

The accident aircraft
was a McDonnell Douglas MD-83,



MCDONNELL DOUGLAS MD-83

Narrow-body jet airliner

First flight: October 18, 1979



DC9



MD-81



MD-82



MD-83

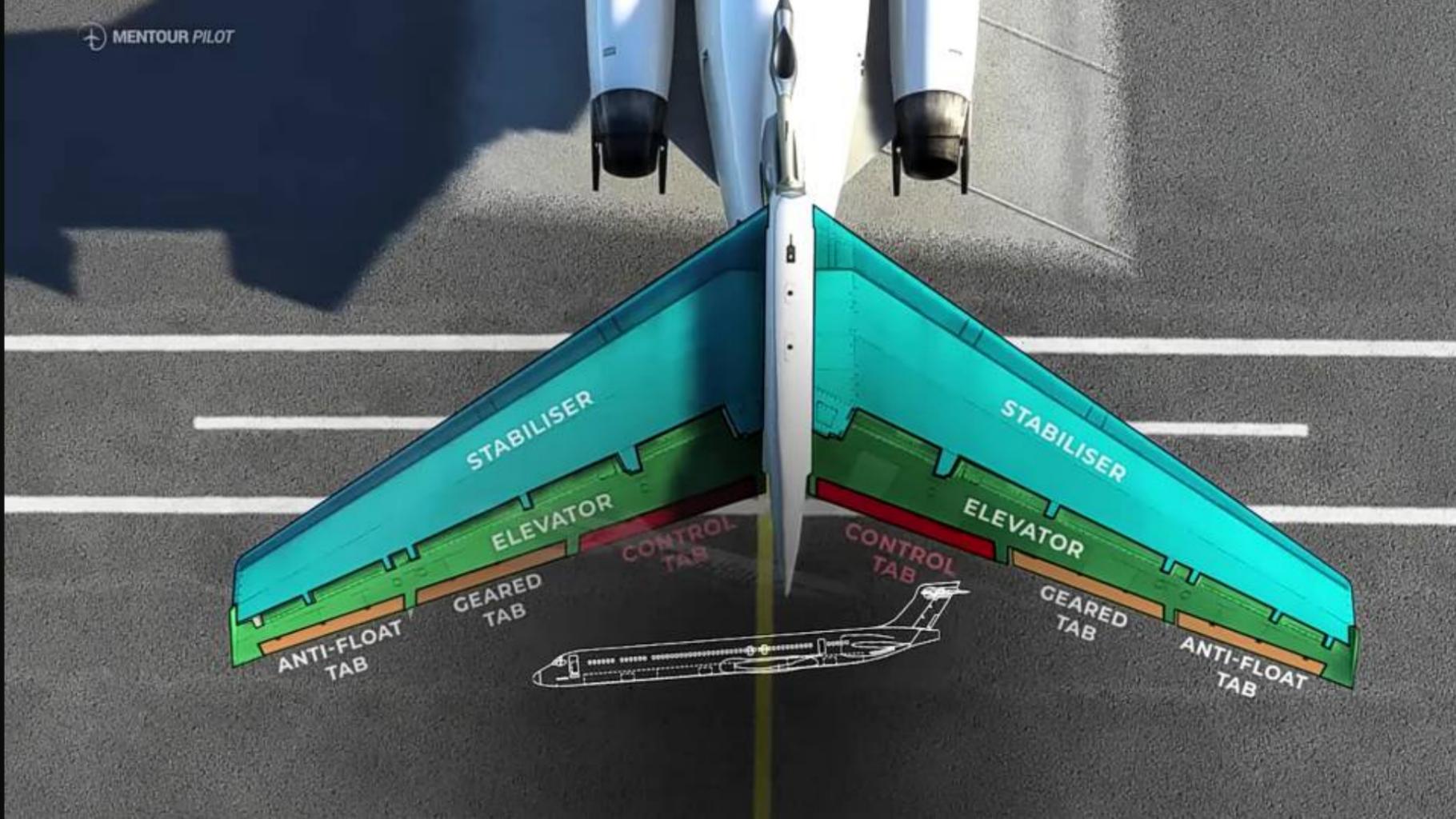


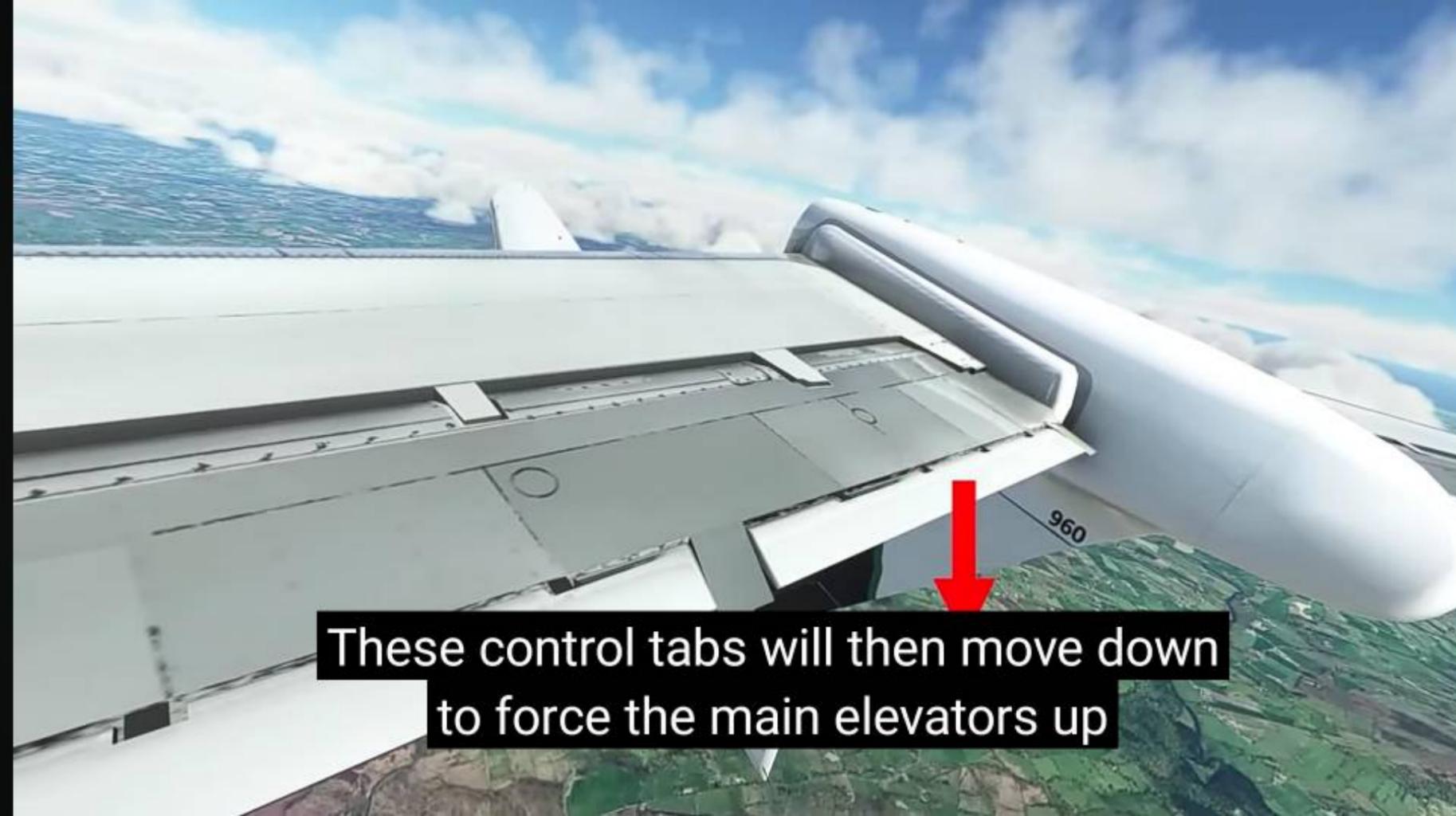
MD-88



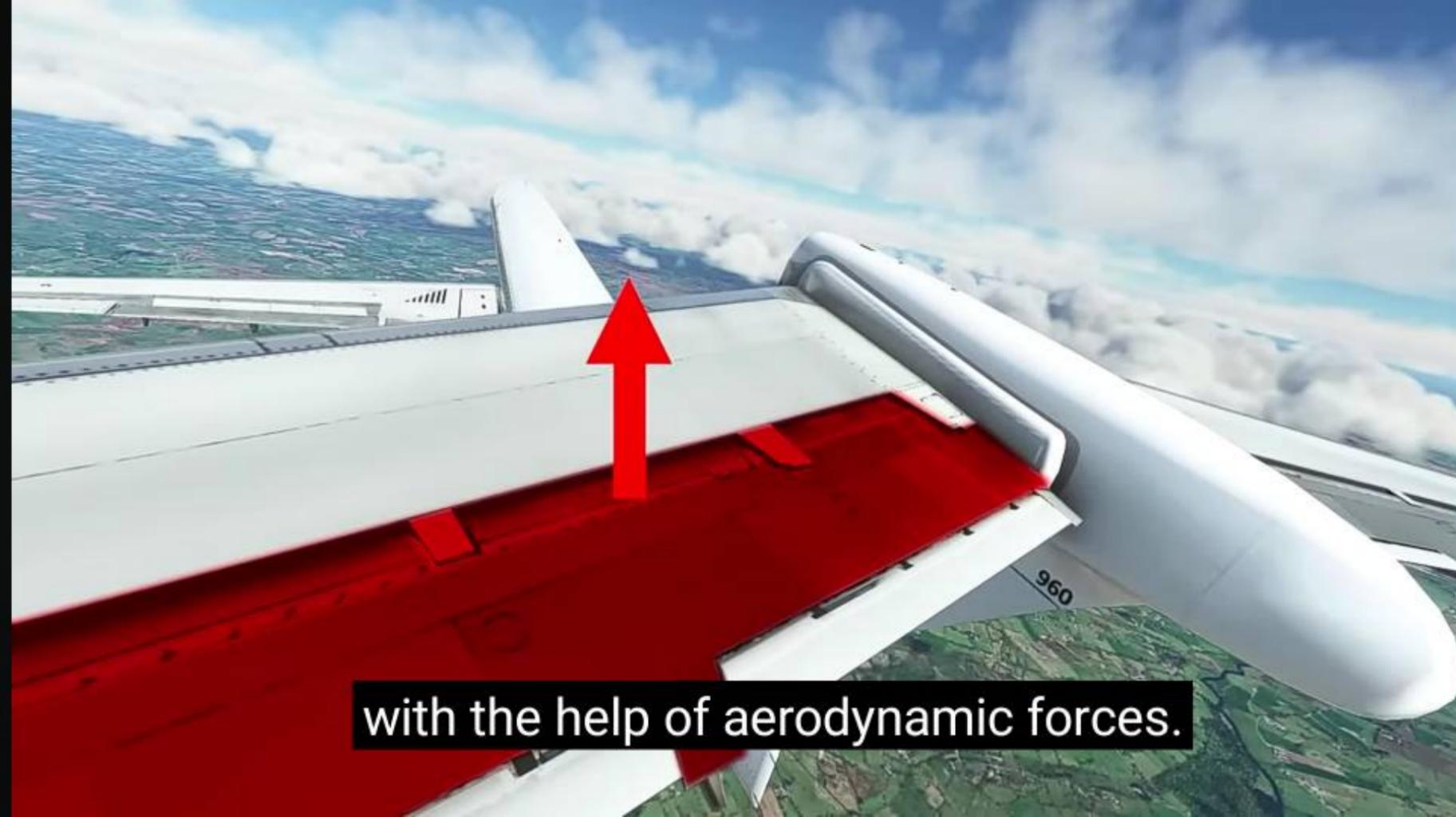
BOEING 717

and then finally, the Boeing 717.





These control tabs will then move down
to force the main elevators up

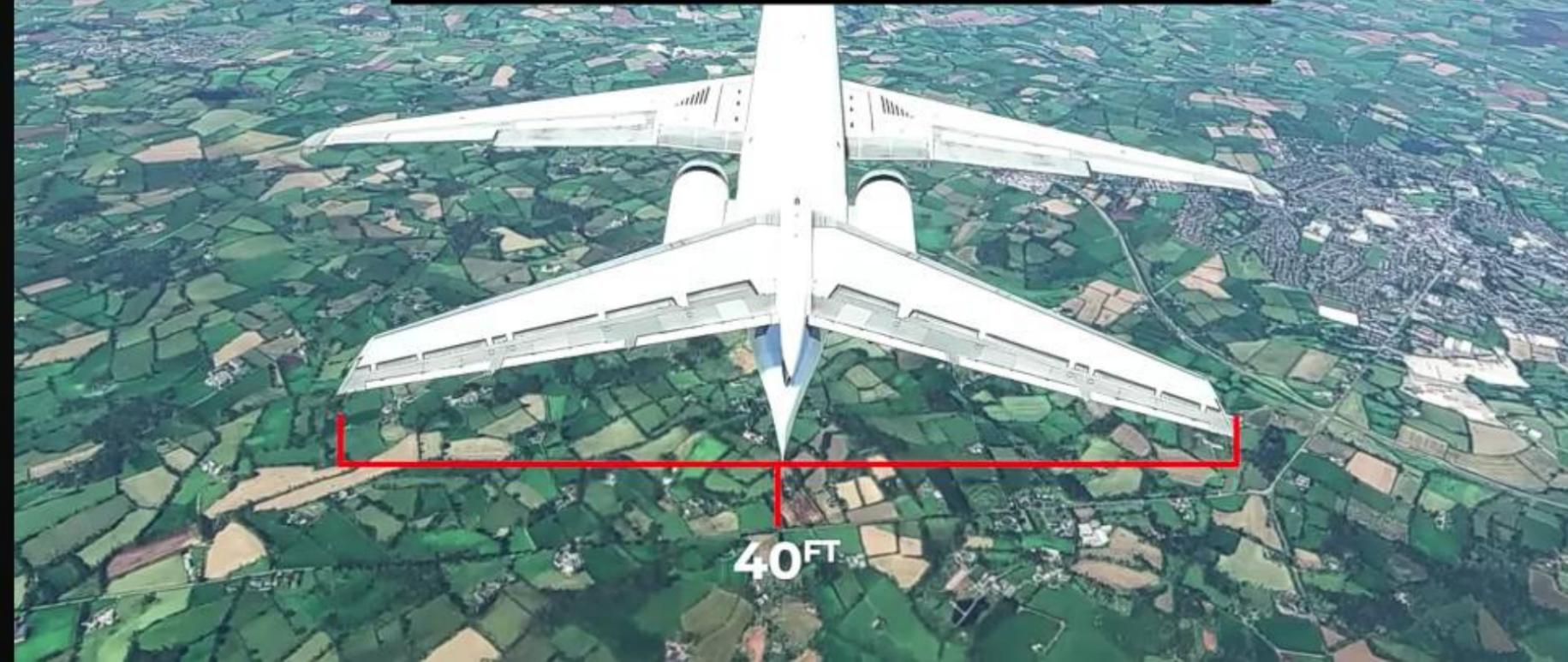


with the help of aerodynamic forces.



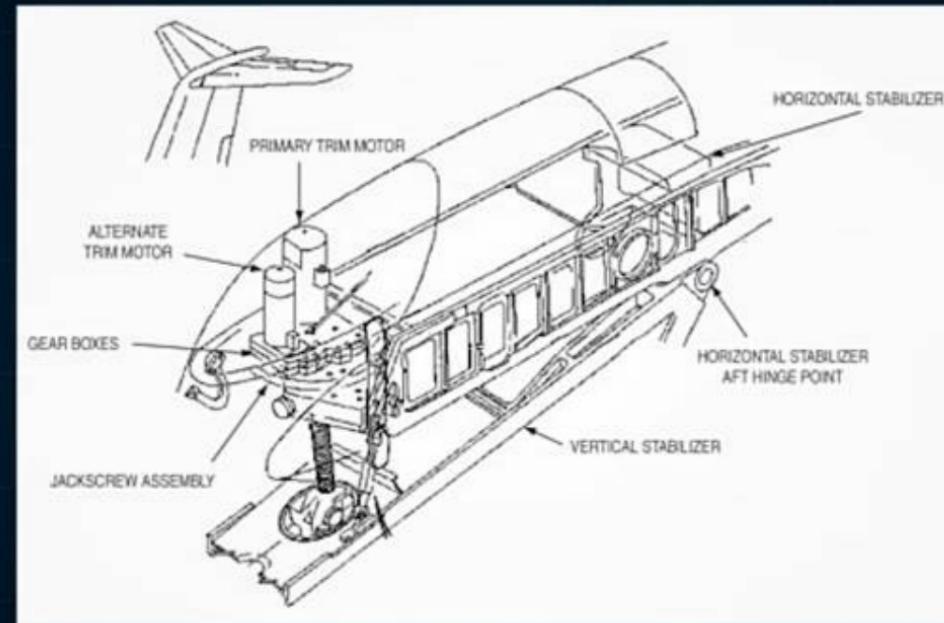
which is basically
the entire horizontal back wing

The movable horizontal stabilizer
on the MD-80 is about 40 feet wide.

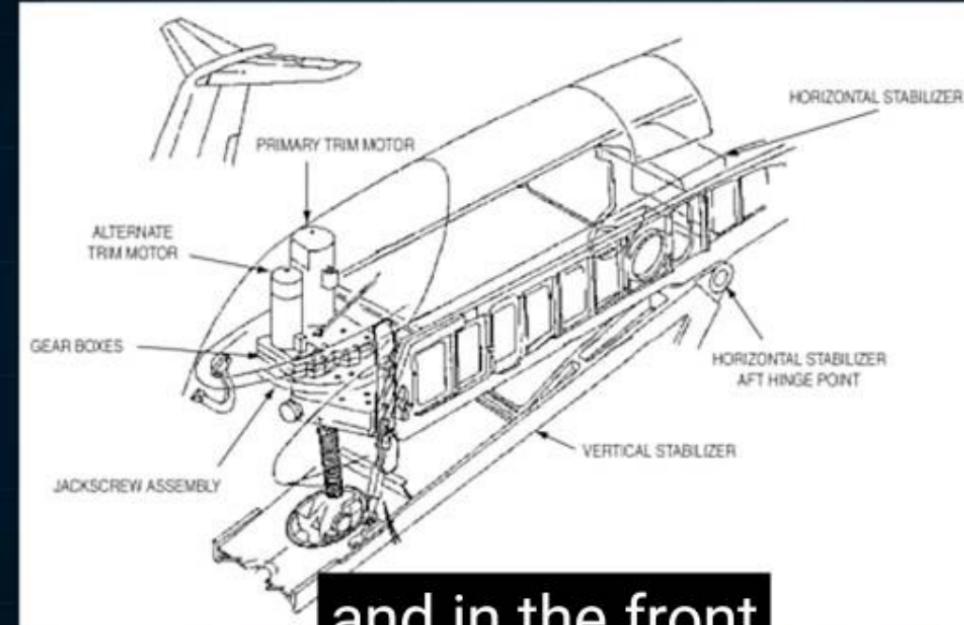




via two hinges in the aft spar



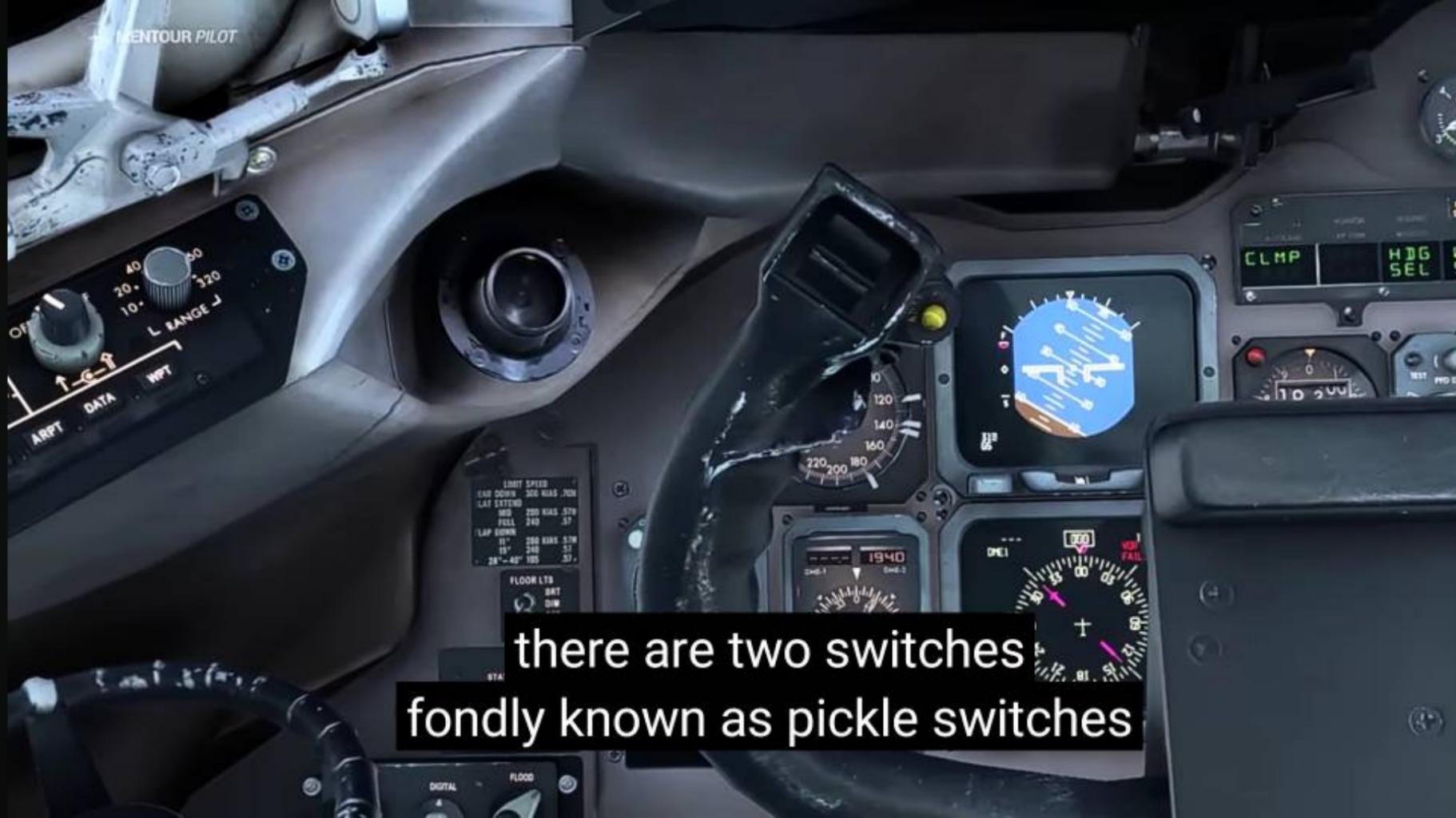
via two hinges in the aft spar



and in the front
via a single jackscrew assembly



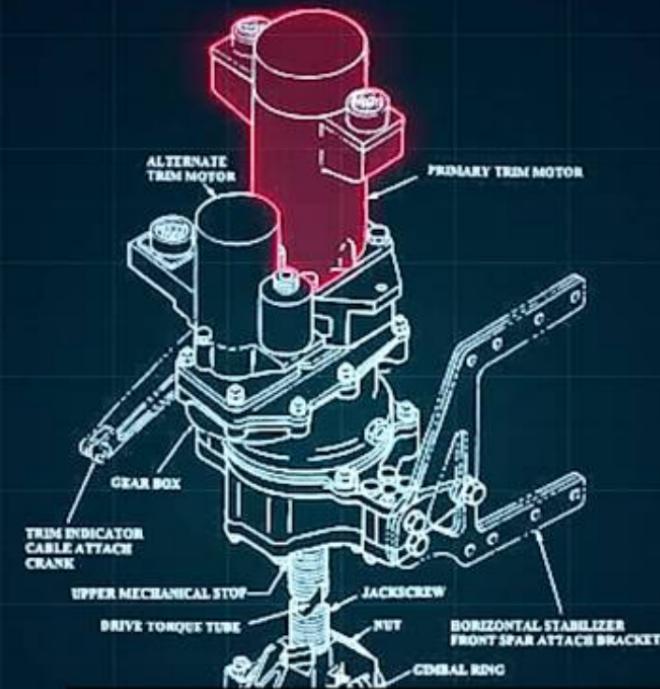
On the control yoke,



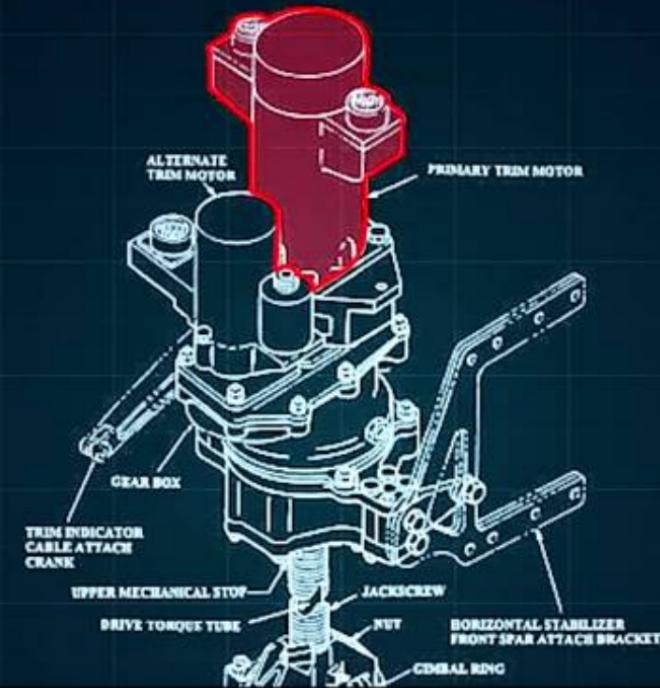
there are two switches
fondly known as pickle switches



who, when they're pressed simultaneously



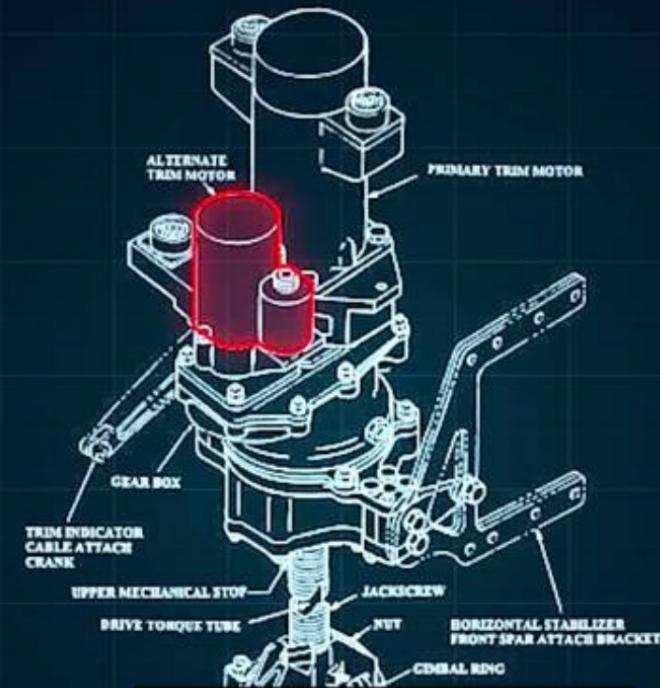
will activate a primary
electrical trim motor



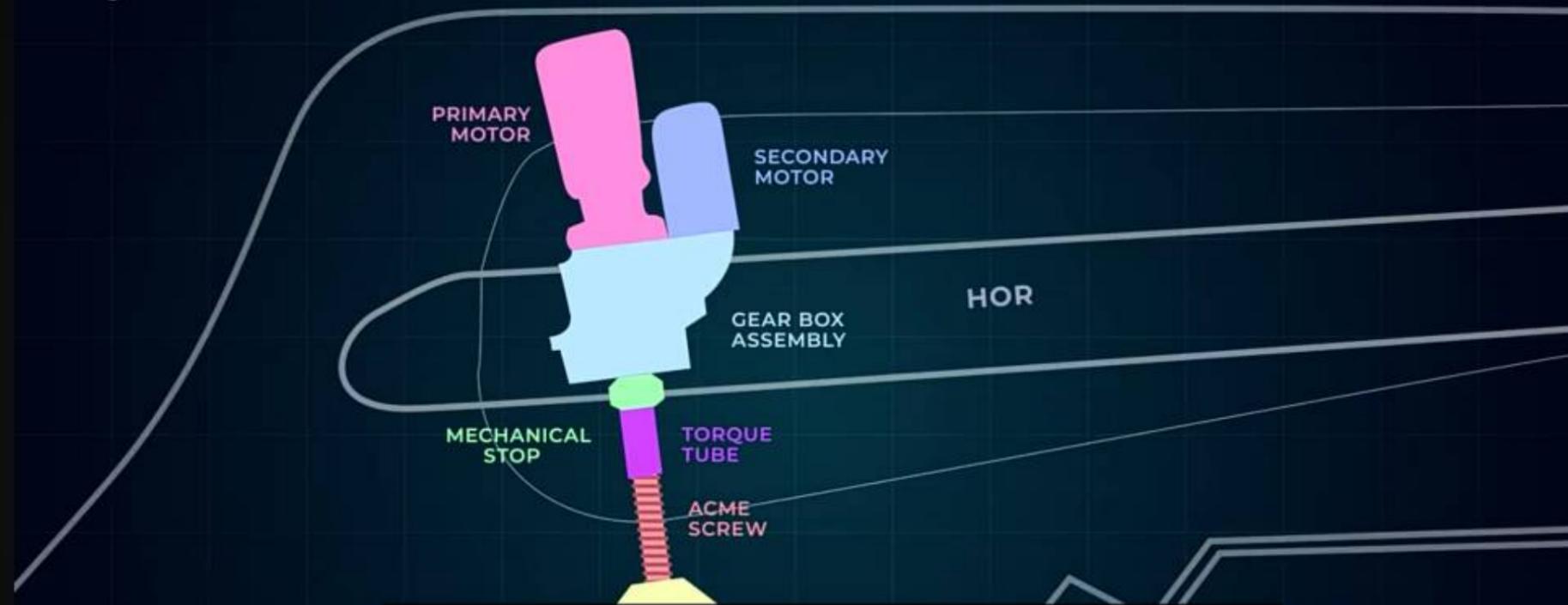
which is mounted with its gearbox assembly
connected to the front spar



There's also a set of standby switches
on the central pedestal

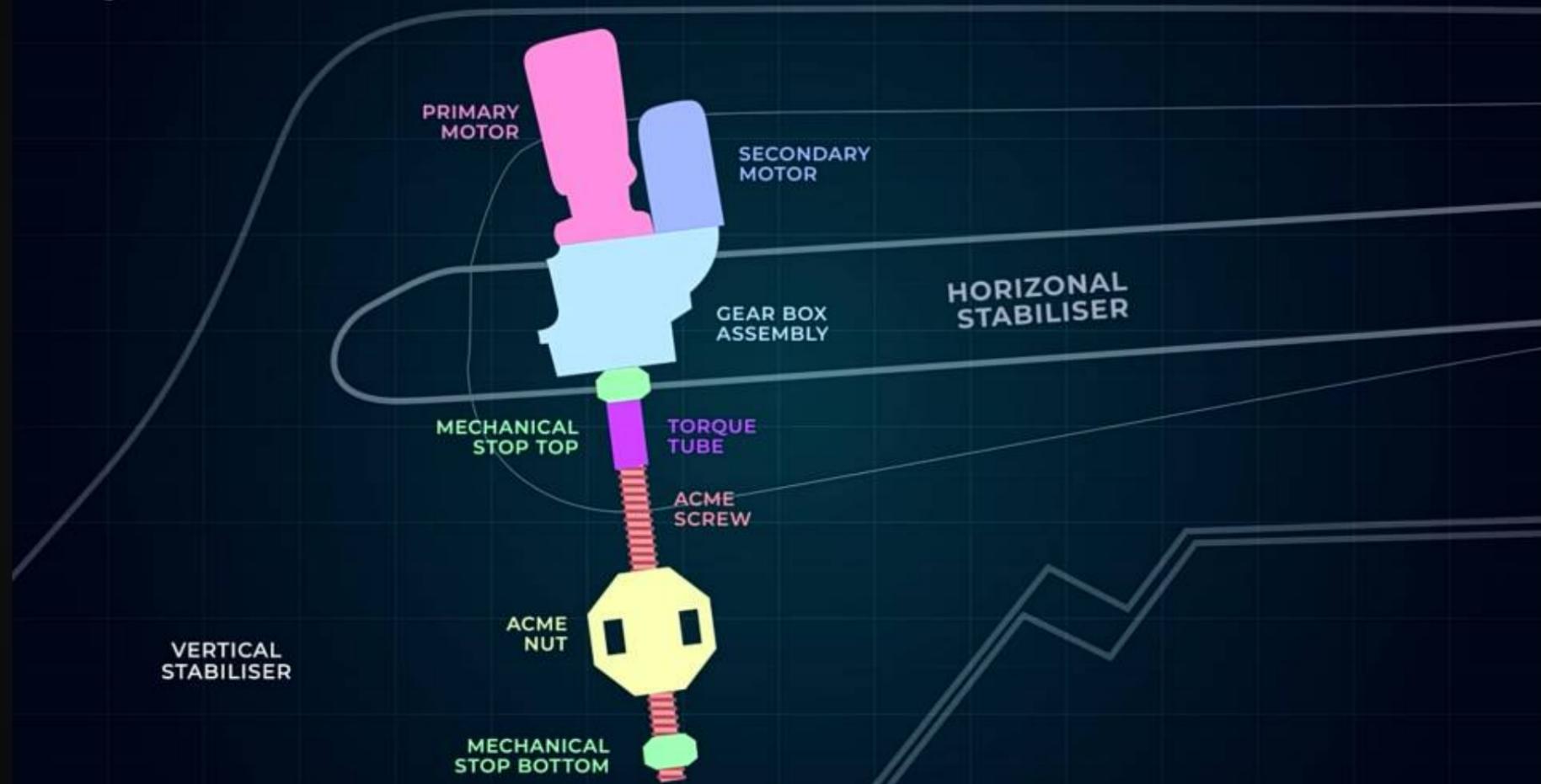


who can activate
a standby electrical motor



they will start to rotate a torque tube
inside of an ACME screw



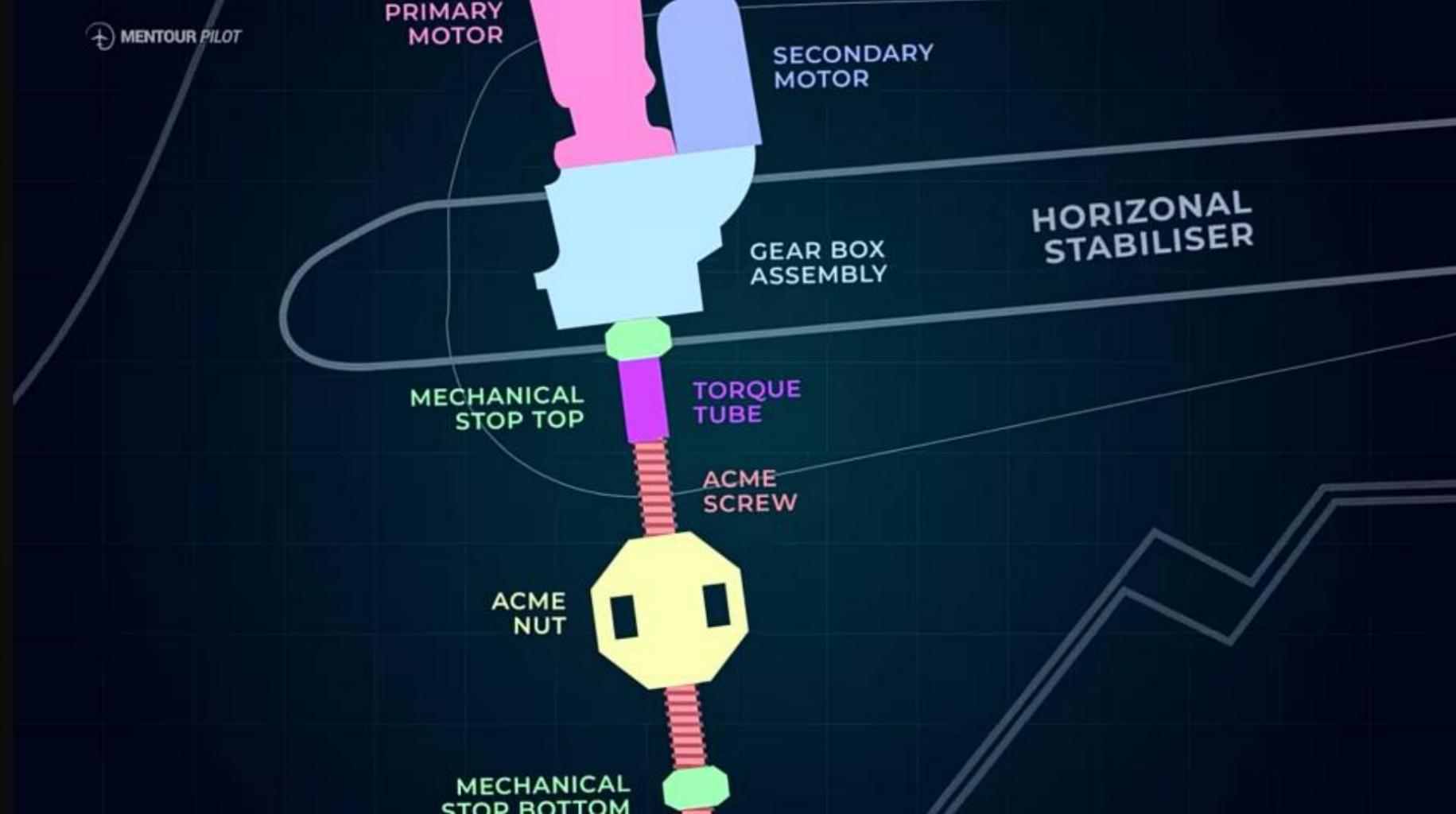




Now, obviously, there are constraints to how much this screw is allowed to move,



and that's achieved by programmed maximum
and minimum trim values



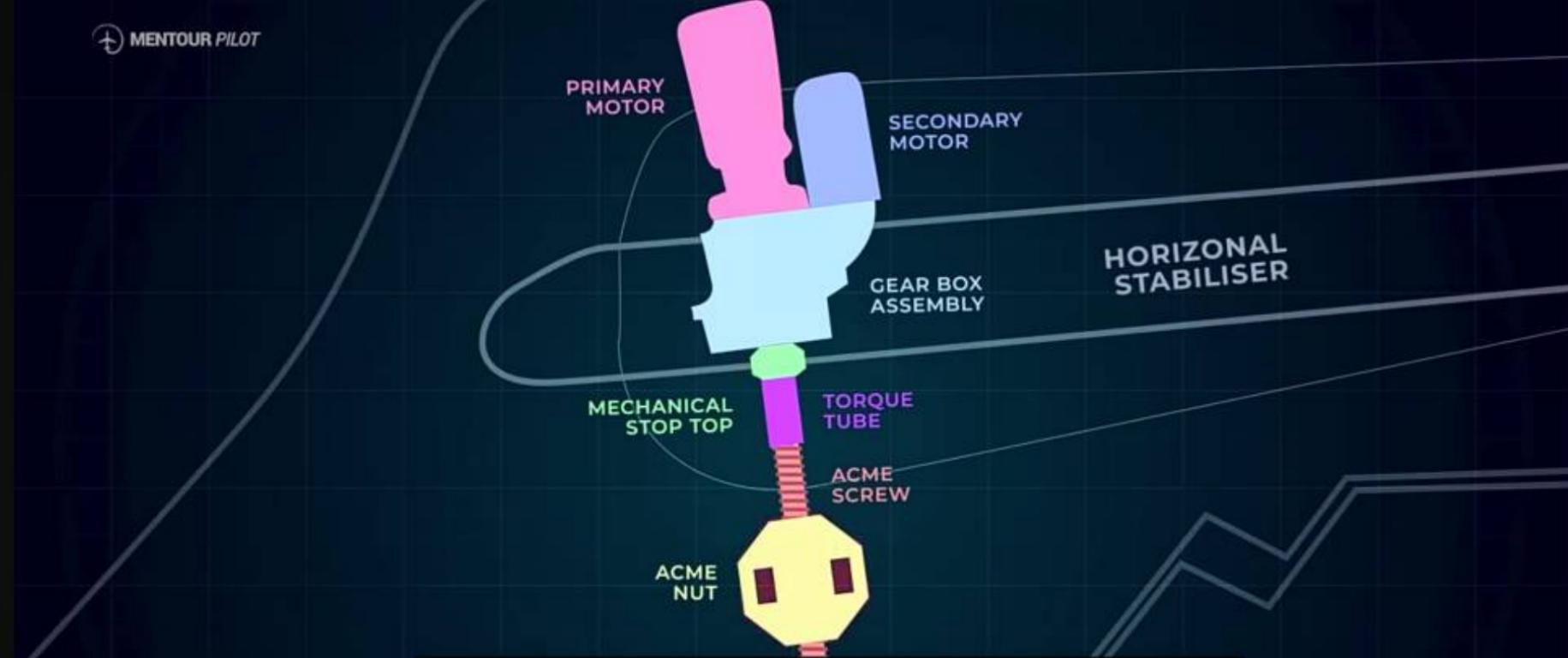


who serves as ultimate guarantees
that the screw won't move





which can be used to stop
any trim movement



that there's only one ACME screw
and nut in this system.



And because of this,
inspections were put in place



at regular intervals to measure this wear.

a lubrication interval
of the jackscrew assembly



every 300 to 350 flight hours.



DC-9

LUBRICATION EVERY

300-350

FLIGHT HOURS

This was then extended for the
MD-80 family up to every 900 hours.







Now, Alaska Airlines
followed these recommendations



A man with short blonde hair and a beard, wearing a black t-shirt with the word "POSITIVE" printed on it, is sitting in a dark armchair and speaking. He is gesturing with his right hand. The background is a purple-lit studio set with some foliage and geometric shapes.

and extended the interval
for lubrication to, in their case,

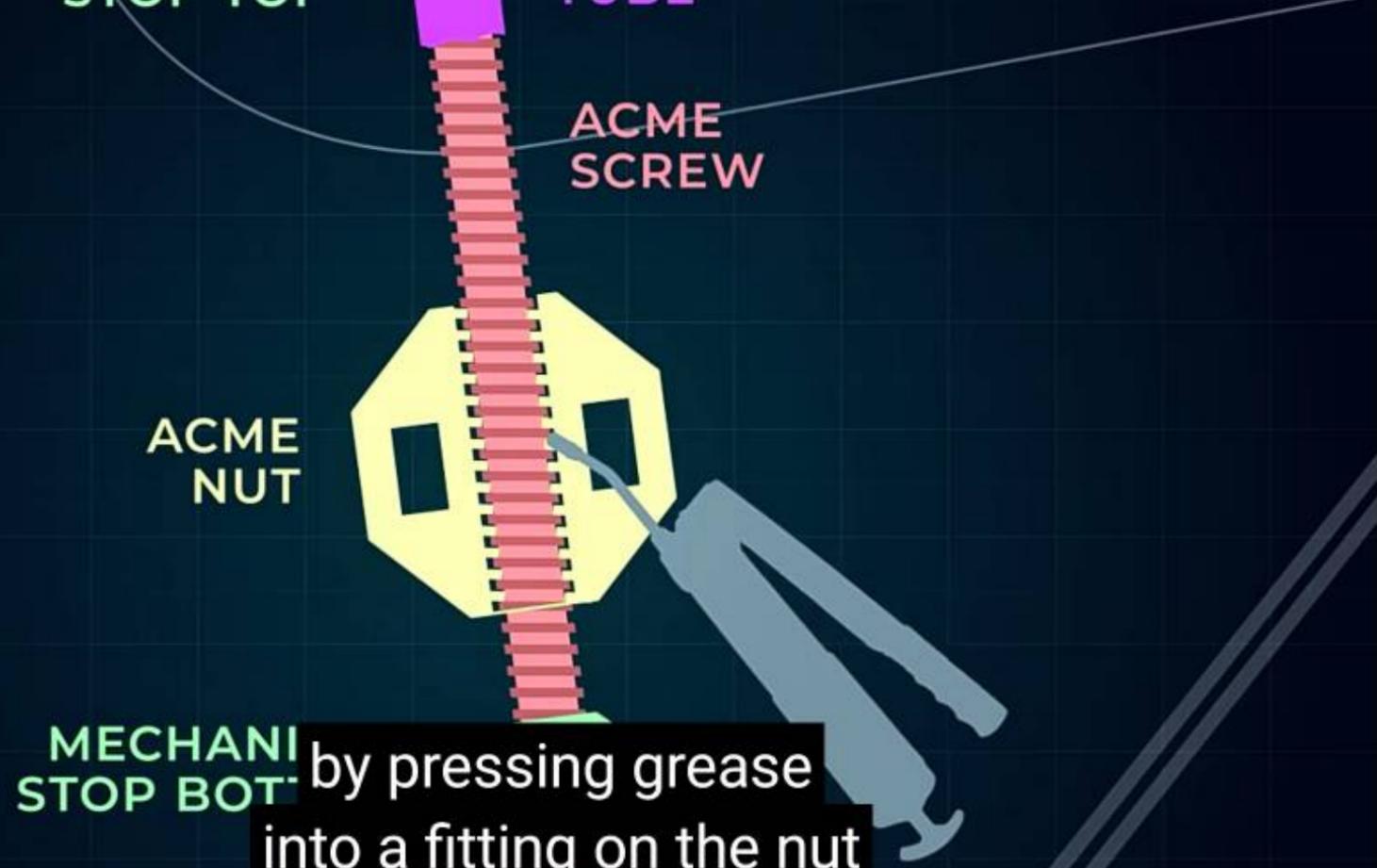


every 8 months,
which was actually more conservative

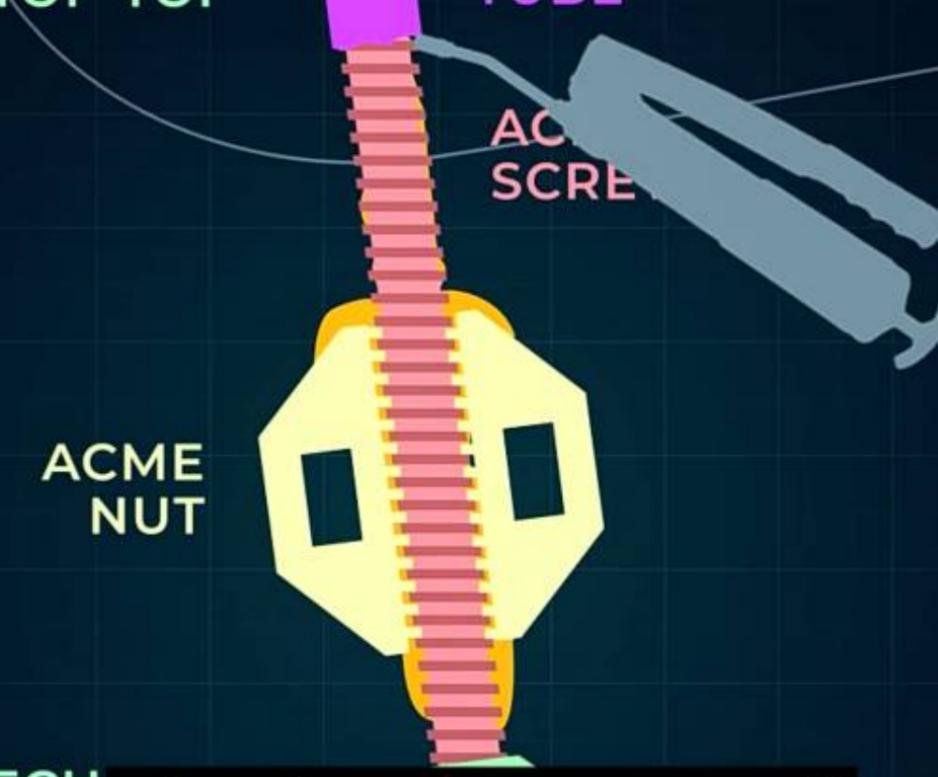
LUBRICATION EVERY
8 MONTHS

than the manufacturer's recommendation.





MECHANIC
STOP BOT by pressing grease
into a fitting on the nut



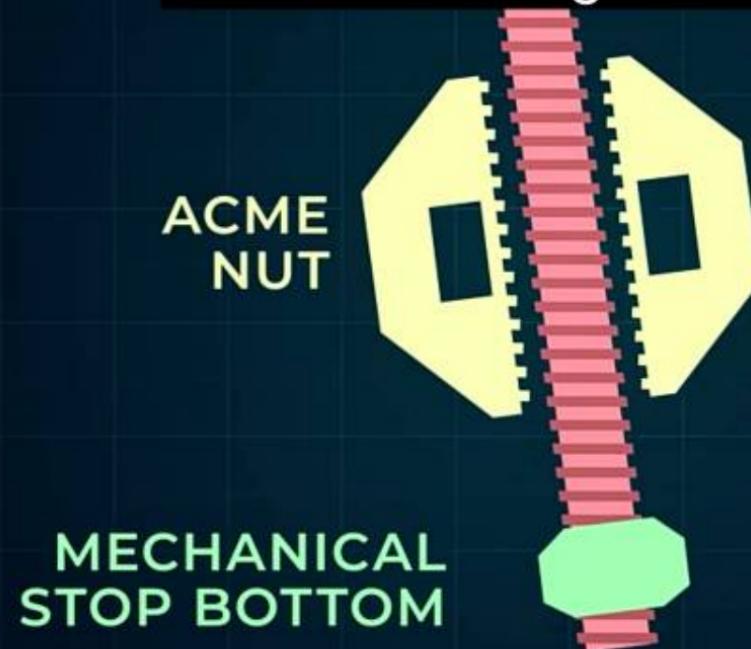
**MECH
STOP R** After that, the screw itself
needed to be properly greased up

and he couldn't account
for each of the individual steps.

4 1
HOURS HOUR



a procedure for measuring this wear
had been designed using a tool



*ANIMATION EXAGGERATED FOR ILLUSTRATIVE PURPOSES

ACME NUT



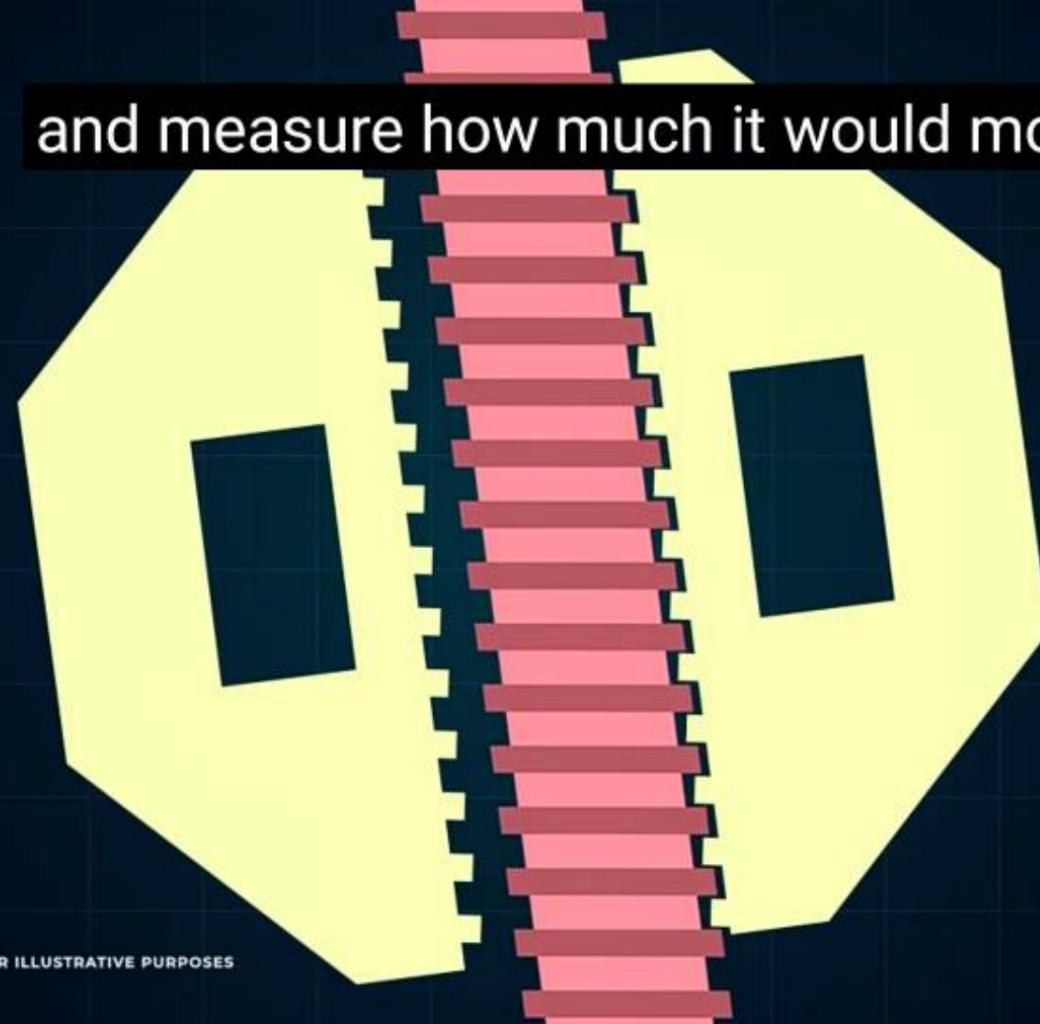
A diagram showing a yellow hexagonal ACME nut being threaded onto a dark blue ACME screw. The screw has a series of red, horizontal, slanted threads. A black callout box points to the top of the screw, stating: "that would tension the nut towards the ACME screw".

that would tension the nut
towards the ACME screw

*ANIMATION EXAGGERATED FOR ILLUSTRATIVE PURPOSES

and measure how much it would move.

CME
NUT



*ANIMATION EXAGGERATED FOR ILLUSTRATIVE PURPOSES



This was supposed to be done using specific Boeing-made restraining fixtures



But Alaska Airlines had decided
to instead make their own ones,



These wear checks
had been recommended to be performed

A close-up photograph of the side of a Boeing 737 aircraft. The aircraft is white with dark blue/black stripes running along its fuselage. The windows are visible, and the landing gear is deployed. The background shows a runway and some trees under a cloudy sky.

every 30 months or 7,200 hours,
whichever came first.

BOEING
WEAR CHECKS EVERY
30 months / 7,200 hrs

that this check would need to be done
every 30 months, but with no hourly limit.



BOEING
WEAR CHECKS EVERY
30 months / 7,200 hrs

ALASKA AIRLINES
WEAR CHECKS EVERY
30 months

it would take close to 9,550 hours
between each of these checks.



BOEING
WEAR CHECKS EVERY
30 months / 7,200 hrs

ALASKA AIRLINES
WEAR CHECKS EVERY
30 months = 9,500 hrs

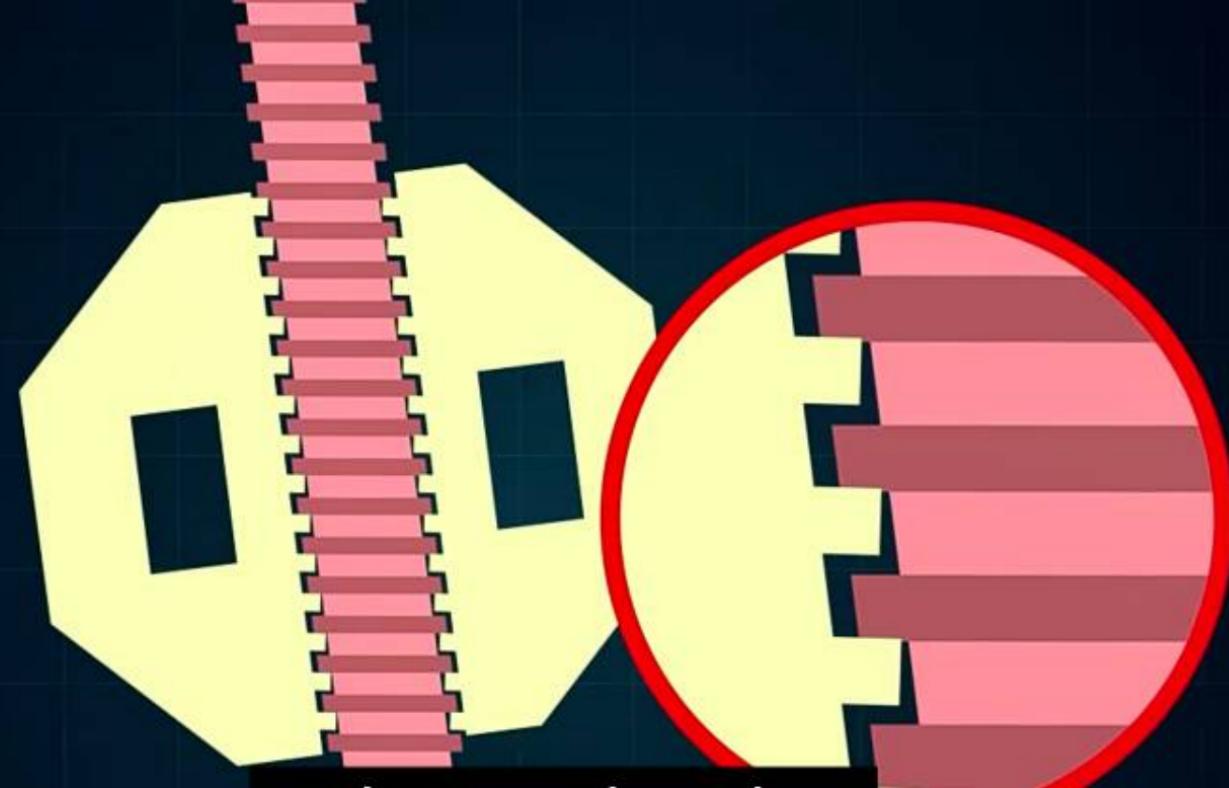
And the accident aircraft was coming up
towards the end of these 30 months.





For several thousand hours,
the screw had been grinding down

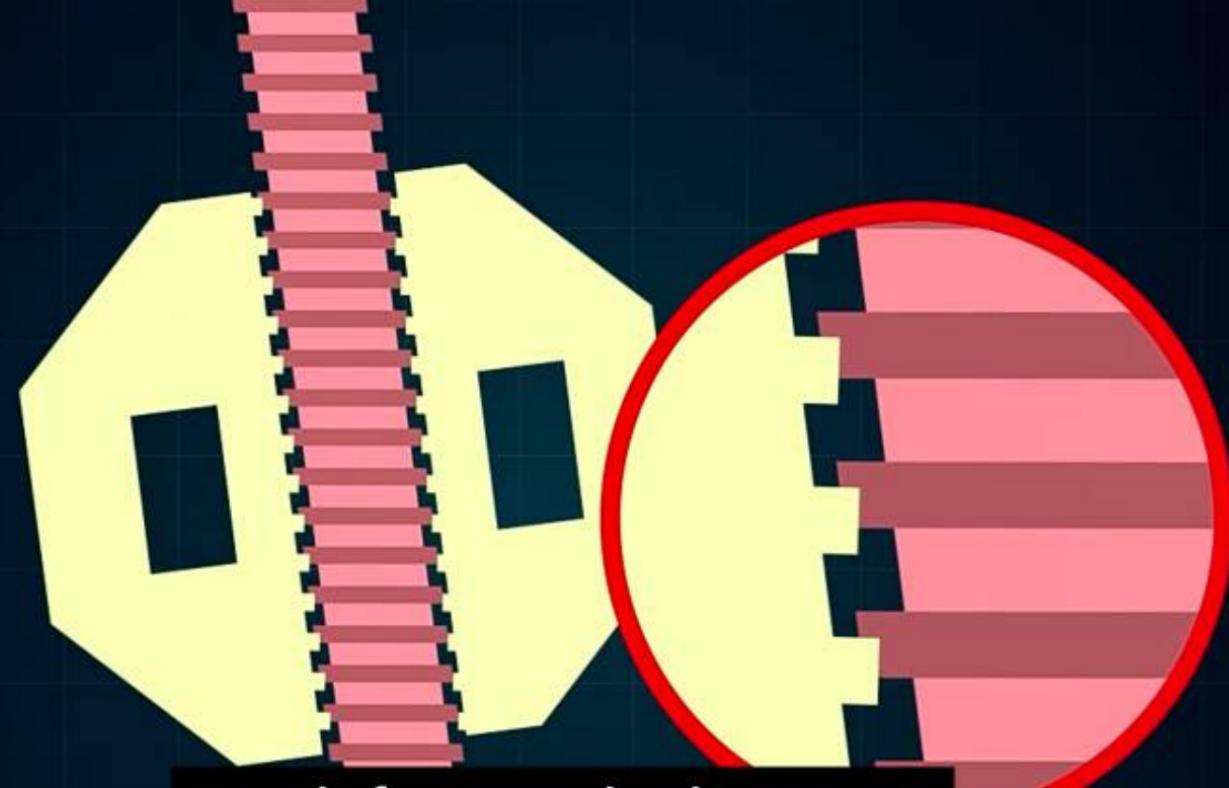
ACME
NUT



And now, only a sliver
of the original thread

MECHANICAL

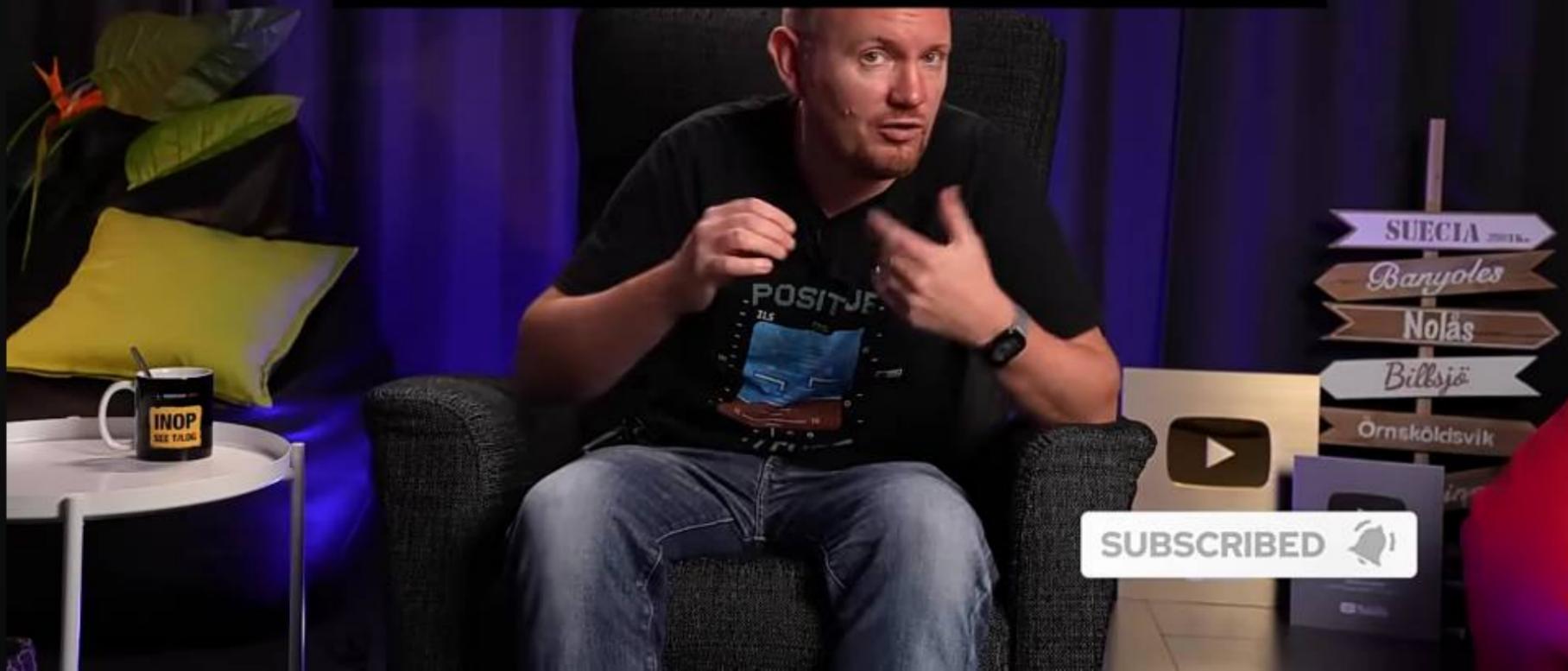
ACME
NUT



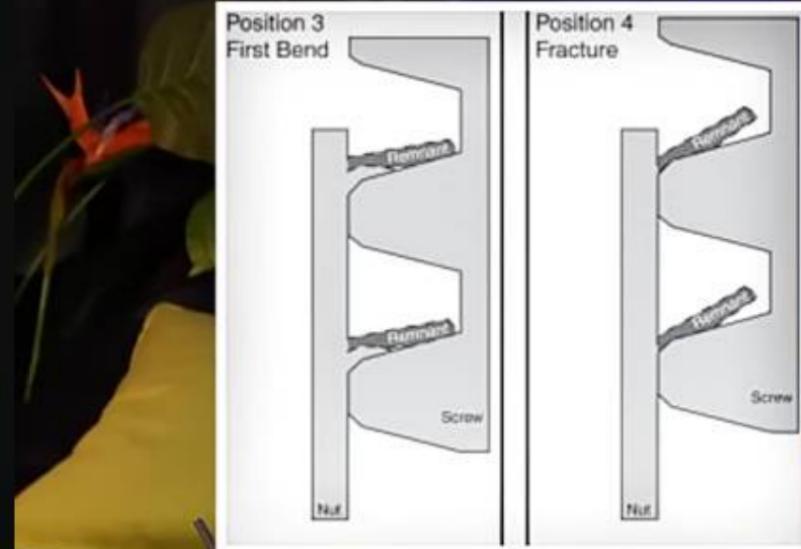
was left to guide the screw
as the autopilot was turning it.

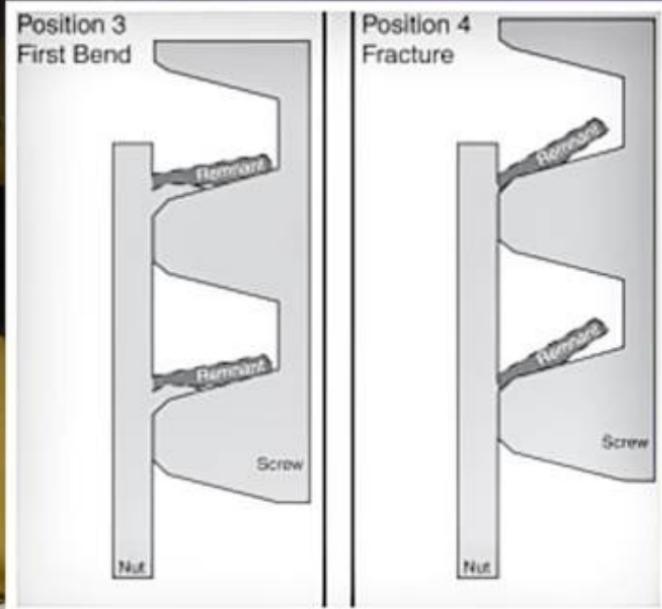
ECHANICAL

but it is possible that the tips
of what was left of the ACME nut thread



SUBSCRIBED 





INOP
SEE T/LOG

which just caused the screw to seize up.





Now, you might be wondering
why the pilots didn't just turn around







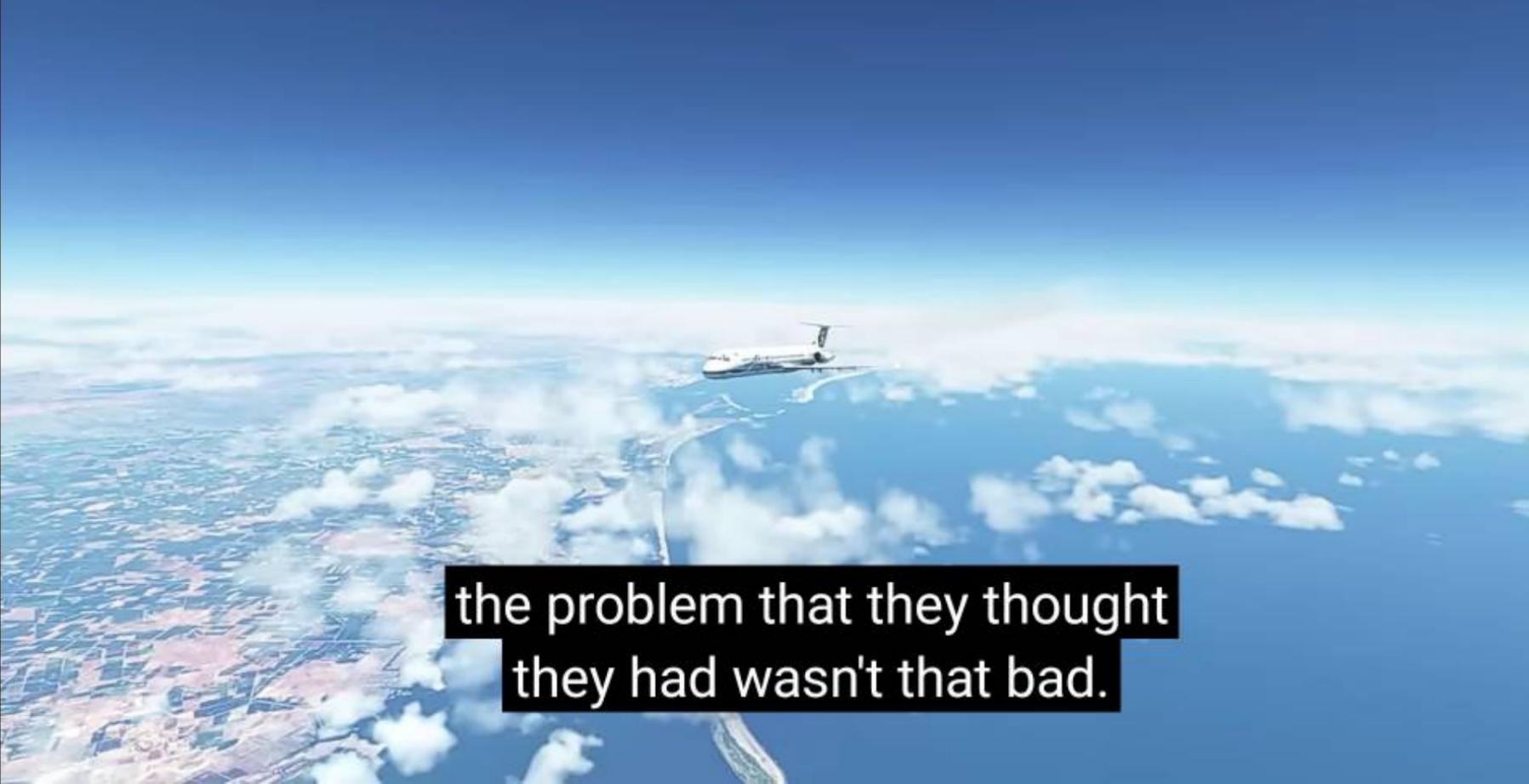




with higher than normal approach
and landing speeds.



And from a strict handling perspective,



the problem that they thought
they had wasn't that bad.



And the non-normal checklist
didn't advice them

A photograph of a white commercial airplane flying at a high altitude over a coastal city. The city below is densely packed with buildings, and a large body of water is visible in the foreground. The sky is clear and blue.

to land at the nearest available airport.



But that doesn't mean that the pilots
didn't think about diverting.

CME
NUT



SCREW

ICAL



and simultaneously,
several small radar returns



as the tip fairing was ripped off
and separated from the aircraft.



as the tip fairing was ripped off
and separated from the aircraft.





and this caused an immediate
and violent pitch forward.



effectively counteracting
the downward pitch of the stabilizer.



Because of the roll,
the pitch decreased from minus 70 degrees



to 29 and then minus 9 degrees





During the next few seconds,
the flight data recorder



indicated aileron movements
both in left and right direction



back on the right keel again.



And that was followed by a call to,
"Kick rudder, left rudder, left rudder."



This effort didn't work
and 10 seconds later, Captain Ted said,

CAPTAIN

*"gotta get it over again... at least
upside down we're flyin."*

but at least upside down we're flying."





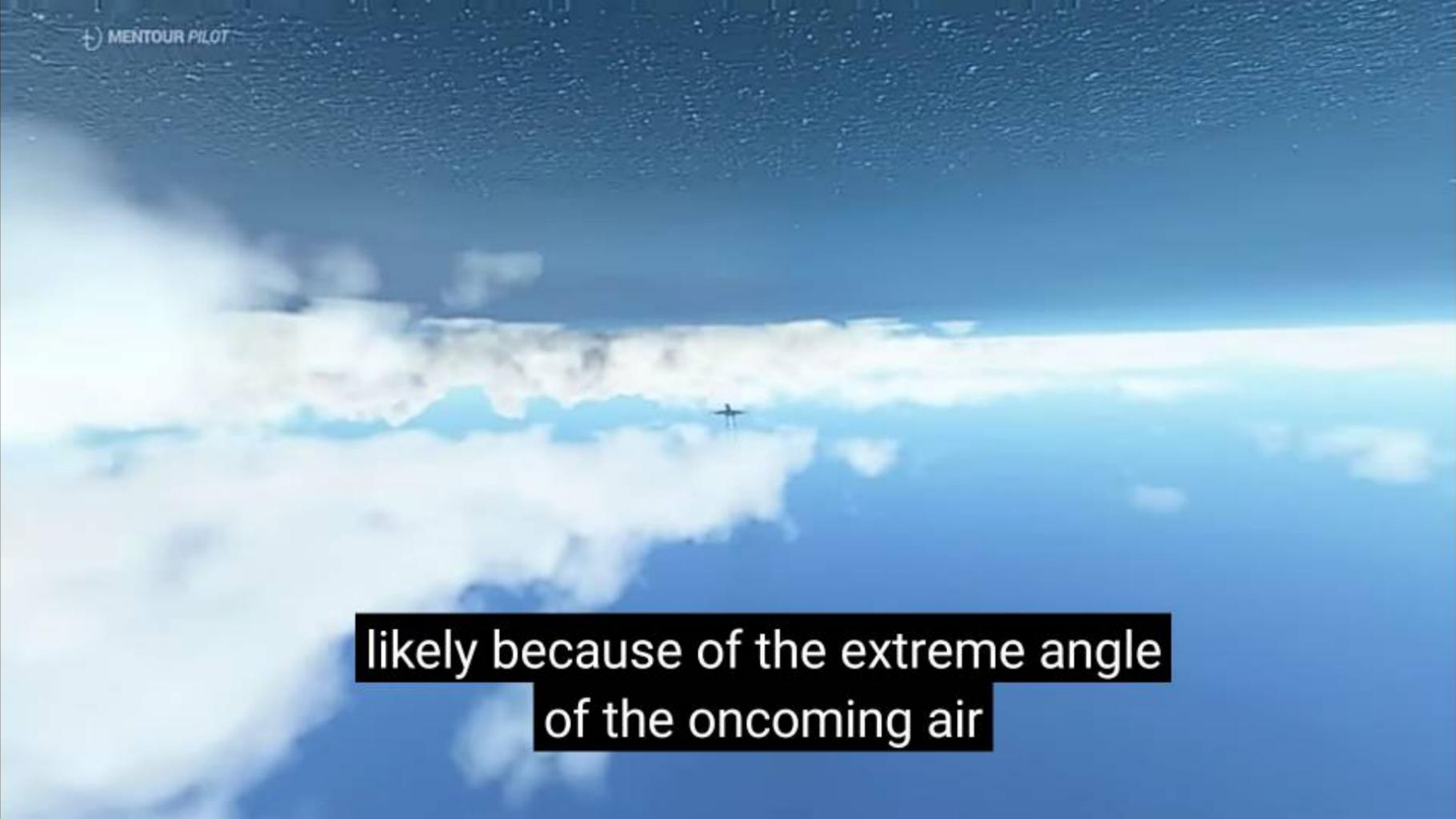
But sadly, this call
was almost immediately followed



by the sound
of several compressor stalls



and the sound of the right engines
spooling down,



likely because of the extreme angle
of the oncoming air



that was hitting the engine inlets.



From this point,
there was nothing more that could be done.

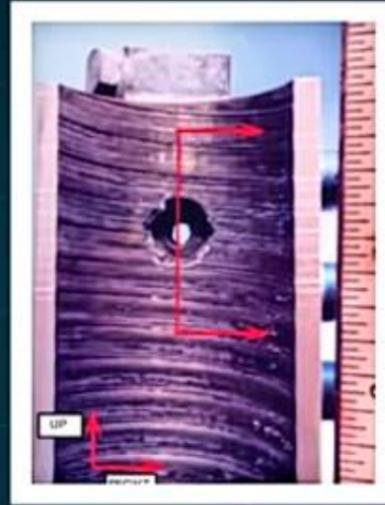
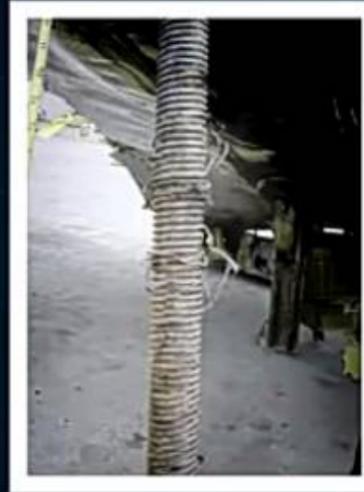


Captain Ted asked
for the speed brakes to be extended,

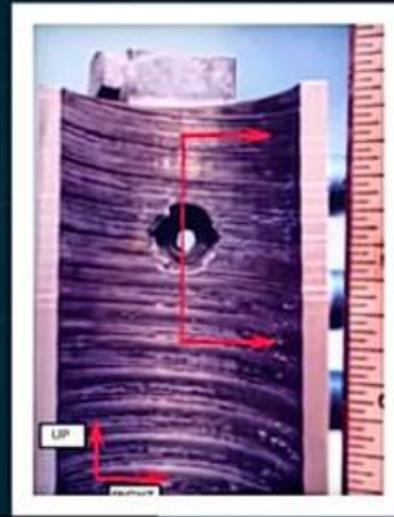
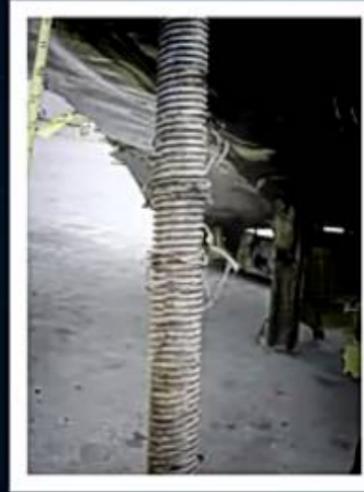




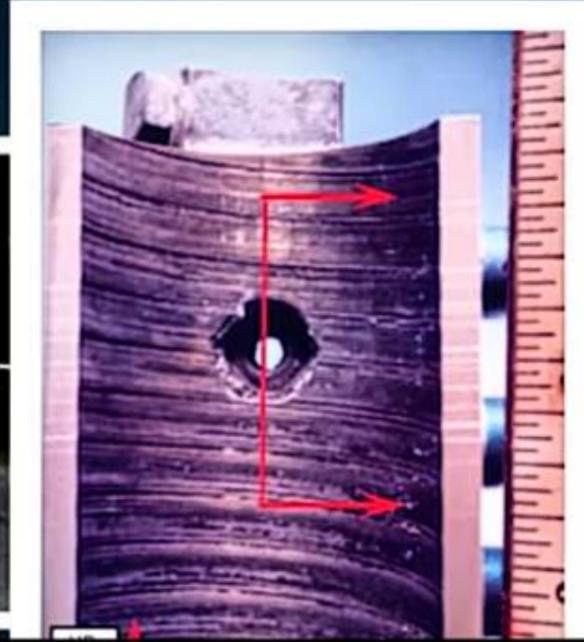
on what had caused this horrible tragedy.



When they looked closer
on the ACME screw and nut,



they saw that the nut
was almost completely smooth,



with only remnants of threads
still left inside.



On the ACME screw, they found several spiral form pieces of thread



which had been ripped out of the nut,
likely during that first dive.

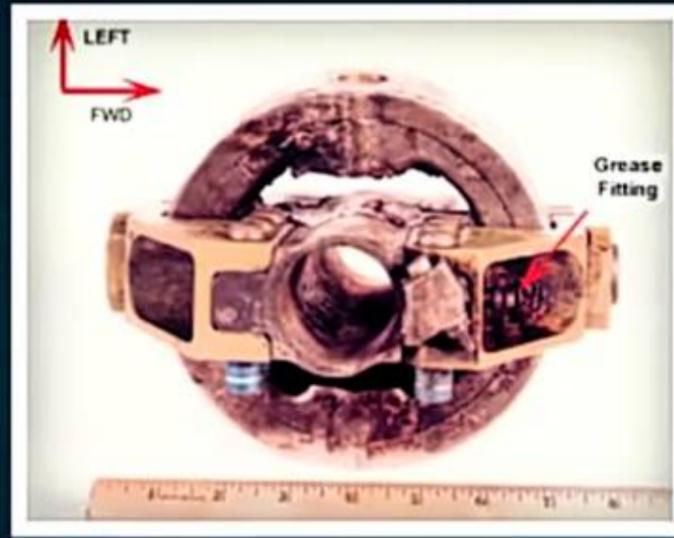




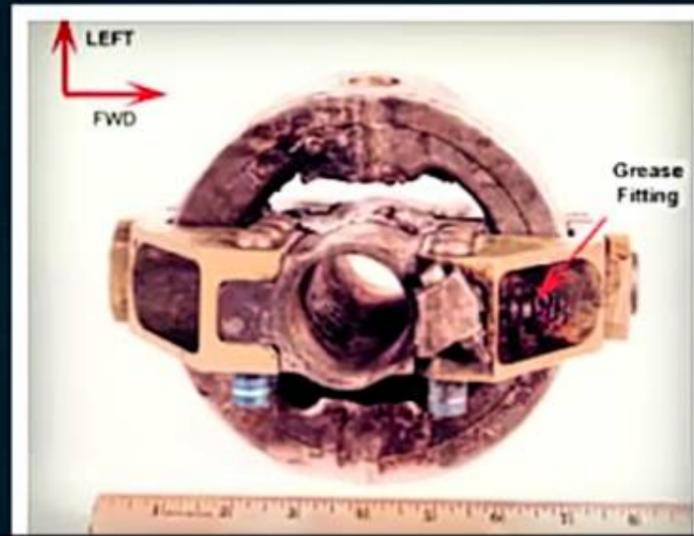
was that there didn't seem to be
any grease at all left,



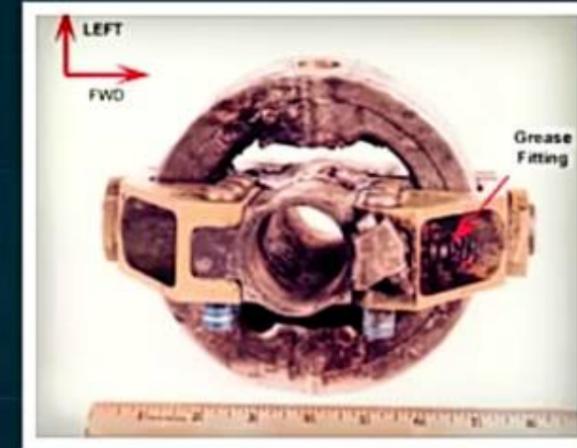
neither on the screw or on the nut.



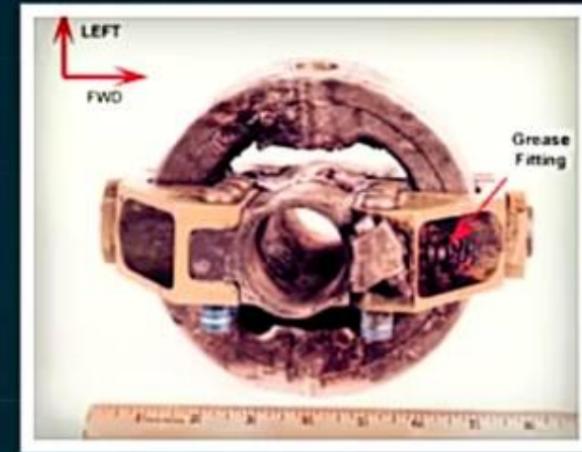
The grease fitting on the nut was clogged



with a gray mixture of old grease
and wear material.



And the rest of the components
were completely dry.



There was no lubricant at all on them.





There were 24 safety recommendations
that came out of the investigation.





about not repeating actions in checklists
regarding the trim system



and not using the autopilot
with flight control problems.



But the vast majority
of the recommendations



were aimed at Alaska Airlines and the FAA regarding maintenance intervals,

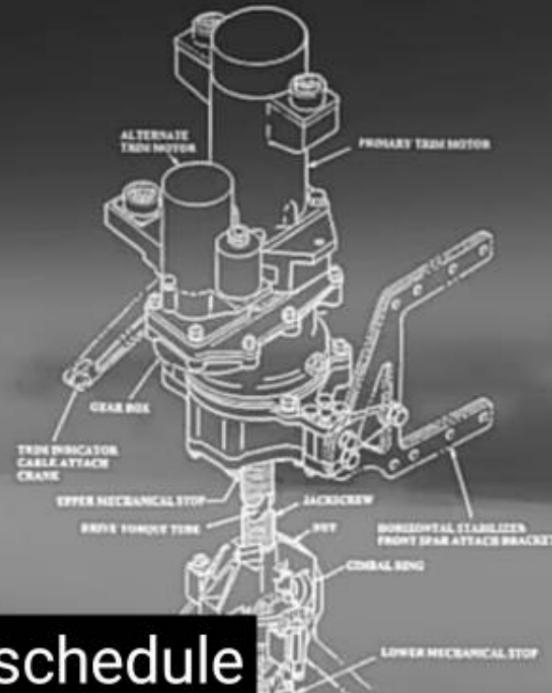
lubrication and wear checks
of the horizontal stabilizer.



After the accident,

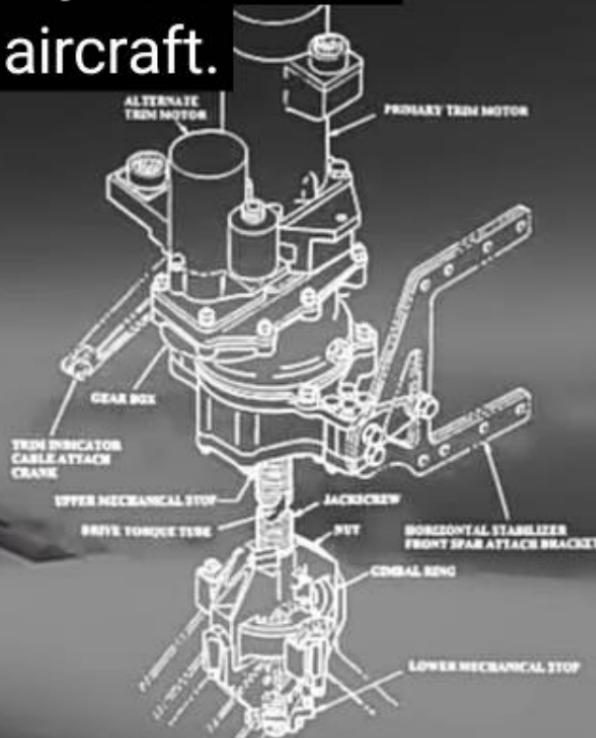


the lubrication schedule
was immediately changed



to be completed every 650 hours
on all MD-80 aircraft.

LUBRICATION EVERY
650
FLIGHT HOURS



“

Before the implementation of any proposed changes in allowable lubrication applications for critical aircraft systems, require operators to supply to the FAA technical data (including performance information and test results) demonstrating that the proposed changes will not present any potential hazards and obtain approval of the proposed changes from the principal maintenance inspector and concurrence from the FAA applicable aircraft certification office. (A-01-45)

about not allowing certification
of aircraft unless they could prove

“

Before the implementation of any proposed changes in allowable lubrication applications for critical aircraft systems, require operators to supply to the FAA technical data (including performance information and test results) demonstrating that the proposed changes will not present any potential hazards and obtain approval of the proposed changes from the principal maintenance inspector and concurrence from the FAA applicable aircraft certification office. (A-01-45)

that they weren't susceptible
to catastrophic single point failures