National Transportation Safety Board
Aviation Accident Factual Report

Location:	Las Vegas, NV	**Accident Number:**	WPR16FA166
Date & Time:	08/18/2016, 0739 PDT	**Registration:**	N140EM
Aircraft:	DOUGLAS TA-4K	**Aircraft Damage:**	Destroyed
Defining Event:	Loss of engine power (total)	**Injuries:**	1 Minor
Flight Conducted Under:	Public Aircraft		

HISTORY OF FLIGHT

On August 18, 2016, about 0739 Pacific daylight time, an experimental Douglas TA-4K, Skyhawk turbo-jet airplane, N140EM, was destroyed when it collided with the ground following a loss of engine power shortly after entering the traffic pattern at Nellis Air Force Base (LSV), Las Vegas, Nevada. The airline transport pilot sustained minor injuries. The airplane was registered to and operated by Draken International Inc., for the U.S. Department of Defense as a public aircraft in support of the U.S. Air Force and U.S. Navy. Visual meteorological conditions prevailed at the airport and a military flight plan was filed for the simulated combat training flight. The local flight originated about 0620.

According to the pilot, he was the lead airplane of a flight of two aggressors, returning to LSV after completion of their Weapons School support flight in the Nevada Test and Tactics Range. The flight was uneventful until the formation break-up on initial, in the traffic pattern. The pilot led the formation to the overhead pattern for runway 21R, and shortly after the break to downwind, the airplane experienced a loss of engine power. The pilot reported hearing a loud "thump," then noticed the engine's rpm decreasing, and heard the engine surging. During this time, the engine did not respond to throttle movements. The pilot at first initiated a turn towards the airport; however, he realized that he was unable to make the runway and consequently turned left towards a field. He selected manual fuel control and thought the engine might respond but the rpm continued to rapidly drop. Once assured that the airplane would impact in the field, the pilot initiated a successful ejection and sustained minor injuries. The airplane subsequently struck terrain and was consumed by fire, about 1 mile north of the approach end of runway 21R.

Witnesses reported observing the airplane on downwind, as being low and descending. Shortly thereafter, they observed the pilot eject and then the airplane descended rapidly towards the ground and upon impact, produced a large fireball outside the base perimeter.

A review of surveillance video shows the airplane flying wings level at a low altitude and descending. A few seconds later, the ejection sequence was initiated and two chutes (one from

the unoccupied back seat) were observed deployed. A couple of seconds later, the airplane impacts terrain.

PERSONNEL INFORMATION

The pilot held an airline transport pilot certificate with ratings for airplane single-engine land, multi-engine land, and instrument. He also held ratings for a flight instructor certificate in airplane single-engine and instrument. Additionally, he was type rated in the Boeing 737, and held an experimental airplane authorization for the Douglas Corporation A-4 Skyhawk.

The pilot was issued a first-class airman medical certificate on August 15, 2016, without limitations or waivers. The pilot reported that he had accumulated 8,076 total flight hours, 230 hours in the accident make and model airplane, and had flown 211 hours in the last 3 months. He also had previously flown the General Dynamics (now Lockheed Martin) F-16 Fighting Falcon airplane for the United States Air Force and logged about 5,200 hours in it.

AIRCRAFT INFORMATION

The TA-4K Skyhawk was a swept-wing, two-seat jet airplane powered by a single Pratt & Whitney J52 turbojet engine that was manufactured in 1970 by the Douglas Corporation and later upgraded by Draken International Inc. The airplane was developed for the U.S. Navy and Marine Corps during the Vietnam war era.

Maintenance was accomplished by Draken International Inc. A review of the maintenance logbooks revealed that the last continuous airworthy inspection was accomplished on July 29, 2016, at an airframe time of 6,850.2 hours. The engine had a total time of 3,211.5 hours, 428.7 hours since inspection, and 1,826.3 hours since overhaul.

The airplane utilized a single Pratt & Whitney J52 turbojet engine that produced about 9,200 lbs of thrust. The J52 is a continuous flow, gas turbine engine which incorporates a split 12 stage, axial-flow compressor and 2 turbine stages. A 5-stage low-pressure compressor (LPC) is driven by a single-stage low pressure turbine (LPT) front compressor drive turbine rotor and a 7-stage high compressor (HPC) is driven by a single-stage high pressure turbine (HPT) rear compressor drive turbine rotor.

The accident airplane had an engine write-up on May 18, 2016, for a thrust deficiency while performing acrobatic maneuvers. The write-up stated that the engine seemed like it was not producing the correct amount of thrust. Military (MIL) power, also referred to as full-power or 100% power, would only indicate 98% power, with a noticeable humming noise, and the airplane became slow during acrobatics with the normal power settings. As a result, maintenance accomplished an engine run to 75% and all engine parameters checked good. The write-up also stated that maintenance would monitor the engine for any trends at 75% power or greater.

Fuel servicing records indicated that the accident airplane was fully refueled with 916 gallons on the morning of the accident. The fuel truck that serviced the airplane had a fuel sample tested after the accident, and the sample was within established standards. The airplane forms indicated 8,200 pounds of fuel was onboard, prior to the flight. According to the pilot, he

confirmed that about 8,000 pounds of fuel was onboard the airplane during preflight. The pilot further stated that during the flight, the formation accomplished about 3 fuel checks in the area. According to the accident pilot's wingman, during the flight, after their area work was complete, a final battle damage assessment check with the lead airplane was accomplished, prior to returning to the LSV. The lead airplane reported 2,300 pounds of fuel and his status as the wingman was 1,800 pounds of fuel. Draken International Inc.'s operations procedures stated that the minimum fuel for the airplane was 800 pounds and emergency fuel was 500 pounds. Additionally, the fuel at initial or the final approach fix was 1,000 pounds.

The aircraft's flight manual lists the following procedures for a Low Altitude Loss of Thrust/Flameout:

1. Throttle – Check full forward.
2. Zoom climb.
3. If below 1,500 above ground level (agl) and 250 knots indicated airspeed (KIAS) - Eject.
4. Throttle – Retard.
5. Fuel Control switch – Manual.

   - If thrust is not regained immediately, proceed as follows:
6. RAT (Ram Air Turbine) – Deploy
7. Throttle - Ignition, then idle. (Monitor EGT for signs of relight).
8. External Stores – Jettison, if required.
9. Throttle – Cautiously advance.
10. Below 5,000 ft agl – Nil engine response, eject.
11. Above 5,000 ft agl – Airstart. (if time and altitude permit, establish 250 kts glide and commence airstart).

The TA-4K aircraft flight manual stated: ejection is mandatory "when an engine flameout occurs below 1,500 ft agl and 250 kias," except when unusual circumstances clearly dictate otherwise.

METEOROLOGICAL INFORMATION

A review of data from LSV, automated weather observation station revealed that at 0756 conditions were wind calm, visibility 10 statute miles, scattered clouds at 11,000 ft, temperature 30°C, dew point 9°C, and an altimeter setting of 29.91 inches of mercury.

AIRPORT INFORMATION

LSV is a United States Air Force (USAF) owned, towered airport, with a field elevation of 1,869 ft. The airport was equipped with two concrete runways, runway 3L/21R (10,120 ft long by 200 ft wide) and runway 3R/21L (10,051 ft long by 150 ft wide). Airport remarks for the runway 21R, listed a caution for a crane training site north of the departure end of runway 03L, maximum height was 100 ft.

WRECKAGE AND IMPACT INFORMATION

Examination of the accident site by the National Transportation Safety Board (NTSB) investigator-in-charge (IIC) revealed that the airplane impacted desert terrain at an elevation of about 1,926 ft. All major components of the airplane were contained within the main wreckage site. The airplane impacted the ground at a relatively shallow angle and on a magnetic heading of about 087°. After impact, the airplane continued to slide forward on the ground for about 30 ft and then struck and breached a concrete wall. The airplane continued to slide forward for about another 45 ft before coming to rest on its right side against a berm. A post-crash fire ensured, and the debris was mostly contained from the concrete wall to where the airplane came to rest.

The fuselage sustained substantial damage to most of its right side, from the vertical stabilizer forward to the cockpit area. The left speed brake was extended. The right speed brake was separated but appeared to be fully extended. The cockpit and nose area sustained extensive damage due to impact with the wall and the post-crash fire. The manual flight control release mechanism on both the horizontal stabilizer and aileron hydraulic power pack was found in the manual flight control mode.

The engine was observed to be mostly intact and lying on its right side. The first stage compressor blades near the 6 o'clock position, were fractured and bent rearward, with minimal rotational deflection (bent in the direction opposite rotation). The inlet guide vanes and inlet case exhibited ground impact damage and were buckled and fractured near the 6 o'clock position. The engine-driven generator was separated from the front of the engine and was recovered nearby.

The engine's no. 1 bearing was exposed and observed to be shiny, intact, and undamaged. No apparent damage was noted on the second stage turbine airfoils. All but one of the Pt7 (total pressure) probes were intact. One Pt7 probe was observed to be fractured. All six, Tt7 (referred to as the exhaust gas temperature (EGT) probes), were intact. The burner pressure (combustion pressure) Pb line remained attached but was observed to be fractured just forward of the electrical disconnect junction box, located on the bottom of the engine. The engine's gearbox had separated from it mounting points but was still partially attached to the engine by tubing. The engine's tailpipe was partially separated just aft of the rear engine flange.

The engine was removed from the wreckage and further examination revealed that the left side of the engine was encased in molten metal. The main upper tower shaft was recovered nearby. A Pratt and Whitney investigator began a partial disassembly and examination of the rear portion of the engine, while on site.

A follow up engine and airframe examination was accomplished at the salvage facility of Air Transport, in Phoenix, Arizona by the NTSB IIC. Engine representatives and investigators from the NTSB, Pratt and Whitney, Draken International Inc, and Boeing, were in attendance.

A comprehensive borescope analysis of the engine was accomplished. The front of the engine was accessed, and multiple viewing revealed no foreign object damage (FOD) or blade tip interference. Access through an ignitor port allowed a view of the no. 4 and no. 3 combustion cans and several 1st stage turbine blades and vanes. No anomalies were noted. No damage to the turbine section was observed. A borescope was inserted through the tower shaft cavity towards the engine centerline and no anomalies were observed with the no. 3 bearing. All bearings were unremarkable with no discoloration or surface anomalies observed.

The gearbox assembly exhibited damage consistent with ground impact and had separated from the engine mounts. The gear train was exposed due to large fragments of the housing being separated. Visual examination of the gearbox revealed no damage attributed to operation prior to impact. Housing damage prevented the gear train from being manually rotated. The gearbox was disassembled and examined. The drive shafts and gear teeth of the tach drive, the fuel pump, main bevel, and fuel control gears were all intact. The only anomaly noted was the fracture of the lower tower shaft cup which is part of the main bevel gear assembly. The lower tower shaft cup was separated from the rest of the assembly and about 40% of its engagement teeth were missing. The shaft was also bent about 60°

Several cockpit instruments were removed and shipped to the NTSB's Material laboratory for examination. The instruments had sustained thermal damage and had various levels of damage from impact. No reliable information that was pertinent to the investigation was obtained from the instruments.

The engine parts and accessories were examined further at another examination. Investigators from the NTSB, Pratt and Whitney, USAF, and Draken International Inc. were present. The engine's gearbox lower tower shaft/drive gear assembly and cup and the P2 pressure tube, were removed and examined at the NTSB's Materials Laboratory. Microscopic examination revealed that all separation surfaces were from overstress fractures, consistent with impact damage. No indications of preexisting cracking or corrosion were noted at the fracture areas. The Materials Laboratory also examined the no. 1 and no. 6 bearing, P3 pressure manifold, and the low-pressure spool (N1) shaft, and no anomalies were observed.

No anomalies were noted during the airframe and engine examination that would have precluded normal operation.

The main fuel control (MFC) unit and main fuel pump (MFP) were examined at the Naval Air Station Depot facility in Jacksonville, Florida.

The MFP was unable to be functionally bench tested due to impact damage. Disassembly and examination of the MFP revealed no mechanical anomalies that would have prevented normal operation. The drive gears, bearing sets, and impeller were intact. Normal wear and minor corrosion were observed but were consistent with other similar type MFPs being overhauled at

the facility. The fuel filter was contaminated with dirt and debris from the crash. The fuel lines going to the filter were breached and allowed contamination to enter the filter.

The MFC permits the selection of a desired engine thrust while automatically compensating for ambient operating conditions. Further, the MFC accurately governs the engine steady-state speed and controls fuel flow during acceleration and deceleration. The MFC is mounted to the bottom of the engine's accessory gearbox and features a hydromechanical control. Two internal filters protect it from any potential contaminants from the high-pressure fuel discharged from the main fuel pump. There is a relief valve to bypass the filter that protects the metering section. The other filter is self-cleaning.

The MFC consists of two basic operating engine operating systems, the primary control system and a manual backup system. During primary control operation, the MFC metering section regulated fuel to the engine as a function of the throttle requested and ambient conditions.

Manual control of the MFC is used in the event the primary control system malfunction and is engaged by a switch in the cockpit. Once the manual system is engaged, fuel is blocked to the primary throttling valve and directs it to the manual throttle valve. The manual throttle is positioned by the power lever which directly relates to the fuel flow commanded, with no metering function.

In both modes, the first area where the fuel flows to is the transfer valve, where the manual and normal fuel flows take separate paths. The fuel flows continue to the area where their respective and separate system pressure regulator valve is located. Next, the fuel enters their separate throttle valve system area. Both fuel flows then merge back together in the check valve and then flow to the minimum pressure regulating shutoff valve location, before the fuel exits the MFC.

The MFC sustained impact and thermal damage and could not be functionally tested. The MFC housing appeared to be intact except for the fuel outlet port to the fuel flow transmitter was fractured. The MFC's drive spline was able to manually be rotated. In addition, no witness marks were observed on the speed servo that would help determine the MFC's speed setting at the time of impact and the internal filters were clear of contaminants. The only anomaly noted was that an unknown non-metallic material was located inside the MFC's minimum pressure regulating and shutoff valve port and the check valve port; both of which are interconnected and near the exit point of the MFC. The material was removed and sent to the NTSB's Materials laboratory for analysis.

The NTSB laboratory determined that the non-metallic material located in the MFC was that of a nylon 6/6 material. Therefore, the MFC specifications, drawings, and other historical technical data were reviewed to determine the type and amount of non-metallic materials located in the MFC's interior. Locations in the MFC were identified and noted that utilized the nylon 6/6 material for various sealing functions.

Another examination of the MFC was accomplished. During the second examination, all expected non-metallic seals were identified and located in their proper position inside the MFC. All the seals were intact except the one located at manual system pressure regulating valve, which sustained thermal damage. The fuel flow paths between the primary and manual

fuel system pressure valves to the throttle valves, and then to the minimum pressure regulating and fuel shutoff valve exit port was examined. No debris or obstructions were observed. No evidence of additional nylon 6/6 material was observed inside the MFC, other than what was originally observed on the first examination. Additionally, a borescope examination was accomplished of the fuel flow paths and revealed no obstructions.

The closest internal source of the nylon 6/6 that was thermally damaged, like the foreign contamination (the non-metallic material discovered during the initial MFC examination), was the manual system pressure regulating valve. The valve's seal had sustained thermal damage, but most of its remnants appeared to be present. The remnants of the seal were collected and weighted at 1.229 grams. An exemplar, new nylon 6/6 seal, used for that valve, was weighted at 1.43 grams. Therefore, the seal remnants were consistent with the seal being in place preimpact. Further, the weight of the foreign contamination located, during the first MFC examination, was 0.833 grams, and would not be consistent with being part of the seal remnants at the manual pressure regulating valve.

The MFC unit was located on the left side of the bottom of the engine. However, during the accident sequence, the engine came to rest on its right side and the MFC was now inverted and located on the top side of the engine. The area of the contamination was therefore, now situated near the highest point of the MFC. Examination of the flow paths from the manual system pressure regulating valve to the area where the contamination was located, would require the valve debris remnants to travel through a couple of valve areas (check valve and minimum pressure regulating shutoff valve), in a vertical and then downward flow, a couple of times.

The engine components downstream of the MFC, that were on the fuel flow path to the engine fuel nozzles, were also examined, to ensure no foreign material was deposited into the MFC during the postimpact fire. The fuel flow transmitter was the first component in the flow after the MFC; no anomalies were noted in its internal portions. Next in the flow path was the fuel-oil cooler. Internal examination revealed no anomalies besides external thermal damage and a small speck of black contamination, observed internally, that did not obstruct flow. The pressurizing and dump valve was next in the flow path and was removed and disassembled. Inside the pressurizing and dump valve, there was a heavy build-up of material located within the strainer assembly that was consistent with the remnants of the fuel dump valve lower valve seat. The lower seat was not located during disassembly. However, since the strainer captured all the valve remnants, there was no material deposited inside the pressuring valve cavity that would potentially restrict fuel flow.

According to Draken International Inc, the airplane's MFC total time was 3,063 hours. It was inspected on a 750-hour interval during a main engine inspection. The MFC time at the last inspection was 2,635.5 hours. It was 427.7 hours since the last inspection and had 322.3 hours remaining until the next inspection. The MFC had maintenance accomplished on it in 1997 and 1998. In 1999, the MFC was rebuilt and has subsequently flown for a total of 425 hours, with 275 of those hours flown by Draken International.

Several other components of the fuel system were examined. The fuel level control valve, fuel boost pump, fuel transfer pump, and fuel shut off valves. None of the components could be

tested because of the significant impact and thermal damage sustained, however examination of the components revealed no preimpact anomalies.

MEDICAL AND PATHOLOGICAL INFORMATION

Toxicology testing was not performed on the pilot by the FAA, and the decision to conduct testing was left to be determined by Draken International Inc. under their established guidelines. According to the Draken International Inc, the pilot's results were negative from the testing performed by the USAF.

ADDITIONAL INFORMATION

The canopy, both ejection seats, and parachutes were examined by the NTSB IIC with a life support specialist from Draken International Inc. The ejection sequence appeared to function normally, and no anomalies were observed with the equipment. The investigation was unable to determine the ejection altitude. However, the pilot stated he may have delayed his ejection decision. Further, witnesses reported the ejection occurred just a few seconds prior to the airplanes impact, and the surveillance video confirmed what the witnessed observed.

A review of the ejection seat assembly revealed that all inspections and time change requirements were current, with the exception of the separation rocket motor inspection, which were due on both ejection seats in July 2015. However, an extension of the inspections, was approved by the FAA, with the manufacturer's assessment memorandum.

Draken International Inc. operated the airplane and was a contract air support organization that provided aggressor support, red air, and close air support for the U.S military, Department of Defense, and allied militaries globally. The organization operated the world's largest commercial fleet of tactical ex-military jet airplanes consisting of about 150 tactical fighter jet airplanes.

Pilot Information

Certificate:	Airline Transport	**Age:**	54, Male
Airplane Rating(s):	Multi-engine Land; Single-engine Land	**Seat Occupied:**	Front
Other Aircraft Rating(s):	None	**Restraint Used:**	
Instrument Rating(s):	Airplane	**Second Pilot Present:**	No
Instructor Rating(s):	Airplane Single-engine; Instrument Airplane	**Toxicology Performed:**	Yes
Medical Certification:	Class 1 Without Waivers/Limitations	**Last FAA Medical Exam:**	10/17/2015
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	10/17/2015
Flight Time:	(Estimated) 8076 hours (Total, all aircraft), 230 hours (Total, this make and model), 6921 hours (Pilot In Command, all aircraft), 211 hours (Last 90 days, all aircraft), 42 hours (Last 30 days, all aircraft), 2 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	DOUGLAS	**Registration:**	N140EM
Model/Series:	TA-4K NO SERIES	**Aircraft Category:**	Airplane
Year of Manufacture:	1970	**Amateur Built:**	No
Airworthiness Certificate:	Experimental	**Serial Number:**	157914
Landing Gear Type:	Retractable - Tricycle	**Seats:**	2
Date/Type of Last Inspection:	07/29/2016, Continuous Airworthiness	**Certified Max Gross Wt.:**	24500 lbs
Time Since Last Inspection:		**Engines:**	1 Turbo Jet
Airframe Total Time:	6850.2 Hours at time of accident	**Engine Manufacturer:**	Pratt and Whitney
ELT:	Not installed	**Engine Model/Series:**	J52-P8
Registered Owner:	DRAKEN INTERNATIONAL INC	**Rated Power:**	9200 lbs
Operator:	DRAKEN INTERNATIONAL INC	**Operating Certificate(s) Held:**	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual Conditions	**Condition of Light:**	Day
Observation Facility, Elevation:	LAS, 1869 ft msl	**Distance from Accident Site:**	11 Nautical Miles
Observation Time:	0756 PDT	**Direction from Accident Site:**	30°
Lowest Cloud Condition:	Scattered / 11000 ft agl	**Visibility**	10 Miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	Calm /	**Turbulence Type Forecast/Actual:**	/ None
Wind Direction:		**Turbulence Severity Forecast/Actual:**	/ N/A
Altimeter Setting:	29.91 inches Hg	**Temperature/Dew Point:**	30°C / 9°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Las Vegas, NV (LSV)	**Type of Flight Plan Filed:**	IFR
Destination:	Las Vegas, NV (LSV)	**Type of Clearance:**	IFR
Departure Time:	0620 PDT	**Type of Airspace:**	Class D; Military Operation Area

Airport Information

Airport:	NELLIS AFB (LSV)	**Runway Surface Type:**	N/A
Airport Elevation:	1869 ft	**Runway Surface Condition:**	
Runway Used:	21R	**IFR Approach:**	None
Runway Length/Width:	10120 ft / 200 ft	**VFR Approach/Landing:**	Traffic Pattern

Wreckage and Impact Information

Crew Injuries:	1 Minor	**Aircraft Damage:**	Destroyed
Passenger Injuries:	N/A	**Aircraft Fire:**	On-Ground
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 Minor	**Latitude, Longitude:**	36.235000, -115.033889 (est)

Administrative Information

Investigator In Charge (IIC):	Albert P Nixon
Additional Participating Persons:	Michael McComb; Federal Aviation Administration; Las Vegas, NV John Takach; Pratt and Whitney; Hartford, CT Andrew Gorzela; Boeing; St Louis, MO Paul Kingsley; Draken International Inc.; Lakeland, FL Randy Rushworth; USAF Safety Center; Albuquerque, NM
Note:	The NTSB traveled to the scene of this accident.
Investigation Docket:	http://dms.ntsb.gov/pubdms/search/dockList.cfm?mKey=93855