# Table of Contents

**Introduction**  
**Aircraft Description**  
**Aircraft servicing**  
**Aircraft Systems**  
  - Electrical  
  - Caution and Warning  
  - Instruments  
  - Fuel System  
  - Power Train  
  - Flight Controls  
  - Power Plant  
**Operation Procedures**  
  - Ground & Flight  
  - Weight & Balance  
  - Emergency  
**Pilot Notes**
INTRODUCTION

Enstrom 280FX and F28-F series Helicopter Pilot Training Course Objectives

The purpose of this course is to prepare an experienced helicopter pilot for a smooth transition into the Enstrom Piston powered helicopters.

This course includes descriptions and theory of operation for the systems, and the location of the system components.

The course also includes the description of the pilot pre-flight procedures and the pilots are expected to perform these pre-flight Inspections.
GENERAL DESCRIPTION

The Enstrom 280FX and F28-F helicopters are 3 bladed, single engine helicopters manufactured by the Enstrom Helicopter Corporation and certified by the FAA under part 6 of the Civil Air Regulations.

Turning Radius

The turning radius is about 23 feet when pivoted on the wheels about the mast.

Principal Dimensions
CHARACTERISTICS

Helicopter description

The Enstrom 280FX and F28 F helicopters are single engine, piston powered helicopters certified for day and night VFR flight that can be equipped for IFR flight training. The F28 F helicopter was originally certified in 1980 and the 280 FX in 1985 to the CAR 6 regulations.

Early F28 F and 280F helicopters were certified to 2350 lb maximum gross weight and can be changed to the later 2600 lb gross weight by incorporating the appropriate modifications.
Beginning in 1984, F28 F and 280FX helicopters were produced with the maximum gross weight limitation of 2600 pounds.

Enstroms are relatively quiet helicopters due to the installation of the turbocharger, and the slow turning main and tail rotors. They can be equipped with an optional secondary muffler that lowers the noise signature significantly.

All Enstrom helicopters feature a three bladed, fully articulated main rotor system which has over 3,000,000 flight hours and which has never had a catastrophic failure or thrown a blade. The tail rotor is two bladed and completely unblocked for exceptional effectiveness. Due to the high inertia rotor design, the helicopter possesses outstanding auto-rotational capabilities.

In addition to being a versatile and crashworthy helicopter, the 280FX and F28 F helicopters were designed to be procured and operated for minimum costs. The helicopter does not require hydraulic boost or stability augmentation systems.

The limited number of fatigue critical parts, the long overhaul intervals, and the low hour/flight maintenance ratio resulting from high reliability and easy maintenance combine to yield low operation and support costs.
SERVICING

Fuel

100/130 Aviation Grade Mil-G-5572
100LL Aviation Grade

Engine Lubrication Oils

Oil, Ashless Dispersant MIL-L-22851

Flight Control Lubricants

Grease, MIL-G-81322 (Mobil 28, Shell 22)

Landing Gear Oleos

Oil, MIL-H-5606

Nitrogen

Main Rotor Dampers

Oil, L-45 Silicone Oil (GE Silicone L-45-20)

Main and Tail Transmissions

Oil, MIL-PRF-2105 (Mobil 1 Gear Oil) Mobil 1 Synthetic Gear Lubricant (75W-90)
Overrunning Clutch

Oil,  MIL-L-23699 (Mobil Jet II, Shell Turbine Oil 500 or equivalent)

Tach Drive Cables

Grease,  2701-109 (S.S. White CO, LPS 2)

Notes:

Landing gear oleos should be serviced with the weight of the helicopter off of the landing gear, and should be all serviced at the same time or at the very least, in pairs, front and back struts together.
CONSTRUCTION DETAILS

Fuselage

The fuselage is the forward section of the airframe extending from the nose to the forward end of the tailcone. The cabin shell is molded out of fiberglass and the aluminum seat and floor structure is fabricated and then bonded into the fiberglass shell.

The pylon structure is welded up out of high carbon molybdenum steel. The landing gear, cabin and tail cone are bolted on to the pylon structure. The engine and main rotor transmission are also attached to the pylon.
Tailcone

The tail cone is bolted to the aft end of the pylon. It is a tapered semi-monocoque structure comprised of skins, bulkheads, longerons and stringers. The tailcone supports the tail rotor, tail-rotor transmission, horizontal and vertical stabilizers, and the tail-rotor guard. It houses the tail rotor drive shaft and can be used to mount some of the helicopter electrical equipment.
Landing Gear

Main Landing Gear: The main landing gear consists of two tubular aluminum skids attached to the airframe by means of the forward and aft cross tubes through four air-oil oleo struts. The struts cushion ground contact during landing.

Drag struts give the gear stability and strength and prevent fore and aft movement during ground contact maneuvers. Due to their design, the drag struts will sustain landings with significant forward movement of the helicopter; however, landing with rearward movement may overload the structure and cause its collapse.

Replaceable hardened steel skid shoes are installed on each skid to resist skid wear on hard surfaces.
On the 280FX and the F28 F, the ground handling wheels are permanently secured to the landing gear skid tubes with brackets. To place the helicopter on the wheels, remove the lynch pin and secure the supplied wheel bar over the lug with the handle aft. Using a sharp motion pull the bar over the top to the forward position. Then secure the position of wheel with the pin before removing the wheel bar.

Be sure to secure that the helicopter is off of the wheels and that the safety clip on the lynch pin is secured before flying the helicopter.
NOTE

Use extreme caution that the wheel bar does not slip off of the wheel lug as serious injury may result

NOTE

Some helicopters may be prone to falling on the tail when the second wheel is lowered. It is good practice to place the tail rotor in the horizontal position before lowering the wheels, or have some one hold the tail hoop.

Crew Compartment

The crew compartment consists of pilot and passenger/co-pilot seating, Instrument panel, radio console and pilot and co-pilot flight controls mounted to the aluminum floor structure and enclosed in the fiberglass cabin shell.

The co-pilot controls are removable and a seat cushion for the third passenger is inserted into the space vacated when the co-pilot collective is removed.
To remove the co-pilot collective, remove the securing pin and slide the collective lever from its socket. Reinstallation of the lever is accomplished in the opposite order. The securing pin is attached to a cable and can be recovered by reaching a finger into the slot and feeling for the cable. It’s also important to note that the locking lever can be latched in two positions, 180 degrees apart. The correct position is the one that requires force to lock the lever in the down position.

To remove the co-pilot cyclic lever two 3/8 wrenches must be used to remove the securing hardware, do not replace the nuts with a safety pin as the cyclic will vibrate due to looseness.
The co-pilot pedals can be removed by removing two pins at the pedal stalk top. There is an optional modification that allows the pedal stalks to be removed at the floor.
Cabin Doors

The cabin doors are a fiberglass molded structure with a transparent Plexiglas window bonded on the outside. The outside edges of the door glass are painted so that the internal door structure is not shown. Replacing a broken door glass is thus an expensive project so it is necessary for the pilot to be extremely vigilant so that the doors are not damaged.

NOTE

Enstrom recommends never leaving the doors unattended without shutting and latching them.

Cabin ventilation is provided by sliding vent windows with positionable winglets. Optional pop-out vents are available.

To remove the doors on the 280FX, disconnect the safety clip and pull the ball end off of its stud. Remove the screw securing the forward end of the restraint strap to the inside cabin wall.
Then remove the bolt securing the upper door hinge on the outside using two 7/16 wrenches and while holding the door, remove the bolt while catching the spacer that maintains distance between the two hinge brackets. Be sure to store the bolt, nut, spacer and washer in the door hinge bracket to ensure that it is not lost.

To remove the door on the F28 F, disconnect the gas strut as on the 280, open the door and withdraw the hinge pins. In both aircraft, install the doors using the procedures in reverse order.
Seats

The seats in the piston engine Enstrom Helicopters consist of NASA form fitting type foam that is secured to the fiberglass seat deck with Velcro. To carry three people, the center collective is removed and is replaced by a contoured cushion.

Inertial Reel Shoulder Harness

An inertial reel and shoulder harness is used for all seats. With the shoulder straps properly adjusted, the reel strap will extend to allow the occupant to lean forward; however the reel will automatically lock if the helicopter encounters an impact force of 2 to 3 "G" deceleration. To release the lock, it is necessary to lean back slightly to release tension on the lock.

Flight Controls

The flight controls include three primary systems: the collective, cyclic, and anti-torque or directional controls. The aircraft also has fixed horizontal and vertical stabilizers that are mounted on the tail cone to provide additional stability and attitude control during high-speed flight.
Engine

The piston powered Enstrom helicopters are powered by a Lycoming built HIO-360-FIAD four cylinder, air cooled engine that produces 225 Shaft Horse Power. The maximum horsepower is achieved with the aid of a Kelley Aerospace turbocharger that incorporates an adjustable waste gate that is controlled by a breakaway control rod.

The engine is cooled by a large fan that is installed between the crankshaft and the lower belt pulley. Cooling air for the engine is drawn in from the overhead scoop mounted behind the main rotor mast, through the fan and then around the cylinders and through the oil coolers.

There is a clean out trap mounted adjacent to the two oil coolers to facilitate cleaning debris away from the oil coolers.
Power Train

The power train includes the main rotor transmission, an upper pulley assembly incorporating the overrunning clutch, jack strut, drive belt, lower pulley, drive shaft and tail rotor gearbox.
Main Rotor System

The main rotor system is a three bladed, high inertia, fully articulated rotor hub with aluminum blades. The main rotor hub assembly is composed of two opposing forged aluminum hub plates separated by an aluminum cylindrical spacer. Through bolts hold these items together along with steel spline adapters.

Three steel universal blocks are mounted on roller bearing units that permit flapping and lead-lag motions. Laminated phenolic pads are used to limit blade travel in both the lead-lag and flapping axes. A thrust nut on the bottom of each universal block transfers vertical blade forces to both hub plates through the universal block.

The rotor blades are secured to each universal block on the hub through a forged aluminum grip which is in turn secured to a steel spindle assembly through an elastomeric feather bearing (Lamiflex Bearing) and a retention nut.
Closed circuit hydraulic dampers are incorporated between each flapping pin and the rotor hub to limit the lead-lag velocity of the blades. Because the hydraulic dampers have no centering spring, they are quite limber; this, coupled with the large heavy blades causes the ground rock that is often experienced while the helicopter rotor system is spooling up or at high blade RPM.
The main rotor blades are of hollow construction consisting of an extruded leading edge spar, with a 7 degree twist, to which is bonded upper and lower aluminum skins. The blade root is composed of a bonded doubler assembly.

A single retention pin connects the blade root to the grip and a non-adjustable drag brace connects the trailing edge of the blade to the grip.

A cap is bonded to the tip of each blade in which there are provisions for spanwise and cordwise balance weights. Two tracking tabs are riveted to the trailing edge of each blade.
Tail Rotor Assembly

The tail rotor is a two bladed, wide cord, teetering, delta hinged rotor assembly.

The fly-weights on the blade retention plates unload the tail rotor twisting forces in flight so that the pilot does not need to carry left pedal at cruise power settings. They are weighted so that when the aircraft is being flown at approximately 29 inches manifold pressure, the pedals are neutral and the slip ball centered.

For this reason, the aircraft requires very slight left pedal in hover and in climb, and significant right pedal in low power situations.

A tubular aluminum tail rotor guard is installed on the aft end of the tailcone. It acts as a warning to the pilot upon an inadvertent tail-low landing and aids in protecting the tail rotor from damage while the helicopter is on the ground.

IMPORTANT!

The tail rotor guard will not prevent damage to the tail rotor in the event of a hard landing.
ELECTRICAL SYSTEMS

Description – Starter / Generator Systems

The starter on current production Enstrom 280FX and F28-F helicopters consists of a Skytech manufactured high-speed starter mounted on the engine, behind the main oil cooler driving on a ring gear that is mounted on the outside of the engine flywheel.

A 24 volt battery is mounted just aft of the engine and below the baggage compartment on the right side of the aircraft. The starter solenoid is mounted on the battery tray, and the master switch solenoid is mounted on the firewall just inboard of the engine air cleaner. The aux power plug is mounted above the oil cooler, inside the right engine cowl door.
The master switch on the instrument panel energizes the master switch relay which powers up the helicopter systems. The alternator switch powers the voltage regulator which controls the alternator output. The start switch energizes the starter button on the pilot’s collective.

**Starting systems**

For aircraft starting the master switch, alternator switch, and the start switch are placed in the **on** position, and the magneto switch is placed in the **both** position. If an APU unit is used, the alternator switch is left in the **off** position. When the starter switch on the collective is pressed, the starter solenoid energizes the starter and the starting vibrator.

The starting vibrator has an internal relay that switches off the right magneto for starting and that directs a hot steady spark through the left magneto and the retard points to the spark plugs. This is to facilitate the start and prevent the engine from kicking back. It’s important to note that the starting vibrator requires over 9 volts to operate so the engine generally will not start if it is cranked with a low battery.

**IMPORTANT**

*NEVER PERFORM A MAGNETO CHECK IN A HELICOPTER WHILE FLYING. IF THE ENGINE IS SWITCHED TO AN INOPERATIVE MAGNETO, THE ENGINE WILL STOP RUNNING.*
Because the magneto is not connected to the helicopter electrical system, turning off the battery switch while flying will not affect the operation of the engine, except that the electric boost pump will not operate.

**Alternator Systems**

The electrical generating system in the 280 FX and the F28-F consists of the 24 volt battery, 60 amp alternator and a solid state voltage regulator. Power to the voltage regulator is controlled by the switch marked *Alternator* on the instrument consol switch panel. When the switch is turned on, the voltage regulator is energized which then controls the voltage produced by the alternator by varying the field voltage.

The battery is located behind the engine, just under the forward side of the baggage compartment, and the voltage regulator is located under the right side of the co-pilot seat. The alternator is located on the aft left side of the engine compartment and the alternator belt can be inspected through a removable panel just above the auxiliary oil cooler.

On the Enstrom helicopters, the ammeter measures the voltage that is going in and out of the battery; it is not a load meter. After the engine is first started, the ammeter will indicate a high rate-of-charge as the battery charge is replenished. As the battery becomes charged, the rate-of-charge indicated by the ammeter will drop off slowly until it reads only slightly above zero. If the alternator stops charging, the *Alternator* segment on the annunciator panel will light, and the ammeter will indicate negative amperage equal to the electrical load being used by the helicopter.

The voltage regulator is sensitive to both over-voltage and momentary charging interruptions. If the operator notices the alternator caution light is illuminated, the voltage regulator may be reset by turning off the alternator switch for a few seconds and then turning it back on.

NOTE

The engine magneto develops electrical power to fire the sparkplugs internally and there is no connection between the magneto and the helicopter electrical system.
CAUTION AND WARNING SYSTEMS

Description- Caution and warning systems

The annunciator panel is located at the top of the instrument console and consists of 8 indicator lights with a press-to-test switch at the extreme left. Pressing this switch will illuminate all of the indicator lights.

The following warning and precautionary information is displayed on the annunciator panel.

<table>
<thead>
<tr>
<th>SEGMENT</th>
<th>COLOR</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>STARTER RELAY</td>
<td>AMBER</td>
<td>Starter is operating</td>
</tr>
<tr>
<td>LOW ROTOR RPM</td>
<td>AMBER</td>
<td>Main rotor RPM is below 334</td>
</tr>
<tr>
<td>OVERBOOST</td>
<td>AMBER</td>
<td>Manifold pressure is approaching Red Line</td>
</tr>
<tr>
<td>CLUTCH ENGAGE</td>
<td>RED</td>
<td>Belt Clutch is disengaged</td>
</tr>
<tr>
<td>TRGB CHIP</td>
<td>AMBER</td>
<td>Tail rotor gearbox chip detector has detected ferrous metal fragments</td>
</tr>
<tr>
<td>MRGB CHIP</td>
<td>AMBER</td>
<td>Main rotor gearbox chip detector has detected ferrous metal fragments</td>
</tr>
<tr>
<td>LOW FUEL PRESSURE</td>
<td>RED</td>
<td>Electric Boost pump is producing less than 15 PSI</td>
</tr>
<tr>
<td>LOW VOLTAGE</td>
<td>RED</td>
<td>Alternator is off-line</td>
</tr>
</tbody>
</table>
WARNING SYSTEMS DESCRIPTIONS

Starter Relay

The starter relay warning light is operated by a circuit connected to the starter relay. Its purpose is to alert the pilot that the starter is operating or is engaged.

There is a slight possibility that the starter might not disengage after the starter button is released. Continued operation of the helicopter with the starter engaged, will cause damage to the starter and the starter ring gear, and will result in the helicopter not starting.

CAUTION
INADVERTENT OPERATION OF THE STARTER CIRCUIT IN FLIGHT WILL CAUSE A SUDDEN AND SEVER LOSS OF POWER

Low Rotor RPM

The Low Rotor RPM circuit consists of a magnetic sensor in the main rotor gearbox, a signal generator located behind the passenger's seat back, a light located in the annunciator panel, and an audio warning horn.
The RPM sensor in the main rotor gearbox is a magnetic pick-up unit that is installed in the forward section of the gearbox. It senses the speed of the passing ring gear teeth and sends a signal to a relay and control box that are located on a bulkhead just behind the right passenger seat back.

The sensor reads the signal that comes from the gearbox magnetic pickup and routes it to the annunciator panel and the audio warning horn. The audio warning system consists of a horn located in the headliner and a connection with the helicopter intercom system that broadcasts the horn into the pilots head sets.

Because the low rotor warning system is armed by the clutch-engage switch, the Low Rotor RPM warning light will only illuminate if the clutch is engaged. There is also a switch on the collective system that disengages the Low Rotor RPM warning system when the collective is in the full down position.

After the engine is started, the following sequences will occur in the Low Rotor RPM warning system. The red Clutch Disengage light will be on until the clutch is engaged. When the clutch handle snaps into position, the red Clutch Disengage light will go out, and the amber Low Rotor light will illuminate.

The Low Rotor RPM warning light will remain on until the Rotor RPM exceeds 334, but the horn will not sound unless the collective is raised off the bottom stop and the RPM is less than 334 RPM.

The Low Rotor RPM warning light and horn will activate anytime the clutch is engaged, the rotor RPM is less than 334, and the collective is raised off of the down stop.

The RPM that the low rotor RPM system operates at can be adjusted by turning a potentiometer that is located on the sensor that is behind the passenger seat.

**Overboost**

The overboost circuit consists of a pressure switch that is installed in the manifold pressure gauge line and an amber light in the annunciator panel. The switch is designed to illuminate the light at between 36 and 40 inches of manifold pressure. The switch and light may be activated by short pressure pulses that might not register on the manifold pressure gauge. The light is a warning to the pilot that maximum manifold pressure limits may be exceeded and that the manifold pressure gauge should be monitored.
The overboost light is intended to be a warning; the manifold pressure gauge should be used to determine actual manifold pressure.

**Clutch Engage**

The clutch engage light is activated by a switch that is located on the belt clutch capsule. It is a normally closed switch that is opened when the clutch over-center mechanism snaps into place as the belt clutch is engaged. One side of the same switch is used in the low rotor warning system.

If the **Clutch Disengage** light does not go out when the handle is stowed, or comes on in flight, a problem with the clutch over-center locking mechanism is indicated.

**DO NOT FLY THE AIRCRAFT UNTILL THE FAULT HAS BEEN REPAIRED.**

**Main or Tail Transmission Chip Lights**

MRGB and TRGB chip lights indicate metallic particles on the chip detectors. Normally these chip lights do not indicated an immediate emergency. The pilot should land as soon as possible and inspect the chip detectors for condition. If the pilot elects to continue the flight the temperatures of the gearboxes should be monitored carefully as impending problems with a gearbox are usually indicated by a rise in operating temperatures.
Low Fuel Pressure

The low fuel pressure circuit consists of a pressure switch in the fuel line located between the electric boost pump, and the engine driven fuel pump. If the pressure at the switch falls below 15 PSI the lamp on the annunciator panel will illuminate. The most common cause of the **Low Fuel Pressure** lamp lighting is failure of the Electric Boost Pump.

Low Voltage

The **Low Voltage** lamp is controlled by an electrical sensor that is located on the inside right side of the instrument pedestal. Illumination of this light indicates that the alternator has dropped off line.

Functional Tests – Warning systems.

Turn on the Master Switch.

Push the Press-to-Test switch on the left side of the Annunciator Panel. All of the segments in the Annunciator Panel should light and then go out when the switch is released. In the 280FX and the F28 F there is no diagnostic check performed, so false indications of main and tail transmission chip lights are possible.

Engage the belt clutch handle. The Clutch engage light should go out, and the low rotor RPM light should light. Release the collective friction and raise the collective control off of the down stop. The low rotor RPM warning audio horn should activate.

Secure the clutch in the disengaged position and turn off the Battery Switch.
INSTRUMENTS

Dual Tach

The Dual RPM rotor and engine RPM tachometer is driven by separate tachometer cables, one from the engine and one driven by belts off of the tail rotor drive shaft.

Rotor Limitations

The minimum allowable transient rotor speed is 280 RPM. This is a transient limit and positive corrective action (lowering the collective) must be taken immediately by the Pilot to regain at least 334 RPM (minimum power off rotor RPM)

<table>
<thead>
<tr>
<th>ROTOR</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>385 RPM</td>
<td>Red Radial</td>
<td>Max RPM Power Off</td>
</tr>
<tr>
<td>334 - 385</td>
<td>Green ARC</td>
<td>Continuous Operation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Including Autorotation)</td>
</tr>
<tr>
<td>334</td>
<td>Red Radial</td>
<td>Minimum RPM, Power off</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ENGINE</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>3050</td>
<td>Red Radial</td>
<td>Max RPM</td>
</tr>
<tr>
<td>2900 - 3050</td>
<td>Green ARC</td>
<td>Continuous operation</td>
</tr>
<tr>
<td>2900</td>
<td>Red Radial</td>
<td>Minimum RPM continuous</td>
</tr>
</tbody>
</table>
Airspeed

117 MPH, 280FX max airspeed, power on
112 MPH F28 F max airspeed, power on
85 MPH 280FX & F28 F max airspeed, power off

Manifold Pressure

10 in. to 39 in. - Green Arc, normal operating range
39 in. - Red Line, Never exceed limit
Over Boost illuminates, 36 to 39in mp.

Fuel Flow:

29 in. MP or below

Maximum Fuel Flow – Full Rich
Minimum Fuel Flow – Leaned to 1650F, rich side of peak

29 in. MP to 39 in. MP – Full Rich

0 lbs/hr to 160 lbs/hr – Green Arc

Fuel Quantity Gauge

Full – 240 lbs, (40 Gal)
Empty – 0 lbs, (0 Gal)
Unusable Fuel, (2 Gal)

Transmission Oil Temperature

225F – Red Line
0 to 225F – Green Arc
Oil Pressure Gauge

100 PSI – Red Line (maximum oil pressure on start up)
60 to 100 PSI – Green Arc
25 to 50 PSI – Yellow Arc
25 PSI – Red Line

Oil Temperature Gauge

245F – Red Line
120 to 245F – Green Arc
60 to 120F – yellow Arc

CHT

500F – Red Line
200 to 500F – Green Arc

TIT

1650F – Digital Read Out

FUEL SYSTEM

The fuel system in the 280FX and the F28 – F consists of two 21 gallon fuel tanks that are interconnected and feed simultaneously to the engine. The tanks are mounted on the right and left side of the aircraft above the engine compartment. The tanks have a total fuel capacity of 42 gallons with a total unusable fuel of 2 gallons, one gallon for each tank.

The two tanks drain by gravity and are connected together at the fuel shut off valve which is mounted just above the engine, behind the pilot and passenger. The shutoff valve control is mounted just above the back of the seat in the center of the aircraft.
The shutoff valve is pulled out (forward) for off, and pushed in (aft) for on. The fuel valve should stick out approximately 1/8 to ¼ inch from the back wall when the control is in the on position.

Each fuel tank has a drain valve located just inside the small upper engine compartment door, and there is a main-low-point sump just inside of the right side ¼ panel that is drained by pushing in on the drain hose that protrudes through the side.

The fuel boost pump switch is located on the consol switch panel and a red light is installed in the annunciator panel that will light any time the boost pump is switched off or malfunctions.

There is a fuel quantity gauge mounted in the engine gauge cluster that continuously monitors the fuel quantity, the float type sender unit is mounted in the right fuel tank.

CAUTION
If the fuel quantity system malfunctions, the fuel quantity gauge will most likely continuously read full. Never rely solely on the fuel quantity gauge for fuel quantity.

The refueling ports are located on the top of each fuel tank. To physically measure the fuel in each tank, insert the fuel dip stick into the fuel tank vertically until the line marked Fuel filler level is adjacent the fuel filler adapter.

Fuel management may also be managed with an optional digital fuel flow system. If the aircraft is equipped with the optional fuel flow system, the actual fuel level must be entered into the Fuel Flow Totalizer.
POWER TRAIN

Power Train

The power train includes the main rotor transmission, upper pulley, overrunning clutch, lower pulley, belt and the belt tensioning system.

Main Rotor Transmission

The main rotor transmission is a ring and pinion type gear reduction utilizing a splash type lubrication system. There is an electric chip plug drain fitting in the bottom of the transmission that can be removed to inspect or clean without losing the oil from the transmission.

The oil level of the transmission can be checked by looking at a sight gauge that is visible through the top kick-in foot step. There is a temperature probe in the forward bottom of the transmission to operate the transmission temperature gauge in the instrument cluster.

To reach and remove the chip detector, remove the cover under the left side fuel tank, and above the engine cowl door. Reach in towards the aft under side of the transmission. Usually the wire can be found first, and it can be followed up to the chip plug. Press the plug up, and turn ¼ turn anti-clockwise to remove. Helicopters built since the late 1990’s have a plug that can be separated to remove the chip plug from the aircraft for cleaning. Reverse the order to reinstall the chip detector.

The main transmission is driven by the tail rotor drive shaft, through the overrunning clutch.

Overrunning Clutch
The overrunning clutch is installed in the center of the upper belt pulley. It is a sprag-type free wheeling unit that allows disengagement from the engine in the event of a power failure and thus allows the main and tail rotor systems to rotate in order to accomplish safe autorotation landings.

In the driving direction, the sprags engage and connect the outer housing to an inner drive housing which transmits the engine torque to the pinion shaft of the main transmission, and through the tail rotor driveshaft to the tail rotor transmission.

The lower pulley drive system consists of the lower pulley and the jack strut. The lower pulley is bolted on to the crankshaft output flange of the engine with the cooling fan in-between. The purpose of the jack strut is to maintain the...
separation between the engine and the main transmission when the belt clutch is engaged, and therefore maintain belt tension.

Belt Clutch Engage System

The clutch engagement lever is mounted at the right side of the pilot’s seat, on the forward side of the seat structure. The clutch lever is used to engage and disengage the belt clutch mechanism, and therefore the rotor drive system.

A red light on the annunciator panel illuminates any time the battery switch is on and the clutch handle is in the disengaged position.

The rotor system is engaged by pulling the clutch lever upward, and then rearward, until it hits the stop and the light on the annunciator panel goes out. Then the lever can be disconnected by lifting it straight up and then pivoting it down to the floor. When the clutch handle is stowed, it must lay flat on the floor. The clutch lever must be stowed whenever the rotor system is engaged.
NOTE
If the clutch lever does not lay flat on the floor, do not fly the aircraft until the belt clutch rigging has been checked in accordance with SDB 0080 and section 11 of the maintenance manual.

CAUTION
The engine will stall if the clutch is engaged too quickly.

There is a red light on the annunciator panel that is activated by a micro-switch mounted on the belt clutch side plate. If the light illuminates, it indicates a clutch unsafe condition. Land immediately and investigate.

Clutch unsafe safety switch
The engine can be run leaving the belt disengaged without damaging the belt or drive components.

To engage the belt, the engine RPM should be at idle RPM, (1500). Check that the rotors are untied and clear. Engage the clutch handle and slowly begin to lift the handle up. By controlling the handle, drag the engine RPM down into the 1000 to 1100 RPM range and modulate it to keep the RPM in range. When the Blade RPM reaches 100, the clutch can be fully engaged and then the handle stowed.

To disengage the belt, the throttle must be fully closed.

**CAUTION**

Do not attempt to disengage the belt unless the throttle is fully closed. Serious damage to the engine can result.

Engage the clutch handle and slowly release the belt by pushing the handle forward. Hold the handle tightly so that it cannot spring forward out of control. Push the handle until it is completely down to the floor. The rotor system should slowly decrease until it stops. It is preferable not to disengage the handle after releasing the belt clutch.

(Depending on the tightness and the rubber compound of the belt, the rotor may not completely stop rotating on some helicopters.)

**Belt**

The Enstrom helicopters use a wide single piece serpentine belt that is wound using a continuous Kevlar cord. There has never been belt failure on an Enstrom helicopter.

Look at the inside ribbing of the belt during the preflight inspection. Small cracks running across the belt ribs are a normal sign of aging. The belt may be
continued to operate until pieces of the ribbing are shed that are approximately ¾ inch diameter. The internal cord of the belt should never be visible through the cracks in the ribbing on the inside of the belt.

FLIGHT CONTROLS

Cyclic Controls

The cyclic sticks on the piston series Enstroms are attached to the lateral torque tubes which are supported in bearings mounted to the fore and aft bulkheads of the seat structure. There are bell cranks and trim motors mounted under the seat structure and a set of control rods that run up the back of the seat to another set of bell cranks mounted on the back firewall. A final set of control rods are connected to the swashplate on the bottom of the main transmission.

Collective Controls

The collective control levers are attached to a collective torque tube that runs laterally across the helicopter under the seat. The left side of the torque tube terminates in the throttle correlator. There is a collective spring capsule mounted under the seat between the two pilot seats that balances the collective control system forces and that can be adjusted. There are a series of bell cranks and push rods that run up through the seat back to the collective walking beam which is mounted on the bottom of the main transmission.

The collective friction knob located at the left side of the seat deck is used to lock the collective in the down position. The Enstrom helicopters have very heavy
symmetrical blades that are extremely stable in flight. The flight loads into the collective control system are downward, and the spring capsule under the seat balances out these forces. For this reason there are strong upward forces on the collective control lever which are normally balanced out when the blades are at operating RPM.

Anytime the helicopter is operated on the ground particular care must be taken to ensure that the collective friction is on and/or that the collective is guarded.

HEAVY SPRING FORCES ARE PRESENT WITH ZERO OR LOW ROTOR RPM, AND DAMAGE TO THE HELICOPTER OR ENGINE CAN RESULT IF THE COLLECTIVE IS ALLOWED TO RISE WHILE UNATTENDED.

Tail Rotor Controls

The anti-torque pedals are mounted on the forward floor structure and operate a series of bell cranks that transfer the motion to cables. The cables run back along the left side of the fuselage through the engine compartment and then through the tail cone to the tail rotor controls at the tail rotor transmission.

There is a set of penepital weights installed on the tail rotor blade retention plates that maintain the blade pitch in the event of a failure of a cable. This system is designed to maintain the pitch of the TR blades so that the slip ball is approximately centered when the manifold pressure is 29 in.

In the case of a stuck TR, or failure of a TR cable, the TR blades will maintain their pitch which allows the helicopter to be successfully landed with out tail rotor control.
POWERPLANT
A Lycoming built HIO-360-F1AD 225 HP engine is used in the F series Enstrom helicopters. It is a horizontally opposed, fuel injected direct drive, air cooled engine that is turbocharged.

Oil System

The Lycoming engine installation has a capacity of 10 quarts. This includes 8 quarts in the engine and an additional 2 quarts in the oil filter and the oil radiators. The oil dip stick is calibrated to read the oil contained in the engine and therefore is marked Low - 6Qt and Full - 8Qt.

A thermostatic bypass valve automatically controls the oil temperature by regulating the oil that is flowing through the oil coolers.

There is oil scavenge pump that is installed between the fuel pump and the engine that returns the oil that is circulated through the turbocharger to the engine oil sump.

Engine Controls

1. Throttle. A twist grip throttle is located on the collective pitch control stick. The throttle is connected through a mechanical correlator which coordinates throttle control to changes in the collective stick position.

   A round head rivet mounted on the forward end of the twist grip is used to index the proper position for starting the engine.
2. Mixture Control. A vernier mixture control is installed on the radio consol. Full rich is in the “in” position and lean / idle cut off is in the “out” position. Turning the control gives the pilot the ability to make precise adjustments to the fuel mixture and pushing the red button on the end of the control allows the pilot to make large adjustments to the fuel mixture.

3. Magneto Switch. The magneto switch is a key-operated switch located on the far left side of the switch/circuit breaker panel. For starting, place the switch in the “both” position.

4. Start Switch / circuit breaker switch. The start switch / circuit breaker switch energizes the starter button on the end of the collective.

5. Starter Button. The starter button is mounted on the forward end of the collective control with a guard around it to prevent inadvertent activation. Push the switch to activate the starter.

CAUTION
INADVERTENT OPERATION OF THE STARTER CIRCUIT IN FLIGHT WILL CAUSE A SUDDEN AND SEVER LOSS OF POWER

6. Master Switch. The master switch (Battery Switch) is located on the left side of the switch / circuit breaker panel. Turning it on energizes the master relay and connects the battery to the aircraft systems.

Turbocharger

The turbocharger consists of a housing and a spinning shaft that has a turbine wheel on one end and a compressor wheel on the other end.
Energy from the engine exhaust provides the power to compress the intake air by the compressor side of the turbocharger. The increased available manifold pressure from the turbocharger increases the available power of the engine to 225 shaft horse power.

Compressing the engine’s intake air allows the engine to operate with the same volume of air at high altitudes as it does at sea level which gives the engine constant available power up to 12,000 ft density altitude.

**Wastegate**

The Wastegate is a variable adjusting valve that is installed in the exhaust system and which controls the amount of exhaust that is directed through the turbocharger, thus affecting the efficiency of the turbocharger.

The Wastegate is operated by a rod from the throttle actuating arm on the fuel injection servo.

The rod has a break-away feature in the event that the wastegate freezes up in flight, the throttle can be controlled once the Wastegate has released.
Exhaust Gas Temperature System

Turbocharger Inlet Temperature (TIT)

Turbocharger inlet temperature is a measurement of the exhaust gas taken just before it enters the turbocharger. TIT is a combination of all of the individual EGT’s (exhaust gas temperature) and is normally about 40 degrees higher than the individual EGT readings.

Aircraft built before 2001 used a GEM 603 which used a single digital read out at the top of the instrument for monitoring TIT. Current production aircraft are supplied with the GEM 610.

**NOTE:** On aircraft that have an Insight Graphic Engine Monitor, the maximum temperature placard calls out MAX EGT 1650F. This temperature imitation is intended to be TIT.

The GEM 610 has a feature that allows the unit to scroll through the various digital EGT and CHT settings as well as the TIT. This can lead to some confusion as the flight manual and placards on the instrument panel reference EGT when discussing mixture leaning procedures and engine operation.

This is due to the fact that the flight manual was written prior to the release of the GEM engine monitors. The factory is changing EGT to TIT on the placarding and in the flight manual. As a practical mater, any time EGT is referenced in the flight manual, or on the instrument panel placards, TIT is intended.

Cabin Heat

The cabin heat control is located just under the right side of the pilot’s seat. Pull the control out to regulate the amount of heat that is supplied through the vents.
just in front of the tail rotor pedals, and through the vent in the front of the seat structure.

**Clutch Engaging Lever**

The belt clutch engagement lever is located at the right front side of the pilot seat and is used to engage the rotor drive system to the engine. There is a caution light on the annunciator panel to alert the pilot that there might be a problem with the belt-engagement system.

The rotor drive system is engaged by pulling the clutch lever upward and rearward until the lever hits the stop, and the warning light goes out. The handle is stowed in the flight position by lifting it straight up and pivoting it down to the floor. The handle must lay flat on the floor while in the stowed position.

The clutch handle must be placed in the stowed position anytime the rotor drive system is engaged.

### NOTE!

If the Clutch Engage light stays on or if the handle does not lay flat on the floor, the helicopter must not be flown.

**OPERATION PROCEDURES**

**Preflight**

1. If the doors are removed, be careful not to lose the spacer that is installed between the two hinge brackets. These spacers are individually fitted and are not interchangeable.
Please do not fly with the hardware loose or with quick release pins. The door vibrates and wears out the hinge pin holes.

2. Look in the intake air filter scoop for daylight between the black gasket on the airbox and the inside of the cowl door. This must be an airtight seal; otherwise hot air from the engine compartment will be sucked into the engine causing a significant power loss.

3. At the same time, check the condition of the seal itself. It needs to be in good condition.

4. Reach in behind the air box, and grasp the red hose and the hose clamp where they attach to the back of the air box. Verify that the hose is secure and that the clamp is tight.

There has been more than one accident that resulted from the hose coming off and then sticking itself to the back of the air box!
5. The Rubber bag around the fuel tank is actually a containment bag that is supposed to collect fuel in the event of a leak in the tank and drain it overboard. During pre-flight pat the bottom of the bag just to be sure that there is no fuel laying in it.

Check that the fasteners in the top engine covers are all secure. In the event of unusual high cylinder head, engine and MRGB oil temp, check that one of these two covers has not come loose. The cover will deflect from air pressure and let the hot air out into the transmission area.

6. During pre-flight note the middle part of the pulley, it should be clean and shiny. There is normally a narrow band of dirt and grease on the outside ends of the pulley. If the pulley is shiny clean all the way to one side, it could be an indication of belt track problems.

7. Line the mark on the fuel dip stick up with the lip on the fuel filler neck to get an accurate fuel quantity measurement.
8. This is a good spot to store the fuel dip stick in the piston helicopters

9. Occasionally one of the aft stabilizer attach brackets might be found cracked. The second hole in the tab is used when floats are installed on the helicopter

10. Push the stabilizer up and down and look for movement that might suggest problems in the spar mounting area.
11. Cycle the TR blades to the full left pedal position; line the blade up with the TR cable and push the blade against the teeter stop. The distance between the strike tab and the cable must be at least 1.1 inch.

The purpose of the strike tab is to alert you to that the tail rotor could have had a strike.

12. A small amount of oil leaking from the tail transmission output seal is acceptable. It will actually contribute to lubricating the pitch-change slider mechanism.

13. Check the pitch link attach bolt carefully as they sometimes can loosen up. A loose pitch link attach bolt can cause an occasional bump that is felt in the TR pedals when flying the helicopter.
14. Check the pylon in the area of the clutch capsule bell crank for cracks.

15. Inspect the tail pipe weld close to the turbo for cracks. Also it’s a good idea to inspect the two clamps carefully for cracks.

The first sign of a failing exhaust pipe is usually a distortion at the bottom of the tailpipe just under where the by-pass attaches.

16. Grasp the waste gate linkage firmly and shake it in and out. The break-a-way function should stay engaged.

If it releases have it checked by a technician. The force required to release the break-a-way must be 15 to 20 lbs. Each time the break-a-way releases, the small plastic tipped plunger wears a bit and the force required to release the rod decreases.
Starting Engine:

Notes:

Immediately following the engine start, before it is warmed up, the engine may not idle with the electric fuel pump off. Once it has warmed up, turning off the

Takeoff to Hover

1. Cyclic in neutral position.
2. Set engine RPM to 3050.
3. Slowly and smoothly increase collective pitch, maintaining engine RPM by simultaneously rolling off the throttle.
4. The helicopter should come off the ground smoothly with the RPM in the green.

Correlator Operation

The correlator is a mechanical governor that will automatically maintain the engine RPM when the pilot makes adjustments to the blade pitch with the collective lever.

Throttle twist grip
Throttle friction
Correlator
Unlike an electronic governor, the throttle twist grip must not be allowed to move as the collective pitch is adjusted for the mechanical correlator to operate correctly. It is important for the pilot to adjust the throttle friction tightly enough that the throttle will not move on its own when the collective is moved up or down.

If the throttle is allowed to move, or if the pilot tries to chase RPM with throttle, the proper operation of the correlator is defeated.

**NOTE:** The pilot needs to be aware that the correlator does not take into effect, and cannot compensate for changes in tail rotor pitch or translating tendency.

Proper operation of the correlator is described below.

1. Begin the take off procedure by increasing the throttle to 3050RPM with the collective full down.

2. As the collective is raised slowly to lift the helicopter into a hover, roll off the throttle gently to maintain RPM in the green.

3. Just before the struts are fully extended pause and ensure that the RPM is in the green.

4. Gently and slowly raise the collective so that the helicopter enters a hover. The correlator will maintain RPM in the green if the throttle is not allowed to move, and if the helicopter is flown smoothly.

5. If pedal turns are performed in strong winds, the pilot will need to make slight adjustments to the throttle as the correlator will not compensate for changes in tail rotor pitch.

6. It is important for the pilot not to chase RPM with throttle. If an adjustment is needed to the throttle to maintain blade RPM in the green, gently squeeze on or off a slight bit of throttle and pause to allow the blade RPM to catch up. The Enstrom has extremely high inertia blades and the most effective way to adjust blade RPM is by manipulating the collective in addition to making throttle changes.
7. Because the correlator cannot compensate for changes in tail rotor pitch, the correlator has a tendency to over compensate while the helicopter transitions from a hover into climb and from forward flight into decent.

During smooth transition into a climb from a hover, it is common for the RPM to climb and exceed the red line. The pilot should compensate by squeezing off a slight bit of throttle and then pause to see the effect of the change before adjusting the throttle further.

During transition into a decent from cruse, the RPM may have a tendency to drop out the bottom of the green arc. In this case, the pilot should squeeze on a bit of throttle and pause to see the effect before adjusting the throttle again.

NOTE: The pilot needs to be aware that the correlator does not take into effect, and cannot compensate for changes in tail rotor pitch or translating tendency.

Fuel Mixture Operation

Proper fuel mixture operation is complicated by conflicting information that is found in several publications. The Lycoming engine operation manual states that information on leaning of turbocharged engines must be found in the aircraft flight manual. The flight manuals for the F28-F and 280FX state that full rich mixture must be used for power settings over 75 percent, however they also state that the engine may need to be leaned for base density altitudes.

Some F and 280FX series aircraft have fuel injection servos that are flowed quite rich, resulting in too much fuel flow which reduces available power. The performance charts in the flight manual were developed using a calibrated engine and aircraft in which the servo provided the proper amount of fuel resulting in a TIT of 1450. If the helicopter being flown has a TIT in a full-rich hover colder than 1450°F, then the fuel injector servo is flowing too much fuel and the helicopter may not meet the performance specifications that the pilot expects.

The difficulty is that when a pilot makes an approach into a confined area he may have no idea as to what the base altitude density altitude is and how to compensate for it.
While the flight manual states that maximum available TIT is 1650 it is recommended that the helicopter not be operated with TITs higher than 1570 or 1580 degrees F to prevent damage to the exhaust components.

NOTE
The push button on the vernier mixture control is intended to be used for starting and shutting off the engine only. When adjusting the mixture, use the vernier adjustment feature, turn the mixture control one turn and pause to note the result. Never use the pushbutton to push or pull on the mixture control during flight.

The chart on the following page shows that the max power TIT is about 100 to 200 degrees colder than the peak TIT. (Peak TIT is 1650 F on turbocharged Enstrom Helicopters)

Using this chart, if a pilot is intending to make an approach to a confined area, it would be prudent to set the mixture to achieve 1500 degrees TIT before beginning the approach to ensure that suitable power will be available when the approach terminates.

Enstrom F and 280FX series helicopters have a fuel injection servo that incorporates an automatic mixture control which corrects the mixture for changes in density altitude. The net effect is that if the pilot leans the mixture to 1500 degrees TIT while in cruse and then makes an approach, the TIT will be approximately 1500 degrees when the helicopter is stabilized in a hover.
This representative diagram shows the effect of leaning on: cylinder head temperature, exhaust gas temperature or TIT, engine power, and specific fuel consumption for a constant engine rpm and manifold pressure.

Note:

Textron Lycoming does not recommend operating on the lean side of peak EGT.
The purpose of checking the fuel flow indicator and the manifold pressure gauge during the run up is to verify that the fuel flow is within specification to ensure adequate power and performance for the hover and take off. If the manifold pressure gauge shows higher than 18 inches and the fuel flow is higher than 65 lbs/hr than the pilot must be aware that the hover and take off performance of the aircraft may not meet the specifications published in the Rotorcraft Flight Manual.

To compensate for differences in base altitude the pilot can lean the mixture while the helicopter is operating on the ground with the blade RPM in the green and the collective full down by leaning the mixture to obtain 65 lb/hr fuel flow. When the helicopter is lifted into a hover, and after the hover is stabilized, the pilot must check the TIT gauge to verify that the TIT is not above 1500F.

**Cruise**

3050 RPM and 29 inches manifold pressure sets the engine power at 75 percent. Lean the mixture by turning the mixture control knob counter-clockwise one turn at a time. Pause after each turn and note the change in TIT and fuel flow.

Leaning the mixture by turning the mixture control knob counter-clockwise will cause the fuel flow to decrease and the TIT to increase.

**NOTE**

The push button on the vernier mixture control is intended to be used for starting and shutting off the engine only. When adjusting the mixture, use the vernier adjustment feature, turn the mixture control one turn and pause to note the result. Never use the pushbutton to push or pull on the mixture control during flight.

Expected fuel flow settings on an F or FX series Enstrom would be expected to be approximately 100 lbs/hr (16.6 gallons per hour) at 29 inches manifold pressure, 3050 RPM and the mixture leaned to 1570 TIT.

**Landing**

Before beginning the decent, richen the mixture by screwing the vernier mixture control clockwise until the TIT is 1450 to 1500 degrees Fahrenheit. This ensures that there will be sufficient power to hover once the approach has been terminated.
With most Enstroms, the correlator will reduce the throttle excessively so it may help to squeeze on just a bit of throttle as the collective is lowered to maintain the RPM in the green.

Maintain blade RPM in the green and airspeed at 60 MPH for the approach.

Terminate the approach with a smooth transition into a hover.

**After Landing**

Collective down and locked.

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**CAUTION**

Heavy spring capsule forces are present with zero or low rotor rpm, and damage to the helicopter and engine can result if the collective is allowed to rise.

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Reduce throttle to 2000 RPM for one minute

Reduce throttle to Idle (1500)

Disengage belt clutch

**Caution:**

Clutch disengagement with throttle open will result in engine overspeed. Clutch disengagement is signaled by a red warning light on the instrument consol.

Idle engine for 2 minutes

Boost pump off, avionics off, switches off.

Mixture control to idle cut off.

All switches off.
GENERAL OPERATION PROCEEDURES

Avoid maneuvers which require full tail rotor pedal input of rapid tail rotor reversals. If the tail rotor gets into severe flapping and the tail rotor cables are not tensioned properly, there is a chance that the tail rotor could pick up a cable.

Weight and Balance

General

The helicopter must be flown with the weight and center of gravity limits stated in section 2 of each Operating Limitations. The updated helicopter empty weight and balance information is found on form F-165A in section 6 of the Rotorcraft Flight Manual.

Removal or installation of equipment will change the helicopter weight and C.G., and must be recorded on form F-165A so that a running basic total weight and C.G. location can be maintained. The pilot should use this running basic total weight and C.G location when determining whether the helicopter is loaded within the limits.
Approved limits

1. Longitudinal C.G range (see chart below) is variable with gross weight from 92.0 inches to 100.0 inches.
2. Lateral C.G. range is variable with gross weight form -3250 to +3250 in/lb.

a. Two people on board:
   
   Left seat (pilot)  -13.5
   Right seat (co-pilot) +13.5

b. Three people on board:

   Left seat (Pilot)  -13.5
   Center passenger  +3.0
   Right Passenger   +20.5

It is the responsibility of the pilot to insure that the helicopter is loaded properly.

**EMERGENCY**

**General**

This section describes the sysem failures and malfunctions that might occur and outlines some of the procedures that may be used to maintain control and get the helicopter safely on the ground.
Engine Failure

The indications of an engine failure, either partial or complete power loss, area are a left yaw and a drop in engine and main rotor RPM.

In the event of engine failure proceed as follows:

1. Enter Autorotation (Collective full down and right pedal to trim helicopter).

2. Stabilize at 58 mph glide (best rate of decent speed)

   CAUTION: below 8200 feet autorotation speed is limited to 85 mph to avoid high rates of descent. Maximum glide distance is attained at 80 mph and 334 rotor RPM. Reduce collective to build rpm entering the flair.

3. Select landing site.

4. Check engine rpm. If engine RPM is still showing, add collective pitch slowly to see if blade rpm can be maintained. Continued flight might be possible at reduced manifold pressure settings. Be prepared for a complete loss of power at any time under these conditions.

5. At approximately 50 ft AGL, flair the helicopter to reduce speed with aft cyclic.

6. Level the helicopter with forward cyclic at an altitude sufficient to provide tail rotor clearance. As the helicopter settles toward the ground, cushion the landing by using up collective.

Note: Maximum recommended ground contact speed on prepared surfaces is 35 mph. Reduce speed for landings on rough surface.
Air restart

After an engine failure in flight, the decision to attempt a restart will depend on the altitude and potential landing areas available.

CAUTION

Helicopter control is the primary concern after entering autorotation. **DO NOT** attempt air restart when below 3000 feet.

1. Adjust collective as required to maintain rotor RPM in green arc and establish 58 mph autorotative glide.
2. Select landing site.
3. Turn off boost pump.
4. Set throttle to start position.
5. Engage starter.
6. If engine fires, turn on boost pump.
7. Slowly increase throttle until engine and rotor tach needles join.

**Engine failure - altitude above 10 feet and below 375 feet AGL**

When an engine failure occurs at low altitude and low airspeed, sufficient altitude may not be available to increase rotor rpm. The collective must be adjusted for the conditions in order to reach the touchdown point without excessive rotor droop. The collective reduction will vary from no reduction at zero airspeed and 10 feet to full down collective at higher altitudes and airspeed. When engine failure occurs proceed as follows.
1. Adjust collective to maintain rotor rpm, and add right pedal to trim helicopter.

2. Adjust cyclic for autorotative glide.

3. NOTE: At higher altitudes and low airspeed use forward cyclic to increase forward speed to approximately 58 mph. At low altitude and higher airspeed aft cyclic will be required to reduce speed prior to ground contact.

4. At approximately 50 feet AGL use aft cyclic to reduce forward speed.

5. Level helicopter with forward cyclic at an altitude sufficient to provide tail rotor clearance.

6. As helicopter settles toward the ground, apply up collective to cushion landing.

7. The maximum recommended ground contact speed on prepared surfaces is 35 mph, reduce speed on rough surfaces.

8. CAUTION: Avoid rapid lowering of collective or use of aft cyclic after ground contact or during ground slide.

**Engine failure at in-ground effect hover**

Engine failure at a hover is indicated by a sudden yawing of the helicopter to the left. Avoid sideward or rearward movement after engine failure and proceed as follows:

1. Apply right pedal to prevent yawing and align skids in direction of motion.

2. Do not raise collective.

3. As the helicopter settles to the ground, add up collective to cushion the landing.
**Turbocharger or wastegate failure**

Turbocharger or wastegate failure will be evidenced by loss of manifold pressure if the engine is being operated at manifold pressures above ambient pressure. It should be possible to maintain level flight at reduced airspeeds and altitudes as the engine should be capable of maintaining pressure close to ambient pressure. If the turbocharger seizes or the wastegate seizes in the full bypass condition, proceed as follows.

1. Perform a power check to confirm power available for landing.
2. Land as soon as practicable being prepared to make a run-on landing.

**Low engine oil pressure**

1. Low oil pressure and normal oil temperature;
   
   1.1. If low oil pressure is accompanied by normal oil temperature there is a possibility that the oil pressure gauge or relief valve is malfunctioning. This is not necessarily cause for an immediate precautionary landing. Proceed as follows:
      
      1.1.1. Land at nearest suitable landing area.
      1.1.2. Inspect for and correct this source of trouble before continuing flight.

2. Total Loss of oil pressure
   
   2.1. If a total loss of oil pressure is accompanied by a rise in oil temperature, this good indication that the engine failure is imminent. Proceed as follows:
      
      2.1.1. Reduce engine power immediately.
      2.1.2. Select a suitable forced landing field and land with power.
Tail rotor malfunctions

There can be three types of tail rotor failure associated with the Enstrom style of tail rotor system:

1. Complete loss of thrust:
   1.1. Hovering flight
      1.1.1. Perform hovering autorotation
   1.2. During Flight
      1.2.1.1. Use cyclic control for directional control and collective and power settings to maintain 60 to 80 MPH and 45 degrees yaw
      1.2.1.2. When suitable landing site is reached, perform autorotation landing

Note: Airflow past the cabin, tailcone, and tail fins may permit controlled flight at low power levels and sufficient airspeeds to reach a suitable landing site. The landing should be made with the throttle closed.

Note: Due to friction from the transmission bearings the helicopter will have a tendency to rotate nose left. To avoid the chance of the helicopter rolling over, the landing must be made with no forward drift.

2. Tail Rotor Cable Failure:

Due to the flyweights on the tail rotor blade retention plates the tail rotor should maintain a pitch setting suitable to allow controlled flight with airspeeds above 50MPH and manifold pressure in the 23 to 29 inch range.

The most effective approach is a long flat approach with left turns as necessary, which then terminates over the runway at hovering altitude and translational speed. The landing is then accomplished by using a combination of increased collective and reduced throttle to allow the helicopter to settle onto the ground without spinning.
The pilot can easily remember which way the nose will respond to the throttle movement by grasping the throttle twist grip with the index finger pointed down. As the throttle is turned, the index finger will indicate which way the nose will swing.

3. Fixed Pitch Settings:

3.1. Stuck Right or Left Pedal

3.1.1. The procedures for stuck pedals are essentially the same as for a broken tail rotor cable. The more left pedal that is experienced, the more collective and the less throttle will be necessary to prevent aircraft rotation as the aircraft loses airspeed and sets down.

Main rotor gearbox

1. Transmission Temperature; if the main rotor transmission exceeds red line, reduce power. If the temperature remains above red line, make a power-on landing as soon as possible.

2. Main Rotor Transmission chip light: If the main rotor transmission chip light comes on in flight and the transmission temperature is below the red line, monitor the temperature and land as soon as practicable. On landing, remove and inspect the chip detector. (See NOTE).

   If the main rotor transmission chip light is accompanied by high transmission temperatures, land as soon as possible.

3. Tail rotor transmission chip light: If the tail rotor transmission chip light comes on in flight, make a power-on landing as soon as practicable and inspect the chip detector. (see NOTE)

NOTE: New or recently overhauled gearboxes generally will generate ferrous “fuzz” which will collect around the chip detector as a gray sludge. This type of contamination is normal and may be cleaned off with a soft cloth, after which the chip detector may be reinstalled and the flight continued.

Any Metallic chip greater than 1/16 inch in diameter of cross section, or chip light accompanied by high transmission temperature is cause for discontinuation of normal flight. In the event of finding large chips contact a service center or the factory.
Specific instructions for inspection chip indicators is in Section 8, paragraph V of the Rotorcraft Operators Handbook.

**Fire in flight**

If fire, smoke, or the odor of smoke is detected in flight, proceed as follows:

1. Land immediately using power-on approach.
2. Turn electrical switches off.
3. If smoke obstructs vision, unlatch doors and let them trail open.
4. Shut off the engine as soon as the aircraft is on the ground.
5. Fuel valve off.
6. Pilot and passengers clear the helicopter immediately.

**Fire on the ground**

If fire, smoke, or the odor of smoke is detected, proceed as follows:

1. Shut off engine and all switches.
2. Shut fuel valve off.
3. Pilot and passengers clear the helicopter immediately.

**Alternator malfunction**

A malfunction of the alternator will be indicated by a zero charge rate or constant discharge on the ammeter. To reset the alternator, proceed as follows:

1. Check to see that the Alternator and alternator excite circuit breakers are properly set.
2. Turn off alternator switch.
3. Wait 5 seconds and turn alternator switch back on.
4. If the alternator is not restored, or goes off line again, turn off all nonessential electrical equipment and land as soon as practicable.
Electric boost pump failure

Failure of the electric boost pump will be indicated by the illumination of the red LOW BOOST warning light on the caution panel. The engine will continue to function. If the LOW BOOST light comes on, first check that the fuel on / off valve is pushed all the way in.

If pushing in the fuel on / off valve does not correct the problem, land as soon as practicable.

Clutch disengage light on

If the manual clutch becomes disengaged during flight, it will result in an instantaneous engine overspeed and severe left yaw if the manifold pressure is much above idle. These indications will be instantaneous and the pilot should immediately enter autorotation.

An indication of a clutch disengagement without engine overspeed or severe yaw may mean that a clutch disengagement is probable or that the microswitch or electrical circuit has malfunctioned. The pilot should proceed as follows:

1. Clutch disengagement light with left yaw.
   1.1. Enter autorotation and reduce power to idle.
   1.2. Perform autorotative landing.
   1.3. Correct the source of trouble before continuing flight.

2. Clutch disengagement light on without left yaw.
   2.1. Reduce power and be prepared for sudden clutch disengagement.
   2.2. Land at nearest suitable landing area.

   CAUTION: Be prepared for autorotation should the clutch become disengaged.

   2.3. Correct the source of trouble before continuing flight.
Abnormal vibrations

Vibrations in these helicopters can usually be classified as either low frequency or high frequency. Low frequency vibrations are generally cause by the main rotor system while the high frequency vibrations usually originate from the engine, drive system or tail rotor.

Any abnormal vibrations are an indication that something is not correct and should be investigated before further flight. If a vibration suddenly appears during a flight, it is an indication that something has suddenly changed. The helicopter should be landed as soon as practical and inspected to find the cause of the vibration.