



NATIONAL TRANSPORTATION SAFETY BOARD
Office of Aviation Safety
Washington, D.C. 20594

February 7, 2022

AIRWORTHINESS GROUP CHAIRMAN'S FACTUAL REPORT

NTSB No: CEN20LA167

A. ACCIDENT

Operator: Houston Police Department
Aircraft: MD Helicopters 369E, registration N8375F
Location: Houston, Texas
Date: May 2, 2020
Time: 0203 central daylight time

B. GROUP

Group Chairman:	Chihoon Shin National Transportation Safety Board Washington, District of Columbia
Member:	Daniel Prince Federal Aviation Administration Houston, Texas
Member:	Sgt. Randy Martin Houston Police Department Houston, Texas
Member:	Joan Gregoire MD Helicopters Mesa, Arizona
Member:	Dave Riser Rolls-Royce Indianapolis, Indiana

LIST OF ACRONYMS

CFR	<i>Code of Federal Regulations</i>
COVID-19	coronavirus disease 2019
FAA	Federal Aviation Administration
IAH	George Bush Intercontinental Airport
NTSB	National Transportation Safety Board
PCL	pitch change link
TRDS	tail rotor drive shaft
TX	Texas

C. SUMMARY

On May 2, 2020, about 0203 central daylight time, a MD Helicopters 369E, N8375F, was substantially damaged after impacting a roof and subsequently the ground during an emergency landing in Houston, Texas (TX). The pilot sustained serious injuries and a tactical officer sustained fatal injuries. The helicopter was operated under the provisions of Title 14 *Code of Federal Regulations (CFR)* Part 91 as a public aircraft flight. The pilot held a commercial pilot certificate and a second-class medical certificate. At 0153, the recorded wind at George Bush Intercontinental Airport (IAH) was 170° at 4 knots and visibility was 10 statute miles. According to the United States Naval Observatory indications, the Moon had set (more than 30° below the horizon) and provided no illumination at the time of the accident. A ground witness video of the accident helicopter showed it began to rotate in the yaw axis while in the air, and subsequently descended. The helicopter initially impacted the roof of a building and then the ground adjacent to the building.

On March 30-31, 2021, members of the Airworthiness Group convened at a Harris County impound lot in Tomball, TX to examine the wreckage and review the helicopter maintenance records.¹

D. DETAILS OF THE INVESTIGATION**1.0 HELICOPTER INFORMATION****1.1 HELICOPTER DESCRIPTION**

The MD Helicopters 369E has a five-bladed, fully articulated main rotor system that provides helicopter lift and thrust as well as a two-bladed teetering tail rotor system that provides directional control. The helicopter is equipped with a high skid-type landing gear. The 369E is equipped with one Rolls-Royce 250-C20B turboshaft engine. The helicopter is type certificated under Federal Aviation Administration (FAA) type certificate data sheet No. H3WE.

¹ Due to the coronavirus disease 2019 (COVID-19) pandemic, National Transportation Safety Board (NTSB) investigators did not travel to the accident site and examination of the wreckage was delayed.

1.2 HELICOPTER HISTORY

The accident helicopter, serial number (S/N) 0586E, was manufactured in 2008 and was acquired by the Houston Police Department that same year. Engine S/N CAE-837101 was installed new on the accident helicopter when it was manufactured. The helicopter was equipped with a flight hour-meter as well as a maintenance hour-meter. At the time of the accident, the maintenance hour-meter showed 4,787.9 hours but the flight hour-meter was unreadable. According to the maintenance records, the aircraft total time (ATT) was about 5,227.8 hours at the time of the accident.

2.0 OBSERVATIONS AT THE ACCIDENT SITE^{2,3}

The helicopter came to rest on its left side at the base of a building (**Figure 1**). The helicopter initially impacted the roof of a building and subsequently fell to the ground. The wreckage area was compact with no significant debris trail. There was no postcrash fire. All five main rotor blades were present at the accident site. The left skid tube was separated from the main fuselage but the right skid remained attached. A longitudinal tear was observed along the skin and structure of the fuselage underside. The tail boom remained attached to the main fuselage but the empennage, composed of the vertical fin, horizontal stabilizer, tail rotor gearbox, and tail rotor, was separated from the tail boom; the empennage came to rest on top of the right side of the helicopter near the engine bay. The tail rotor gearbox remained installed on the empennage and both tail rotor blades remained attached to the tail rotor hub.



Figure 1. The helicopter at the accident site. (Image courtesy of the FAA)

² The terms “left”, “right”, “up”, and “down” are used when in the frame of reference of looking forward from the aft end of the helicopter, i.e. aft looking forward (ALF). All locations and directions will be viewed from ALF unless otherwise specified. Additionally, clock positions are in the ALF frame of reference unless otherwise specified.

³ Photographs and observations were gathered by the operator and the FAA.

3.0 POST-RECOVERY WRECKAGE EXAMINATION

On March 30-31, 2021, members of the Airworthiness Group convened at a Harris County impound lot in Tomball, TX to examine the wreckage.

3.1 AIRFRAME

The main fuselage exhibited multiple fractures and deformation from the impact. The majority of the cockpit canopy was separated from the airframe (**Figure 2**). The upper fairings, including the engine inlet and filter, were present and whole. The right engine bay door remained attached to the main fuselage but the left engine bay door was separated. The left side of the cockpit and the left (pilot) seat were partially attached to the structure. A piece of lumber had penetrated, and remained lodged within, the cabin structure from underneath the helicopter. The right skid tube and its struts remained attached to the main fuselage. The left skid tube was fractured and separated but its struts remained attached to the main fuselage. The fuel bladder was torn but was present within the main fuselage.



Figure 2. The helicopter main fuselage.

The tail boom remained attached to the main fuselage (**Figure 3**) but its empennage was fractured and separated (**Figure 4**). There was impact deformation on the left side of the aft end of the tail boom, likely due to contact with main rotor blades. Blue paint transfer of the same color as the tail boom was observed on the leading edges of the 'yellow' and 'green' main rotor blades.

The empennage was displaced to the left. The leading edges of the upper and lower vertical fins were also displaced to the left. The left and right horizontal stabilizers exhibited impact deformation, with the right horizontal stabilizer leading edge exhibiting impact deformation in the aft direction. The left horizontal stabilizer tip plate remained attached and the right horizontal stabilizer tip plate was fractured and separated, but recovered.



Figure 3. An aft view of the main wreckage showing deformation to the tail boom.



Figure 4. The separated empennage.

3.2 MAIN ROTOR SYSTEM⁴

The main rotor hub, main rotor drive shaft and static mast, and main transmission remained installed on the airframe (**Figure 5**). All five pitch housing assemblies remained attached to the main rotor hub. The main rotor blade airfoils were separated from the main rotor head during recovery and storage (**Figure 6**).

⁴ The main rotor rotates counterclockwise when viewed from above the helicopter. The five main rotor blades and their components are identified by a unique color. The order of rotation of the main rotor blades, when viewed from the pilot seat and with the blade traversing from left to right, is as follows: 'yellow', 'green', red', 'white', and 'blue'.

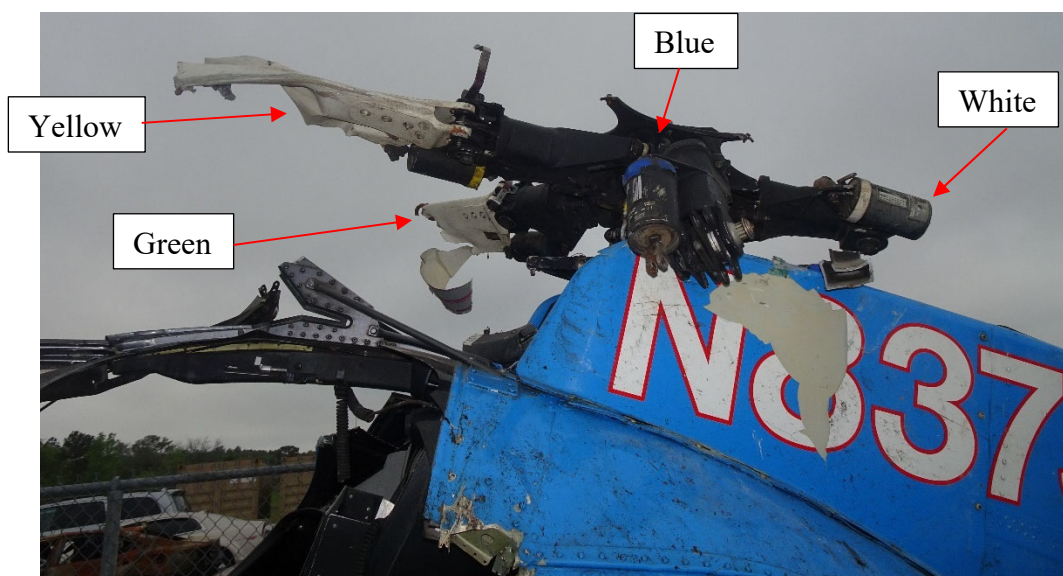


Figure 5. The main rotor head installed on the helicopter.



Figure 6. The five main rotor blades.

The 'yellow' main rotor blade root fitting, along with an inboard portion of the 'yellow' blade airfoil, remained attached to its pitch housing assembly. The 'yellow' pitch change link (PCL) was whole and connected to both its pitch horn and the rotating swashplate. The 'yellow' blade damper remained installed between its pitch horn housing and blade. The 'yellow' blade was fractured near its inboard end but was continuous and whole from the fracture to its tip end. The outboard section of the blade was generally straight with no significant deformation to its leading edge.

The 'green' main rotor blade root fitting, with an inboard portion of the 'green' blade airfoil, remained attached to its pitch housing. The 'green' PCL was fractured at the threaded portion of both upper and lower rod ends. The 'green' PCL body was straight but fractured on its internal threads at the upper rod end. The lower portion of the 'green' PCL body contained the threads from the lower rod end as well as its retaining nut. The 'green' blade damper remained installed and connected between its pitch housing and blade. The 'green' blade was fractured near its inboard end but was continuous and whole from the fracture to its tip end. The outboard section of the blade was generally straight with no significant deformation to its leading edge.

The 'red', 'white', and 'blue' main rotor blades were separated from their respective pitch housing assemblies during recovery of the helicopter. Based on the on scene photographs, the 'red' blade was resting on a nearby palm tree and its tip was pointed vertically upward. The 'white' blade was resting on the ground with its tip pointed aft. The 'blue' blade was folded over the top of the rotor head cover and resting on the ground with its tip pointed forward.

The 'red' PCL remained installed between its pitch horn and the rotating swashplate. The 'red' blade damper remained attached to the pitch housing assembly and was disconnected from its blade attachment point during recovery of the wreckage. The 'red' blade damper piston was extended outside of its housing. The 'red' blade was whole from the root fitting to its tip end. The 'red' blade exhibited a generally straight appearance with no significant deformation to its leading edge.

The 'white' PCL remained attached between its pitch horn and the rotating swashplate. The 'white' blade damper remained attached to the pitch housing assembly but its piston was separated from the damper housing and the piston remained attached to the 'white' blade. The 'white' blade was whole from the root fitting to its tip end. The 'white' blade exhibited a generally straight appearance with no significant deformation to its leading edge.

The 'blue' PCL remained attached between its pitch horn and the rotating swashplate, but the 'blue' pitch horn was fractured from its pitch housing assembly. The 'blue' blade damper remained attached to the pitch housing assembly and was disconnected from its blade attachment point during recovery. The 'blue' blade was whole from the root fitting until a fracture near its outboard end. The 'blue' blade exhibited significant deformation as well as twisting and a partial fracture at its inboard end. The outboard section of the blade, up to the blade tip, exhibited a generally straight appearance.

The stationary scissor link was intact and remained installed between the main transmission and the stationary swashplate. The rotating scissor link remained installed to the main rotor shaft and the rotating swashplate, but the lower link was fractured near its attachment to the upper link.

The main transmission chip detectors were removed and free of magnetic debris. The overrunning clutch remained installed on the engine gearbox and exhibited normal functionality in both the drive and freewheeling directions when manually rotated. The engine-to-transmission (Kaflex) driveshaft remained installed but was fractured at the aft Kaflex coupling. A dent was observed on the firewall adjacent to the fractured aft Kaflex coupling. The remainder of the Kaflex driveshaft exhibited no other anomalous damage. Continuity of rotor system drive was confirmed via manually rotating the Kaflex driveshaft and observing a corresponding rotation of the main rotor head as well as the tail takeoff flange. The drive belt between the main transmission input flange and the oil cooler remained installed and intact.

3.3 TAIL ROTOR SYSTEM

The tail rotor drive shaft (TRDS) remained connected to the main transmission tail takeoff flange. The TRDS was fractured in two locations between the tail takeoff flange and the tail rotor gearbox Kaflex coupling. The forward segment of the TRDS was continuous until a fracture immediately adjacent to the aft side of the steel sleeve (on the TRDS) that contacted the

TRDS dampener (**Figures 7 and 8**). The fracture was circumferential and generally on the same [transverse] plane, i.e. not a spiral fracture. On the aft side of the fracture, a small, longitudinal gouge (perpendicular to the fracture plane) was present but the source of the gouge in areas adjacent to the TRDS could not be determined. A dent was observed at the aft edge of the TRDS steel sleeve; the dent was offset from the gouge by about 0.5 to 1.0 inches (**Figure 9**). The dampener was whole and its mounting holes showed deformation from impact with its attaching hardware. The middle segment of the TRDS, aft of the fracture near the dampener, was continuous until a second fracture that was co-located with the fractured and separated aft section of the tail boom (**Figure 10**). The aft segment of the TRDS remained within the separated empennage. The aft segment of the TRDS was a singular piece up to its attachment to the tail rotor gearbox input flange, but the TRDS contained a fracture partially around its circumference (**Figure 11**). **Figure 12** shows a view of the reconstructed TRDS after its removal from the tail boom. Portions of the TRDS were cut by the investigation group to retain smaller segments of the TRDS for metallurgical examination of the fracture adjacent to the steel sleeve by the NTSB Materials Laboratory in Washington, D.C.



Figure 7. The TRDS fracture (red arrow) near the dampener within the tail boom.



Figure 8. The TRDS fracture near the dampener (red bracket) after removal of the TRDS from the tail boom. The tail rotor control tube is seen above the TRDS.

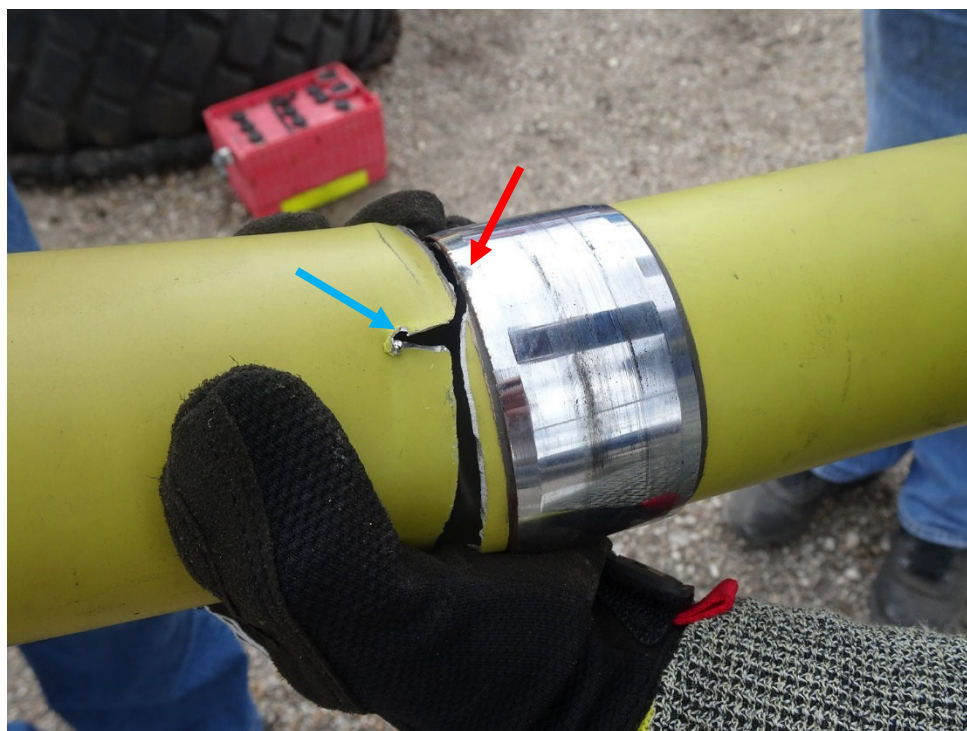


Figure 9. The two fracture halves of the fracture near the TRDS dampener. The red arrow points to the dent on the steel sleeve and the blue arrow points to the gouge.



Figure 10. The TRDS fracture (red bracket) co-located with the aft tail boom separation.



Figure 11. The aft TRDS segment leading to the tail rotor gearbox.



Figure 12. A view of the reconstructed TRDS after removal from the tail boom.

The tail rotor gearbox remained installed on the aft section of the tail boom. Manual rotation of the aft section of tail rotor gearbox input flange resulted in a corresponding rotation of the tail rotor with no evidence of binding or restriction. The tail rotor gearbox chip detector was removed and was free of magnetic debris.

The two tail rotor blades remained attached to the tail rotor hub. Both tail rotor blades were whole and did not exhibit fractures, fragmentation, or significant deformation. One of the two tail rotor blades exhibited a small impact dent at the tip end of the leading edge, but no other anomalous damage was found on either tail rotor blade. The two tail rotor PCLs remained installed between the pitch change sleeve and the tail rotor blades. Manual movement of the pitch change sleeve showed no evidence of binding. The splines on the output shaft were intact and exhibited no anomalous damage.

3.4 FLIGHT CONTROL SYSTEM

The left seat and right seat collective controls remained installed in the cockpit. The left collective control was fractured near its base (to which the control stick is normally attached). The collective torque tube remained installed with no evidence of fractures. The one-way lock

assembly remained installed and its aft rod end remained attached to the airframe but was fractured at its threads.

The left seat cyclic control was found within the cockpit and exhibited multiple fractures, but remained attached to the cockpit via wiring. The right cyclic control base was visible but the cyclic control was not present. According to the operator, the right cyclic control and right seat foot pedals are not normally installed except for when the helicopter is used for dual-piloting purposes, and therefore were not installed for the accident flight. The vertical (tunnel-routed) control tubes for lateral and longitudinal cyclic remained connected between the mixing unit and the bellcranks near the transmission deck. The control linkages remained attached between the transmission deck bellcranks and the stationary swashplate.

The left seat pedal mounts and its linkages were recovered as a single assembly but was separated from the main fuselage (**Figure 13**). The foot pedals were also separated from the assembly but were recovered. The torque tube extending to the left seat pedal assembly was fractured with signatures consistent with overload. The torque tube remained installed in the main wreckage but the tube was collapsed about mid-length and its outboard end was deformed upward (**Figure 14**). The torque tube remained connected to the [center] sleeve assembly and its attaching hardware remained installed. The sleeve assembly remained installed within the main fuselage.

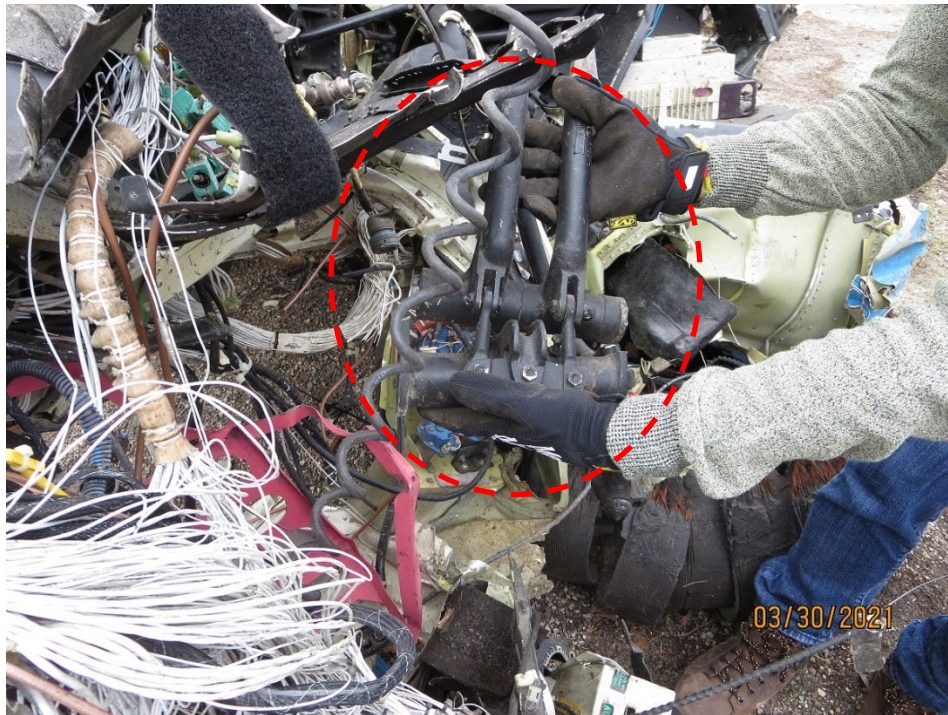


Figure 13. The recovered left seat pedal mounts and linkages. (Image courtesy of MD Helicopters Inc.)



Figure 14. The red arrow points to the pedal torque tube as seen in the main wreckage. (Image courtesy of MD Helicopters Inc.)

The right seat pedal mounts and its linkages were recovered as a single assembly but was also separated from the main fuselage. The foot pedals were not installed at the time of the accident. The torque tube was fractured in a location within its sleeve assembly, but the torque tube attaching hardware remained installed. The sleeve assembly remained installed within the main fuselage.

The directional control system's longitudinal control tube, between the pedal torque tube installation and the mixing unit, was present. The longitudinal control tube was deformed and fractured near its forward rod end threads with the fracture exhibiting signatures of overload. The forward rod end remained attached to the torque tube installation. The aft end of the longitudinal control tube remained attached to the mixing unit. The bungee spring remained installed between the control tube and the airframe. The directional control system's vertical control tube, between the mixing unit and the airframe station (STA) 96 bellcrank, forward-left of the main transmission, remained installed and did not exhibit significant deformation or fractures (**Figure 15**). The directional control system was continuous from the STA 96 bellcrank to the fractured and separated aft tail boom section (containing the tail rotor). The remainder of the control tube was found within the separated aft tail boom section and remained connected to the tail rotor gearbox bell crank, and directional control continuity was present through the tail rotor pitch change sleeve.



Figure 15. Transmission deck flight control bellcranks. The red arrow points to the directional control system bellcrank at STA 96.

3.5 ENGINE

The engine remained partially attached to the airframe but had rotated upward due to impact deformation of the engine bay (**Figure 16**). The left engine mount remained installed but exhibited a fracture near its engine attachment. The center engine mount remained installed but its left arm exhibited a fracture near its airframe attachment. The right engine mount remained installed and intact. All engine accessories remained installed onto the engine accessory gearbox. The left compressor discharge tube was deformed inward due to impact and the outer combustion case was crushed inward. The left and right exhaust tubes were also deformed. The upper and lower chip detectors were removed and were free of magnetic debris.

The first stage compressor blades were observed through the inlet and exhibited no evidence of foreign object debris ingestion or other anomalous damage. All first stage compressor blades were present. Manual rotation of the compressor resulted in a corresponding rotation of the starter/generator pad (after removal of the starter/generator), confirming continuity of drive within the gas generator drivetrain. The first stage turbine wheel was present and exhibited no anomalous damage. The fourth stage turbine was observable through the engine exhaust ports and all turbine blades were present. Manual rotation of the fourth stage turbine was attempted but the power turbine drivetrain would not rotate. Residual fire retardant was observed in the vicinity of the turbine wheels.



Figure 16. A view of the engine installation within the airframe prior to its removal.

4.0 METALLURGICAL EXAMINATION

The forward TRDS fracture was examined by the NTB Materials Laboratory in Washington, D.C. Examination of the fracture surfaces showed signatures consistent with overstress. Compressive buckling was observed in multiple locations. Overall, the observed fracture features were consistent with torsional overstress with some bending.

Additional details of the metallurgical examination can be found in the NTSB Materials Laboratory Factual Report No. 21-041 in the docket for this investigation.

5.0 MAINTENANCE

According to the aircraft maintenance records, as of May 1, 2020, the maintenance hour-meter had 4,782.3 hours and the flight hour-meter had 5,222.2 hours. According to the operator, the airframe total time and the flight hour-meter were the same times. The last aircraft inspection was performed at a maintenance hour-meter time of 4,775.3 hours, which entailed a 25-hour inspection that was completed on April 28, 2020. The last 100-hour/annual inspection was performed on March 18, 2020 at a maintenance hour-meter time of 4,700.7 hours.

Attachment 1 of this report contains the last aircraft inspection performed on April 28, 2020.

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