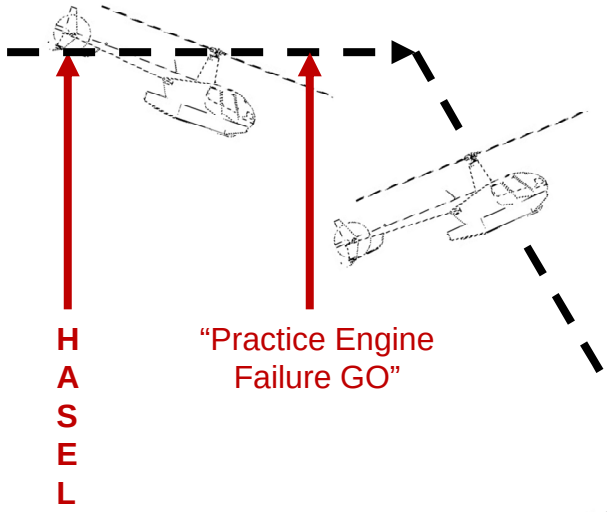
Exercise 10 - Basic Autorotation

AIM: To learn how to enter, control and recover from autorotations

T.E.M.: HASEL Check, Carb Heat, Verbal Warning, Wind, Limitations, Rotor RPM Limits



ENTRY

POWER - Lower Collective, all way to bottom
ATTITUDE - Aft Cyclic to keep aircraft attitude
TRIM - Right Pedal
Roll throttle idle (instructor)
Check Collective UP to prevent Overspeed

AUTO. DESCENT

70 knots
RRPM Middle of Green Arc
R.O.D. 1500 f.p.m.

H – eight
A – rea
S – ecurity
E – ngine
L - ookout

RECOVER TO POWERED FLIGHT

Open Throttle 80% (instructor=
Needles Re-join
"GO Around"
POWER - Gently Raise Collective
ATTITUDE - Forward Cyclic to keep aircraft attitude
TRIM - Left Pedal
23 inches M.A.P. Climb Attitude, Vy
Carb Heat IN

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H.A.S.E.L. Check

Height –	sufficient to enter & recover
Area –	safe area below clear of obstructions
Security –	No loose objects, doors, harnesses
Engine -	Lights, RPM, MAP, T's & P's and FULL Carb Heat
Lookout –	all round, possibly a full 360° turn

R44 Limitations

Rotor RPM Limits:	90% - 108%
Low RPM Horn & Light:	97%
Vne Autorotation:	100 knots

EFFECTS OF CONTROLS IN AUTOROTATION

Cyclic Movement	Primary Action	Rotor RPM	Corrective Action
	Disc Loading		
Rapid Aft (Flare)	Increasing ↑	Increasing ↑	Lever ↑
	Disc Unloading		
Rapid Forward	Decreasing ↓	Decreasing ↓	Lever ↓
	This situation will only exist whilst the aircraft is in the flared state, when normal aircraft attitude is restored the RRPM will return to previous amounts		
	Airspeed		
Gently Forward	Increasing ↑	Increasing ↑	Lever ↑
Gently Aft	Decreasing ↓	Decreasing ↓	Lever ↓
	Turning		
Left or Right Cyclic	Turn Left or Right ← →	Increasing ↑	Lever ↑
	This situation will only exist whilst the aircraft is turning, when normal aircraft attitude is restored the RRPM will return to previous amounts		

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DISC LOADING

- Higher Disc loading will increase Rotor RPM
- Lower Disc loading will reduce Rotor RPM

HELICOPTER WEIGHT

- Higher weight will increase Disc Loading
- Lower weight will reduce Disc Loading

G-FORCES

- High G-Forces will increase Disc Loading
- Low G-Forces will decrease Disc Loading
- Negative G-Forces will create a Right Roll, due to the Tail Rotor Thrust, which if, countered with opposite Cyclic can cause Mast Bumping, the Main Rotors to contact the tail boom and cabin and usually fatal. Negative G must be avoided.
- Correct action is Aft Cyclic to reload the Disc and then roll wings level.

DENSITY ALTITUDE

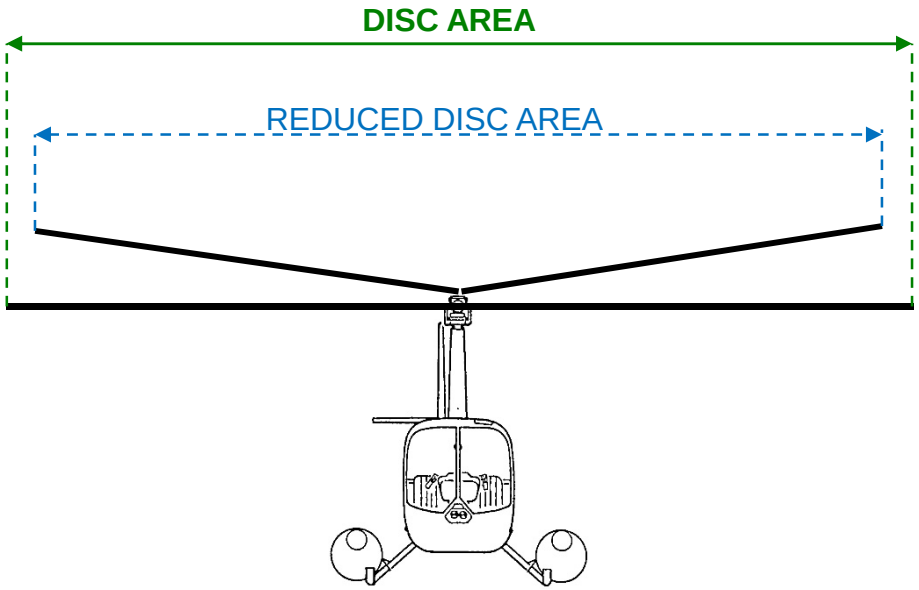
- At a given speed, a higher Density Altitude will result in a higher Rate of Descent and Rotor RPM, therefore a high Collective Pitch Angle will be required to maintain Rotor RPM within limits.

VORTEX RING

- This is covered in depth in Exercise 18
- When recovering from Autorotation you must have positive Airspeed (above 30 knots) before engaging power.

CONSERVATION OF ANGULAR MOMENTUM

- The value of angular momentum is a fixed constant and is related to disc area and rotor RPM.
- Disc area can be changed by helicopter loading and G-Force.
- If the disc area is reduced the rotor RPM must increase to keep angular momentum constant.
- If disc area is increased then the rotor RPM must reduce to keep angular momentum constant



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Safety Notice SN-27

Issued: Dec 87 Rev: Jun 94

SURPRISE THROTTLE CHOPS CAN BE DEADLY

Many flight instructors do not know how to give a student a simulated power failure safely. They may have learned how to respond to a throttle chop themselves, but they haven't learned how to prepare a student for a simulated power failure or how to handle a situation where the student's reactions are unexpected. The student may freeze on the controls, push the wrong pedal, raise instead of lower the collective, or just do nothing. The instructor must be prepared to handle any unexpected student reaction.

Before giving a simulated power failure, carefully prepare your student and be sure you have flown together enough to establish that critical understanding and communication between instructor and student. Go through the exercise together a number of times until the student's reactions are both correct and predictable. Never truly surprise the student. Tell him you are going to give him a simulated power failure a few minutes before, and when you roll off the throttle, loudly announce "power failure". The manifold pressure should be less than 21 inches and the throttle should be rolled off smoothly, never "chopped". Follow through on all controls and tighten the muscles in your right leg to prevent the student from pushing the wrong pedal if he becomes confused. And always assume that you will be required to complete the autorotation entry yourself. Never wait to see what the student does. Plan to initiate the recovery within one second, regardless of the student's reaction.

There have been instances when the engine has quit during simulated engine failures. As a precaution, always perform the simulated engine failure within glide distance of a smooth open area where you are certain you could complete a safe touch-down autorotation should it become necessary. Also, never practice simulated power failures until the engine is thoroughly warmed up. Wait until you have been flying for at least 15 to 20 minutes.

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PRACTICE AUTOROTATIONS CAUSE MANY TRAINING ACCIDENTS

Each year many helicopters are destroyed practicing for the engine failure that very rarely occurs.

Many practice autorotation accidents occur when the helicopter descends below 100 feet AGL without all the proper conditions having been met. As the aircraft descends through 100 feet AGL, make an immediate power recovery unless all of the following conditions exist:

1) Rotor RPM in middle of green arc
2) Airspeed stabilized between 60 and 70 KIAS
3) A normal rate of descent, usually less than 1500 ft/min
4) Turns (if any) completed

Instructors may find it helpful to call out "RPM, airspeed, rate of descent" prior to passing through 100 feet. At density altitudes above 4000 feet, increase the decision point to 200 feet AGL or higher.

A high percentage of training accidents occur after many consecutive autorotations. To maintain instructor focus and minimize student fatigue, limit practice to no more than 3 or 4 consecutive autorotations.

There have been instances when the engine has quit during practice autorotation. To avoid inadvertent engine stoppage, do not roll throttle to full idle. Reduce throttle smoothly for a small visible needle split, then hold throttle firmly to override governor. Recover immediately if engine is rough or engine RPM continues to drop.

Basic Autorotations – Common Errors

- Entry - Nose drop on entry (Aft Cyclic)
- Entry - No right pedal, uncoordinated entry
- Entry - No Collective Check UP
- Auto - Airspeed slowing down in descent
- Auto - Maintaining 100% RRPM
- Auto – RRPM UP – LEVER UP, RRPM DOWN – LEVER DOWN
- Recovery – Opening Throttle too much – Overspeed
- Recovery – Aggressive Collective UP - Overspeed
- Recovery – allowing nose up pitch
- Recovery, low speed, high R.O.D., beware of Vortex Ring