

DIRECTORATE OF CIVIL AVIATION

**AIRCRAFT
ACCIDENT REPORT**

**ALEV
UNGARIAN AIRLINES**

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Kastrup.

times in this report are GMT.

Aircraft type:

Ilyushin-18V.

Registration:

HA-MOC.

Owner/User:

Magyar Légiközlekedési Vállalat.

The Airline company MALEV, Budapest, Hungary

Crew:

Cockpit:

Captain Dezső Szentgyörgyi - deceased.

Co-pilot Jozsef Menyhart - deceased.

Navigator Pál Jancsovics - deceased.

Flight Engineer Lázlo Aladi - deceased.

Radio Operator Károly Lantos - deceased.

Cabin:

Stewardess Klara Tolnai - deceased.

Stewardess Eva Margit Ivan - deceased.

Stewardess Janosne Szalay - deceased.

Stewardess Katalin Tamasne - deceased.

Passengers:

22 Deceased.

1 Missing.

2 Slightly injured.

Location of the accident:

5 3/4 N.M. NE of EKCH (55°41'51"N - 12°41'51"E)

The 28th. August 1971 at 1852 hours.

tives from the Directorate of Civil Aviation
airport, Kastrup, at approximately 1930 hours on the same day.

According to Article 26 of the ICAO convention it was the responsibility of the Danish authorities to conduct an investigation into the accident.

An accident investigation group consisting of representatives from the Danish Directorate of Civil Aviation, the Hungarian Aviation Authorities and the Hungarian airline company took part in the investigations in Kastrup airport. In connection with concrete technical investigations, representatives of the Russian Aviation Authorities also took part.

Brief Summary of the accident.

On the 28th. August 1971 at 1852 hours, an Ilyushin-18V aircraft HA-MOC, crashed while making an ILS approach to runway 22L in EKCH. The aircraft was totally destroyed and sank in water which was 3.5 - 4 metres deep.

3 of the people onboard were rescued, 30 died and 1 is missing, 1 of those rescued however died 3 days later.

Accident Investigation.

History of the flight.

The aircraft HA-MOC was on an ordinary flight Budapest - Oslo - Budapest with intermediate landings in Berlin and Copenhagen. HA-MOC, with a normal departure time from Oslo (ENFB) at 1715, took off as MA-731 at 1755 with an expected arrival time at Copenhagen (EKCH) of 1853. The late departure was caused by a late arrival at ENFB. According to information received from the Norwegian civil aviation authorities, the crew of HA-MOC remained onboard the aircraft for the 54 mins. which the aircraft stayed in the airport.

After take-off, MA-731 climbed in accordance with the ATC clearance to flight level 210. The transcript of the

...clearance to flight level 50. This clearance had been given by Malmo ACC.

At 1846 and immediately after MA-731 had reported at flight level 50 the aircraft was instructed by APP to turn to the right on a heading of 190° . In answer to a question from APP, MA-731 gave his speed as 200 (knots is understood). At this time APP had MA-731 on radar scope about 20 N.M. NE of EKCH. About 30 seconds later MA-731 was cleared to 2500 ft. as APP at the same time gave an altimeter setting of 1007 mb and permission to maintain a speed of 200 knots given. At 184841 MA-731 was cleared to 1500 ft. and an ILS approach runway 22L. At 185045 he was instructed to turn to the right toward the localizer. At 185131 the aircraft was observed by the APP radar at a distance of 9 N.M. from the runway and on the centreline and he was asked to change to the tower frequency of 118.1 mcs. At 185159 contact was established with the control tower and it was intimated that the aircraft was on an approach to runway 22L. MA-731 did not any time report at 1500 ft. At 185218 the aircraft was instructed to continue the approach and this was acknowledged according to the be of the ATC.

At this time a rain shower was 7 - 5 N.M. from the approach and this caused such a strong clutter on the radar screen, that the echo of MA-731 was washed out. The result of this was that the flight of the aircraft in this area could not be registered on the radar in the tower. It was not possible to get radio or radar contact with the aircraft at any time later. At 1920 the wreckage of HA-MOC was localized $5 \frac{3}{4}$ N.M. from the end of the runway about 100 metres S of the centreline.

The three passengers who survived the crash itself, have expressed that the flight from Oslo was normal and that there was no, or only light turbulence. Two of the passengers, sitting respectively in the first and second row on the left side of the main cabin, had a feeling prior to the collision, that they were going down steeply, as the

The crash was seen by the witness at this position when they were on the approach to Kastrup. On the question, while he was sitting in his car sheltering from the rain, he was looking at the aircraft through binoculars. He saw an aircraft with its landing lights on, and which, in his opinion was rather low. The witness followed the descent of the aircraft, which was steeper than normal, until it hit the water.

Two witnesses were on Saltholm island, at a point about 2 km south of where the crash took place, saw the aircraft just before it hit the water in a big flash of light. The aircraft hit the water at an angle which was estimated at about 15° . They had heard nothing because of the heavy rain and the storm and at first they thought it was a ship, as they had seen a single light move slowly at a point which in their opinion, would be equivalent to the height of a ship's mast.

In addition, the aircraft was observed from a boat which was on the way from Svanemøllen to Malmo. The witnesses here did not see the collision, but the flight of the aircraft at a height estimated at about 100 metres.

2. Injuries to persons.

Injuries	Crew	Passengers	Others
Fatal	9	23 ^{x)}	-
Non-Fatal	0	2	-
None	0	0	-

x) 1 passenger is missing and is presumed to be dead.

Other damage.
None.

5. Crew information.

Captain Dezső Szentgyörgyi, born on the 6th. January 1915, was the holder of Airline Transport Pilot Licence no. I 01-28, issued on the 25th. August 1946 by the Hungarian civil aviation authorities. It was valid until 31st. January 1972.

Co-pilot Jozsef Menyhart, born on the 26th. May 1926, was the holder of Commercial Pilot Licence no. III 03-20, issued on the 25th. September 1957 by the Hungarian civil aviation authorities and valid until 31st. January 1972.

Navigator Pál Jancsovics, born on the 26th. May 1926, was the holder of Navigator certificate no. 04-13, issued on the 9th. December 1958 by the Hungarian civil aviation authorities and valid until 31st. January 1972.

Radio Operator Károly Lantos, born on the 15th. July 1913, was the holder of Radio Operator certificate no. 05-17, issued on the 9th. May 1958 by the Hungarian civil aviation authorities and valid until 31st. January 1972.

Flight Engineer Lázlo Aladi, born on the 13th. December 1913, was the holder of Flight Engineer certificate no. 06-15, issued on the 25th. September 1957 by the Hungarian civil aviation authorities and valid until the 31st. January 1972.

The cabin personnel consisted of stewardesses Klara Tolnai, born on the 3rd. June 1942, Eva Margit Ivan, born on the 21st. August 1942, Janosne Szalay, born on the 10th. January 1942 and Katalin Tamasne, born on the 8th. December 1946, All four were in possession of valid certificates.

All crewmembers were qualified to carry out the flight in question. For more detailed information of the crewmembers refer to

Ilyushin-18V type, registered

The aircraft had certificate of airworthiness no. 302 issued on the 12th. April 1961, finally renewed on the 7th. A and valid until the 7th. April 1972.

HA-MOC, serial no. 2903, built in 1961 had a total flight of 13,150 hours 45 minutes, of which 3,803 hours was flown since last main overhaul. The time between main overhauls 6,200 hours last 75 hours inspection was made on the 17th. August 1971.

According to information received from the Hungarian authorities all modifications and inspections which were due had been carried out on time.

6.2. Engines.

HA-MOC was equipped with 4 turbo-propeller engines of type, each of which produced 4015 h.p.. The engines were installed in the following positions:

Position	I	II	III	IV
Serial number	H 2635108	H 2715007	C 2415170	H 2715
Built	1966	1967	1964	196
Total time	4,469:10	6,263:57	6,930:11	5,571:
Hours since last main overhaul	518:22	2,277:18	674:14	1,382:
Hours between main overhauls	4,000:00	4,000:00	2,000:00	4,000:
Number of main overhauls	1	1	3	1

6.3. Propeller.

The engines are equipped with 4-bladed constant speed propellers of type AB-68 series 03 with hydraulic pitch control. The propellers were mounted in

Assembled	10.Feb.1971	10.Sept.1970	28.Sept.1970	1.Aug.1971
Total time	4,752:37	1,347:28	3,301:23	5,688:28
Hours since main overhaul	-	-	-	1,295:21
Hours between main overhauls	5,000:00	5,000:00	5,000:00	1,900:00
No. of main overhauls	0	0	0	3

The propellers are equipped with an hydraulic pitch-lock mechanism which operates in the range 0° - 45° . The object of the mechanism is to prevent overspeeding in case of engine or propeller failure and also prevent the propeller blades from moving below the flight fine pitch stop, which is 12° .

The propellers can be feathered using either an automatic or two manually operated systems. The automatic system operates at a decrease in positive torque developed by the engine at a 0,7 nominal rating or higher. It also operates at negative thrust in excess of 1,800 kgs. at all ratings and at a turbine overspeed between 13,750 - 14,600 RPM. The manual systems, an electrical and a mechanical, operate according to traditional principles at least as regards the electrical. The mechanical system is activated by means of feathering handles, which by pulling a cable operates the valves to a nitrogen bottle. Pressure is then led to the fuel control of the engine in question, where the fuel supply is cut off, and to the propeller governor, where the oil pressure is guided so that feathering is begun. The change in the pitch of the propeller takes place at a rate of about 3° a second.

Weight and Balance.

The "loading list" normally used by MALEV was not used for the flight in question, but a loadsheet was worked out by the SAS personnel in ENFB on the basis of information given by the crew. SAS takes care of MALEV aircraft at ENFB.

The maximum permissible take-off weight for HA-MOC was 61,200

C. so that 2000 litres of fuel were in the right wing tanks. A fuel analysis showed that Kastrup fulfilled the required specifications.

According to the loadsheet, the position of the centre of gravity was not calculated for the flight in question.

The "Instructions on loading and balancing IL-18 aircraft" require that a "loading list" be made in 2 copies, of which one shall remain at the aerodrome of departure. This instruction was not followed in the case.

According to the same book of instructions, the limitations for the aircraft centre of gravity were as follows: Aft limit: 23% MAC, undercarriage retracted and the forward limit: 16% MAC, undercarriage retracted equivalent to: 18% MAC, undercarriage extended.

The following values have been given for HA-MOC by MALEV: empty weight 32,885 kg., passenger seats and service equipment 10,000 kg., and that the empty weight centre of gravity, undercarriage retracted, was 10.7% MAC.

In order to try and determine the position of the centre of gravity at the time of the crash, a comparison has been made with a number of loadsheets used on previous flights with HA-MOC.

If it is assumed that all the passengers onboard HA-MOC were sitting in the main cabin, section 2, a calculation shows that the position of the centre of gravity would have been 16.41% MAC. On the other hand, if it is assumed that the passengers were placed in the position in which they were found, which is to say that 6 passengers have been in section 1, then the centre of gravity would have been 14.09% MAC. With the undercarriage extended the equivalent values would be respectively 18.41% MAC and 16.09% MAC.

Description of the systems.

1. Control systems.

The aircraft's control systems...

differ appreciably from other auto-pilots. In the de-clutched position the movement of the servo-motors will follow the manual steering of aircraft.

The angle of incidence of the wing and tailplane is $+3^\circ$ and -1° respectively. The elevator has a movement of 25° up and 15° down.

Flaps.

The flaps are electro-mechanically operated and have three positions 0° , 15° and 30° . The max. IAS for flight with flaps extended is 320 kilometres per hour and for flaps extended to 30° is 300 kilometres per hour.

Fuel system.

The aircraft is equipped with 22 fuel tanks, divided into 8 main and 3 auxiliary tanks in each wing, which can contain a fuel quantity equivalent to 18,600 kg. The engines on the right and left side have their own independent fuel system which is fed from the remaining 10 fuel tanks in each wing. Fuel can be cross fed via a valve in each wing to all four engines. 4 booster pumps and 6 transfer pumps are mounted in the fuel tanks.

De-icing system.

The aircraft's de-icing system is operated electrically and de-icing takes place on the leading edges of the wings, the leading edge of the tailplane, the engine induction air intake, the propeller and the cockpit windows. The heating of the leading edges of the wings, tailplane and the propeller are controlled by a number of timers.

Meteorological information.

A cold front lying over the central part of Denmark (EKCH F) was expected to pass Copenhagen on the 28th. August 1971 about 24 hours. The actual time of passage was at 22.20 hours.

Just before the time of the accident the weather in the EKCH F

	1750	1820	1850	1900
Wind direction/ strength	220°/18 kts.	220°/18 kts.	220°/18 kts.	230°/18 kts.
Visibility	6 kms. rain	6 kms. rain	6 kms. rain	8 kms.
Clouds	4/8 1200 feet	3/8 1200 feet	3/8 1200 feet	3/8 1200 feet
	8/8 5000 feet	8/8 5000 feet	8/8 5000 feet	8/8 5000 feet
Temperature	16°C	16°C	16°C	16°C
Dew point	15°C	15°C	15°C	15°C
QFE	1006.5	1006.5	1006	1006
QNH	1007	1007	1007	1007
Gradu	6 km.1200 ft.	6 km.1200 ft.	6 km.1200 ft.	Nos

The above mentioned MET reports were, with the exception of QFE figures, also broadcast on VOLMET 127.0 mc/s.

TAF EKCH 1500-2400 broadcast at 1345:

Wind direction/strength 230°/20 kts.

Visibility 10 kms.

Clouds 3/8 cu 3000 ft.

7/8 ac 8000 ft.

Gradu 1600-1900 8 km. rain 7/8 sc 1

Tempo 1900-2400 4000 m rain/drizzle

500

The winds aloft observed at 1800 hours by the Copenhagen ra-
sonde station which is about 20 km. northwest of EKCH:

0-360 metre 225°/20 kts.)

360-670 " 245°/42 kts.)

860-1270 " 265°/52 kts.)

average values

Positive "windshear" between 300 metres and 400 metres.

Winds aloft and the temperatures on the route from ENFB-EKCH

ENFB

ESGB

EKCH

5000 ft.

230°/20 kts. +3°C

250°/35 kts. +5°C

10000 -

conditions with rain showers and light to moderate turbulence. The actual glidepath was kept with no difficulty as regards turbulence but in moderate to heavy rain. The ceiling and visibility were about 1000 feet and 4-6 kms. with the wind just about down to the runway.

Relair OY-DHS BN-2A landed 1842.

The preparation for and an actual ILS-approach to runway 22L was carried out in IMC conditions from about 2000 feet to approximately 50 feet. Apart from the fact that the aircraft was in rain for the whole of the time that they were on the glidepath, there were no other comments.

K 672A Caravelle landed 1848.

ILS-approach to runway 22L was carried out in light to moderate turbulence and in heavy gusts but in moderate rain. The crew had the runway 22L in sight at a height of about 1000 feet.

K 256 Metropolitan landed 1851.

Immediately before the aircraft intercepted the glidepath for ILS-approach to runway 22L, it flew into a rain shower with moderate rain and light to moderate turbulence. The crew had the approach lights in sight at a height of 1100-1200 feet.

K 465 DC-9 landed 1858.

The crew in the aircraft, which during the approach to EKCF was 10 N.M. behind Malev 731, saw a heavy rain shower on the radar in the approach sector. Apart from a heavy rain, light turbulence and somewhat reduced horizontal visibility, the crew had no comments. The vertical visibility was 1500 feet when the glidepath was intercepted. During the whole ILS-approach the aircraft was at all times in heavy rain and poor wind conditions. The crew had the approach lights to runway 22L in sight at a distance of about 1.3 kms.

had the
NB 162 Caravelle landed 1920.

Just before intercepting the localizer the aircraft entered an area with clouds with moderate to heavy rain, windshear and at a distance of 10-11 N.M. from runway 22L and on a heading of 100°. The ASI was swinging $\pm 7-8$ kts. Furthermore, the aircraft was losing height and speed, 150 kts., it was necessary to keep high power setting. During the approach on the localizer and it was necessary to have a WCA of $+20^\circ$ down to 600-700 feet. At 1000 feet the aircraft became clear of clouds at the same time as the rain and the windshear/turbulence stopped.

The witnesses on Saltholm have described the weather as overcast and windy or almost as a cloudburst with poor visibility. The weather in the boat from Svanemøllen til Malmo characterized the weather as overcast with poor visibility and strong winds.

1.8. Aids to navigation.

1.8.1. Ground.

During the approach to Copenhagen airport, Kastrup, the following navigational aids are used when landing on runway 22L:

- ILS LLZ 109.10 mc/s, ILS GP 331.40 mc/s, MM 75.00 mc/s
- VOR/DME 112.50 mc/s, NDB "SA" 394 kc/s.

All the navigational aids and frequencies functioned normally on the day in question. The ILS installation to runway 22L was checked by a control flight - refer to Appendix D.

1.8.2. The aircraft.

According to information received by the airline some of the navigational aids in the aircraft have not been used during the time in question.

As regards the ADF 2 the function change selector was in ANIL

the instrument selector in ADF and the band selector on 1071.2 kc/s.

The ILS system 1 frequency selector was found indicating 109.5 mc/s. The localizer receiver was found tuned on 109.1 mc/s, and the sideloop receiver on 331.4 mc/s. System 1 has therefore been set correctly on the ILS frequencies for runway 22.

The selector system for changing between system 1 and system 2 was found in position system 1.

The frequency selector for ILS system 2 was found in position 2.55 mc/s, the radio selector switch in position VOR 2 and the F/FOR-RMI selector switch in ADF 2.

The frequency of the receiver was tuned to 112.50 mc/s and the heading to 225°. The system has therefore been tuned to Kastrup VOR and set on radial 225 to the station. The voice signal has been used for listening to ATIS.

The operating panel for the radio altimeter giving the warning lights of 50-100-150-200-250-300 and 400 m. has not been salvaged. The alarm is indicated by both light and sound. The 10 largest and warmest radio valves in the salvaged radio altimeter had been destroyed being cooled so it must be supposed that the system had been switched off.

During HA-MOC's flights Jeppesens route Manual and Maps have been used. Both the maps and the approach charts from the manual were up to date.

Communication.

HA-MOC was equipped with the following communication equipment of importance for the flight in question:

1 duplicated WILCOX VHF installation with a transmitter of the 707A type and a receiver of the 705A type and 1 intercommunication installation of the SPU-7 type.

x E. as given in APP
The transcript of the radio communication with the Fornebu tower that MA 731 established communication with the Fornebu tower with the object of starting the engines and until the time of the crash.

1.10. Aerodrome and ground facilities.

Copenhagen airport, Kastrup, runway 22L - 223^oMag - is 3000 metres long and 46 metres wide surfaced with concrete.

The reference point of the airport, 553705N - 123908E, is 150 metres from runway 22L and 30 metres from runway 22R, that is, 1110 metres from the west end of runway 22L.

In the northeast end the height is 8 ft. A.M.S.L. and in the west end it is 10 ft. A.M.S.L.

Runway 22L is equipped with white high intensity uni-directional and white low intensity omni-directional and for the threshold lights high intensity and low intensity uni-directional lights which extend out 900 metres in the line of the extended centreline. The approach lights as well as the runway lights were at their full intensity.

Runway 22L was not equipped with VASIS.

The ILS-glideslope transmitter for runway 22L is positioned 150 metres after the threshold.

1.11. Flight recorder.

The aircraft was not equipped with a flight recorder as prescribed by ICAO Annex 6 "Operations of Aircraft". According to 6.3.1. in this annex, all turbo-propeller aircraft with a maximum weight of 5.700 kgs. or more shall be equipped with a flight recorder by January 1970.

The barospeedograph of type K-2-75 which was installed for the purpose of recording speed, height and time was out of service to the airline company, as they were advised.

north-east of the airport.

The aircraft which had crashed in water about 3.5 - 5.0 metres deep, was found separated into six main parts.

The main cabin from the wing root to the tail section was open both ends and was found with the longitudinal axis on a heading of about 200° .

The forward section of the main cabin from the wing root to the cockpit section, was found to the right of the main cabin and in the same area as the cockpit section.

The tail section, which was torn off at the point at which it attached to the main cabin, was found with the right tailplane above water about 100 metres away from and in a direction of about 60° from the main cabin.

The right wing was broken off the fuselage and lay without end immediately to the right of, and parallel with the main cabin.

The left wing was also broken off the fuselage, but was lying in its proper place as regards the fuselage, but with its rear edge above water. Engine no. 1, furthest left, and its propeller was on wing.

The remaining wreckage, including engines no. 2, 3 and 4, propellers, flaps and main undercarriage, were lying within the 250 m by 50 metres area previously mentioned, and generally in a direction 220° .

The salvage of the larger sections was begun on the 31st. August 1971 and was finished on the 4th. September 1971. An additional search was carried out by frogmen and salvage of wreckage parts and various components from an area of about 16,000 square metres was made in January - February 1972.

All of the salvaged wreckage was taken to Copenhagen airport for further investigation.

The cockpit section with the nosewheel undercarriage and main fuselage, the cockpit, including the controls, the control pedestal, the i

throttles equivalent to 47° on the FCU scale. No. 2 throttle was a little below this value and a little above.

Propeller pitch stop release switches were found in ON for propellers no. 1 and 3, and OFF for propellers no. 2 and 4.

The emergency feathering handles for propellers no. 1 to 4 were pulled up 9 cm, 14 cm, 12 cm and 13 cm respectively. The feathering buttons for all 4 propellers were in the neutral position.

The fuel booster pump switches for engines no. 1 and 2 were in OFF and for engine no. 4 in ON position. The switch for engine no. 3 was broken off. The cross feed valve control switch was found in OFF position and the transfer pump switches were all found in ON position with the exception of the far left side. The reserve transfer pump switch was found in OFF.

The flap selector lever, which, on an underwater photo had a DOWN position, showed after salvaging an UP position. All the other controls were in NEUTRAL but with the elevator trim slightly NOSE UP. The cover for the landing gear handling button was open.

The switches for the aircraft cabin pressure, heating and ventilation were found in an OPEN position.

The auto-pilot was found in an OFF position.

It should be noted that these observations were made after the wreckage was salvaged and do not necessarily indicate the position of the switches, levers etc. at the instant of collision.

An examination of all the circuit breakers, which are of the toggle-switch type, and therefore can well have altered position after the impact as well as during the salvage operations, gave no indication of malfunctioning of the systems during flight.

G. A summary of the instruments and their positions is given in the report of the investigation.

Forward main cabin from fuselage station 73.1 to 73.00

47 and FS 51 and on the right by the cabin windows at FS 33 and 34 a hole about 70 cms. by 90 cms. Of the 4 emergency exits placed between FS 27 and FS 28 and FS 29 and FS 30 on the left side and right side respectively, the two exits on the left side were intact and in the correct place whereas the forward exit on the right side was missing and the rear exit bore signs of having been attempted opened.

The tail section and the pressure bulkhead were found separated from the main cabin (FS 56). The left tailplane had been dragged from the rest of the tail section by being bent backwards. Impression marks had been made on the leading edge at an angle of 13° - 16° in relation to the chord of the tailplane. The impressions on the right tailplane indicates an angle of 20° - 33° in relation to the chord. The upper part of the rudder was missing.

Both wings had separated from the fuselage so that the faces of the parts that had broken off were right in by the fuselage as far as the left wing was concerned. The leading edge of the wing from the wing root to the outside of the inner nacelle was missing. About half of the leading edge of the wing between nacelle no. 1 and no. 2 had been deformed by pressure from below at an angle of about 20° in relation to the chord of the wings. The rest of the leading edge was undamaged.

As far as the right wing was concerned the surfaces of the fractures were by nacelle no. 3 for the top surface of the wing and about 150-200 cms. from the nacelle and in towards the fuselage for the lower surface. From nacelle no. 4 and outwards the outer wing was severely deformed. The damage to the leading edge of the wing was equivalent to that mentioned for the left wing. In addition, 5-6 metres of the leading edge of the right wing was pressed flat.

The surfaces of the fractures on both wings indicated a force directed from below.

The landing lights' mechanism placed in the lower outer portion of both wings was found in the retracted position.

located in the nose section of the aircraft.

und was deformed and had isolated cracks and holes in the plates

With the exception of the inner flap spindle on the right wing the other three spindles were broken into two pieces. Both the left and right outer spindles were broken 62.5 cms. from the shaft by which they were turned. The left spindle had turned $16\frac{1}{2}$ revolutions.

Control systems.

An inspection of the control system of the aircraft, including the trim, showed that the trim-tab of the elevator was measured to be 6 cms. up, equivalent to a nose-down position of 6° on the scale in the cockpit. A number of impressions were found on the push-pull rods of the elevators, and at the passage of these at the bell-crank in the pressure wall to the tail section. The marks on the pressure wall were measured as being equivalent to a deflection of the elevators of -13° downwards (pitch-down) at the time the marks were made. Impressions made by the push-pull rods' passage of FS no. 28-29 and FS no. 55-56 were measured at values equivalent to the elevator being 11° and 25° (maximum) pitch-up.

In the aircraft's tail section a broken wire was found between the main elevator system and the servo-motors from the auto-pilot. Following a closer examination of the auto-pilot system it could be ascertained that the mechanical part of the servo-motor, which normally follows the movement of the elevators when the auto-pilot is disengaged, was biased in position of the wheel, by which the two systems are connected, such that the length of the two pieces of wire, showed that the position of the servo-motor was $8^{\circ} - 9^{\circ}$ downwards, when the wire broke.

The steel cored wire was found to be well greased and maintained. One of the two pieces of wire was found to contain 2 kinks, respectively 15 cms. and 22 cms. from the point at which it had broken. The appearance of the breakage was as if the diameter of the wire had

on the axle.

The explosive charge, which is controlled from the cockpit, was still in its normal place in the wheel which connects the manual control with that controlled by the auto-pilot. It had not activated.

Engine no. 1 was found in two sections which had parted by the compressor stage and with the aft part still sitting on the wing. The lower part of the forward cowling above the reduction gear had an impression about 25 cms. deep by the bulkhead between the reduction gear and the rest of the engine section. The axle from the gear box to the compressor was broken in the area by the fixed guide vanes. The compressor did not have any direct marks from broken blades, but it did have marks in the blades of the forward stages.

Engine no. 2 had been torn off the wing. The forward part of the air intake was heavily damaged and the cowling was lightly damaged. The reduction gear was missing from about 80 cms. inwards in the engine section and the axle had broken. The forward stages of the compressor were bent against the direction of rotation. The tailpipe had broken off to the right and was lying loose in the nacelle. The forward section was bent to the right.

Engine no. 3. About half of the air intake was missing. The cowling was heavily damaged. The reduction gear housing was broken off about 100 cms. from the forward edge of the air intake. The forward stages of the compressor were bent against the direction of rotation. The tailpipe was broken and was lying loose in the nacelle. The forward section was bent to the right and the aft section to the left.

Engine no. 4. Most of the cowling was missing. The damage to the nacelle was similar to the damage to engines no. 2 and 3. The

x H. of an examination more detailed examination of the

Propellers.

3 of the aircraft's propellers, no. 2, 3 and 4, were salvaged in positions which indicated that they had been torn from the aircraft in a sequence from the right to the left.

Propeller no. 1 was in place but it would be seen that it was revolving after the aircraft had come to rest in the sand as to the position of the sand on the spinner had drawn the spinner into a similar shape. All 4 propeller blades were bent backwards in a similar manner and, as was the case with the spinner, bore signs of having rotated in the sand.

Propeller no. 2 was found with its reduction gear in place. The propeller blades were bent backwards in a similar manner. Blade no. 1 had scratches on the outer part of the leading edge and had the leading edge facing rearward, in the direction of rotation. Blade no. 4 had scratches in the outer part of the trailing edge.

Propeller no. 3 was found with the spinner totally destroyed with the point missing. The outer third of blades 1, 2 and 4 were bent backwards 70° - 90° , while about half of blade no. 3 was bent backwards about 60° .

Propeller no. 4 was found without a spinner. Part of the reduction gear was still in place. All the propeller blades had scratches and some of them had cuts and they were all bent backwards in a similar manner.

A visual inspection of the propeller blades - see photographs - showed an almost exactly similar bending. The bending was of a type that indicated a near equal revolution and as well as an equal power output. A measurement of the propeller pistons showed that the diameters were at 29.7 mm., 66.1 mm., 43.8 mm. and 58.75 mm. for propellers

fuel system.

The aircraft fuel system was relatively undamaged as regards the system in the left wing. The auxiliary tanks had been torn up during the separation of the wing from the fuselage. After the salvage of the wreckage to EKCH, 1500 litres of fuel were drained from the main tank.

In the right wing both the auxiliary tanks and the outer main tanks were destroyed, but the remaining main tanks were intact. No fuel was found in this wing.

The fuel shut-off valves for engines no. 1, 3 and 4 were in open position, but the shut-off valve for engine no. 2 has not been found. The crossfeed valve was found to be in the closed position.

Engine fire extinguisher.

All 6 bottles, 3 in each mainwheel well, were found filled and had not been activated. The discharge switches in the cockpit were in the OFF position.

Medical information.

A post-mortem was performed on all crewmembers. In no case was any sign of illness discovered which could be connected with, or put forward as a direct cause of the accident.

Blood-tests taken for the purpose of deciding whether there was any reaction to either alcohol or carbon monoxide, were negative in all crewmembers.

Fire.

No fire was caused during the accident.

Survival aspects.

When Malev 731, after expected passage of the rain area mentioned in item 1.1., did not re-appear on the radar screen or answer radi

rt at 1905.

The RCC and the Naval Operations Command (SOK), who had been armed with the Øresunds Naval District (SUM) caused helicopters and all available sailing material to be engaged.

Two boats, LVG 1 and LVG 2, from air station "Middelgrundsfort" which were included in the search and rescue work, were called for by Hølmens Commando Central (HKC) about 1/2 hour after HKC were asked to assist.

Furthermore, the pilot boat from Dragør brought 13 frogmen/divers and 2 doctors to the accident site.

The fire and rescue service's fire extinguisher boat reached the wreck at about 1945. The rescue boats arrived about 10 minutes later.

Both the fire and rescue service's boat and that from LVG 1 arrived at the site of the accident at 2007. LVG 2 arrived at 2030, these boats quickly located the wreckage of HA-MOC, as the two hydrofoil boats, "Svalen" and "Flyvefisken", as well as a S-61 helicopter from the Royal Danish Air Force were already at the site.

The crew of the two hydrofoil boats had sailed to the wreck as they had seen some unusual echoes on their radar, and also because they had heard of an aircraft accident in the Øresund from Lyngby radio. One survivor was taken onboard "Svalen" and a further 2 were taken aboard "Flyvefisken" via a liferaft from "Svalen". As the cries for help had faded out and a further 40 minutes search gave no result, the hydrofoil boats left the scene at about 2000, as the rescue craft mentioned earlier are now on the scene. Almost at the same time the fire and rescue service's extinguisher boat left the area in order to sail to Kastrup with a presumed survivor.

When LVG 1 arrived on the scene the forward section of the cabin part of the largest piece of wreckage (main cabin) was about 1 metre above the surface of the water. This section sank after about 20 minutes.

As it was impossible to enter the wreckage without the help of

rk and at 0130 on the 29th. August, when 11 bodies and 3 survivors
d been salvaged, salvage work was temporarily shut down for a short
me.

On the same day a further 9 bodies were salvaged by naval frogm
d on the 1st. September 9 bodies were released from the wreckage. O
the bodies was found later by the west coast of Sweden while one
ssenger is still missing and is presumed to have perished.

The direct cause of death has been determined to have been
owning in 19 cases. Of these 19 cases, 5 were found outside the wre
ereas 2 bodies were released from 1st. class, and the remaining 12
eleased/salvaged from the main cabin. Nearly all passengers had sust
njuries to the lower legs and were either seated with their seat be
astened or were squeezed between seats which had been torn free of
eir moorings or between sections of the flight kitchen which partl
locked the one end of the main cabin.

2 of the 3 survivors of the collision, of whom 1 died 3 days l
ere seated in the forward part of the main cabin by the left wing.
assengers who had their lap straps fastened were thrown out of the
pening which arose during the collision.

The third survivor sat on the rearmost left seat in the main
and was able to loosen his seatbelt and when the water began to pre
ts way into the cabin, was able to leave the aircraft through the
which had arisen between the rear cabin and the tail section.

The accident must be classified as non-survivable for those p
sengers and crewmembers who were sitting in the forward cabin (1st.
and as survivable for most of the others.

Tests and research.

As regards the transmission at 185220 it has not been possib
determine by normal means whether this transmission was sent by Ma
in this respect the communication between the tower co

also be mentioned that other conditions can also affect stability.

In "Practical Aerodynamics for the IL-18", issue of 1972, being flying, it is also mentioned that if the instructions for extending flaps and for flying with wing flaps extended are not observed, the aircraft can become unstable and unsteerable in the longitudinal axis. This can occur when the angle of attack of the tailplane reaches a "critical" value of 15° both positive as well as negative. As an example, different values of both the tailplane as well as the wing's angle of attack at different flap positions and different weights but at the same airspeed are given. At a weight of e.g. 45.000 kgs. and with a speed of 290 kmt. the wing and the tailplane's angle of attack will be $+4^\circ$ and -3° respectively at 15° flaps. When the flaps are extended to 30° it will be necessary, due to the increased lift, to reduce the angle of attack of the wing by 4° to maintain the height of the aircraft. Besides an equivalent reduction of the angle of attack of the tailplane, this is reduced by about an additional 3° because of the increased "downwash". Whether the weight is reduced and the A.S.I. is kept constant or the weight is kept constant and the A.S.I. is increased, the angle of attack mentioned will be reduced.

In case of instability, the aircraft will suddenly begin to descend and the descent angle and the rate of descent will be increased. An ordinary recovery in the form of a pulling back on the control column will only result in an increased descent and angle, it is only possible to get the aircraft steerable again by retracting the flaps completely or partly.

In the book mentioned, the following 3 factors are described as helping to pull the aircraft into a dive, i.e.:

- 1) The placing of the centre of gravity a long way forward,
- 2) The extension of the flaps at too great a speed, especially at low weights, and

the angle of attack takes place when the wingflaps are extended, there will be, in unfavourable cases, a risk that the negative angle of attack on the tailplane reaches a supercritical value with a resultant loss of longitudinal stability and steerability.

Re point 3. With the extension of the wingflaps to maximum increment the uninterrupted extension will take place as a continuous shifting forward of the control column. At the end of this extension of the wingflaps, the aircraft will have obtained such great velocity and such a change of the angle of attack, that the inertia will cause the angle of attack to continue to decrease, even after the flaps have stopped moving. The tailplane can thus attain a negative supercritical angle of attack.

quickly that as there was no possibility of a cause being established immediately prior to the accident, the cause must be attempted to be established by a process of elimination.

The cockpit crew and the cabin crew were in possession of valid licences and were qualified to execute the flight in question in accordance with the rules that were valid.

A perusal of diverse technical journals has given no indication that the aircraft was encumbered with technical remarks which could have had any influence on this accident.

The aircraft's weight and balance has, inasmuch as weight concerned, been within the limits. The position of the centre of gravity on the other hand, or rather, the lack of information about this, makes it impossible to calculate this with any certainty. Even if the crew did not follow the instructions about leaving a copy of the load sheet in the airport of departure and the position of the passengers, baggage and other load is thus unknown, it must be assumed that the position of the centre of gravity has been within the limits established for take-off from Oslo. As regards the position of the centre of gravity at the time of the accident, it can not be excluded that this has been outside the limitations according to the calculations made. This calculation assumes though that the passengers were placed where they were found i.e. as described in the example given in item 1.6.4.

A confirmed reconstruction of the flight has not been possible as the aircraft was not equipped with a flight data or cockpit voice recorder. With regard to this, the part of the flight that has been reconstructed has been based on the radio correspondence, the meteorological conditions on the day in question, information from Malev concerning the operating conditions and the statements of witnesses from the approach and departure control in Copenhagen airport.

The courses of the aircraft and the changes hereto are based on the radio correspondence and the statements of the air traffic controller. On the other hand the aircraft's height and speed have been calculated from the time of the radio correspondence and information from the

According to the radio correspondence "Malev 731" left Goteborg 1827 and established connection with "Malmo" 7 minutes later. The phraseology used in the call to "Malmo" at 1834: "*Malev 731 standing for descent*" is however so unlike "Malev's" other calls, which all began with "*Good afternoon*" or "*Good evening*" when radio connection was established, that this can hardly have been the first call til Malmo. Because of the lack of recording equipment mentioned previously, and because the recording equipment in Malmo had functioned normally, it has been impossible to account for the missing 7 minutes or for the apparently abnormal call up. From the excerpts of the radio correspondence between Malev and Oslo and also from statements by the flight controllers in Oslo it is clear that the transmissions from Malev at times were not very good.

When requested by the approach control Malev 731 reported at 184644 that the airspeed was 200 (knots is understood). Course and heading were at this time respectively 190° and FL 50. On the other hand the configuration of the aircraft is unknown, but as the speed had been above the maximum permissible for the extending the flaps and the undercarriage, it must be supposed that the aircraft was "clean". As Malev 731 received permission at 184708 to maintain high speed during the continued descent to 2500 feet, it must be assumed that the speed during this descent has increased similarly to the speed during the flight performed in Budapest. That is to say that the speed at 2500 feet has been 330 kilometres per hour which is equivalent to 232 kts. At 184841 Malev 731 was cleared to 1500 feet and left 2500 feet at 184848. According to "Flight Operating Instructions" the rate of descent below a height of 4000 metres may take place at up to 10 m/sec. Therefore it is hardly likely that the aircraft was level at 2500 feet, but rather that the descent begun at flight level 50 has continued direct through 2500 feet.

Whether Malev 731 established a flight altitude at 1500 feet or not, is not known as this height was never reported. Judging from the location of the accident and the fact that Malev 731 established radio contact after leaving

in the range of 330-370 kilometres per hour (178-200 kts.).
Furthermore, it must be assumed from the radio correspondence that until 185159 the flight crew have considered the flight as normal and that neither an emergency call nor a message concerning technical or operational problems was sent.

As previously mentioned, it cannot immediately be ascertained whether a flight altitude of 1500 feet was established or whether descent was continued through this altitude. If this last condition has been the case, it can be explained by the fact that the crew has either attempted to make a visual approach - and hereby disregarded the clearance they had received to make an ILS-approach - or that there had been inaccuracies with regard to the ILS installation and navigational aids.

As regards the ILS installation in EKCH and the navigational aids associated with runway 22L, this last possibility can be disregarded according to item 1.8.1.

Furthermore, the possibility that an attempt should have been made to make a visual approach can also be left out of consideration. With regard to the weather and light conditions and to the circumstances, the crew confirmed the clearance that they received for an ILS approach to runway 22L, that the localizer and glideslope frequencies were correctly tuned in on the aircraft's no. 1 ILS system, and that the aircraft did not fly through 1500 feet according to the statement of the traffic controller, then the possibility must be considered as minimal in any case.

An examination of the aircraft confirmed that it was in landing configuration when it hit the water. That is to say that the undercarriage was down and locked and that the flaps were extended to 30°.

It is not known when the gear has been selected down or when the flaps have been extended to 15°, or whether this has been executed normally done, when the approach has been made.

limit of 2.11° will cut the 1500 feet level at a distance of 86 metres from the end of the runway. In an equivalent manner, the path of 2.78° will cut the level mentioned at a distance of 99 metres from the end of the runway. As the lower limit of the slope also passes the point where the first impact is assumed to have taken place at a height of 1,375 feet, it can therefore, provided the normal procedure for extending the flaps have been followed, be discounted that the aircraft has been below this height.

It is therefore predominantly probable that the cockpit crew fully followed the instructions given by the approach controller as regards flight altitude and flew the approach at the height ordered of 1,500 feet, and partly had the intention of executing an ILS-approach.

It has not been possible to interpret, either in English or German, the wording of the last transmission which took place at 00:20 according to the recording. According to the analysis made by the Acoustical Laboratory it can be established with reasonable certainty that it originates from MA 731. The click at the beginning, which, according to the analysis, coincides with the end of speech signal, is equivalent to the click when the other transmissions from MA 731 were analysed, and also the voice speaking is similar to the voice which was earlier spoken from MA 731.

The reason why the transmission seems to have been interrupted in the middle of a word or a sentence is unknown. The actual collision, the possible reason, or a manoeuvre with the aircraft of such violence that the person in question making the transmission, has not been able to continue.

According to statements from the passengers who survived the crash, the cabin crew did not at any time advise of any irregularities. According to the assertions of these same passengers, the flight had been quite normal until respectively just before the aircraft crashed and the collision. As is stated in item 1.1., 2 of the passenger report.

er, the autopilot is not used on such short routes as en-
ed by Malev, the autopilot is not used on such short routes as en-
question, and even if, in any case, it would have been de-clutched
ight of at least 1000 metres, part of the mechanical system will
ys follow the manual elevator systems movements. The circumstance
the emergency de-clutching system of the auto-pilot was found de-
vated and sealed can therefore not be taken as an indication of fr
ation of the elevator. Regarding this, it must furthermore be rega
doubtful as to whether the crew would attach any weight at all to a
latched auto-pilot in connection with possible problems with the
l elevator system.

As mentioned in item 1.12. it could be ascertained that the posi
e elevator was 8° - 9° down when the wire broke. Impressions made o
levator pull rods and also their passage through the bulkhead in
ailsection indicated conversely both positive and a negative posi
of the elevator when the impressions were made. As it must be tak
ranted that the collision forces have caused the controls in the
it to be forced forward by the pilots, then the impressions that
the most positive indication of the elevator position, must also
e position that the elevator had when the original impact took
. The impression that is found on the elevator pull-rod during it
ge of FS no. 55-56 indicates a position equivalent to maximum pos
deflection, which is to say that the pilots have had the controls
back when the first impact took place. The difference in the pos
positions of the elevator can only be explained by the fact that
reaking open of the aircraft has taken place by stages and suffi-
y slowly to allow this and/or the pull-rods to alter position.
The position of the elevator, which was ascertained with the he
e broken wire in the auto-pilot system, indicates therefore that
re can not have been broken just at the instant of collision,
ther before this or as a result of a secondary force in connect
he collision

movement of these was impeded. Regarding this it must be seen as a natural reaction on the part of the crew to try and overcome such a situation by a backward and forward movement of the controls, during which the controls have reached a position of 8° - 9° downwards, before the wire has broken.

An experiment has shown that while a comparatively small force was needed to block the mechanical part of the auto-pilot the force which has to be applied to the controls, before the wire breaks, is not overwhelming. A wire having a breaking strength of approximately 740 kg. will break when a pull of about 98 kg. is applied to the controls in the cockpit.

Yet another condition for that a broken wire could have had the significance for the accident, is that the height has been insufficient to get the aircraft on an even keel before it hit the water in spite of the free movement of the elevator.

As was mentioned in item 1.12., the tail section was found separated from the rest of the fuselage at FS no. 56. Furthermore, it was ascertained that the push-pull rods of the elevator from that part of the system which was attached to the tail section, had made marks on the bellcrank in the pressure bulkhead which were equivalent to a maximum position of the elevator. At the FS mentioned, part of the push-pull rod was found in the fuselage section of the aircraft. On this part of the fuselage impressions were found equivalent to a maximum positive deflection of the elevator. Scratch marks, made in connection with these last mentioned impressions, did not indicate at any place a negative value of the elevator angle. It can therefore be concluded, that the connection between the tail section and the rest of the aircraft, was broken while the elevator was still positive. This is also confirmed by the position and distribution, which indicates that the tail section was separated from the body of the aircraft and was directly connected to the forward section. Considering the force w

breakage. In case of breakage of the controls, the making of the mark in the bulkhead was fortuitous and at the same time something of a coincidence that it should indicate just the elevator position, equivalent to indicated by the broken wire.

If the wire has been broken in connection with the collision indicates also that the metal chips that caused a bearing to seize the servomotor have had no significance as regards the accident. The wire has thus been broken because the system has not been able to follow the forces by which it has been influenced, or whether deformed have caused a blockage of the system, is therefore immaterial.

As was mentioned in item 1.12., all the feathering handles were found in the activated position. Even if certain deformations of the structure around the handles, including the controls, indicate that the handles were activated before the collision, during activation of the engines as well as the propellers, nothing has been found that could support this. Even if the system has been activated before the collision, and considering the positions in which the propeller pitch locks were found, and having regard to the method of operation of the system and the fact that the feathering speed was 3° per second, it can be ascertained that the feathering can only have taken place within a maximum of 3 seconds before the collision. As this can only be confirmed in the case provided that the throttle positions were at "Flight Idle", propeller pitch 12° and airspeed 180 kilometres per hour, it seems unlikely to suppose that the position in which the handles were found was caused by the break-up of the cockpit. Nevertheless, it cannot be excluded that the flight engineer may have pulled the handles when he saw that a collision was inevitable, as this item is part of the Ditching Checklist.

This checklist states moreover that a ditching shall be performed with gear and flaps up (item 6) and also that the landing lights shall be on.

inevitability of a ditching, the retraction of both the undercarriage and flaps has not been attempted. This indicates at the same time that the factors which led to the accident were not present when 30° flaps were extended.

As mentioned in item 1.12., the valves for the Cabin Pressure system were found in the OPEN position. This system is part of "Before Starting Approach to Land" checklist according to which it shall be switched off. "Flight Operating Instructions" for IL-18 state that it should be performed at a height of 400-600 metres. Out of regard for comfort of the passengers however, it is the policy of the company that the crew do not perform this check until a height of 100-150 metres height is reached. Even if this point can have been forgotten, it is probable to suppose that this height was not passed in a normal manner.

Nothing has been found of the results from the examinations that suggest that the accident could have been caused by technical irregularities. Neither is there any reason to suggest that the flight has been normal until the time that the crew established radio contact with TWR EKCH and/or until that point where the crew had an indication of glideslope and where extension of flaps to 30° took place.

Even if the possibility that unknown factors could have been a contributing cause of the accident, it seems mainly probable that factors which led to the accident arose in connection with, or immediately after, the extension of 30° of flaps. It has been ascertained with considerable certainty that the factors were not present prior to the extension of 30° flaps, that they did not arise before 185159, and that the height was above 1,375 feet. Furthermore, the extension of 30° flaps is a very simple operation which can be imagined executed within the time for which the reason for the accident has to be found.

Regardless of the fact that the instrument examinations have not been able to give a positive indication of the attitude of the aircraft at the instant of collision, the break-up of the aircraft as well as the spread and position of the wreckage indicates that it has been "broken up" from the leading edge of the wings and

is assumed to be more correct. The peller blades supports this assumption, it must be supposed that the angle has been of the order of 15° - 20° . As the surfaces of the structure and the bending of both wings indicated that these were influenced by a force that came from below, it can be demonstrated that this angle has been less than the angle that the aircraft was moving at in relation to the surface of the water.

As is evident from Appendix F, it must be supposed that the impact has taken place about 130 metres before the position given on the map of the site of the accident. The horizontal difference between the point of impact and the point where the crew have received an indication of the glideslope is 979 metres.

If it is assumed that the height of the aircraft was 1500 metres (450 metres) when the factors causing the accident arose, and if the angle arose in connection with the extension of 30° flaps, the angle must then have been about 25° . At a height of 480 metres the angle will be reduced to 15° .

The angle of the aircraft in relation to the surface of the water and the angle of collision can therefore very well have been of approximately the same value.

As was mentioned in item 1.17., besides icing, operation of the flaps which is not performed according to the established instructions can make the aircraft unstable and unsteerable longitudinally. In the same section 3 factors are mentioned which contribute to pull the aircraft into a dive and furthermore, it is mentioned that an ordinary recovery with a pull back on the elevator controls will only result in increased descent speed and angle.

With regard to icing, it has not been possible because of the construction of the anti-ice system and method of operation, to ascertain whether the system has been working at the time of the crash. Referring to item 1.8. the meteorological conditions however were of such a character, that icing was not possible at the height in which the aircraft was flying.

tion of the centre of gravity at the time of the crash, can have been as far forward as 16.9 % MAC, which is to say, outside the limitations with undercarriage extended. As previously mentioned, this calculation presumes however, that the passengers were positioned where they were found during the salvaging operations.

The second of the factors mentioned in item 1.17., which could have influenced the stability of the aircraft, deals with the extension of the flaps at a high speed and particularly at a low weight, finally the last factor deals with the extension of the flaps to maximum in operation.

With regard to the airspeed until the point where the extension of flaps to 30° has taken place, the accuracy of this is not known. According to "Flight Operating Instructions" the aircraft will normally be stabilized at a speed of about 300-320 kilometres per hour during that part of the approach which takes place with the gear out and the flaps at 15° .

In the opinion of the company however, it is not improbable that the crew have regarded the permission to maintain high speed as a release from approach control, and therefore the airspeed could very well have been faster than during a normal approach. Regarding this, the company will not dismiss the possibility or find it unnatural if the crew, in order to maintain a higher speed than normal for as long a time as possible, have waited until the last moment to extend the flaps and then did this in one operation, from 0° to 30° .

That the airspeed has been greater than that normally used during an approach seems to have been very probable. Regardless of the fact that the exact time of the accident is unknown, it must be assumed, as mentioned earlier, that the factors which led to the accident, occurred between 185159 and 185220. Referring to the transcript of the radio correspondence, Malev 731 received a 9 N.M. check at 185131, compared with the point at which, at the latest, the flaps have been extended to 30° , the average speed between the two points mentioned must have been about 300 kilometres per hour indicated airspeed. If the aircraft

to get a confirmation that the preparation of the SAS loadsheet was correct, and even if some are still unknown, the total weight was on the low side, compared to the weight it could have been.

The aircraft's speed at the time of the crash is not known. It is assumed to have been considerably less than the speed for a normal approach in landing configuration. With the exception of an indication of about 250 kilometres per hour on the airspeed indicators placed respectively in front of the first pilot and the second pilot, the examination of the instruments of the aircraft, gave no indication of a position which could be connected to the speed of the aircraft at the time of collision. The position that could be ascertained by the throttle setting after the accident, could not be confirmed by an examination of the instruments as being the position at the moment of collision. Compared with the normal approach speed of 300-320 kilometres per hour the throttle setting would be equivalent to a throttle setting of 35° - 40° according to the "Operating Instructions" which is equivalent to a rating of 0.4-0.5. As stated in Appendix L, the propeller pitch at the speed and throttle setting mentioned was about 24° . As previously mentioned, if the aircraft has been made at a greater speed than normal, it is probable that the throttle setting has been less than 35° - 40° , as a reduction in speed must have taken place simultaneously with the extension of the propeller. In which case, the propeller pitch has not only been less than approximately 24° , but also on its way towards an even finer position.

Compared with the propeller examination the bending of the propeller indicated that the angle between the aircraft and the surface of the water had neither been steep nor flat, that the r.p.m. had been normal and that the propellers had been windmilling or under low power. Examination of the pitchlock mechanism showed that the propeller pitch at impact was respectively 20° , 18° , 19.5° and 19° for the 4 propellers. Referring to Appendix L, these positions indicate that the throttle setting could not have been much greater than 35° - 40° unless the

ve been present.

As mentioned in item 1.7., positive windshear between 300 and 0 metres height was seen by the radiosonde station in Copenhagen. It is also stated in the same item that the crew of only one aircraft, Caravelle, which landed in EKCH at 1920, have noticed this effect. Whereas the crews of six other aircraft, which landed in EKCH immediately before or immediately after the assumed time of the crash, agree with the Caravelle crew in that there was moderate to heavy turbulence and in with gusty wind conditions.

As the speed at which the crew of HA-MOC flew the last part of the approach is assumed to have been greater than normal, it is hardly probable that a possible horizontal windshear can have had any great influence.

Whether possible vertical windshear in connection with turbulence and the heavy shower activity can have affected the airstreams around the tail to such an extent that the longitudinal stability has been lost cannot be either confirmed or denied.

Whether the aircraft has lost longitudinal stability because of this or because of one of the three facts mentioned previously and having entered a dive, it is only possible, with the configuration that the aircraft was in, to make it steerable again by retracting the flaps wholly or partly.

As an ordinary recovery, in the form of a pull back on the control column will only result in an increased descent speed and increased descent angle, the 30° flap position which was ascertained after the accident, together with the indication of full positive elevator deflection, on the one hand indicate that there was no question of loss of longitudinal stability. On the other hand, it could also suggest that the cockpit crew did not interpret the situation thus, but only carried out a normal and natural correction to a nose-down alteration of the aircraft's position which has led to a deterioration of the situation.

Conclusions.

a. Findings.

1. The cockpit crew held the necessary valid licences and had extensive experience in IL-18 aircraft.
2. Nothing has been found to indicate that the pilots were physically or psychologically unfit to perform the flight concerned.
3. The medical examination showed that at the time of the accident none of the crewmembers were under influence of alcohol. Examination of blood produced no evidence to suggest carbon monoxide poisoning.
4. The aircraft's certificate of airworthiness was valid.
5. The aircraft was not equipped with a Flight Data Recorder as prescribed in ICAO Annex 6 "Operation of Aircraft".
6. The aircraft weight was within the permissible limits.
7. It has not been possible to establish the exact position of centre of gravity at the moment of impact but there might be a possibility that the C of G has been ahead of the forward limitation.
8. The crew did not act in accordance with the instructions laid down in "Instructions on loading and balancing IL-18 aircraft" as they did not leave a copy of the load sheet in ENFB.
9. The crew did not report any abnormal flight condition or an emergency before the accident.
10. According to the radio communications the flight was normal at least until 185159.
11. Fuel remaining at the time of the accident was sufficient for more than one hour of flight.
12. There has been no evidence...

with the flaps set at 30° .

16. The elevator control surface was in the full up position i.e. 25° at the time of impact.
17. The angle between the surface of the water and the longitudinal axis of the aircraft was $15^{\circ} - 20^{\circ}$ at the moment of impact.
18. The descent angle was greater than the angle mentioned in 17.
19. It can not be excluded that weather (heavy rainshowers and turbulence) has been a contributing factor to the accident.

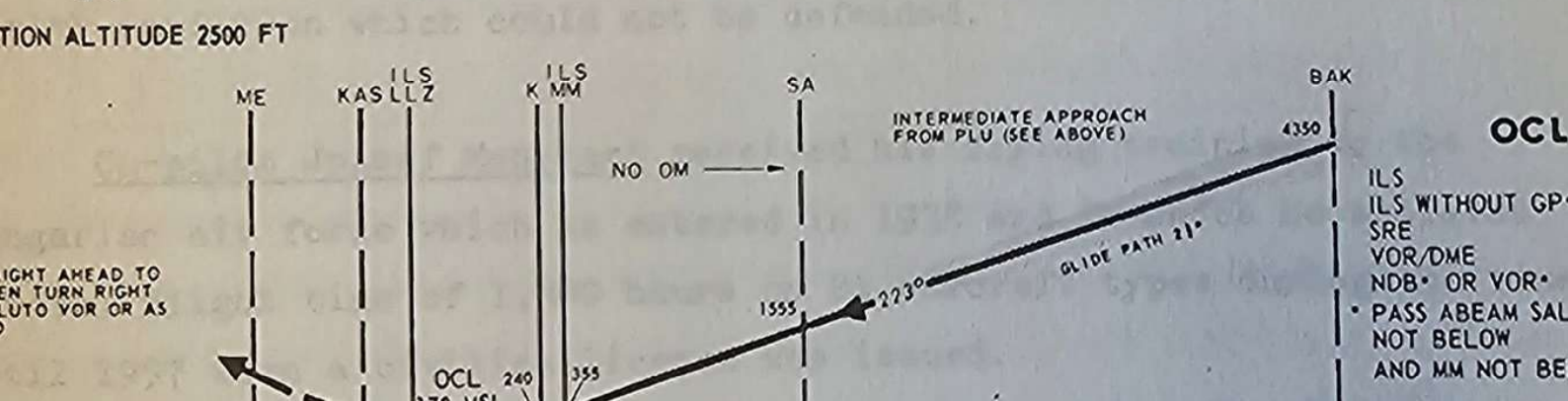
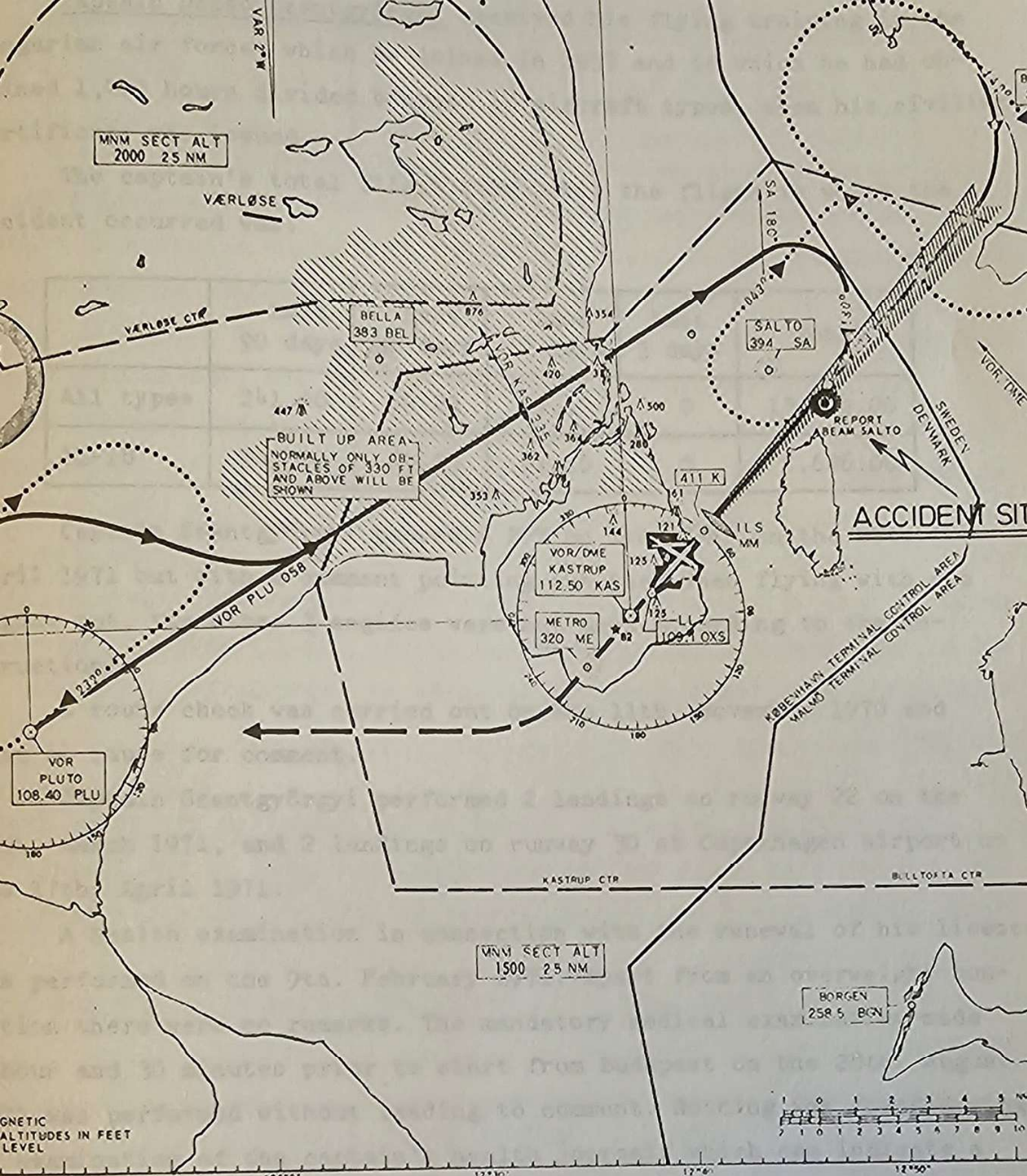
Probable cause.

The probable cause of this accident was loss of control of the aircraft at the moment where the aircraft was about to intercept the ILS glideslope to runway 22L at Copenhagen airport, Kastrup.

Although it has not been possible to establish the cause of the loss of control, it is most likely to believe that the aircraft in the landing configuration was affected by a deterioration of the airflow over the tailplane to such a degree that longitudinal stability was lost.

The Danish Directorate of Civil Aviation, January

Approved by Ministry of Public Works, 27th May 19



garian air force, which he joined in 1935 and in which he had ob-
ned 1,400 hours divided between 19 aircraft types, when his civilian
tificate was issued.

The captain's total flight time until the flight in which the
ident occurred was:

	Last 90 days	Last 30 days	Last 7 days	Last 3 days	Total
All types	241.00	69.23	11.10	0	13.594.00
IL-18	241.00	69.23	11.10	0	7.626.00

Captain Szentgyörgyi passed a PFT on the IL-18 on the 25th.
il 1971 but with a comment pointing out that when flying with one
ine out, the other 3 engines were not used according to the in-
uctions.

A route check was carried out on the 11th. November 1970 and
e no cause for comment.

Captain Szentgyörgyi performed 2 landings on runway 22 on the
n. March 1971, and 2 landings on runway 30 at Copenhagen airport on
17th. April 1971.

A health examination in connection with the renewal of his licen
performed on the 9th. February 1971. Apart from an overweight con-
ion there were no remarks. The mandatory medical examination made
our and 30 minutes prior to start from Budapest on the 28th. August
was performed without leading to comment. Nothing was found during
examination of the captain's health journals which can indicate a
th condition which could not be defended.

Co-pilot Jozsef Menyhart received his flying training in the
garian air force which he entered in 1938 and in which he achieved
otal flight time of 1,300 hours on 21 aircraft types during the tir
1 1957 when a civilian licence was issued.

All types	162.00	56.12	13.22	6.16	9.362.00
IL-18	162.00	56.12	13.22	6.16	2.391.00

Jozsef Menyhart passed a PFT on IL-18 on the 24th. April 1971

without comment.

The pilot landed twice on runway 30 at Copenhagen airport on the 17th. April 1971.

The health examination in connection with the renewal of his licence was performed on the 12th. January 1971. Jozsef Menyhart was adjudged suitable as a pilot at this examination as he was at the previous semi-annual medical examination carried out on the 12th. July 1971. The mandatory medical examination made 1 hour and 30 minutes prior to take-off from Budapest on the 28th. August 1971 was carried out without comment. During a perusal of the pilot's medical journal nothing has been found which can indicate an indefensible condition of health.

Navigator Pál Jancsovics served in the Hungarian air force from 1948 and achieved while serving as navigator a total of 600 flight hours. He was issued a civilian licence in 1958 and has since been attached to MALEV.

His total flight time until the flight during which the accident occurred was:

	Last 90 days	Last 30 days	Last 7 days	Last 3 days	Total
All types	242.00	76.29	11.10	0	8.623.00
IL-18	242.00	76.29	11.10	0	8.023.00

Qualification check took place on the 21st. May 1971 and recurrent check on the 23rd. April 1970. Both checks were performed satisfactorily.

condition.

Radio Telegraphist Károly Lantos, who was employed in the Hungarian post and telegram service in 1948, served as a radio telegraphist in MALEV in ground stations from 1953 to 1958 and as flight telegraphist from 1958.

His total flight time until the flight during which the accident occurred was:

	Last 90 days	Last 30 days	Last 7 days	Last 3 days	Total
All types	247.00	69.58	9.50	5.21	9.077.00
IL-18	247.00	69.58	9.50	5.21	6.383.00

His qualification check took place on the 25th. April 1971 and his route check on 16th.-17th. January 1971. Both checks were performed without comment.

The medical examination in connection with the renewal of his license took place on the 11th. November 1970. Károly Lantos was found to be suitable as a telegraphist. The semi-annual medical examination on the 2nd. June 1971 resulted in a temporary prohibition of flight.

The mandatory medical examination performed 1 hour and 30 minutes prior to the take-off from Budapest on the 28th. August 1971 was without comment. A perusal of Károly Lantos' health journals gives no indication of an indefensible condition of health.

Flight Engineer László Aladi served in the Hungarian air force from 1951 to 1957 and achieved here a total flight time of about 1,150 hours mainly on LI-2.

His total flight time until the flight in which the accident occurred was:

IL-18

211.00

50.29

12.31

László Aladi was, at the last health examination made - 7th February 1971 - found to be fit for continued service.

The mandatory medical examination made 1 hour and 30 minutes start from Budapest on the 28th. August 1971 was carried out with comment. At a perusal of L. Aladi's medical journals nothing was which could indicate a health condition which was indefensible.

Stewardesses Klara Tolnai employed in MALEV on the 2nd. June
Eva Margit Ivan employed on the 8th. August 1968, Janosne Szalay
on the 30th. April 1963 and Katalin Tamasne employed on the 8th.
1969 fulfilled, according to information received from the Hungarian
airline company, the health requirements at the last medical inspection
made.

Duty time etc.

All crewmembers who had reported for duty in Budapest on the
August 1971 at 0910 hours, had, until the time of the accident, a
duty time of 9 hours and 42 minutes. The Hungarian regulations allow
a total duty time of 15 hours per day - with a maximum of 210 hours
month.

The last emergency training practice for all crewmembers was
made without comment.

Sample of: Fuel from IL-18, HA-MOC. (collected)

The Directorate of Civil Aviation,
 Accident Investigation Department.
 Delivery date: 20-9-71

Reference: The Directorate of Civil Aviation's letter xx.511.264 of the 15th. Sept. 71

Against: UK spec. D. Eng. R. D. 2494 ISS 6

/US spec. MIL-F-

test performed by: GA/HJ/NK

Test.	Method:	Results.	Unit
Specific gravity 60°/60°F	ASTM: D 1298-67	0,8158	g/ml
API gravity	ASTM: D 287-67/calc.	42,12	°API
Saybolt color	ASTM: D 156-64	+ 20	.
Freezing point	ASTM: D 2386-67	- 55	°C
Reid Vapor pressure	ASTM: D 323-58		p.s.i.g.
Aromatics	ASTM: D 1319-69	15	% Vol
Bromine number	ASTM: D 1159-66		g/100 g
Olefin content	ASTM: D 1319-69	0	% Vol
Copper corrosion test	ASTM: D 130-68	1A	.
Silver corrosion test	IP: 227/71	0	.
Gum existent	ASTM: D 381-64	4,2	mg/100
Gum accelerated (16 hrs)	ASTM: D 873-65		mg/100
Oxidation stability: induction period at 212°F	ASTM: D 525-55		minute
Sulfur total	ASTM: D 1266-64T	0,17	% Wt.
Sulfur Mercaptan	ASTM: D 1219-61	0	% Wt.
Doctor test	ASTM: D 484-52	POS	.
Smoke point	ASTM: D 1322-64	30	mm
Smoke volatility index		65	.
Aniline point	ASTM: D 611-64	138,2	°F
Aniline-gravity product		5821	.
Total acid number	ASTM: D 974-64(MOD)	0,001	mg K
Tetraethyllead in gasoline	ASTM: D 526-66		ml/US
Tetraethyllead in trace conc.	ASTM: D 1368-64	1	ml/US
Thermal stability: Preheater deposit Pressure drop (5 hrs)	ASTM: D 1660-69	-	inche
Water reaction	FED.test meth. std.no. 791.3251 or ASTM: D 1094-67	0 2	ml
Rating of fuel interface	FED.test meth.		

evaporated at	2	% Vol
porated at 143°C	61	.
porated at 188°C	78	.
covered at 200°C	83	.
porated at 204°C		.
porated at 243°C	222	°C
	1,7	% Vol
ue	1,3	.

System Icing Inhibitor (Freeze Point Method):

38,0 °C

Point - ABEL - PENSKY (IP 170°C)

Remarks:

...t from Thermal Stability, for which there was insufficient fuel, the
...le fulfilled brit. spec. D Eng. R.D. 2494 ISS 6 for JET A-1. (JP-1)
...Doc.test. Last mentioned deviation can presumably be blamed on the s
...ution by sea water

E. Repstorff Holtveg

Signature

V., DEN

NYT TELEX NR. FRA I. OKT.: 27096

ariaafdelingen

tfartsdirektoratet

Glide Path 22 L Kastrup.

During the night August 28th and 29th, 1971, 0100-0300 local time
Flight Test was carried out on Said Glide Path by the calibration
aircraft OY-IVA.

The Glide angle as well as the displacement Sensitivity was controlled.

The angles was found to be correct as shown below.

Glide angle; 0 dot	0 μ a	2,78°
Displacement sensitivity		
dot fly down ~	90 μ a	3,19°
dot fly up ~	90 μ a	2,38°
dot fly up ~	150 μ a	2,11°

course structure: Meets the ICAO requirements for Kategori II.

GND MA 731 good afternoon
 MA 731 Ready for start up
 GND MA 731 is cleared to start, the QNH 997,5
 MA 731 997,5 cleared to start, thank you
 MA 731 MA 731 request taxi
 GND MA 731 is cleared to holding RWY 24, check a Caravell
 coming in afront you
 MA 731 Roger
 GND MA 731 your clearance
 MA 731 Come in
 GND MA 731 cleared to Copenhagen A) FL 210
 MA 731 Cleared to Copenhagen A9, 210
 GND MA 731 correct, contact Fornebu TWR for climb out, 11
 MA 731 Good day
 GND Good day."

Communication between Fornebu TWR and MA 731 on 118.1 mc/s:

MA 731 MA 731 good evening
 TWR MA 731 good evening, hold position, we have traffic
 joining left base
 TWR MA 731 is cleared into position
 MA 731 731 into position 24
 TWR Correct
 TWR MA 731 is cleared for take off, left turn direct
 Fredrikstad
 MA 731 731 is cleared for take off left turn direct
 Fredrikstad
 TWR That is correct
 TWR MA 731 airborne at 55, understand you are not
 equipped with rotating beacon
 MA 731 Airborne time is 55, and say again all after
 TWR Understand your anti collision flash light is out
 of service
 MA 731 What is out of service?
 TWR The red rotary beacon, the flashing red beacon, over
 MA 731 Oh sorry, it is switched off
 TWR O.K.
 TWR MA 731 report on course Frederikstad
 MA 731 Roger
 MA 731 MA 731 on course Fox Sierra Tango this time 40,
 climbing, estimate 08
 TWR MA 731 roger, contact Oslo control on 125,0 good-day
 MA 731 Good day."

Communication between Oslo ACC and MA 731 on 125.0 mc/s:

1808.50 MA 731 Malev 731
 D1 Gøteborg Malev 731 Gre. Grest
 1815.10 MA 731 Brevik 23 210
 Malev 731
 1815.20 D1 Ja
 1815.40 ESMM Revision på Malev Herring 36
 D1 36
 ESMM Ja
 D1 Gøteborg Malev 731 at 25 Nolvik level 210
 1825.20 MA 731 Herring 36
 Malev 731
 1827.00 D1 Malev 731 Malmö Control 120,9 good evening
 D1
 MA 731 Good night."

Communication between Malmo ACC and MA 731 on 120.9 mc/s

"1834 MA 731 Malev seven three one standing by for descent
 ESMM roger malev seven three one cleared inbound Bars
 bäck via Kullen flight level five zero for runwa
 two two left
 MA 731 roger cleared to Barsbäck via Kullen five zero
 runway two two left leaving two one zero this t
 ESMM roger malev seven three one
 1837 MA 731 malev seven three one three seven Herring Kulle
 at four one
 ESMM malev seven three one
 1842 MA 731 malmö malev seven three one kullen at four two
 Barsbäck four nine one zero zero descending
 ESMM roger malev seven three one contact approach on
 one nine eight good-bye
 MA 731 good-bye."

Communication between Kastrup APP and MA 731 on 119.80 m

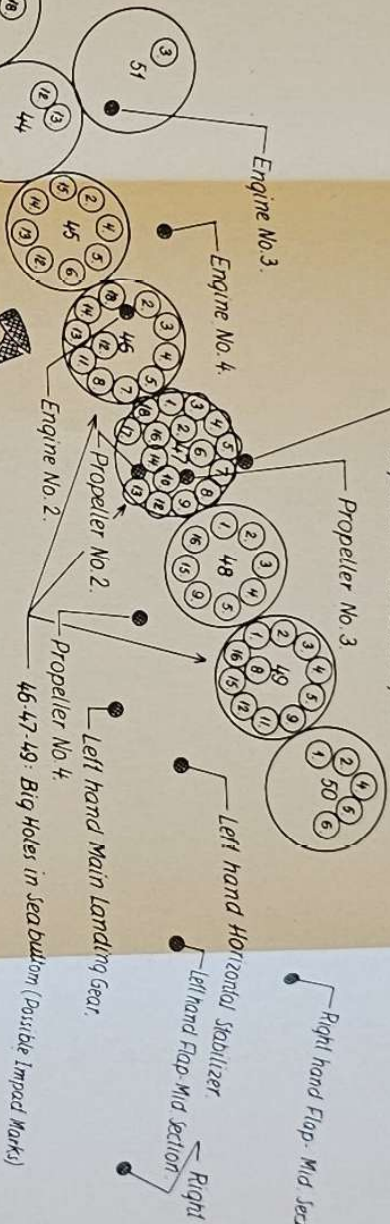
"1843.02 MA 731 Kastrup malev seven three one good evening info
 mation november Kullen four two Barsbaeck four
 nine one zero zero descending five zero
 13 APP good evening seven three one report passing fli
 level six zero
 23 APP malev seven three one report passing flight lev
 zero
 27 MA 731 six zero will do
 1845.27 MA 731 out of six zero
 29 APP seven three one roger
 36 MA 731 five zero seven three one
 40 APP malev seven three one roger
 1846.13 SK 465 Copenhagen approach scandin

feet Q N H one zero zero seven you are welcome
 to maintain high speed
 16 MA 731 take high speed two thousand five hundred feet one
 zero zero seven
 21 APP roger
 22 MA 731 leaving five zero
 23 APP thank you
 30 APP scandinavian four six five start reduce to two
 one zero recleared flight level five zero
 38 SK 465 speed two one zero we are reducing now and level
 five zero
 46 APP roger
 48.41 APP malev seven three one cleared one five zero zero
 feet cleared for I L S approach
 48 MA 731 thank you leaving two thousand five hundred for
 fifteen hundred cleared I L S approach two two le
 54 APP roger
 59 APP four six five cleared two five zero zero feet
 49.04 SK 465 leaving eight zero for two five zero zero feet
 four six five
 08 APP roger
 50 APP scandinavian four six five turn right to heading
 one nine five
 55 SK 465 right one nine five leaving six zero
 50.03 APP roger intercept and follow the localizer
 07 SK 465 thank you
 32 APP scandinavian four six five and reduce to your
 final approach speed as soon as convenient
 39 SK 465 roger four six five will reduce to final approach
 42 APP roger
 45 APP malev seven three one turn right for the localizer
 49 (transmission click heard)
 51.31 APP malev seven three one you are nine miles from
 the runway contact tower one one eight decimal one
 37 MA 731 good night
 38 APP night."

Communication between Kastrup TWR and MA 731 on 118.10 mc/

51.59 MA 731 malev seven three one good evening approaching
 two two left
 52.07 TWR was that air france seven nine five calling
 10 MA 731 negative this is calling good
 afternoon
 15 TWR air france seven nine five will call you back
 with clearance
 17 AF 795 ah roger

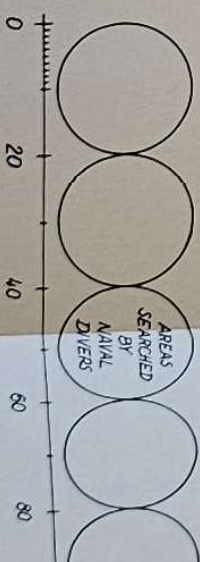
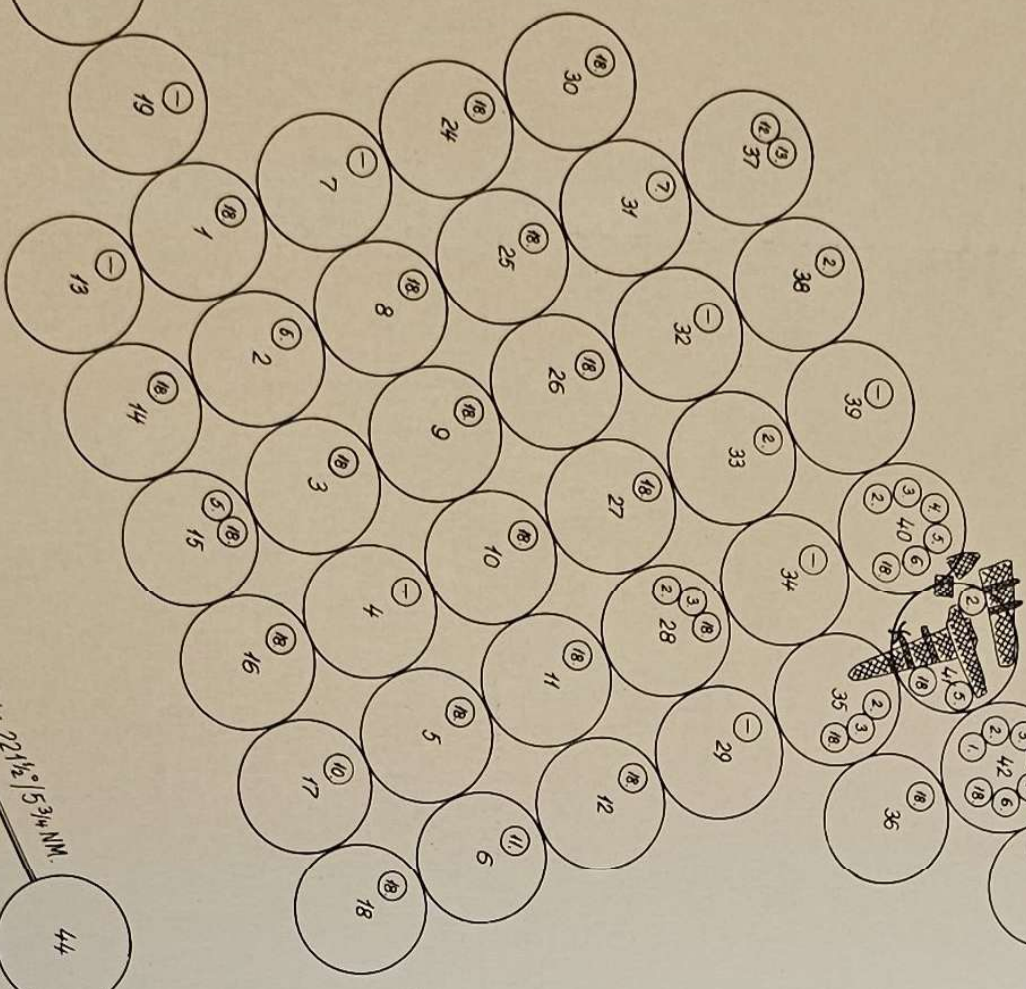
and one one nine three five when airborne
59 TWR air france seven nine five cruising level is
two seven zero but you have to maintain flight
level four zero Falo over
1853.06 AF 795 roger four zero to Falo
08 TWR yeah
1854.03 AF 795 air france seven nine five we are ready to
line up
06 TWR roger seven nine five stand by
09 AF 795 seven nine five standig by
19 TWR malev seven three one confirm you have just
passed abeam sierra alfa
28 TWR malev seven three one
37 TWR malev seven three one Kastrup tower do you read
48 (transmission click heard)
50 TWR malev seven three one Kastrup tower do you read
1855.07 TWR malev seven three one Kastrup tower do you read.



MALEV 731 (REG. HA-MOC)
ACCIDENT IN ØRESUND
ON AUGUST 28, 1971.

Sea depth: Average 4.5 Metres
 Sea current: 0.5 kts. Southward (reversing).
 W/V: 240°/20kts.

- ① Nose Gear Parts.
 - ② Nose Section Parts.
 - ② Radar (Radome) Parts.
 - ② Cockpit Parts.
 - ③ Forward Cabin Parts.
 - ③ Forward Baggage Compartment Parts.
 - ③ Forward Toilet Parts.
 - ④ Main Landing Gear Parts.
 - ⑤ Wing Center Parts.
 - ⑥ Baggage Compartment Parts.
 - ⑥ Main & Rear Cabin Parts.
 - ⑦ Rear Cabin Parts.
 - ⑧ Tail Section Parts.
- (Hydraulic Jack Parts & Abu Parts)
- ⑨ Right hand Wing Parts.
 - ⑩ Left hand Wing Parts.
 - ⑪ Engine No. 1 Parts.
 - ⑫ Engine No. 2 Parts.
 - ⑬ Engine No. 3 Parts.
 - ⑭ Engine No. 4 Parts.
 - ⑮ Right hand Flap
 - ⑯ Left hand inboard Flap spindle Pa
 - ⑰ Left hand outboard Flap spindle Pa
 - ⑱ Passenger Seat Parts.



INSTRUMENTS INVESTIGATED

The following is the report of the investigations carried out on each separate instrument with general comments added to some groups of instruments.

condition of the
defects were found which could not be attributed either
effect of the impact itself or the corrosive attack of the
ter.

us nothing implies that the instruments did not function
to the moment of impact.

Introduction.

The investigation has been requested by the civil danish a
thorities in connection with the crash of aircraft IL-18
-MOC in Øresund near Copenhagen Airport on the 21 August
The purposes of the investigation were:

To collect as much information as possible as regards
figuration and the condition of the aircraft, its eng
systems as expressed by the instrument indications at
of impact.

To ascertain (if possible) the serviceability of the
examined.

all a total of 38 instruments were examined.

Methods.

The following is a short general statement of the methods
ples used in instrument investigations. The specific ob
asurements etc. appear in the report of the separate in
Generally the investigation is divided into the following

Identification.

If possible the component is identified by its type/m
manufacturer, part no. and serial no.

In this case most information was found on the instru
and comprised usually of what was considered to be a
and a serial no.

External inspection.

During this

...they are removed.

External inspection.

After the instrument case is removed the instrument is then inspected under microscope. If necessary it is cleaned, preferably in clean water. In this case corrosion products often obscured the scale and covered mechanism parts. The products were successfully removed using an ultrasonic bath.

Conclusion.

In this phase the facts are summed up and the reliability of the result is considered.

This decision is often very difficult and its validity depends to a high degree on the experience of the investigators.

In this report the following phrases are used:

Arbitrary - This signifies that no indication could be obtained or that the indication could have been anything within the range of the instrument. This is often the case when parts of the instrument is available or when the instrument mechanism is intact and the pointer has no fixed Zero position (f.ex. on synchro, magnesyn and DC-selsyn instruments with return spring).

Insignificant - This signifies that an indication could not be determined but that it is highly improbable that it has any connection with the actual condition - which it should have been - at the moment of impact. This is often the case when the instrument mechanism is intact and has returned to its normal Zero position, or that it has moved out of range due to damage on the instrument mechanism (punctured aneroid).

Very uncertain - This signifies that an indication was obtained or observed, but that it should be used only when reliable facts/observations confirms it. Usually it must by itself - be considered as highly improbable.

Intertain - This signifies that a more reliable indication was determined f.ex. if a pointer indication is confirmed by marks on a gear sector or the condition of the mechanism is such, that it is likely that it was fixed in that position.

- Barometric scale indication on altimeters.
 - Position of adjustable indices (if in mesh).
 - Counter indications (if in mesh or fixed).
 - Two or more instruments measuring the same parameter (f.ex. airspeed) gives same indication.
- and most important:
- Servodriven instruments if the gear train is intact fixed in position.

Concluding remark - It should be noted that the nature of crash is important considering the reliability of the instruments. These are most reliable when the instruments have been subjected to one shock only and may be utterly unreliable when multiple shocks have been experienced.

0-10.000m.

Description: Mechanical aneroid instrument with two pointers (1000 and 10.000m per revolution) and barometric scale in mm Hg.

Condition: Apparently undamaged with small amount of water inside instrument case. Instrument corroded.

Investigation before disassembly: Instrument reading: $\pm 30 \pm 40m$, barometric scale: 754,5mm Hg. Triangular index on scale at 0.

Disassembly: Instrument case removed.

Investigations after disassembly: Instrument scale inspected under microscope and ultraviolet light. No evidence was found which would confirm the instrument reading. The instrument was then cleaned in ultrasonic bath and inspected again. A "shadow" was now observed on the 10.000m pointer at Zero, in all probability due to corrosion caused by the saltwater in the instrument. The instrument mechanism was intact (except for some corrosion) and no evidence of tooth marks etc.) was found which could confirm the reading of the instrument.

Conclusion: The reading of the instrument $\pm 30 \pm 40m$ could not be confirmed and must be considered as uncertain. The barometric scale reading 754,5mm Hg. is practically certain.

2. Altimeter (2. pilot). Right panel.

Manufacturer: BbICOTA

Manufacturer: -

Serial no.: -

Serial no.: 834749

Scale: 0-10.000m.

Description: As item 1. except that the 1000m pointer counter is slightly different.

Condition: Frontglass broken, otherwise apparently undamaged. Corrosion. 1000m pointer loose on axle.

Investigation before disassembly: Instrument reading: 1000m approx. 04 and counterweight

of the aneroid
r sector and aneroid was loose. The
wn to its minimum reading position by a gear wheel hairspr
Conclusion: Regarding the condition of the mechanism, the rea
instrument is insignificant. The barometric scale readin
practically certain.

m 3. Altimeter. Navigators panel.

e: BbICOTA
t no.: -
ge: 0-10.000m.

Manufacturer: -
Serial no.: 942776

cription: As item 1.

Condition: Apparently undamaged with small amount of water
instrument. Instrument corroded.

Investigations before disassembly: Instrument reading appro
n the instrument was rotated the reading changed between
. Barometric scale reading: 753,2mm Hg. Triangular index
0.

Disassembly: Instrument case removed .

Investigations after disassembly: Instrument scale and mech
pected before and after ultrasonic cleaning. No evidence
nd which could confirm the instrument reading observed.
corrosion the instrument mechanism was intact.

Conclusion: Regarding the condition of the instrument, the m
erved is very uncertain. The barometric scale reading is
ly certain.

m 4. Airspeed Indicator (1. pilot). Left panel.

e: CKOPOCTb
t no.: -

Manufacture: -

Investigations before disassembly: The direction of the IAS-pointer determined using the fracture at the hub. The direction pointed to an indication of approx. 850 km/h. The TAS-pointer indication was 250 km/h. but the pointer could be freely rotated.

Investigations after disassembly: Instrument scale inspected before ultrasonic cleaning. No pointer impressions were found. Pointer for TAS-pointer loose on shaft. Gear sector axle for pointer loose. Gear sectors out of mesh with pointer gearwheel.

Conclusion: Regarding the condition of the instrument mechanism, findings indicated must be considered insignificant.

Airspeed Indicator (2. pilot). Right panel.

СКОРОСТЬ

Manufacturer: -

0.: -

Serial no.: 58983

100-1200 km/h.

Description: As item 4.

Conclusion: Rear part of instrument case partly missing. Front glass missing. IAS-pointer broken at pointer hub.

Investigations before disassembly: Instrument scale inspected before ultrasonic cleaning. TAS-pointer indicated approx. 250 km/h. Slight fluoridation around 50 km/h. which might have been caused by IAS-pointer.

Investigations after disassembly: Front flange and pieces of glass removed.

Investigations after disassembly: Inspection of the scale revealed that the tip of the IAS-pointer was pressed against the scale (glass) at a reading of approx. 1075 km/h. (corresponding to 100 km/h. below the 100 km/h. scale point). The pointer part was heavily corroded and fell almost completely to dust when the scale was removed.

After ultrasonic cleaning the instrument mechanism was inspected. The capsule was loose, the connecting rod between the IAS- and TAS- mechanism was loose. No marks were found on the different gearwheels.

range: 100-1200 km/h.

Description: As item 4.

Condition: Frontglass broken, instrument case damaged (partially) behind front flange. Instrument corroded.

Investigations before disassembly: IAS-pointer indicating TAS-pointer at 110 km/h.

Disassembly: Front flange and pieces of glass removed. Instrument mechanism removed from case.

Investigations after disassembly: Instrument scale inspected after ultrasonic cleaning. No pointer impressions found on under UV-light showed a thin fluorescent radial line in the number "10".

IAS-pointer mechanism was practically intact and rested on zero stop. The TAS intermediate shaft was loose, including gear sector.

Conclusion: Considering the condition of the instrument mechanism seems likely that the pointers were moving anticlockwise, when they were stopped by the glass pieces of the frontglass. The indications observed must be considered as insignificant.

Item 7. Airspeed Indicator. Position unknown.

Manufacturer: -

Serial no.: 02405

range: 100-1000 km/h.

Description: Mechanical diaphragm actuated instrument with TAS pointer showing TAS (only pressure compensated) (see item 4. to 6.). No IAS indication.

Condition: Frontglass broken, front flange slightly damaged, static connections missing - including parts of instrument mechanism and scale corroded.

Investigations before

n: pointer evidently rotated approx. 1½ turn before coming
Indication insignificant.

comments to item 4, 5, 6 and 7.

case we have no less than 7 pointers which (theoretically) have identical indications.

There are however only two pointers where this condition is fulfilled. These are the TAS-pointers of item 4 and 5, which both indicate approx. 250 km/h. Regarding the position of these two pointers in the aircraft (left and right panel resp.), there is a possibility, that this indication corresponds to the airspeed impact.

Gyro Horizon (1. pilot). Main. Left panel.

AGB-2 (AGB-2)

Manufacture: -

: -

Serial no.: 704352

Pitch indication: $\pm 80^\circ$.

Roll indication: $\pm 90^\circ$.

Description: Self-contained electrically driven gyro instrument (36 V, 400 Hz) with built-in slip indicator (ball).

Condition: Instrument case rear section damaged. Electrical connections missing. Instrument corroded. Instrument mechanism undamaged. Defects in the rear section and corrosion.

Investigations before disassembly: Warning flag not visible. Airspeed silhouette normal position. Roll indication: 5° right bank. Pitch indication: Pitch bar moves easily up and down. Position correct.

Investigations after disassembly: Instrument case and front section removed.

Investigation of the mechanism (rotor housing, gimbal rings etc.) showed no evidence, according to which the indication of the instrument could be determined. It is assumed that the warning flag is

ge: As item 8.

cription: The instrument is identical to item 8.

Condition: Frontglass missing. Instrument case rear section pressed against mechanism frame, which is slightly deformed. Instrument corroded.

Investigations before disassembly: Warning flag not visible. Pitch bar not visible. Pitch bar silhouette in normal position. Pitch bar not visible. Pitch bar indication approx. 60° right bank.

Disassembly: Instrument case and front section removed.

Investigations after disassembly: The pitch bar was found in position corresponding to approx. 45° dive angle. Investigation of mechanism revealed that both roll stops were bent. The stops could not be moved, but the rotor housing and pitch bar rotated through approx. 45°.

Conclusion: The deformation of the roll stops on the gimbal assembly with almost certainty, that the gimbal ring has struck a fixed stop on the instrument frame, whereby the instrument was precessed violently before coming to rest. The indications observed are therefore insignificant.

10. Remote Attitude Indicator, Standby (1. pilot). Location:

Part no.: -

Manufacturer: -

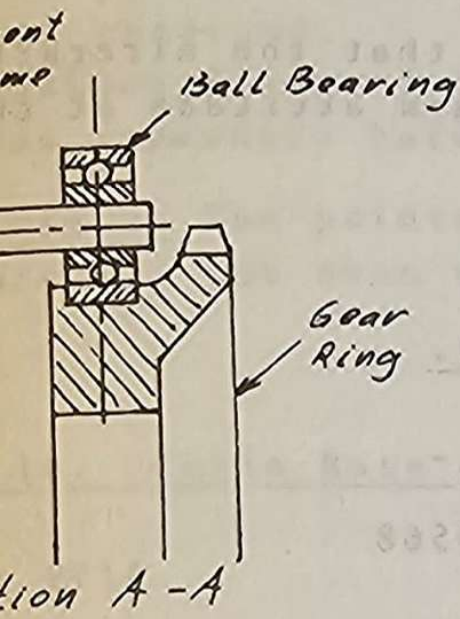
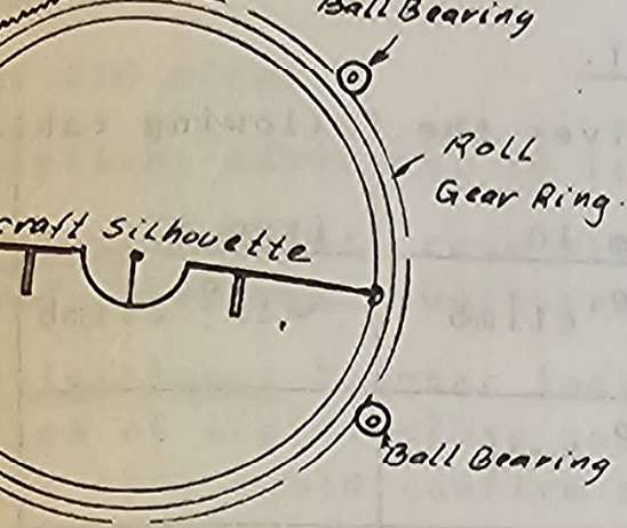
Serial no.: 709853

Range: Presumably ±360° in both pitch and roll.

Description: Two-axis servo-driven Attitude Indicator with circular pitch scale.

Condition: Slightly damaged on rear section of instrument case. Instrument corroded.

Investigations before disassembly: Pitch indication: 6-8° c
Pitch indication: Approx. 35° right bank.
Disassembly: Instrument



groove along the circumference of the gear ring. No deformation of the ring was observed. Inspection of the groove and its edges showed three minor impressions or marks which could have been caused by the ball bearing. When the gear ring was placed in an approx. 0° bank position, these three impressions corresponded exactly to the position of the three ball bearings.

Conclusion: The indication of servomotor driven indicators is generally reliable provided the servomotor gear train is in mesh also after the impact. In this case the pitch indication of approx. 7° climb must be considered as practically certain, whereas the roll indication of approx. 35° is uncertain. It seems likely that the gear ring went out of mesh at the moment it impacted free, and therefore the bank indication of approx. 0° is more likely than the 35° indication.

11. Remote Attitude Indicator, Standby (2. pilot). Right

YF
no.: -

Manufacturer: -
Serial no.: 403710

Pitch: $\pm 30^\circ$.
Roll: $\pm 360^\circ$ (presumably).

Description: Synchro (or DC-selsyn) driven instrument.

Condition: Frontglass missing. Otherwise apparently undamaged with smaller dents in case. Instrument corroded.

Investigations before disassembly: Pitch indication approx. 10° indication: Roll bar moves freely.

...ral comments...
 ...ing up the indications observed gives the following ta

	item 8	item 9	item 10	item 11
h	-	(45° dive)	~7° climb	~10° clim
	5° right	(60° right)	~0° bank	-

...ing from these results it seems likely, that the aircr
 ...ight nose up, and no or a slight right bank attitude at
 ... of impact.

12. Rate of Climb Indicator (1. pilot).

: BAP-30M

Manufacturer: -

no.: -

Serial no.: 69568

e: ±30 m/sec.

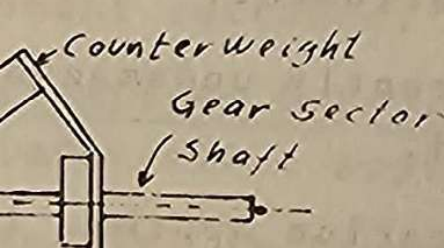
ription: Mechanical diaphragm actuated instrument.

ition: Frontglass, front flange, front section of inst
 missing. Instrument corroded.

stigations before disassembly: Pointer indication: App
 m/sec. (unstable).

sssembly: Instrument case removed.

stigations after disassembly: Inspection of scale befo
 r ultrasonic cleaning revealed no pointer impressions
 ection of the mechanism showed that the gear sector co
 he pointer pinion gear had deflected the pinion shaft
 as the counterweight as shown on the
 The gear sector still meshed with th
 gear, and when rotated to maximum do
 deflection the pointer indi



±30 m/sec.

ption: Identical to item 12.

ion: Complete case missing. Instrument mechanism slightly d. Diaphragm punctured. Instrument corroded.

igations: Pointer indication: ~ ±30 m/sec. (unstable). In on of scale before and after ultrasonic cleaning revealed g that could confirm this indication. A very slight defle of pointer pinion and gear sector counterweight (as on ite s observed.

ximum downward deflection position was difficult to ascer s somewhere between ± 5 and ± 10 m/sec. pointer indication.

sion: The pointer indication seems to have been between ± 5 m/sec., but even this range is rather uncertain.

4. Cabin Rate of Climb Indicator.

BP10

Manufacturer: -

no.: -

Serial no.: 20344

±10 m/sec.

ption: Mechanical diaphragm actuated instrument.

tion: Apparently undamaged but partly filled with water. ent corroded.

igations before disassembly: Pointer indication $\pm 6, \pm 8$ m/sec. er moves according to movement of water.

sembly: Instrument mechanism removed from case.

igations after disassembly: Inspection of scale and mec e and after ultrasonic cleaning revealed nothing that co rm the indication observed. The mechanism was intact exc deformation of diaphragm.

usion: The indication observed must be considered as ins

t.

e: 0-110%.

ription: Dual mechanism. Magnetic drag coupling driven synchronous motor.

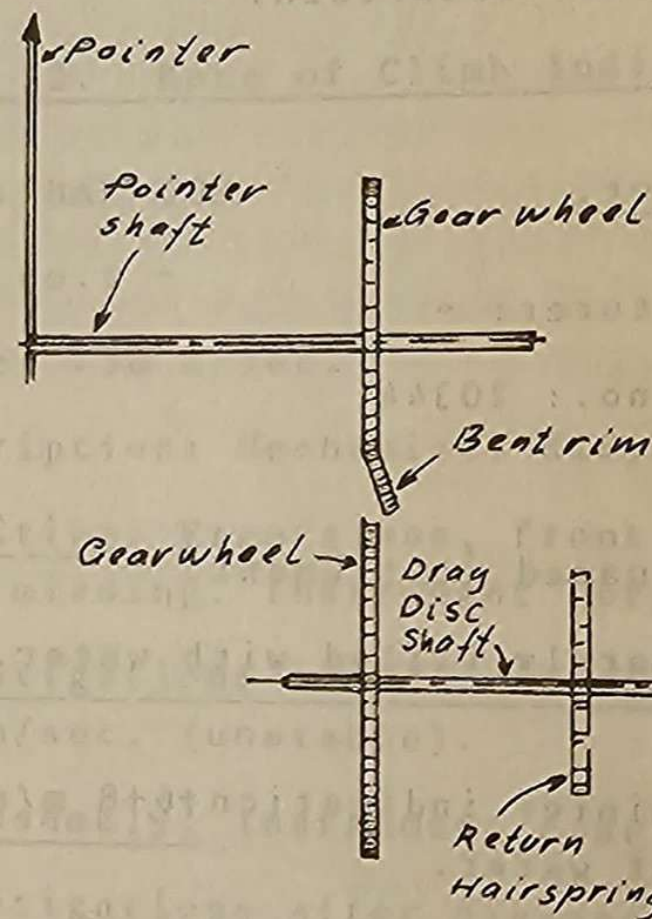
ition: Instrument case dented. Backplate forced backward left mounting lug missing. Slightly corroded.

stigations before disassembly: No. 1 pointer indicated 2 pointer indicated 57%.

sssembly: Instrument case removed.

stigations after disassembly: Inspection of scale revealed evidence which could confirm the pointer indications.

Pointer no. 1 mechanism: Pointer drive shaft gear was b



out of mesh with disc gear. Magnetic disc gear could not rotate freely and returned to a Zero position by the return hairspring. With no. 1 pointer indicated 107%, the maximum deflection of the rim of the drive shaft gear was not in mesh with the normal mesh with the magnetic drag disc shaft. The marks shown on the scale were in fact very close to the 107% position.

Pointer no. 2 mechanism: The gears of this mechanism were in mesh and it seemed to be practically intact. When the return hairspring on the drag disc shaft was cut, it moved approximately 15 degrees corresponding to an indication of approx. 5%. The hairspring seemed completely intact. No marks were found on the gear.

slipped on their shafts. Judging from the condition of the mechanism neither of these seems very likely; but nothing better be found presently.

to this both indications stated must be considered insignificant.

Engine Tachometer Indicator (Engine no. 3 and 4).

50 POT 61, NT 3-2(?)

Manufacturer: -

: -

Serial no.: 02386

0-110%

tion: Same type as item 15.

on: Instrument case rear section missing. Front section intact, frontglass cracked. Instrument corroded.

Indications before disassembly: No. 3 pointer indicated 22%, no. 4 indicated 63%.

Disassembly: Instrument case front section removed.

Indications after disassembly: Inspection of scale revealed no marks which could confirm the pointer indications.

Pointer no. 3 mechanism: Pointer drive shaft gear was out of mesh with drag disc gear. Pointer and drag shaft could be rotated freely. On the pointer gear rim was found a slight forward deflection (as on item 15, pointer no. 1). Adjusting the pointer to the point of max. deflection gave a pointer indication of approx. 45%. No marks which could confirm this indication were found on the teeth of both gears.

Pointer no. 4 mechanism: The two gears were in mesh and could be rotated with some friction. A rearward deflection was found on the pointer shaft gear and by adjusting as described in paragraph 15 an indication of approx. 75% was found. No marks which could confirm this indication were found on the gears. When the rear spring on the pointer drive shaft was cut, it rotated approximately corresponding to a 20-25% indication.

ion:

(iii) 25% based on the
Based on the investigations performed and the condition
mechanism it is not possible to tell which of the indications
that are least unlikely and it should be noted, that the
reference between (iii) and the two other indications cannot
explained properly at present.

- - - - -

General comments to item 15 and 16.

For pointer 1 the indications found are very doubtful
and contradict each other which may be caused by the nature of
more than one impact ?).

Pointers 2 and 4 are adjusted to a position where the hair
spring would have been Zero (both hairsprings are cut) the
indication is approx. 50% instead of 0%. This could have been
caused by pointer, gear or hairspring slippage of approx. 180°, which
is unlikely (there are serrations on the shafts) and as no
satisfactory explanation of this can be given presently.

17. Exhaust Gas Temperature Indicator (Engine no. 1)

Model: GP-XA

Manufacturer: -

no.: -

Serial no.: 03425

Range: 0-900°C.

Description: Millivoltmeter moving coil type instrument with
bimetal cold junction compensation.

Condition: Front ring and -glass missing. Instrument case slightly
damaged. Instrument corroded.

Investigations before disassembly: Pointer indication approx.
500°C.). Pointer moves freely.

Disassembly: Instrument case removed.

Investigations after disassembly: Instrument scale inspected
after ultrasonic cleaning.

100-900° C.

Description: Millivoltmeter type (moving coil) without bimetal compensation.

Condition: Electrical plug missing, otherwise undamaged. Instrumented.

Investigations before disassembly: Pointer indication below 100 after fixed in position.

Disassembly: Instrument case removed.

Investigations after disassembly: Pointer now moves freely. Pointer mechanism out of balance. Indication change from approx. 100 to approx. 500° C. when rotated. Instrument scale inspected before ultrasonic cleaning. No useable evidence found. Inspection mechanism revealed no useable evidence.

Conclusion: The indication observed is insignificant.

19. Exhaust Gas Temperature Indicator (Engine no. 4).

TBF-2

Manufacturer: -

Serial no.: 02526

100-900° C.

Description: Millivoltmeter type (moving coil) without bimetal compensation.

Condition: Apparently undamaged, except for corrosion.

Investigations before disassembly: Pointer indication approx. 100 after moves freely.

Disassembly: Instrument case removed.

Investigations after disassembly: Instrument scale inspected after ultrasonic cleaning. No useable evidence found. Inspection mechanism revealed no useable evidence.

Conclusion: The indication observed is insignificant.

Range: Fuel Flow : 0-1200 kg/h.
Fuel Totalizer: 0-9990 kg.

Description: Dual instrument. One Fuel Flow pointer synchro (brushless type) driven, and a counter driven a pawl mechanism.

Condition: Instrument complete and undamaged except for counter a slightly bent adjusting knob.

Investigations before disassembly: Pointer indication: 8500 kg/h. Counter not visible through glass.

Disassembly: Instrument case removed.

Investigations after disassembly: Counter indication: Between 8620 kg. Instrument scale inspected before and after unmounting. No useable evidence found. Synchro position fixed. Inspection due to corrosion in magnetic damper on synchro shaft. Inspection of mechanism revealed no useable evidence.

Conclusion: The pointer indication is very uncertain as the instrument is mechanically undamaged and no other evidence confirmed. Counter indication must be considered as practically certain.

Item 21. Fuel Flow and Totalizer Indicator (Engine no. 2)

Reference: PTMC 1, 2 - B1
Item no.: -

Manufacturer: -
Serial no.: T32141

Range: As item 20.

Description: As item 20.

Condition: Frontglass (2 ea) missing. Otherwise practically undamaged except for corrosion.

Investigations before disassembly: Fuel flow pointer indication: 8580 kg/h. Counter indication: 8580 kg.

Disassembly: Instrument case removed.

Investigations after disassembly:

As item 20.

ption: As item 20.

ion: Frontglass missing. Pointer slightly deflected. Ot
ndamaged except for corrosion.

igations before disassembly: Fuel flow pointer indicati
/h. Counter indication: 8575 kg.

sembly: Instrument case removed.

igations after disassembly: Instrument scale inspected
ter ultrasonic cleaning. No useable evidence found. Fue
r fixed on shaft. Synchro position fixed due to corrosi

sion: Pointer indication very uncertain. Counter indica
cally certain.

3. Fuel Flow and Totalizer Indicator (Engine no. 4).

PTMC 1,2 - 51

Manufacturer: -

o.: -

Serial no.: TE0771

As item 20.

ption: As item 20.

ion: Electrical plug missing. Otherwise practically un
for corrosion.

igations before disassembly: Fuel flow pointer indicat
kg/h. Counter indication: 8590 kg.

sembly: Instrument case removed.

igations after disassembly: Instrument scale inspected
fter ultrasonic cleaning. No useable evidence found. F
er fixed on shaft. Synchro position fixed due to corro

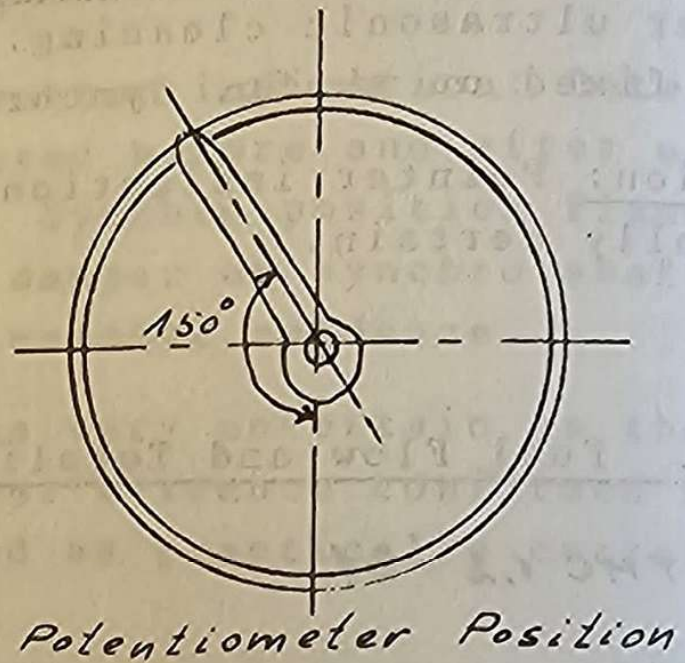
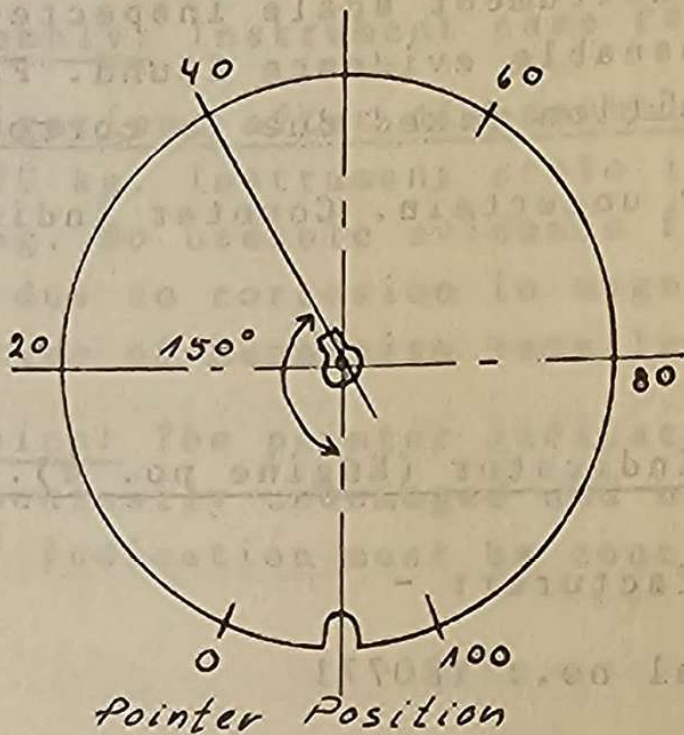
usion: Pointer indication very uncertain. Counter indi
cally certain.

Scale: Dual scale: Inner: 0-8000 kg.
Outer: 0-100 (presumably %).

Description: Servodriven instrument.

Condition: Instrument case including frontglass missing. Pointer bent near hub. Instrument corroded.

Investigations: Pointer directed against approx. 40 (outer scale). Inspection of scale revealed no useable evidence. Inspection of mechanism showed that the gear train from servomotor to potentiometer was intact.



The potentiometer was intact and its position could be determined corresponding to the pointer deflection.

Conclusion: The indication determined (40% or approx. 3200 kg) is considered as practically certain.

25. Fuel Quantity Indicator. (Left or right?).

Part no.: C3TC-280

Manufacturer: -

no.: -

Serial no.: NTV 0345

Reference: As item 24.

Description: As item 24.

27. Fuel Control Lever Position Indicator. (Engine no. 1 a

UPRT-2

Manufacturer: -

Serial no.: 50273

0-115 (units ?).

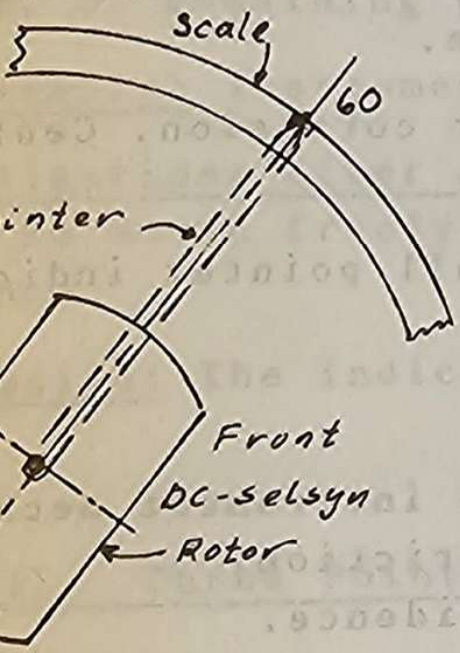
Description: Dual pointer instrument, driven by (presumably) a DC-selsyn system.

Condition: Electrical connector missing. Otherwise practically good except for corrosion.

Investigations before disassembly: Indications observed. Pointer 2: 60.

Disassembly: Instrument case, pointers and scale removed.

Investigations after disassembly: Inspection of the front Selsyn showed that pointer 2 was aligned along symmetry axis of the rotor as shown on sketch. Inspection of the rear Selsyn showed that this was not the case for pointer 1.



Inspection of the scale revealed no evidence.

Conclusion: The indications observed not confirmed by other evidence and considered as uncertain.

27. Fuel Control Lever Position Indicator. (Engine no. 3

UPRT-2

Manufacturer: -

Serial no.: 51033

no.: -

As item 26.

Description: As item 26. Electrical connector loose. Otherwise practically good.

pointer 3 (as item 26 pointer 3)
section of the scale revealed no useable
Conclusion: As for item 26 the indications observed must be
as uncertain.

Item 28. Three Pointer Indicator. (Engine no. ?).

Part no.: YK3-3

Manufacturer: -

Part no.: -

Serial no.: 50480

- Range: Central scale : 0-100 kg/cm .
- Left small scale : 0-10 kg/cm .
- Right small scale: $\pm 50 - +50^{\circ} \text{C}$.

Description: Triple pointer instrument. The central scale
(presumably) Fuel Pressure, the left side scale
(presumably) Oil Pressure and the right side scale
(presumably) Oil Temperature. All three instrument
mechanisms are of a ratiometer type.

Condition: Practically undamaged except for corrosion. Center
pointer missing.

Investigations before disassembly: Left small pointer ind
ication: $\pm 50^{\circ} \text{C}$.

Disassembly: Instrument case removed.

Investigations after disassembly: All three instrument me
chanisms would be moved freely with practically no friction.
Inspection of scales revealed no useable evidence.

Conclusion: The indications observed are insignificant.

Item 29. Three Pointer Indicator. (Engine no. ?).

Part no.: YK3-3

Manufacturer: -

Part no.: -

Investigations after disassembly: All three instrument mechanisms can be moved freely. Inspection of scales revealed no useable information.

Conclusion: The indications observed are insignificant.

30. Three Pointer Indicator. (Engine no. ?).

Part no.: YK-3
Manufacturer: -
Serial no.:

Condition: As item 28.

Description: As item 28.

Condition: Frontglass cracked. Frontring, right small pointer missing. Center pointer partly missing. Instrument corroded.

Investigations before disassembly: Left small pointer indication: 0. Remaining part of center pointer: Vertically downward.

Disassembly: Instrument case removed.

Investigations after disassembly: All three instrument mechanisms can be moved freely. Inspection of scales revealed no useable information.

Conclusion: The indications observed are insignificant.

31. Three Pointer Indicator. (Engine no. ?).

Part no.: YK3-3
Manufacturer: -
Serial no.: 90216

Condition: As item 28.

Description: As item 28.

Condition: Practically undamaged except for corrosion. Left small pointer missing.
Disassembly: Center pointer indication:

2N-100

Serial no.: 80031

no.: -

Range: Two scale (left and right): 0-100 kg/cm.

Description: Dual instrument. Both instrument mechanisms ratiometer type (as item 28).

Condition: Practically undamaged except for corrosion.

Investigations before disassembly: Indication of both pointers arbitrary (both pointers moves when instrument is moved).

Disassembly: Instrument case removed.

Investigations after disassembly: Both instrument mechanisms moved freely. Inspection of scales revealed no useable evidence.

Conclusion: Indications arbitrary.

Item 33. Torque Pressure Indicator. (Engine no. 3 and 4).

2N-100

Manufacturer: -

no.: -

Serial no.: 60223

Range: As item 32.

Description: As item 32.

Condition: Practically undamaged except for corrosion.

Investigations before disassembly: Both pointers below 0.

Disassembly: Instrument case removed.

Investigations after disassembly: Both pointers fell off (mechanisms wrongly corroded). Both mechanisms could be moved freely. Inspection of scale revealed no useable evidence.

Conclusion: Both indications are insignificant.

Item 34. Right

Disassembly: Pointer indication: Arbitrary.

Assembly: Instrument case removed.

Investigations after disassembly: Instrument mechanism could be moved freely. Inspection of scale revealed no useable evidence.

Conclusion: Indication arbitrary.

35. Left Landing Gear Position Indicator.

W-48

Manufacturer: -

no.:

Serial no.: 21837

As item 34.

Condition: As item 34.

Condition: Apparently undamaged except for broken connector.

Investigations before disassembly: Pointer indication: Arbitrary.

Assembly: Instrument case removed.

Investigations after disassembly: Instrument mechanism could be moved freely. Inspection of scale revealed no useable evidence.

Conclusion: Indication arbitrary.

36. Flaps Position Indicator.

Y3A-47

Manufacturer: -

no.:

Serial no.: 14629

Angle: 0-45°.

Description: Single pointer instrument driven by (presumably) a DC-selsyn system (as item 34).

Condition: Apparently undamaged except for corrosion.

Investigations before disassembly: Pointer moves (erratically) when instrument is rotated.

Assembly: Instrument case, pointer and scale removed.

Description: Single pointer instrument
radiometer type (as item 28-31).

Condition: Instrument case dented, frontglass cracked. Other parts damaged except for corrosion.

Investigations before disassembly: Pointer indication: Apparent pointer apparently fixed in position by pieces of glass.

Disassembly: Instrument case removed. Pointer and scale removed.

Investigations after disassembly: Instrument mechanism cannot be operated. Inspection of scale revealed no useable evidence.

Conclusion: The indication observed is insignificant.

Item 38. Radio Altimeter (1. pilot). Left panel.

Part no.: YB-57

Manufacturer: -

Part no.: -

Serial no.: 27454

Range: 0-600 m.

Description: Single pointer instrument driven by a moving magnet mechanism.

Condition: Frontglass missing. Instrument case deformation. Instrument corroded.

Investigations before disassembly: Pointer indication: Below zero.

Disassembly: Instrument case removed.

Investigations after disassembly: Instrument mechanism could not be operated. Inspection of scale revealed no useable evidence.

Conclusion: The indication observed is insignificant.

LØSE.

Sample of: Filter, dirt from Governor splines and Oil s

From: The Directorate of Civil Aviation, Delivery date: 20/9 71.
Accident Investigation Department.
The Directorate of Civil Aviation's letter xx.511.264 of the 15th. Se

Subject: Content of dirt and the viscosity of the oil.

test performed by: KSC/NP

Sample mrk. IV Eng. Oil Filter:

quantity taken out of the dirt by lye: 4 ml.
dirt contents: about 65 g.
chloride content in dirt: 1,5%

The dirt consists of Al_2O_3 easily dissolved in 4N hydrochloric acid, and
the aluminium flakes. No metal flakes or iron content are contained in
the dirt. Very few grains of quartz.

The filter must be characterized as plugged.

Sample from the oil system mrk: Starter generator, governor splines, pos. 2

The dirt consists of Al_2O_3 easily dissolved in 4n hydrochloric acid.

Sample mrk: Coarse fuel filter eng. IV.

Dirt contents: about 4 g. Al_2O_3 with individual grains of quartz.
Large chloride contents.

metal flakes.

Al_2O_3 is much more difficult to dissolve than the dirt in 1 or 2, and has
certainly originated by corrosion during the time the aircraft has been
floating in the water.

The filter is only plugged up to an unappreciable degree.

Sample mrk: Governor Filter 2.

Viscosity at 100°F 47.7 c St
Viscosity at 210°F 5.25 c St.
Content of metal flakes about 290 mg. per litre (see fig.)



Enlargement

have been brought about during

(signed) E. Repstorff Holtveg

Leader of Flight Technical
Departments Material Section

... taken out of the dirt by ...
... about ...
... content in dirt ...

... consists of Al_2O_3 easily dissolved in hydrochloric acid, and
... calcium flakes. The small flakes of iron contents are contained in
... Very few grains of quartz.
... must be characterized as planned.

... the oil system with greater separator, governor applier, and
... consists of Al_2O_3 easily dissolved in hydrochloric acid.

Work (course) filter egg. V.

... about 1-2% Al_2O_3 with individual grains of quartz.
... chloride contents.

... much more difficult to dissolve than the dirt in 1 or 2, and has
... originated by corrosion during the time the aircraft has been
... in the water.

... is only divided up to an appreciable degree.
Work (course) filter egg. V.

... at 100°C
... at 210°C
... of small ... about 100 mg per liter (see 114.)



Enlargement

Directorate of Civil Aviation

Delivery date: 20-9-71

Accident Investigation Department

Directorate of Civil Aviation's letter xx.511.264 of the 15th. Sept. 1971.

Contamination and full spec. test.

test performed by: GA/HJ/NK

2. Fuel Fine Filter 2.

The fuel was contaminated by particles of quartz, fiber, flakes of rust and metal particles of up to 100 micron.

Contents: 2,74 mg/l.

3. Fuel Fine Filter 3.

The fuel was very contaminated by particles of quartz, fiber, metal particles and particles of an undeterminable kind.

Contents: 18,8 mg/l.

4. Fuel from ENG. 4 FCL.

The fuel was a very strong yellow.

Presumed to contain oil.

Gum content 35,4 mg/100 ml.

5. L4 Wing Tank 4 consisted of about 99% water (salt water) and about 1% fuel.

(signed) E. Repstorff Holtveg
Leader of Flight Technical
Departments Material Section.

The procedure used during the investigation.

Report

Investigation of the contents of the information contained in communication between the flight control in Kastrup Airport and the crew in the aircraft HA-MOC on the 28th. August 1971.

Ordered by: Accident Investigation Branch

Directorate of Civil Aviation

Codanhus

Gl. Kongevej 60

1850 Copenhagen V.

Introduction.

The accident commission laid down in view of HA-MOC's accident during the flight from Oslo to Copenhagen (route no. MA 731) on the 28th. August 1971 has asked the Acoustical Laboratory to investigate the registration of the magnetic band recording the communication between the flight controller and the crew of HA-MOC.

The aim of the investigation is, if possible, to bring to light information, which can illuminate the sequence of events around the time of the crash better than listening to the communication is able to do.

At the disposal of the accident commission during the investigation are magnetic tape registerings of the relevant sections of the communications between HA-MOC and the flight controllers in Kastrup, partly from the time around the accident, and partly just before the landing of the aircraft in Kastrup on the 28th. August 1971 at 1440 GMT (route no. MA 730).

The procedure used during the investigation.

licated electrical signal. The results
paper cover a period of about 3 seconds and are called sonagrammer.
It has been considered whether the use of both normal frequen
analysis and statistical analysis of the content of the signals for
individual frequency intervals could be used but it is thought to b
doubtful as to whether the results of these two methods of analysi
could be usable, when the large content of meaningless noise is tak
into consideration.

As both the airport's band stations and the radiophonic commu
cation limit the transmitted signal to the range of 300-3000 c/s, a
ter which removes signals in the frequency range below 150 c/s has
used in the laboratory analysis.

On the basis of listening to communications on the control to
frequency of 118.1 MC/s, some sonagrammes, each 3 seconds long, wer
made of all important parts of the tower's communications with MA
and a French aircraft, route no. AF 795, around the time of the ac
dent. Furthermore, sonagrammes have been made of some sentences fro
the tower's conversation with MA 730 between 1436 and 1440 GMT on
28th. August 1971.

16 sonagrammes have been chosen from those which formed the
for the observations which have been accounted for in the section,
results of the investigation".

The results of the investigation.

The 16 sonagrammes are examined in chronological order in a
scale of about 1:2 in index 1-4.

Wording in the communication.

On each sonagram the laboratory's interpretation of the mess
been noted so that letters and sound, as far as possible, are by t
corresponding section of the sonagram. The text is given in two li
out of regard for clarity, when one speech-sound is used in two c

9 ma731 ←1 malev seven three one good evening approach-
ing two two left 1→

7 twr ←2 was that air france seven nine five calling 2→

0 ma731 ←3 negative this is 3→ ←4 calling good
afternoon 4→

5 twr ←5 air france seven nine five will call you back ←6
with clearance 5→

7 af795 ah roger

8 twr ←7 malev seven three one continue approach 6→

0 ma731 7→
continue

1 twr air france seven nine five is cleared to Orly
amber nine level two seven zero Falo two two
departure maintain flight level four zero to
Falo contact Kastrup departure one one nine
decimal three five when airborne

+1 af795 ←8 roger air france seven nine five cleared to
Paris 8→ Orly via amber nine level two seven zero
Falo departure two two maintain two zero zero
and (voice from cockpit: Michaelsdorf at two
seven zero) ah Michaelsdorf at two seven zero
and one one nine three five when airborne 9→

59 twr ←9 air france seven nine five cruising level is
two seven zero but you have to maintain flight
level four zero to Falo over

06 af795 roger four zero to Falo

08 twr yeah

←10 air france seven nine five we are ready to

354¹⁹ twr malev seven three one
passed abeam sierra alfa

854²⁸ twr malev seven three one

854³⁷ twr ←11 malev seven three one Kastrup tower do yo

854⁴⁸ ←12
(transmission click heard)

854⁵⁰ twr ←13 malev ¹²→ seven three one Kastrup tower do yo

436 ma730 ←14 malev seven three zero good afternoon sev
miles out 15→ 14→

twr malev seven three zero good afternoon con
approach

ma730 continue
16→

twr jat three six seven you are cleared in fo
parking one two one decimal niner

ju367 one two one decimal niner good day

twr day

twr oscar tango romeo cleared for take-off.

otr cleared for take-off tango romeo

twr malev seven three zero cleared to land tw
left surface wind two three zero two zero

ma730 land two two left

1440 twr malev seven three zero landed four zero c
right off contact Kastrup parking one two
decimal niner

The voice is reproduced mainly between 300 c/s and 1500 c/s.

The speech is mixed with loud noise, which can be both acoustic noise in the aircraft and noise in connection with the radio communication. It should be mentioned that we are informed that in HA-MOC carbon microphones are used. This type of microphone has a rather large modulation distortion, which can cause that on some of the signals registered in the frequency range 1500-3000 c/s can be noise that occurs in time with the speech.

At the end of the message there appears a cut-off click consisting of two impulses (vertical strokes on the sonagram) at a distance of 5 mS.

sonagram no. 2.

The voice is reproduced in the major part of the transferred frequency range of 300-3000 c/s. The sonagram shows a better reproduction of the speech and gives a better analysis than sonagram no. 1.

The sonagram furthermore shows that the tower also gives a cut-off click, but that this has a different appearance than that which is given by HA-MOC. It consists of three impulses at a distance of 20 and 10 mS. The middle impulse has a woolly structure.

sonagram no. 3 and 4.

Two voices are heard, speaking simultaneously. The speech is overriden by a strong tone on a frequency of 3100 c/s. The tone originates presumably from interference between the carrier waves for the two radio transmitters which are operated simultaneously. The voice which is heard clearest, is reproduced in the majority of the transferred frequency range.

It has not been possible to interpret the whole of the message which is given in the voice which is heard most clearly, even if the tone is eliminated by using a filter. The first three words are

Furthermore, one person
am no. 4 with the words: "good afternoon", which MA 731 some second
earlier used "good evening".

sonagram no. 5.

Call from the control tower, which shows the same characteristic
with regard to the reproduction and the cut-off click as sonagram
no. 2. The word "will" (see translation) has hardly been said.

sonagram no. 6.

The sonagram contains the last part of the call-up which is tra
ced in sonagram no. 5 and the first part of the control tower's call
MA 731.

In the first second of the call to MA 731 the speech is overrid
a tone with a frequency of about 1300 c/s and its 2nd. harmonic of
out 2600 c/s. The tone presumably originates by interference between
the carrier waves of the two radio transmitters which are operated
simultaneously.

The last part of the call-up (see sonagram no. 7) shows both by
listening and by observation of the break-off click that it is the
control tower's call-up which is the dominant. It would be natural,
the depressed call-up originated from AF 795 but the flight radio se
e's interpretation of AF 795: "ah rodger" is not found on the mag
ic tape.

sonagram no. 7.

About 0.7 seconds after the control tower's confirmation to MA
that the approach can be continued speech is heard for about 0.2
seconds. The message cannot be made out but seems to be part of a wo
sentence. It is mainly reproduced in the frequency range 300 c/s
0 c/s and the voice sounds like the voice which had been

gram no. 8.

The sonagram shows AF 795's receipt for clearance. A comparison of that part which includes the words "france seven niner five" with sonagram no. 4 makes it probable that the dominant signal on sonagram 4 originates from AF 795.

gram no. 9 and 10.

These are mainly included in order to illustrate the characteristics of AF 795's break-off clicks: some few spread impulses ending two impulses at a distance of about 130 mS.

gram no. 11 and 13.

The sonagrams show two identical call-ups to MA 731 from the control tower after radio contact has been lost with MA 731. A rather poor degree of reproduction both as regards the speech signal and the method of analysis.

gram no. 12.

Between the 3rd. and 4th. vain call-up to MA 731 from the control tower a transmission click is heard in the flight radio service intercom at 185448. This is apparently about 1 second after the beginning of the sonagram. The signal contains about 0.2 seconds speech which is reproduced in the majority of the frequency range 300-3000 c/s. The frequency distribution of the speech, the character of the voice and the characteristics of the break-off click seems to show, that there is no question of an attempt by MA 731 to communicate, but an unintentional activation of the transmitter from the control tower.

The last part of the sonagram shows the beginning of the 4th. call-up in vain to MA 731.

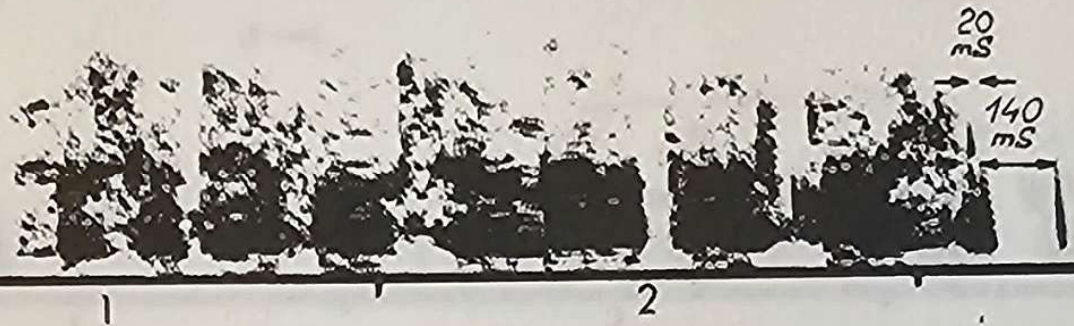
Sonagram no. 16.

The possibility, that the message at 185220 from MA 731 is or a receipt for permission to continue approach (e.g. "continue") do not seem to be confirmed by sonagram no. 16.



2

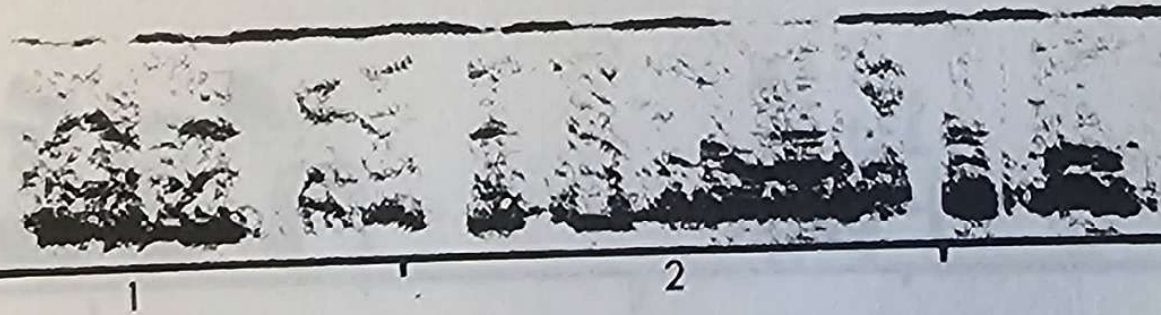
was that ai-r france seven niner five coll-ing



3

nega-tive this is

2 →



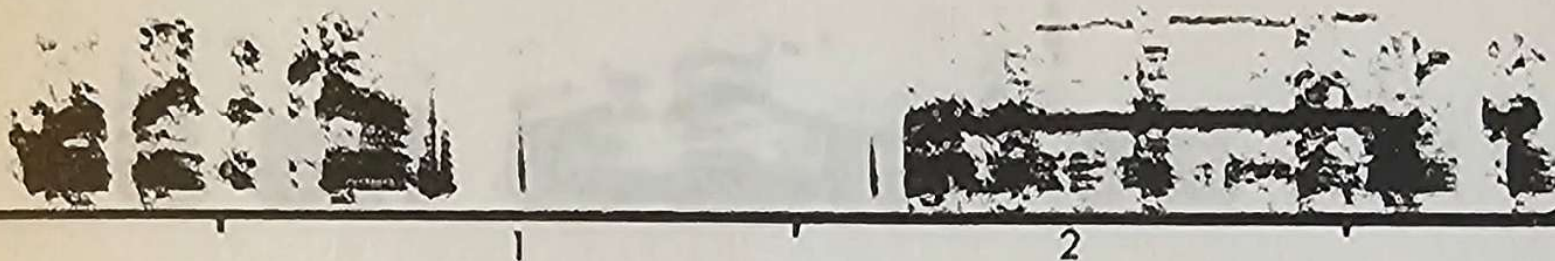
2



call back with clearance

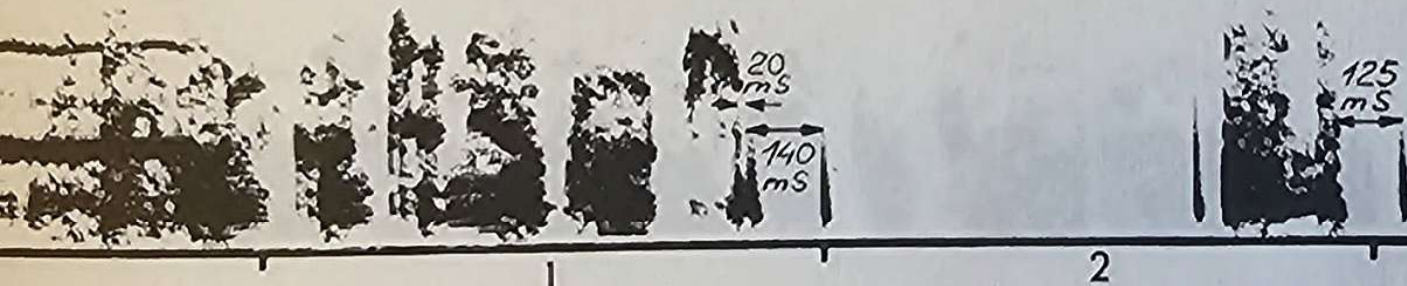
ma-lev seven three one con-

5 →



one con-tin-ue a-pproa-ch

6 →

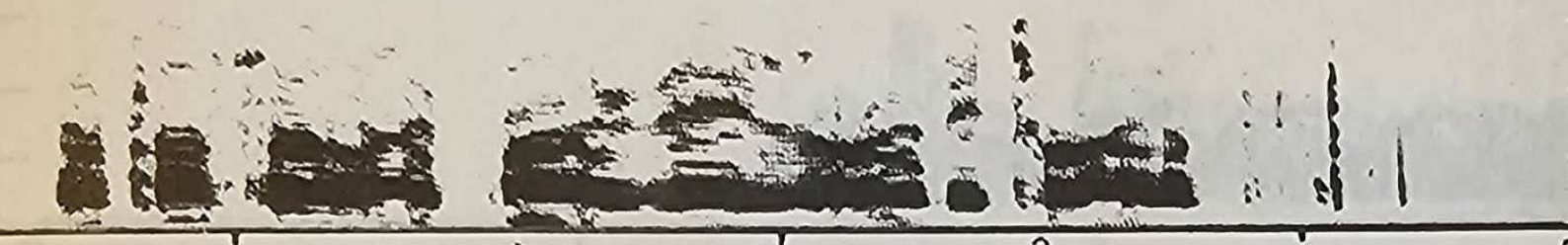




2

10

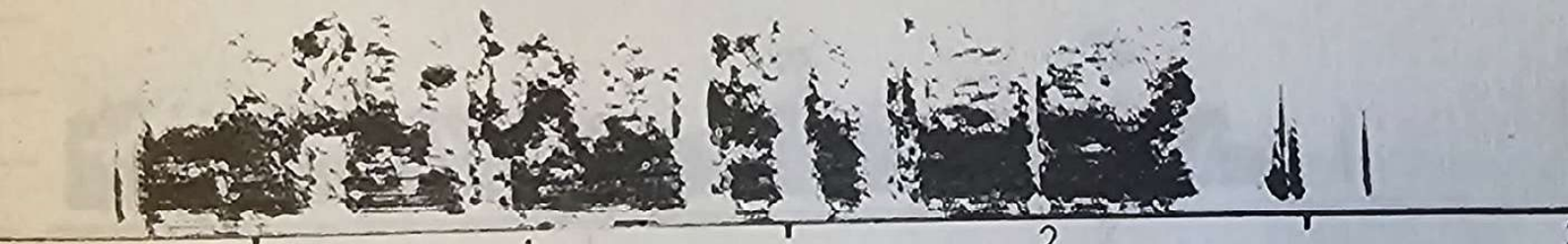
air france seven niner fiv-e l-s- rea- dy to line up



2

11

ma-lev s-even three one kast-rup tower do read
you

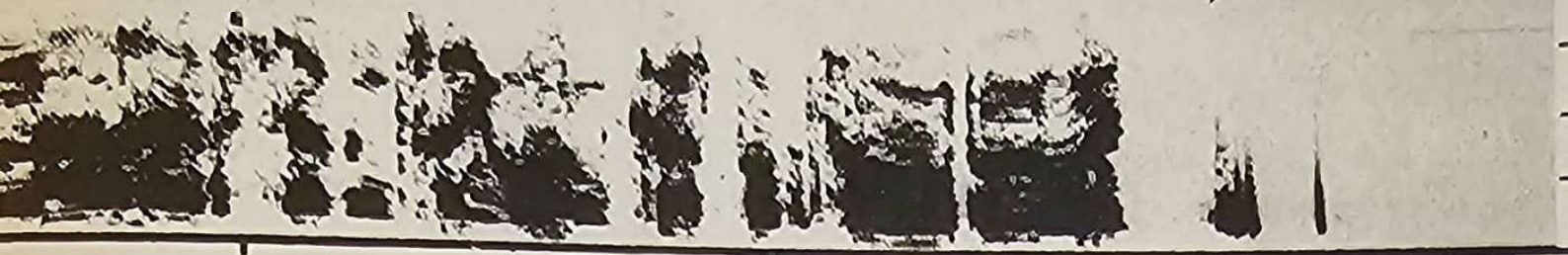


2

12

ma-lev seven

...up tower do you read



2

14

malev s-even three zero good-of



2

15

ree zero good-after noon s-eve-n mile-s out

14 →

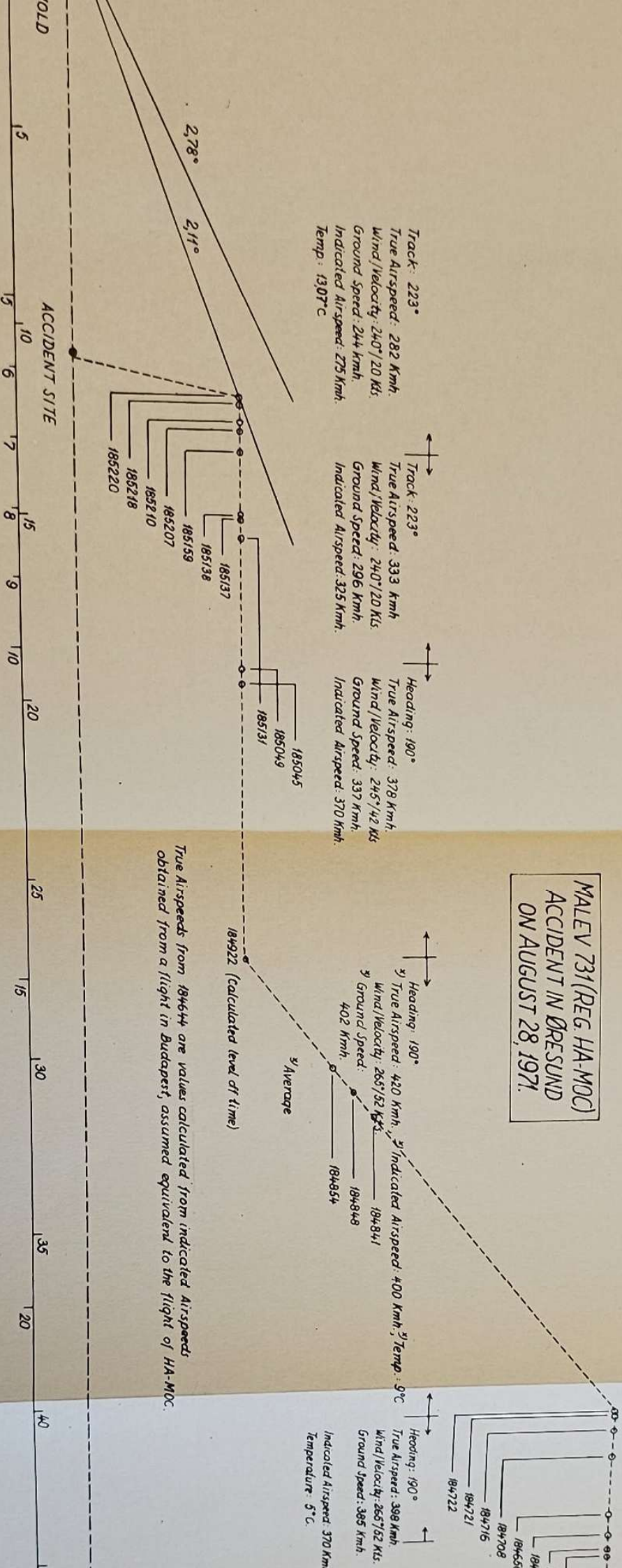


2

16

continue

**MALEV 731 (REG. HA-MDC)
ACCIDENT IN ØRESUND
ON AUGUST 28, 1971.**



True Airspeeds from 184644 are values calculated from indicated Airspeeds obtained from a flight in Budapest, assumed equivalent to the flight of HA-MDC.

is type aircraft to be taken by the crew prior to take-off and landing" received from the Airline Company, the following items are to be checked before landing, and before a ditching being performed:

"Before starting approach-to-land.

- Study - the approach and airport charts and crew must be ready to start approach.
- Set - directional system selector switch into GPK position/prior descending.
- Calculate - navigational data of approach and landing.
- Check - the proper tuning of ADF's on frequencies of LO and LM if applicable.
- Check - the functioning of ILS system or the electrical zero of PSzP and that PSzP tumble is set into SzP-50 /Matyerik / position.
- Check - that nosewheel control switched off.
- Release - undercarriage down and check the "off" position of parking brakes / according to pressure indicators and signal lamps.
- Switch off - cabin pressure system."

"Prior to approach to land:

- Cross check - GPK-52 and KSz-6 instruments
- Turning - KSz directional system into GPK position /before starting descend/
- Tuning - ADF's to the relevant locator stations
- Calculate - the necessary data for landing /wind direction, descending speed, time calculations, etc

shall be carried on board.

When the flight is conducted in a distance of more than 1000 miles away from the shore additionally the following survival equipment shall be carried on board:

- SzP-12 life-raft for group accommodation and LASz-5M2 life-raft
- Distress and communication equipment
- Reserve food and medicines
- Seawater desalt device
- Fluorescent liquid for colouring the water surface to facilitate

the more expeditious discovery of passengers and crew.

Note: Flight crew members shall be quite familiar with the disposition of the survival equipments, their construction and the instructions for use.

In emergency case every action of flight crew members shall be well-considered which they may improve during special practice.

2. Upon deciding the ditching the pilot-in-command shall advise the crew members about this and shall instruct the passengers to be ready for landing.

As instructed by the pilot-in-command the cabin attendants and other crew members shall control the fastening of the passengers and help them in preparing for landing as stated in the emergency landing instruction.

3. Prior to reaching the water surface the pilot-in-command shall instruct the crew members to prepare the group rescue facilities and release them into the water and dehermetize.

4. Flight crew transmits the S.O.S. signal, repeating it on 121.5 MHz for ships.

After S.O.S. signal transmitted crew shall communicate the emergency signal on alarm and report his location by radio.

5. In case of ditching

Flattening out shall perform at a height of 8-10 m.

The emergency landing on the water surface shall be as far as possible performed at minimum speed taking good care the aircraft not to vibrate.

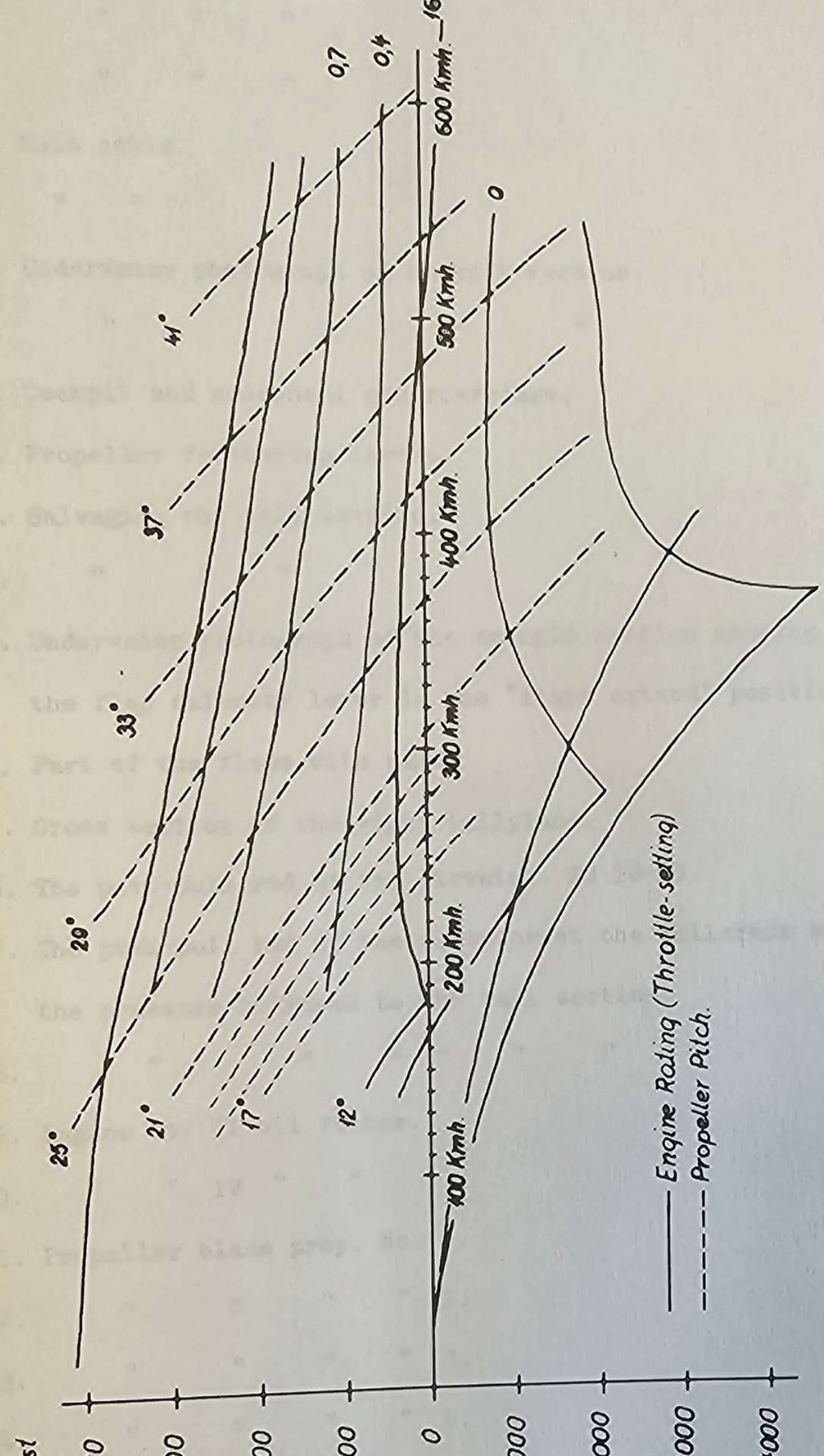
At ditching the aircraft shall be in normal landing position and the control stick shall be quite rear.

After landing when the aircraft has come to rest the crew members shall organize the evacuation of passengers according to instructions.

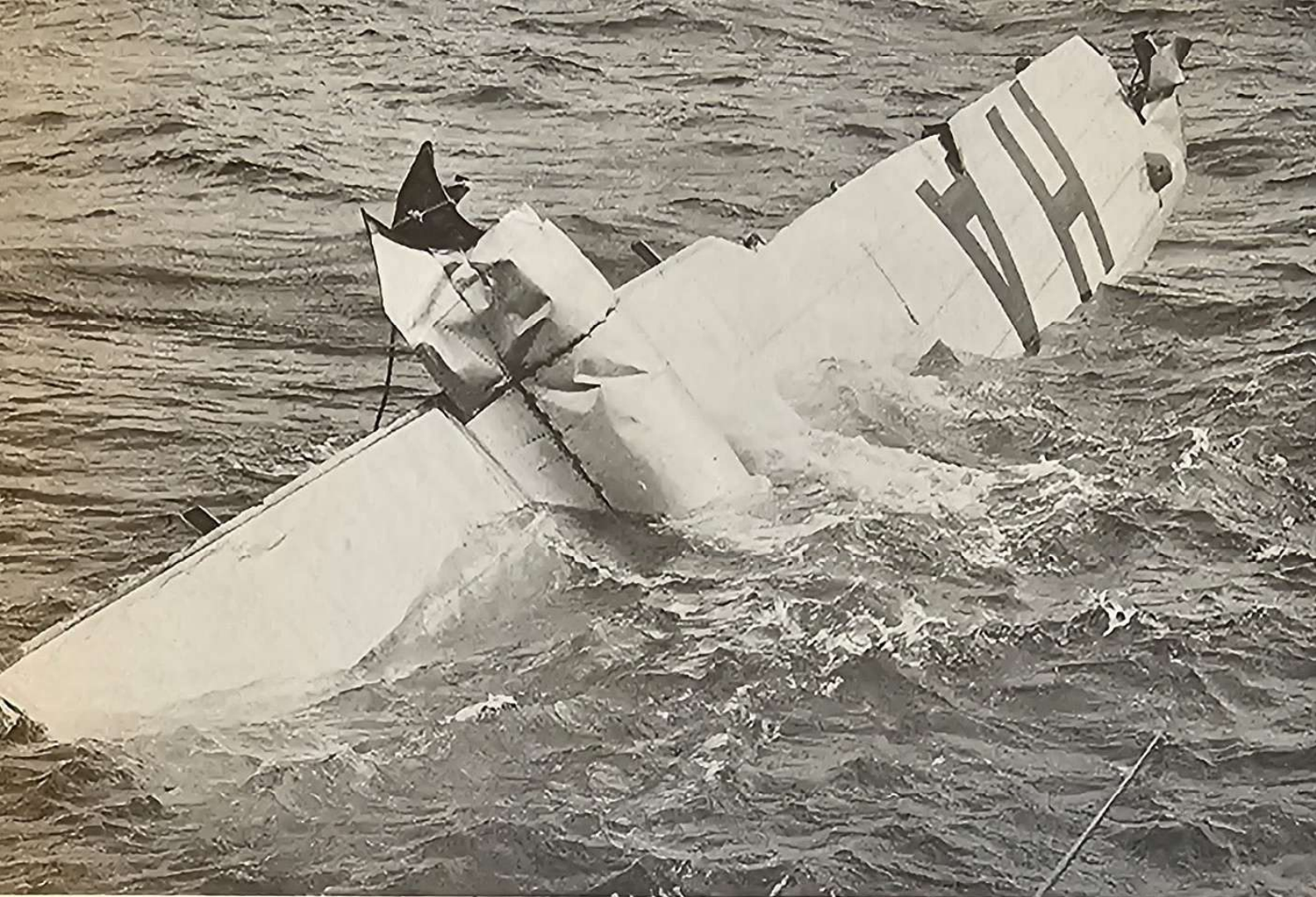
At night emergency landing the search lights shall be switched on at a height of 100-150 m and full attention shall be paid to the flattening out before reaching the water surface taking care of no dash against the water and that no loss of the speed.

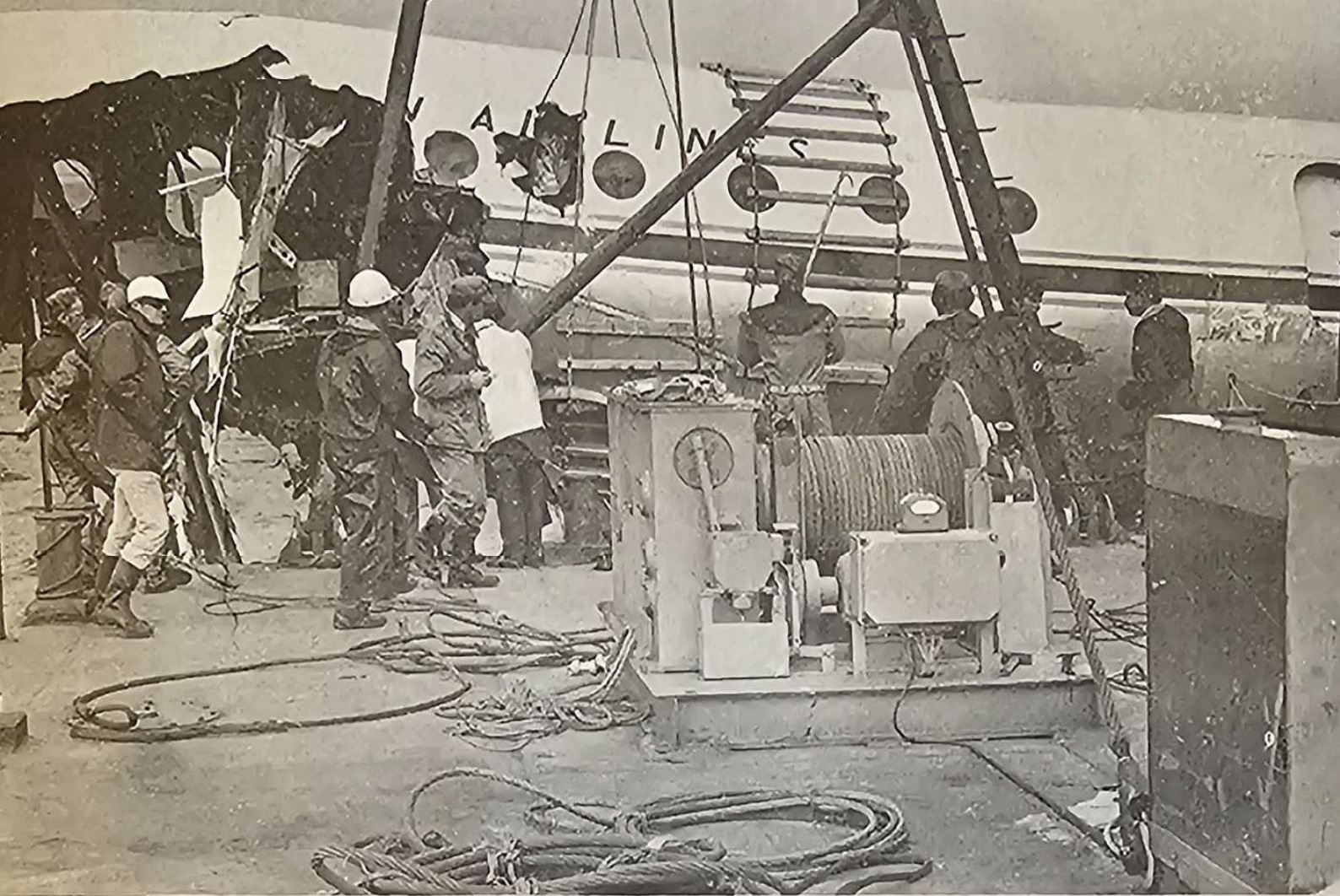
Notice: In fog or in clouds search lights shall not be switched on.

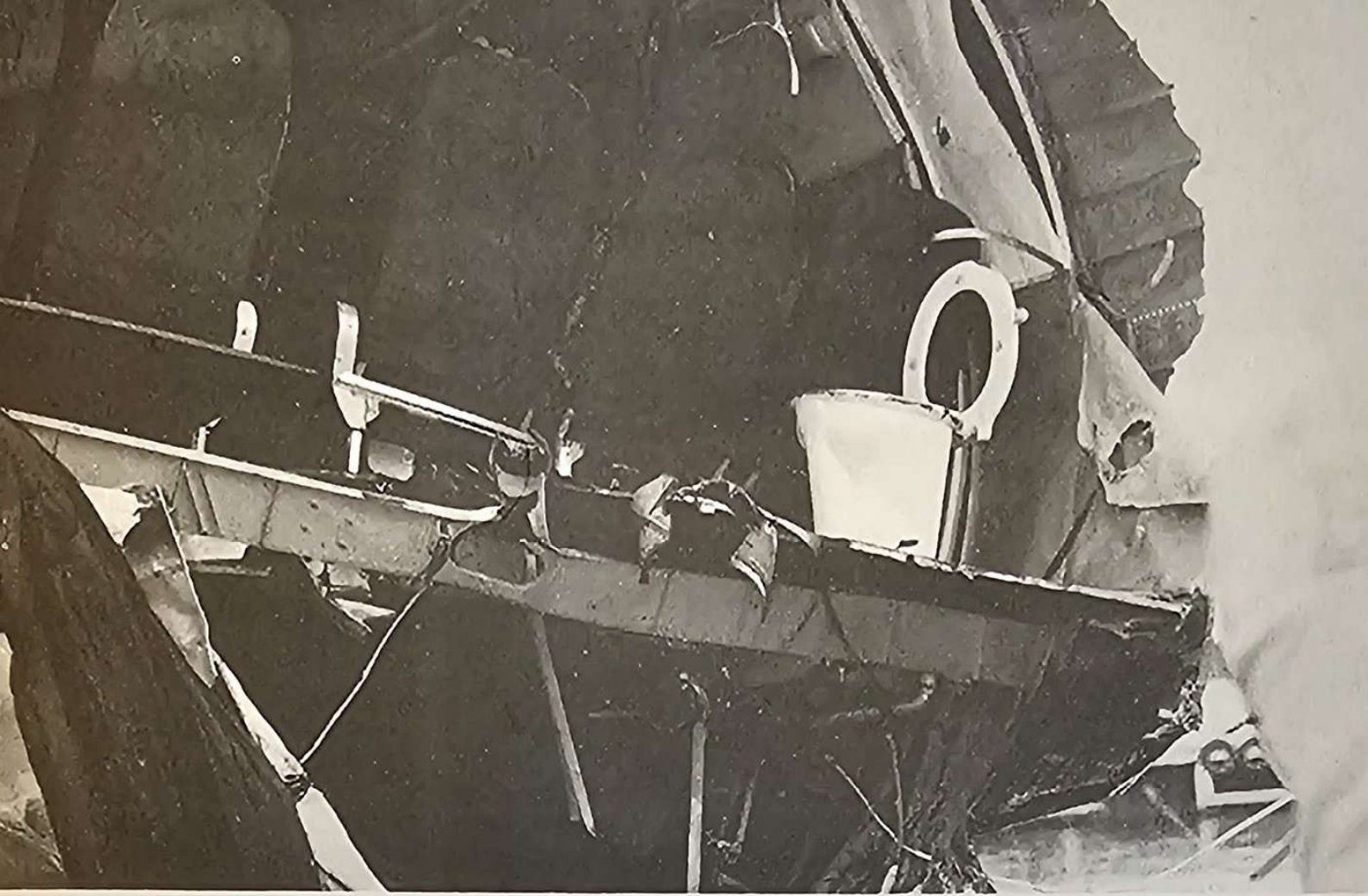
In complicated weather conditions when the visibility is poor or no visibility/ an instrument landing shall be carried out at rate of descent 0,5 - 1 m/sec."



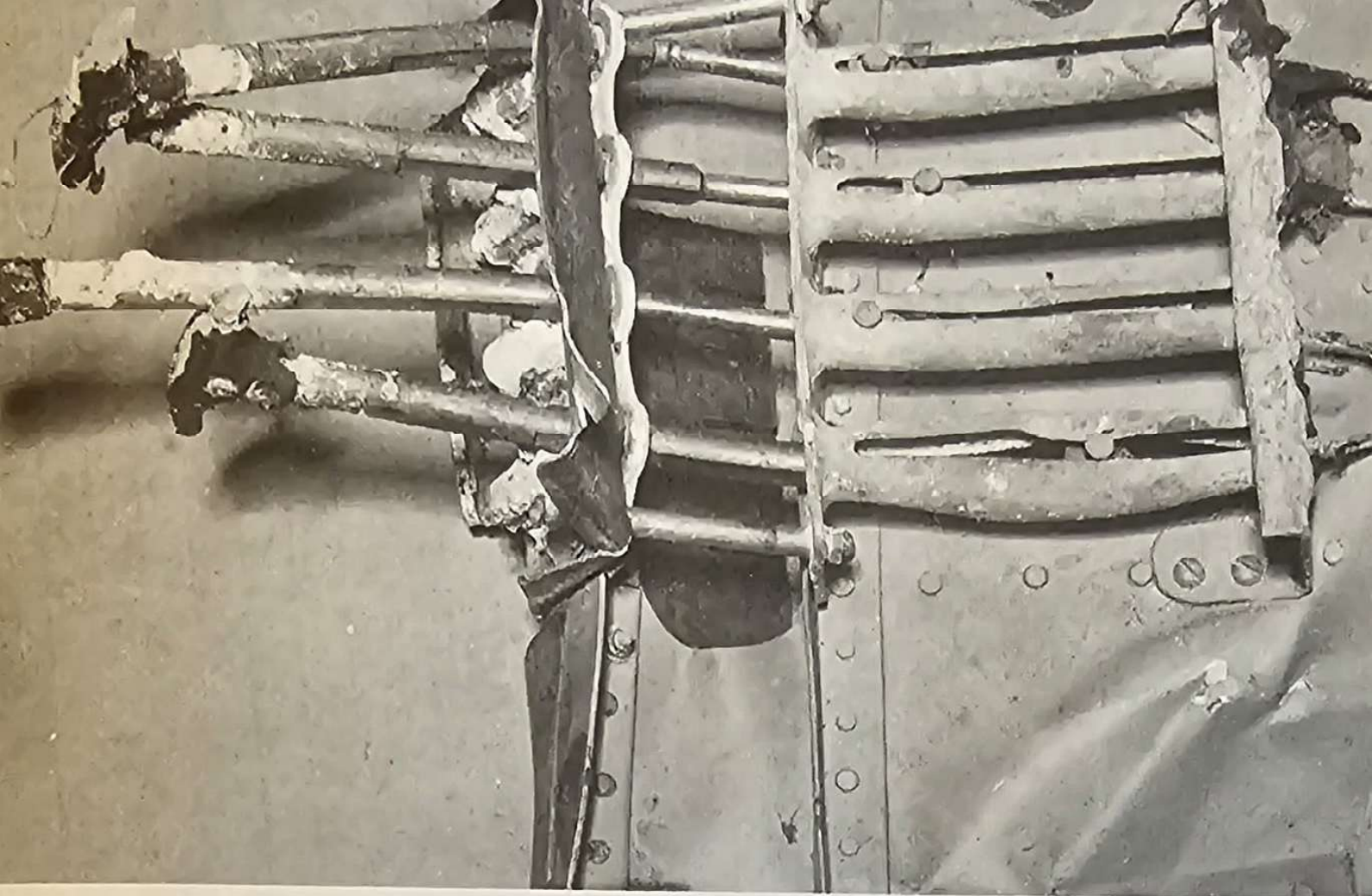
3. " " "
4. " " "
5. Main cabin.
6. " "
7. Underwater photograph of cockpit section.
8. " " " " "
9. Cockpit and nosewheel undercarriage.
10. Propeller feathering levers.
11. Salvaging the tail section.
12. " " " "
13. Underwater photograph of the cockpit section showing
the flap selector lever in the "flaps extend" position.
14. Part of the flaps with axle.
15. Cross section of the right tailplane.
16. The push-pull rod of the elevator. FS 28-29.
17. The push-pull rod of the elevator at the bellcrank at
the pressure bulkhead to the tail section.
18. " " " " " "
19. Engine No. II oil filter.
20. " " IV " "
21. Propeller blade prop. No. 1.
22. " " " " 2.
23. " " " " 3.
24. " " " " 4.

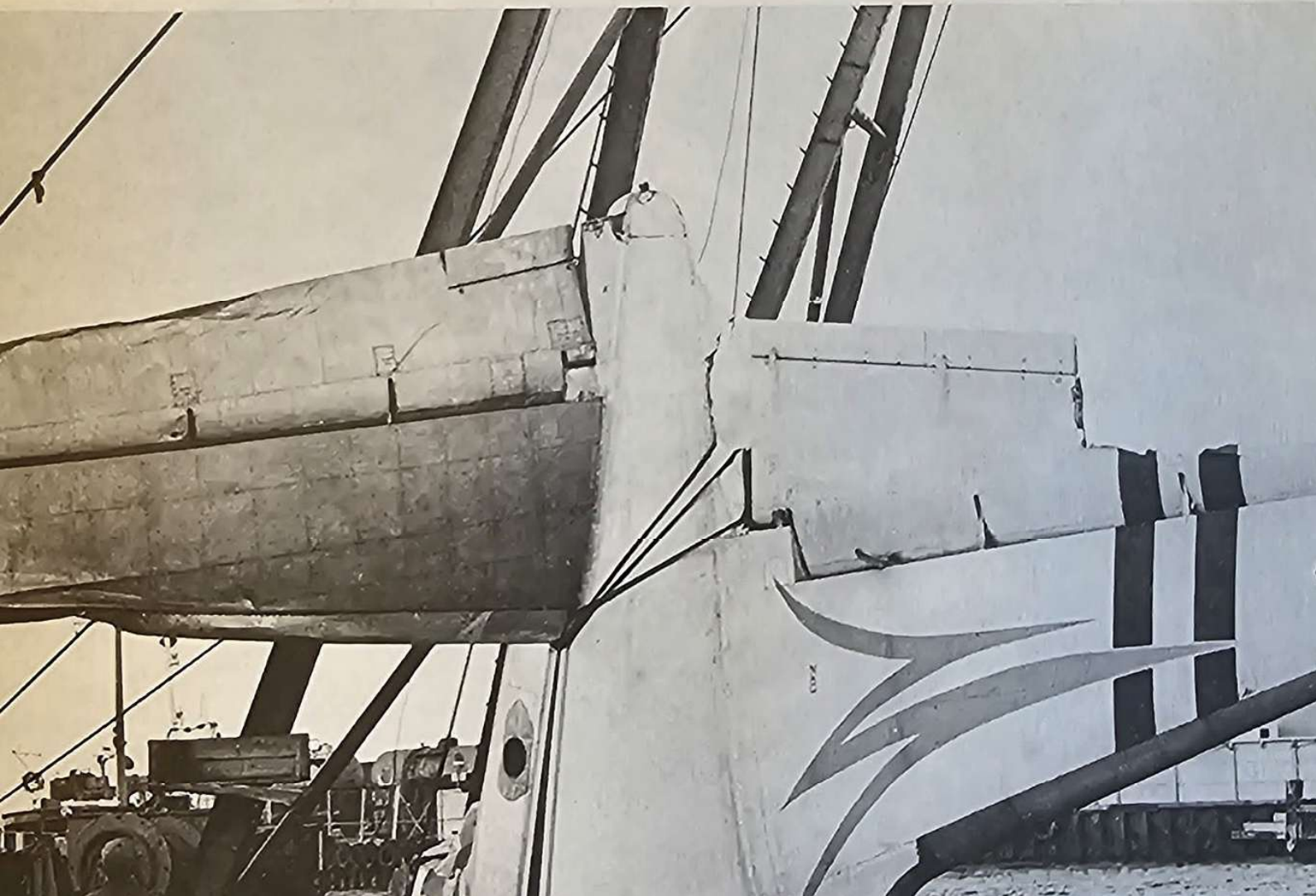




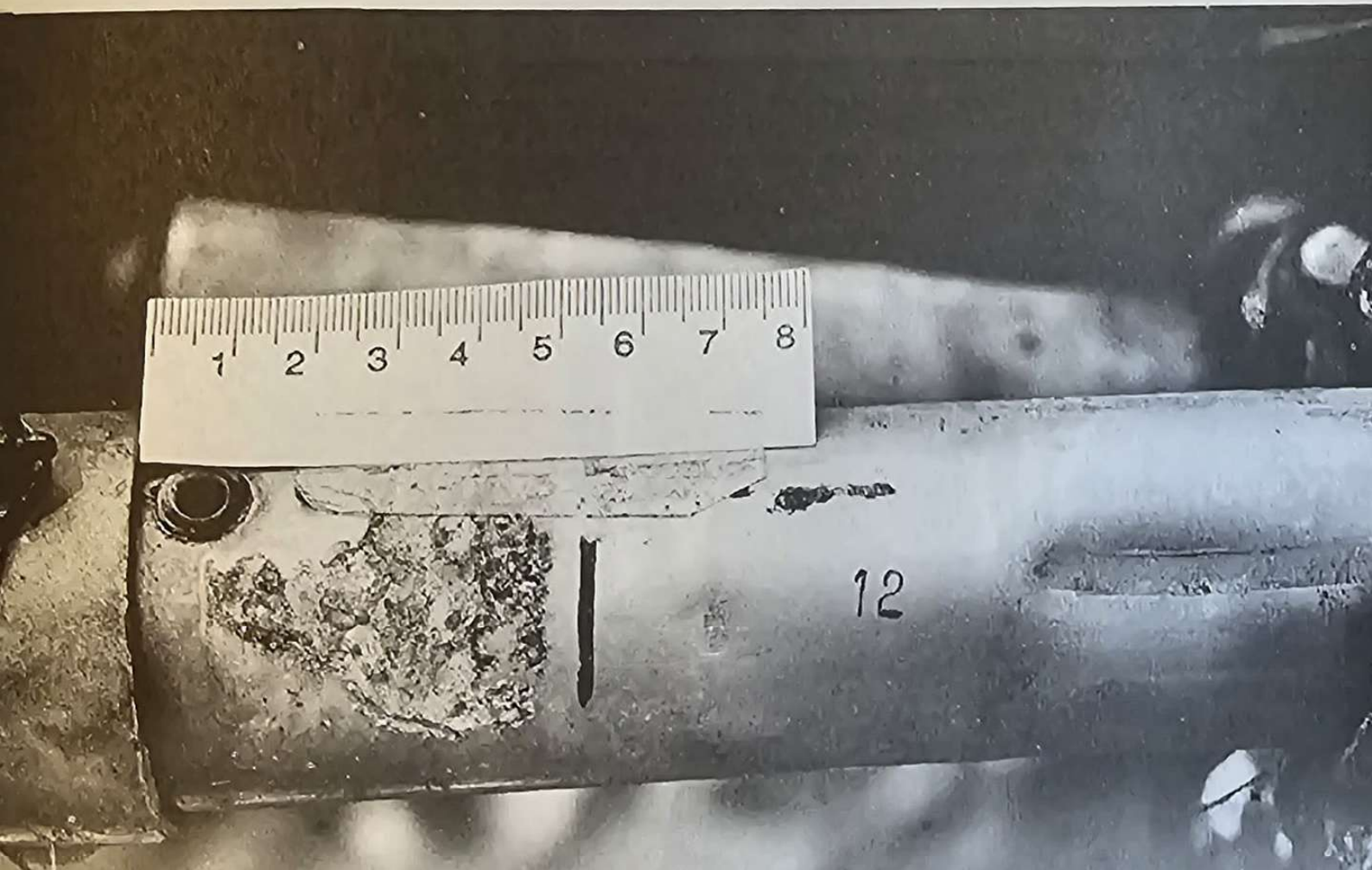
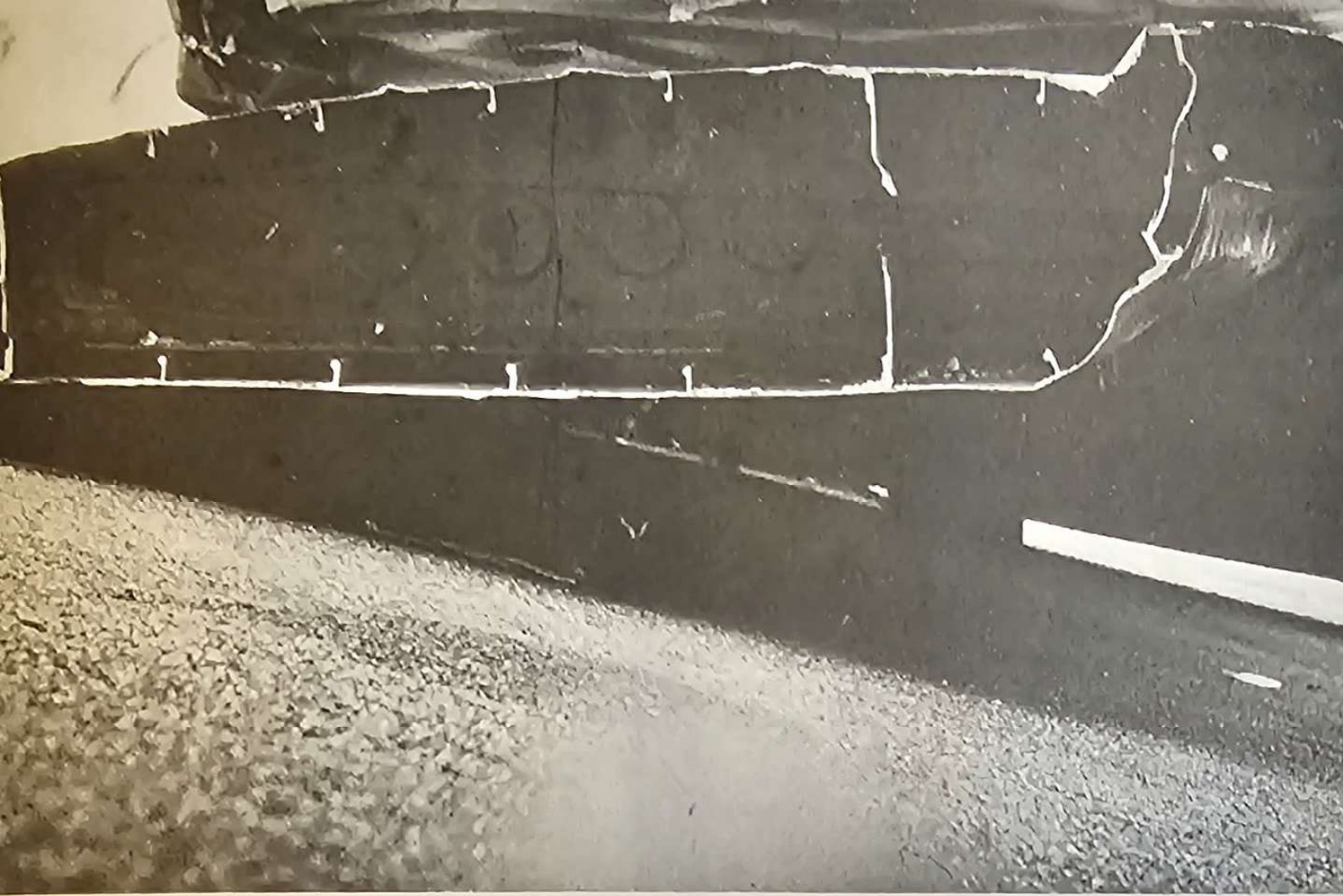


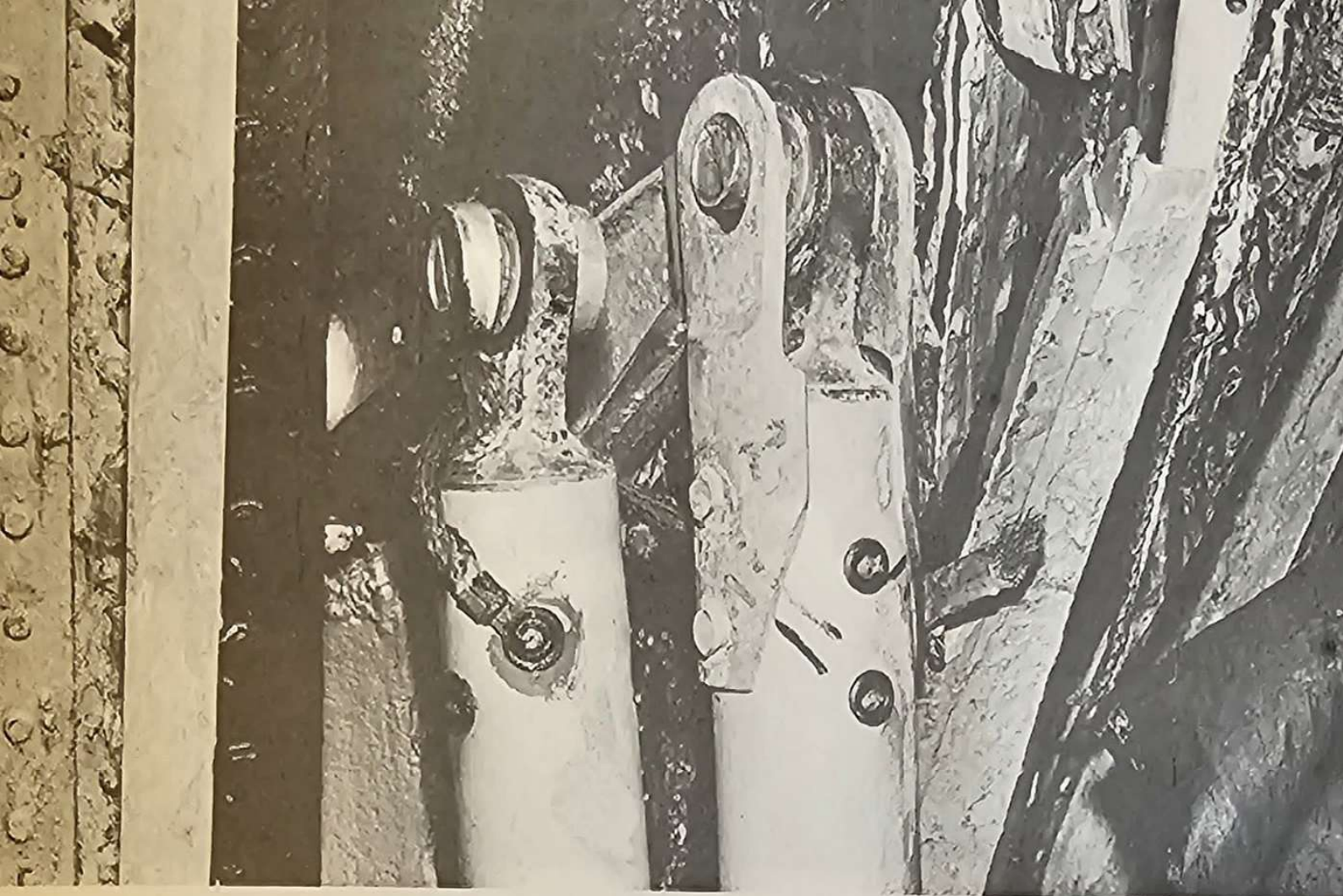


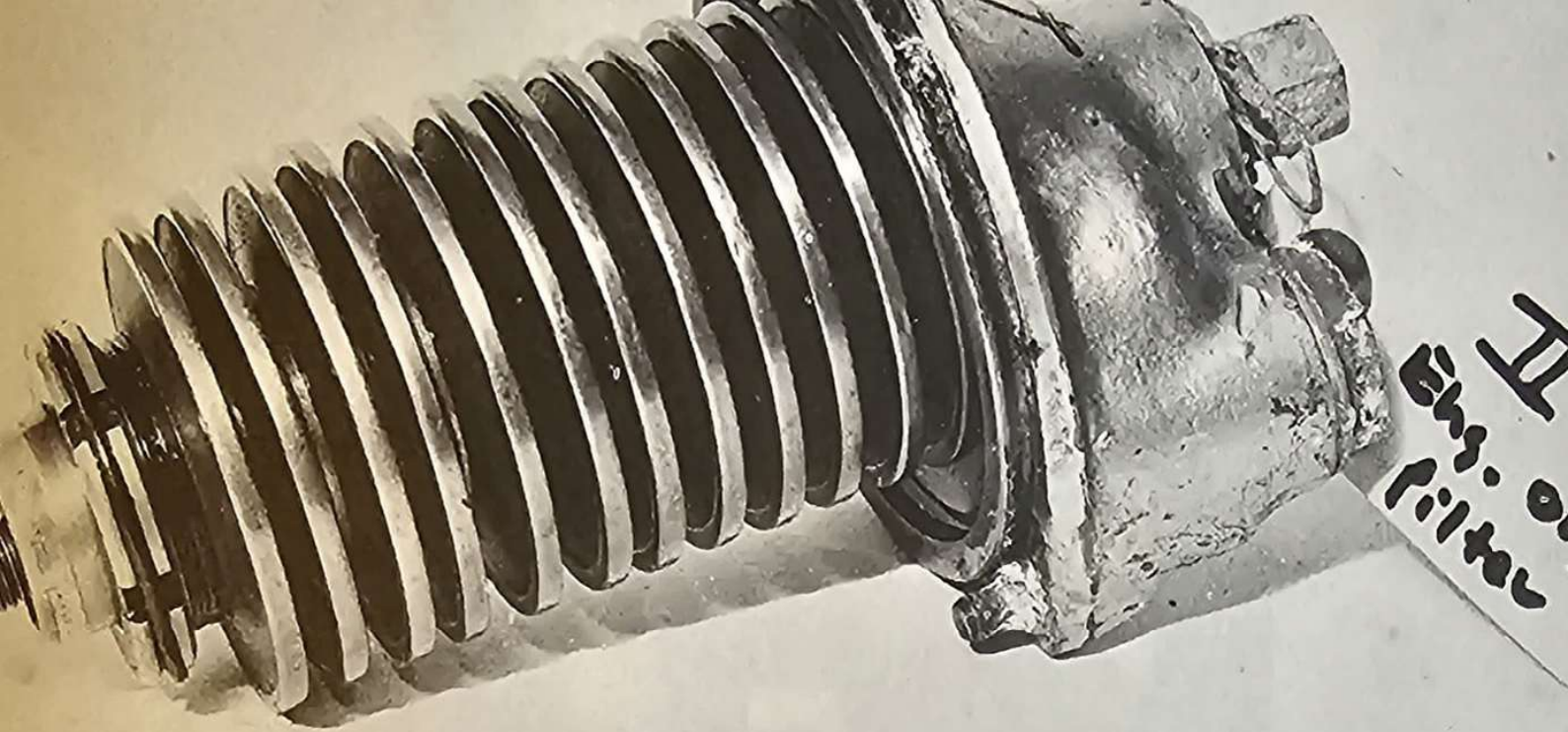








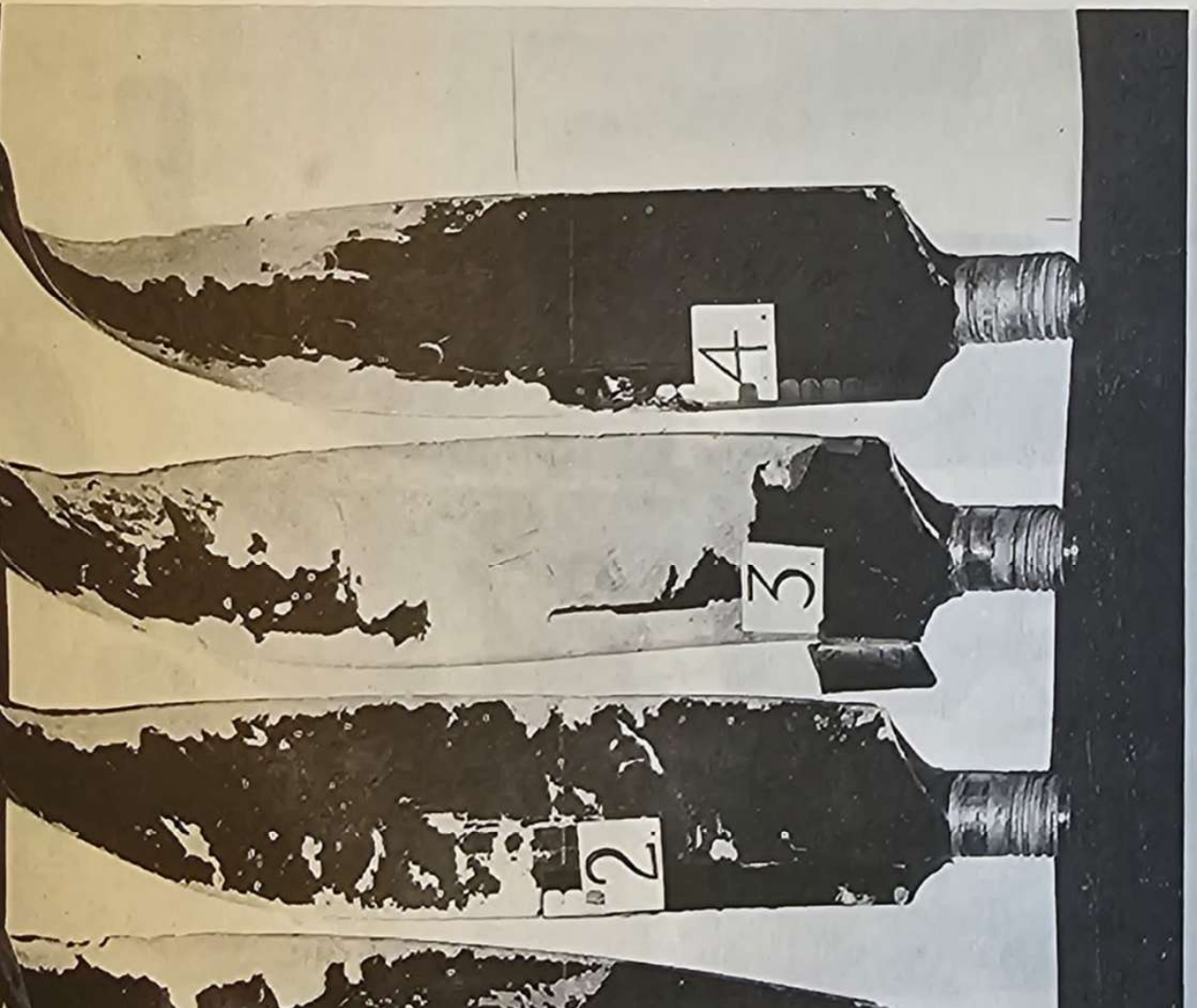


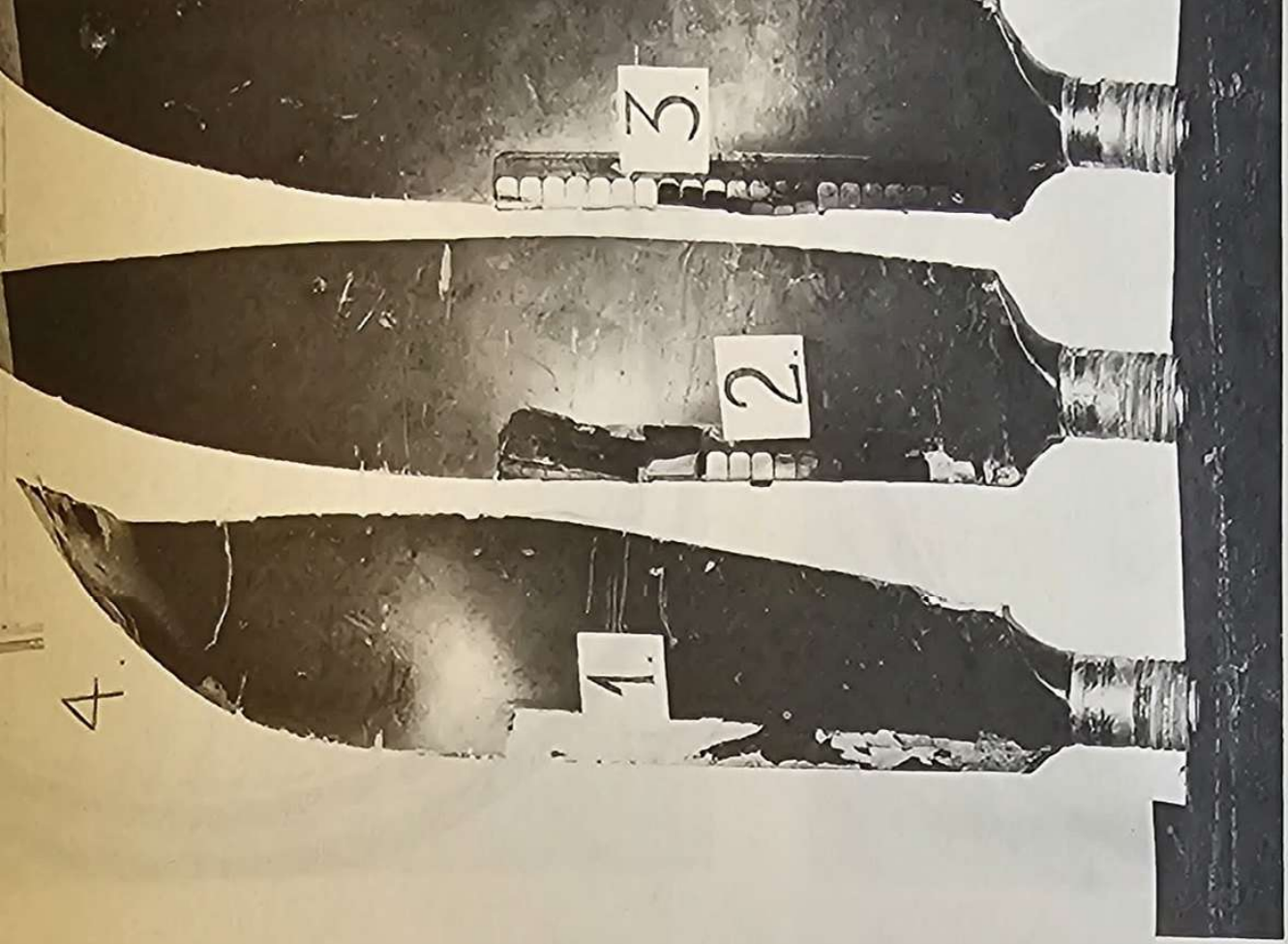


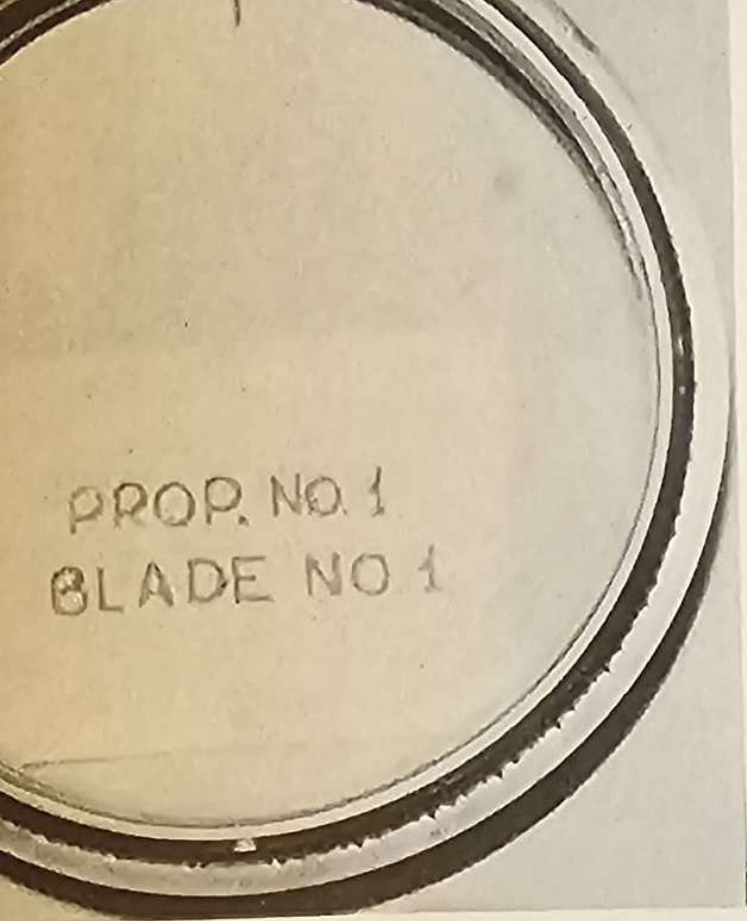
III
Ems. 00
Filter



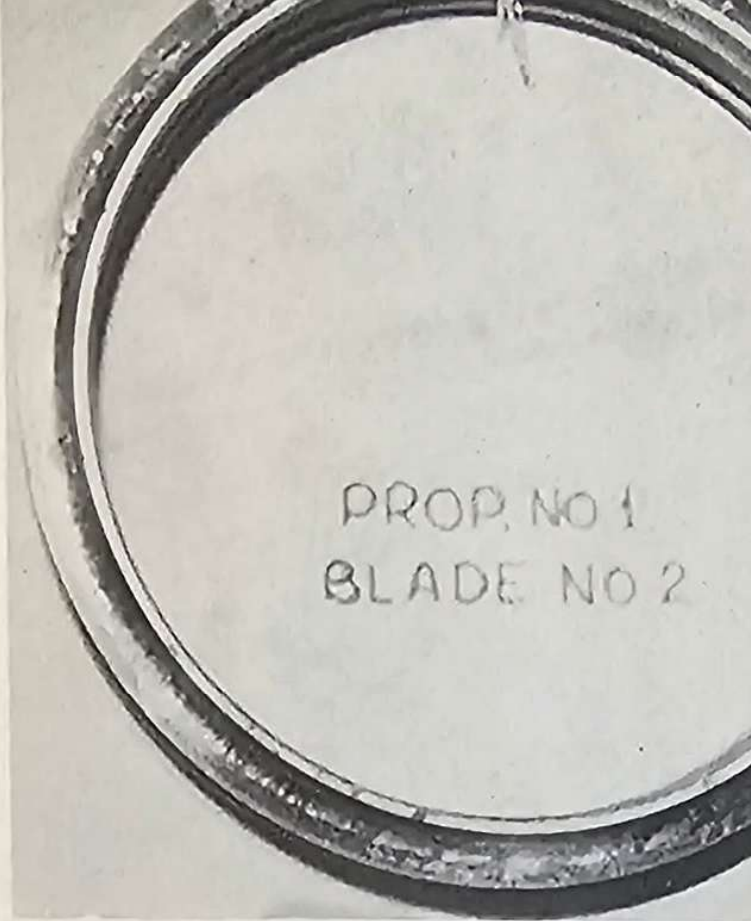
III
Ems. 00
Filter



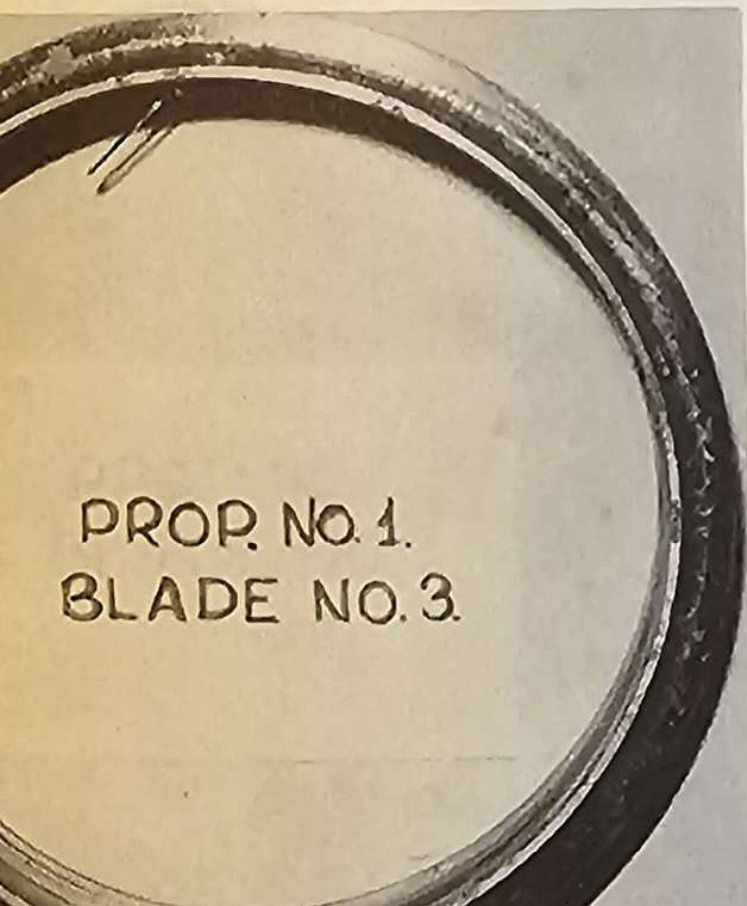




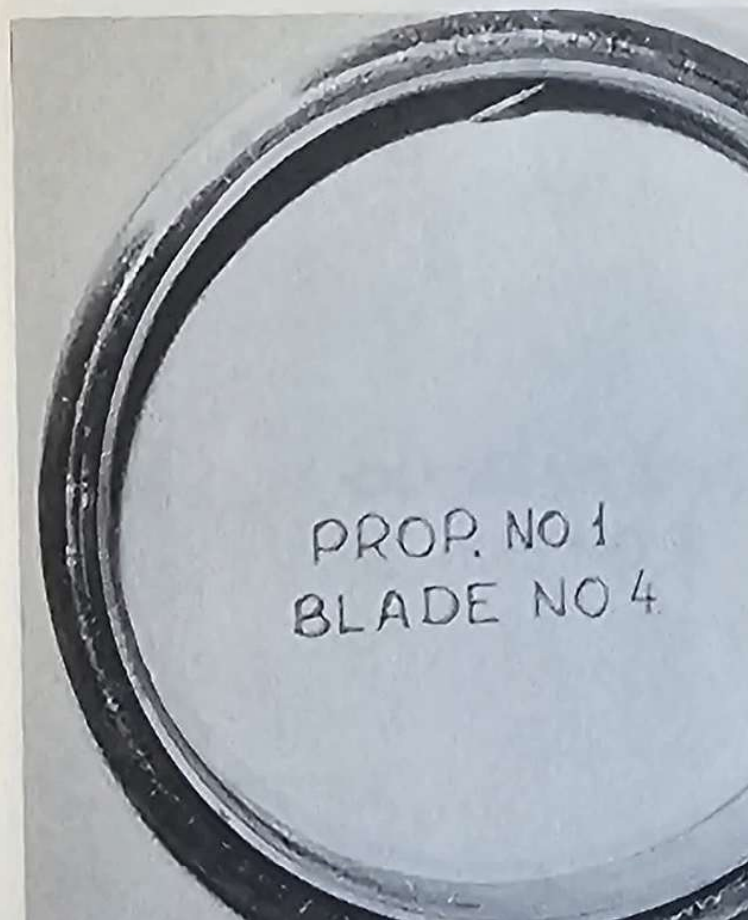
PROP. NO. 1
BLADE NO 1



PROP. NO 1
BLADE NO 2



PROP. NO. 1.
BLADE NO. 3.



PROP. NO 1
BLADE NO 4

