280FX Pilot Training Guide

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INTRODUCTION

Enstrom 280FX 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.

Company history and information

- Founded in 1959, community funded
- F-28A certified in 1968. Rate production started
- F-28C and 280C certified in 1976
- F-28F and 280F certified in 1981
- 280FX certified in 1985
- Turbine powered TH-28 certified in Sept. 1992
- Turbine powered 480 certified to FAR 27 standards in Dec. 1994
- Turbine powered 480B certified to FAR 27 standards in Feb. 2001
- Over 1,100 helicopters produced in Menominee, MI
  - Over 700 still in operation
  - Over 4,000,000 fleet hours
- Excellent safety record

ENSTROM HELICOPTER CORPORATION

Current Helicopter Models

Piston powered:

F28F – three-place, turbocharged, used for training, police patrol, general commercial work and personal/VIP transportation

280FX - three-place, turbocharged, used for personal/VIP transport and training

TH-180 Trainer

Turbine Powered:

480B – Five-place, used for training, patrol, VIP transport, light cargo, and general commercial work.

TH-48 - Three-place, with possibility of four place, used for training.

AIRCRAFT DESCRIPTON & CONSTRUCTION DETAILS

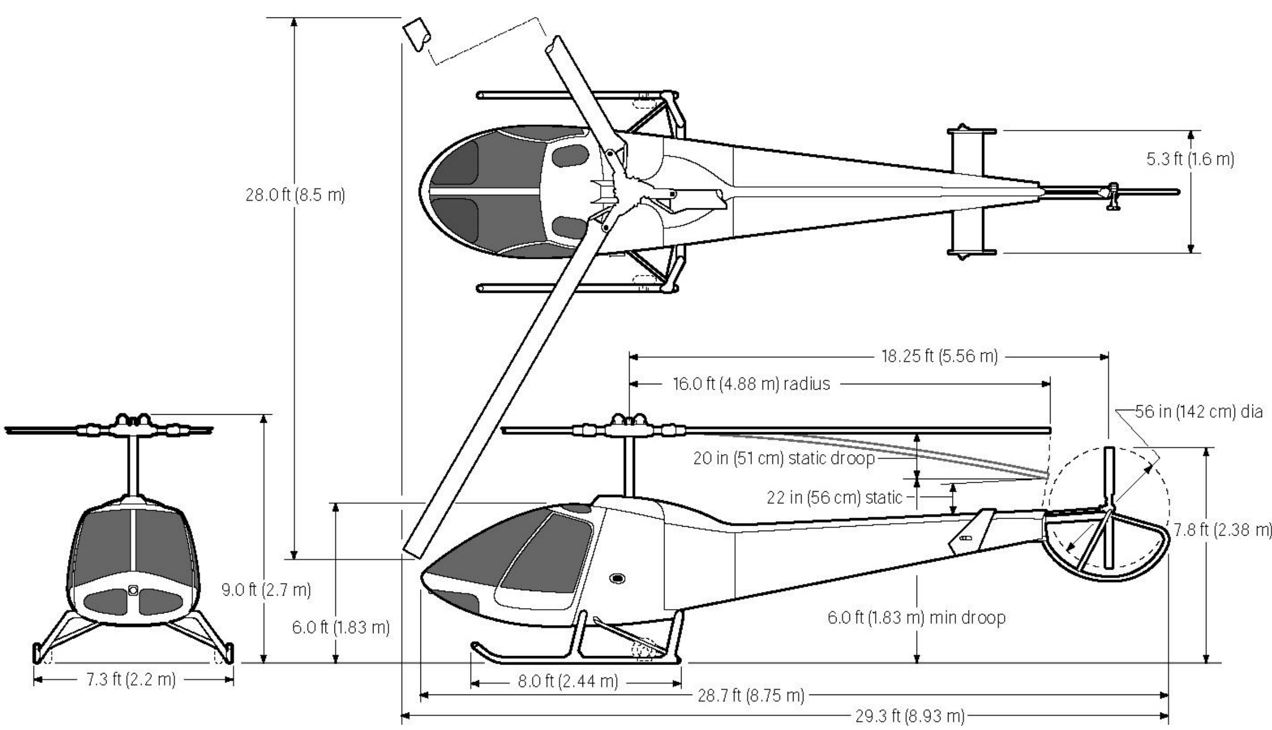
GENERAL DESCRIPTION

The Enstrom 280FX helicopter is a 3 blade, single engine helicopter 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 helicopters is a single engine, piston powered helicopter certified for day and night VFR flight and that can be equipped for IFR flight training. The 280 FX was certified by the FAA in 1985 to the CAR 6 regulations.

Enstrom Helicopters are relatively quiet due to the installation of the turbo-charger, and the slow turning main and tail rotors. They can be equipped with an optional secondary muffler that lowers the noise signature significantly.

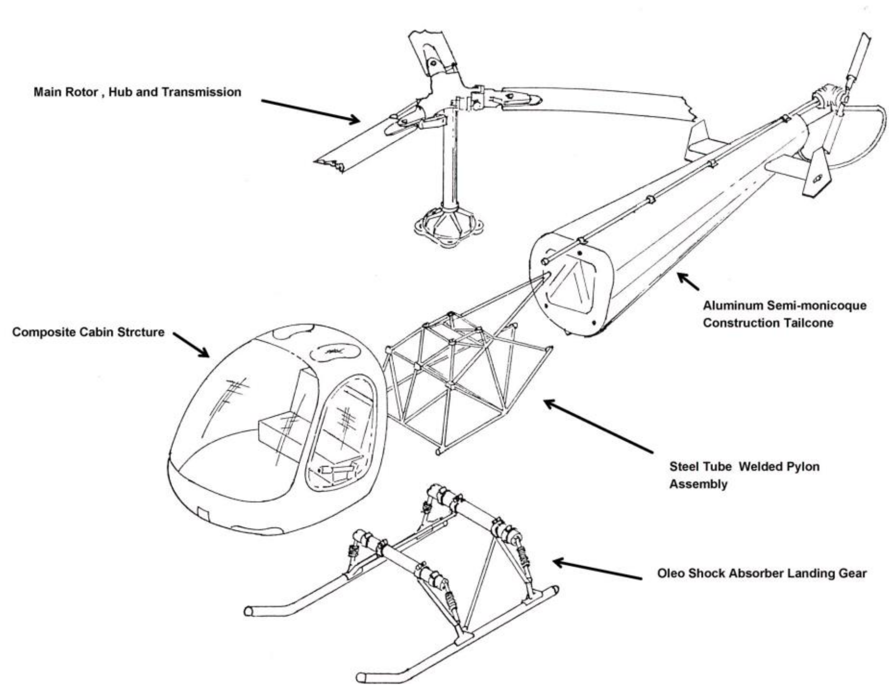
All Enstrom helicopters feature a three bladed, fully articulated main rotor system which has over 4,000,000 flight hours. The tail rotor is two bladed and completely unblocked for exceptional effectiveness. Due to the high inertia rotor design, the helicopter possesses out-standing auto-rotational capabilities.

In addition to being a versatile and crashworthy helicopter, the 280FX 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 ratio resulting from high reliability and easy maintenance combine to yield low operation and support costs.

Construction Details

Construction Details



Pylon

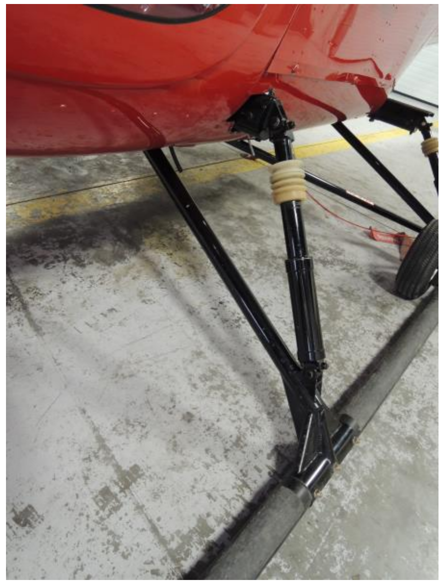
The pylon is a welded high strength steel assembly that is the backbone of the helicopter. The engine, transmission, cabin, tailcone and landing gear are all attached to the pylon in modular type construction.

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 operated by the throttle mechanism and that is connected to the throttle 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 are clean out doors mounted adjacent to the two oil coolers to facilitate cleaning out debris.



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. The civilian model of the 280FX has fairings installed over the oleo struts for appearance. It recommended that the fairings be removed for high activity flight schools to assist in maintenance.

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.

Cabin

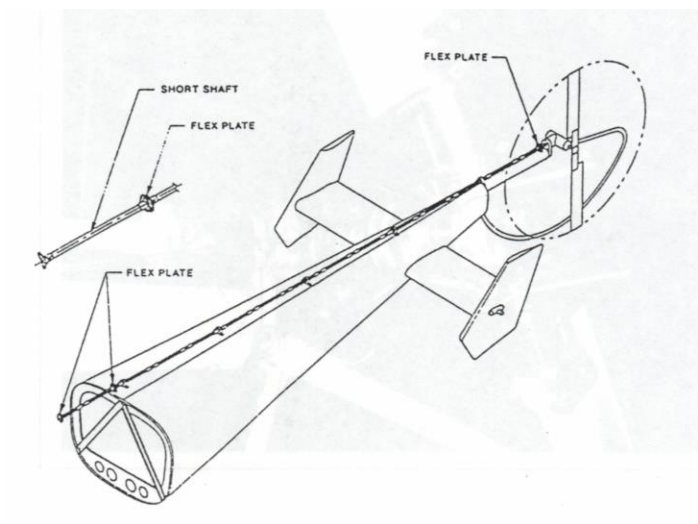
The cabin assembly is constructed with a one piece fiberglass shell into which is bonded a built up aluminum structure which supports the instrument panel, controls and pilots seats.

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.

Tailcone



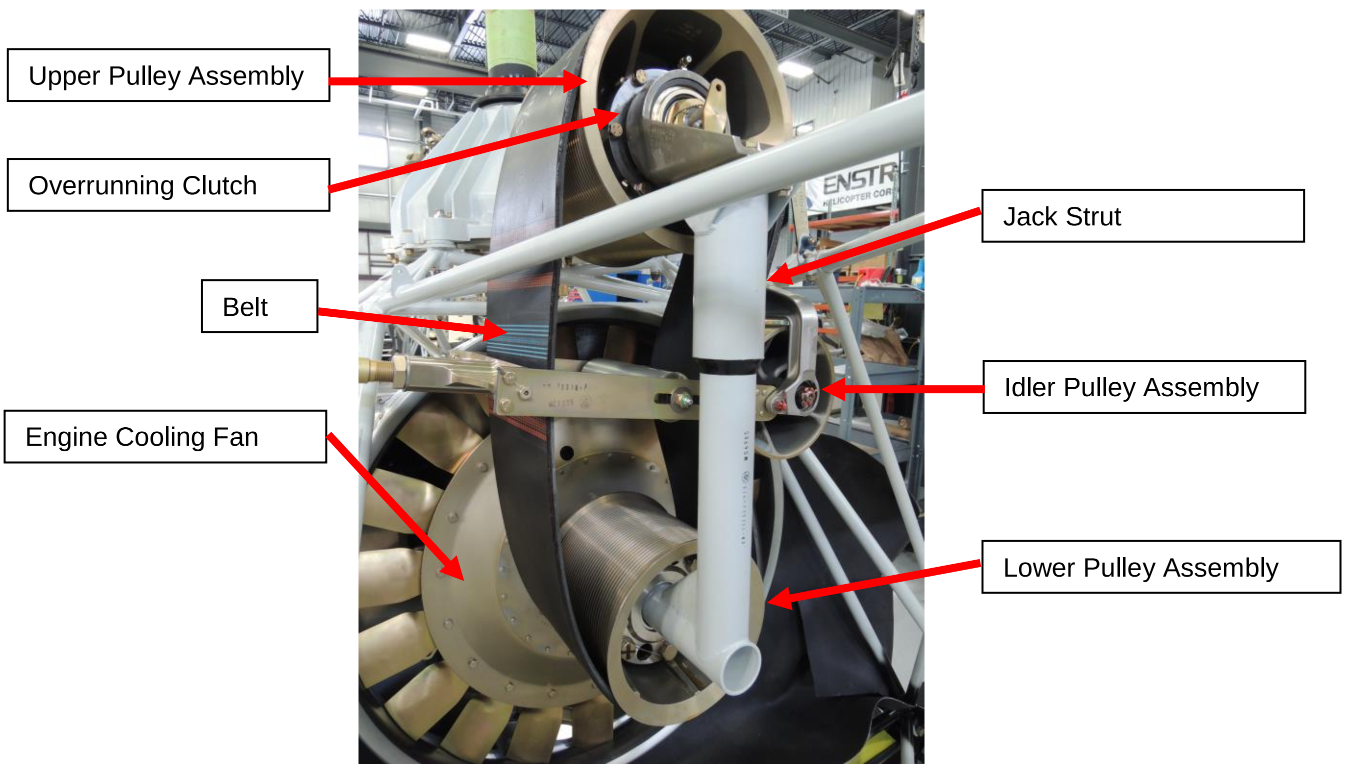
The tail cone is bolted to the aft end of the pylon. It is a tapered semi-monocoque structure comprised of skins, bulkheads, longerons, and stringers. The tailcone is constructed from aluminum and supports the tail rotor, tail-rotor transmission, horizontal and vertical stabilizers, and the tail-rotor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

Fuel Tanks

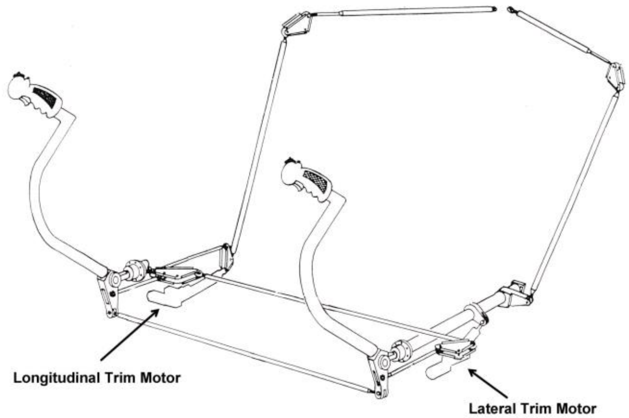
The fuel tanks are constructed from two fiberglass parts, the tub and the outside cover which are bonded together. There is a rubber containment bag attached to the outside of the tank to collect any fuel that might leak from the tank and drain it overboard. They are attached to the pylon assembly.

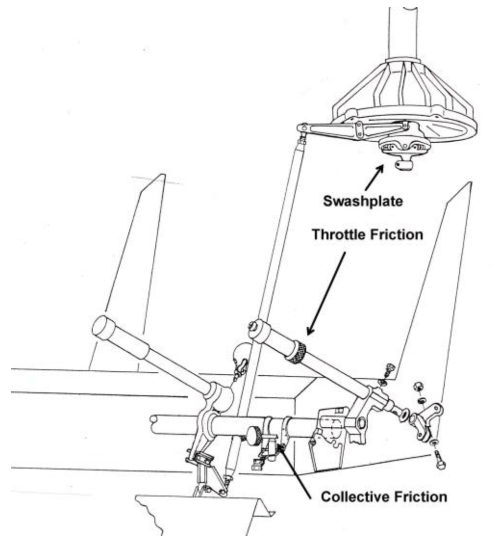
Power Train

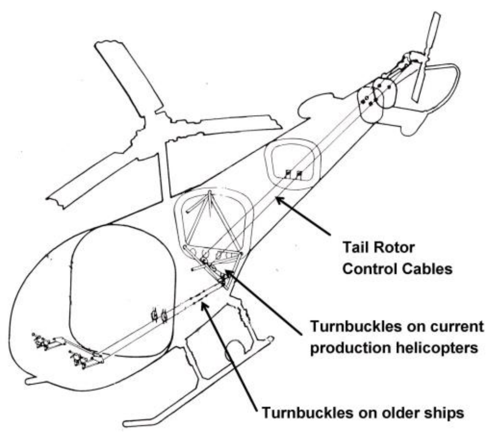
The power train includes the main rotor transmission, an upper pulley assembly incorporating the overrunning clutch, jack strut, drive belt, lower pulley, drive shaft and tail rotor gearbox.



Flight Controls

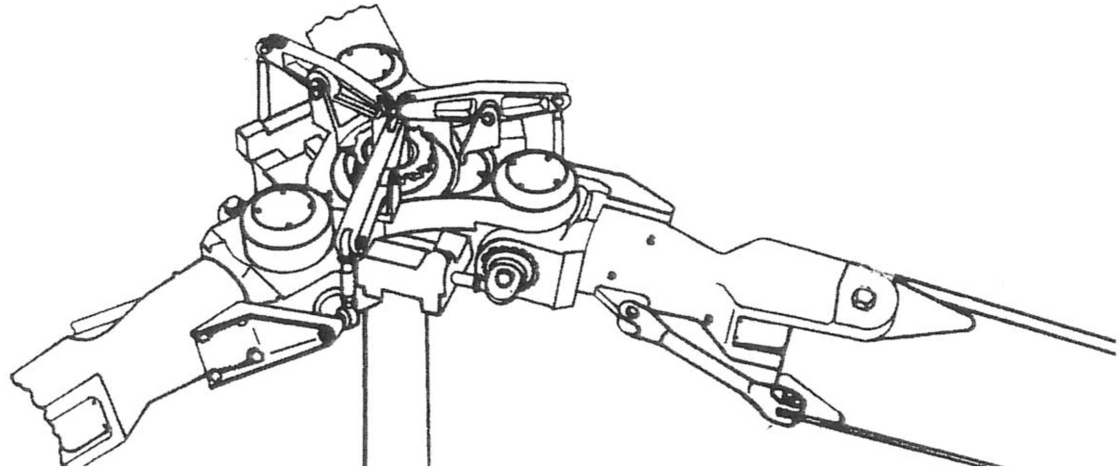






The flight controls include three primary systems: the collective, cyclic, and anti-torque or directional controls. There is no hydraulic system installed on Enstrom Helicopters, cyclic forces are relieved using electric mechanical trim motor operated spring capsules. Collective forces are managed using a spring capsule assembly.

The helicopters also have fixed horizontal and vertical stabilizers that are mounted on the tail cone to help provide stability and attitude control during forward flight.



Main Rotor System

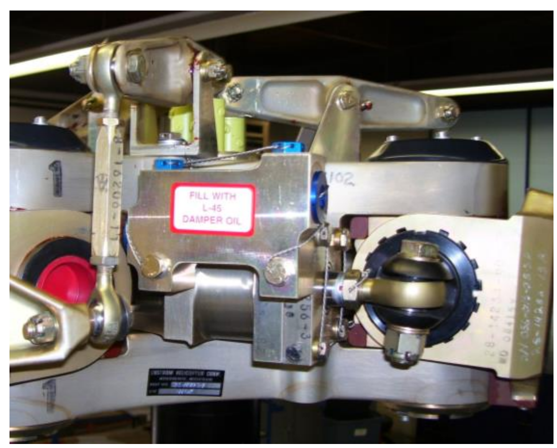
The main rotor system is a three bladed, high inertia, fully articulated rotor system.

Hub

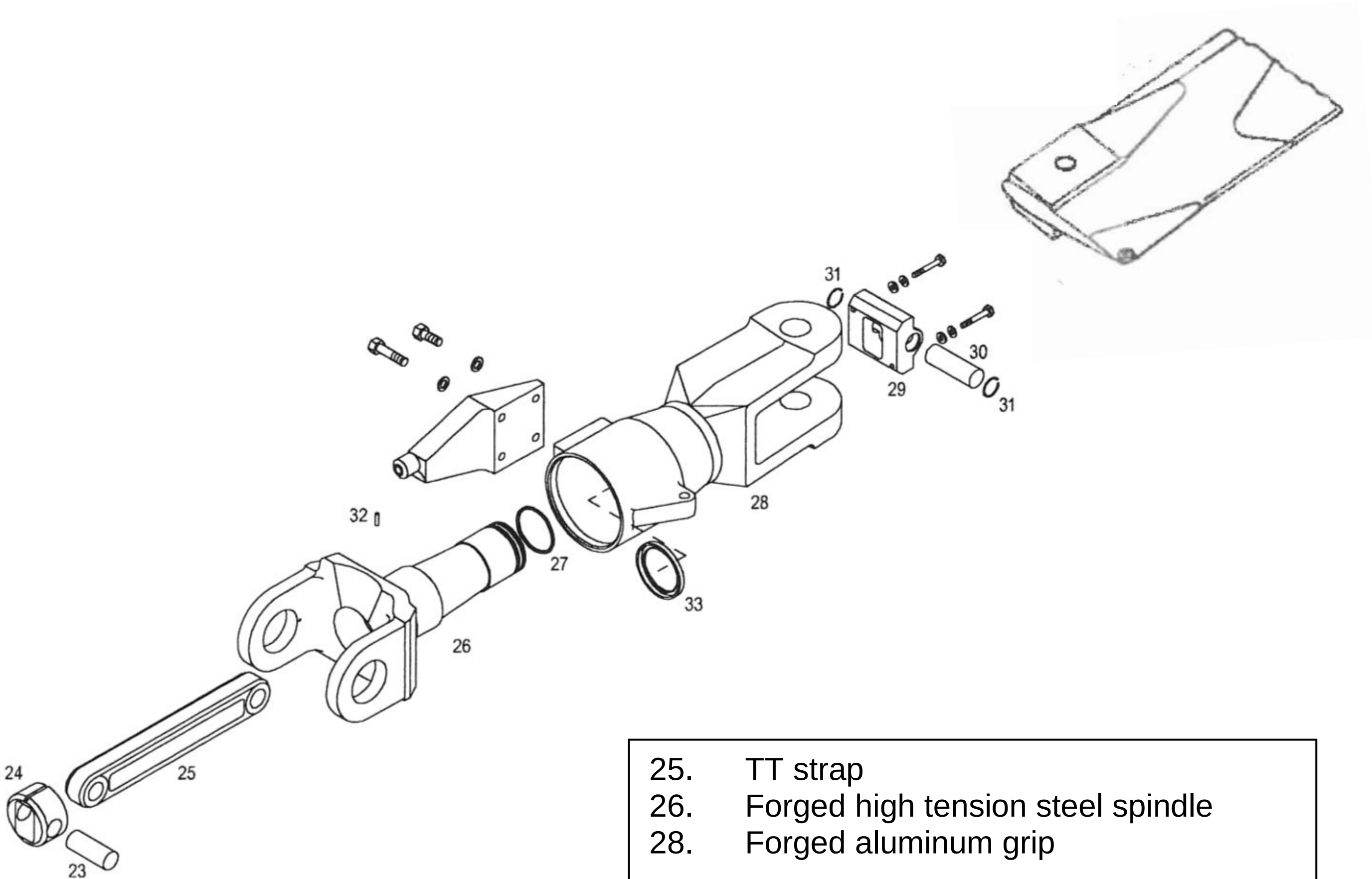
The main rotor hub assembly is composed of two opposing forged aluminum hub plates separated by an aluminum cylindrical spacer. Through-bolts hold these items together along with steel spline adapters.

Three steel universal blocks are mounted on roller bearing units that permit flapping and lead-lag motions. Non-moving 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.

Dampers



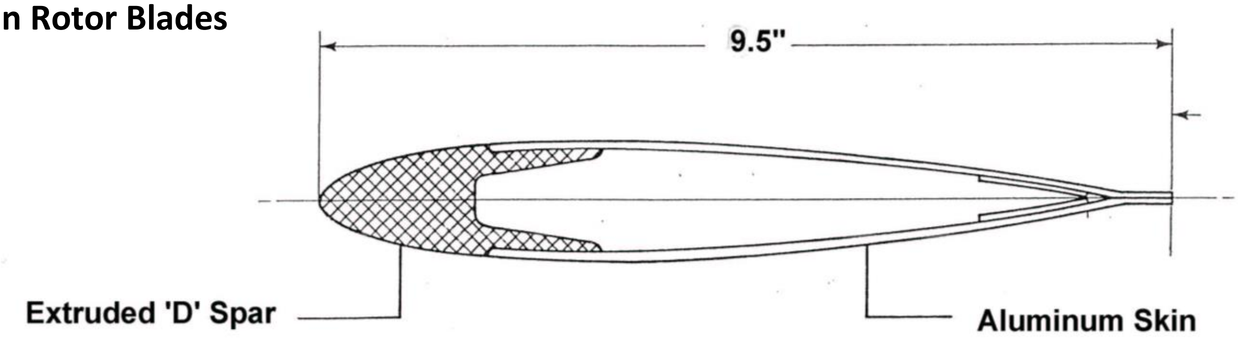
Closed circuit hydraulic dampers are incorporated between each flapping pin and the rotor hub to limit the lead-lag velocity of the blades. Because the hydraulic dampers have no centering spring, they are quite limber; this, coupled with the large heavy blades causes the ground rock that is often experienced while the helicopter rotor system is spooling up or during ground running, but makes ground resonance unlikely.



25. TT strap
26. Forged high tension steel spindle
28. Forged aluminum grip

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 using a Tension Torsion Strap and supported by two roller feather bearings. The TT strap is on-condition and calendar limited to 5 years.

Main Rotor Blades



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.

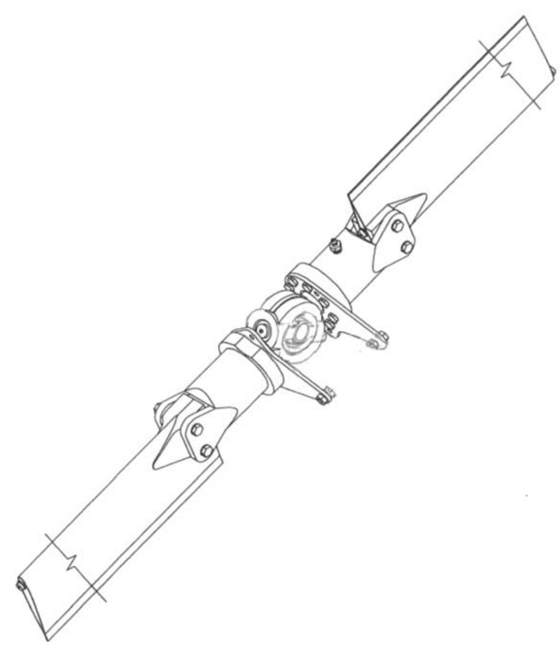
A cap is bonded to the tip of each blade in which there are provisions for spanwise and cordwise balance weights. Two tracking tabs are riveted to the trailing edge of each blade.

Tail Rotor Assembly

The tail rotor assembly 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 cruse power settings. They are weighted so that when the aircraft is being flown at approximately 29 in mp, the pedals are neutralized and the slip ball centered.

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



Tail Rotor Guard

Tail Rotor Guard: A tubular aluminum tail rotor guard is installed on the aft end of the tailcone. It aids in ground handling and 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.

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- 25537. (Shell 14)

MIL-G-81322 , (Shell 22)

Landing Gear Oleos

Oil, MIL-H-5606

Nitrogen

Main Rotor Dampers

Oil, SF96-20 & 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.

Aircraft Systems

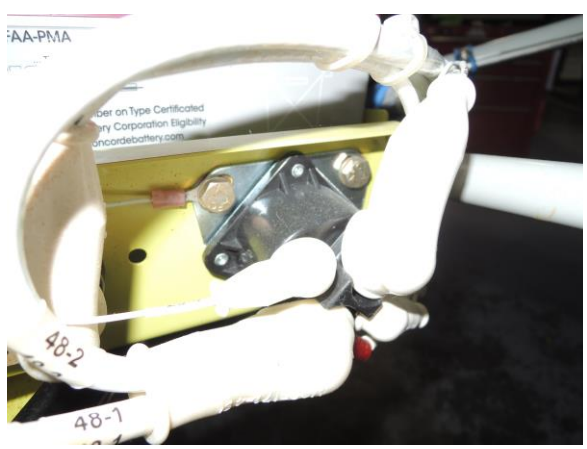
ELECTRICAL SYSTEMS

The 280FX helicopter has a 24 volt electrical system with the sealed battery mounted just forward and below the baggage compartment.

Description – Starter / Generator Systems

The starter is 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.

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 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 should be **off**. When the starter switch on the collective is pressed, the starter solenoid energizes the starter and the starting vibrator which retards the magneto timing and provides a hot spark for starting.

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 more than 13 volts to operate so the engine will not start if it is cranked with a low battery.

NOTE

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

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.

IMPORTANT
NEVER PERFORM A MAGNETO CHECK IN A HELICOPTER WHILE FLYING. IF THE ENGINE IS SWITCHED TO AN INPERATIVE MAGNETO THE ENGINE WILL STOP RUNNING.

Alternator Systems

The electrical generating system in the 280 FX consists of the 24 volt battery, a 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 until 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.

CAUTION AND WARNING SYSTEMS

Description- Caution and warning systems

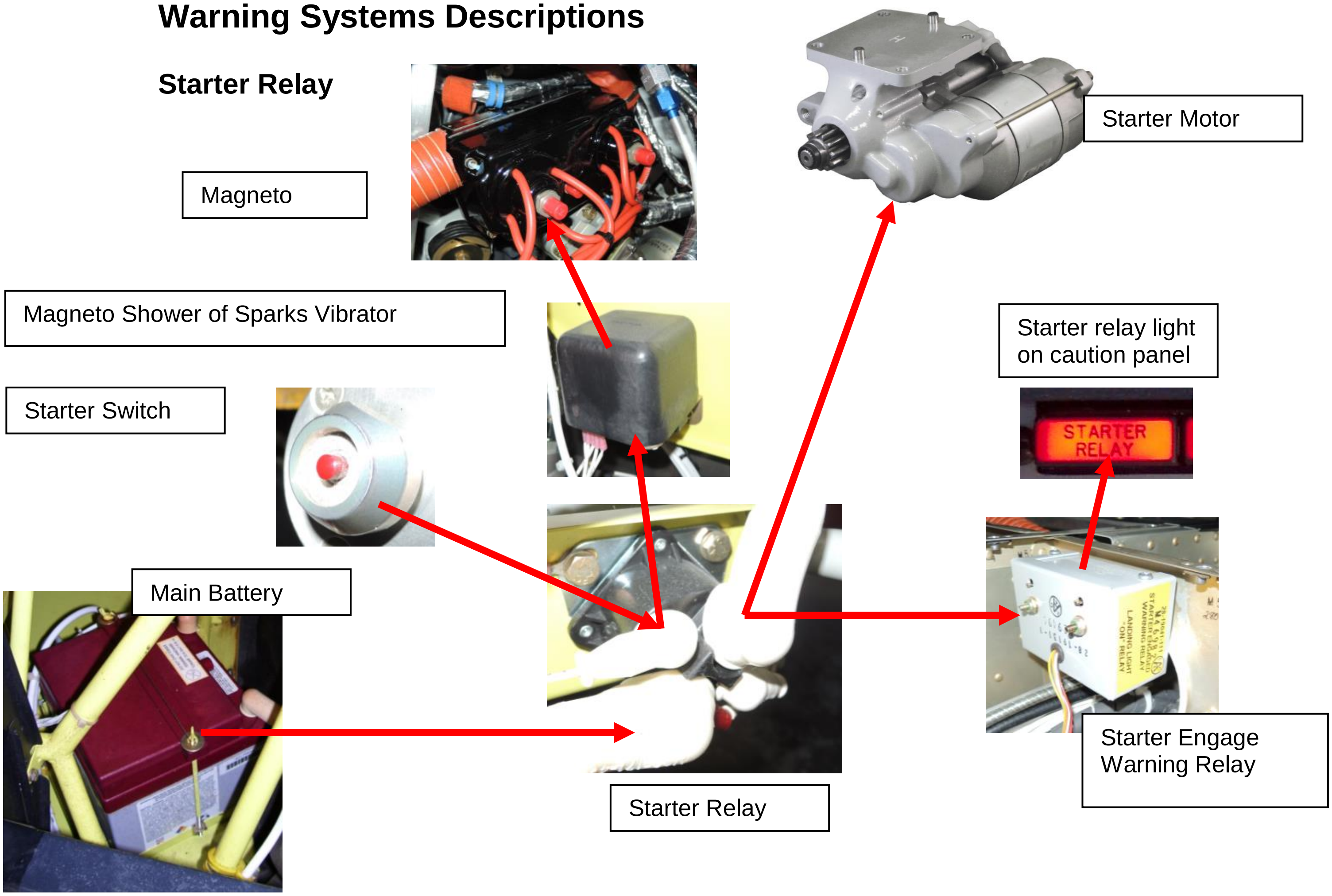
The annunciator panel is located at the top of the instrument console and consists of 8 indicator lights with a press-to-test switch at the extreme left. Pressing this switch will illuminate all of the indicator lights.

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

SEGMENT	COLOR	DESCRIPTION
STARTER RELAY	**RED**	Starter is operating
LOW ROTOR RPM	**RED**	Main rotor RPM is below 334 or above 385 RPM
OVERBOOST	**AMBER**	Manifold pressure is approaching Red Line
CLUTCH ENGAGE	**RED**	Belt Clutch is disengaged
TRGB CHIP	**AMBER**	Tail rotor gearbox chip detector has detected ferrous metal fragments
MRGB CHIP	**AMBER**	Main rotor gearbox chip detector has detected ferrous metal fragments
LOW FUEL PRESSURE	**RED**	Electric Boost pump is producing less than 15 PSI
LOW VOLTAGE	**AMBER**	Alternator is off-line

Warning Systems Descriptions

Starter Relay

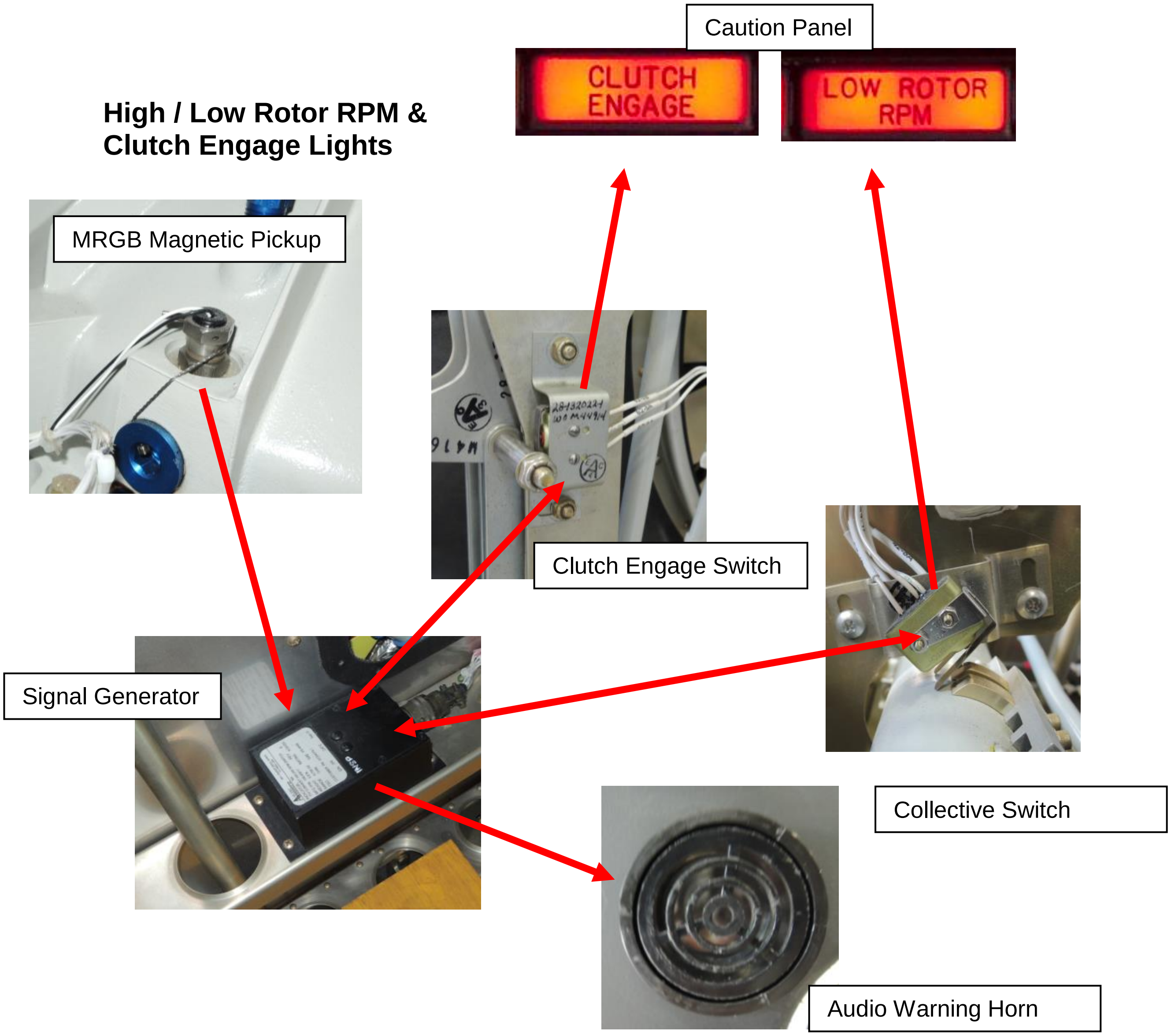


The starter relay warning light is operated by a circuit connected to the starter relay. Its purpose is to alert the pilot that the starter is operating or the starter gear is engaged.

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

It is also possible that in the event of a starter solenoid failure, the starter might remain engaged and also the magneto might remain in the retard mode which would result in a sever reduction of power and a rough running engine.

High / Low Rotor RPM & Clutch Engage Lights



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 and that senses the ring gear teeth passing 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.

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

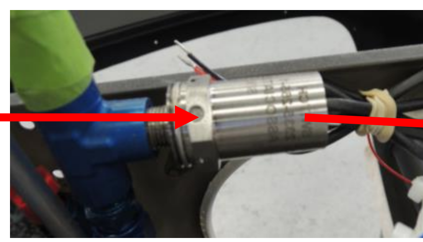
The clutch engage switch is installed on the belt clutch capsule and indicates whether the belt over center mechanism is fully engaged and locked. If the light is illuminated, the belt clutch is not locked over center and the helicopter must not be flown until the fault is corrected.

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

The 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 rotor RPM warning light and horn will activate anytime the clutch is engaged, the rotor RPM is less than 334 or higher than 385 RPM, and the collective is raised off of the down stop. If the collective is on the down stop, the light will still illuminate but the warning horn will not activate.

Overboost

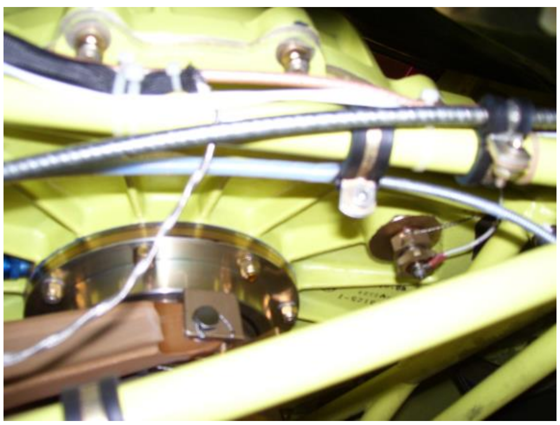


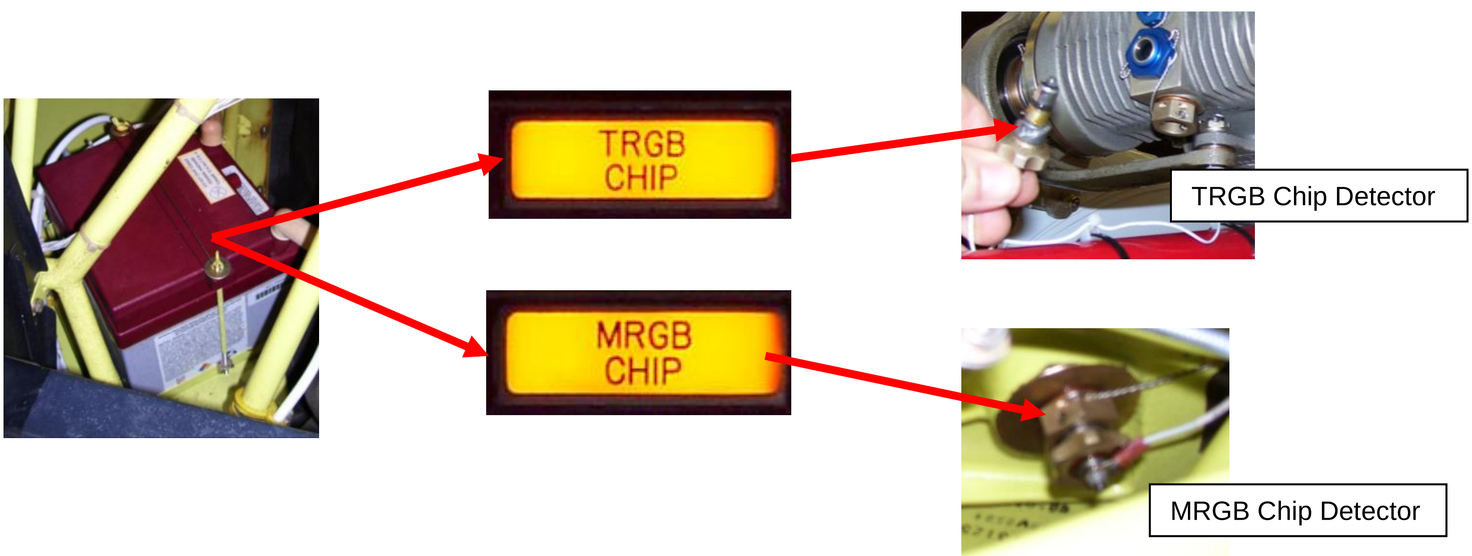
The overboost circuit consists of a pressure switch that is installed in the manifold pressure gauge line and an amber light in the annunciator panel. The switch is designed to illuminate the light at between 36 and 40 inches of manifold pressure. The switch and light may be activated by short pressure 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.

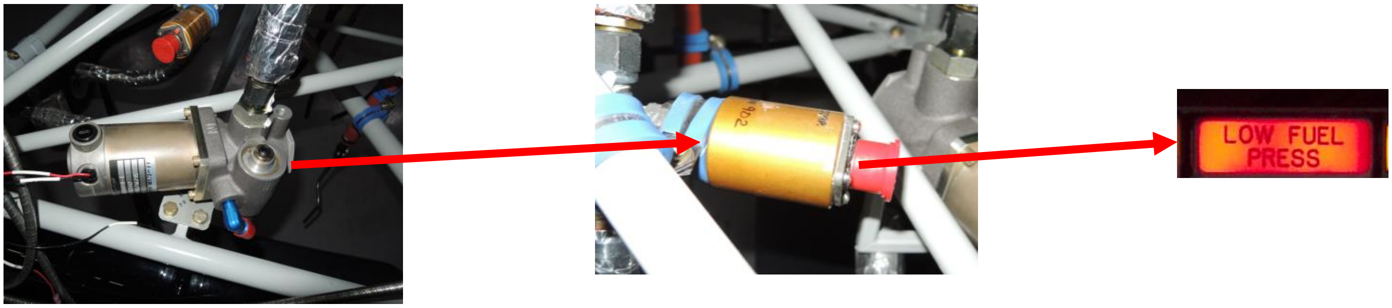
Main and Tail Transmission Chip Lights

MRGB and TRGB chip lights indicate metallic particles on the chip detectors. Normally these chip lights do not indicate an immediate emergency. The pilot should land as soon as practicable 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.

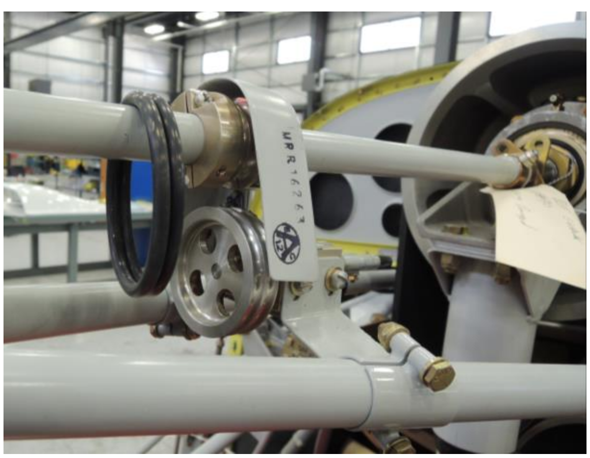
Push the Press-to-Test switch on the left side of the Annunciator Panel. All of the segments in the Annunciator Panel should light and then go out when the switch is released. Engage the belt clutch handle. The Clutch Engage light should go out, and the High / Low Rotor RPM light should illuminate. Release the collective friction and raise the collective control off of the down stop. The High / 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)

ROTOR		
385 RPM	**Red Radial**	**Max RPM Power Off**
334 - 385	**Green ARC**	**Continuous Operation (Including Autorotation)**
334	**Red Radial**	**Minimum RPM, Power off**

ENGINE		
3050	**Red Radial**	**Max RPM**
2900 - 3050	**Green ARC**	**Continuous operation**
2900	**Red Radial**	**Minimum RPM continuous**

Rotor Overspeed limitations:

385 - 405 rpm for 5 seconds or less, no inspection required.

385 – 405 rpm for more than 5 seconds or 406 – 420 rpm requires visual inspections of rotor hub.

Overspeeds exceeding 420 rpm require full NDT inspection of the rotor hub.

Engine Overspeed Limitations: (Lycoming SB369P)

IAW Lycoming SB 369S no overspeeds are allowed

Engine Overboost limitations: Lycoming SB 592)

2 in MP for less than 3 seconds requires log book entry.

Up to 3 in MP for 5 seconds requires log book entry.

Up to 5 in MP for 10 seconds requires 50 hr inspection with extra attention to cylinders, oil screens and spark plugs.

Above 5 in MP requires teardown inspection of engine

Airspeed

117 MPH, Max airspeed, power on

85 MPH, 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 light illuminates, 3
6 to 39in mp.

Fuel Flow

Maximum Fuel Flow – Full Rich

29 in. MP to 39 in. MP.

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)

Total fuel capacity is 42 gallons with 2 gallons unusable. (Two 21 gallon tanks)

Transmission Oil Temperature

225F – Red Line
0 to 25F – Green Arc

Oil Temperature Gauge

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

CHT

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

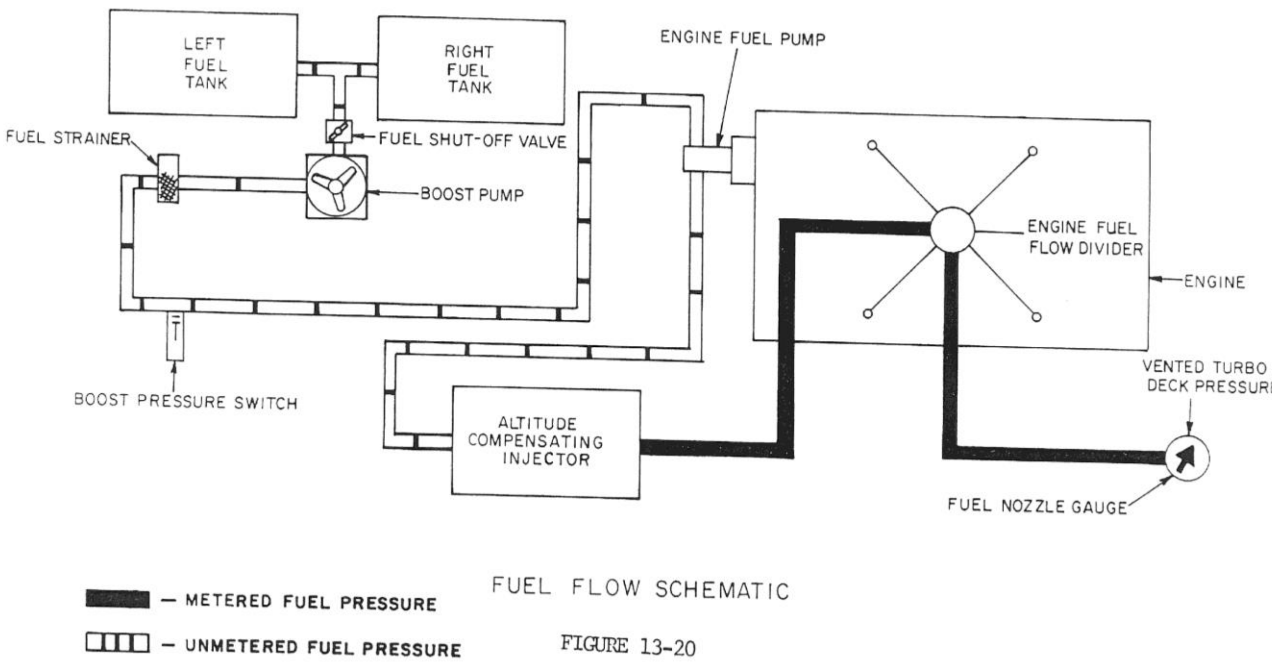
TIT, Exhaust Gas Temperature System

The turbocharger Inlet Temperature (TIT) is used for managing fuel mixture in flight. TIT is obtained from a temperature probe located in the exhaust stack just below the turbocharger in the exhaust inlet to the turbocharger, and measures the temperature of the exhaust gases that are flowing into the turbocharger.

Maximum allowable TIT is 1650°F but operators are cautioned that operating the helicopter with TIT's exceeding 1580°F will damage the exhaust system components and lead to premature overhaul.

The JPI 700 Engine Monitor displays EGT, TIT, and CHT in analog form (Vertical columns) and can display any of the individual EGT's, CHT's TIT, system voltage and OAT in digital form.

FUEL SYSTEM



FUEL FLOW SCHEMATIC

FIGURE 13-20

The fuel system in the 280FX 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 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.

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 pipe 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 electric boost pump is switched off or malfunctions.

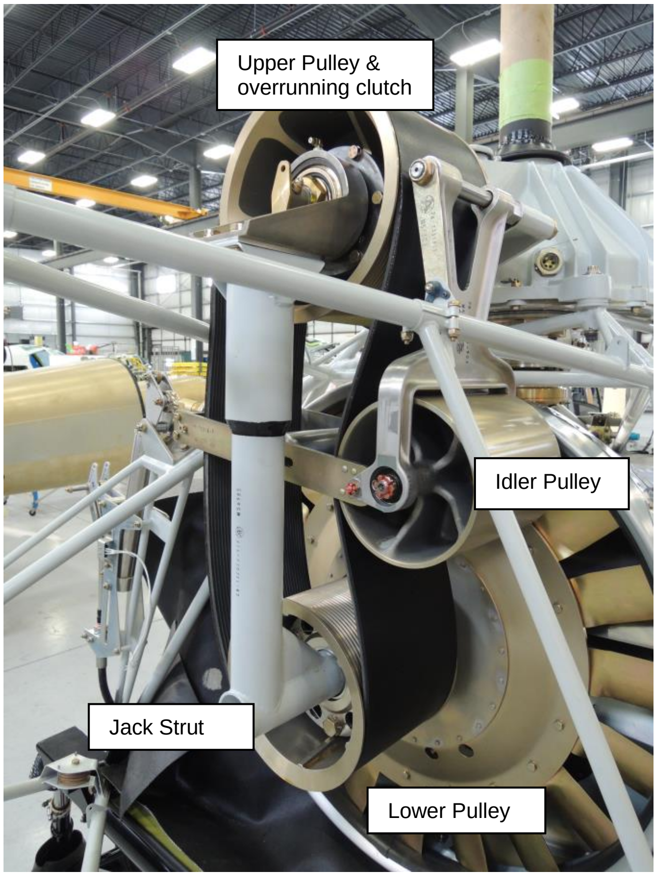
There is a fuel quantity gauge mounted in the engine gauge cluster that continuously monitors the fuel quantity, and a float type sender unit is mounted in the right fuel tank.

CAUTION

The fuel quantity systems malfunctions, it 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.

POWER TRAIN



The power train system includes the main and tail rotor transmissions, upper pulley, overrunning clutch, tail rotor drive shaft, 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 remove the chip detector, first remove the side panel above the left side engine cowl. Reach in towards the aft end of the compartment and locate the chip detector on the bottom of the main rotor gearbox. Usually the wire can be found first, and then can be followed up to the chip plug. Press the plug up, and turn ¼ turn anti-clockwise to remove. Reverse the order to reinstall the chip detector.

The main transmission is driven by the belt driving 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 the drive system to disconnect from the engine in the event of a power failure which 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 shafts of the transmissions through the tail rotor driveshaft

Lower Pulley

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 Engage System

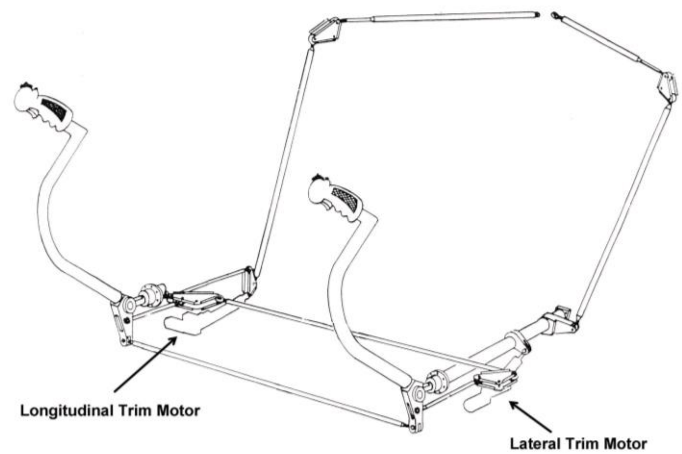
The clutch engagement lever is mounted at the right side of the pilot's seat, on the forward side of the seat structure. The clutch lever is used to engage and disengage the belt clutch mechanism, and therefore the rotor drive system.

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 a 280FX helicopter.

FLIGHT CONTROLS

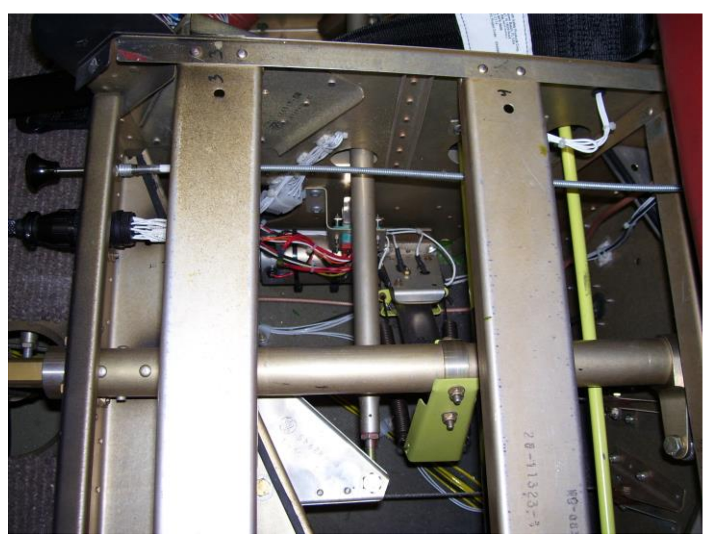
Cyclic Controls



The cyclic sticks on the piston series Enstroms are attached to longitudinal 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.

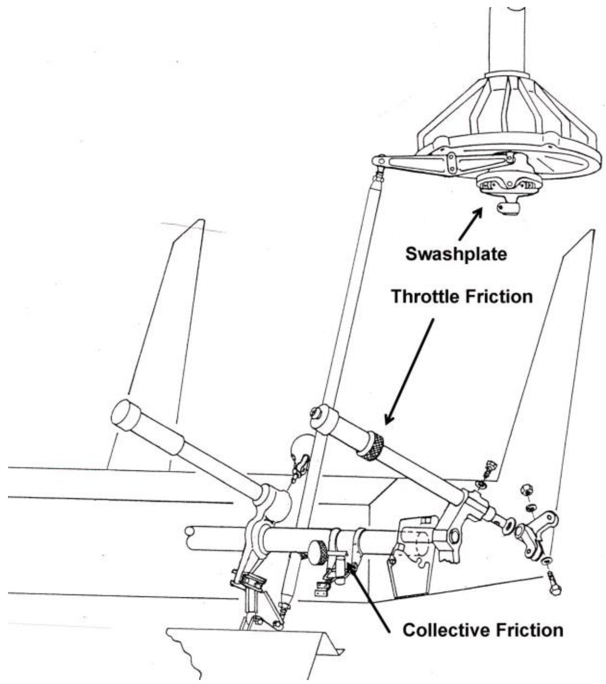
The trim motors are mounted under the pilot and copilot seat structure. There are also a set of electronic trim switches mounted on the structure adjacent to the trim motor capsule assemblies.

The Enstrom helicopters have no hydraulic assist for the flight controls and the trim capsules are designed to assist the pilot in countering the flight forces due to dissymmetry of lift.



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 floor 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.



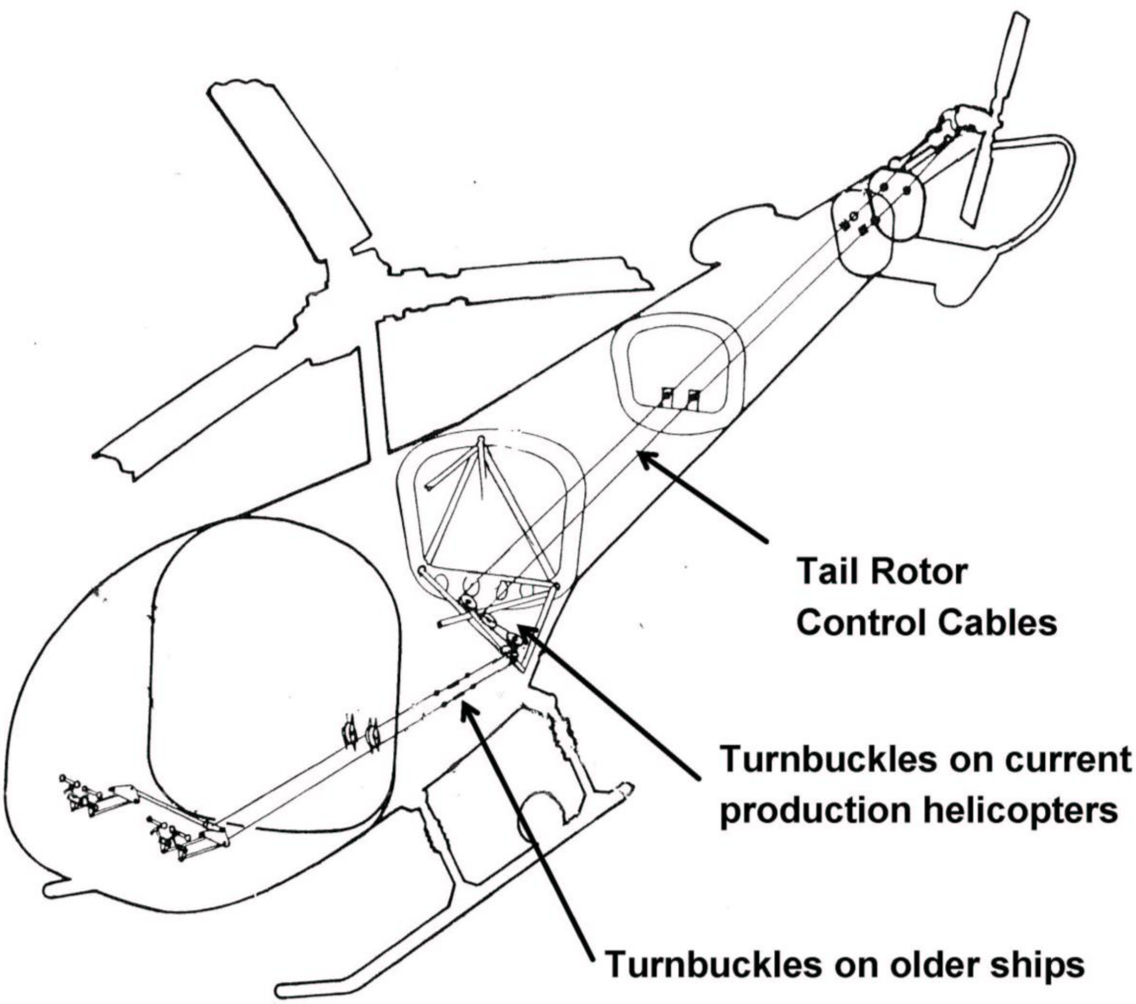
The collective friction knob located at the left side of the seat deck is used to lock the collective in the down position. The Enstrom helicopters have very heavy symmetrical blades that are extremely stable in flight. The flight loads into the collective control system are downward, and the spring capsule under the seat balances out these forces.

Anytime the helicopter is operated on the ground and the blade RPM is out of the green, particular care must be taken to ensure that the collective friction is on and that the collective is guarded.

The collective spring capsule should be adjusted so that in a hover, the same amount of force is required to lift the collective up as it takes to push the collective down. If the collective spring capsule is correctly adjusted, the collective will remain in position any time that it is released during flight.

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.



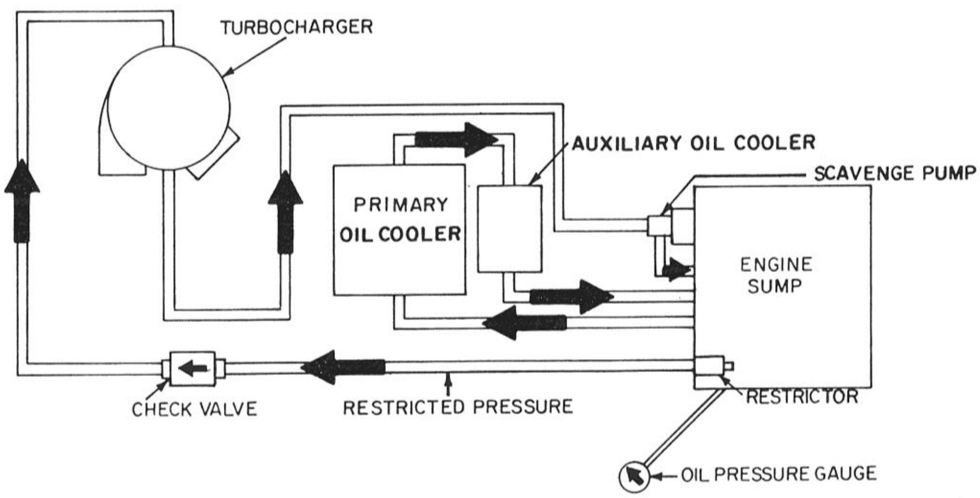
There is a set of penepital weights installed on the tail rotor blade retention plates that maintain the blade pitch in the event of a failure of a cable. The penepital weights function like governor flyweights and work to hold the tail rotor blade pitch at a constant pitch angle that will keep the slip ball centered when the manifold pressure is near 29 inches of manifold pressure.

In the case of a stuck TR, or failure of a TR cable, the TR blades will maintain their pitch which will allow the helicopter to be successfully landed without tail rotor control.

POWERPLANT

A Lycoming built HIO-360-F1AD 225 HP engine is used in the 280FX 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 of lubricating oil. 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 at 6Qt and Full at 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 under the fuel pump 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 that automatically coordinates throttle control to changes in the collective stick position.

2. **Mixture Control**. A vernier mixture control is installed on the radio consol. Full rich is in the “in “(forward) position and lean / idle cut off is in the “out” (aft) 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 position the mixture control for idle cut off.

NOTE

TO PREVENT INADVERTANT ENGINE FAILURE, USE ONLY THE VERNIER CONTROL TO MAKE MIXTURE ADJUSTMENTS WHILE IN FLIGHT

3. **Magneto Switch**. The magneto switch is a key-operated switch located on the far left side of the switch/circuit breaker panel

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

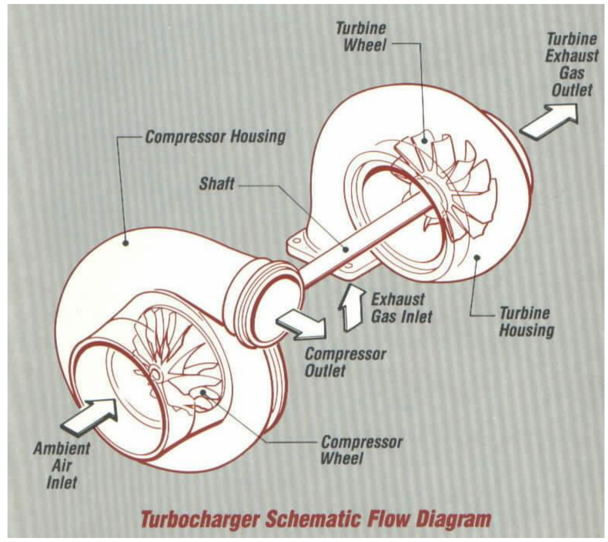
5. **Starter Button.** The starter button is mounted on the forward end of the collective control with a guard around it to prevent inadvertent activation. Push the switch to activate the starter.

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.

CAUTION
INADVERTANT OPERATION OF THE STARTER CIRCUIT DURING FLIGHT WILL CAUSE A SUDDEN AND SEVERE LOSS OF POWER.

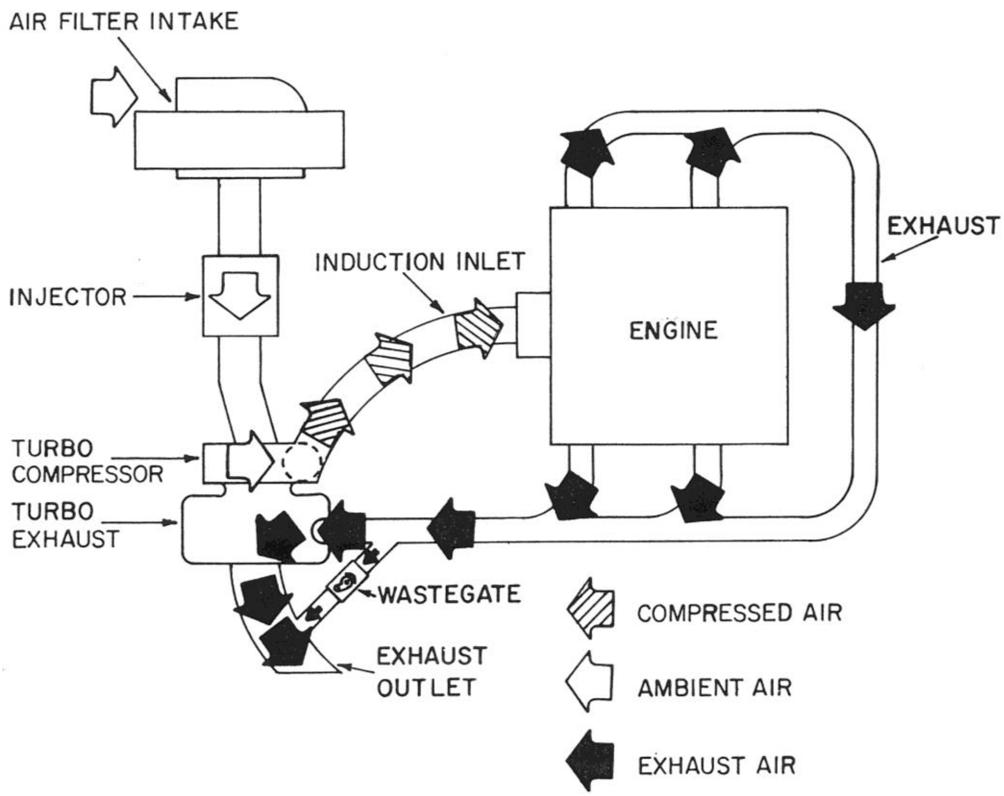
Turbocharger

The turbocharger consists of housing and a spinning shaft that has a turbine wheel on one end and a compressor wheel on the other end.

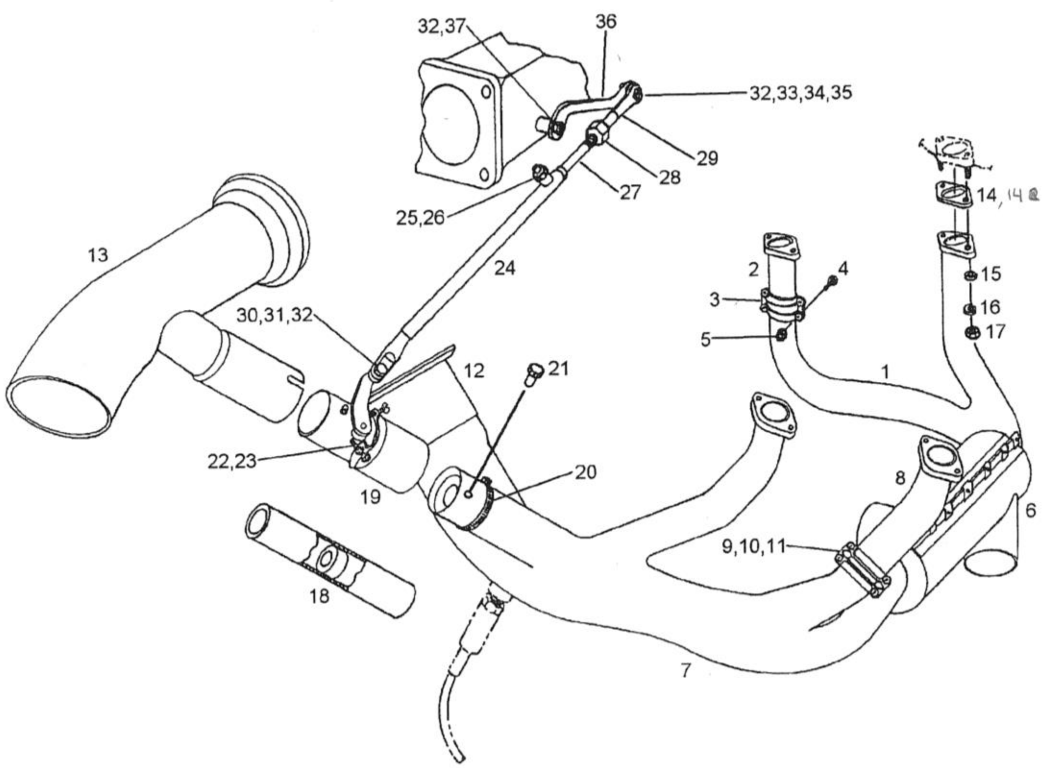


Energy from the engine exhaust spins the turbine wheel which is connected to the compressor wheel. The compressor wheel compresses the intake air which provides increased pressure and available engine power.

PRIMARY AIR FLOW SCHEMATIC



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 about 12,000 ft density altitude.



Wastegate

The Wastegate is a variable adjusting valve that is installed in the exhaust system which controls the proportion 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 that allows the throttle to be controlled in the event of a seized waste gate assembly.

OPERATIONAL PROCEDURES

Ground Handling Wheels

The ground handling wheels are permanently secured to the landing gear skid tubes with brackets. To place the helicopter on the wheels, remove the securing pin and install the wheel bar on the attaching lug with the handle pointing forward. 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 the safety clip on the securing pin before flying the helicopter.

There is option for removable double wheel ground handling wheels that makes moving the helicopter much easier and that greatly increases the life of the tires.

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 fall on the tail when the wheels are moved to the down position. It is good practice to place the tail rotor in the horizontal position before lowering the wheels, or have some one hold the tail while the position of the wheels is changed

Landing gear oleos

Multi-bladed fully articular rotor helicopters are subject to phenomena called ground resonance which is caused by the center of gravity of the blades diverging out away from the rotor hub instead of closer to the hub. Ground resonance is normally prevented by the landing gear oleos and the rotor system lead-lag dampers and could be experienced during start-up of the rotor system or during landings.

On some helicopters, ground resonance during start-up begins with a slow wallowing from side to side or front to back which worsens which can worsen quickly ending with destruction of the helicopter.

Because the Enstrom rotor system uses hydraulic lead-lag dampers that have no centering mechanism, the Enstrom will not normally experience ground resonance. The fore and aft ground rock is a result of the blades continuously seeking equilibrium of their center of gravity and the relative limber oleo effect in the fore and aft direction.

It is important to establish the condition of the landing gear oleos during the preflight to prevent the helicopter from experiencing ground resonance. Normally, the oleos are serviceable if .75 in (19mm) to 1.75 in (51mm) of the chromed piston extends past the seal retainer.

The aft oleos will compress while moving the helicopter on the wheels so they may show less than the required .75 inch after moving the helicopter on the wheels. In this case the crew should establish that the two front oleos have relatively even extension and that the two aft oleos have relatively even extension.

The landing gear oleo extensions should return to normal after flying the helicopter. If they do not, they should be serviced.

The engineering department at Enstrom has determined that below 334 RPM there is not normally enough energy in the rotor system to initiate ground resonance unless there is a serious maintence issue such as no pressure in the oleos. If ground resonance is encountered during landing, the helicopter must be lifted back into a hover.

If the touch down cannot be accomplished without the helicopter entering ground resonance, hold the helicopter in a hover over soft ground such as grass and bleed the rpm off slowly by reducing throttle while holding the helicopter in the hover by increasing collective pitch until the helicopter finally settles on to the ground with reduced rotor RPM. (A very slow hovering throttle chop).

Removing and installing cabin doors

The cabin doors are fiberglass molded structures with transparent acrylic windows bonded on the outside. The outside edges of the door glass are painted so that the internal door structure is not visible. 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.

To prevent damage to the doors, they should never be left unlatched and unattended.

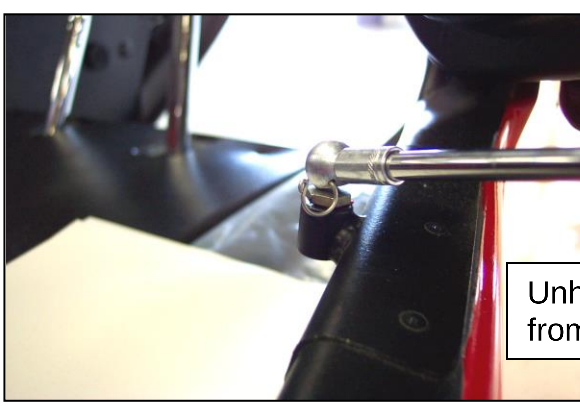
There are no restrictions when flying the 280FX helicopters with one or both doors removed, however care must be taken to remove any loose objects from the cockpit and to secure the seat cushions to prevent them from blowing out the doors. (280FX Operators Manual paragraph 2-1 (2))

NOTE

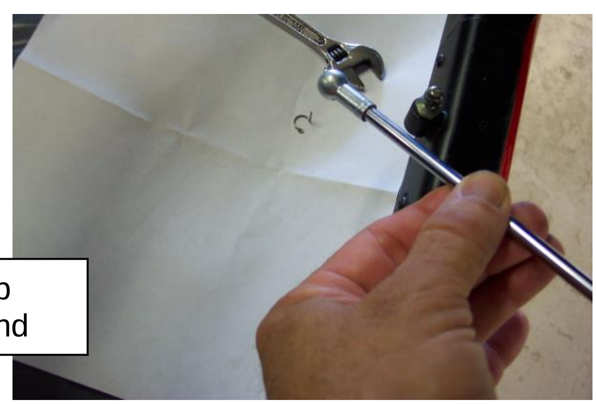
Enstrom recommends never leaving the doors unattended without shutting and latching them.

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.



Unhook clip from ball end



Remove the screw securing the forward end of the restraint strap to the inside cabin wall.

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.

NOTE
The spacers are fitted to the individual doors and are not interchangeable. Take care not to loose or interchange the spacers.

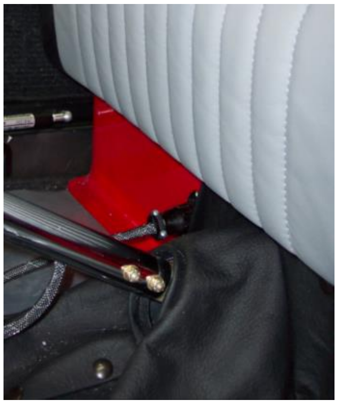
Cabin Heat

The cabin heat control is located just under the right side of the pilot's seat. Pull the control out (forward) 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.

Removable Controls **(Service Information Letter 0179 R1)**

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 locking lever can be latched it 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. Torque the nuts to 12 - 15 in lbs.

The pilot and co-pilot pedals can be adjusted by removing two pins at the pedal stalk top and sliding the pedals forward or aft.

The copilot pedals can be removed by removing bolts and nuts at the bottom of the pedal stalk. During reinstallation, torque the nuts to 30 to 40 in lbs.

Fuel System Operational Information

The fuel quantity indicator failure mode is to read full fuel and not empty. The pilots should be aware that if the fuel quantity indicated on the instrument reads full fuel and has not changed within 30 minutes of flying, the quantity reading should not be trusted.

There are three primary ways to monitor fuel quantity and the pilot should **ALWAYS** use all three. If the pilot sees an anomaly in any one of these three parameters, the safe procedure is to land and check to see that there is sufficient fuel on board or if there might be a problem.

1. Fuel quantity instrument.
2. Clock (time flown).
3. Fuel burn.

The 280 FX will normally burn approximately 16.5 gallons per hour in cruse at 3050 RPM and 29 inches of manifold pressure. This fuel burn allows 2 hours of cruse flight with about 25 minutes reserve.

Low Fuel Pressure caution light. The low fuel pressure caution light is activated by a pressure switch that is installed between the electric boost pump and the engine driven pump. It will illuminate the Low Fuel Pressure caution panel light when the fuel pressure from the electric boost pump is less than 15 PSI. This is NOT a low fuel warning system; it is a warning to the pilot that the electric boost pump is not operating.

Fuel Flow. The fuel flow indicator is a pressure gauge that is hooked into the flow divider on the top of the engine. Although it is calibrated in lbs/hr (pounds of fuel/ hour) it is actually a pressure gauge and the metered fuel pressure can be seen in the small white squares just to the inside of the fuel flow numbers. The fuel injector servo provides a specified amount of fuel to the engine through the fuel injector nozzles and because a plugged fuel injector nozzle will restrict the amount of fuel flowing into the engine cylinders, the fuel flow will record an increase in pressure and higher than normal fuel .

Preflight actions. It is important for the crew to perform the fuel draining procedures in the correct order to avoid introducing water into the fuel system.

The two fuel tank drains must be drained first before the low point sump is drained. (See section 4-3 in the RFM (Before Preflight Inspection).

Engine Management

Starting the engine.

To start the engine after the preflight has been completed, use the following procedure.

1. Collective down and locked.

2. Close the throttle.

3. Set the throttle friction so that slight effort is required to rotate the throttle.

4. Mixture lean. (Idle cut off).

5. Ensure the rotor clutch is disengaged.

6. Prime the engine using one of the following sequences:

   a) Cold engine;

      i) Mixture rich.
      ii) Throttle wide open.
      iii) Run the boost pump until the fuel flow instrument needle movement stops moving, then off. (3 to 5 seconds)
      iv) Mixture lean,
      v) Throttle to the start positon. (Rivet to 12 o'clock plus 1/8 inch (3 mm).
      vi) Magnetos on Both.
      vii) Press starter button and crank engine.
      viii) When engine starts, mixture rich and fuel boost pump on.

   b) Hot Engine (only shut down for less than 10 minutes).

      i) Mixture lean.
      ii) Run the boost pump for 2 seconds to pressurize the system, then off.
      iii) Magnetos on both.
      iv) Press the starter button to crank the engine and as the same time slowly move the mixture control to the full rich positon.
      v) When the engine starts release the starter button and turn on the electric boost pump.

   c) Hot engine (shut down for more than 10 minutes or if the quick start procedure above doesn't start the engine.

      i) Mixture lean.
      ii) Throttle wide open.

iii) Mixture full rich.
iv) Run electric boost pump for 2 to 3 seconds, then off.
v) Mixture lean.
vi) Press the starter button and crank engine.
vii) When the engine starts, SLOWLY move the mixture control to the full rich positon and turn on the electric boost pump.

Belt Clutch Operation

When the belt clutch system is not engaged, the clutch engage handle should be left in the engaged position in its bracket.

Prior to starting the engine, the pilot can determine that the clutch is fully disengaged by pressing down on the clutch engage handle.

Ensure that the clutch engage caution light is on, and that the low rotor rpm warning light is off.

The clutch can be engaged after engine start as soon as there is oil pressure showing. It can also be left in the disengaged positon if the pilot desires. There is no limit to how long the engine can be run with the clutch disengaged but the crew needs to be aware that the blades may turn slowly.

Engage the rotors using the following procedure:

If the engine is warm, the idle speed should be 1450 to 1500 rpm. If the engine is cold the idle speed may be less and should be set to 1500 rpm before engaging the belt clutch mechanism.

Slowly begin lifting the clutch engage handle until the rotors begin to turn.

Use the clutch handle control the engine rpm between 1000 and 1200 rpm. When the rotor speed reaches 100rpm, slowly fully engage the clutch engage handle, release it from its bracket, and lay it flat on the cabin floor. It must lay flat on the floor.

The clutch engage caution light must go out, and the low rpm waring light should light.

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

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.

To disengage the clutch, make sure that the throttle is fully closed. Engage the handle into its bracket and while maintaining a firm grip on it, slowly push I the handle forward and down as far as it will go.

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

The rotors should slow and coast to a stop. Depending on the tolerances of the belt, the rotor blades may not stop rotating completely.

The belt clutch system is fail-safe because once the system is fully engaged and the clutch capsule is over center, a failure of the clutch cable will make it impossible to disengage the system but will not affect the safety of the system in flight.

Lighting of the clutch engagement light on the caution panel during flight is an indication that the clutch may be in an unsafe condition and must be acted on immediately by the crew.

High-low Rotor RPM Warning System

The high-low rotor rpm warning system is activated by the micro switches on the collective torque tube under the pilot's seat and on the cutch spring capsule near the belt. It senses rotor rpm and will light a caution light and sound a warning horn if the rotor rpm decays to less than 332 RPM or increases to more than 385 rpm.

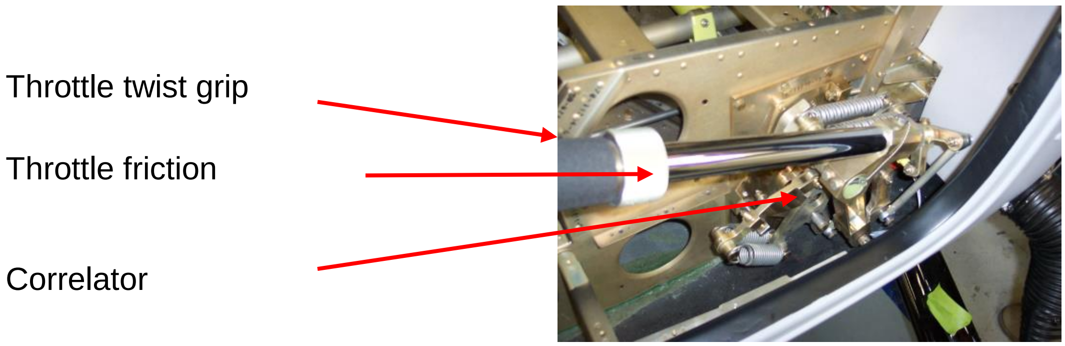
When the rotor cutch is engaged and the clutch capsule goes over center, a micro switch is activated that switches off the clutch engage warning light and activates the rotor rpm warning system. The low rpm warning caution light will light but the micro switch under the pilot's seat prevents the horn from sounding while the collective is in the full down position.

There is a magnetic pick-up in the forward section of the main rotor transmission that will switch off the light and horn when the rotor rpm increases to 334 rpm.

To test the low rotor warning system the clutch must be engaged and the spring capsule locked over center. Release the collective friction and raise the collective slightly until the horn sounds. Then set the collective on the down stop and the horn should stop. Re-tighten the collective friction.

Throttle 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.



The correlator function is similar to an electronic governor but unlike the governor the throttle must not be allowed to move while the collective pitch is adjusted. It is important for the pilot to adjust the throttle friction to be tight enough so that the twist grip throttle will not move on its own while 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 correlation function of the throttle and collective system is defeated.

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 lifts into 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 to increase or decrease blade angle of attack in addition to making small throttle changes.

7. Because the correlator cannot compensate for translational lift, the correlator has a tendency to over compensate while the helicopter transitions from a hover into climb, from forward flight into decent, and back into the hover

   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 cruise, the RPM may have a tendency to droop 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 translational lift.

Fuel Mixture Operation

Proper fuel / air mixture to the engine is essential for the helicopter to meet the published performance specifications.

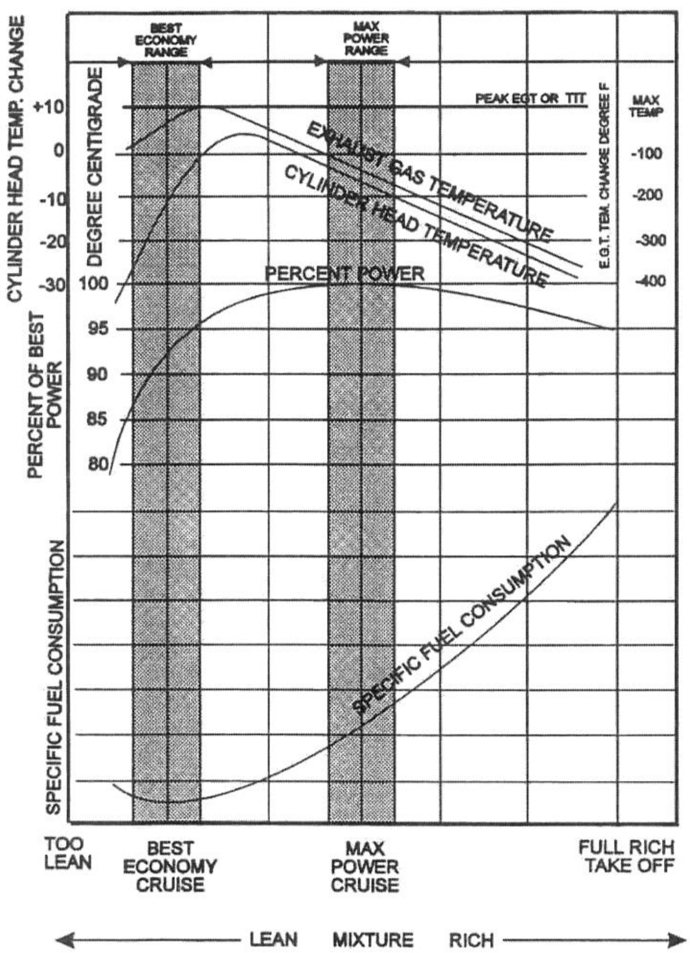
The performance specifications in the rotorcraft flight manual are based on a calibrated engine used for certification and testing that flowed the proper amount of fuel to achieve 1450°F TIT with the mixture control in the full rich positon.

Some 280FX helicopters have fuel injection servos installed 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 to achieve a TIT of 1450. If the helicopter being flown has a TIT in a full-rich hover colder than 1450F, then the fuel injector servo is flowing too much fuel and the helicopter may not meet the performance specifications that the pilot expects.

While the flight manual states that maximum available TIT is 1650 it is recommended that the helicopter not be operated with TITs higher than 1550 F to prevent damage to the engine and exhaust system 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.

The chart on the following page shows that the max power TIT is about 100 to 200 degrees colder than the peak TIT. (Maximum approved TIT is 1650 F on turbocharged Enstrom Helicopters but it is possible to see TIT's as high as 1800° if improper leaning procedures are used).



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.

According to this chart, if a pilot expects to need full rated power for takeoff or landing, it would be prudent to set the mixture to achieve 1450 to 1500° TIT before beginning the maneuver to ensure that suitable power will be available when it is needed.

The Enstrom 280FX helicopter has a fuel injection servo that incorporates an automatic mixture control which corrects the mixture for changes in density altitude. The net effect is that the pilot can pre-set the desired hover mixture TIT before initiating a maneuver.

In accordance with the above discussion, 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.

Take off and hover

To compensate for differences in base altitude or the fuel injection servo settings, the pilot can lean the mixture while the helicopter is operating on the ground with the blade RPM at 3050 and the collective full down by leaning the mixture to obtain 65 to 70 lb/hr fuel flow (cold engine). 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.

See paragraph 4-10 (4) in the RFM.

Cruise

3050 RPM and 29 inches manifold pressure sets the engine power to 75 percent power. Lean the mixture by turning the mixture control knob counter-clockwise no more than one turn at a time. Pause after each turn and note the change in TIT and fuel flow. Leaning the mixture will cause the fuel flow to decrease and the TIT to increase.

Fuel flow settings during cruse flight on an FX series Enstrom can 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.

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.

CAUTION

Over leaning the mixture will cause significant engine damage and can lead to significant engine damage, loss of power or engine failure.

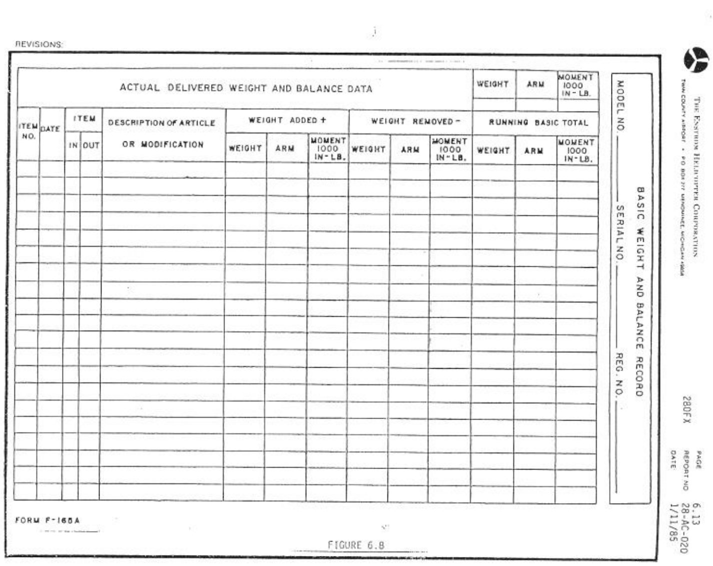
Landing

Before beginning the approach and decent, adjust the mixture with the Vernier mixture control 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.

WEIGHT AND BALANCE

General

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



REVISIONS:

ACTUAL DELIVERED WEIGHT AND BALANCE DATA												WEIGHT	ARM	MOMENT 1000 IN-LB.
ITEM NO.	DATE	ITEM		DESCRIPTION OF ARTICLE OR MODIFICATION	WEIGHT ADDED +			WEIGHT REMOVED −			RUNNING BASIC TOTAL			
		IN	OUT		WEIGHT	ARM	MOMENT 1000 IN-LB.	WEIGHT	ARM	MOMENT 1000 IN-LB.	WEIGHT	ARM	MOMENT 1000 IN-LB.	

MODEL NO. ____ SERIAL NO. ____ REG. NO. ____

BASIC WEIGHT AND BALANCE RECORD

THE ENSTROM HELICOPTER CORPORATION

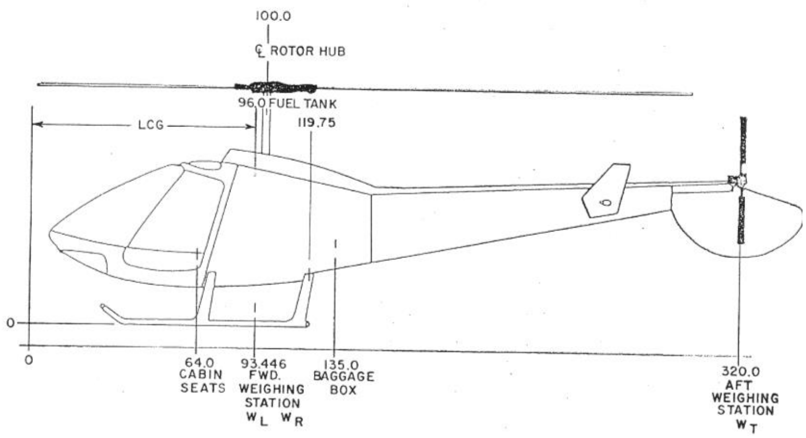
280FX

PAGE 6.13
REPORT NO 28-AC-020
DATE 1/11/85

FORM F-165A

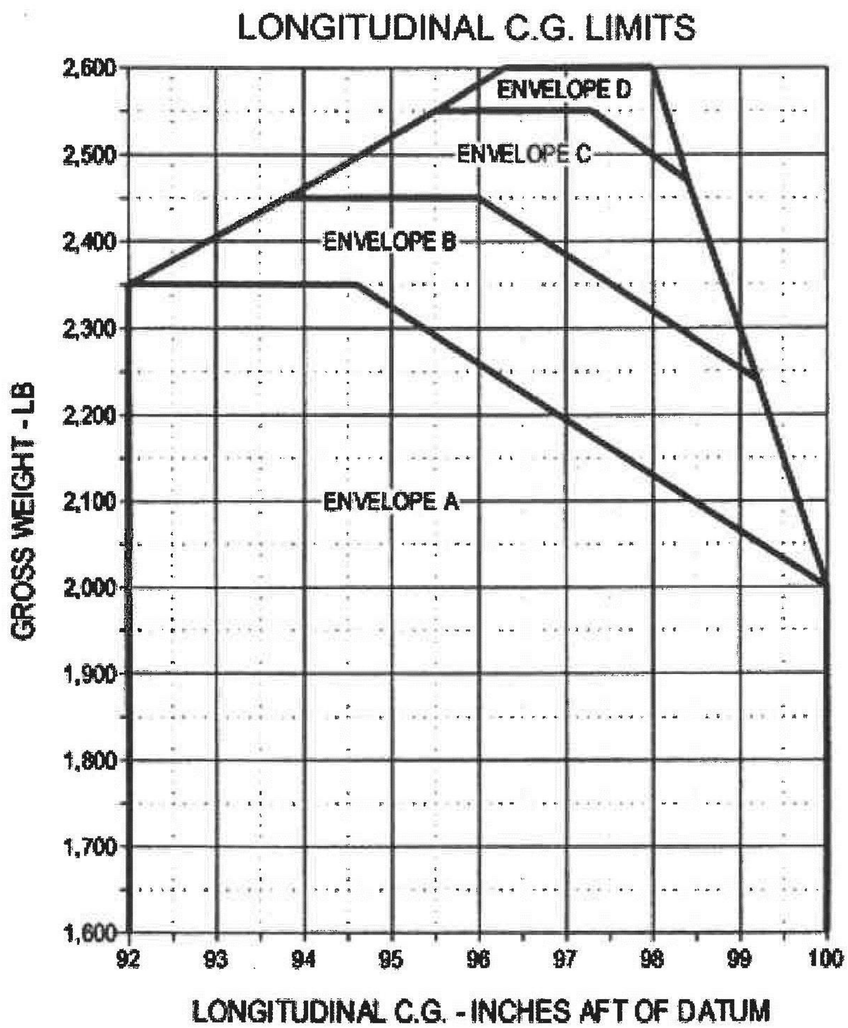
FIGURE 6.8

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 us this running basic total weight and C.G location when determining whether the helicopter is loaded within the limits.

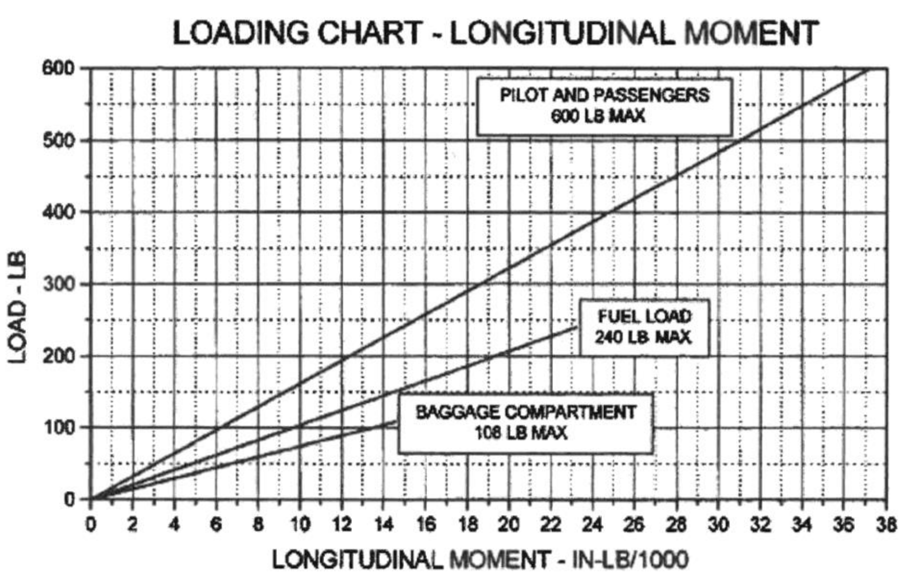


Approved limits

Longitudinal C.G range (see chart below) is variable with gross weight from 92.0 inches to 100.0 inches.



Descriptions	Weight	Long Arms used for W&B calculations	Lat Arms
Pilot		62.0	-13.5
Copilot		62.0	13.5
Right seat passenger		62.0	20.5
Center passenger		62.0	3.0
Fuel		96.0	0
Baggage		135.0	0
Right Door	10.2	59.8	29.25
Left Door	10.2	59.8	-29.25
Copilot Cyclic	2.0	51.0	20.0
Copilot Collective	1.4	64	0.5
Copilot Foot support (2)	0.6	30	20.0
Copilot pedal stalk (2)	0.5	31.5	20.0
Center Seat Cushion	1.2	64	-1.5



Item	Weight	Arm	Moment
Empty Wt C.G.			
Pilot		62	
Copilot		62	
Baggage		135	
Fuel		96	
Cabin door (1)	10.2	59.8	609.96
Cyclic stick (co-pilot)	2.0	51	102.0
Collective	1.4	64	89.6
Foot support (2)	.6	30	18.0
Pedal leg (2)	.5	64	32.0
Center seat cushion	1.2	64	76.8
Total Wt & Moment			

Sample Longitudinal Weight & Balance Calculation Sheet

Maximum Gross Weight is 2600 Lbs
Center of gravity = Total Moment / Total Weight

Sample Lateral Weight & Balance Calculation Sheet

Item	Weight	Arm	Moment
Empty Weight C.G.			
Pilot		13.5	
Copilot		-13.5	
Right seat pass		20.5	
Center passenger		3.0	
Right door	10.2	29.25	298.35
Left door	10.2	-29.25	-298.35
Copilot cyclic	2.0	13.5	27.0
Copilot collective	1.4	0.5	0.7
Copilot foot support (2)	0.6	13.5	8.1
Copilot pedal stalks (2)	.5	13.5	8.8
Center seat cushion	1.2	-1.5	-1.8
Total Wt & Moment			

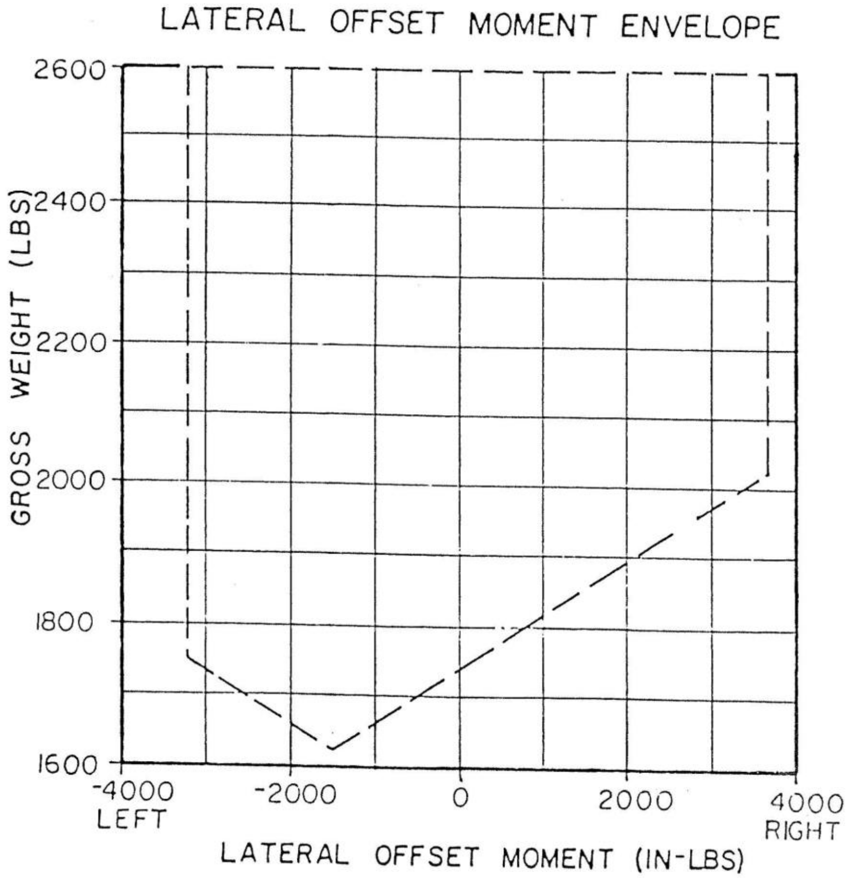


Figure 6.2

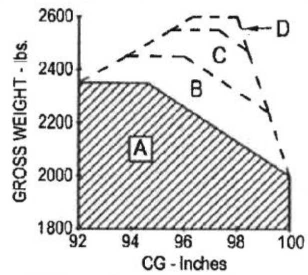
Lateral C.G. range is variable with gross weight form -3250 to +3250 in/lb.

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

PERFORMANCE

VNE Charts

The purpose of the VNE charts in the flight manual is to alert pilots to the maximum VNE limits determined by outside air temperature, pressure altitude and gross weight.



V_{NE} - IAS (MPH) FOR ENVELOPE 'A'

PRESSURE ALTITUDE	OUTSIDE AIR TEMPERATURE °F							
	-20	0	20	40	60	80	100	120
SEA LEVEL	117	117	117	117	117	117	117	117
2000	117	117	117	117	117	114	109	104
4000	117	117	117	115	110	105	96	87
6000	117	116	111	105	96	87	78	69
8000	112	107	96	87	78	69	60	
10,000	99	88	78	69	59			
12,000	81	70	60					

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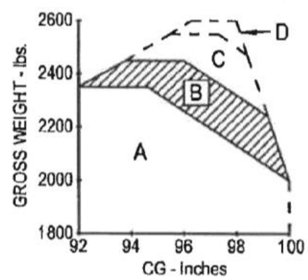
A



V_{NE} - IAS (MPH) FOR ENVELOPE 'B'

PRESSURE ALTITUDE	OUTSIDE AIR TEMPERATURE °F							
	-20	0	20	40	60	80	100	120
SEA LEVEL	104	104	104	104	104	104	104	104
2000	104	104	104	104	104	102	98	94
4000	104	104	104	102	99	94	85	76
6000	104	103	99	95	85	76	68	60
8000	100	96	86	76	67	58		
10,000	89	78	68	58				
10,800	81	70	60					

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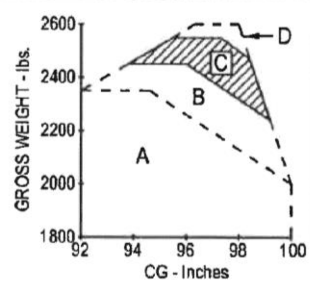
B



V_{NE} - IAS (MPH) FOR ENVELOPE 'C'

PRESSURE ALTITUDE	OUTSIDE AIR TEMPERATURE °F							
	-20	0	20	40	60	80	100	120
SEA LEVEL	91	91	91	91	91	91	91	91
2000	91	91	91	91	91	89	87	85
4000	91	91	91	90	87	83	74	65
6000	91	90	87	83	74	65	57	
8000	88	85	75	65	56			
9600	81	71	61					

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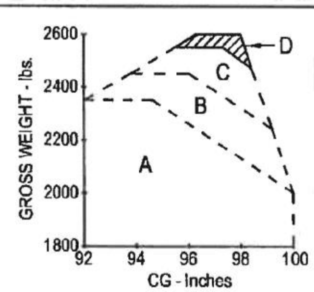
C



V_{NE} - IAS (MPH) FOR ENVELOPE 'D'

PRESSURE ALTITUDE	OUTSIDE AIR TEMPERATURE °F							
	-20	0	20	40	60	80	100	120
SEA LEVEL	85	85	85	85	85	84	83	82
2000	85	85	85	84	83	82	81	80
4000	85	84	83	82	81	78	69	60
6000	83	82	81	79	69	59		
8000	81	80	70	60				
9000	80	71	60					

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D

HIGI Chart

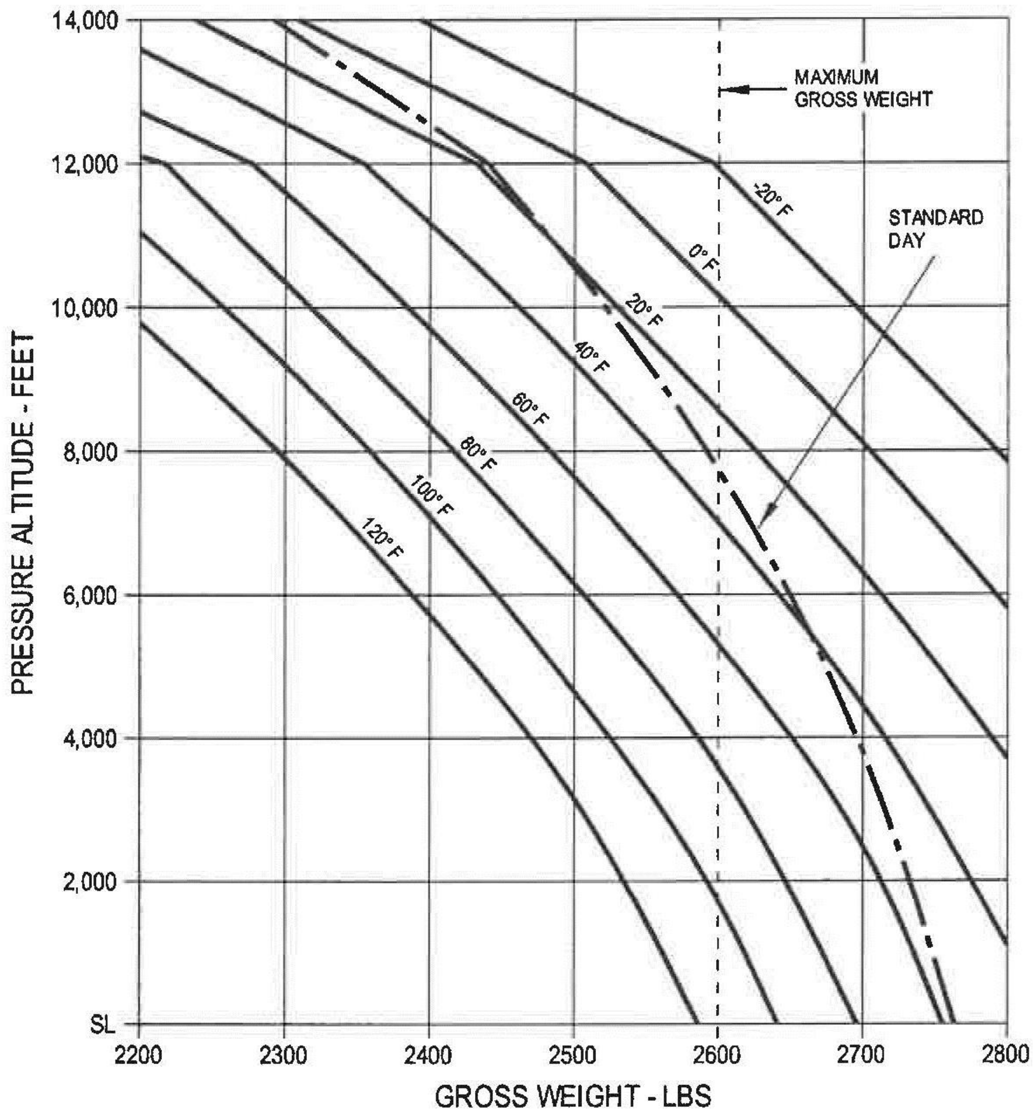


Figure 5-3. Hover Ceiling In-Ground Effect

2 ft Skid Height

350 Rotor RPM

HOGI Chart

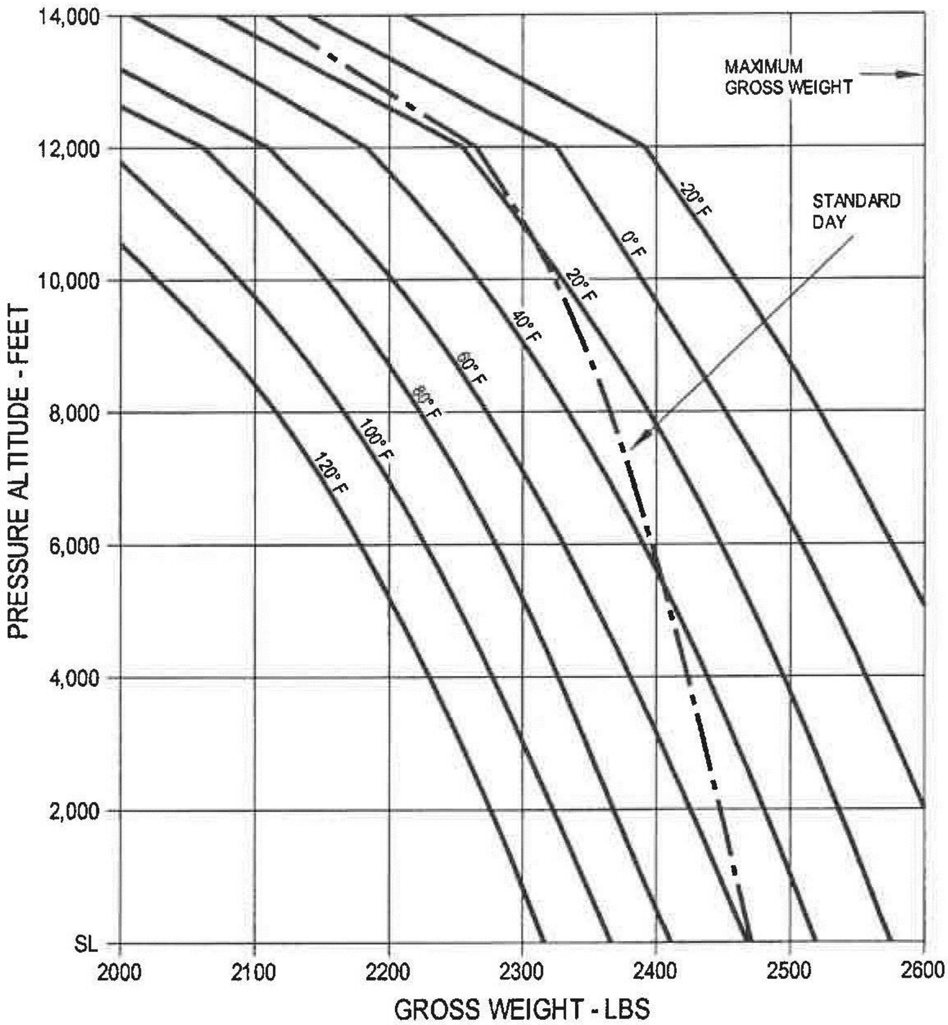


Figure 5-4. Hover Ceiling Out-of-Ground Effect

40 ft Skid Height

350 Rotor RPM

Height Velocity Diagrams

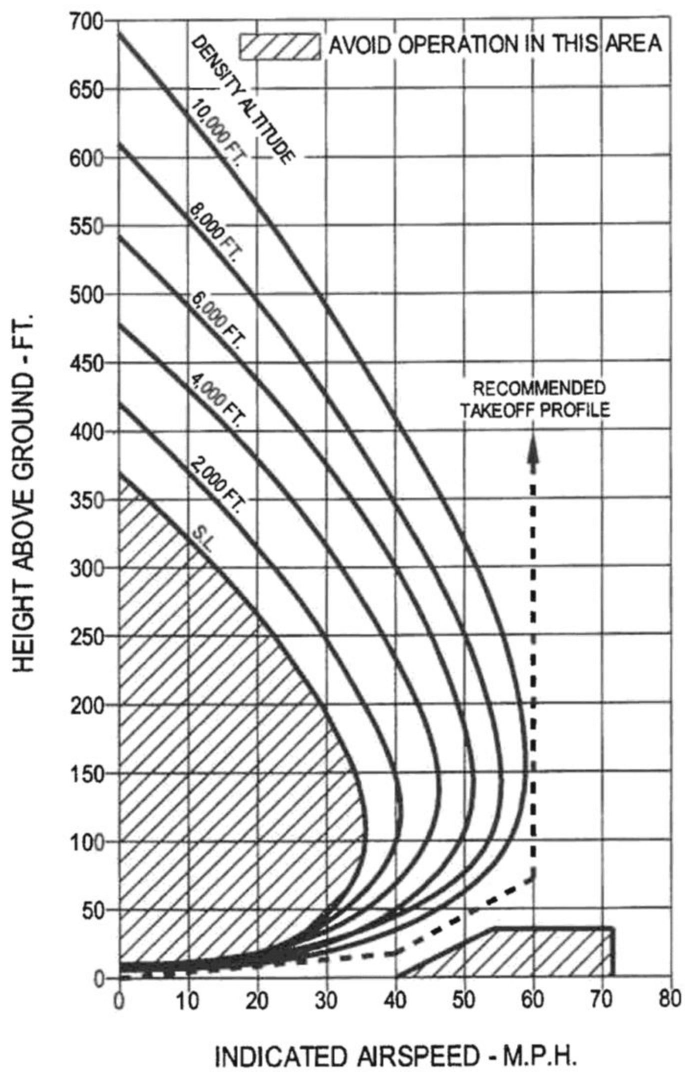


Figure 5-5. Height Velocity Diagram

2350 lb Gross Weight

NOTE

Tests conducted on prepared surfaces.

5-2. Effect of Loading on Choice of H-V Envelope

The H-V curves presented in Figure 5-5 are valid for operations at 2350 lb gross weight for the specific density altitude conditions presented. For operation at other than 2350 lb gross weight, determine the proper H-V curve to be used for the intended gross weight and density altitude for the flight from the curves presented in Figure 5-6 below. For operations above 2500 lb gross weight, use the H-V curves presented in Figure 5-7 in place of Figures 5-6 and Figure 5-5.

1. A gross weight of 2000 lb and 3900 ft H_d would allow the use of the sea level envelope.

2. A gross weight of 2200 lb and 4500 ft H_d would require a 2800 ft curve. To be conservative, use the next higher curve, 4000 ft.

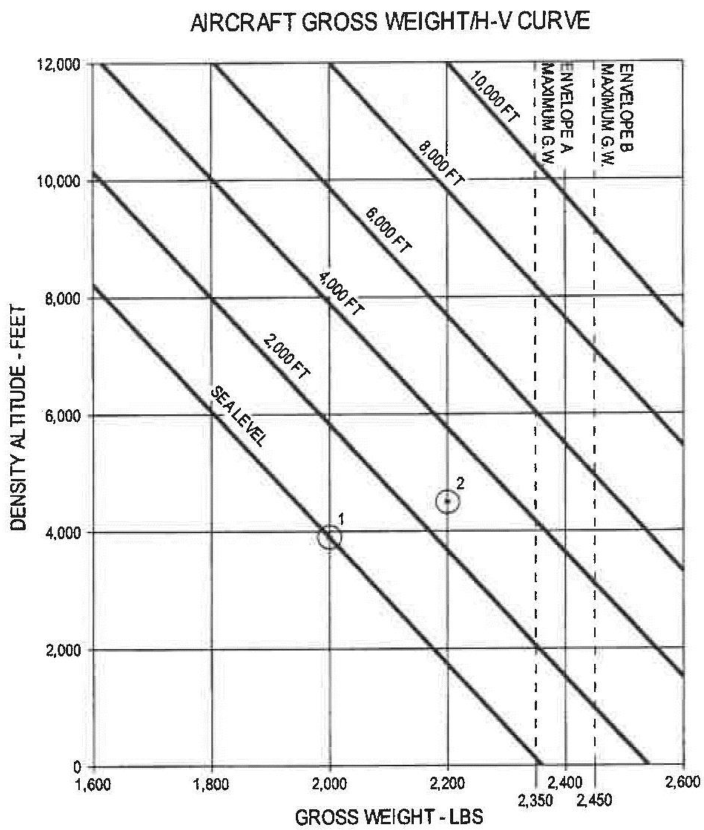


Figure 5-6. Effect of Loading on Choice of H-V Envelope

NOTE

Altitude operations may also be limited by V_{NE} and OGE hover. Cross check Figure 5-1 and Figure 5-4 for intended operations when using this figure.

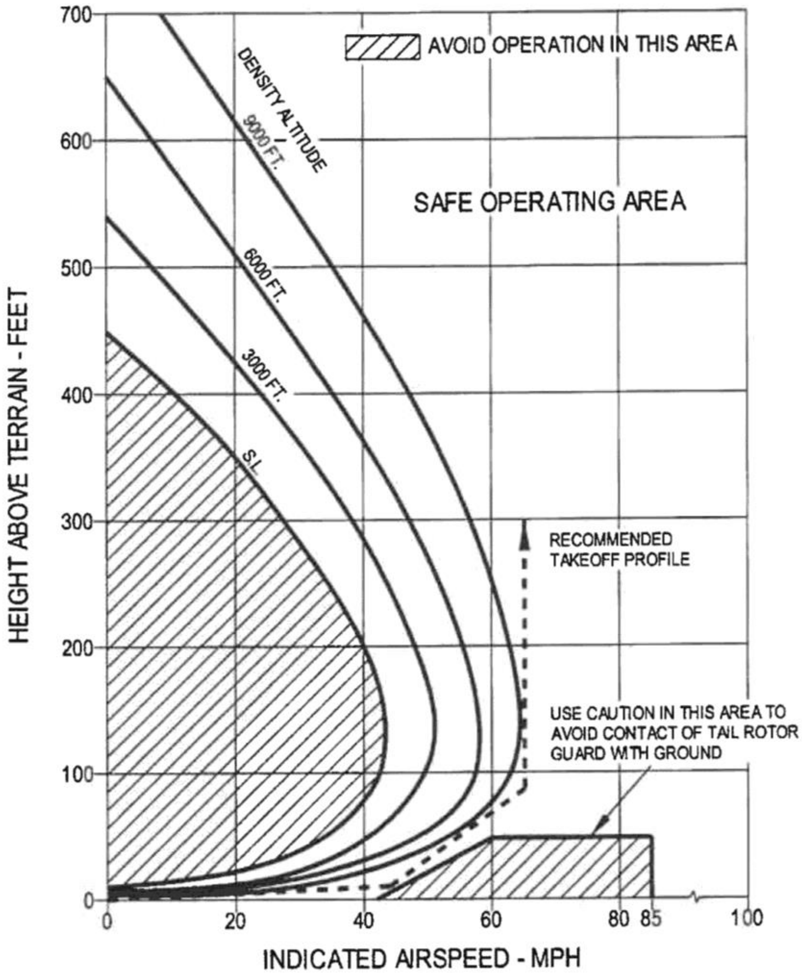


Figure 5-7. Height Velocity Diagram

2600 lb Gross Weight

EMERGENCY

General

This section describes the system 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.

Definition of Terms

Immediate Emergency Actions - actions that must be performed immediately in an emergency procedure. In the RFM they are underlined and must be committed to memory.

Land immediately – perform a landing at the closest suitable landing site.

Land as soon as Practicable - Land at the nearest suitable airport or landing facility.

Emergency Exit – First attempt to open the doors. If the doors will not open, break any windows necessary to allow exit.

Sustained autorotation speed is limited to 85 MPH or VNE to prevent high rates of decent. Maximum glide distance in autorotation is with 80 mph airspeed and 334 blade rpm.

Engine Failure

The indications of an engine failure, either partial or complete power loss, are a left yaw and a drop in engine and main rotor RPM. There will normally be a Low Rotor Warning Horn and Light.

In the event of engine failure proceed as follows:

Above 375 Ft (AGL)

1. Enter Autorotation (Collective full down, roll off throttle, use right pedal to trim helicopter).

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

3. Check and adjust Rotor RPM.

4. Select landing site.

5. 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.

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

7. When airspeed is as desired, perform a collective check which will level the helicopter. Use forward cyclic to adjust forward speed as necessary. 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.

Above 10 Ft and below 375 Ft

If an engine failure occurs at low altitude and / or low airspeed, there may not be enough altitude to increase rotor rpm. The collective must be adjusted to maintain rotor rpm and to reach the landing point.

1. Adjust collective to maintain rotor rpm, roll off throttle to idle, and use right pedal to trim helicopter.

    a. At higher altitudes and low airspeeds, use forward cyclic to increase airspeed to 58 mph. Forward cyclic will have a dramatic effect reducing rotor RPM which must be monitored carefully to prevent from decaying out of the green.

    b. At low altitudes and high airspeed use aft cyclic to reduce airspeed prior to landing.

At Hover, in ground effect

1. Use right pedal to align helicopter.

2. Do not reduce collective.

3. As the helicopter settles to the ground, use up collective to cushion the landing.

At Hover, out of ground effect

In an out-of- ground effect hover, the downwash from the rotor system exerts a downward force on the tail stabilizers. If the engine stops, the forces on the stabilizer will switch from down from the rotor wash to up from the helicopter falling through the air. This will have the effect of pitching the helicopter over into a nose down attitude. If the cyclic is moved forward, the effect is that an already slowing rotor speed will be slowed even further, possibly to the point where the rotor speed cannot be recovered.

It is important for the pilot to not pitch the helicopter forward until the rotor rpm has stabilized and recovered and then to monitor rotor speed as the nose is pitched down to recover airspeed.

1. <u>Full down collective and right pedal to align helicopter.</u>

2. Monitor rotor rpm and as it recovers, gently use forward cyclic to gain airspeed to 58 mph.

3. Perform auto-rotation landing.

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.**
> **<u>DO NOT</u> attempt air restart when below 3000 feet.**

1. Select landing site.

2. Turn off boost pump.

3. Set throttle to start position.

4. Engage starter.

5. If engine fires, turn on boost pump.

6. Slowly increase throttle until engine and rotor tach needles join.

Ditching without power

If engine power is lost over water, accomplish engine failure emergency procedure and proceed as follows.

1. Unlatch doors.

2. Complete normal autorotation landing in water.

3. As the collective reaches full up position and the helicopter settles into the water, apply full lateral cyclic in the direction that the helicopter tends to roll.

Ditching with power

1. Descend to a low hover altitude over the water.

2. Exit passengers.

3. Hover clear of passengers

4. Turn off master and alternator.

5. Close throttle and complete hovering autorotation.

6. As collective reaches the full up position and the helicopter settles into the water, apply full right lateral cyclic.

7. Exit the helicopter when the rotor stops.

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.

Wastegate failure, stuck throttle

One possible result of a wastegate failure is stuck throttle. In the event of stuck throttle the pilot should give a hard twist of the throttle in the open direction. If the breakaway rod releases, the throttle will increase suddenly. The pilot will need to control the throttle to prevent overspeed and needs to be aware that full manifold pressure may not be available for flight.

Low engine oil pressure

1. Low oil pressure and normal oil temperature;

    a. 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:

        i. Land at nearest suitable landing area.

        ii. Inspect for and correct this source of trouble before continuing flight.

2. Total Loss of oil pressure

    a. 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:

        i. Reduce engine power immediately.

        ii. Select a suitable forced landing field and land with power.

    Be prepared for sudden engine failure at any time.

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**:

   a. Hovering flight

      i. Perform hovering autorotation

   b. During Flight

      1. Use cyclic control for directional control and collective and power settings to maintain 60 to 80 MPH and 45 degrees yaw

      2. When suitable landing site is reached, perform autorotation
      3. 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.

1. **Tail Rotor Cable Failure**:

The TR blades incorporate flyweights (penepital weights) on the blade grips which help to control blade pitch angles and which allow controlled flight with airspeeds above 50MPH and manifold pressure in the 23 to 29 inch range.

The most effective approach with loss of pitch control is a long flat approach with turns as necessary and which 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.

1) Fixed Pitch Settings;

a) Stuck Right or Left Pedal

i) 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 may 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, or blown off with compressed air 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. Turn electrical switches off.
2. Land immediately using power-on approach.
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 practical.

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.

NOTE: Because the engine has a mechanical fuel pump, the engine should continue to run without the electric boost pump working.

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. <u>These indications will be instantaneous and the pilot should immediately enter autorotation</u>.

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

1. **Clutch disengagement light with left yaw.**

    a. <u>Enter autorotation and reduce power to idle.</u>

    b. <u>Perform autorotation landing.</u>

    c. Correct the source of trouble before continuing flight.

2. **Clutch disengagement light on without left yaw.**

    a. <u>Reduce power and be prepared for sudden clutch disengagement.</u>

    b. Land at nearest suitable landing area.

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

    c. 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.

PREFLIGHT

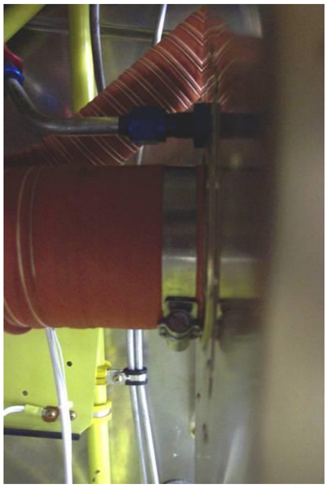
NOTE!
The following preflight actions are intended to clarify and supplement the preflight procedure listed in the aircraft Rotorcraft Fight Manual: and are not intended to replace them.

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.

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 its self. It needs to be in good condition

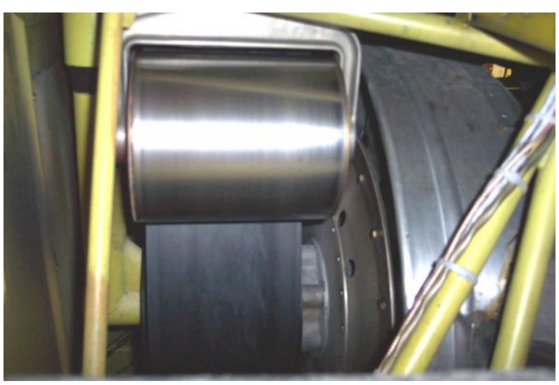


4. Reach in behind the air box, and grasp the red hose and the hose clamp where they attach to the back of the air box. Verify that the hose is secure and that the clamp is tight.

There has been more than one accident that resulted from the hose coming off and then sticking its self 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.

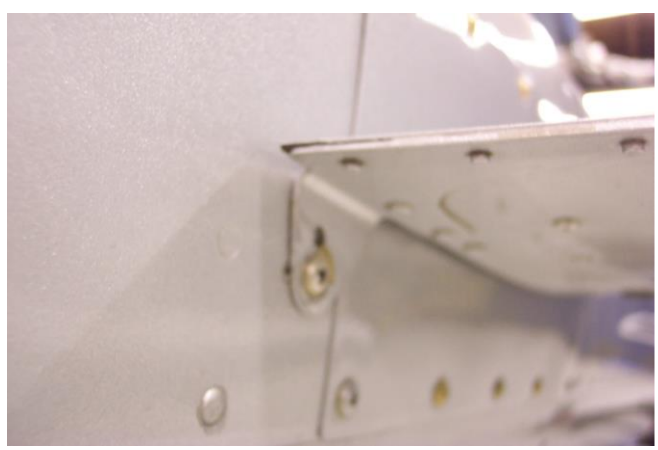


6. During pre-flight note the middle part of the pulley, it should be clean and shinny. There is normally a narrow band of dirt and grease on the outside ends of the pulley. If the pulley is shinny clean all the way to one side, it could be an indication of belt track problems.

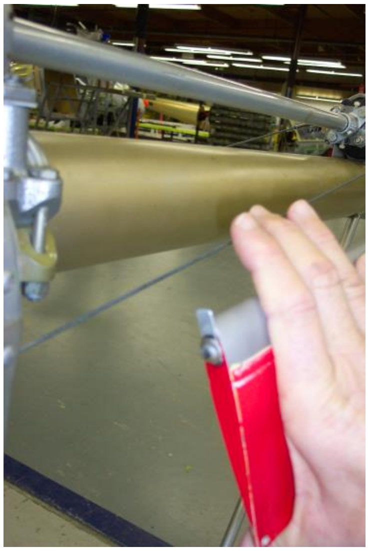
7. Line the mark on the fuel dip stick up with the lip on the fuel filler neck to get an accurate fuel quantity measurement.

.   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 extra hole in the tab is used when floats are installed on the helicopter



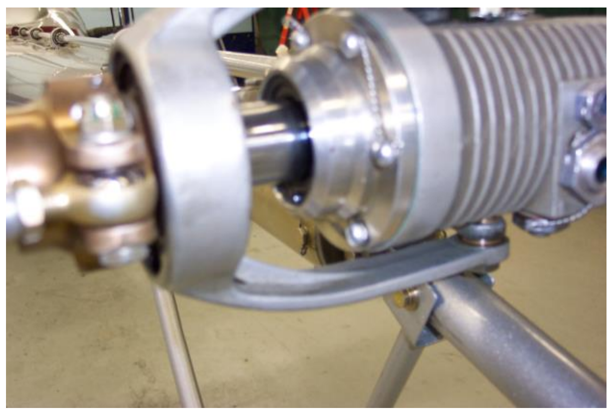
10 Push the stabilizer up and down and look for movement that might suggest problems in the spar mounting area.



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.

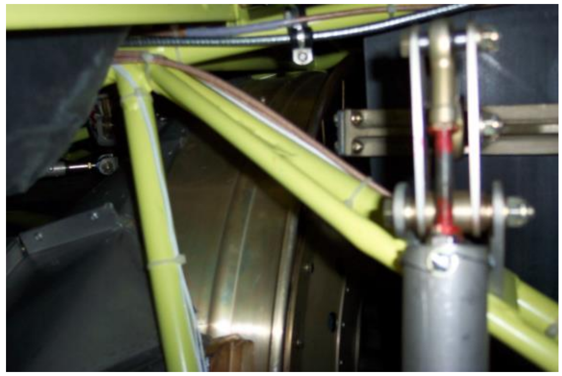
The purpose of the strike tab is to alert the pilots and technicians that the tail rotor could have had a strike.

12. A small amount of oil leaking from the tail transmission out-put 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. Grab the bolt and nut and try to turn. If it turns do not fly until the problem has been corrected.

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. Carefully inspect the two clamps 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.

PILOT NOTES