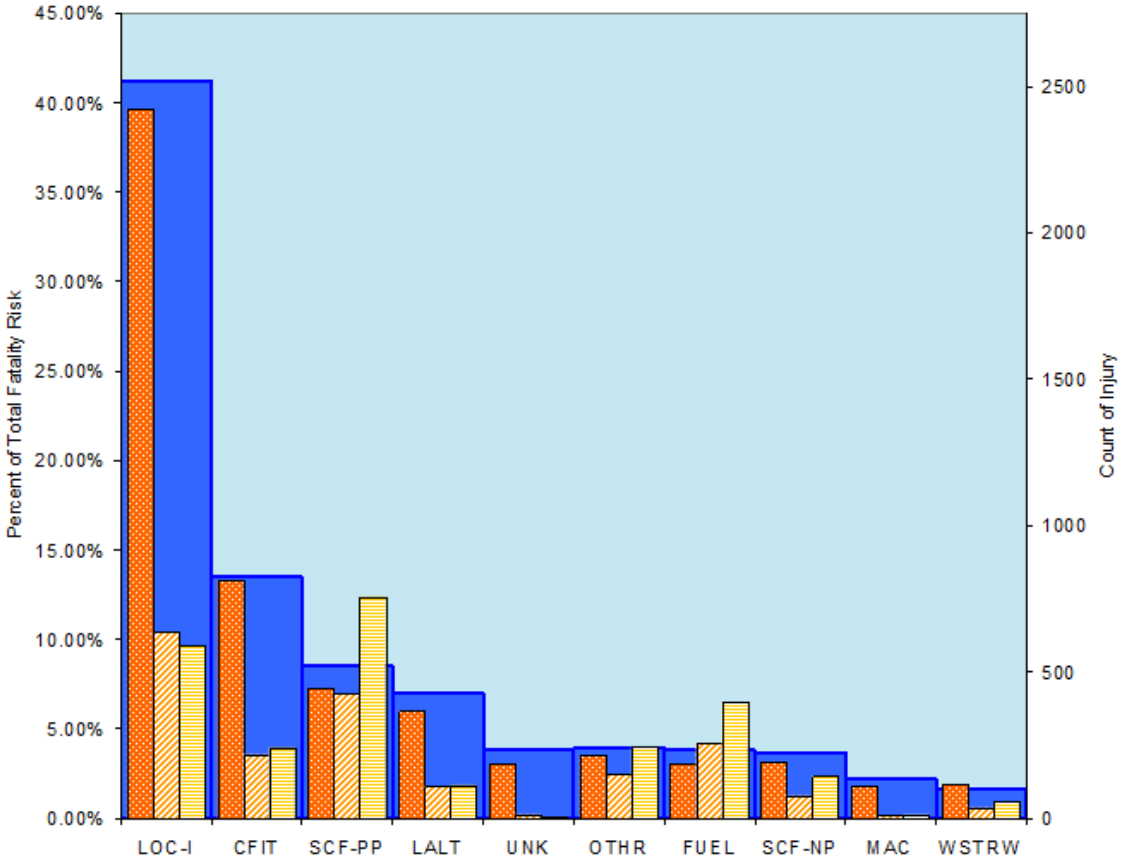
Membership expertise: Although the SMEs used in this working group represented a significant cross section of the GA industry, it became apparent during the course of the work that additional SMEs might have provided additional benefit. For example, none of the SMEs represented repair stations, maintenance facilities, or the experimental kit manufacturer/engine community.

Survivability: LOC and SCF–PP accidents have a substantial difference in survivability—LOC accidents have a fatality risk of over 40 percent, whereas the fatality risk for SCF–PP accidents is less than 10 percent (see figure 3). SCF–PP is one of the few categories in which the probability of receiving minor injuries is higher than the risk of receiving fatal injuries. The working group decided it was important to address survivability to help reduce the risk of fatal accidents due to SCF–PP (see SE 41).

Better communication between SMEs and their respective organizations: One key area that will help ensure the GAJSC's success is constant communication between working group members and their respective leadership. As previously reported by the two prior GAJSC working groups, it is imperative that there is regular communication within the organization participating in the working group to ensure the SEs will be supported and implemented after approval.

Figure 3. 2001–2010 SAT Accident Data Fatality Risk Analysis, Top 10

Source: NTSB Aviation Accident/Incident Database.
Note: 66% of fatal accidents have been finalized for 2010.



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IV. Approved SEs

SE 35—Direct Tension Indicators

SE Action:	Direct Tension Indicating (DTI) Technology
Implementers:	FAA, SAT, academia, GAMA, engine manufacturers, hardware manufacturers
Statement of Work:	To help prevent fatal GA accidents due to failure of the powerplant system, the GA community should further research and develop the use of DTI technology. Within the SCF−PP dataset, there were six accidents where inadequate bolt torque led to powerplant failures or loss of propellers. DTI technology utilizes visual indications for mechanics to confirm proper torque. In their current state, they are single-use mechanical load cells used to indicate when the required tension has been achieved in structural fastener assemblies. This SE is intended to improve a mechanic's ability to determine adequate torque and improve the inspection process. The following six accidents prompted this SE: NYC05FA005 ANC07FA013 NYC03FA043 NYC08FA053 LAX06FA129 MIA06FA024
Relation to Current Aviation Community Initiatives:	Currently, DTI technology exists; however, it has not yet been tested in aviation applications.
Performance Goal Indicators:	Development, certification, sale, and use. Reduction of inadequate torque/loss of torque accidents.
Key Milestones:	Output 1: 12 months Output 2: 12 months Output 3: 12 months **Completion: 36 months**

Potential Obstacles:	Feasibility, price
Output 1:	
Description:	Propose or identify existing standard for DTI bolt to be certified for use in aircraft.
Lead Organization:	GAMA
Supporting Organizations:	ANE, SAE, ASTM
Actions:	1. GAMA to propose or identify existing standards.
Output Notes:	ASTM F959 (compressible washer) direct tension indicators are recognized in this specification as a bolt-tension-indicating device.
Output Indicator:	Standard is established for DTI bolts.
Time Line:	12 months
Output 2:	
Description:	Encourage use of DTI bolts in new aircraft.
Lead Organization:	GAMA
Supporting Organizations:	FAA Flight Standards Service (AFS)−800, Experimental Aircraft Association (EAA)
Actions:	1. Outreach to engine and airframe manufacturers to encourage use of DTI bolts.
Output Indicator:	Aircraft and engine manufacturers utilize DTI bolts.
Time Line:	12 months
Output 3:	
Description:	Encourage use of DTI bolts in existing aircraft.
Lead Organization:	Aircraft Owners and Pilots Association (AOPA)
Supporting Organizations:	GAMA, AFS−800, AFS−300, EAA
Actions:	1. Encourage pilots and mechanics to use DTI bolts in existing aircraft.

Output Indicator:	DTI bolts are purchased and installed.
Time Line:	12 months

SE 36—V_{MC} Scenario Training

SE Action:	FAA and industry to encourage the development of training scenarios based on fatal accidents caused by V_{MC} related LOC to be used in multiengine training.
Implementers:	AOPA Air Safety Institute, FAA, Training Providers, Redbird, FRASCA
Statement of Work:	To help prevent fatal GA accidents due to failure of the powerplant system, the GA community should further develop training scenarios to address V_{MC} related LOC. Nine of the accidents in the SCF−PP reviewed dataset involved V_{MC} LOC events following powerplant failures. With the improvements in desktop trainers, flight training devices, and simulators, the SCF−PP Working Group believes that scenario-based training offered in these formats could help multiengine pilots identify the conditions leading to a V_{MC}-related LOC and prevent their occurrence in high-risk areas (single-engine go-arounds, takeoff loss of power events, and low-level maneuvering). Therefore, this SE is directed at the FAA and flight training community to develop simulated V_{MC} training scenarios and provide affordable, readily-available training options to the GA multiengine community. The following nine accidents prompted this SE: DFW06FA037 LAX01FA302 DFW05FA188 DEN05FA045 DEN03FA025 DEN05FA034 DEN04FA109 CHI05FA049 FTW03FA051
Relation to Current Aviation Community Initiatives:	SAFE Upset Recovery Update to Chapter 4 of AFH CAST 121 Propulsion System Malfunction + Inappropriate Crew Response (PSM+ICR) FAA−P−8740−66 (Flying Twins) FAA 8083−3A FAA Safety Team (FAASTeam) Weather Technology in the Cockpit (potentially model training scenarios off of existing program)
Performance Goal Indicators:	Develop simulated V_{MC} training scenarios.

Key Milestones:	Total Months / Start Date / End Date Output 1: 12 months Output 2: 24 months **Completion: 36 months**
Output 1:	
Description:	Develop training scenarios from GAJSC SCF−PP accident database.
Lead Organization:	AOPA Air Safety Institute
Supporting Organizations:	FAA AFS, AVP, Partnership to Enhance General Aviation Safety, Accessibility and Sustainability (PEGASAS), SAFE, National Association of Flight Instructors (NAFI), TCC, flight training device (FTD)/simulator operators, FTD/simulator manufacturers, type clubs, training providers
Actions:	1. AOPA ASI will work with AVP as needed to determine accidents that represent common V_{MC} LOC scenarios from NTSB accident database. 2. AOPA will develop scenarios and online training materials for multiengine training based on the chosen scenarios.
Time Line:	12 months
Output 2:	
Description:	Publish training scenarios online and make available to training providers.
Lead Organization:	AOPA
Supporting Organizations:	Training providers, FAA AFS−800
Actions:	1. Initiate publication of training scenarios in appropriate online venues and courses. 2. Encourage use of training scenarios at part 61, 141, and 142 training centers.
Output Notes:	Traveling desktop trainers to WINGS—Pilot Proficiency Program seminars Web-based Training Guidance/Videos
Time Line:	24 months

SE 37—Multiengine Emergency Management Technology

SE Action:	Encourage a research program to develop requirements and performance specifications for proposed V_{MC}-imminent warning device designs under asymmetric thrust conditions, as well as research and develop technological solutions to prevent pilots from feathering the wrong engine. FAA/industry to implement developed solutions.
Implementers:	FAA, avionics manufacturers
Statement of Work:	To help prevent fatal GA accidents due to failure of the powerplant system, the GA community should develop emergency cockpit management technology for multiengine aircraft. Nine of the accidents in the SCF−PP reviewed dataset involved V_{MC} LOC events following powerplant failures. The SCF−PP Working Group believes that technology that aids the pilot in decisionmaking following an engine failure would substantially reduce the occurrence of fatal accidents. The following nine accidents prompted this SE: DFW06FA037 LAX01FA302 DFW05FA188 DEN05FA045 DEN03FA025 DEN05FA034 DEN04FA109 CHI05FA049 FTW03FA051
Relation to Current Aviation Community Initiatives:	Aspen "Connected Cockpit" and Garmin "Conext;" MITRE concept, linkage to LOC Working Group SE 25, 26, and 27.
Performance Goal Indicators:	Technology developed and used
Key Milestones:	Total Months / Start Date / End Date Output 1: 24 months Output 2: 6 months **Completion: 30 months**
Potential Obstacles:	Cost and complexity

Output 1:	
Description:	GAJSC SAT encourages development of smart cockpit technology with app developers and avionics manufacturers by developing a white paper that identifies use of smart cockpit technologies in mitigating SCF–PP accidents.
Lead Organization:	GAJSC SAT
Supporting Organizations:	GAMA, AEA, engine manufacturers, airframe manufacturers, propeller manufacturers
Actions:	1. Develop white paper that identifies and encourages further development of multiengine emergency management technology. The white paper should: a. Identify options to detect engine thrust and loss of thrust. b. Identify options available to detect speed margin from V_{MC} OR margin from LOC. c. Identify options available to present warnings to the pilot. d. Identify options available that alert pilot of failed engine. e. Identify technological options for auto feather in reciprocating engines. f. Encourage a solution that incorporates appropriate technology.
Output Notes:	Self-launched gliders currently equipped with detection technology; compare to AOA SE.
Time Line:	24 months
Output 2:	
Description:	GAJSC SAT developed white paper is promoted
Lead Organization:	FAA AFS–800
Implementers:	AOPA, EAA, type clubs, NBAA, app developers
Actions:	1. White paper is promoted through appropriate channels.
Time Line:	6 months

SE 39—Smart Cockpit Technology

SE Action:	Industry to research and develop smart cockpit technology that helps identify emergency situations, prompts pilots (aurally/visually) through pertinent checklist items, and provides instructions based on aircraft position and condition of flight.
Implementers:	FAA, avionics manufacturers
Statement of Work:	To help prevent fatal GA accidents due to failure of the powerplant system, the GA community should develop emergency cockpit management technology. A review of the SCF−PP accident dataset indicated that a large percentage of the accidents resulted in fatalities because of the pilot's inability to identify the failure or appropriately manage the aircraft post-engine failure. The intent of this SE is to develop technologies which could not only help predict and alert the pilot to potential emergency situations, but also ease the workload during high stress/emergency situations. This work ties in with SE 25 from LOC Working Group two for safety enhancing technology and can work in conjunction with the flight envelope protection system described in SE 25.
Relation to Current Aviation Community Initiatives:	Aspen "Connected Cockpit" and Garmin "Conext;" MITRE concept, linkage to LOC Working Group SE 25, 26, and 27.
Performance Goal Indicators:	System developed and integrated
Key Milestones:	Output 1: 12 months Output 2: 6 months **Completion: 18 months**
Potential Obstacles:	Cost and complexity
CICTT Code:	SCF−PP

Output 1:	
Description:	SAT to encourage development of smart cockpit technology with app developers and avionics manufacturers by developing a white paper that identifies use of smart cockpit technologies in mitigating SCF–PP accidents.
Lead Organization:	SAT
Supporting Organizations:	GAMA, PEGASAS, MITRE, Avionics manufacturers, app developers, AEA
Actions:	1. Develop white paper that identifies and encourages further development of smart cockpit technology. Aimed at technology that is both predictive and aids the pilot in decisionmaking post-engine failure. 2. "Smart cockpit" technology should include some or all of the following: a. performance data b. biometrics (O2 monitoring) c. engine monitoring and exceedance resolution d. fuel monitoring e. system monitoring f. aircraft configuration g. general alerts/warnings i. VMC imminent ii. turbocharger failure iii. clearance conformance iv. weather v. airspace and runway information vi. NOTAMS vii. flight planning h. emergency situations i. prompts pilots (orally/visually) through pertinent checklist items j. conditional instructions based on aircraft position and condition of flight k. energy management l. best glide m. best path "highway in the sky" n. available runways 3. Flight testing of program established by research body. 4. Input/demo process as established by research body.
Time Line:	12 months

Output 2:	
Description:	GAJSC SAT developed white paper is promoted.
Lead Organization:	FAA AFS−800
Implementers:	AOPA, EAA, type clubs, NBAA, app developers
Actions:	White paper is promoted through appropriate channels.
Time Line:	6 months

SE 41—Survivability

SE Action:	FAA/industry to research survivability issues and potential solutions (air bags, shoulder harnesses, UV wear indication, helmets, fire prevention, ballistic parachutes, etc.) and implement recommendations.
Implementers:	FAA and academia
Statement of Work:	To help prevent fatalities resulting from GA powerplant system failures, the GA community should research and, if applicable, implement survivability recommendations. During the SCF−PP evaluation of accident data, ten accidents were identified that had crash survivability issues, such as separated seatbelts, post-crash fires, water egress issues, etc. The purpose of the SCF−PP Working Group was to identify issues that would prevent fatalities in powerplant-related accidents. Since fewer than 15 percent of powerplant-related accidents have a total fatality risk, the SCF−PP elected to address crash survivability issues. By improving the crash survivability and post-accident egress training, many of the fatalities encountered in the dataset could have been prevented. Therefore, the purpose of this SE is to research accident survivability factors and implement any recommendations stemming from the research. The following 10 accidents prompted this SE: ANC04FA092 DFW06LA041 LAX02FA148 DFW02FA106 MIA05LA046 LAX06FA129 MIA04FA076 ANC07FA013 LAX02FA056 ANC05FA070
Relation to Current Aviation Community Initiatives:	NTSB Safety Study SS−11/01 TSB of Canada SII A05−01 CAPS/BRS AMSAFE Whitepaper Surviving an Aircraft Crash with Airbag Restraints EASA 2012.04 ATSB—Flight Safety Australia FAA−AM−71−13 (Flight Helmets)

	14 CFR 29.952 Fuel System Crash Resistance FAA Alaska Region/Alaskan Airmen's Association Aeroquip (crashworthy fittings) ACE−00−23.561−01 (policy statement is to address methods of approval for retrofit shoulder harness installations in small airplanes)
Performance Goal Indicators:	Improve Crash Survivability
Key Milestones:	Output 1: 18 months Output 2: 6 months Output 3: 24 months Output 4 12 months **Completion: 60 months**
Output 1:	
Description:	Implement Part 23 ARC recommendations pertaining to survivability and crashworthiness.
Lead Organization:	FAA ACE−100
Supporting Organizations:	Academia, National Aeronautics and Space Administration (NASA), manufacturers of crashworthy/safety technology, Civil Aerospace Medical Institute (CAMI), ASTM F44, Working Group 41313
Actions:	1. Implementation of Part 23 ARC recommendations. 2. GAJSC SAT reviews accident dataset to analyze injuries and specific causes of fatalities.
Output Notes:	General crashworthiness, goggles, airbags, CO indicators, fire suppressants, helmets, life jackets, rafts, seat belt cutter, ballistic parachutes, glass breakers, cold winter gear, shoulder harnesses, seat belt UV wear, natural fiber wear, etc.
Time Line:	18 months
Output 2:	
Description:	FAA to establish policy to facilitate simplified installation of safety equipment (harnesses, airbags, etc.).

Lead Organization:	FAA ACE−100
Supporting Organizations:	FAA, OEMs, ASTM, industry associations, component manufacturers
Actions:	1. Implementation of Non-Required Safety Enhancing Equipment (NORSEE) policy
Time Line:	6 months
Output 3:	
Description:	Promote use of survivability products and technology.
Lead Organization:	GAJSC SAT
Supporting Organizations:	UAA, FAASTeam, AOPA, EAA, type clubs; military facilities, universities, safety training organizations, U.S. Coast Guard, CAMI
Actions:	1. SAT promotes survivability technology and products to manufacturers, maintenance providers, and pilots.
Output Notes:	Conduct outreach in conjunction with Outreach SE.
Time Line:	24 months
Output 4:	
Description:	Develop increased opportunities for proper off-field landing, water ditching techniques, and survival training. Encourage pilots to participate in existing and developed programs.
Lead Organization:	FAA AFS−800
Supporting Organizations:	NTSB, AVP−100, AOPA, CAMI
Actions:	1. Compile database (list) of currently available classes. 2. Encourage pilots to participate in available classes/training. 3. Encourage CAMI to expand training opportunities. 4. Increase opportunities for participation.
Time Line:	12 months (concurrent with output 1)

SE 44—Maintenance Data Exchange

SE Action:	FAA evaluate the feasibility of a modernized maintenance data exchange program to take the place of the current M&D/SDR process and improves the ability to identify issues/trends with components across multiple OEMs and across multiple certification offices.
Implementers:	FAA
Statement of Work:	To help prevent fatal general aviation accidents due to failure of the powerplant system, the general aviation community should evaluate the effectiveness of a maintenance data exchange and fully implement the system if deemed feasible and beneficial. During the SCF–PP it was noted that three separate v-band clamp-related accidents were represented in the 10-year sample group. Further research indicated that v-band clamp issues were occurring since the mid-1980s and that the FAA had issued airworthiness directives (AD). However, the v-band clamp issue was only addressed on an aircraft-specific basis over a span of many years and did not address the global extent of the issue. Feedback from the FAA (e.g., aging aircraft program) and industry have identified the existing weakness in the M&D/SDR program including lack of incentive to submit general aviation reports and the use of outdated technology and limited ability to analyze the data. Additionally, 35 accidents involved inadequate and/or improper maintenance or maintenance operations simply not being performed. The following accidents prompted this safety enhancement: FTW03FA120 LAX05FA296 CHI04FA234 LAX01FA199 CHI08LA166 NYC08FA053 DEN05FA045 LAX00FA013 LAX05LA100 IAD05FA068 FTW02FA106 CHI01FA329 CHI05FA162 WPR10FA056 MIA05LA046 LAX02FA097 CHI04FA203 MIA02FA131 NYC06LA097 WPR10FA056 LAX02LA223 NYC05FA005 ANC07FA013 ANC04FA092 CHI02FA042 CHI04LA128 DFW06FA037

	DEN03FA025	SEA02LA072	FTW98LA350
	ATL02FA176	MIA04FA076	MIA06FA024
	DEN03FA199	SEA04FA003	ATL03FA009
	LAX06FA129	NYC03FA043	
Total Financial Resources	$XX		
Relation to Current Aviation Community Initiatives:	AVDEX currently exists but requires full support and funding from the FAA		
Performance Goal Indicators:	Provide evaluation results of a maintenance data exchange process and its ability to filter and identify trend data and safety issues across in-service fleets to SAT.		
Key Milestones:	**Total Months**	**Start Date**	**End Date**
	Output 1: **12 months**		
	Completion: **12 months**		
Output 1:			
Description:	Examine and track the FAA's ability to implement a maintenance data exchange system.		
Lead Organization:	FAA AFS–600		
Supporting Organizations:	AFS–300/800, AIR		
Actions:	1. Internal gap analysis of current programs (e.g., M&D, SDR, MSAD) 2. Request OEM input/feedback 3. Evaluate consistency of acquiring OEM data between different ACOs 4. Evaluate communication between different ACOs and directorates		
Output Notes:	Potential test subject/issue (such as v-band clamps)		
Time Line:	12 months		

SE 45—Maintenance Alert Placard

SE Action:	Industry to develop, distribute, and promote a tool/device to be displayed in the windscreen of aircraft undergoing maintenance and aircraft that have not been maintained in a substantial amount of time.
Implementers:	Industry associations, manufacturers
Statement of Work:	To help prevent fatal GA accidents due to failure of the powerplant system, the GA community should develop, distribute, and promote a device to be displayed in the windscreen of aircraft undergoing maintenance. During the SCF−PP evaluation of accident data, three accidents were identified that were caused by incomplete maintenance. Even more accidents were attributed to the aircraft not being maintained for a substantial amount of time. The group determined that there needed to be a more effective way to alert the pilot and mechanic that the airplane is not currently airworthy. The following three accidents prompted this SE: SEA07FA195 ATL04LA103 LAX02LA223
Relation to Current Aviation Community Initiatives:	Maintenance/remove before flight streamer
Performance Goal Indicators:	Constant production of device Feedback from PAMA/other groups on distribution
Key Milestones:	Total Months / Start Date / End Date Output 1: 6 months Output 2: 12 months **Completion: 18 months**
CICTT Code:	SCFPP

Output 1:	
Description:	Industry to develop a highly visible device which will alert pilots when aircraft is undergoing maintenance and/or is not airworthy.
Lead Organization:	GAMA
Supporting Organizations:	Component manufacturers, trade associations, suppliers
Actions:	1. Develop and produce a standard template for a highly visible warning device that meets the following recommendations: a. Red b. "Undergoing Maintenance, Do Not Fly" or other indication that aircraft is not airworthy/has not received maintenance/has not flown c. Suggested size of 8" x 5" d. Vinyl cling decal e. Octagon shape
Output Notes:	Suggestion: Vinyl placards. Should be highly visible from inside/outside aircraft.
Time Line:	6 months
Output 2:	
Description:	Device will be distributed at various tradeshows and made available to pilots and mechanics
Lead Organization:	GAMA
Supporting Organizations:	Trade associations, manufacturers, suppliers
Actions:	1. GAMA distributes "sample" placard to manufacturers with recommended specifications. 2. GAMA will recommend a coordinated release of placards between manufacturers. 3. Manufacturers personalize and distribute placards to customers, through regular parts shipments, and at air shows, trade shows, training seminars, etc.
Time Line:	12 months

SE 47—A&P Education/Training

SE Action:	Improved guidance and improved availability of guidance to maintenance professionals and improved training and outreach. Additionally, compilation of research and additional research as required in regards to human factors in maintenance.
Implementers:	FAA academia industry
Statement of Work:	To help prevent fatal GA accidents due to failure of the powerplant system, the GA community should examine available training and education for maintenance professionals. Within the SCF−PP dataset, 35 accidents involved inadequate and/or improper maintenance or maintenance operations simply not being performed. Though the human factors behind these maintenance-related errors were rarely investigated, the reoccurrence of the problem throughout the dataset warranted an SE that would help improve a mechanic's understanding of critical maintenance procedures and the consequences of not performing maintenance inspections or procedures, or doing the maintenance improperly. The best way to accomplish this throughout the maintenance community is through improved training and ensuring that best practices and protocols are not only followed, but easily accessible to the A&P. The following 35 accidents prompted this SE: FTW03FA120 LAX05FA296 CHI04FA234 LAX01FA199 CHI08LA166 NYC08FA053 DEN05FA045 LAX00FA013 LAX05LA100 IAD05FA068 FTW02FA106 CHI01FA329 CHI05FA162 WPR10FA056 MIA05LA046 LAX02FA097 CHI04FA203 MIA02FA131 NYC06LA097 LAX02LA223 NYC05FA005 ANC07FA013 ANC04FA092 CHI04LA128 DFW06FA037 DEN03FA025 SEA02LA072 ATL02FA176 MIA04FA076 MIA06FA024 DEN03FA199 SEA04FA003 ATL03FA009 LAX06FA129 NYC03FA043

Relation to Current Aviation Community Initiatives:	Consider FIRC (Flight Instructor Renewal Courses) and online FIRC programs, IA renewal seminars, etc. ASTM recently established Committee F46, which focuses on qualification of Aerospace Personnel, including—specifically—mechanics.
Performance Goal Indicators:	Reduction in the number of maintenance-related contributing factors cited in accident investigations once recurrent A&P training is implemented.
Key Milestones:	Output 1: 12 months Output 2: 24 months Output 3: 12 months **Completion: 48 months**
Potential Obstacles:	Costs and time associated with required training intervals. AMFA kickback
Output 1:	
Description:	Compilation and review of existing research.
Lead Organization:	SAT
Supporting Organizations:	GAJSC SAT, type clubs, maintenance facilities, overhaul shops, OEMs
Actions:	1. Review existing human factors in maintenance research and determine if additional research is required. 2. Review SCF−PP accident dataset with human factors experts. 3. Determine “Top Ten Mistakes” for use in outreach and training.
Time Line:	12 months
Output 2:	
Description:	Recommend and incentivize recurrent training for A&Ps based on available training, current IA training, and the results of output 1.
Lead Organization:	FAA AFS−300/800
Supporting Organizations:	Maintenance operators and insurance carriers, OEMs

Actions:	1. Incentivize recurrent training for A&Ps. 2. Consider program structures such as FIRC and online FIRC. 3. Examine and encourage use of AMT Awards Program. 4. Consider interactive aircraft and engine specific online training courses to tailor-fit a mechanic's current operations or background. 5. Examine feasibility of accredited training/training programs that equate to college credit. 6. Recommend A&Ps attend IA training. 7. Improve WINGS program for A&Ps. 8. Develop "Gold Seal" A&P program. 9. Develop interactive aircraft and engine specific online training courses to tailor-fit a mechanic's current operations and background.
Time Line:	24 months
Output 3:	
Description:	Improved outreach.
Lead Organization:	FAA AFS−300/800
Supporting Organizations:	Type clubs, maintenance facilities, overhaul shops, OEMs
Actions:	1. Review current guidance available (to include EAA and type clubs). 2. Publish/distribute/outreach on guidance. 3. Incorporate in training. 4. Make information easily and readily available (searchable database).
Output Notes:	Consider online tech tip publications/videos. Consider maintenance seminars with examples.
Time Line:	12 months

SE 48—Ignition Systems

SE Action:	Improve reliability in reciprocating engine ignition systems through research and possible promotion of alternative ignition systems.
Implementers:	EAA, FAA, academia
Statement of Work:	To help prevent fatal GA accidents due to failure of the powerplant system, the GA community should research and, if applicable, develop alternative ignition systems with enhanced reliability in reciprocating engines. Within the SCF−PP dataset, there were five accidents involving ignition system problems which led to loss-of-engine-power events. Four of the five accidents involved magneto-related issues. Magnetos have been certified and in use since the earliest days of aviation. That being said, there are variations to legacy magneto/impulse coupling ignition systems, such as shower of sparks, solid-state ignition systems (SSIS), and combinations of legacy and SSIS that have had exposure primarily in the experimental segment of GA. This SE is intended to research the use of alternative systems such as SSIS to potentially improve ignition systems and help prevent powerplant failures. The following five accidents prompted this SE: LAX02FA056 DEN03FA023 MIA04FA076 CHI08LA166 CHI04FA234
Relation to Current Aviation Community Initiatives:	EAB use of SSIS Certificated aircraft use alternative ignition systems that eliminate the need for impulse couplings.
Performance Goal Indicators:	Less loss of engine power events due to ignition system problems.
Key Milestones:	Output 1: 12 months Output 2: 12 months **Completion: 24 months**

Potential Obstacles:	Cost, certification process, market motivation
CICTT Code:	SCFPP
Output 1:	
Description:	FAA to compile and analyze existing data that ANE has researched and compiled.
Lead Organization:	FAA AVP
Supporting Organizations:	ANE
Actions:	1. FAA AVP to conduct research and accident analysis to determine reliability of ignition systems for reciprocating engines. 2. ANE to pursue further research if deemed necessary.
Time Line:	12 months
Output 2:	
Description:	Encourage use of SSIS or comparable system in new aircraft if data shows the system is an improvement over magnetos.
Lead Organization:	GAMA
Supporting Organizations:	AFS−800, EAA
Actions:	1. GAMA, EAA, and FAA to promote use of alternate ignition systems in new aircraft through articles and technical briefings.
Time Line:	12 months
Output 3:	
Description:	Encourage use of SSIS or comparable system in existing aircraft if data shows the system is an improvement over magnetos.
Lead Organization:	AOPA
Supporting Organizations:	AFS−800, AFS−300, EAA, GAMA
Actions:	1. AOPA, AFS−800/300, EAA, and GAMA to promote the use and installation of alternate ignition systems in existing aircraft.
Time Line:	12 months (done consecutively with output 2)

SE 49—SCF–PP Outreach

SE Action:	Outreach
Implementers:	FAA AFS–800
Statement of Work:	To help prevent fatal GA accidents due to failure of the powerplant system, GA associations in coordination with the FAA should communicate through a previously established procedure (SE 34) to the GA community on the following topics: Topic #1—Outreach to airframe and powerplants (A&P) on the importance of checking critical parts during work that makes these parts accessible, even if parts are not the subject of maintenance. Topic #2—Outreach to pilots on emergency situations and survival training. Topic #3—Outreach to pilots on engine maintenance and monitoring engine performance. Topic #4—Outreach regarding the broader use of FADEC systems. Topic #5—Outreach that highlights existing guidance on determining the best glide speed and distance for amateur-built aircraft. Topic #6—Smart Cockpit Technology, see SE 39 Topic #7—V-Band Clamp Failures and Turbocharger Safety Topic #8—Enhanced Vision Systems
Relation to Current Aviation Community Initiatives:	GAJSC SE 34
Topic One	**A&Ps Checking Critical Parts During Maintenance**
Output 1:	Topic One
Description:	FAA/industry to educate A&Ps on importance of checking critical parts during work that makes them accessible, even if said parts are not the subject of maintenance.
Lead Organization:	FAA AVP

Supporting Organizations:	SAT, FAASTeam, PEGASAS, other university research
Actions:	1. Review current materials (literature review) on topic—individual topics will be researched by an entity selected by FAA (such as an educational institution or Center of Excellence). 2. The entity identified above will generate a resource list of currently available materials on each topic and deliver to the GAJSC SAT. 3. The SAT will develop an "Outreach Guidance" document that includes: a. Why the topic is important and how it relates to SCF−PP. b. Specific teaching points that should be included in any outreach on this topic. c. A tracking tool where outreach organizations can log completed outreach. d. Recommendations on how frequently outreach on this topic should be accomplished. 4. The SAT will recommend changes to the following FAA guidance documents: a. Aviation mechanic; general, airframe, and powerplant PTS b. FAA Order 8900.1 c. Handbooks 5. The SAT will recommend new materials to be developed (if any). 6. The SAT will document the procedures and process to do this work. 7. The entity will develop a metric to measure the effectiveness of outreach on each topic. 8. Material and recommendations will be distributed to the SAT for review 60 days before release for use in output 2.
Output 2:	Topic One
Description:	Develop outreach program.
Lead Organization:	GAJSC SAT
Supporting Organizations:	FAASTeam, AOPA, EAA, NBAA, PAMA, AMT Society, type clubs

Actions:	1. Develop an Outreach Program based on Outreach Guidance Document from output 1. a. Initial outreach—possible channels: i. Magazines ii. Web sites iii. Emails iv. Newsletters v. Social media vi. Maintenance Alerts (Advisory Circular (AC) 43.16A) b. Develop calendar for ongoing outreach—possible outreach options: i. Flight Review Special Emphasis List ii. Include in AMT Awards Program iii. Include at inspection authorizations (IA) Renewal Sessions iv. Include in SSD for the year v. Develop Safety Stream
Output 3:	Topic One
Description:	Report on metrics.
Lead Organization:	FAA AVP
Supporting Organizations:	PEGASAS, academia
Implementers:	FAA
Actions:	1. Report on metrics for how effective the outreach on each topic has been. a. Determine if changes in the system may have caused a need to change the outreach. b. Review and recommend changes to intervals when training needs to be reemphasized on each topic.
Topic Two	**Emergencies and Survival**
Output 1:	Topic Two
Description:	1. ADM—FAA/industry to conduct outreach campaign to pilots on emergency procedures including but not limited to: a. Ditching an aircraft b. Engine-out procedures c. Landing site selection including wind considerations d. Stall avoidance e. Energy management 2. SURVIVAL—Encourage pilots to obtain training in off-airport landings, water ditchings, and safely egressing an accident aircraft (see SE XX).

Lead Organization:	FAA AVP
Supporting Organizations:	SAT, FAASTeam, PEGASAS, other university research
Actions:	1. Review current materials (literature review) on topic—individual topics will be researched by an entity selected by FAA (such as an educational institution or Center of Excellence). 2. The entity identified above will generate a resource list of currently available materials on each topic and deliver to the GAJSC SAT. 3. The SAT will develop an "Outreach Guidance" document that includes: a. Why the topic is important and how it relates to SCF−PP. b. Specific teaching points that should be included in any outreach on this topic. c. A tracking tool where outreach organizations can log completed outreach. d. Recommendations on how frequently outreach on this topic should be accomplished. 4. The SAT will recommend changes to the following FAA guidance documents: a. Applicable Practical Test Standard (PTS)/Airman Certification Standard (ACS) b. FAA Order 8900.1 c. Handbooks 5. The SAT will recommend new materials to be developed (if any). 6. The SAT will document the procedures and process to do this work. 7. The entity will develop a metric to measure the effectiveness of outreach on each topic. 8. Material and recommendations will be distributed to the SAT for review 60 days before release for use in output 2.
Output 2:	Topic Two
Description:	Develop outreach program.
Lead Organization:	GAJSC SAT
Supporting Organizations:	FAASTeam, AOPA, EAA, NBAA, PAMA, AMT Society, type clubs

Actions:	1. Develop an Outreach Program based on Outreach Guidance Document from output 1. a. Initial outreach—possible channels: i. Magazines ii. Web sites iii. Emails iv. Newsletters v. Social media b. Develop calendar for ongoing outreach—possible outreach options: i. Flight Review Special Emphasis List ii. Include in WINGS required course iii. Include in SSD for the year iv. Develop Safety Stream
Output 3:	Topic Two
Description:	Report on metrics.
Lead Organization:	FAA AVP
Supporting Organizations:	PEGASAS, academia
Implementers:	FAA
Actions:	1. Report on metrics for how effective the outreach on each topic has been a. Determine if changes in the system may have caused a need to change the outreach. b. Review and recommend changes to intervals when training needs to be reemphasized on each topic.
Topic Three	**Aircraft Engine Maintenance and Performance**
Output 1:	Topic Three
Description:	1. ADM—FAA/industry outreach campaign on need for ADM with emphasis on but not limited to: a. Engine maintenance b. Monitoring engine performance 2. ADM—Industry/FAA to educate pilots on recognizing preignition/detonation scenarios and taking appropriate action
Lead Organization:	FAA AVP
Supporting Organizations:	SAT, FAASTeam, PEGASAS, other university research

Actions:	1. Review current materials (literature review) on topic—individual topics will be researched by an entity selected by FAA (such as an educational institution or Center of Excellence). 2. The entity identified above will generate a resource list of currently available materials on each topic and deliver to the GAJSC SAT. 3. The SAT will develop an "Outreach Guidance" document that includes: a. Why the topic is important and how it relates to SCF−PP. b. Specific teaching points that should be included in any outreach on this topic. c. A tracking tool where outreach organizations can log completed outreach. d. Recommendations on how frequently outreach on this topic should be accomplished. 4. The SAT will recommend changes to the following FAA guidance documents: a. Applicable Practical Test Standard (PTS)/Airman Certification Standard (ACS) b. FAA Order 8900.1 c. Handbooks 5. The SAT will recommend new materials to be developed (if any). 6. The SAT will document the procedures and process to do this work. 7. The entity will develop a metric to measure the effectiveness of outreach on each topic. 8. Material and recommendations will be distributed to the SAT for review 60 days before release for use in output 2.
Output Notes:	Review OEM emergency procedures and incorporate into revised training material.
Output 2:	Topic Three
Description:	Develop outreach program.
Lead Organization:	GAJSC SAT
Supporting Organizations:	FAASTeam, AOPA, EAA, NBAA, PAMA, AMT Society, type clubs

Actions:	1. Develop an Outreach Program based on Outreach Guidance Document from output 1. a. Initial outreach—possible channels: i. Magazines ii. Web sites iii. Emails iv. Newsletters v. Social media b. Develop calendar for ongoing outreach—possible outreach options: i. Flight Review Special Emphasis List ii. Include in WINGS required course iii. Include in SSD for the year iv. Develop Safety Stream
Output 3:	Topic Three
Description:	Report on metrics.
Lead Organization:	FAA AVP
Supporting Organizations:	PEGASAS, academia
Implementers:	FAA
Actions:	1. Report on metrics for how effective the outreach on each topic has been a. Determine if changes in the system may have caused a need to change the outreach. b. Review and recommend changes to intervals when training needs to be reemphasized on each topic.
Topic Four	**FADEC**
Output 1:	Topic Four
Description:	FAA/industry to encourage the broader use of FADEC systems.
Lead Organization:	FAA AVP
Supporting Organizations:	SAT, FAASTeam, PEGASAS, other university research

Actions:	1. Review current materials (literature review) on topic—individual topics will be researched by an entity selected by FAA (such as an educational institution or Center of Excellence). 2. The entity identified above will generate a resource list of currently available materials on each topic and deliver to the GAJSC SAT. 3. The SAT will develop an "Outreach Guidance" document that includes: a. Why the topic is important and how it relates to SCF−PP. b. Specific teaching points that should be included in any outreach on this topic. c. A tracking tool where outreach organizations can log completed outreach. d. Recommendations on how frequently outreach on this topic should be accomplished. 4. The SAT will recommend changes to the following FAA guidance documents: a. Applicable Practical Test Standard (PTS)/Airman Certification Standard (ACS) b. FAA Order 8900.1 c. Handbooks 5. The SAT will recommend new materials to be developed (if any). 6. The SAT will document the procedures and process to do this work. 7. The entity will develop a metric to measure the effectiveness of outreach on each topic. 8. Material and recommendations will be distributed to the SAT for review 60 days before release for use in output 2.
Output Notes:	Review OEM STC, and PMA FADEC options. Determine the reliability of FADEC systems in reciprocating engine operations.
Output 2:	Topic Four
Description:	Develop outreach program.
Lead Organization:	GAJSC SAT
Supporting Organizations:	FAASTeam, AOPA, EAA, NBAA, PAMA, AMT Society, type clubs

Actions:	1. Develop an Outreach Program based on Outreach Guidance Document from output 1. a. Initial outreach—possible channels: i. Magazines ii. Web sites iii. Emails iv. Newsletters v. Social media b. Develop calendar for ongoing outreach—possible outreach options: i. Flight Review Special Emphasis List ii. Include in WINGS required course iii. Include in SSD for the year iv. Develop Safety Stream
Output 3:	Topic Four
Description:	Report on metrics.
Lead Organization:	FAA AVP
Supporting Organizations:	PEGASAS, academia
Implementers:	FAA
Actions:	1. Report on metrics for how effective the outreach on each topic has been a. Determine if changes in the system may have caused a need to change the outreach. b. Review and recommend changes to intervals when training needs to be reemphasized on each topic.
Topic Five	**Best Glide Speed—Amateur-Built Aircraft**
Output 1:	Topic Five
Description:	Highlight existing guidance on determining the best glide speed and distance for amateur-built aircraft.
Lead Organization:	FAA AVP
Supporting Organizations:	SAT, FAASTeam, PEGASAS, other university research

Actions:	1. Review current materials (literature review) on topic—individual topics will be researched by an entity selected by FAA (such as an educational institution or Center of Excellence). 2. The entity identified above will generate a resource list of currently available materials on each topic and deliver to the GAJSC SAT. 3. The SAT will develop an "Outreach Guidance" document that includes: a. Why the topic is important and how it relates to SCF−PP. b. Specific teaching points that should be included in any outreach on this topic. c. A tracking tool where outreach organizations can log completed outreach. d. Recommendations on how frequently outreach on this topic should be accomplished. 4. The SAT will recommend changes to the following FAA guidance documents: a. Aviation mechanic; general, airframe, and powerplant PTS b. FAA Order 8900.1 c. Flying Handbooks 5. The SAT will recommend new materials to be developed (if any). 6. The SAT will document the procedures and process to do this work. 7. The entity will develop a metric to measure the effectiveness of outreach on each topic. 8. Material and recommendations will be distributed to the SAT for review 60 days before release for use in output 2.
Output Notes:	Review OEM/Kit Suppliers/type club emergency procedures and incorporate into revised training material.
Output 2:	Topic Five
Description:	Develop outreach program.
Lead Organization:	GAJSC SAT
Supporting Organizations:	FAASTeam, AOPA, EAA, NBAA, PAMA, AMT society, type clubs

Actions:	1. Develop an Outreach Program based on Outreach Guidance Document from output 1. a. Initial outreach—possible channels: i. Magazines ii. Web sites iii. Emails iv. Newsletters v. Social media vi. Maintenance Alerts (AC 43.16A) b. Develop calendar for ongoing outreach—possible outreach options: i. Flight Review Special Emphasis List ii. Include in AMT Awards Program iii. Include at IA Renewal Sessions iv. Include in SSD for the year v. Develop Safety Stream
Output 3:	Topic Five
Description:	Report on metrics.
Lead Organization:	FAA AVP
Supporting Organizations:	PEGASAS, academia
Implementers:	FAA
Actions:	1. Report on metrics for how effective the outreach on each topic has been a. Determine if changes in the system may have caused a need to change the outreach. b. Review and recommend changes to intervals when training needs to be reemphasized on each topic.
Topic Six	**Smart Cockpit Technology**
Output 1:	Topic Six
Description:	See SE 39. Pilots are encouraged to use developed technology.
Lead Organization:	FAA AVP
Supporting Organizations:	SAT, FAASTeam, PEGASAS, other university research

Actions:	1. Review current materials (literature review) on topic—individual topics will be researched by an entity selected by FAA (such as an educational institution or Center of Excellence). 2. The entity identified above will generate a resource list of currently available materials on each topic and deliver to the GAJSC SAT. 3. The SAT will develop an "Outreach Guidance" document that includes: a. Why the topic is important and how it relates to SCF−PP. b. Specific teaching points that should be included in any outreach on this topic. c. A tracking tool where outreach organizations can log completed outreach. d. Recommendations on how frequently outreach on this topic should be accomplished. 4. The SAT will recommend changes to the following FAA guidance documents: a. Applicable Practical Test Standard (PTS)/Airman Certification Standard (ACS) b. Flight Review c. FAA Order 8900.1 d. Flying Handbooks 5. The SAT will recommend new materials to be developed (if any). 6. The SAT will document the procedures and process to do this work. 7. The entity will develop a metric to measure the effectiveness of outreach on each topic. 8. Material and recommendations will be distributed to the SAT for review 60 days before release for use in output 2.
Output Notes:	Review current smart cockpit technology and what items could possibly be developed and utilized on legacy fleets.
Output 2:	Topic Six
Description:	Develop outreach program.
Lead Organization:	GAJSC SAT
Supporting Organizations:	FAASTeam, AOPA, EAA, NBAA, PAMA, AMT society, type clubs

Actions:	1. Develop an Outreach Program based on Outreach Guidance Document from output 1. a. Initial outreach—possible channels: i. Magazines ii. Web sites iii. Emails iv. Newsletters v. Social media vi. Maintenance Alerts (AC 43–16A) b. Develop calendar for ongoing outreach—possible outreach options: i. Flight Review Special Emphasis List ii. Include in WINGS required course iii. Include at IA Renewal Sessions iv. Include in SSD for the year v. Develop Safety Stream
Output 3:	Topic Six
Description:	Report on metrics.
Lead Organization:	FAA AVP
Supporting Organizations:	PEGASAS, academia
Implementers:	FAA
Actions:	1. Report on metrics for how effective the outreach on each topic has been a. Determine if changes in the system may have caused a need to change the outreach. b. Review and recommend changes to intervals when training needs to be reemphasized on each topic.
Topic Seven	**V-Band Clamp Failures and Turbocharger Safety**
Output 1:	Topic Seven
Description:	Develop outreach to mechanics and pilots on the safe operation of turbocharged aircraft and awareness of appliance specific issues such as v-band clamps.
Lead Organization:	FAA AVP
Supporting Organizations:	SAT, FAASTeam, PEGASAS, other university research

Actions:	1. Review current materials (literature review) on topic—individual topics will be researched by an entity selected by FAA (such as an educational institution or Center of Excellence). 2. The entity identified above will generate a resource list of currently available materials on each topic and deliver to the GAJSC SAT. 3. The SAT will develop an "Outreach Guidance" document that includes: a. Why the topic is important and how it relates to SCF−PP. b. Specific teaching points that should be included in any outreach on this topic. c. A tracking tool where outreach organizations can log completed outreach. d. Recommendations on how frequently outreach on this topic should be accomplished. 4. The SAT will recommend changes to the following FAA guidance documents: a. Applicable Practical Test Standard (PTS)/Airman Certification Standard (ACS) b. Flight Review c. FAA Order 8900.1 d. Flying Handbooks 5. The SAT will recommend new materials to be developed (if any). 6. The SAT will document the procedures and process to do this work. 7. The entity will develop a metric to measure the effectiveness of outreach on each topic. 8. Material and recommendations will be distributed to the SAT for review 60 days before release for use in output 2.
Output Notes:	Review OEM and experimental aircraft to determine which fleets typically utilize v-band clamps. Thorough identification of fleet is required to focus present and future outreach program.
Output 2:	Topic Seven
Description:	Develop outreach program.
Lead Organization:	GAJSC SAT
Supporting Organizations:	FAASTeam, AOPA, EAA, NBAA, PAMA, AMT society, type clubs

Actions:	1. Develop an Outreach Program based on Outreach Guidance Document from output 1. a. Initial outreach—possible channels: i. Magazines ii. Web sites iii. Emails iv. Newsletters v. Social media vi. Maintenance Alerts (AC 43.16A) b. Develop calendar for ongoing outreach—possible outreach options: i. Flight Review Special Emphasis List ii. Include in WINGS required course iii. Include at IA Renewal Sessions iv. Include in SSD for the year v. Develop Safety Stream
Output 3:	Topic Seven
Description:	Report on metrics.
Lead Organization:	FAA AVP
Supporting Organizations:	PEGASAS, academia
Implementers:	FAA
Actions:	1. Report on metrics for how effective the outreach on each topic has been a. Determine if changes in the system may have caused a need to change the outreach. b. Review and recommend changes to intervals when training needs to be reemphasized on each topic.
Topic Eight	**Enhanced Vision Systems**
Output 1:	Topic Eight
Description:	Compile existing low-cost enhanced vision systems and educate the pilot population on benefits of utilizing these systems and availability of systems.
Lead Organization:	FAA AVP
Supporting Organizations:	SAT, FAASTeam, PEGASAS, other university research

Actions:	1. Review current materials (literature review) on topic—individual topics will be researched by an entity selected by FAA (such as an educational institution or Center of Excellence). 2. The entity identified above will generate a resource list of currently available materials on each topic and deliver to the GAJSC SAT. 3. The SAT will develop an "Outreach Guidance" document that includes: a. Why the topic is important and how it relates to SCF−PP. b. Specific teaching points that should be included in any outreach on this topic. c. A tracking tool where outreach organizations can log completed outreach. d. Recommendations on how frequently outreach on this topic should be accomplished. 4. The SAT will recommend changes to the following FAA guidance documents: a. Applicable Practical Test Standard (PTS)/Airman Certification Standard (ACS) b. Flight Review c. FAA Order 8900.1 e. Flying Handbooks 5. The SAT will recommend new materials to be developed (if any). 6. The SAT will document the procedures and process to do this work. 7. The entity will develop a metric to measure the effectiveness of outreach on each topic. 8. Material and recommendations will be distributed to the SAT for review 60 days before release for use in output 2.
Output Notes:	Ensure pilots are educated of benefits and availability of low-cost solutions.
Output 2:	Topic Eight
Description:	Develop outreach program.
Lead Organization:	GAJSC SAT
Supporting Organizations:	FAASTeam, AOPA, EAA, NBAA, PAMA, AMT society, type clubs

Actions:	1. Develop an Outreach Program based on Outreach Guidance Document from output 1. a. Initial outreach—possible channels: i. Magazines ii. Web sites iii. Emails iv. Newsletters v. Social media vi. Maintenance Alerts (AC 43.16A) b. Develop calendar for ongoing outreach—possible outreach options: i. Flight Review Special Emphasis List ii. Include in WINGS required course iii. Include at IA Renewal Sessions iv. Include in SSD for the year v. Develop Safety Stream
Output 3:	Topic Eight
Description:	Report on metrics.
Lead Organization:	FAA AVP
Supporting Organizations:	PEGASAS, academia
Implementers:	FAA
Actions:	1. Report on metrics for how effective the outreach on each topic has been. a. Determine if changes in the system may have caused a need to change the outreach. b. Review and recommend changes to intervals when training needs to be reemphasized on each topic.

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V. SEs Reserved for Possible Future Implementation

	**SE 40—Flight Instructor, Flight Schools, Mechanic & FAA Technical Counselor/Flight Advisor Databases**
SE Action:	Industry work with current consumer oriented databases to include: A. Select CFIs and/or flight schools based on qualifications, years of experience, and training. B. Owners/operators to select A&P/IA and/or maintenance facility based on qualifications, years of experience, and training (AMT award program) C. EAA Technical Counselor/Flight Advisors
Implementers:	SAFE, NAFI, TCC, Type Clubs
Statement of Work:	To help prevent fatal general aviation accidents due to failure of the powerplant system, the general aviation community should research feasibility of creating a searchable database that allows pilots and owners/operators to select maintenance and flight services. During the course of the SCF–PP working group, two accidents were at least partially attributed to a mechanic and a flight instructor that were not familiar with their respective accident aircraft make and model. The working group's attempts to identify mechanics and flight instructors with the necessary qualifications/experience to maintain and/or instruct in a particular make and model were unsuccessful. Therefore, the intent of this Safety Enhancement is to improve upon existing public systems that aid consumers in making informed decisions when buying goods and services. The working group would like to see existing Web sites include a database of flight instructors, flight schools, and mechanics that will provide information regarding their qualifications, certifications, specializations, additional training, workshops attended, awards, etc. (with the possibility of providing user reviews and violations). The following two accidents prompted this safety enhancement: DEN03FA023 ATL02FA072
Total Financial Resources:	$XX

Relation to Current Aviation Community Initiatives:	EAA Database, AOPA Database, LOBO, NAFI Yelp.com Angie's List
Key Milestones:	Total Months / Start Date / End Date Output 1: 12 months Output 2: 12 months **Completion: 24 months**
Output 1:	
Description:	Collect lists of flight instructors/flight schools/mechanics/IAs (to include qualifications/specializations)
Lead Organization:	Industry Coalition
Supporting Organizations:	SAFE, NAFI, PAMA, AMT Society, type clubs, TCC
Actions:	1. Collect lists of flight instructors and flight schools (to include quals/specializations) 2. Collect lists of A&P/IA and maintenance facilities (to include quals/specializations) 3. Collect lists of EAA technical advisors (to include quals/specializations)
Time Line:	12 months
Output 2:	
Description:	Outreach and collaboration with existing Web-based databases
Lead Organization:	Industry Coalition
Supporting Organizations:	MITRE, PEGASAS, AMT Society
Actions:	1. Collaboration with existing databases that will provide voluntary personal information (phone, email, Web site, facility location, social media information) for contact purposes. 2. Encourage inclusion of flight instructors, safety pilots, flight schools, EAA technical advisors, A&P mechanics, maintenance facilities, etc.
Time Line:	12 months

	SE 43—Enhanced Accident Data Collection and Standardized Reporting
SE Action:	Encourage improved interaction between NTSB/FAA accident investigators, and technical advisors, in addition to improved and standardized data collection and utilization of all available resources.
Implementers:	FAA, NTSB, Industry
Statement of Work:	To help prevent fatal general aviation accidents due to failure of the powerplant system, the general aviation community should evaluate the thoroughness of NTSB accident investigation reports and address any deficiencies. Eight of the accidents reviewed in the SCF–PP working group involved investigations that contained insufficient data to properly analyze the root cause of the accident. There were several more accidents that the group was unable to analyze due to insufficient data. Ultimately, being able to obtain sufficient data supports the safety enhancement process. If unable to determine the cause of the accident, it is impossible to work towards preventing future accidents of the same nature. Many of the NTSB accident reports provided inconsistent or inadequate information in the factual narrative and/or public docket. Though some of the NTSB accident investigations were unsuccessful at determining probable cause, added factual information and public docket material could lead others in the aviation safety community to determine a likely scenario for the accident and establish preventative measures in their area(s) of expertise. The inclusion of type-clubs and technical advisors could aid the NTSB/FAA in understanding the aircraft, system, and/or component and the operation/maintenance of said aircraft, system, and/or component. With this assistance, the NTSB could better determine what information is needed in the NTSB factual reports and public dockets. The following accidents prompted this safety enhancement: CHI02LA159 NYC08FA012 MIA00LA153 DFW07FA020 DFW05FA241 LAX04FA226 ANC05FA070 CHI02LA037
Total Financial Resources:	$XX

Relation to Current Aviation Community Initiatives:	Experimental/legacy aircraft type clubs have gained party status on recent accident investigations
Performance Goal Indicators:	Further inclusion of type clubs Improved awareness by NTSB of type-specific issues. Better (more informed) accident investigation reports
Key Milestones:	Total Months — Start Date — End Date Output 1: 6 months Output 2: 6 months **Completion: 12 months**
Output 1:	
Description:	Encourage NTSB to utilize experimental type clubs, kit builders and additional technical advisors (industry professionals) that have not, or traditionally do not, receive party status.
Lead Organization:	GAJSC SAT
Supporting Organizations:	Type Club Coalition, FAA, NTSB, EAA, Manufacturers, NBAA, GAMA, NAAA, AOPA, HAI
Actions:	1. Develop a comprehensive list of type clubs & their leadership and distribute to NTSB investigators and FAA accident investigation inspectors. 2. Create guidance for the investigation participants for collecting accident information and how they can participate in the investigation process. 3. Industry to develop a list of standards investigative groups must meet in order to qualify for party status to an accident investigation.
Time Line:	6 months
Output 2:	
Description:	Encourage improved and standardized data collection and utilization of all available resources
Lead Organization:	GAJSC SAT
Supporting Organizations:	NTSB, FAA, GAMA

Actions:	1. Improved human factors analysis in regards to maintenance related accidents. 2. Improved data collection on SCF–PP related accidents would include the narrative description and supporting public docket information that describes: a. Part Name/Number and Serial Number b. Date of component manufacturer c. Date and type of last maintenance d. Date and type of last inspection e. Date of last overhaul f. Operational history (including prior discrepancies and functional tests) g. Related non-volatile memory data h. Service documents and/or airworthiness directives pertaining to the component 3. Improved/Updated data collection form 4. Include all available non-proprietary data in docket 5. Encourage the review of factual narratives and docket material by technical advisors/party members for thoroughness/correctness of information.
Output Notes:	Use NTSB training/meetings to conduct outreach
Time Line:	6 months

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VI. Other Important Subject Areas

Human Factors in Maintenance

The SCF−PP Working Group analyzed 70 accidents and found 35 of those accidents had maintenance errors identified as a contributing factor. Examples of these errors included omitted or incorrect procedures or not recognizing anomalies/malfunctions. Notably, in the accidents the SCF−PP Working Group analyzed, when the NTSB's factual report pointed to maintenance errors as a contributing factor to the accident, limited analysis was conducted on the cause of the possible mechanic errors.

When a pilot makes an error, the consequences can become apparent almost immediately. In contrast, a maintenance error may take years to manifest itself in as a contributing factor in an accident, and the NTSB may not be able to (1) find the mechanic who erroneously performed the inspection or repair, (2) interview the responsible mechanic, or (3) determine the human factors behind the maintenance error that was conducted years prior. However, a significant effort should be made to improve the human factors data collection on relatively recent, short manifestation maintenance errors.

The SCF−PP Working Group highlights the lack of human factors data in maintenance-related accident reporting and emphasizes the importance of providing and analyzing human factors data to enhance safety.

Continued Prevalence of Drug Use/Prescription Medications

Several accidents analyzed by the SCF−PP Working Group were also examined during the first and second LOC Working Groups.[7] When the SCF−PP Working Group was examining accidents related to drug use/prescription medication, two of the LOC Working Group's SEs that pertain to drugs and prescription medications were still in the process of being implemented. Therefore, the SCF−PP Working Group supports the LOC Working Group's SEs related to drug use/prescription medication, but notes that the issue of pilots flying while medicated remains a safety concern.

Lack of Data

Because the SCF−PP Working Group focused on GA aircraft, some data limitations existed that made accident analysis difficult (and in some cases impossible). The working group acknowledges that the NTSB does not have the time, manpower, or resources to investigate every accident and must prioritize its investigations to benefit public interest. It is understood that this is why, even in fatal accidents of small certified piston or experimental aircraft, the NTSB sometimes chooses not to conduct onsite investigations. However, this made some of the reports supplied by the NTSB to the SCF−PP Working Group unfit for analysis because they did

[7] This can occur when an accident analyzed using a CICTT categorization taxonomy has contributing factors that fall into more than one category.

not contain enough information to be useful. This lack of data, particularly regarding the actual failure of the engine, forced the working group to exclude several accidents from analysis.

Additionally, several accident reports categorized SCF−PP as a contributing factor, but no anomalies were found in the engine teardown report. In these cases, it was determined an SCF−PP contributing factor was included because a witness report had been filed stating engine issues were heard. Reports of this nature were removed from analysis only if no data points existed for examination by the working group.

Fuel

According to the CICTT taxonomy,[8] FUEL accidents, such as misfueling or fuel exhaustion, cannot be coded as SCF−PP. However, the SCF−PP Working Group noticed several FUEL accidents had been miscoded as SCF−PP. The working group recommends performing a thorough analysis of the FUEL category of the GAJSC Pareto (see figure 1) as a preliminary analysis has shown that the miscoding problem regarding FUEL versus SCF−PP is substantially larger than originally thought. Additionally, the SCF−PP Working Group recommends establishing a working group to address FUEL accidents, assuming the problem of miscoding is verified.

[8] For full taxonomy: http://www.intlaviationstandards.org/Documents/CICTT_SCF-PP_Sub_Category_Definitions.pdf

Appendix A. Charter

GAJSC Risk Reduction WG

SCF−PP

January 28, 2014

A. Background

The GAJSC chartered an SAT to conduct a review of fatal GA accidents for 2001 through 2011. The SAT reviewed 2,472 fatal GA accidents based on CAST−ICAO CICTT categories and identified SCF−PP accidents as the third most prevalent accident type with 282 fatal accidents during the SAT timeframe.

Industry and Government agreed to conduct a data-driven approach to identify high priority safety initiatives for GA and jointly agreed to work toward the mitigation of accident causes. The GAJSC chartered an initial project to study LOC accidents beginning with those occurring during the approach and landing phase of flight, determine the contributing factors, and develop intervention strategies. After completion of the project, a second group was formed to analyze the remaining LOC events during all other phases of flight. CFIT accidents, the second highest category of GA fatal accidents, appear in decline while SCF−PP fatal accident numbers appear stagnant. For this reason, the GAJSC determined the next WG should analyze SCF−PP accidents. This study will look at SCF−PP accidents during all phases of flight.

B. Tasks

1. The WG will conduct an in-depth analysis and review of the SCF−PP accidents provided to the WG by the SAT. The SAT has established a statistically acceptable process to reduce the 282 SCF−PP accidents between 2001−2011 into a data-set that can be reviewed by the WG within its timeframe. This resulted in 90 SCF−PP accidents assigned to the WG.
2. The WG will review and determine the level of applicability of other work done in the area of SCF−PP. This work includes, but is not limited to, FDM engine failure predictive analysis, PSM+ICR guidance material, and CAST SEs.
3. The WG will develop and prioritize safety intervention strategies to reduce the potential for SCF−PP fatal accidents. In addition to documenting its results of the analysis and recommended intervention strategies, the WG will also document its assumptions regarding the analysis.
4. The WG, with help from the SAT, will identify prospective interventions for implementation and present them to the GAJSC for review and approval. The analysis and rationale for how all the intervention strategies were dispensed will be included in the final report.
5. Following the approval of the GAJSC of the interventions, the WG will develop an SE for each intervention.
    a. Each SE will contain—
        i. Prioritized implementation strategies,
        ii. Parties responsible for action,

iii. Major implementation milestones,
iv. Metrics to monitor progress in meeting these milestones, and
v. Metrics for tracking success of the interventions after they are implemented.

b. The WG, with help from the SAT, will present each SE to the GAJSC for review and approval.

6. The WG will provide feedback to the GAJSC about what worked and what did not work to aid future WGs in this process.

C. Products

The WG will deliver the following to the GAJSC:

- Progress reports,
- A report documenting analysis and recommendations on mitigation strategies,
- An implementation plan for review and approval, and
- SEs, including metrics for monitoring effectiveness of mitigation strategies.

D. Membership

The WG will include representatives with the appropriate technical background provided by the industry and Government including several members from the SAT that can further assist with the data analysis.

Additionally, the membership will provide specific expertise in the following categories:

- Maintenance
- Accident Investigation
- Engines
- Flight Training
- Manufacturer Requirements
- Regulatory Requirements
- Human Factors

E. Resources

The GAJSC participating organizations agree to provide appropriate financial, logistical, and personnel resources necessary to carry out this charter and approved implementation strategies. The WG will primarily use conference calls for the technical meetings, but will also meet face-to-face at the discretion of the WG Government/industry co-chairs.

F. Schedule

The WG is expected to exist for 12 months, but can be extended at the discretion of the GAJSC. The WG is requested to target its deliverables as follows:

- October 2015: Report documenting analysis and recommendations for mitigations.

G. Specific Resources

The GAJSC recognizes that while the SCF−PP is the third WG for the joint FAA-industry safety program for GA, the organizations providing personnel resources to this project are asked for discretion in possible changes in the need for resources. However, based on an initial

assessment, it is expected that the WG consist of two co-chairs and approximately 30 members, each contributing on average 3 days every month and a half. The skill sets needed include:

Industry Co-Chair	1
FAA Co-Chair	1
Pilots (light, instructors, turbine)	2
Manufacturers	4
Training Providers	2
Analysis Support (AVP, Universities)	6
Government (Policy & Technical)	10

H. SCF–PP WG Membership

Name	Organization
Kate Fraser (Co-Chair)	GAMA
Frank Stadmeyer (Co-Chair)	FAA (AVP–220)
Peter Basile	Textron Aviation
Elizabeth Bjerke	University of North Dakota
Nicole Charnon	Continental Motors
Tom Charpentier	Experimental Aircraft Association
Kevin Clover	FAA (AFS–850)
Ken Degg	National Agricultural Aviation Association
Jeff Edwards	Lancair Owners and Builders Organization
Kristine Hartzell	Aircraft Owners and Pilots Association Air Safety Institute
Dale Hawkins	FAA (AFS–320)
Paul Joly	FAA (AFS–WP19)
David Keenan	FAA (AVP–100)
Peter Korns	National Business Aviation Association
Ken Knopp	FAA (ANG–E28)
Randy Knuteson	ESI
Roger Love	FAA–BOS–AEG
Jeb Burnside	Aircraft Electronics Association
Rob Ramey	Textron Aviation

Name	Organization
Dave Sizoo	FAA (ACE–112)
Aaron Spotts	Lycoming Engines
Joanne Soliman	FAA (AVP–210)
Doug Stewart	Society of Aviation Flight Educators
Alan Stolzer	Embry-Riddle Aeronautical University
Karen Marais	PEGASAS
Mark Thom	PEGASAS

I. Approved

This charter was approved by the GAJSC on April 22, 2014

Industry Co-Chair Government Co-Chair

Appendix B. Participants

Kate Fraser (co-chair) *General Aviation Manufacturers Association*	• Kansas State University – Bachelor of Science in Aeronautical Technology • Commercial Pilot Certificate with Airplane Single Engine Land (ASEL) and Airplane Multiengine Land (AMEL) ratings, Certified Flight Instructor ASEL (CFI), Certified Flight Instructor Instrument (CFII)
Frank Stadmeyer (co-chair) *FAA, AVP–230*	• Private Pilot Certificate with ASEL rating • Director of Flight Safety, Certification and Airworthiness, Pratt & Whitney; P&W Engine Representative to CAST • Amateur Radio (Ham) General Class license
Peter Basile *Textron Aviation*	• University of Central Missouri – Master of Science in Aviation Safety, Bachelor of Science in Aircraft System Design Technology • U.S. Department of Transportation, Transportation Safety Institute, Aircraft Accident Investigation Courses; Basic, Advanced, Turbine Engine, and Human Factors • Private Pilot Certificate with ASEL and Instrument Airplane ratings • Mechanic Certificate with Airframe and Powerplant (A&P) ratings, Inspection Authorization (IA)
Elizabeth Bjerke *University of North Dakota*	• University of North Dakota – Doctor of Education in Educational Leadership, Master of Business Administration, Bachelor of Business Administration • Chair for the Department of Aviation • Former Assistant Chief Flight Instructor for the University of North Dakota part 141 flight training program
Jeb Burnside *Representing Aircraft Electronics Association*	• Commercial Pilot Certificate with ASEL and Airplane Single Engine Sea (ASES) and AMEL with Instrument Airplane ratings • Current editor-in-chief of Aviation Safety magazine; writer for AirVenture Today, AVweb.com, Professional Pilot, and The Robb Report and Avionics News
Nicole Charnon *Continental Motors*	• Embry-Riddle Aeronautical University – Master and Bachelor of Science in Aeronautical Science, Associate of Science in Aviation Maintenance Technology • CFI, Mechanic Certificate with A&P ratings • Previously Air Safety Investigator and Senior Air Safety Investigator with the NTSB • Associate Instructor Transportation Safety Institute – Aircraft Accident Investigation Courses (Powerplant Investigations)
Tom Charpentier *Experimental Aircraft Association*	• Bowdoin College – Bachelor of Arts, Government and Legal Studies • Private Pilot Certificate with ASEL rating • Government Advocacy Specialist • Previously worked as a legislative aide to a Massachusetts State Representative

Kevin Clover *FAA, FAASTeam*	• Juris Doctor in Law, Bachelor of Science in Social Ecology • Airline Transport Pilot (ATP) Certificate with AMEL rating, Commercial Pilot Certificate with ASEL rating, CFI, CFII, Advanced Ground Instructor • Three Accident Investigation courses taught by the Transportation Safety Institute
Ken Degg *National Agricultural Aviation Association*	• Bio not provided
Jeff Edwards *Lancair Owners and Builders Organization/AvSafe*	• Doctoral student, Parks College Saint Louis University in Aviation Science • Former FAA Designated Pilot Examiner, FAA Repairman certificate, Instrument; ATP AMEL; Commercial Pilot Certificate with ASEL and ASES and Instrument Airplane ratings • Founder, President Lancair Owners & Builders Organization (LOBO) • U.S. Navy (retired) • President, AvSafe, LLC, an aircraft accident investigation and reconstruction consulting company
Sean Hafner *FAA, AVP–210*	• Western Michigan University – Bachelor of Science in Aviation Flight Science • Operations Research Analyst – FAA Office of Accident Investigation and Prevention • Aircraft Dispatcher Certificate
Kristine Hartzell *Aircraft Owners and Pilots Association, Air Safety Institute*	• Embry-Riddle Aeronautical University – Bachelor of Science, Aeronautical Studies • ATP, CFI, and CFII • Chief Flight Instructor for the AOPA Foundation's Air Safety Institute • Previously worked as a pilot, Check Airman, and Human Factors Manager at a part 121 air carrier and Chief Pilot for a part 135 charter operator
Dale Hawkins *FAA, AFS–320*	• Embry-Riddle Aeronautical University – Bachelor of Science in Aeronautical Studies/Aircraft Maintenance Management, Associate of Science in Aviation Maintenance Technology • Mechanic Certificate with A&P ratings; Private Pilot Certificate with ASEL rating • Manager, Flight Standards Service Maintenance Division Special Programs Branch
Paul Joly *FAA, AFS–WP19*	• Commercial Pilot Certificate, CFI, CFII, and MultiEngine Instructor (MEI) • Formerly an Air Traffic Controller and Supervisory Aviation Safety Inspector • On the Advisory Board for Human Factors at Embry-Riddle Aeronautical University (Daytona)
Dave Keenan *FAA, AVP–100*	• St. Louis University – Bachelor of Science in Aeronautical Engineering • Private Pilot Certificate with Instrument Airplane ratings and Mechanic Certificate with A&P ratings • Aviation Safety Inspector, NTSB, FAA IIC on over 100+ accident and incident investigations

Ken Knopp *FAA, Tech Center*	• Wichita State University – graduate courses and Bachelor of Science in Aerospace Engineering • Commercial Pilot Certificate with ASEL and Rotorcraft – Helicopter ratings
Randy Knuteson *Engineering Systems Inc.*	• Bachelor of Arts in Communications • Certified through University of Southern California in Accident Investigation and Air Safety, FAA authorized instructor for IA, A&P rating, Private Pilot Certificate–ASEL • Turbo Systems, Fuel Systems, Alternators, Starters, Voltage Regulators and Heaters – Kelly Aerospace
Peter Korns *National Business Aviation Association*	• University of Southern California Viterbi School of Engineering – Aviation Safety & Security Certificate • CFI
Roger Love *FAA, BOS–AEG*	• U.S. Navy Jet Engine Mechanic Training school, Spartan School of Aeronautics, FAA part 147 Airframe and Powerplant mechanic school. • Mechanic Certification with A&P rating; Principal Maintenance Inspector, part 135 operators, part 145 repair stations, part 141 pilot training school, part 147 mechanic school, part 137 agriculture operators and accident/incident investigations • Test Cell School, Norfolk, VA, jet engine test cell coordinator (water cooled test cell and hush house operator) and recurrent test cell instructor and crew leader • FAA part 135 operator, part 145 radio repair station, and part 141 pilot training school
Karen Marais *Purdue University*	• Massachusetts Institute of Technology – Ph.D. from the Department of Aeronautics and Astronautics, Masters of Science in Space-Based Radar; University of Stellenbosch – Bachelors of Engineering; University of South Africa – Bachelors of Science in Mathematics
Matt Pollack *MITRE*	• Bachelor of Physics • Commercial Pilot Certificate ASEL, CFI, and CFII • Flight simulation and research
Rob Ramey *Textron Aviation*	• Bio not provided
David Sizoo *FAA, ACE–112*	• Massachusetts Institute of Technology – Masters and Bachelors of Science in Aerospace Engineering • ATP, Instructor Pilot, Evaluator Pilot, FAA Check Airman, Flight Test Pilot with the FAA Small Airplane Directorate, Human Factors specialist • Sponsoring research on human performance and Flight Deck Technology Integration
Joanne Soliman *FAA, AVP–210*	• Bio not provided

Aaron Spotts *Lycoming*	• Embry-Riddle Aeronautical University – Bachelor of Science in Aeronautics, Associate of Science in Aircraft Maintenance; Pennsylvania College of Technology – Aviation Maintenance Technician • Mechanic Certificate with A&P ratings • Private Pilot Certificate with ASEL ratings
Doug Stewart *Society of Aviation and Flight Educators*	• CFI, Designated Pilot Examiner, 8-times Master CFI with over 11,200 hours of dual given
Alan Stolzer *Embry-Riddle Aeronautical University*	• Indiana State University – Ph.D. in Technology Management; Embry-Riddle Aeronautical University – Master of Science in Aeronautical Science; College of the Ozarks – Bachelor of Science in Aviation Technology • CFI, CFII, MEI, ATP; Ground Instructor Certificate, Advanced and Instrument ratings; Mechanic Certificate with A&P ratings; former Designated Pilot Examiner • Fellow of the Royal Aeronautical Society
James M. Thom *Purdue University*	• University of Missouri-St Louis – Master of Arts in Industrial Psychology; Purdue University – Bachelor of Science in Aviation Technology • FAA A&P ratings, FAA Designated Mechanic Examiner, FAA Private Pilot Certificate • Purdue University, Aviation Technology, Associate Professor

Appendix C. Schedule of Meetings

January 21–23, 2014, Melbourne, Florida

March 11–13, 2014, Dallas, Texas

April 29–May 1, 2014, Phoenix, Arizona

June 17–19, 2014, Atlanta, Georgia

August 19–21, 2014, Seattle, Washington

October 15–17, 2014, Grand Forks, North Dakota

December 9–11, 2014, Daytona Beach, Florida

January 20–21, 2015, Washington, DC

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Appendix D. Accident Selection Process and Accident Dataset

Methodology for GAJSC SAT Accident Selection

This section outlines the methodology for the GAJSC SAT's accident selection process.

To provide a quantitative framework for investigation of selected focal areas, the SAT will use appropriate and empirically based vetting protocols, which will provide a meaningful foundation for the team's subsequent analyses. The underlying foundation of the methodology will use the following principles:

(1) Preprocessing of the search criteria will be as exhaustive as practical;

(2) Random selection (each resultant accident report will have an equal probability of being selected) will be used; and

(3) During the post analytical process, pruning and/or outlier removal will occur only when—

- There exists a substantial lack of information contained in the report that was not readily apparent in the preprocessing tasks,
- An accident report was inaccurately and obviously misclassified, or
- There is a justifiable basis to believe the report will not materially contribute to the focal area.

Preprocessing

The NTSB's aviation accident database and its associated interactive search capability will be used to select accidents for further inquiry. Unless otherwise directed by the GAJSC or by the majority of the SAT, all accident selections will use the following criteria:

Investigation Type:	Accident
Injury Severity:	Fatal (with Non-Fatal augmentation; see below)
Category:	Airplane
Operation:	All GA*
Report Status:	Probable Cause

*SAT may decide to include 14 CFR part 135 reposition and other nonrevenue flights.

If desired by a majority vote of the SAT, further narrowing of selection criteria can be used with the following parameters:

- Experimental Amateur Built (may be used as an additional sample; see below)
- Engine Type
- Purpose of Flight
- Broad Phase of Flight

Further preprocessing activities will use a word string phrase or phrases agreed upon by the majority vote of the SAT and congruent with the selected focal areas. Once agreed upon, all records used for a focal area must use the same criteria and word string phrase or phrases.

Random Selection

If the resultant search query from the NTSB's database exceeds 30 separate accident reports, a random sample of the available reports will be collected. The random sample will include a minimum of 30 samples. If 30 reports are not available, Non-Fatal accidents may be used to bring the total sample size to 30. In addition, the SAT may decide that a separate and additional sample involving amateur-built aircraft be used.

A software tool, such as Microsoft's Excel or IBM's SPSS, will be used to randomize and select the sample. The randomizing will only use the NTSB report number, and once run, will constitute the master list of accident reports to be used for analysis. Further information within the accident report will be accessed only after the master list is compiled.

Post-Analysis

Each report will be assigned to at least two members of the subgroup tasked with the focal area. Each member will review the report and make an initial judgment as to the suitability of the report as it relates to the task at hand. When making this judgment, the subgroup member must be able to answer question 1 in the affirmative and question 2 in the negative.

1. Does the report have adequate information available to form an appropriate qualitative assessment?
2. Has the accident outlined in the report been obviously misclassified, or does the report contain an error that would render any conclusion drawn therein not relevant to the focal area?

If the majority of subgroup members assigned to the specific accident report agrees that the answer to question 1 is in the affirmative or the answer to question 2 is in the negative, the next available accident from the randomized master list will be selected for analysis. The process would then repeat.

Once a report has passed this initial check, the subgroup members assigned to a report will conduct a preliminary analysis of the accident report.

If, after completing the analysis, the members of the subgroup unanimously conclude that the accident in question will not materially contribute to the analysis of the focal area, the report will be excluded. In making the decision to exclude any accident report, the following question should be answered in the negative:

3. Will the accident report materially contribute to the analysis of the considered focal area?

If there is doubt regarding the answer to this question, the question should be answered in the positive, and the report should be included for further analysis.

Working Group

Once the subgroup members have compiled a sample list of accidents using the above methodology, they will forward the list to the assigned working group. In addition, the subgroup will also forward an additional list of reports, known as the reserve dataset, to be used if the working group concludes a particular accident report is not suitable for further analysis given the focal area. If no accident report remains in the reserve dataset, the subgroup will reconvene to generate additional reports drawn from the master list and processed in accordance with the post-analysis procedures listed above.

Accident Dataset

SEA07FA195
ERA10LA175
CHI04FA234
LAX05FA296
ANC04FA092
DEN05FA034
LAX05LA100
ANC07FA013
NYC08FA012
DFW06FA037
ATL05LA103
WPR10FA056
NYC03FA164
LAX04FA226
NYC05FA048
SEA02LA072
DEN04FA109
NYC03FA043
ANC05FA070
MIA02FA131
SEA04FA003
LAX00FA310
LAX01FA302
MIA01FA192
LAX02FA056
LAX01FA199
CHI04LA128
DFW06LA041
CHI04GA130
LAX02FA097
CHI05FA162
SEA08LA127
CHI03LA201
LAX02FA148
DFW05FA188
CHI04FA203
NYC02FA131
CHI02LA159
CHI01FA329
ATL05FA032
FTW02FA054
FTW02FA106
ATL03FA009
DEN05FA045
DEN03FA023
ATL03FA025
IAD05FA068
NYC06LA097
DEN03FA025
NYC08FA053
MIA05LA046
LAX04FA001
LAX06FA129
CHI05FA049
MIA04FA076
ATL02FA072
LAX02LA223
CHI08LA166
MIA06FA024
FTW03FA051
ATL02FA175
NYC05FA005
FTW03FA120
DFW07FA020
ATL03FA009

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Appendix E. SE Overview

SE 35, Direct Tension Indicating (DTI) Technology

To help prevent fatal GA accidents due to failure of the powerplant system, the GA community should further research and develop the use of DTI technology.

Within the SCF−PP dataset, there were six accidents where inadequate bolt torque led to powerplant failures or loss of propellers. DTI technology utilizes visual indications for mechanics to confirm proper torque. In their current state, they are single use mechanical load cells used to indicate when the required tension has been achieved in structural fastener assemblies. This SE is intended to improve a mechanic's ability to determine adequate torque and improve the inspection process.

The following six accidents prompted this SE:

NYC05FA005 ANC07FA013 NYC03FA043 NYC08FA053 LAX06FA129

MIA06FA024

SE 36, V_{MC} Scenario Training

To help prevent fatal GA accidents due to failure of the powerplant system, the GA community should further develop training scenarios to address V_{MC}-related LOC.

Nine of the accidents in the SCF−PP reviewed dataset involved V_{MC} LOC events following powerplant failures. With the improvements in desktop trainers, flight training devices, and simulators, the SCF−PP Working Group believes that scenario-based training offered in these formats could help multiengine pilots identify the conditions leading to a V_{MC}-related LOC and prevent their occurrence in high risk areas (single engine go-arounds, takeoff loss of power events, and low-level maneuvering). Therefore, this SE is directed at the FAA and flight training community to develop simulated V_{MC} training scenarios and provide affordable, readily available training options to the GA multiengine community.

The following nine accidents prompted this SE:

DFW06FA037 LAX01FA302 DFW05FA188 DEN05FA045 DEN03FA025

DEN05FA034 DEN04FA109 CHI05FA049 FTW03FA051

SE 37, Multiengine Emergency Management Technology

To help prevent fatal GA accidents due to failure of the powerplant system, the GA community should develop emergency cockpit management technology for multiengine aircraft.

Nine of the accidents in the SCF−PP reviewed dataset involved V_{MC} LOC events following powerplant failures. The SCF−PP Working Group believes that technology that aids the pilot in decisionmaking following an engine failure would substantially reduce the occurrence of fatal accidents.

The following nine accidents prompted this SE:

DFW06FA037	LAX01FA302	DFW05FA188	DEN05FA045	DEN03FA025
DEN05FA034	DEN04FA109	CHI05FA049	FTW03FA051	

SE 39, Smart Cockpit Technology

To help prevent fatal GA accidents due to failure of the powerplant system, the GA community should develop emergency cockpit management technology.

A review of the SCF–PP accident dataset indicated that a large percentage of the accidents resulted in fatalities because of the pilot's inability to identify the failure or appropriately manage the aircraft post-engine failure. The intent of this SE is to develop technologies which could not only help predict and alert the pilot to potential emergency situations, but also ease the workload during high stress/emergency situations.

This work ties in with SE 25 from LOC Working Group two for safety enhancing technology and can work in conjunction with the flight envelope protection system described in SE 25.

SE 41, Survivability

To help prevent fatalities resulting from GA powerplant system failures, the GA community should research and, if applicable, implement survivability recommendations.

During the SCF–PP evaluation of accident data, 10 accidents were identified that had crash survivability issues, such as separated seatbelts, post-crash fires, and water egress issues. The purpose of the SCF–PP Working Group was to identify issues that would prevent fatalities in powerplant-related accidents. Since fewer than 15 percent of powerplant-related accidents have a total fatality risk, the SCF–PP elected to address crash survivability issues. By improving the crash survivability and post-accident egress training, many of the fatalities encountered in the dataset could have been prevented. Therefore, the purpose of this SE is to research accident survivability factors and implement any recommendations stemming from the research.

The following 10 accidents prompted this SE:

ANC04FA092	DFW06LA041	LAX02FA148	DFW02FA106	MIA05LA046
LAX06FA129	MIA04FA076	ANC07FA013	LAX02FA056	ANC05FA070

SE 44, Maintenance Data Exchange

To help prevent fatal general aviation accidents due to failure of the powerplant system, the general aviation community should evaluate the effectiveness of a maintenance data exchange and fully implement the system if deemed feasible and beneficial.

During the SCF–PP Working Group it was noted that three separate v-band clamp-related accidents were represented in the 10-year sample group. Further research indicated that v-band clamp issues were occurring since the mid-1980s and that the FAA had issued airworthiness directives (AD). However, the v-band clamp issue was only addressed on an aircraft-specific basis over a span of many years and did not address the global extent of the issue. Feedback from the FAA (e.g., aging aircraft program) and industry have identified the existing weakness in

the M&D/SDR program including lack of incentive to submit general aviation reports and the use of outdated technology and limited ability to analyze the data. Additionally, 35 accidents involved inadequate and/or improper maintenance or maintenance operations simply not being performed.

The following accidents prompted this safety enhancement:

FTW03FA120	LAX05FA296	CHI04FA234	LAX01FA199	CHI08LA166
NYC08FA053	DEN05FA045	LAX00FA013	LAX05LA100	IAD05FA068
FTW02FA106	CHI01FA329	CHI05FA162	WPR10FA056	MIA05LA046
LAX02FA097	CHI04FA203	MIA02FA131	NYC06LA097	WPR10FA056
LAX02LA223	NYC05FA005	ANC07FA013	ANC04FA092	CHI02FA042
CHI04LA128	DFW06FA037	DEN03FA025	SEA02LA072	FTW98LA350
ATL02FA176	MIA04FA076	MIA06FA024	DEN03FA199	SEA04FA003
ATL03FA009	LAX06FA129	NYC03FA043		

SE 45, Maintenance Alert Placard

To help prevent fatal GA accidents due to failure of the powerplant system, the GA community should develop, distribute, and promote a device to be displayed in the windscreen of aircraft undergoing maintenance.

During the SCF−PP evaluation of accident data, three accidents were identified that were caused by incomplete maintenance. Even more accidents were attributed to the aircraft not being maintained for a substantial amount of time. The group determined that there needed to be a more effective way to alert the pilot and mechanic that the airplane is not currently airworthy.

The following three accidents prompted this SE:

SEA07FA195	ATL04LA103	LAX02LA223

SE 47, A&P Education and Training

To help prevent fatal general aviation accidents due to failure of the powerplant system, the general aviation community should examine available training and education for maintenance professionals.

Within the SCF–PP dataset, 35 accidents involved inadequate and/or improper maintenance or maintenance operations simply not being performed. Though the human factors behind these maintenance-related errors were rarely investigated, the reoccurrence of the problem throughout the dataset warranted a safety enhancement that would help improve a mechanic's understanding of critical maintenance procedures and the consequences of not performing maintenance inspections or procedures, or doing the maintenance improperly. The best way to accomplish this throughout the maintenance community is through improved training and ensuring that best practices and protocols are not only followed, but easily accessible to the A&P mechanic.

The following 35 accidents prompted this safety enhancement:

FTW03FA120	LAX05FA296	CHI04FA234	LAX01FA199	CHI08LA166
NYC08FA053	DEN05FA045	LAX00FA013	LAX05LA100	IAD05FA068
FTW02FA106	CHI01FA329	CHI05FA162	WPR10FA056	MIA05LA046
LAX02FA097	CHI04FA203	MIA02FA131	NYC06LA097	LAX02LA223
NYC05FA005	ANC07FA013	ANC04FA092	CHI04LA128	DFW06FA037
DEN03FA025	SEA02LA072	ATL02FA176	MIA04FA076	MIA06FA024
DEN03FA199	SEA04FA003	ATL03FA009	LAX06FA129	NYC03FA043

SE 48, Engine Ignition Systems

To help prevent fatal GA accidents due to failure of the powerplant system, the GA community should research and, if applicable, develop alternative ignition systems with enhanced reliability in reciprocating engines.

Within the SCF−PP dataset, there were five accidents involving ignition system problems which led to loss-of-engine-power events. Four of the five accidents involved magneto-related issues. Magnetos have been certified and in use since the earliest days of aviation. That being said, there are variations to legacy magneto/impulse coupling ignition systems, such as shower of sparks, solid-state ignition systems (SSIS), and combinations of legacy and SSIS that have had exposure primarily in the experimental segment of GA. This SE is intended to research the use of alternative systems such as SSIS to potentially improve ignition systems and help prevent powerplant failures.

The following five accidents prompted this SE:

LAX02FA056	DEN03FA023	MIA04FA076	CHI08LA166	CHI04FA234

SE 49, SCF–PP Outreach

To help prevent fatal GA accidents due to failure of the powerplant system, GA associations in coordination with the FAA should communicate through a previously established procedure (SE 34) to the GA community on the following topics:

Topic #1—Outreach to airframe and powerplant (A&P) on the importance of checking critical parts during work that makes these parts accessible, even if parts are not the subject of maintenance.

Topic #2—Outreach to pilots on emergency situations and survival training.

Topic #3—Outreach to pilots on engine maintenance and monitoring engine performance.

Topic #4—Outreach regarding the broader use of FADEC systems.

Topic #5—Outreach that highlights existing guidance on determining the best glide speed and distance for amateur-built aircraft.

Topic #6—Smart Cockpit Technology, see SE 39.

Topic #7—V-Band Clamp Failures and Turbocharger Safety.

Topic #8—Enhanced Vision Systems.

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Appendix F. Intervention Strategy Methodology

The two SCF−PP Working Group subteams were assigned a set of 35 accident reports to analyze. Each subteam developed an event sequence spreadsheet (see appendix J) that included the events necessary to provide context for understanding the nature of the accident sequence. The subteams then evaluated the events to determine if they represented a "problem" involving hardware/software failure or human execution errors, decisions, or procedural noncompliance.

If the subteam members considered an event contributory to the accident, they developed a statement describing why it contributed to the accident. They identified the specific nature of the problem associated with an event in the sequence along with the factors that could have precipitated the problem. These contributing factors were then restated in more general terms as standard problem statements to make them relevant beyond the specific accident.

The subteams rated the standard problem statements as described below. They developed potential interventions to address each standard problem statement.

Standard Problem Statement Development

Ratings

The subteams used the following rating factors to prioritize the interventions: power (P), confidence (C), and applicability (A). They determined the overall effectiveness (OE) using the scores assigned to "P," "C," and "A."

Power indicates how important a problem was to an accident and the degree to which an intervention could have prevented or resolved the problem, broken the chain of events, and prevented the accident. There was confusion in previous CAST Joint Safety Analysis Teams (JSAT) about the practical meaning of power. In practice, "P" sometimes was scored to indicate the relative power of the targeted problem in the accident; at other times it indicated the power of an intervention to resolve a specific problem and thereby break the chain of events. As a result, "P" often failed to integrate the two concepts and instead scored one side of the concept to the exclusion of the other.

Recognizing this confusion, CAST approved a process change following the Approach and Landing JSAT. The two factors outlined above were partitioned into "P1" and "P2" so each could be rated separately.

> P1 indicates the importance of the problem or contributing factor as a causal link in the accident.
>
> P2 indicates the ability of the rated intervention to mitigate the problem or contributing factor.

The 0–6 rating scales used to evaluate P1 and P2 were similar to those used for previous ratings. The two scores were combined arithmetically to produce a single power rating. This explicitly addressed the past confusion and yielded a single power score conceptually equivalent to the power rating used by previous JSATs.

The SCF−PP Working Group will incorporate the change into revised process guidelines. In sum, P1 focuses on the problem or contributing factor, while P2 focuses on the intervention.

Confidence indicates how strongly the subteam believed everyone and everything would perform as expected if the interventions were implemented. The confidence factor assesses the real world, in which interventions are seldom perfect or 100 percent effective.

Applicability indicates how frequently the problems being addressed by the specific intervention recur. Applicability provides a bridge from the specifics of the accident to future operations.

Overall Effectiveness

To support prioritization of the proposed interventions, the subteams ranked each intervention by its overall effectiveness. To do this, it was necessary to reduce the P/C/A ratings to a single value that roughly approximated OE. The intent was for the OE score to provide the first sort of the interventions.

The following algorithm is used to convert P/C/A to OE:

$$OE = P \times C/6 \times A/6 = P \times C \times A/36$$

Appendix J lists the interventions ranked by OE.

Bucketed Interventions.

The two subgroups bucketed the interventions according to common themes or concentration areas such as training, policy, guidance, outreach, and research. This resulted in a manageable number of 98 interventions that were divided between two groups responsible for assessing the feasibility of each intervention.

Assigning Feasibility

The feasibility assessment was accomplished by assigning a numerical value to each intervention for each of the following six elements:

1. Technical,
2. Financial,
3. Operational,
4. Schedule,
5. Regulatory, and
6. Sociological.

Feasibility values of 1, 2, or 3 were assigned to each feasibility element and are described as follows:

Technical feasibility is the ability of the project to take advantage of the current state of technology in pursuing further development.

3—Off-the-shelf technology, no development required.

2—Some development required, not currently in public use.

1—Major technology development effort required.

Financial feasibility should consider the total cost of the implementation, including the planning process. Financial feasibility also involves the capability of the participating organizations (FAA, manufacturers, and air carriers and operators) to provide the appropriate funding needed to implement the project.

3—Less than $100 million to implement.

2—Between $100 million and $250 million to implement.

1—Greater than $250 million to implement.

Operational feasibility involves the practicality of the project within the context of the operating environment including areas such as the National Airspace System (NAS), ground operations, maintenance, and inspection. It also considers which organizations within the aviation system are affected and the degree of the impact.

3—Minimal change to entities within the operating environment.

2—Modest change to operating environment.

1—Major change to operating environment.

Schedule feasibility addresses whether the project can contribute to achieving the goal in a selected timeframe. It must consider implementation schedule by project.

3—Less than 2 years to full implementation.

2—Full implementation in 2−5 years.

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Appendix G. Intervention Feasibility

1—Longer than 5 years to full implementation.

Regulatory feasibility should be evaluated against current rules and certification process. A long approval process could be a deterrent.

3—No policy change.

2—Guidance change only (orders, handbooks, policy).

1—Rule change.

Sociological feasibility requires an evaluation of the project goals' compatibility with the prevailing goals of the political system. Worthy projects may face heavy opposition because of political factors.

3—Positive push from political system.

2—Neutral.

1—Negative.

Once each subteam completed all the feasibility evaluations, they collated their numbers and added the value for each feasibility element and the average value for that project into the spreadsheet. To build consensus and ensure the values were defendable, the SCF−PP Working Group reviewed the numerical assessments for each feasibility element after the subteams entered all the values. Once this step was completed, the SCF−PP Working Group combined the interventions in a single spreadsheet.

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Appendix H. Intervention Analysis

Intervention Rating Assignment				
OE	**F**	**OE x F**	**IS No**	**Intervention Strategy (IS)**
3.94	2.50	9.84	1	TECHNOLOGY—Industry to adapt, approve, and implement ”SmartBolt” technology torque bolts (color-changing validation of correct torque).
3.08	3.00	9.23	2	TRAINING—FAA and industry to develop V_{MC} scenarios to be used in simulators for initial and recurrent training. Including, but not limited to, conventional scenarios for V_{MC} multiengine training where appropriate.
3.08	2.67	8.21	3	RESEARCH—Industry to develop a V_{MC}-imminent warning device under asymmetric thrust conditions.
2.73	3.00	8.18	4	OUTREACH—Aeronautical Decision Making (ADM)—FAA/industry outreach campaign on need for ADM with emphasis on, but not limited to— A. Operating twin-engine aircraft with one engine inop. B. Importance of altitude selection relative to engine-out performance.
2.55	2.83	7.21	5	OUTREACH—FAA/industry to educate A&Ps on importance of checking critical parts during work that makes them accessible, even if said parts are not the subject of maintenance.
2.73	2.50	6.82	6	TECHNOLOGY—FAA/industry implement existing infrared/night vision goggles (NVG)/spectral technology on GA fleet to avoid hazards at nighttime or in low visibility conditions; to include IR cameras that can be coupled to glass display electronic flight instrument system (EFIS).
2.05	3.00	6.14	7	RESEARCH—FAA/industry to research feasibility of creating a searchable database that allows pilots to perform the following: A. Select CFIs and/or flight schools based on qualifications, years of experience, and training. B. Owners/operators to select A&P and/or Mx facility based on qualifications, years of experience, and training (AMT award program). Note: Reference Medicare.gov physician compare Web site. Include provisions for CFIs to voluntarily participate. Include provisions for mechanics to voluntarily participate. TECHNOLOGY—FAA/industry to implement system for use by GA community.
2.42	2.50	6.06	8	RESEARCH—FAA/industry to develop engine monitoring systems that require exceedance resolution. TECHNOLOGY—FAA/industry to implement developed technology.

Intervention Rating Assignment				
OE	**F**	**OE x F**	**IS No**	**Intervention Strategy (IS)**
2.00	3.00	6.00	9	OUTREACH—ADM—FAA/industry to encourage pilots to develop better understanding of the limitations of the aircraft, its systems, and their own abilities. Special emphasis on aircraft performance when operating on edge of Center of Gravity/weight envelope.
2.40	2.50	6.00	10	RESEARCH—FAA/industry to research survivability issues (air bags, shoulder harnesses, helmets) and implement.
1.84	3.00	5.53	11	TRAINING—FAA/industry to emphasize pre-takeoff immediate action emergency contingency planning in GA ops, as in other facets of aviation (such as military), throughout initial and recurrent training.
1.84	2.67	4.91	12	GUIDANCE—FAA to publish Special Airworthiness Information Bulletin (SAIB) referencing manufacturers' documentation regarding turbocharged aircraft and V-band failure, stressing the need for inspection and proper replacement procedures. OUTREACH—FAA/industry outreach campaign on current documentation.
2.08	2.33	4.86	13	RESEARCH—Research and develop technological solutions to prevent pilots from feathering the wrong engine. TECHNOLOGY—FAA/industry to implement developed solutions
1.60	2.83	4.53	14	OUTREACH—EQUIPMENT—FAA/industry to encourage the broader use of FADEC systems.
1.50	3.00	4.50	15	OUTREACH—ADM—Industry/FAA to educate pilots on recognizing preignition/detonation scenarios and taking appropriate action.
1.67	2.50	4.17	16	RESEARCH—FAA/industry to develop avionics that aid pilots with respect to suitable emergency landing areas in the event of obscured vision and/or power loss. Avionics to include, but not limited to, synthetic/enhanced vision and real-time decision making tools. TECHNOLOGY—FAA/industry to aid in the implementation of developed technology. TECHNOLOGY—Promote the use of energy management and/or automated glidepath calculation software/systems; such as X–avion (glide range to suitable airport/landing area).
1.67	2.50	4.17	17	TECHNOLOGY—Industry to develop smart cockpit technology that helps identify emergency situations, prompts pilots (aurally/visually) through pertinent checklist items, and provides conditional instructions based on aircraft position and condition of flight.
1.33	3.00	4.00	18	TRAINING—FAA and industry to emphasize positive safety culture during primary, and recurrent, training and testing.

Intervention Rating Assignment				
OE	**F**	**OE x F**	**IS No**	**Intervention Strategy (IS)**
1.33	3.00	4.00	19	TRAINING—Teach proper techniques for managing unexpected events/teach how to recognize and manage startle response (observe, orient, decide and act (OODA)).
1.33	2.83	3.78	20	OUTREACH—EAA to highlight existing guidance on determining best glide speed and distance for amateur-built aircraft.
1.30	2.83	3.67	21	TRAINING—Revise/update appropriate training material (including, but not limited to, Pilot's Handbook of Aeronautical Knowledge (PHAK) and AFH) to include recognition of loss of engine power as a result of turbocharger failure and appropriate action items.
1.33	2.67	3.56	22	TRAINING—Improve FAA inspector training in the area of accident investigation. POLICY—Expand test program in FL to station an investigator at each Flight Standards District Office (FSDO); FAA implementation of national aviation safety inspector (ASI) program. Specialized FAA ASIs for accident investigation.
1.25	2.83	3.54	23	OUTREACH—SURVIVAL—FAA/industry to encourage pilots to attend FAA-sponsored pilot survival training in Oklahoma City (Airman Education Program: Basic Survival Training). (The training is free of charge.)
1.41	2.50	3.53	24	OUTREACH—FAA to review, continuously update, and improve wide dissemination of FAA−H−8083−19A (GA Information Guide: "Plane Sense") to include safety management system (SMS) concepts to the GA community.
1.18	2.83	3.33	25	TECHNOLOGY—FAA/industry to encourage the broader use of solid state ignition systems.
1.17	2.83	3.31	26	TECHNOLOGY—Improve data that is housed within the NTSB docket. NTSB should work with party members to improve the data that goes into their final report. Promote combined database (FAA−KC presentation: SDRs, MSAD, NTSB, etc.).
1.32	2.50	3.29	27	RESEARCH—FAA/industry/academia study on recurring education of A&P and IAs. TRAINING—Implement results of study into education programs.

Intervention Rating Assignment				
OE	**F**	**OE x F**	**IS No**	**Intervention Strategy (IS)**
1.16	2.83	3.28	28	RESEARCH—Academia to research how to best teach pilots to select suitable emergency landing areas and implement results of the study. OUTREACH—ADM—FAA/industry to conduct outreach campaign to pilots on emergency procedures including, but not limited to— A. Ditching an aircraft. B. Engine out procedures. C. Field selection including wind considerations. D. Stall avoidance. E. Energy management. OUTREACH—Potential to bring the expertise of glider pilots to the greater population of pilots (powered aircraft). Outreach specifically to CFIs on the importance of conducting an effective flight review; emphasis on, but not limited to, 2 and 3 above.
1.07	3.00	3.20	29	OUTREACH—ADM—FAA/industry outreach campaign on need for ADM with emphasis on, but not limited to— A. Engine maintenance. B. Monitoring engine performance.
1.17	2.67	3.11	30	POLICY—FAA to reduce regulatory barrier to encourage installation of supplemental, nonrequired, engine monitoring technology for part 91 operations/GA aircraft (similar to current EASA component list).
1.00	2.83	2.83	31	RESEARCH—FAA to evaluate effectiveness of MSAD procedures in identifying problems with components across multiple OEMs and across multiple certification offices. TECHNOLOGY—FAA to improve any discovered deficiencies.
0.94	2.83	2.67	32[9]	OUTREACH—Educational outreach by FAASTeam/industry/PAMA to mechanics, owners, and operators on criticality of following documented powerplant maintenance procedures and complying with manufacturers' recommendations and guidance materials (service bulletins (SB), service letters (SL), service instructions (SI), etc.). OUTREACH—FAA to increase emphasis on engine system knowledge for pilot/operator.
0.91	2.83	2.58	33	POLICY—FAA should review current standards and ensure all airports are free of aboveground obstacles in immediate airport environment (AC 150/5370–10G).

[9] Red border represents Mendoza Line.

Intervention Rating Assignment				
OE	**F**	**OE x F**	**IS No**	**Intervention Strategy (IS)**
0.83	3.00	2.50	34	RESEARCH—FAA/industry to research feasibility of incorporating UV wear indicator on seatbelts. This would alert the mechanic to change the seatbelt when belt has been worn/faded past a certain point. TECHNOLOGY—Industry to incorporate existing/developed products.
0.83	3.00	2.50	35	TECHNOLOGY—FAA/industry to develop a red flag suction cup to display in the windscreen to designate maintenance in progress. OUTREACH—Distribute at various tradeshows to pilots and mechanics along with a checklist for usage.
0.86	2.83	2.43	36	OUTREACH—EQUIPMENT—FAA/industry/manufacturers to educate owners/operators on proper use of engine monitors and value of engine monitor in troubleshooting potential engine problems.
0.80	3.00	2.40	37	RESEARCH—FAA/industry to research industry best practices involved with maintenance procedures regarding operator/mechanic communication. OUTREACH—Trade associations (EAA, PAMA, AMT, AOPA) to develop outreach opportunities for the aviation maintenance community based on best practices.
0.83	2.83	2.36	38	RESEARCH—Academia to research best practices on how to crash an airplane and proper ditching techniques. OUTREACH—CFIs to teach proper decisionmaking when impact is imminent. Emphasize the dangers of impacting the ground stalled versus crashing under control even if terrain/obstacles are adverse. Help pilots understand the crashworthiness of their particular aircraft.
0.83	2.83	2.35	39	OUTREACH—FAA/industry to provide GA community with examples of accidents with neglected airplanes and recommend best practices on extensive static ground run-ups and/or test flight for aircraft that have been out of annual or not been used for an extended period of time.
0.93	2.50	2.31	40	GUIDANCE—FAA/industry to emphasize the importance of pre-takeoff passenger briefings in guidance to include flight risks, emergencies, and post-crash survival.
0.79	2.83	2.24	41	OUTREACH—FAA/industry outreach campaign emphasizing following topics regarding emergency procedures: A. When to declare an emergency. B. Stress the importance of reviewing emergency procedures thoroughly before flight, special emphasis on review before Mx test flights. C. Emergency checklist review during biennial flight review (BFR), including supplemental information to CFIs. D. Educate PIC responsibilities, including proper communication with ATC in the event of an emergency.

Intervention Rating Assignment				
OE	**F**	**OE x F**	**IS No**	**Intervention Strategy (IS)**
0.83	2.67	2.22	42	RESEARCH—FAA/industry to examine processes for issuing ADs with respect to timing and importance. POLICY—FAA to improve any discovered deficiencies.
0.83	2.67	2.22	43	GUIDANCE—Change pilot training via the Handbook of Aeronautical Knowledge and FAA guidance to include power-off stall entry and recovery (with no power). TRAINING—Instructors encouraged to practice power-off stall recovery (with no power). OUTREACH—Inform instructors that the PTS are the minimum standards and encourage them to teach this procedure (with no power).
0.76	2.83	2.16	44	OUTREACH—FAA and industry to educate operators, mechanics, and pilots on the importance of time between overhaul (TBO) and the importance of timelines on regular Mx (50 and 100 checks), including supplemental information to IAs.
0.71	3.00	2.12	45	OUTREACH—ADM—FAA/industry outreach campaign on need for ADM with emphasis on preflight planning. Special emphasis on importance of resolving maintenance discrepancies before flight.
0.73	2.83	2.07	46	RESEARCH—FAA to research feasibility of incorporating emergency procedures and limitations contained in supplements into appropriate section of Pilot's Operating Handbook (POH). GUIDANCE—Incorporate changes.
0.76	2.67	2.03	47	FINANCIAL—Encourage insurance carriers to provide incentives— A. To owner maintaining the asset in accordance with federal regulations including type design. B. For adherence to recommended overhaul periods. Insurance industry should be encouraged to share data as well.
0.69	2.83	1.97	48	OUTREACH—FAA/industry to create and/or promote a product on “how to survive an airplane crash” covering crashworthiness/survivability.
0.88	2.17	1.91	49	INDUSTRY—Develop, review, and implement terminating actions which eliminate repetitive inspections in SBs (where feasible).
0.67	2.83	1.89	50	OUTREACH—FAA/industry campaign to recognize point of takeoff abort, aircraft orientation with remaining useable runway, discontinued operation (V_r).

Intervention Rating Assignment				
OE	**F**	**OE x F**	**IS No**	**Intervention Strategy (IS)**
0.66	2.83	1.86	51	OUTREACH—ADM—Outreach program to GA stakeholders (including pilots, family, etc.) to encourage a "see something, say something" mentality, including, but not limited to, hotline to appropriate party and presentations to stakeholders highlighting risks of flying with a poor personal safety culture. Special emphasis on CFI roles and responsibilities to safety.
0.69	2.67	1.85	52	GUIDANCE—Manufacturers include inspection criteria for engine cylinder head temperature (CHT) and oil temperature exceedances.
0.78	2.33	1.81	53	TECHNOLOGY—Manufacturers to develop advanced diagnostic tools for detecting impending engine component failures.
0.59	3.00	1.78	54	OUTREACH—FAA/industry to promote pilot utilization and membership in EAA's Flight Advisor Program.
0.63	2.83	1.77	55	POLICY—FAA to increase oversight by Principal Maintenance Inspector (PMI) when mandatory SBs are issued.
0.60	2.67	1.60	56	OUTREACH—FAA/industry to put emphasis on the use of approved parts for owners, operators, pilots, and MX (AC 21–29C CHG2). FINANCIAL—Encourage insurance carriers to review policy language in relation to owner maintaining the asset in accordance with Federal regulations, including type design.
0.56	2.83	1.57	57	OUTREACH—All MX personnel should be made aware of the importance of a thorough inspection and the risks involved by not doing so or in using incorrect parts. Include training for IAs specifically. OUTREACH—Type clubs/industry associations to distribute information involving accidents caused by failure of parts not typically inspected; recommend periodic observation/maintenance as required.
0.54	2.83	1.54	58	OUTREACH—Builder (Experimental) outreach program to be aware of technology applications that would result in a high power setting sufficient for flight; e.g., fuel control spring (14 CFR §§ 23.1143(g) and 23.1147(b)).
0.54	2.83	1.53	59	RESEARCH—FAA/industry to examine feasibility of throttle default to higher power setting (see new one on mixture control).
0.54	2.83	1.52	60	OUTREACH—FAA/industry to reinforce importance of filing malfunction or defect reports (M&D) and their distribution to appropriate parties.
0.53	2.83	1.51	61	OUTREACH—FAA/industry to emphasize the importance of properly following checklist procedures.

Intervention Rating Assignment				
OE	**F**	**OE x F**	**IS No**	**Intervention Strategy (IS)**
0.50	3.00	1.50	62	OUTREACH—FAA/industry to develop training aids/inspection tools for pilots to use during pre-flight inspection to better identify propeller damage (e.g., tap test). Guidance should provide next steps on what to do if damage is discovered.
0.54	2.67	1.44	63	GUIDANCE—FAA and industry to develop guidance regarding objective, third-party testing. OUTREACH—Encourage all users to be more proactive regarding evidence of possible imminent component failures.
0.49	2.83	1.40	64	OUTREACH—FAA/industry outreach campaign emphasizing following topics regarding maintenance practices: A. Recommend that a second qualified individual verify all parts are properly torqued/safetied before return to service following maintenance. B. Promote the value of conducting Spectrometric Oil Analysis Program (SOAP) and filter checks to owner/operators and mechanics. C. Emphasize that during annual inspection, the condition of all safety wires/pins/anti-tamper devices should be verified. D. Emphasize proper maintenance log entries and capturing all work performed, including importance of IA review of historical log records to ensure airworthiness (14 CFR § 91.417).
0.49	2.83	1.39	65	OUTREACH—EAA to reach out to its members emphasizing the importance of powerplant design intent and the risks involved with modifying original design.
0.51	2.67	1.37	66	OUTREACH—MAINTENANCE—FAA/industry to encourage the use of supervisory/mentorship programs for newly certificated IA and/or A&P mechanics.
0.48	2.83	1.36	67	OUTREACH—Distribute cards with the “3 P” decisionmaking tool to pilots.
0.99	1.33	1.32	68	POLICY—FAA to require that all field repairs, field approvals, and Parts Manufacturer Approvals will be routed to manufacturer for engineering review and comment before approval by the FAA.
0.45	2.83	1.29	69	OUTREACH—MEDICAL—FAA/industry to encourage pilots to consult with an aeromedical expert post-medical procedure or post-medical evaluation (reference 14 CFR § 61.53), including current prescription dose schedule. TECHNOLOGY—Develop anonymous “hotline” that pilots would have access to an aeromedical expert.

Intervention Rating Assignment				
OE	**F**	**OE x F**	**IS No**	**Intervention Strategy (IS)**
0.44	2.83	1.26	70	OUTREACH—SURVIVAL—FAA/industry to encourage owner and Mx professionals to consider the effects of the operating environment when checking the restraint system.
0.42	2.83	1.18	71	OUTREACH—EQUIPMENT—FAA/industry to create outreach campaign emphasizing the importance of using or preserving powerplant equipment.
0.46	2.50	1.14	72	RESEARCH—Develop fuel monitoring systems that will provide awareness of fuel system abnormalities. TECHNOLOGY—Warning system alerting pilot of fuel contamination.
0.38	2.83	1.07	73	OUTREACH—FAA/industry to encourage maintenance providers/installers/inspectors (A&P/IA/repair stations)/pilots to follow manufacturer guidance on shoulder harness installations and maintenance records and recommended time interval replacement.
0.35	3.00	1.04	74	RESEARCH—Kit suppliers to study the compatibility of recommended engine-prop-airframe combinations. OUTREACH—FAA/industry to inform EAB builder/operators of potential hazards stemming from vibrations due to engine-prop-airframe combinations.
0.35	2.83	1.00	75	OUTREACH—Encourage maintenance community to send feedback to manufacturers, particularly as it applies to omitted/unclear instructions.
0.35	2.83	1.00	76	OUTREACH—Industry, specifically trade associations and type clubs, to perform outreach to owners/operators regarding obtaining and maintaining required maintenance records, back to the origin of the product if possible. Special emphasis on experimental and home-built community.
0.37	2.67	0.99	77	POLICY—Quality control process and procedures to include supplier audits. Potential Manufacturing Inspection District Office (MIDO) oversight of frozen processes/audit.
0.33	2.83	0.93	78	OUTREACH—ADM—Outreach campaign to pilots/owners/operators considering maintaining their own aircraft and engaging in hazardous behaviors (highlighting risks and common pitfalls), the effect a loss will have on family members and friends.
0.46	1.83	0.85	79	RESEARCH—FAA/industry determine appropriate individual with required level of authorization for monitoring run-up and departure of ferry flight. POLICY—Designee required to monitor the run-up and departure of the ferry flight. Flight manifest required at time of ferry flight application. Flight plan required to be filed for all ferry flights.

Intervention Rating Assignment				
OE	**F**	**OE x F**	**IS No**	**Intervention Strategy (IS)**
0.56	1.50	0.83	80	GUIDANCE—FAA/industry to identify alternative components when replacement parts are not available.
0.33	2.50	0.83	81	POLICY—For new type designs, FAA to introduce life limitation on webbing and require re-webbing of restraint system after determined appropriate time.
0.31	2.67	0.83	82	POLICY—FAA should be responsible to monitor Continued Operational Safety (COS) (issuance of SB's and ADs) of their OEM parts and aftermarket parts which are identically approved and notify the appropriate part manufacturer(s) of potential safety issues.
0.30	2.67	0.81	83	GUIDANCE—FAA/industry to develop and provide improved guidance on how to assess fitness for flight following major medical events.
0.30	2.67	0.81	84	RESEARCH—CAMI to research Medical Examiner (ME) selection process. OUTREACH—CAMI to share discoveries and stress importance of followup on all precursors.
0.25	2.50	0.63	85	GUIDANCE—FAA/industry to develop a common taxonomy on Service Bulletin levels of criticality.
0.20	3.00	0.60	86	RESEARCH—Manufacturers to evaluate and improve effectiveness of their maintenance instructions.
0.17	2.83	0.47	87	OUTREACH—FAA/industry to promote awareness/use of programs such as CFI Gold Seal Program and WINGS Program.
0.17	2.83	0.47	88	OUTREACH—Training on available options to owners/operators regarding sharing best practices with aircraft ownership, purchasing, maintaining (i.e., FAA–H–8083–19A: "Plane Sense").
0.13	3.00	0.39	89	OUTREACH—Manufacturers should be encouraged to ensure suppliers/vendors follow manufacturer specifications when supplier changes occur.
0.13	2.17	0.29	90	POLICY—Regulator to require the following for seatbelts and/or seat parts: A. Testing of technical standard order (TSO) seatbelt and seat parts in aircraft type. B. Mandatory life limits on seatbelts in high risk aircraft.
0.08	2.67	0.22	91	RESEARCH—Incorporation of vision improvement and fire detection/suppression systems in piston aircraft. OUTREACH—EQUIPMENT—Remind pilots that smoke and fire impairment risks exist and that there are products available to assist in those situations.
0.06	2.83	0.17	92	TECHNOLOGY—Create and promote a mobile application (app) to advise pilots of drugs that can degrade pilot skills.

Intervention Rating Assignment				
OE	F	OE x F	IS No	Intervention Strategy (IS)
0.00	2.50	0.00	93	GUIDANCE—FAA to emphasize mechanical discrepancies and the importance of corrective action in PHAK. TRAINING—FAA training providers to emphasize mechanical discrepancies and the importance of corrective action in training materials.
0.00	3.00	0.00	94	GUIDANCE—Provide the NTSB with a SME repository that will assist them in selecting individuals that have expertise in areas that will assist in the investigation.
0.00	3.00	0.00	95	GUIDANCE—Reinstate AC 43−16A, General Aviation Maintenance Alerts.
0.00	2.83	0.00	96	GUIDANCE—SAIB on powerplant failures to encourage owners to not fly aircraft out of annual. Highlight risks using historical accident data.
0.00	2.83	0.00	97	OUTREACH—FAA/industry to encourage use of low-cost borescope equipment for internal visual inspection (CONTINENTAL MOTORS SB−03−3).
0.00	2.83	0.00	98	OUTREACH—FAA/industry to provide incentives for attendance at safety events, such as FAASTeam outreach.
0.00	2.33	0.00	99	POLICY—Improve the FAA's ability to enforce regulations regarding flying an aircraft out of annual inspection. FINANCIAL—Rather than a certificate action, fine offenders.
0.00	2.83	0.00	100	RESEARCH—Create a program to educate owners on the benefits of replacing/refurbishing cylinders. Possibly include incentives.
0.00	2.00	0.00	101	RESEARCH—Develop/determine what sticker system programs exist that would show whether an aircraft has had its annual. Develop/determine how to implement this program nationwide. Determine if there are any existing programs that this could be coupled with. Determine appropriate locations for sticker. TECHNOLOGY—Implement nationwide program.
0.00	2.67	0.00	102	RESEARCH—Explore wire-marking/illumination technologies to aid identification of wire obstructions in critical locations.
0.00	2.83	0.00	103	RESEARCH—When engine monitoring technology is used, assess feasibility of providing any/all of the following: A. Recommendations on Mx intervals based on cycles. B. Lifetime assessment on discs/blade/hot section components for high cycle operations. C. Lifetime assessment on cylinder components looking for wear and fatigue in terms of thermal cycling.
0.00	3.00	0.00	104	TRAINING—Incorporate manufacturer replacement requirements on restraining system in IA renewal program.

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Appendix I. SE Development Methodology

The SCF−PP Working Group developed 10 SEs, which were presented to the SAT in February 2015. The SAT undertook an effectiveness assessment of the 75 randomly selected SCF−PP accidents. The scores developed during this assessment were used as an additional tool for the GAJSC's decisionmaking process on which SEs would be assigned resources for implementation as part of the FAA Industry GA Safety Plan.

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Appendix J. Event Sequence Spreadsheet Example

Event/Data Point	Problem (What)	Contributing Factors (Why)	SPS No.	Standard Problem Statement	P_1	A	IS No.	Intervention Strategy	P_2	C	Power	OE
MIA02FA131 Randy (HOLD FOR DOCKET)												
Corrosion found on steel components including the crankshaft, camshaft, and accessory gears. Bearing surfaces were heavily embedded with dirt and particles.	Engine had exceeded the manufacturer's recommended 12-year overhaul period by 11 years. Potential for foreign object debris (FOD)/ Excessive-wear-related engine failure.	Lycoming Service Instruction No. 1009AQ indicates that the O–320 Series engine should be overhauled after 2000 hours time in service or within 12 years.	NEW	Owner—failure to follow manufacturer recommended guidelines on TBO.	5	4	NEW	OUTREACH—Training campaign on the importance of TBO, including supplemental information to IAs.	2	1	2.9	0.3
Failure to replace old style exhaust valve (pre-'84) with new style valve IAW Lyc MSB 240W.	Resulted in excessive in-service wear of exhaust valve guide/stem clearances.	Maintenance requirements of Lycoming SB 388C and SI 1485 not fully performed.	86	AIRCRAFT—Required maintenance inspections not performed (A2.5).	5.5	2.5	NEW	OUTREACH—Trade associations and type clubs perform outreach regarding required maintenance to owner/operator.	4	1	4.6	0.3

Event/Data Point	Problem (What)	Contributing Factors (Why)	SPS No.	Standard Problem Statement	P_1	A	IS No.	Intervention Strategy	P_2	C	Power	OE
A failed exhaust valve damaged the piston when the valve tulip separated from the valve stem rendering the cylinder inoperative.	Intake valve in cylinder #4 had worn beyond in-service tolerances.	The 400-hour inspection on July 2, 1999, should have included replacement of the martensitic stainless steel exhaust valve with the new nickel-based super alloy valve assemblies.	86	AIRCRAFT—Required maintenance inspections not performed (A2.5).	5.5	2.5	NEW	OUTREACH—Trade associations and type clubs perform outreach regarding required maintenance to owner/operator.	4	1	4.6	0.3
Loss of engine power.	Failure of cylinder #4 exhaust valve.	Bell-mouthing of valve guide resulting in excessive clearances and valve failure.	84	AIRCRAFT—Powerplant malfunction (A1).	6	1.5	NEW	OUTREACH—Training campaign on the importance of TBO, including supplemental information to IAs.	4	1.5	4.8	0.3
Emergency descent and forced ditching of aircraft in the Everglades.	AC nosed over in 5 feet of water,	Due to engine failure.	NEW	PILOT—Emergency checklist procedure was not followed.	5	2	NEW	OUTREACH—FAA/industry campaign on the importance of emergency checklist review during BFR, including supplemental information to CFIs.	5	2	5.0	0.6