Four Decades of Commitment To Aviation Maintenance Safety

Anniversary Editorial

by
Robert A. Feeler
Editorial Coordinator

This issue of the *Aviation Mechanics Bulletin* marks the 40th anniversary of the publication. The bulletin was begun by Joe Chase in 1953 and he continued to serve as editor until his retirement in 1972. Elmer Buckthal was named editorial coordinator in 1975. He was succeeded by Robert B. Phillips in 1981 and I assumed this responsibility in January 1991.

Chase died on Dec. 11, 1972. The Joe Chase Award, established by his wife, is administered by the Flight Safety Foundation and the recipient is selected by the Professional Aviation Maintenance Association (PAMA). An award has been made to an outstanding aviation mechanic each year since 1973.

Chase's efforts to foster the education, recognition and integrity of those who had chosen aviation maintenance as a profession earned him many awards and worldwide recognition. He became known throughout the industry as "the champion of the forgotten man, the aircraft mechanic."

Reference resources credit Joe Chase with adapting "Murphy's Law" to aviation. According to the *Oxford Encyclopedia*, Murphy's Law is said to have been invented by George Nichols in 1949 when Nichols was a project manager working for Northrop Corp. in California. Nichols is said to have developed the maxim from a remark made by a colleague, Capt. E. Murphy at the Wright Field Aircraft Laboratory. Chase's adaptation, "If an aircraft part can be installed incorrectly, someone will install it that way," first appeared in the *Aviation Mechanics Bulletin* in the 1955 May/June issue.

Chase was also the author of the "Mechanic's Creed" (back cover of this bulletin).

He made it a point to travel throughout the United States to visit with mechanics where they worked. I remember his visits to my first employer, Lake Central Airlines, in Indianapolis, Indiana, during the late 1950s and early 1960s. Chase was, indeed, the spokesman of the profession, and did more to advance the integrity and recognition of aviation mechanics than any other individual before or since.

Portrait of a Patron

Most of the Foundation's activities and awards are sponsored and supported by businesses or professional organizations. The Joe Chase Award, however, was founded by a donation from Chase's widow, Katherine, in 1973. She continued to contribute to the endowment each year until her death several years later.

After Katherine Chase died, the contributions were continued through the generosity of Ms. Elizabeth Clymer, a close friend of Joe and Katherine Chase. She said she admired the dedication and perseverance Joe displayed in promoting the recognition of aviation mechanics and their role in ensuring airplane airworthiness and flight safety.

Clymer is a delightful person, now retired in Connecticut after 40 years of teaching French in a private girls' school in New York City. She spends the winter months in Connecticut and the summer months at her cottage in Vermont, which overlooks the home where Joe and Katherine lived for many years.

Her only interest in aviation resulted from her acquaintance with Joe and Katherine, yet she continues tosupport the Joe Chase Award endowment each year. This dedication and recognition of friendship exemplifies the principles and standards for which Chase was so well known.

The Foundation and the aviation industry appreciate this generous support. It seems especially fitting that this "unknown" person is providing the means to recognize the aviation mechanic, whom Chase characterized as "the forgotten man of aviation." Speaking for these technicians, I salute Elizabeth Clymer.

Robert A. Feeler

The first issue of the *Aviation Mechanics Bulletin* began with an editorial dedicated to mechanics. This stated the Foundation's goals in creating this special publication. The first editorial and several other articles written by Chase (and guest authors) are reprinted in this issue. We think you will find them as pertinent today as when they first appeared 30 to 40 years ago. ♦

Broaden Selection of Award Recipients

For many years, the Joe Chase Award was presented at the Flight Safety Foundation's annual Corporate Aviation Safety Seminar (CASS), but since 1991, the venue for the presentation has been the annual Professional Aviation Maintenance Association (PAMA) annual Aviation Maintenance Symposium and Trade Show, where the award recipient can be recognized by a larger gathering of his or her peers. Because Joe Chase and PAMA (whose directors constitute the selection committee) were closely identified with corporate aviation activity in the U.S., and the period of history when the award was established, the awards have been made predominantly to U.S. technicians.

Discussions are underway between FSF and PAMA about considering the worldwide aviation maintenance community when selecting award recipients. In view of efforts to strengthen common international standards and to encourage harmonization, this recognition of all professional maintenance technicians will be in keeping with Chase's untiring commitment to the persons "whose knowledge, craftsmanship and integrity form the core of air safety."

Walter A. Seymour Named 1993 Joe Chase Award Recipient

Walter A. Seymour was named the recipient of the prestigious Joe Chase Award at the Professional Aviation Maintenance Association (PAMA) annual Aviation Maintenance Symposium and Trade Show in New Orleans, Louisiana, U.S., on Feb. 17, 1993. Robert A. Feeler, editorial coordinator for the Flight Safety Foundation's *Aviation Mechanics Bulletin*, presented the plaque and honorarium, which was funded first by the late Mrs. Joe Chase and later by friends of the Chase family.

Photograph not available.

Walt Seymour (L), 1993 Joe Chase Award recipient, and Robert Feeler, AMB editorial coordinator, who presented the award during the annual PAMA Trade Show.

Preceding the presentation, Feeler took a few moments to recall Chase's contributions to the aviation technician's profession and noted that this year marks the award's 20th anniversary.

Seymour is employed by Enron Corp. at its Houston, Texas, U.S., base of operations. He was cited by his peers for his dedication, integrity and unstinting devotion to safety during more than 42 years in aviation maintenance. Seymour is known by his fellow workers as one who freely shares his knowledge and experience, and has served as a mentor to others just beginning their careers in aviation maintenance.

Seymour was also praised for his creativity and ingenuity in developing special tools and equipment to complete difficult mechanical tasks.

Although he is a modest and very private person, those working with him remember his clear thinking and

Previous recipients of the Joe Chase Award are:

1973	William Collister U.S. Steel	1983	Matt F. Mathews Marathon Battery Co.
1974	Daniel S. Angstadt Chicago Helicopter Airways	1984	David Emison Superior Oil Co.
1975	Max Beitscher Airwork Corp.	1985	J. Doug Connolly Aviall
1976	Joseph B. Fredd Atlantic Aviation	1986	J. C. Meador Texas Eastern Transmission
1977	Richard C. Wartinger Dayton Aviation	1987	Frank Del Gandio Federal Aviation Administration
1978	Arch T. Reed Hanna Mining Co.	1988	Glenn L. McCauley Aero Battery Co.
1979	John G. Hite Atlantic Aviation	1989	Forrest Jones Heli Lift Co.
1980	Jules de Crescento Federal Aviation Administration	1990	Emil John Krumal Philip Morris Services
1981	James W. Brier Parks College of Aeronautics	1991	Michael Arsics Arsics Associates
1982	Gerald L. Weems National Distillers	1992	William H. Rhodes Retired instructor

quick actions, which were instrumental in saving several aircraft and a hangar facility during a serious fire. He directed the removal of undamaged aircraft from the hangar and then returned to the hangar to tow the burning aircraft to a safe location. His concern for others and devotion to his work have served as an inspiration to many, including two of his sons who have elected to follow him in his elected profession.

Walter A. Seymour exemplifies those qualities commemorated by the Joe Chase Award, and the Flight Safety Foundation is proud to add his name to the roll of honorees. ♦

Editor's Note: Following is a selection of editorials published in the Aviation Mechanics Bulletin *during its early years. Although some of the comments are directed to U.S. technicians, the messages are universal.*

Editorial — For Mechanics

(May/June 1953)

This is the first issue of the *FSF Aviation Mechanics Bulletin*, a publication beamed to the aircraft and engine mechanic. Our chief interest is safety, for our aims and purposes are those of the Flight Safety Foundation. But our special interest is the mechanic. That is because we know of no other single factor more important to air transportation.

So if you are a mechanic this is for you, written for you and dedicated to you. It will bring you information you might not see otherwise, reprints and condensations of articles from the technical journals ordinarily available to only a few. It will bring you lessons learned from the study of mechanical difficulties, of failures and fires, lessons which concern you and your job but which too often do not reach you.

It won't be a news magazine, but it will carry announcements of awards to mechanics and citations for significant achievement. It won't fight your battles. Instead it will stick to its own business of increasing safety by increasing knowledge and understanding and craftsmanship.

We start out proudly. Not that we confuse our importance with your importance. No one can share your portion of the final responsibility for air safety. But we are proud of our assignment, and we are proud to be working with you on a job that is as important as life itself. ♦

Joe Chase

Mechanics Linked with Airline Executives

(January/February 1954)

"Beyond all technical advances and more important than any of them in achieving safety has been the organization ability of airlines' executives and the dedicated spirit of aviation personnel, especially mechanics."

"Aviation Makes Big Strides in Safety"
Jerome Lederer in
The Weekly Underwriter

About Security

(March/April 1954)

In January, employees at a factory in England were asked by the management to stop work for a full minute each day for a week to search for anything likely to cause an accident.

In this country, the Flight Safety Foundation left three-fourths of a recent bulletin blank, suggesting that subscribers use the reading time saved, for the study of problems still unsolved.

It is intriguing to conjecture what might happen if all aviation mechanics followed this pattern, if we stopped our regular activities for a moment or two to think constructively about our jobs and about ourselves. It might bring us security.

We could find and avoid most of the unsafe acts and the unsafe conditions that account for our physical injuries. That would constitute security. We could recognize and correct the faulty procedures which permit the extravagant but tolerated abuse of equipment. That would constitute security.

And in the realm of job satisfaction, thought would bring the realization that full security lies, not in having someone else look after us, either the state or the union or the company, but in our freedom to exercise the qualities that are always in top demand and too often are in short supply.

Some of these qualities are integrity, as men and as craftsmen; friendship,

long set forth as the Golden Rule; dignity; and the willingness to grow, to accept new ideas. The freedom to exercise these qualities is not a matter of chance or luck. It does not depend upon education or position or special privilege. It is not limited to the few. It is one of our inalienable rights and it is always as available as the freedom to think.

If security is worth thinking about, let's stop and think. ♦

Joe Chase

Habit

Guest Editorial
by
Norman G. Shidle, SAE Journal
(May/June 1954)

Most of us would be further along if we spent more time getting into habits and less time trying to get out of them.

The very word "habit" has come to have a slightly unsavory connotation. We tend to be apologetic about having one. Ten people are trying to get rid of some bad habit for every one who is busy trying to establish a good one.

Getting good habits is more rewarding than ousting old ones if only because it focuses minds on constructive pursuits. Getting a good habit betters something already good. Spend enough time that way and the bad habits often vanish automatically. Make a habit of being on time and that old habit of arriving late no longer exists. Make a habit of speaking pleasantly to everyone and that old habit of growling ceases to exist. Start giving the other fellow more than half the road and that old habit of crowding other cars becomes a nothingness.

Habit can be a vital, constructive force. It can take care of hundreds of daily decisions. It has to or we'd have time for nothing but trivialities. The best way to get freedom to do what we really like to do is to put more actions under such automatic control that we don't have to spend time discussing them. "What a waste of time and energy," Dr. Ralph Sockman said the other day, "if we

men debated every morning with ourselves whether we should shave or what train we would catch to business!" Such things we reduce to fixed habits and thus free our minds for bigger choices.

Instead of apologizing for our habits, we had better get habits which need no apologizing for. "Mind the Light" is a more productive motto than "Avoid the Darkness." ♦

Mechanics

Guest Editorial
by
C.R. Smith, President, American Airlines
(March/April 1955)

We are told that after the Pilgrims had landed at Plymouth Rock, had looked over the job to be done and had evaluated their resources in personal skills, they promptly returned word to the old country, "Please send us some mechanics, they are needed."

The mechanics came, and took their rightful place in the life and prestige of the community. They devoted their interest, experience and skills to the tasks at hand. Their contribution was a major one, and the small settlement that was the beginning of the great nation we now know as the United States was on its way to ultimate success.

The mechanic aided in winning this country. He also aided in preserving it, twice during our lifetime, first in World War I and again in World War II, the security of our nation was preserved. By the courage and valor of its citizens, of course. But also, in a very major way, by the productive capacity of the nation.

That productive capacity stems directly from the cumulative genius of the American mechanic, engineer and scientist. Without their creative ability, the American industrial machine would never have been developed. Without the continuing availability of their day-to-day ability as mechanics the American productive machine could not be maintained.

In air transportation, the contribution of the mechanic has been uniquely constructive. When the panorama of pioneer aviation is painted, the promi-

nent spot of the foreground will be shared by the builder of the airplane, the pilot, and the mechanic whose skillful attention has permitted the airplane to be flown with safety.

When the young man at school says "My father is a mechanic," pay attention; he is descended from a line which has contributed much to the history of this country. ♦

"Backward" Mechanics Prove Murphy's Law

(Murphy's Law: If an aircraft part can be installed incorrectly, someone will install it that way.)

(May/June 1955)

Aileron Trouble.
During takeoff the right wing went down and the efforts of both pilots plus full left aileron trim were required to keep the aircraft straight. The aircraft was climbed to 15,000 feet and the aileron controls turned on and off without power control returning to either aileron. After about five minutes, both ailerons operated normally.

At 300 feet on the final approach the right aileron power control again malfunctioned, and manual operation required both pilots and full aileron trim.

Investigation revealed that the cover seal of the filter assembly on the right aileron power control unit had been changed because of a leak. The hydraulic specialists had removed the strainer assembly and replaced it up-side-down. The cover was overtorqued, mashing the screen and restricting pressure and flow to the power control unit.

Landing Gear Switch.
After the nose gear came off the ground during the takeoff roll, the pilot felt the aircraft skid to the right and drop. He pulled the aircraft into the air and at the same time looked at the gear switch. It was in the "down" position. About this time it was observed that the gear was coming up. The pilot tapped the brakes and called for "gear up." When the co-pilot put the gear switch in the "up" position, the gear came back down. He then returned the switch to the "down" position and the gear came up.

A safe landing was made after the gear was again lowered by putting the switch in the "up" position, and manually checking the position of the gear.

A review of the maintenance records revealed that a retraction test had been run with the gear switch removed from its receptacle. Afterward the switch was installed backwards.

Aileron Trim Reverse - This Time on a Bomber.

A four-engine bomber could not be trimmed properly with the aileron trim. The Preflight check was satisfactory and no trim was required for takeoff and climb. During flight it was found that the opposite aileron trim gave the results desired. Ground examination of the system showed that the aileron centering spring was installed 180 degrees off. ♦

Joe Chase

A Matter of Privilege

(July/August 1955)

The aviation mechanic is so often reminded of his duties and responsibilities that it is pleasant to pause and remember our many privileges.

One of these privileges is exemplifying so well the craft and the craftsmanship we represent that we can stand in the penetrating light of self-examination and be proud.

Another is to exercise the cool, detached, unhurried and unflurried judgment of the man who knows his job beyond doubt or question.

Working pleasantly with others is a privilege. So is working safely, to the end that everyone finishes his shift sound of wind and limb and fit to work another day.

It is a privilege to provide a truly great service to the public. The aviation mechanic does that to an unusual degree. He also contributes much to the nation's strength, for which we can all be glad.

It is our prerogative to demonstrate respect for law and authority, whether it be labelled the CAR or company procedures or the rights of others. Perhaps it is the craft-wide conformity to principle that engenders such universal respect for the mechanic.

And it is our privilege to enjoy the work of our choice.

It would seem that our privileges greatly outweigh our duties. ♦

Joe Chase

Doubling Our Living Time

(May/June 1956)

The mechanic who finds most of his satisfaction in life between the time he "punches out" at the hangar and the time he falls asleep is truly alive only now and then. If he isn't "really living" until sometime after work, he hasn't much opportunity to enjoy the fruits of his labors. Add up his travel time, his sack time and his hours at work and you come up with a rather startling fact. During more than two-thirds of his day he is *waiting* for happiness! Of course, while he is *waiting* for happiness he hasn't got it.

The way out of this limited and restricted and restrictive experience is to realize that we are rewarded, not *for* what we do, but *by* what we do.

The reward for fine craftsmanship is the skill to perform even more intricate and exacting tasks. The reward for integrity and reliability is still greater trustworthiness. The prize for being courteous and friendly and helpful is that one grows more courteous and friendly and helpful.

The way to more than double our living time is to quit postponing our rewards until after work, and to experience throughout each shift the full satisfaction of the job at hand. ♦

Joe Chase

Pilots and Mechanics Face New Training For Prop-jet Transports

by

B. A. Martin, Chief Pilot

Georgia Division, Lockheed Aircraft Corp.

(July/August 1957)

Martin introduced the Lockheed C-130 Hercules at a luncheon meeting of the Wings Club, New York City. Much of what he said concerned the operating team, the pilot and the mechanic. He has granted the Aviation Mechanics Bulletin *permission to print the following portion of his talk.*

Our airplane (the Lockheed C-130 Hercules) demands of those who would operate it, a new look at their training and maintenance methods. The free application of numerous automatic systems in the new airplane has resulted from the fact that we have lost the battle with the minute. The speed with which modern systems can change exceeds the ability of the human being to respond in an adequate fashion. A minute is too long — a half minute is too long. The automatic system is here because we have reached some of the physical limitations of the human being. The automatic system has changed our flight crew members from operators to monitors, and their training must be pointed in that direction. It will not be easier, but it will be different. The engine starting cycle is a good example.

With a reciprocating engine the pilot or mechanic operated a selector switch, operated a starter switch, operated a primer switch, operated a master ignition switch, operated an engine ignition switch, operated a throttle, and operated a mixture control. He had time, and he performed physically. At this point I would like to go along with the story, offered you by some people, that we have simplified the job of the flight crew member by making the starting cycle on our new prop-jet airplane completely automatic, but I cannot. We have an automatic starting cycle because the pilot cannot perform the necessary functions in the time allowed. The job has not been simplified —it has been changed.

The operator must now be a monitor. To start the T-56 engine the pilot's or mechanic's only physical effort is to depress the starter button which is then held in by a holding solenoid. He then becomes a monitor who understands completely the functions performed automatically. He watches the tachometer indicate that the cycle has begun. He watches the secondary pump light indicate that the fuel pumps have gone to parallel operations. He watches the flowmeter indicate that fuel enrichment has taken place in the right amount and at the right time. He watches the turbine inlet temperature gage indicate that ignition has taken place at the proper time. He watches the tachometer indicate, by its steady increase, that a compressor stall has been avoided. He watches the starter button pop out at the proper time so the starter, an air turbine, will not overspeed and explode. He watches the secondary pump light again as it goes out and indicates that the two fuel pumps are again in series. He watches the turbine inlet temperature again to see that the electronic temperature limiting device is limiting the starting temperature. He watches the tachometer again to see if he can determine that the fifth and tenth stage bleed valves closed at 13,000 RPM.

Our monitor watches all of this take place in half a minute, and there is little he can do about any part of it. It is absolutely necessary, however, that he understand each function thoroughly, for if any one of them does not take place at the right time and in the right amount, it will be necessary to stop the automatic cycle. This is generally true of all automatic systems, and it indicates the direction of training.

From now on we must develop the mental ability of the crew member and train him to be a good monitor, one of the most difficult jobs in the world. He must be continuously vigilant, alert, and ready and able to receive, interpret correctly, and act upon the information offered by every indicator in the cockpit.

The maintenance man, the other half of the operating team, has also had new demands made upon him. The growth of electricity and electronics in our modern airplane now requires that we raise substantially the level of electrical knowledge in all of the people associated with operations. To the maintenance man this means a new approach to maintenance problems and some new opportunities for the improvement of utilization.

In days now almost gone by, it took a relatively short time to find the operating difficulty and a much longer time to make the necessary repairs. Today the operating difficulties of our electrical airplane may be corrected in a few minutes by the replacement of a tube, the tightening of a terminal, the resoldering of a joint, or the replacement of a wire. But finding the difficulty now requires hours of electrical sleuthing. While the total time to find a problem and fix it has not changed much, the ratio of discovery time to repair time has grown tremendously. Therein lies the opportunity. A fascinating field of electrical and electronic trouble shooting is waiting for the vigorous attack of whoever can cut hours from the ground time and thus increase aircraft utilization. ♦

An Editorial for Supervisors
Stay Away from Pinnacles

(September/October 1957)

Some men set themselves up on little pinnacles, apart from their fellows. Pinnacles do have certain attractions. They rear their craggy heads high above the surrounding terrain. They provide an opportunity to look down on a big chunk of the world, and to enjoy being in an elevated position. They afford refuge from interruptions and annoyances and people who are hard to answer. They permit a sense of aloofness, of importance and, perhaps, of superiority.

If you see a pinnacle on your personal horizon, *detour,* because pinnacles are not for supervisors. When you are perched on a pinnacle you are not getting anywhere. But you are on a spot where you can lose your touch, where you can't reach your men and where they can't reach you.

Recently I was with a mechanic when his supervisor passed by without a glance in our direction. This supervisor is a man of vast experience and considerable achievement. I commented that it must be interesting to work with him.

"With *him?*" snorted the mechanic. "He doesn't know I'm alive, much less that I work here."

The disappointment and the hurt of being ignored was evident in his voice. Thinking to ease the pain I asked, "But isn't that better than having him on your neck a dozen times a day?"

The answer was quick and flat and unequivocal.

"No! I do my work well and it would be nice if he noticed it. Perhaps he could show me how to do it better. But he isn't interested. He doesn't even know I'm alive."

Personally I think that this mechanic is mistaken. It is probable that his supervisor knows a great deal about him and about his work. But the two *are* completely out of touch. There has been no communication down from the supervisor and none up from the mechanic.

That is the sad thing about pinnacles. Their cold and lonely heights cut you off from your men and from your job. And the knowledge that

you isolated yourself doesn't help a bit, unless you want to get down.

So stay close. Stay warm and alive. Stay knowable and reachable and friendly. Stay away from pinnacles.♦

Joe Chase

300 Days Are Less Than a Year

(March/April 1958)

We have 300 days to get ready, and the average airline mechanic is no more prepared for commercial jets than he is for Judgment Day. Actually, that is not strange, because the arrival of the jets will *be* Judgment Day for the mechanic who hasn't conditioned himself for the Big Blowhards.

To be sure, most of us are boning up on axial flow and centrifugal flow and bypass engines, on compressor stalls and on the effect of TPT (tail pipe temperature, in case you didn't know). Every airline purchasing jet equipment has committees and planners and engineers scratching their heads around the clock, so there will be experts to train us, and engines and airplanes on which we can be trained.

This is all good, but it is not enough. We must get down to fundamentals, we must *condition ourselves* by establishing work habits suitable for 1959, work habits under which we and the jets can both survive.

The area of foreign object damage to gas turbine engines highlights the point. This is an area that affects both the safety of flight and the economics of jet operation. And it is here the work habits that served us reasonably well in the past create a situation which will be totally unacceptable to commercial jet operation.

The military services have shown us the problem. An airman walked in front of a J-57 while it was being run up for trim. His cap was sucked into the intake. An emergency shutdown was accomplished but not before serious damage occurred. The cap cost less than a dollar; the cost of overhauling the J-57 was approximately $60,000.

We have almost countless incidents where the ingestion of foreign objects has caused impact damage to

compressor blades resulting in either premature fatigue failure or unscheduled, precautionary overhaul.

As is to be expected, metal objects causing engine damage are of first importance in safety of flight. Ordinarily they cause more serious damage than stones, particles of cement, wood, birds, etc. Also they are the most closely related to our work habits. A study made at the U. S. Naval Aviation Safety Center classifies them as:

(a) aircraft and engine fasteners (nuts, bolts, washers, safety wire, etc.)

(b) mechanics' tools (wrenches, pliers, etc.)

(c) extra flight line metal (nails, personnel badges, pens, pencils).

If we are to work safely on the jets we will have to work differently than we have in the past. For example, we will have to account for each nut, bolt and washer used during any phase of aircraft and engine service. We will have to dispose properly of all items replaced, including cotter keys, safety wire and clippings. This will be a tedious and time consuming job which the mechanics must take on, and which supervisors must not only accept but insist upon.

We will have to account for each tool used in the repair or adjustment of an aircraft or engine before the engine is started. In practice this means before we button up the job. A quick check of our tool boxes at shift change will not be enough. And we will have to discontinue our present habit of laying tools on some convenient part of the engine or the cowling.

We will not dare dismiss as meaningless trash any bits and pieces found in the vicinity of an aircraft. Positive identification and knowledge of their source will be essential. We have the example of a nut found on the ground and the loose bolt left in the vicinity of the engine intake section, later to destroy the engine. For most of us this will mean a radical change in our attitude toward ramp and hangar housekeeping.

We must remember that clips and buttons are not satisfactory fasteners for pencils, pens and badges worn around operating engines.

We must make it a practice to bend over and pick up any object we see that would endanger a compressor.

There is much management can and will do to lessen foreign object damage. It can arrange to have the ramps and taxiways swept, perhaps vacuum cleaned. It can provide inverting stands to shake out foreign objects when engines are uncanned. Management can require that aircraft be moved by tugs instead of taxiing.

But ultimately the solution of the problem will fall to the mechanic.

Work habits are formed over a long time. They are not easy to change. Three hundred days are an amazingly short period. We had better start now to work as though the jets were already with us. ♦

Joe Chase

Bad Apples

(May/June 1961)

This publication is increasingly dismayed over the infiltration of the maintenance ranks by people who are not aviation mechanics. We are not referring to beginners or apprentices or to experienced workers who have neglected to obtain their certificates. Neither do we mean the specialists who cannot meet the varied demands made on the mechanic. We refer explicitly to the men who draw mechanic's pay for mechanic's work but who do not think as mechanics, or work as mechanics, the men in the hangar or on the line who lack the character and integrity that make the true mechanic a justly proud and respected citizen.

We are aghast because these people are endangering lives and equipment through their sheer indifference. We are apprehensive because they appear to successfully hoodwink supervision. We are dismayed because they are damaging the fine reputation of the craft and the honest craftsman.

Fortunately, these rotten apples are few in number. They come about one to the barrel. But few as they are they are more than either we or the industry can afford. We can survive them only by the grace of God and because of good inspections that discover and nullify most of their mistakes. Let's cull them out — or convert them to our way of work.

Let's be intolerant — extremely intolerant — not of people but of wrong attitudes and poor workmanship. Let's show our distaste and disdain for carelessness, and our scorn for indifference and dishonesty. Let's make it uncomfortable for the man who tightens a leaking oil line with a 9/16 rag and frees up a binding control with a pencil. Let it be known that the supervisor who "buys" or encourages an unsafe repair has been recognized and is expendable. These people must change — or leave for jobs where their methods will endanger neither lives nor reputations.♦

Joe Chase

"They!" "They!" "They!"

(July/August 1961)

"Why don't they clamp these wires correctly and stop this chafing?"

"When are they going to get us some decent ladders?"

"Why don't they fix this test equipment?"

These aren't questions, but alibis. "They" is the most overworked alibi in the language. Unless we want to be considered alibi artists, forever explaining and excusing our failures, advertising our shortcomings and shifting to others the blame for our lack of achievement, we had better drop the word from our vocabulary.

When we ask why "they" haven't corrected a situation that disturbs us we publicly announce that we haven't done anything about it either. The proverb, "The Lord helps those who help themselves," may have originated in the horse and buggy days, but it is still true. We can never expect either "they" or the Lord to help very much until we have exhausted our own capabilities.

To get personal, take that installation you have found cumbersome, or hard to reach or subject to frequent failure. What have *you* done about it? You have figured out how it could be improved, but have you sent your solution and a sketch to engineering? Or have you shown your foreman what is needed? "They" may not even know the installation is giving trouble.

Have you tagged the ladder that is unsafe so "they" can order the repair?

Have you stopped alibiing that the test rig is a job "they" will have to do and analyzed the trouble yourself? Have you even recorded just how it acts, so "their" job will be simplified?

And about your wages. Are you waiting until "they" revise the scale, or are you qualifying yourself for a better job?

The way to achievement is to assume the responsibility for getting things done. ♦

Joe Chase

Communications: A Responsibility of the Mechanic

(July/August 1962)

It is an established custom to hold management responsible for communication within a company. We will buy that, to a point. It is definitely up to management to provide the manuals, the bulletins and bulletin boards, the news letters, the mechanicaldifficulty reports, and all the etcetera necessary for the flow of maintenance information between the segments of an aviation organization. It is also management's responsibility to create and maintain a climate conducive to good communication, an open door, an open mind. But the channels for communication and the attitudes that nurture it are only the beginning. The mechanic is responsible for making the system work wherever it touches him or his job.

Communication is much more than just a message and the method of its transmission. People are involved. An instruction or report or an idea goes from *someone to someone.* It must be received and understood or it isn't a communication. Without reception and understanding it is as devoid of meaning as a letter that isn't mailed or a radio message that isn't heard.

Here is where the mechanic becomes involved and responsible. To properly receive a communication requires a special skill. If the message is verbal one must listen actively and consciously. This is very different from standing quietly while the boss man speaks. True listening permits no mental meanderings: "This job will cut into my lunch period." "Brother, what a haircut *he's* got." Few of us can fully comprehend an instruction we have only half heard. So listening with full attention becomes a part of our job and our responsibility.

If the message is written, one must read it carefully, completely and with understanding. Suppose the message is not clear. The author is not blameless, but the man who fails to ask for and to get an explanation is the man responsible for the breakdown of the system.

Good communication is like a flight of stairs. It runs from the bottom to the top as well as from the top to the bottom. The mechanic who doesn't use this stairway, who doesn't attempt to reach management with his

ideas and suggestions, is accountable for a system that operates in only one direction.

Good communication is particularly important in our industry. Aviation cannot tolerate confusion as to purpose or method. It cannot permit misunderstanding of intention or of accomplishment. Whether or not we listen well, read carefully, ask questions, make certain we understand is largely up to us. The responsibility to do so is already ours. ♦

Joe Chase

Don't Be a Hero

(September/October 1963)

Someday it will happen to you. Someday you will be handed a job that is just a bit over your head. It may be a job you have never done before. Or something you helped with two or three years ago and haven't touched since. Perhaps it was covered in that course you took on systems, but that was back when the company got the new equipment. So you are not at all sharp on this particular job, but it has been given to you. Well, don't be a "hero."

We were recently reminded of this hero business when a friend mentioned an accident that occurred a few years ago. It was a maintenance accident, an avoidable accident in which many people died. It was set up when a mechanic accepted a job he was not qualified to do, and it was triggered when he blundered ahead without telling anyone he needed help. He might have made out, but he never opened the manual.

It is hard for us to understand this rushing in to save the day, this "hero" bit. It takes more guts to say you don't know than to clam up and hope that no one discovers it. Actually, no one expects you to know all the details of a complex airplane.

It is much easier to use the help available — the manual and the experience of others — than to stumble along alone. Why take the hard way?

No bravery is required to gamble with the lives of others. If you want to bet your own life, try drag racing or highway driving on a three-day weekend.

We have great compassion for the "heroes." They are sadly mistaken and not too bright. They are afraid to confess their weaknesses to themselves. Probably they don't sleep very well.

Don't be a "hero." Be an aviation mechanic. ♦

Joe Chase

Shortage of Aviation Mechanics Foreseen

(July/August 1964)

Aircraft maintenance as an occupational skill in the aviation industry is approaching a serious shortage of manpower, according to a [U.S.] Federal Aviation Agency [since changed to Federal Aviation Administration] (FAA) maintenance survey just issued.

The report reveals that more than half of the certificated aviation mechanics are in the age group 40 to 60, and only three percent are between 18 and 24 years old. The report also indicates that more and more aviation mechanics are discovering new job opportunities in the missile and spacecraft industry.

George S. Moore, the FAA's Flight Standards Director, said the survey "gives definite evidence that the maintenance career field offers a progressive ladder of promotion opportunities and personal achievement to qualified men who remain active in the field." But, he added, the study also shows that relatively few youngsters are being drawn to this career field. "It would seem the industry and the government are going to be hard-pressed to satisfy immediate needs for mechanics, and, particularly, to meet the critical and highly specialized requirements that face us in the decade ahead, when the commercial supersonic transport with be with us."

The problem of anticipated shortages of aviation manpower for the future requirements is of great concern to the federal government and industry. FAA Administrator N.E. Halaby recently announced the formation of a study board to investigate the problem intensively and determine ways to assure the timely availability of necessary aviation skills five, 10 and 20 years in the future.

[Editorial note: Here we are 30 years later … the more things change, the more they stay the same.] ♦

Joe Chase

Technician's Inspection Authority Suspension Upheld by NTSB Administrative Law Judge

The owner of an R4D-8 (Super DC-3) aircraft, which had been in storage for some time, found a buyer outside the United States. In preparing the aircraft for delivery, the owner hired a certificated technician to service and repair the aircraft sufficiently so that an Export Certificate of Airworthiness could be obtained. The technician, in turn, retained the services of a technician with Inspection Authority (IA) to perform an inspection and certify the aircraft airworthy following his repairs.

In the course of this work, a local U.S. Federal Aviation Administration (FAA) safety inspector became involved, and the FAA inspector performed a cursory walk-around check during which he indicated several items that should be repaired before the issuance of the Export Certificate of Airworthiness. The first technician performed the repairs during a period of several weeks, and the IA performed an inspection and certified the airplane airworthy. Based upon the IA's certification, the FAA office issued a ferry permit authorizing the airplane to be flown outside the United States.

When the ferry crew arrived to take the airplane, they were unable to start the engines and, in the course of correcting this problem, several other deficiencies were noted. The FAA inspector who had issued the ferry permit became re-involved and subsequently issued a notice of investigation that resulted in charges against the IA. The FAA charged that the IA's inspection was defective because the aircraft still had numerous deficiencies, some of which had been noted during the initial walk-around several weeks earlier, which had rendered the aircraft unairworthy. The charges resulted in a 30-day suspension of the IA/technician's certificate privileges.

The IA/technician contended that the entire certificate action should be set aside because he had no responsibility to perform an inspection under U.S. Federal Aviation Regulations (FAR) Part 43, and therefore his certification should not result in suspension. He argued that because he had performed an inspection required by Part 21, he could not be held responsible under Part 43.

This argument was found to be without merit by the U.S. National Transportation Safety Board (NTSB) law judge on the basis that FAR 91.27 prohibits any operation of an aircraft without an airworthiness certificate. For the airplane to be flown outside the United States, an inspection under Part 91 was required to comply with Part 43. In addition, the board agreed with the judge's findings that some, but not all, of the alleged deficiencies were those that the technician knew or should have known existed and that he knew or should have known would cause the aircraft to be unairworthy.

The suspension of the IA/ technician's certificate was upheld.

Zetec Offers Eddy Current Training Videos

Zetec Inc., a supplier of eddy current test equipment and services, has produced a series of video training modules designed to enhance written study materials and improve the quality of non-destructive testing (NDT) training for aviation inspectors. The video training program includes four tapes that present the material in logical modules:

- Part I — Principles of Eddy Current Testing. Covers historical background, generation of eddy currents, field intensity, current density and phase/amplitude and current/time relationships.

- Part II — Test Coil Arrangement. Covers probe coils, encircling coils, bobbin coils, absolute coils, differential coils, hybrid coils, and additional coil characteristics.

- Part III — Test Coil Design. Covers resistance, inductance, inductive reactance, impedance, Q or figure of merit, permeability and shielding effects, and coil fixtures.

- Part IV — Effects of Test Coil. Covers electrical conductivity, permeability, skin effect, edge effect, end effect, lift-off, fill factor, discontinuities, and signal-to-noise ratio.

The detailed explanation of eddy current theory and principles, and graphics demonstrations augment any training program. When accompanied by standard written materials, the videos are intended to allow the average student to develop a good grasp of the concepts and theories associated with eddy current NDT.

For the seasoned technician, the training videos serve as a quick refresher of theory and forgotten facts.

They are also valuable for supervisors and managers who may need a working knowledge of the technology. The set of four video tapes is offered with the American Society for Non-Destructive Testing (ASNT) Eddy Current Level III Study Guide and is available in VHS, PAL or Beta format.

Contact Zetec Inc., 1370 NW Mall Street, Issaquah, WA 98027-0140. Telephone: (206) 392-5316 or Fax: (206) 392-2086. ♦

MAINTENANCE ALERTS

This information is intended to provide an awareness of safety problems so that they may be prevented in the future. Maintenance alerts are based upon preliminary information from government agencies, aviation organizations, the press and other sources. The information may not be entirely accurate.

Injuries to Personnel During Push-back Operations Prompt Industry Concern

The increased frequency and severity of ramp personnel injuries during push-back operations has prompted the International Air Transport Section of the U.S.-based National Safety Council (NSC) to pass a resolution calling for safer communications.

In the four-year period from 1989 through 1992, there have been six fatalities and seven additional accidents resulting in serious injuries including the amputation of a leg. In most instances, the injury was suffered by the ramp communications person during pushbacks while connected to the aircraft by a hard-wired headset. The individuals were run over by the aircraft nosewheel or the push-back tractor.

As a result of these accidents, the NSC is recommending that communications with the cockpit be conducted from the comparative safety of the push-back tractor. This can be achieved by the tractor interphone system or an alternate backup method using an external wire cord routed from the aircraft on the towbar to the tractor.

Communications can be conducted best by the tractor driver who has control of the aircraft movement; this provides the fastest communication

in an emergency. Alternatively, the communications operator may be positioned as a second person in the tractor, seated on an approved seat facing the direction of push-back travel. The tractor driver should also be on a live headset and be able to hear the communications operator and the cockpit crew.

With the communications operator on the push-back vehicle (a standard practice for some airlines) the necessity is reduced for anyone to walk on the ramp during aircraft movement.

A number of manufacturers make cordless headsets for communicating with the cockpit and the tractor driver. These cordless units will enable the communications person to sit in the tractor, or to walk while keeping well clear of the aircraft and vehicle.

The use of standard International Civil Aviation Organization (ICAO) hand signals before and after the use of voice communications was also noted as critical to achieving safety. During night operations, the communications person must maintain visual contact with the cockpit crew at all times. To ensure maximum visibility, ground handling crews should be provided with high-visibility/reflective clothing or vests.

The NSC also stressed the importance of establishing written procedures for ground handling personnel involved in aircraft arrival and departure procedures. Because these duties are frequently assigned to contract personnel, who are often subject to rapid turnover or shift changes, the operator must ensure that assigned personnel are adequately trained and qualified before participating in any aircraft arrival or departure. Refresher training was also cited as critical to maintaining safety in push-back operations.

NTSB Investigation Indicates That Repetitive Short Flights Resulted in Rapid Wear of Critical Fuel Valves

In 1992, a Cessna 402C crashed shortly after takeoff at the Grand Canyon Airport, Arizona, U.S., killing the pilot and all nine passengers. The aircraft was operated under Part 135 of the U.S. Federal Aviation Regulations. Shortly after liftoff, the airplane was observed in a right bank that increased suddenly with an abrupt drop of the nose. The airplane impacted the terrain in a flat attitude with high vertical forces.

A U.S. National Transportation Safety Board (NTSB) team recovered three video tapes from cameras among personal effects in the aircraft wreckage. Two of these tapes

recorded portions of the accident flight and confirmed other evidence indicating that the right engine lost power during a right turn at low altitude shortly after takeoff. In one video segment, the pilot can be seen reaching between the front seats to the area where the fuel selector handles are located. This coincides with the point in time when the aircraft first departed from normal flight attitudes.

Disassembly inspections of the engines found that the engines were capable of producing power. Although the investigation is continuing, preliminary results indicate that fuel starvation was the cause of the loss of engine power.

The airplane was equipped with six inlet fuel valves (three in each wing) that are integral to the wet wing fuel cells. The valves are located in the bottom of an inboard "wet wing fuel bay" that has cutouts in the wing rib bulkhead to allow fuel to transfer from the outboard wing section to the inboard section and the fuel valve area. Fuel is restricted from flowing back outboard of the rib bulkhead by check valves consisting of flexible flapper sheets restricting flow to one direction.

The fuel inlet valves are float-actuated to open when there is sufficient fuel in the tank bay to provide full fuel flow. When the fuel level drops in a particular bay, a spring is provided to close that inlet valve to prevent the fuel system from drawing air. All of the fuel inlet valves in the accident airplane exhibited abnormal wear patterns on the valve piston shaft. Testing of the valves disclosed that piston shaft could "hang up" on the inlet screen of the valve.

Under most circumstances, one of these valves sticking open would probably not been noticed. In this operation, however, it was normal procedure to operate with a minimum fuel load of only 20 gallons per side for takeoff. The videotape evidence confirmed that the fuel quantity gauges indicated about 30 gallons left and 20 gallons right during taxi for takeoff. In this aircraft, there is no provision to manually probe for partial fuel levels and the operator relies solely on the electrical fuel quantity indication system. A low-fuel-level warning system is not installed.

The investigation indicates that frequent operations with partial fuel levels caused excessive float movements that resulted in abnormal wear as exhibited on the accident airplane components. Examinations of other aircraft operating in comparable conditions disclosed similar high-wear patterns on the fuel inlet valve piston shafts. It is suspected that a stuck inlet valve became partially or com-

pletely uncovered during the turn maneuver and allowed air to enter the fuel system, resulting in the power loss to the affected engine.

The NTSB has recommended that the manufacturer: "Alert all operators of the Cessna 402C and other applicable 400 series airplanes of the circumstances of this accident and the potential for fuel supply interruption due to worn wing tank fuel inlet valves."

In the cited accident, the subject valve was considered to be an "on condition" unit and no life limits or overhaul requirements had been established. The inspection procedure called out in the manufacturer's manual consists of a pass/fail check for full closure through the application of an air charge to force the valve closed. This would not necessarily disclose the existence of wear on the piston shaft or a tendency to hang up.

Technicians should be alert for unusual wear patterns or high failure rates of systems and components that may be subjected to greater than anticipated stress or repetitive use due to special operating circumstances or unique procedures. Manufacturer's recommended maintenance and inspection intervals and procedures are intended for an airplane in "average operations" and, as in this instance, may not adequately cover unique operations.

Boeing 737 Rudder PCU Valves Are Examined

While investigating a fatal Boeing 737 crash in March 1991 [see details in *Accident Prevention,* May 1993], the U.S. National Transportation Safety Board (NTSB) became aware of several rudder power control unit (PCU) malfunctions on other B-737 aircraft. In the most recent incident, a B-737 pilot reported that the airplane's rudder pedal stopped at about 25 percent left pedal travel during a flight control check while taxiing out for takeoff. The airplane returned to the gate and the rudder PCU was replaced prior to the next flight.

Subsequent testing at the carrier's maintenance facility confirmed that the rudder PCU was intermittently defective. Under certain conditions, the actuator piston would move in a direction opposite to the commanded input. Further testing at the valve manufacturer's facility showed that the dual concentric servo valve installed on the main rudder PCU could, under some circumstances, result in motion opposite to that commanded by the pedal input. The valve manufacturer and the airframe manufacturer have initiated a design review of the anomaly to develop a design change to prevent the reversal, along with an implementation plan.

Initial analysis indicates that the potential for rudder reversal could exist in all B-737 main rudder PCUs. The internal stops of the dual concentric servo valve can allow the secondary slide of some valves to overtravel under some conditions. Normally, the primary slide moves about 0.045 inch (1.12 millimeters) before the secondary slide moves. If the primary slide is pinned or jammed to the secondary slide, control inputs resulting in the normal movement of the primary slide can lead to the overtravel of the secondary slide. If the overtravel of the secondary slide is sufficient, hydraulic fluid could be routed through a flow passage located outside the normal valve travel range, which could result in piston (and rudder) motion in the direction opposite to the input command.

The airframe manufacturer and a major operator have developed a field test procedure to verify the proper operation of the dual servo valve. The operator's fleetwide check disclosed no abnormally operating PCUs; however, tests and design analysis indicate that the anomalous operations will occur only when a unique condition prevents independent movement of the primary and secondary slides of the servo valve (a condition that could develop suddenly or occur intermittently). Thus, a one-time check may not ensure that reversal will not occur.

Investigation of the PCU removed from the aircraft that crashed in 1991 (the accident was not blamed on the PCU) and of another PCU that may have malfunctioned in 1992 is ongoing. Historical maintenance data shows that there have been five other incidents related to the main rudder PCU on B-737 aircraft, two of which were detected in flight, but did not result in a serious control problem.

Of the five previous incidents:

- One was caused by a foreign object lodged in the valve;
- One was caused by system contamination;
- One was caused by contamination and worn seals;
- One was caused by internal corrosion; and,
- The cause of one malfunction is unknown.

Although only two confirmed airborne incidents have resulted in rudder operational anomalies during more than 50 million flight hours of operation of the B-737 fleet, the NTSB believes that interim precautionary measures are warranted, pending completion of the ongoing investigation and design analysis. The NTSB has therefore recommended that the U.S. Federal Aviation Administration (FAA):

- "Require that Boeing develop a repetitive maintenance test procedure to be used by B-737 operators to verify the proper operation of the main rudder power control unit servo valve until a design change is implemented that would preclude the possibility of anomalies attributed to the overtravel of the secondary slide.

- "Require that Boeing develop an approved preflight check of the rudder system to be used by operators to verify, to the extent possible, the proper operation of the main rudder power control unit servo valve until a design change is implemented that would preclude the possibility of rudder reversals attributed to the overtravel of the secondary slide.

- "Require operators, by airworthiness directive, to incorporate design changes for the B-737 main rudder power control unit servo valve when these changes are made available by Boeing. These changes should preclude the possibility of rudder reversals attributed to the overtravel of the secondary slide.

- "Conduct a design review of servo valves manufactured by Parker Hannifin having a design similar to the B-737 rudder power control unit servo valve that control essential flight control hydraulic power control units on transport-category airplanes certified by the FAA to determine that the design is not susceptible to inducing flight control malfunctions or reversals due to overtravel of the servo slides."♦

Expandable Sleeving Stays Round for Easy Application

Nelco Products Inc., Norwell, Massachusetts, U.S., has introduced an expandable protective plastic sleeving which they claim will hold its round shape as it comes off the spool. The sleeving is claimed to be expandable to three times its normal size for use in protecting larger bundles or variations in cable runs.

Photograph not available.

The abrasion-protective sleeving is available in sizes from 1/8 to 4-1/2 inches in diameter and comes in polyester, polypropylene, Halar, Teflon, Ryton, Nylon, Kevlar, graphite, and fiberglass materials. Flame retardant variations are also available.

Literature and free samples are available upon request from Nelco Products Inc., 77 Accord Park Drive, Norwell, MA 02061 U.S. Telephone: (617) 871-3115.

Safer Protective Coating Replaces Cadmium

Pure Coatings Corp. has just announced the release of a brochure describing its CorroBan zinc-nickel plating process designed as a replacement for cadmium. The U.S. Labor Department recently issued rules that require at least 95 percent reduction in workplace exposure to cadmium, which can cause lung cancer and kidney disease. Cadmium plating has long been used to protect aircraft components from corrosion and these new restrictions on its use have prompted the development of suitable replacement processes.

The CorroBan process results in an electrolytic deposit containing 11 to 18 percent nickel (with the balance being zinc) produced by a proprietary process that avoids hydrogen embrittlement normally associated with electroplating. The manufacturer states that CorroBan forms a continuous and level coating and the porosity is optimized to permit hydrogen bake-out and minimizes post-plating embrittlement.

For a copy of the brochure, contact Pure Coatings Inc., 3301 Electronics Way, West Palm Beach, FL 33407 U.S. Telephone: (407) 844-0100. Fax: (407) 845-7480.

New Nontoxic Hand Cleaner Removes Paints, Resins Without Drying Skin

Permatex Industrial Corp. has introduced a paint and resin removing (PARR) hand cleaner that it claims is able to remove tough-to-wash substances like polyurethane, stain, enamel, sealants, etc., without water and without drying the skin. This hand cleaner is intended to provide technicians with a safe andeffective alternative to toxic thinners or other harmful chemicals to clean their hands.

The manufacturer claims that it uses a mild but powerful solvent called dibasic ester (DBE) that removes the hard-to-remove substances without the drying effects associated with some hand cleaners. It contains a fine pumice combined with a pleasant scent and natural skin conditioners to moisturize and soften skin without a greasy residue.

Permatex claims that the PARR formula is biodegradable. The cleaner is available in 7.5- and 15-ounce squeeze bottles and larger containers for use with a dispensing pump. For more information and a free sample, contact Permatex Industrial Corp., 705 North Mountain Road, Newington, CT 06111 U.S. Telephone: (203) 679-9733.

High-tech Masking Used in Plasma Spray Coating

Silicones developed by the General Electric Co. are used in manufacturing a special high-velocity oxy-fuel (HVOF) masking tape manufactured by DeWal Industries. According to the manufacturer, specialized silicone elastomers and pressure-sensitive adhesives allow the tape to stand up to the demanding conditions experienced in plasma-spray coating processes.

This new protective masking tape is claimed to be superior to traditional

masking and metal tapes when used with the newest generation of plasma thermal spray guns, which emit heated particles at speeds approaching Mach 3. These plasma spray processes are commonly used in the repair or coating of turbine engine components.

The manufacturer states that the tape is easier to work with because of its flexibility, is readily adaptable to any masking requirement, and does not degrade, unwind, or lose its effectiveness when exposed to very high temperatures and particle application speeds. Major time savings are also claimed as a result of its ease of application.

The tape is composed of three layers: an adhesive, aluminum foil and a silicone rubber outer surface. The foil, which provides a flexible base, is bonded to a specially modified pressure-sensitive adhesive supplied by GE silicones. The side of the tape exposed to the plasma blast is coated with a silicone rubber which, when exposed to high temperatures, forms a "char layer" of silicon dioxide, which prevents grit particles from adhering to the tape. The tape is available in several widths and in sheets.

For more information, contact Marketing Manager, DeWal Industries, 15 Ray Trainor Drive, Saunderstown, RI 02874 U.S. Telephone: (401) 789-9736.♦