REPORT A-012/2007

DATA SUMMARY

LOCATION

Date and time	**Sunday, 11 March 2007; 08:30 h UTC**
Site	**Cuatro Vientos Airport (Madrid)**

AIRCRAFT

Registration	**EC-EZY**
Type and model	**PIPER PA-28RT 201T**
Operator	**Aeromadrid**

Engines

Type and model	**TELEDYNE CONTINENTAL TSIO 360 FB**
Number	**1**

CREW

Pilot in command

Age	**63 years old**
Licence	**Commercial pilot license – CPL(A)**
Total flight hours	**28,069 h**
Flight hours on the type	**50 h**

INJURIES

INJURIES	Fatal	Serious	Minor/None
Crew			**2**
Passengers			
Third persons			

DAMAGE

Aircraft	**Signficant**
Third parties	**None**

FLIGHT DATA

Operation	**General aviation – Instructional – Dual**
Phase of flight	**Initial climb after takeoff**

REPORT

Date of approval	**28 April 2011**

1. FACTUAL INFORMATION

1.1. History of the flight

Around 08:00 UTC[1] on 11 March 2007, a Piper PA28-201RT, registration EC-EZY, was preparing for its first flight of the day at the Cuatro Vientos Airport (Madrid). The crew attempted to start the engine using the aircraft's own starter system and electric battery without success. They later managed to start the engine with the aid of an external battery.

At 08:17 UTC the aircraft took off on a local VFR training flight with an instructor and a student onboard. Meteorological conditions were CAVOK with light winds and a temperature of 7 °C.

The student was the pilot flying. The takeoff was conducted to the west on runway 28. Before reaching point W on the visual approach chart, the crew noticed that they had lost all radio communications. They also realized that all of the flight instruments had stopped working. They immediately deduced that they were faced with a complete electrical failure and decided to return to the airport.

The captain and instructor took over the controls of the airplane as pilot flying, PF, and the student assumed the duties of the PNF. As the instructor later stated, they initiated the traffic procedure for flying with a communications failure. They departed the normal traffic circuit and flew south of the control tower at an altitude below 328 ft above the field.

Another aircraft in the airport circuit at the time noticed the aircraft's maneuver and informed airport control (TWR) that the aircraft in question was proceeding from point W at an altitude of 2,500 ft due to an unusual circumstance. All attempts made by the TWR to communicate with the aircraft by radio went unanswered.

When the TWR established visual contact with the aircraft, the controllers noticed how it was joining the failed communications circuit and that it was flying with the landing gear up. The airplane circled the circuit several times.

The TWR used flashing green lights to inform the pilot that the aircraft was cleared to join the pattern and land. The pilot interpreted the flashing, as opposed to a steady, green light as a warning that the landing gear was not properly configured for landing. He subsequently headed to the approach zone for runway 10, since the TWR had changed the runway in use after they had taken off. After several attempts to lower the gear and realizing that it had not lowered, the airplane landed on its belly at 08:32 and

[1] All times in this report are UTC (Coordinated Universal Time). To calculate local time, add one hour to the stated times.

came to a stop in the middle of the runway. TWR had already notified emergency personnel.

The crew was uninjured and able to evacuate the aircraft under its own power while rescue services provided aid and secured the aircraft. There was no fire.

The damage to the aircraft was mainly to the propeller and to the underside of the fuselage.

The runway was rendered inoperative for an hour and a half while the aircraft was removed from the flight strip.

1.2. Damage to aircraft

Some parts of the lower fuselage suffered abrasion damage. The propeller, which contacted the ground while rotating at low speed, was damaged, prompting an inspection of the engine.

1.3. Personnel information

The pilot in command and instructor had ample flight experience that totaled over 28,000 h, with some 80 h flown in the last 90 days. He had rested for 15 h prior to commencing his flight activity on that day. Of all his flight hours, about 50 had been on the aircraft type.

The student was completing the final hours of an integrated commercial pilot license CPL(A) course.

1.4. Aircraft information

The Piper 28RT-201T is an advanced single-engine training aircraft with retractable gear.

1.4.1. *Frame*

Manufacturer:	Piper
Model:	PA-28RT-201T
Production number:	28R-8231002
Registration:	EC-EZY

Airworthiness certificate:	No. 3124
Valid until	16-01-2008
MTOW:	1,315 kg

1.4.2. *Maintenance information*

Total flight hours	7,797 h

Last inspections made:

• Last 1000-h inspection	7,725 h
• Date of 1000-h inspection	19/06/2006
• Hours on 50-h inspection	7,776 h
• Date of 50-h inspection	1/03/2007

1.4.3. *Engine*

Manufacturer:	Teledyne continental
Model:	TSIO 360 FB
Serial number:	299862-R
Total hours:	1,260 h

The engine was installed new, along with its accessories, with 6,539 h on the aircraft.

The aircraft logbook shows that the airplane had been used an average of 16 minutes a day in the previous nine months, with each flight cycle lasting approximately 1:11 h.

1.4.4. *Characteristics of the landing system*

The aircraft has a retractable tricycle gear. A lever that can be selected either up or down controls the position of the legs, retracted or extended, by means of hydraulic actuators fed by pump.

A back-up system, if armed, lowers the gear automatically, regardless of the up or down position of the landing gear lever, when at a slow airspeed and low throttle. The system can be disengaged so as to enable the safe performance of certain maneuvers, such as slow flying, stalls and the like, without the maneuvers being upset by unexpected extension of the gear.

In the absence of electrical power, an emergency system allows the landing gear to fall by gravity.

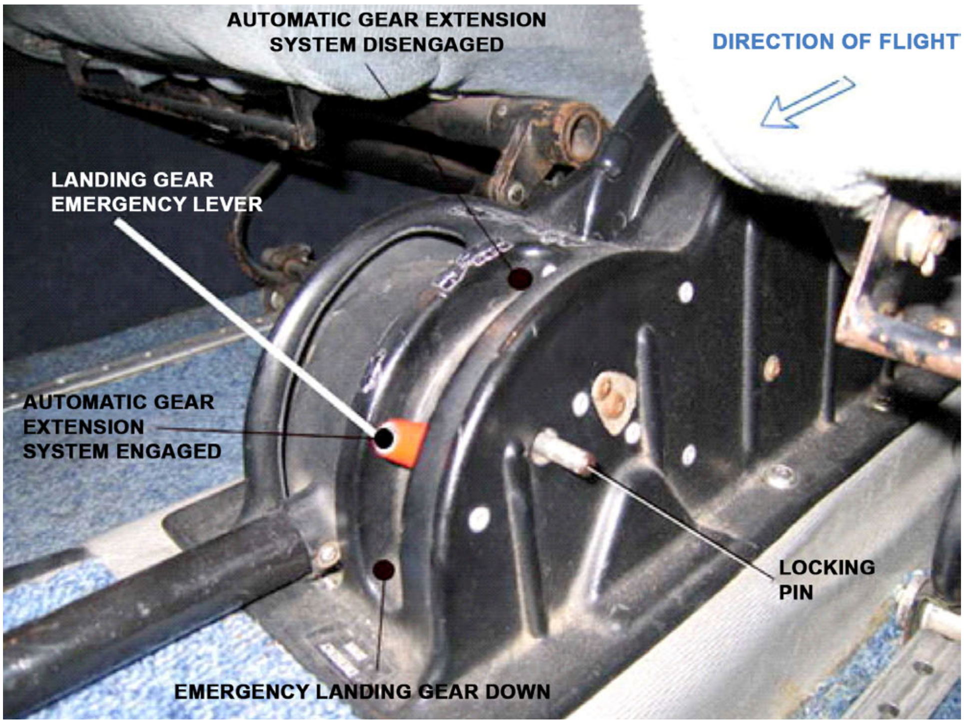


Figure 1. Back-up gear lever

There is a back-up lever for the landing gear between the pilots' seats that regulates the operation of the automatic landing gear extension system. This lever has three positions:

- The "central or normal" position on this lever arms the automatic gear extension system.
- The "down" position emergency lowers the landing gear. This position opens valves in the hydraulic systems so that the fluid does not prevent or block the downward movement of the gear legs.
- The "override" position on the back-up gear lever disengages the automatic extension system. In this position, if electrical power is available, the position of the legs corresponds to the position selected on the landing gear lever. The back-up lever is locked in the override position via a locking pin. To release the lever so that it can be placed in the arm or emergency lower positions, the pin is unlocked by pulling up on the back-up gear lever, after which it can be moved into one of the other positions.

Issues involving the in-service operation of this airplane type prompted the manufacturer to issue Service Bulletin No. 866A, intended to remove and disable the automatic landing gear extender. Part II in this SB provided operating requirements for those operators that opted to leave this system in service.

According to a service bulletin compliance list compiled by the operator, SB 866A, Part II had been implemented on the accident airplane, though the date was not given.

Compliance with that part of the SB required including information on the operation of the airplane and of the landing gear retraction system in the Airplane Flight Manual. The same SB also required that pilots of this aircraft type be provided this information.

1.4.5. *Characteristics of the electrical system and its components*

The aircraft has an electrical power generating and storage system designed to supply the navigations, communications, lighting, gear extension and other systems. The electricity, produced by a generator and stored in a battery, provides starting power for the airplane's engine.

The engine ignition system is supplied by two magnetos that are independent of the electrical system.

The main components of the airplane's electrical system are:

1.4.5.1. Battery

The specific battery mounted on the accident airplane was a 12-V Gill (Teledyne Battery) G-35, serial number G02073139. The battery consists of six electrolytic cells. The manufacturer's manual specifies a nominal capacity of 23 A-h for this battery. In order to be considered airworthy, this battery, when fully charged, must be able to maintain a discharge current of 23A for one hour and a 40A current during the thirty minutes that an emergency might last. At the end of the test, the voltage in each battery cell must not be below 1.67 V, or 10V between the battery posts. If the battery cannot be charged to those levels, it cannot be considered operable. (See data sheet in Appendix 3.)

The manufacturer states that this battery type can last for several years from the initial installation if properly maintained, including tracking its charge condition and electrolyte levels and densities. An initial airworthiness test is required 800 h or 12 months following initial installation and operation, whichever comes first, and periodic tests every 400 h or six months thereafter. When the charge cycles during normal airplane use are short (less than one hour), the battery may not fully recharge following engine start operations, requiring a periodic charge in the workshop under controlled conditions. The battery manufacturer does not recommend bypassing the airplane battery on engine start by using an external battery or electricity source, since this could mask a low-charge condition that would render the battery incapable of supplying the necessary loads in the event of an emergency.

The airplane manufacturer's own maintenance manual, however, does allow the engine to be started with an external battery after the installed battery is disconnected. The manual cautions that if the charge on the airplane battery is low, the charge current in this case will be high. Under these circumstances, the takeoff must not be initiated until the charge current drops to 20A.

1.4.5.2. Alternator

The engine-driven 12V, 60A nominal current and voltage alternator generates the current needed by the various airplane systems and for recharging the battery.

The alternator is coupled to the engine via P/N 635796, which consists of a gear attached to a slip clutch that is joined to the alternator axle. The elastomer of which the clutch is made allows the alternator axle to slip if the alternator seizes or when the drag on it is excessive, thus protecting the engine from more serious damage.

Teledyne Continental Aircraft Engine published SB 95-3B in 1995. The SB was subsequently revised in 2005, and specifies the performance of an initial slippage test for this coupling, followed by a periodic test every 500 airplane hours. The test specifies that the coupling, once removed from the airplane and subjected in the workshop to 100 inch-pounds of torque, must not slip.

According to information provided by the company, SB 95-3B was implemented on 2 February 2005 with 7,526 FH on the airplane, that is, 271 FH before the incident. Additional information provided by the company indicates that the alternator, which had been coupled to the power plant since the engine was installed with 6,539 FH on the airplane, had never been uninstalled. The temporary removal of the coupling for the performance of the test is not considered as an uninstallation per se; at any rate, it must be assumed that the component was manipulated during this procedure.

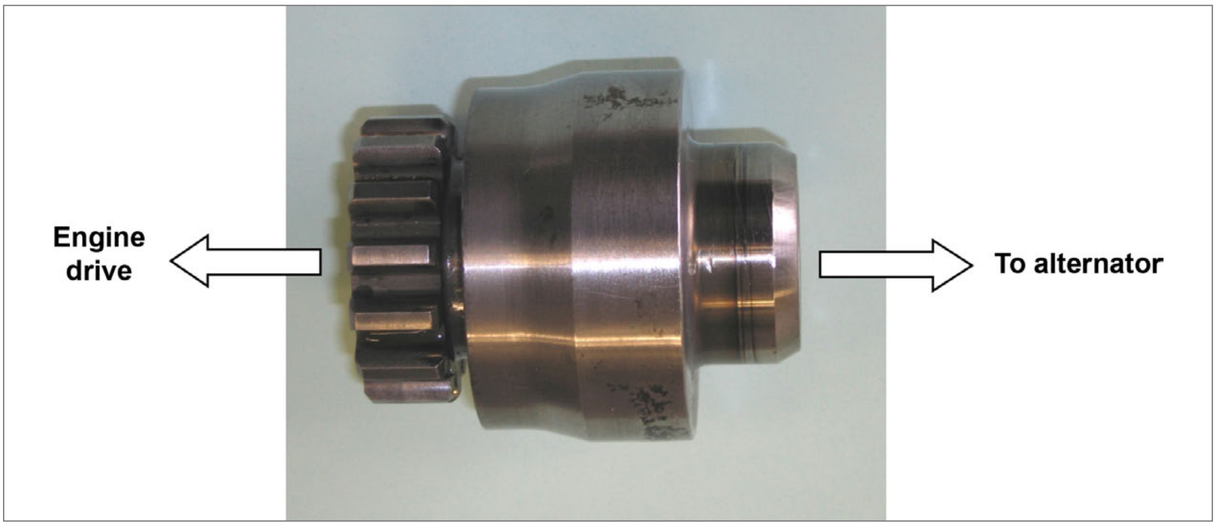


Figure 2. Engine-alternator coupling

1.4.5.3. Voltage regulator

The battery-powered voltage regulator supplies the alternator with the excitation current required for it to produce the electrical current demanded by the systems and to charge the battery.

1.4.5.4. Electrical system indications

The electrical system in the airplane has an ALT caution light that turns on when the airplane, powered by the battery, is not being supplied voltage by the alternator.

An ammeter at the alternator output measures all of the current produced and supplied to the various systems, including the battery charge current.

The magnitude of the current indicated by the ammeter and the demand of the connected loads can be used to deduce the alternator generating capacity and the battery charge current.

1.5. Communications

Communications between the crew and the control tower at the Cuatro Vientos Airport were interrupted as the aircraft neared point W on the visual approach chart. Another airplane that had observed the airplane deviate and return to the field reported these unusual maneuvers to the tower. All attempts made by ATS to communicate with the aircraft were unsuccessful.

Once the aircraft arrived at the communications failure circuit, controllers saw the aircraft make several circuits around the tower (the specific number could not be determined) with the gear retracted. Renewed efforts to communicate via radio also failed.

While the aircraft was flying in the communications failure area, controllers in the tower used a green light to signal the aircraft. They then switched to a red light in an effort to warn the crew of the inadequate position of the gear for the landing. The crew later stated that they saw the flashing green light, but not the red one.

1.6. Airport information

1.6.1. *General airport information*

The Cuatro Vientos Airport is to the southwest of the city of Madrid within an expansive terminal control area (TMA) that also includes the airports and aerodromes of Barajas, Getafe, Torrejon and Casarrubios. The Cuatro Vientos Airport does not have its own CTR. Its airport transit zone (ATZ) is defined by a 3-km radius circle centered on the ARP, with a vertical limit of 600 m or the cloud ceiling elevation, whichever is lower. Appendices 1 and 2 show the AIP charts in use at the time of the incident.

The airport is used for civilian general aviation and military operations involving airplanes and helicopters on VFR flights. Only aircraft equipped with two-way radio transceivers are allowed to operate at the airport.

Cuatro Vientos has a 1500-m long runway whose thresholds are designated as 28 and 10. It is at an elevation of 2,269 ft. Parallel to and north of the runway there is a dirt runway that is closed to civilian traffic. The TWR and parking stand for civilian airplanes are at the south end of the field. The airport's traffic circuits, in a left-hand hand pattern for runway 28 and right for 10, are both located south of the field.

The communications failure procedure published in the AIP for the airport specifies that aircraft must always proceed from point S on the visual approach chart and enter the circuit as described in the diagram below:

22. PROCEDIMIENTOS DE VUELO

Las aeronaves que despeguen por la RWY 10 abandonarán el circuito de tránsito del AD después de finalizar el tramo de viento en cola derecho y pedirán permiso a la torre cuando vayan a cruzar la zona de aproximación a la RWY 10.

→ Debido a la construcción de una nueva TWR, la parte final del tramo de viento en cola y la parte inicial del tramo básico de la RWY 10 no son visibles desde TWR. Esta zona se corresponde con la parte inferior izquierda del siguiente gráfico:

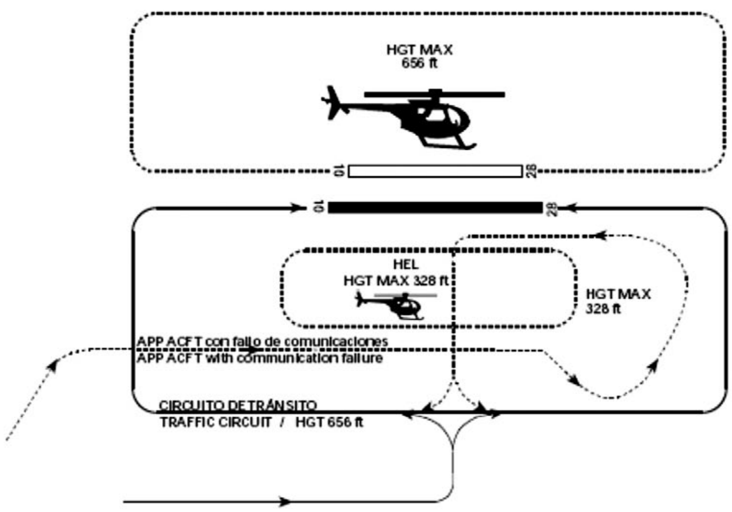
Circuito de tránsito de AD.

FLIGHT PROCEDURES

Aircraft taking-off from RWY 10 shall leave the aerodrome traffic circuit after finishing the right tale wind leg and ask for clearance to control tower to cross the approach area of RWY 10.

Due to new TWR construction, the final segment or RWY 10 downwind leg and the initial segment of RWY 10 base leg of AD traffic circuit are not visible from TWR. This area corresponds with down left side of the following graphic:

AD traffic circuit.



In effect on April 2007

Figure 3. Traffic circuit with communications failure at Cuatro Vientos

1.6.2. *Control tower information*

The control tower at the airport was placed in service in 2006. It is located approximately opposite rapid exit taxiway E-2, a third of the way down the runway from the 28 threshold.

The control stations in the tower are located on the side closest to the runway. On the date of the event, the ATS had a traffic control frequency and another frequency was being implemented for controlling ground movements.

The control room provides 360° views of the entire ATZ, though in order to see parts of the circuits to the south of the field, the controller must turn and look in a direction opposite to that which he would face when at his post and in which approach, takeoff and landing movements usually take place.

Figure 4. Location of Cuatro Vientos Airport

1.7. Tests and research

1.7.1. *Hangar inspection of aircraft*

The aircraft was inspected eight days after the accident in the hangar used by the training center and located in the Cuatro Vientos Airport. The airplane was on lifting jacks and powered by a spare battery different from the one installed during the event. All of the remaining elements and components were the same as on the incident flight.

No damage was observed besides that resulting from the sliding of the aircraft on the runway and the propeller strikes.

Functional tests were carried out to emergency lower the landing gear and to lower and raise the gear normally using the electro-hydraulic system. These tests proceeded normally and did not reveal any faults.

The electrical generating system was inspected. The insulation and continuity were checked at various connecting points. No shorts or lack of continuity were found. The excitation voltage of the alternator was also checked, which yielded correct readings at the regulator connection point. The ALT alternator caution light and the system ammeter was functioning normally.

The AFM was not found inside the cockpit.

1.7.2. *Workshop inspection of electrical components*

The alternator and voltage regulator were removed from the airplane. The battery installed in the airplane during the incident was also inspected.

A check of these components in the workshop revealed the following:

- **Alternator.** The brushes showed normal wear and were properly insulated. The alternator produced electricity when it was installed and rotated directly on a test bench. However, when the coupling piece was subjected to the slippage tests described by the manufacturer in SB 95-3B, it was noted that the clutch slipped before a torque value of 20 inch-pounds was reached. A visual inspection revealed that the clutch was greased. Removing the grease and drying the oil with rags yielded slippage torques of 40 inch-pounds, still far from the 100 inch-pound value required to pass the test.
- **Battery.** A visual inspection revealed defects such as: a dent in one of the lower corners; sulfate build-up on one of the ventilation plugs; a bent positive post and cloudy electrolyte in one of the cells. The battery was subjected to a controlled charge and discharge process to test its operability. The result of the test was unsatisfactory, since the battery could only maintain a 20A discharge rate for 15 minutes before the voltage dropped below 10V. In order to consider the battery airworthy, it should have been able to supply that current for at least 60 minutes.

1.8. Statement from the pilot in command

No abnormal caution lights or ammeter readings were observed during engine start-up. He recalls that several attempts were required before the engine started turning under its own power.

After takeoff and before reaching point W on the visual approach chart, they noticed the failure of the communications and the general failure of the electrical system.

He immediately decided to return to the field and initiated the traffic procedure for a communications failure.

He saw the green light coming from the tower. He interpreted the flashing green light as a warning that the landing gear was not down. He did not see any red lights.

He asked the student to lower the landing gear. The student, who had with him a copy of the AFM, was not able to lower the gear.

The instructor did not take part in the efforts to lower the gear. Assuming that the gear was locked in the up position, he decided to land as quickly as possible.

Once committed to landing and before touching down, he feathered the propeller and disconnected the electrical system.

The crew did not check this aircraft's flight manual. The only copy onboard was the student's, and it was not for the aircraft being used.

1.9. Organizational and management information

1.9.1. *Airplane Flight Manual*

Different sections of the Piper Aircraft Corporation's manual for the PA-28RT-201T were reviewed, yielding the following findings:

- The emergency procedures for a failure of the electrical system provide indications for identifying and handling potential failures.
- It notes that a high ammeter current could be due to an abnormally low battery charge, though in that case the reading should start to decrease to normal values after five minutes.
- The loss of alternator output is indicated by a zero reading on the ammeter.
- A note cautions that if the battery is drained, the landing gear has to be lowered using the emergency procedure.
- The locking pin for the back-up landing gear lever that is mentioned in the system description (Section 7, page 7-7) is not referenced in the emergency procedures (Section 3, pages 3-7, 3-8, 3-12 and 3-16).

1.9.2. *Communications failure in Spain's RCA (Air Traffic Regulations)*

The failure of communications is considered in Spain's RCA in points 2.3.6.5.2 and 4.3.17.

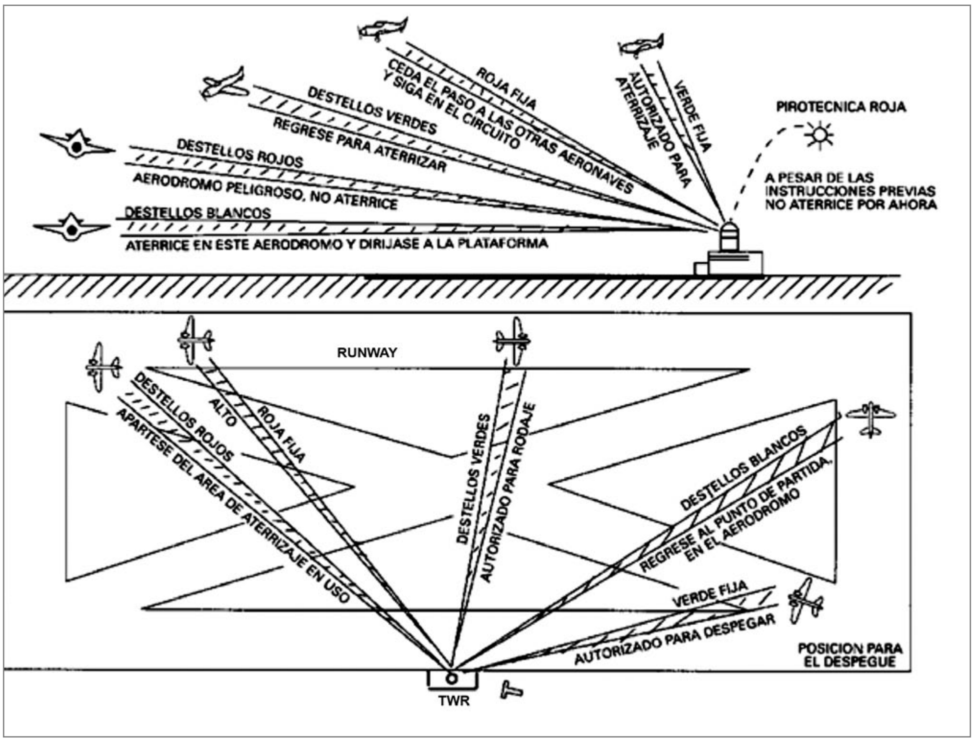
In particular, a note before point 4.3.17 states that if the aircraft is equipped with a SSR transponder, it must be placed in Mode A, squawk 7600.

Point 4.3.17.6 specifies, among other things, that ATC will provide relevant information to other airplanes in the area.

In Appendix C, the RCA describes the following code for the use of aviation light signals:

Light	From the airport ATS	
	To aircraft in flight	To aircraft on the ground
Steady green (1)	Cleared to land	Cleared for takeoff
Steady red (1)	Give way to other aircraft and remain in the circuit	Stop
Flashing green (1)	Return to land (2)	Cleared to taxi
Flashing red (1)	Dangerous airport, do not land	Clear landing area
Flashing white (1)	Land at this airport and proceed to platform (2)	Return to point of departure in airport
Pyrotechnic red light	Disregard previous instructions, do not land for now	

(1) Directed at aircraft in question (see Figure C4-1).
(2) Clearance will be given in due time to land and taxi.



1.9.3. *Operations Manual and training center*

Points a.9 and b.2.1 of the Operations Manual specify that the current flight manual, checklists and pre-flight checks, normal and emergency operating procedures, etc., must be carried on the airplane.

Point b.2.4, on maintenance technical records, references the relevant records for limited life components.

As for the revalidation and renewal of flight instructor pilot ratings, point d.5 of the Operations Manual details the procedures for checking and verifying the proficiency of said instructors.

As of the approval date of this report, the training center, as well as its maintenance center, had ceased their activities.

2. ANALYSIS

2.1. History of the accident

The airplane, in the early hours of a relatively cold morning and after a period of moderate operational activity, was preparing to start up under its own power.

After several failed attempts to start the engine, it was finally started with the aid of an external battery connected in parallel.

The airplane's installed battery may have received some charge while it was connected to the external battery. Once the external battery was disconnected, the airplane's battery received practically no charge since, due to a failure of the piece that couples the engine to the alternator, the latter was unable to supply any current.

This coupling piece, the slip clutch, failed by allowing excessive slippage, which kept the alternator from turning and thus producing electricity to recharge the battery to adequate levels.

Upon taxiing, the airplane's systems, especially the intermittent radio transmissions to the TWR, started draining an already highly discharged battery. After takeoff, the operation of the electrically powered hydraulic pump to retract the landing gear would have discharged the battery even more, resulting in the complete failure of the electrical system.

The back-up landing gear lever would have been in the up, or "override" position to disable the automatic extension of the gear, as specified in SB 866A, or it might have been pulled up and locked then to prevent an untimely extension of the gear.

In this condition the airplane could have flown autonomously since the engine ignition relied only on its magnetos and the fuel flow was provided by an engine-driven fuel pump. The aircraft, however, lacked communications, navigation, lighting, stall warning, indicating, alarm and other systems. Even the landing gear position lights, which were not powered, would have been inoperative. As a result, the prudent course of action was to land as quickly as possible without taking actions that were premature or haste.

Since there was no electrical power to activate the hydraulic pump, prior to touchdown the landing gear had to be activated either through gravity fall or using the emergency method, assuming no additional problems arose during the extension.

The general and sudden failure of the electrical system was due to two faults, that of the alternator and of the battery.

- If the alternator had worked properly, then even if the battery had drained, electricity would have been supplied to meet onboard demands. Eventually the crew would have noticed that the current draw indicated by the ammeter was too high. Even limiting the loads connected to the electrical system would have revealed that all of the alternator output was being used by the battery.
- If the battery had been in good operating condition, the slippage failure of the alternator would have resulted in the ALT light energizing concurrent with a drop in the ammeter current reading to zero. From then on a fully charged battery would have guaranteed the operation of essential aircraft systems for at least 30 minutes.

2.2. Crew actions

In the seconds following engine start-up, if the crew knew that the battery charge was very low, it should have expected to see high initial charge currents, close to a nominal alternator output of 60A. The current monitored by the ammeter would have been expected to reach several dozen amperes over an extended period of time.

If the alternator had reached those values, it is very unlikely that the battery would have drained without the crew noticing the high current draw on the instrument. The aircraft quickly proceeded to take off. It is possible that the alternator light never went on, initially due to residual voltage in the alternator, which may have been loosely progressively coupled to the engine, and then, following the rapid drop in battery voltage, because the warning light would have been too dim to see.

After declaring the emergency, the pilot acted properly by taking the controls, deciding to return to the field to land following the communications failure circuit procedure.

The gear failed to lower despite repeated attempts by the student-pilot. Emergency lowering the gear was possible, as confirmed later during the hangar test. It may be concluded, then, that the student probably did not execute the procedure properly in terms of pulling the back-up gear lever upward in order to release the locking pin. Of note is the fact that the existence of a locking pin, or of the procedure for releasing it, is not mentioned in the emergency procedures or checklists.

The crew could have calmly persisted in their efforts to allow the gear to gravity fall. The crew could also have checked the updated documentation had it been available onboard.

With other airport traffic warned by radio and given the light wind conditions, the airplane was able to execute a good landing on runway 10 with the gear retracted without any further complications.

The lack of any reference to checking the airplane's own flight manual, which should have been onboard, is indicative that said manual may not have been present in the cockpit. Likewise, since the gear worked in emergency, as verified in the workshop, it may be inferred that neither crew member knew how to operate the system in emergency mode.

2.3. ATC actions

The signals provided to the airplane from the tower may have deviated from the procedures in Appendix C of the RCA, but they were effective in conveying ATC's awareness of the problems onboard and in confirming to the crew that the landing gear was improperly configured. The communications with the other aircraft in the visual traffic circuit alerted everyone, including the Tower, to the potential hazards of the situation facing them.

The procedure of having the tower use light signals to communicate with crews was normal in the past, though it has since fallen out of favor given the widespread use of radio equipment present onboard virtually every airplane. These light signals are still in effect, however, and can prove useful in incidents such as the one described herein. As such, both pilots and controllers should be reminded of these signals as part of their refresher training.

Of special interest during a loss of communications is the execution of the procedure to activate the transponder in Mode A, squawk 7600, as specified in the RCA. Although the aircraft was outfitted with this equipment, which now is required throughout the Madrid TMA, the equipment could not transmit following the loss of power.

2.4. Maintenance and organizational actions of the operator

The accident stemmed from the simple, internal fault of a clutch in the piece that couples the engine to the alternator axle. This fault prevented the alternator from generating current to supply airplane loads and charge the battery. The reason for the slippage in the coupling could not be determined, though the increased friction present after cleaning the oil that saturated the component is indicative of an improperly greased gear or of a failed seal.

A simple fault should not have caused such a generalized and sudden loss of electricity in the airplane. But in this case, the fault in the alternator operation coincided with a failure in the battery, which did not deliver sufficient emergency current over a reasonable length of time.

The inspection conducted after the event revealed defects in the battery such as dents, sulfate build-up, etc., but more than anything it highlighted the maintenance organization's lack of records regarding the operation, inspections and services made to that battery. The battery's maintenance schedule was tied to the airplane's inspection periods, but since this component may be installed, depending on warehouse availability, onboard other aircraft, compliance with the periods imposed by the manufacturer, and which ensure its airworthiness, cannot be confirmed. It was also not possible to determine its total time in service, since the initial date of use was not stamped on the battery.

The controlled charge and discharge tests conducted on the battery after the accident confirmed that it was inoperable prior to initiating the accident flight.

The closing of the maintenance center precludes the issuance of a Safety Recommendation directed at the maintenance organization along the lines that it update the procedures used to track battery life and maintenance so as to adapt the maintenance periods and procedures involving this component in keeping with the specific operating conditions at this operator (flight hours per cycle, inactivity periods, etc.) and with the procedures for starting the engine and monitoring the operability of the battery. An analysis of the aircraft logbook reveals that the airplane had been used an average of 16 minutes a day during the previous nine months, with cycles lasting approximately 01:11 hours per flight. This reduced activity could have affected the battery, reducing its capacity.

As for the handling of SB 866A, Part II, a review of the records of directives implemented by the organization shows that said bulletin had been complied with, though the records did not indicate the date.

Compliance with SB 866A, Part II, entailed attaching a specific portion of said SB to the AFM in effect, which is required to be onboard the aircraft, and to have trained pilots in command of this airplane type to familiarize them with the limitations, operation and use of the landing gear extension systems.

The effectiveness of said compliance is questionable considering, first, the possible absence of the AFM from the cockpit; and secondly, the events of the accident and the subsequent tests conducted on the airplane, which suggest a possible lack of knowledge of the exact procedure for emergency lowering the gear. The termination of the operator's activity precludes the issuance of a safety recommendation aimed at resolving these deficiencies.

2.5. Flight manual considerations

The implementation of service bulletin SB 866A allowed operators to maintain or remove the original automatic gear extender. Compliance with the Part II of the SB includes reviewing and understanding operation with said system engaged and including a copy of the bulletin in the flight manual.

Nevertheless, as indicated in Section 1.10.1, it was noted that the locking pin on the back-up gear lever, which is referred to in the system description (Section 7, page 7-7), is not mentioned in the emergency procedures (Section 3, pages 3-7, 3-8, 3-12 and 3-16).

As a consequence, a reference to the locking pin should be included in Section 3 of the aircraft flight manual so that its function is not overlooked, which would make lowering the gear difficult or impossible. A safety recommendation is thus issued to the Federal Aviation Administration (FAA) to modify said manual.

3. CONCLUSION

3.1. Findings

- The aircraft had a valid airworthiness certificate.
- The pilot in command had a valid license and was qualified for the flight.
- The aircraft initiated the VFR flight under ideal VMC with adequate visibility and sky conditions, light winds and a temperature of 7 °C.
- The initial engine start was problematic, requiring the aid of an external battery.
- The airplane taxied and proceeded to take off from runway 28 at Cuatro Vientos in the early morning hours.
- Shortly after takeoff and with the landing gear retracted, a complete failure of the electrical system occurred.
- The aircraft, the transceiver in which was rendered inoperable by the electrical failure, returned to the field and initiated a communications failure traffic pattern.

- The aircraft approached the tower and flew in its proximity with the gear retracted.
- The Tower had already been alerted by other traffic that had seen the accident airplane's maneuvers.
- Given the impossibility of radio communications, the Tower resorted to green, and then red, flashing lights in an effort to warn the crew that its landing gear was still retracted.
- The landing gear could not be operated normally due to the lack of electrical power in the airplane.
- All efforts by the student pilot to emergency lower the gear proved unsuccessful.
- The aircraft landed on its belly and came to a stop in the middle of the runway.
- The wheels-up landing resulted in damage to the aircraft's lower fuselage and to the propeller blades, which were turning slowly when contact was made with the ground.

3.2. Causes

The failure of the electrical system was due to the very low charge conditions present in the battery installed on the airplane and to the failure of the coupling for the engine-driven alternator, which could not supply any loads.

No mechanical reasons were found that would have precluded the emergency lowering of the gear. The inability to lower the gear was possibly due to the improper execution of the emergency gear extension procedure.

4. RECOMMENDATIONS

REC 09/11. It is recommended that the Federal Aviation Administration (FAA) modify the aircraft's flight manual to include in the emergency procedures pages 3.7, 3.8, 3.12 and 3.16 of the PA-28RT-201T Flight Manual on the gravity extension of the gear, and to reference the locking pin that is described in Section 7 of the manual, page 7.7.

Piper has accepted this recommendation, stating that the changes will be made in Section 3 of the flight manual.

APPENDICES

APPENDIX 1
Madrid-Cuatro Vientos airport chart

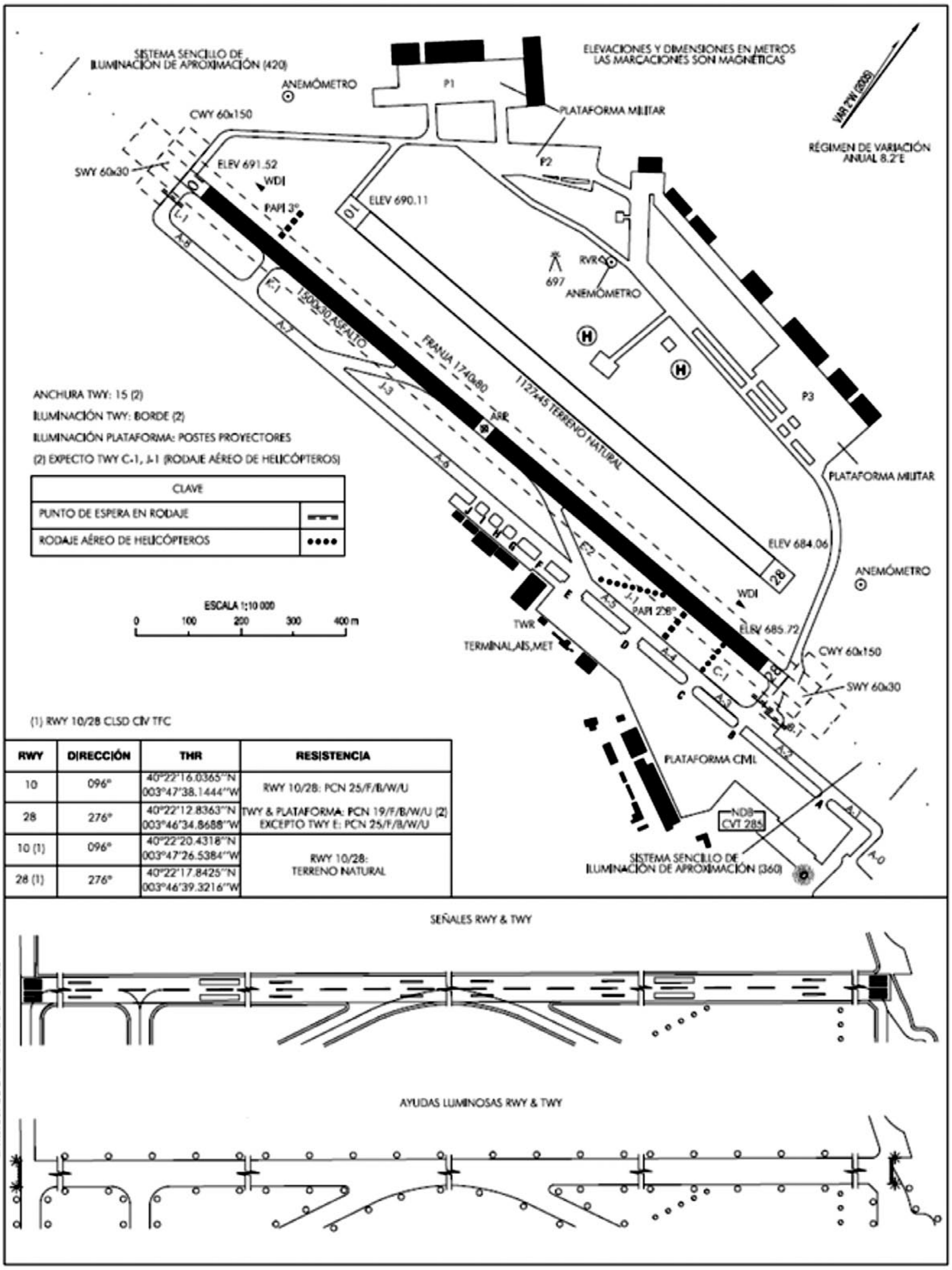
AIP
ESPAÑA

AD 2-LECU/LEVS ADC
08-JUN-06

PLANO DE AERÓDROMO-OACI 40°22'14"N 003°47'07"W ELEV 691.52 m

TWR 118.700
GMC 121.800
MIL 137.525

MADRID/Cuatro Vientos



RWY	DIRECCIÓN	THR	RESISTENCIA
10	096°	40°22'16.0365"N 003°47'38.1444"W	RWY 10/28: PCN 25/F/B/W/U
28	276°	40°22'12.8363"N 003°46'34.8688"W	TWY & PLATAFORMA: PCN 19/F/B/W/U (2) EXCEPTO TWY E: PCN 25/F/B/W/U
10 (1)	096°	40°22'20.4318"N 003°47'26.5384"W	RWY 10/28: TERRENO NATURAL
28 (1)	276°	40°22'17.8425"N 003°46'39.3216"W	

AIS-ESPAÑA AMDT 145/06

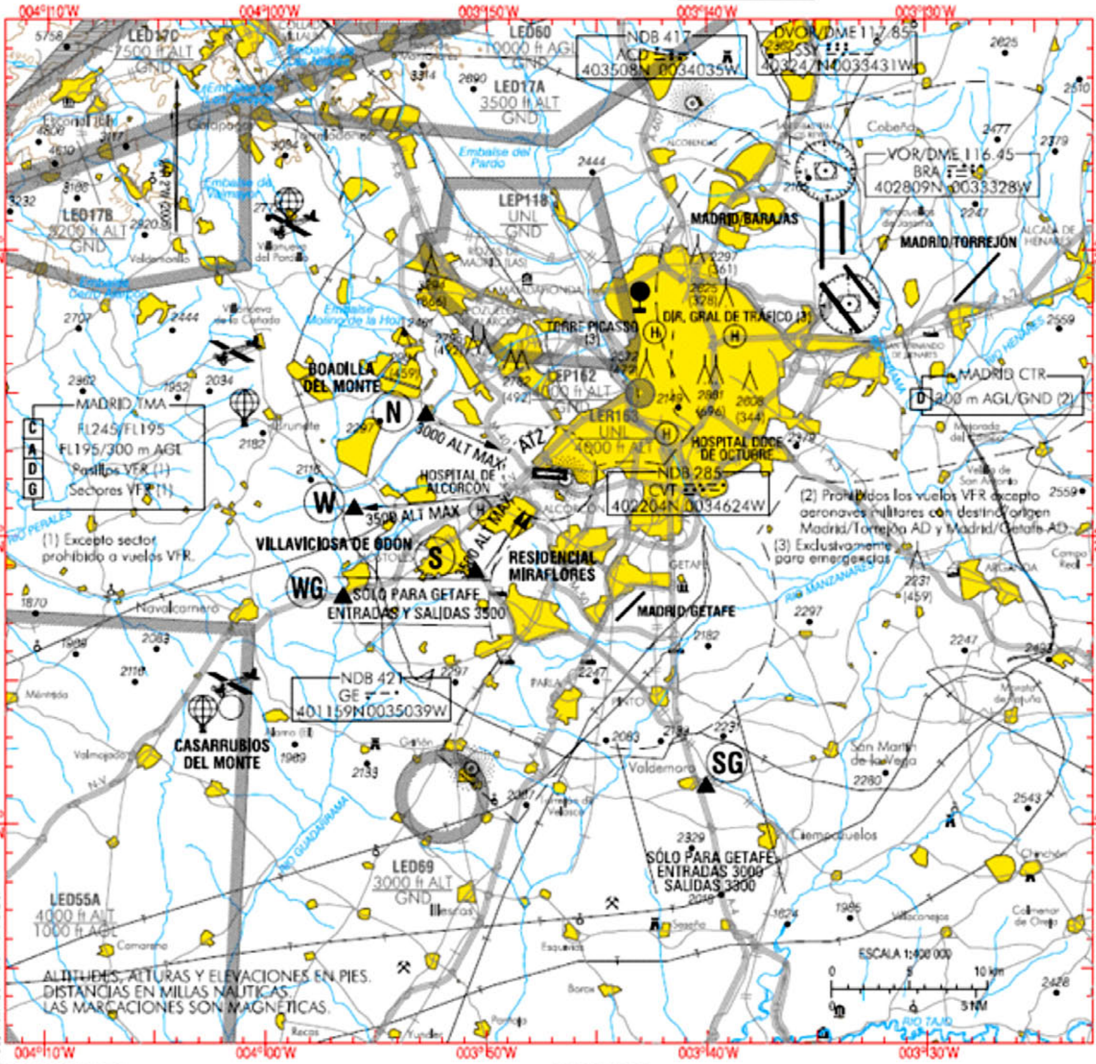
APPENDIX 2
Madrid-Cuatro Vientos approach chart

CARTA DE APROXIMACIÓN VISUAL / VAC-OACI

ELEV AD 2269

MIL	137.525
TWR	118.700
GMC	121.800
ARO	122.500

MADRID/Cuatro Vientos
LECU/LEVS



CAMBIOS: ELEV AD, CLASIFICACIÓN ESPACIO AÉREO MADRID TMA Y MADRID CTR, NUEVAS LEP162 Y LER163, HELIPUERTOS PRIVADOS.

PROCEDIMIENTOS:

LLEGADAS

Las aeronaves con destino Madrid/Cuatro Vientos AD contactarán con TWR en los puntos N (Boadilla del Monte) y S (Residencial Miraflores).

- Punto S:

Aeronaves con IAS igual o inferior a 120 kt según plan de vuelo, procederán a 3000 ft y aeronaves con IAS superior a 120 kt, según plan de vuelo, procederán a 3500 ft, ambas hasta incorporarse al circuito de tránsito del aeródromo.

Aeronaves procediendo a 3500 ft deberán comunicar, antes de cruzar el pasillo de entrada y salida de Getafe, con la TWR de Getafe para información de tráfico.

SALIDAS

Las aeronaves saliendo de Madrid/Cuatro Vientos AD procederán por el punto W (Villaviciosa de Odón).

Aeronaves con IAS igual o inferior a 120 kt según plan de vuelo, abandonarán el ATZ a 3000 ft, y aeronaves con IAS superior a 120 kt según plan de vuelo, abandonarán el ATZ a 3500 ft.

Si está en servicio la pista 10, todas las aeronaves realizarán el viento en cola previo a abandonar el circuito de aérodromo a una altitud de 3300 ft.

PRECAUCIÓN

No sobrepasar 3000 ft en el sector visual al Sur de la carretera N-V.
Los aviones con destino o salida de Madrid/Getafe AD por punto WG, mantienen 3500 ft.

NOTA

Madrid/Getafe TWR podrá autorizar el paso del "corredor Norte" al "corredor Sur" de Madrid/Getafe o viceversa a través de la CTR cuando el tráfico lo permita.

CORREDOR NORTE: Línea que une Getafe con Mostoles.

CORREDOR SUR: Línea que une Getafe, Valdemoro y Aranjuez teniendo como eje la carretera N-IV.

PROCEDURES:

ARRIVALS

Aircraft destination Madrid/Cuatro Vientos AD will contact with TWR in N point (Boadilla del Monte) and S point (Residencial Miraflores).

- S Point:

Aircraft with IAS equal to or below 120 kt as indicated in flight plan, shall proceed at 3000 ft and aircraft with IAS above 120 kt, as indicated in flight plan, shall proceed at 3500 ft, both until joining the aerodrome traffic circuit.

Aircraft proceeding at 3500 ft shall contact with Getafe TWR, for traffic information, before crossing the arrival and departure corridor of Getafe AD.

DEPARTURES

Aircraft departing from Madrid/Cuatro Vientos AD will proceed via the W point (Villaviciosa de Odón).

Aircraft with IAS equal to or below 120 kt as indicated in flight plan, shall leave the ATZ at 3000 ft and aircraft with IAS above 120 kt as indicated in flight plan,shall leave the ATZ at 3500 ft.

If runway 10 is in service, all aircraft will carry out the downwind prior to abandon the traffic circuit at 3300 ft altitude.

CAUTION

Do not surpass 3000 ft in the visual sector to South of N-V road. Aircraft destination or departure from Madrid/Getafe AD by WG point, maintain 3500 ft.

NOTE

Madrid/Getafe TWR may authorize to pass from "North corridor" to "South corridor" of Madrid/Getafe or vice versa across the CTR when traffic permit so.

NORTH CORRIDOR: Line joining Getafe with Móstoles.

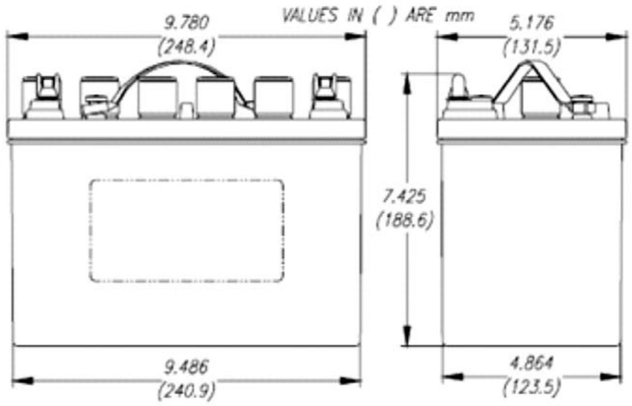
SOUTH CORRIDOR: Line joining Getafe, Valdemoro and Aranjuez, with axis in N-IV road.

15-MAR-07 (AMDT 155/07) AIP-ESPAÑA AD 2-LECU/LEVS VAC 1.1

APPENDIX 3
Gill G-35 battery data sheet

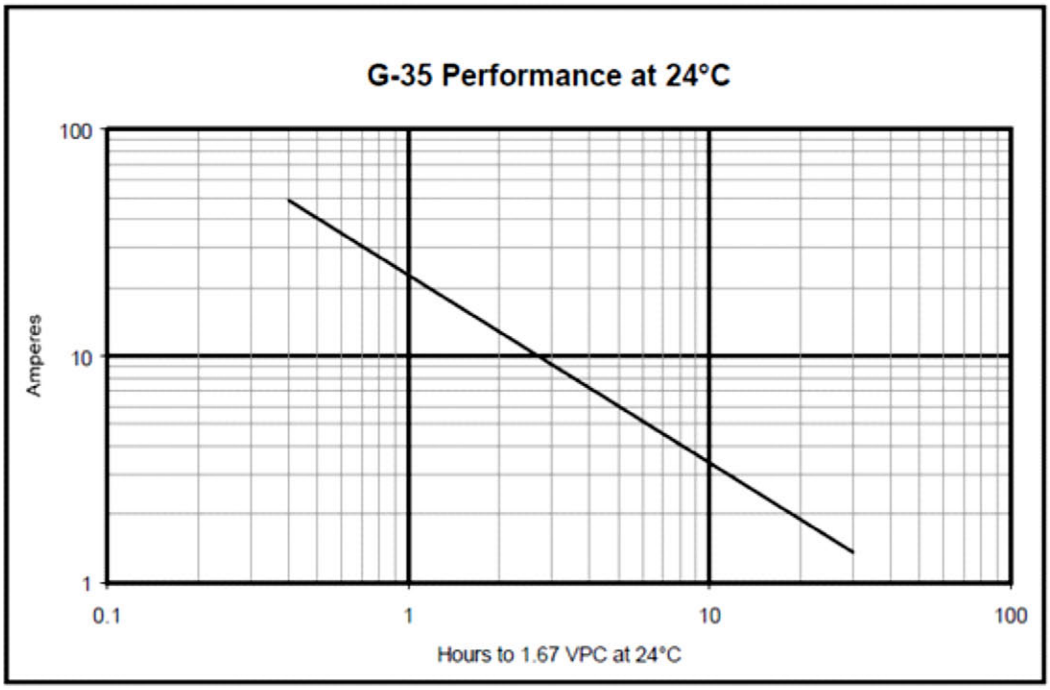
G-35

Gill DRY-CHARGE MAINTENANCE MANUAL



G-35 Performance Data

Run time	End Volts Per Cell	Test Temperature (°C)	Watts	Amps	Capacity (Ah)	Energy (Wh)	Weight (lb)	Electrolyte Volume (quarts)
60 sec	1.2	-18	3,900	325	5	65	27	3
30 min.	1.67	24	480	40	20	240	27	3
60 min.	1.67	24	276	23	23	276	27	3
20 hr.	1.67	24	23	1.9	38	456	27	3



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