Sport Aviation Symposium

An International Meeting on Light and Ultra Light Aircraft Design

Milan, October 24-26, 2005

The partecipation is free. The lectures will be given in English language. For further details please contact:

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DIPARTIMENTO DI INGEGNERIA AEROSPAZIALE

AIDAA
ASSOCIAZIONE ITALIANA DI AERONAUTICA E ASTRONAUTICA

Facoltà di Ingegneria Industriale del Politecnico di Milano
Via La Masa 34 - Campus Bovisa Sud
20156 Milano - Italia

DIA
Dipartimento di Ingegneria Aerospaziale del Politecnico di Milano

AIDAA
Associazione Italiana di Aeronautica e Astronautica
Sezione Lombarda

How to reach Campus Bovisa Sud

***By car**: A1-Tangenziale Ovest-A4 Exit Viale Certosa. Follow Viale Certosa until it crosses Viale Monte Ceneri. Turn to the left and follow Viale Monte Ceneri until it crosses Via Mac Mahon. Turn to the left and follow Via Mac Mahon until Piazza Castelli. Turn immediately to the right and follow the indications to Politecnico.*

***By airplane**: if you arrive at Malpensa Airport catch the train to Milan and descend at the stop Bovisa Politecnico (about half an hour). If you arrive at Milano Linate or Orio al Serio airports you must reach Milan and then arrive at the stop Bovisa Politecnico by underground (Passante Ferroviario) or by Ferrovie Nord trains (Railway station Piazza Cadorna). You can also arrive at the Milano Villapizzone stop by Passante Ferroviario. It takes less than fifteen minutes from the centre of Milan.*

Istruzioni per raggiungere il Campus Bovisa Sud

In auto: A1-Tangenziale Ovest-A4-uscita V.le Certosa, seguire il viale poi a sinistra su V.le Monte Ceneri e quindi ancora a sinistra su Via Mac Mahon. Arrivare in piazza Castelli girare a destra e seguire le indicazioni per Politecnico.

In treno: Fermate del Passante Ferroviario Milano Villapizzone o Bovisa Politecnico.

In Aereo: dall'aeroporto di Malpensa con il treno scendendo alla fermata Bovisa Politecnico. Dall'aeroporto di Linate e dall'aeroporto di Orio al Serio raggiungere Piazza Cadorna a Milano e tramite le Ferrovie Nord arrivare alla fermata Bovisa Politecnico. Oppure raggiungere una fermata del passante ferroviario e scendere alla fermata Bovisa Politecnico o Milano Villapizzone.

PROGRAM / PROGRAMMA

14.00-14.15	***Opening Remarks***	***1st Technical Session***
14.15-14.45	Michael G. Friend: *"Sport Aviation: a Source of Innovation"*	**24th October/24 ottobre**
14.45-15.15	Mark D. Maughmer: *"Wing Design and Winglet Effects"*	
15.15-15.45	Stefan Melber: *"Computational Fluid Dynamics"*	
15.45-16.15	Jan Schwochow: *"Aeroelastic Aspects of Small Aircraft"*	
16.15-16.45	***General Discussion***	
16.45-17.15	Giuseppe Sala: *"Composite Materials for Gliders and Ultralight Aircraft"*	***2nd Technical Session***
17.15-17.45	Christoph Kensche: *"Fatigue in Composite Materials"*	
17.45-18.15	Rodolfo Aoki: *"Composite Materials NDT"*	
18.15-18.45	***General Discussion***	
09.00-09.30	Paul MacCready: *"Soaring on Free Energy"*	***3rd Technical Session***
09.30-10.00	Rudolf Voith-Nitschman: *"Solar Powered Motor Gliders"*	**25th October/25 ottobre**
10.00-10.30	Olivier Liechti : *"Verification of Meteorological Flight Plans for Soaring"*	
10.30-11.00	***General Discussion***	
11.00-11.30	Peter F. Selinger: *"Glider Recovery Systems"*	***4th Technical Session***
11.30-12.00	Petr Kousal: *"Sailplane Cockpit Damage"*	
12.00-12.30	Tony Segal: *"Landing Skid or Nosewheel?"*	
12.30-13.00	***General Discussion***	
	Lunch Break	
14.00-14.30	Ullrich Kopp: *"Sailplane Certification Procedure"*	***5th Technical Session***
14.30-15.00	H-G. Brunßen-Gerdes: *"Ultralight Sailplane Design Rules"*	
15.00-15.30	Luigi Pascale Langer : *"VLA Design Methodology"*	
15.30-16.00	Heiner Neumannn : *"Some Remarks on Spin Investigation of Small Airplanes"*	
16.00-16.30	***General Discussion***	
16.30-17.00	Guido Polidoro: *"Sport Aircraft Propulsion: Past, Present & Trends"*	***6th Technical Session***
17.00-17.30	Stefan Ebert: *"Engine Certification Topics"*	
17.30-18.00	Wolfgang Emmerich: *"Two Strokes Engines for Small Airplanes: Benefits and Troubles"*	
18.00-18.30	***General Discussion***	
20.30	***Social Dinner***	
09.00-09.30	Andre Jansen: *"Engines for Self Launching and Sustaining Gliders"*	***7th Technical Session***
09.30-10.00	Wilhem Dirks: *"Improvements in Engine Data Indication and Control for SLG"*	**26th October/26 ottobre**
10.00-10.30	Jean Marie Clement: *"Problems in Engines for Self Launching Gliders"*	
10.30-11.00	***General Discussion***	
11.00-11.30	Paolo Ballocchi: *"Alisport/Avtek Composite Propellers for Aviation"*	***8th Technical Session***
11.30-12.00	Marcello Bonini: *"Glider Primary Data Display"*	
12.00-12.30	Massimo Luzzana: *"A Synthetic Vision System"*	
12.30-13.00	***General Discussion and Closure of the SAS***	

*On **Monday 24th October**, starting at 10.30 am, the Symposium will be preceded by a ceremony dedicated to the memory of Ermenegildo Preti and his activity as designer of small aircraft and cars. Paul MacCready will give the lecture* "Doing More with Much Less".
*In the afternoon of **Wednesday 26th October** the Round Table* "From Technology to Market: the Role of Regulators" *will be held where the theme of the different and sometimes conflicting rules and their consequences on the design and the activity of light and ultralight aircraft in Europe will be discussed by representatives of governmental agencies, industries and user associations.*

Il simposio sarà preceduto nella mattinata di **lunedì 24 ottobre** da una cerimonia celebrativa a ricordo di Ermenegildo Preti e della sua attività come progettista di piccoli mezzi di trasporto, aerei ed automobili e da una conferenza di Paul MacCready sul tema *"Doing More with Much Less"* con inizio alle ore 10.30.
Nel pomeriggio di **mercoledì 26 ottobre**, con inizio alle ore 14.30, seguirà la Tavola Rotonda *"From Technology to Market: the Role of Regulators"* che dibatterà il tema della differente e spesso contrastante regolamentazione vigente nei diversi paesi europei e dei suoi riflessi sulla progettazione e sull'esercizio degli aerei leggeri e ultraleggeri. Prenderanno parte esponenti degli enti normatori, dell'industria e delle associazioni.

Registration card / **Scheda di registrazione – Sport Aviation Symposium – Milan, October 24-26, 2005**

First name / **Nome**	
Last name / **Cognome**	
Company or institution / **Ente di appartenenza**	
Field of interest / **Interesse professionale**	
Address / **Indirizzo**	
E-mail	

Do you want to be informed on seminar activity of DIA and AIDAA? **Desidera essere informato sulle attività seminariali del Dipartimento di Ing. Aerospaziale e dell'AIDAA?**	***YES***	***NO***
Do you want to receive the Symposium Proceedings on cd-rom (60€ postage included)? **Desidera ricevere il cd-rom con gli Atti del Simposio (costo: 40€ per i soci AIDAA, 60€ per i non soci)?**	***YES***	***NO***
Payment / **Pagamento**	*Upon receival* / **Al ricevimento**	
	Advanced / **Anticipato**	

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Le informazioni contenute in tabella sono riservate. Autorizzo il destinatario (Politecnico-DIA) al trattamento dei dati ai sensi del D.Lgs. 196/2003.

Firma _____

Signature / Firma _____

E-mail or fax the card to Cesare Cardani: / Spedire a Cesare Cardani: **cesare.cardani@polimi.it - fax +39 02 2399 8334**

Motorized Sailplanes

20 Years of Joy and Pain

The Stations of the Cross towards Freedom

Brief History of Personal Experience since 1986

- turbo single seater 1986-1995

- turbo double seater 1995-1998

- self launch double seater 1998

Also Experience of more famous:

- Steve Fossett (2003 & 2004)
- Régis Kuntz + D. Hauss (2003)
- Dick Johnson (1995 test starts with “Propulsion Failure”
- Greenwell, Flament, Pollard, Woodward, Serkowski,
- and dozens of other ones

44 FAILURES in 7 years (Rotax)

2,7 hours MTBF and 30 hours TBO

- **28 flights interrupted (or T.O.)**
- **14 flights to nearest APT**

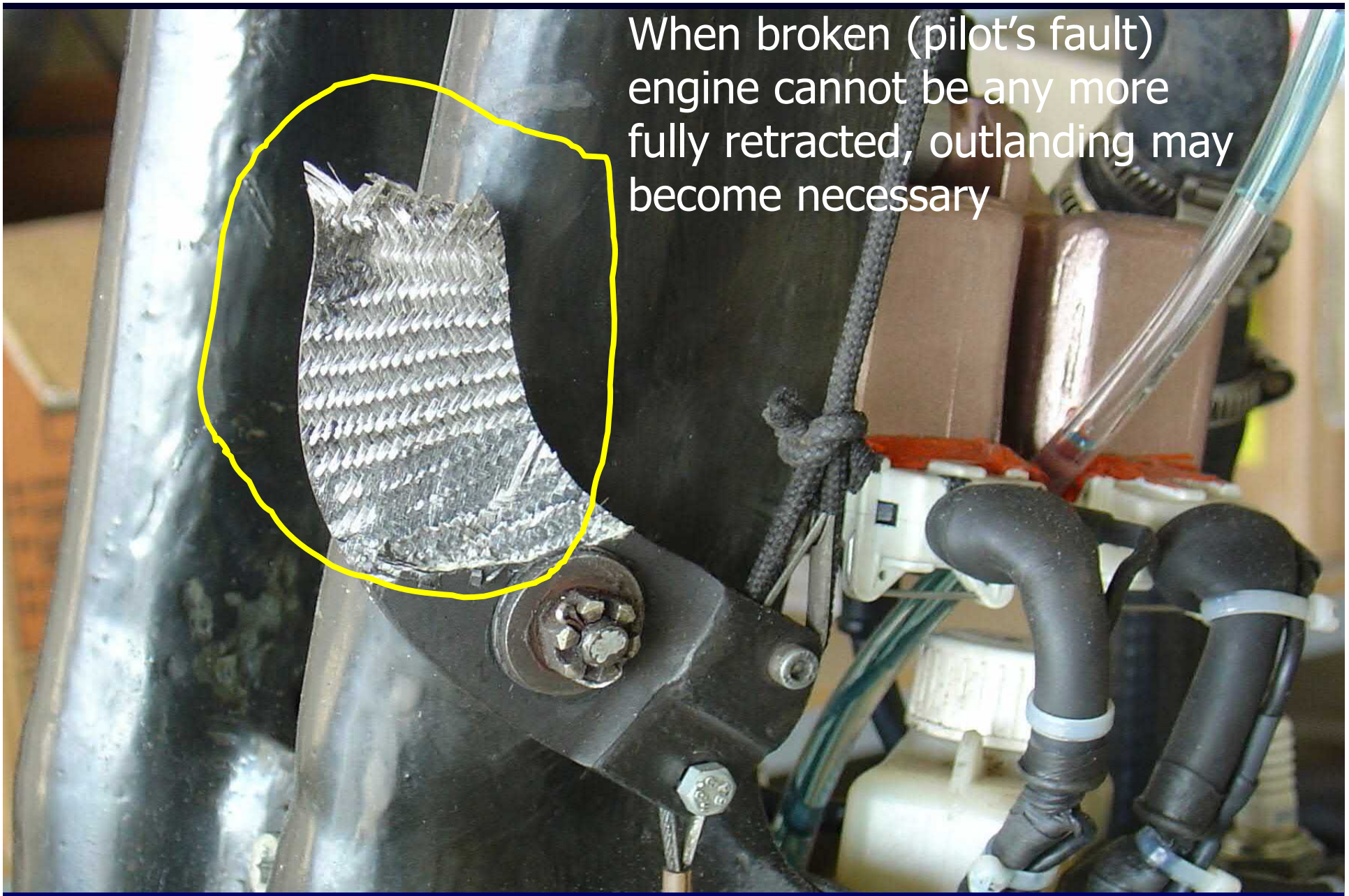
✓ **11 Ignition cables or connectors**
✓ **6 fuel tanks leaking or burst**
✓ **4 belt breaks**
✓ **4 magneto coil failures**
✓ **1 engine oil leakage**

COMPONENTS OF A THERMAL ENGINE POWER PLANT

1. Propeller
2. Reducer
3. Engine
4. Cooling circuit
5. Ignition system
6. Gasoline tanks and pipes
7. Pylon and its rotation device
8. Electrical generation and distribution
9. Control system and interlocks
10. Exhaust gas ducts and muffler

1. Propeller: Speed limit, temperature, balancing, brake pilot tolerant, insensitive to synchronization with engine, independent from belt.

First engine, first problem: One blade is self desintegrating because of speed and vibration (1986)



1. Propeller: the arrestor should be "fault tolerant", otherwise the problem becomes worse (new desing is OK)

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- No reducer means zero problem
- Gear means safe but no vibration tolerance
- V-Belt is vibration tolerant, allows slipping, high torque capacity
- Tooth belt has low torque capacity, low vibration tolerance, low elasticity
- Kevlar containing belt should NOT be used on alternate torque (manufacturer's statement)

CONCLUSION: Most plants use Kevlar based tooth belts……

ACCORDING TO THE MANUFACTURER (GATES):

1. The speed limit on the 25 teeth pulley is 5.500 rpm against 7.100 rpm actual.

2. Not belt tensioner should be applied on the back side. There are 4 rolls diameter 20mm.

3. Even considering 5.500 rpm, the service factor would be only 2. Aircrafts drives require minimum 5 better 7.

4. Polyurethane-Kevlar belts are not usable on alternate motion. Neoprene-Glass fibre YES.

The 2 safest drives have no drive or simple gear reducer

Ventus T

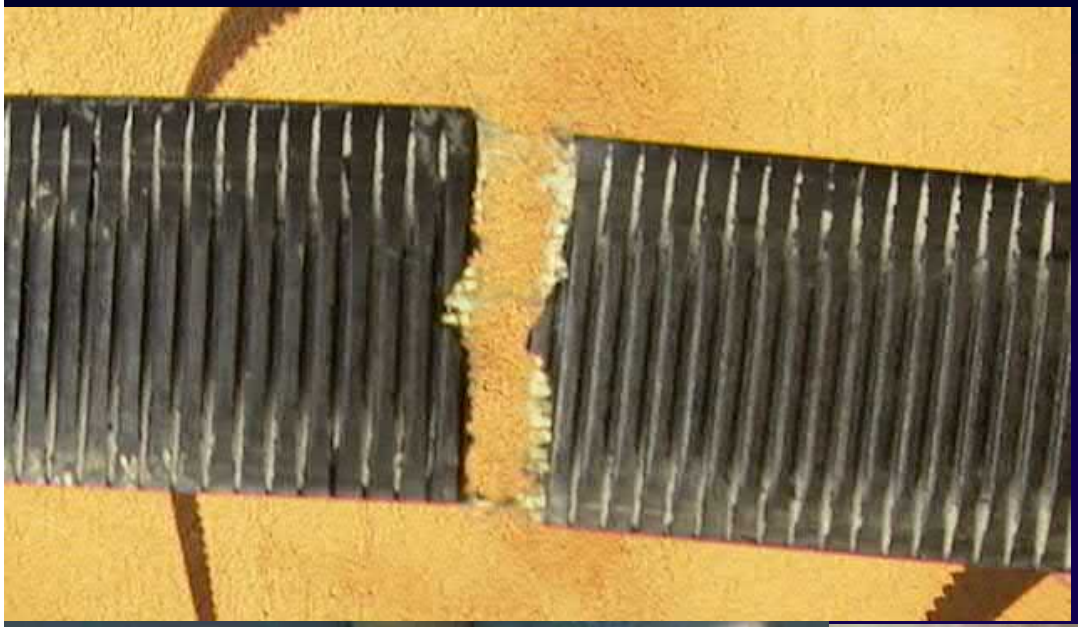
ASH 25E

Two excellent trouble-free V-belt drives

Ventus CM

DG 1000 T

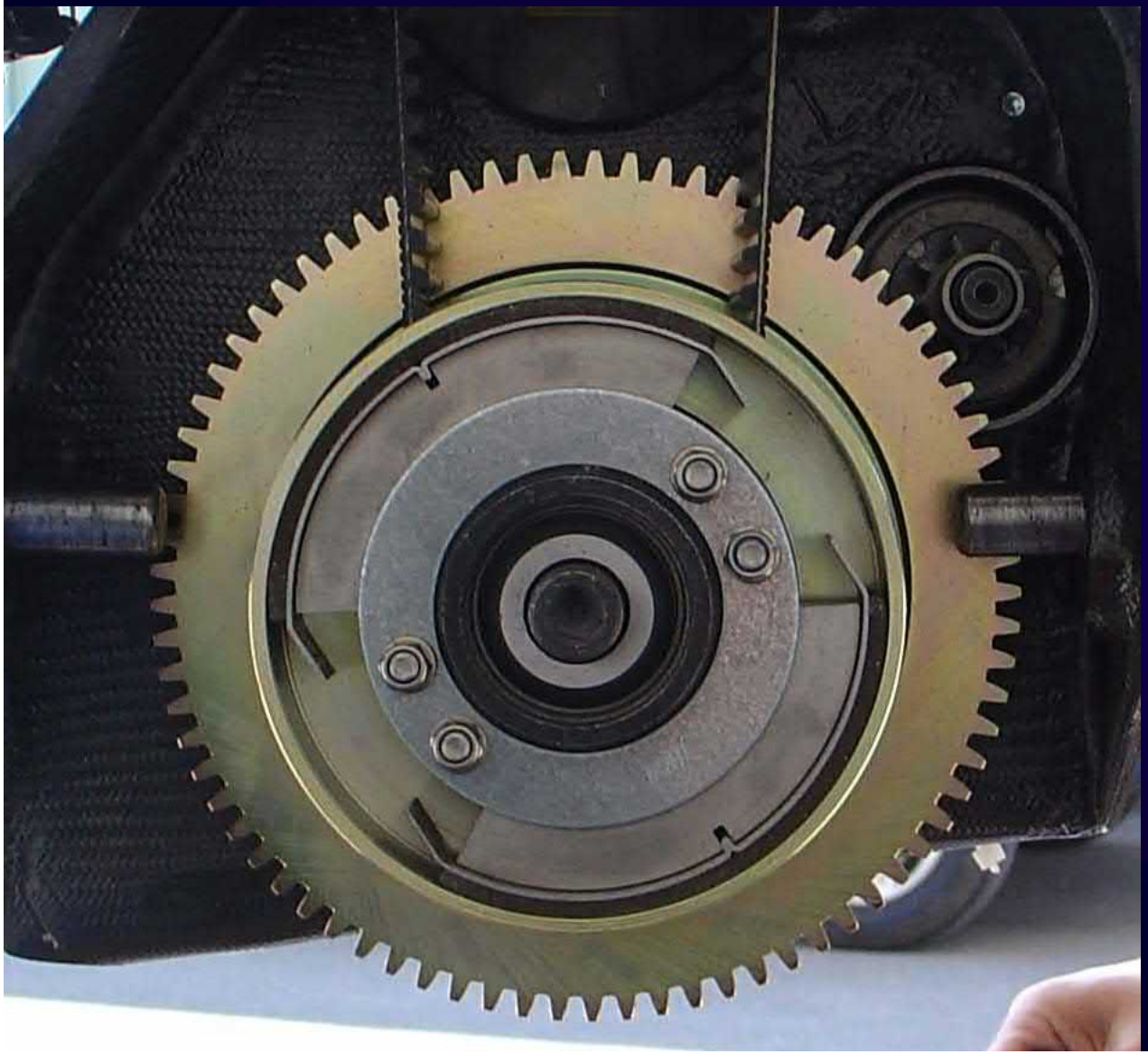
Kevlar tooth belt after 25 hours average life



Manufacturer gives a life time of 10.000 hours if application is correct. Old glass fiber belts look like new after 7 years.

The centrifugal friction is a costly and heavy solution

All Solo engines



Problem was also solved using the original and more flexible10 years old design fiberglass tooth belt.

But setting of tension is difficult because of too short available adjustment travel.

Changing the belt on SHK requires:

- removal of propeller
- removal of radiator
- removal of e-boxes
- removal of oil tank
- removal of ignition wiring
- removal of 4 cylinder head screws
  (on a total of 6 per cylinder, very bad)

Ave. 4 to 6 hours specialized work!

Changing the belt of the Nimbus 4

A FLIGHT TEST EVALUATION OF THE ASH-26E SELF LAUNCHING 18-METER SAILPLANE

By Richard H. Johnson, Published in *Soaring* Magazine, September 1995

DESCRIPTION

The ASH-26E is the latest model high performance sailplane to be produced by the well known Alexander Schleicher Segelflug-zeugbau Company in Poppen-hausen, Germany near the famous Wasserkuppe soar-ing site. It is a very modern 18-meter wingspan sail-plane, and the "E" option equips it with a quiet and smooth running internally mounted Mid-West AE 50 HP self launching Wankel engine. This sailplane design

PROPULSION FAILURE

It was during this testing period that the ASH-26 suffered a propulsion system failure, and we had to resort to aero towing to finish the testing. The engine itself did not fail, but a sealed propeller drive belt idler pulley bearing failed, causing a sudden and complete loss of propeller thrust. The cause of the bearing failure was not determined. The engine had been operated only about 18 hours total time before the bearing failed. The ASH-26 was equipped with both a nose and a CG tow hooks, so most of the testing was able to continue uninterrupted.

ASH26E: The belt drive failed during the test flight by Dick Johnson in 1995.
Only 18 hours since new…

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- 2-stroke: **vibrations**, easy access and maintenance.
  -Many problems but a lot of background
  -Problems always solved locally, even in Patagonia
- Rotating Wankel: smooth running, very temperature sensitive, less power
  -Less problems but **no** maintenance by owner
  -Less problems also because much less sold
- Electric: Just unusable in mountain, insufficient range (maxi 3.000 m per charge)

2-stroke ROTAX

A complete failure because of design errors

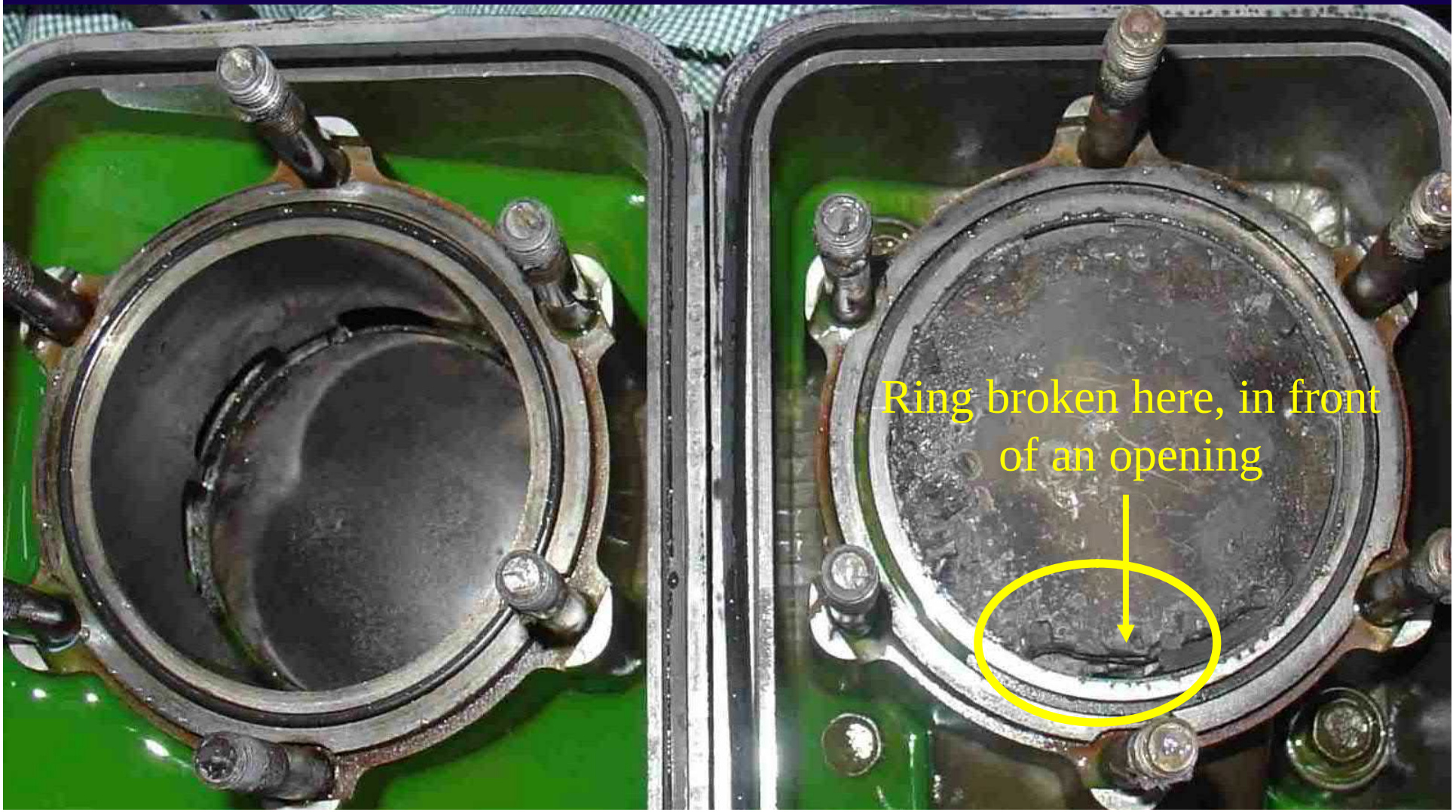
- ✓ Piston ring slot at wrong place
- ✓ Oil tube crimped, not secured, leaks
- ✓ ignition case cut in front of the exhaust elbow
- ✓ Original setting of magnets totally wrong (TN)

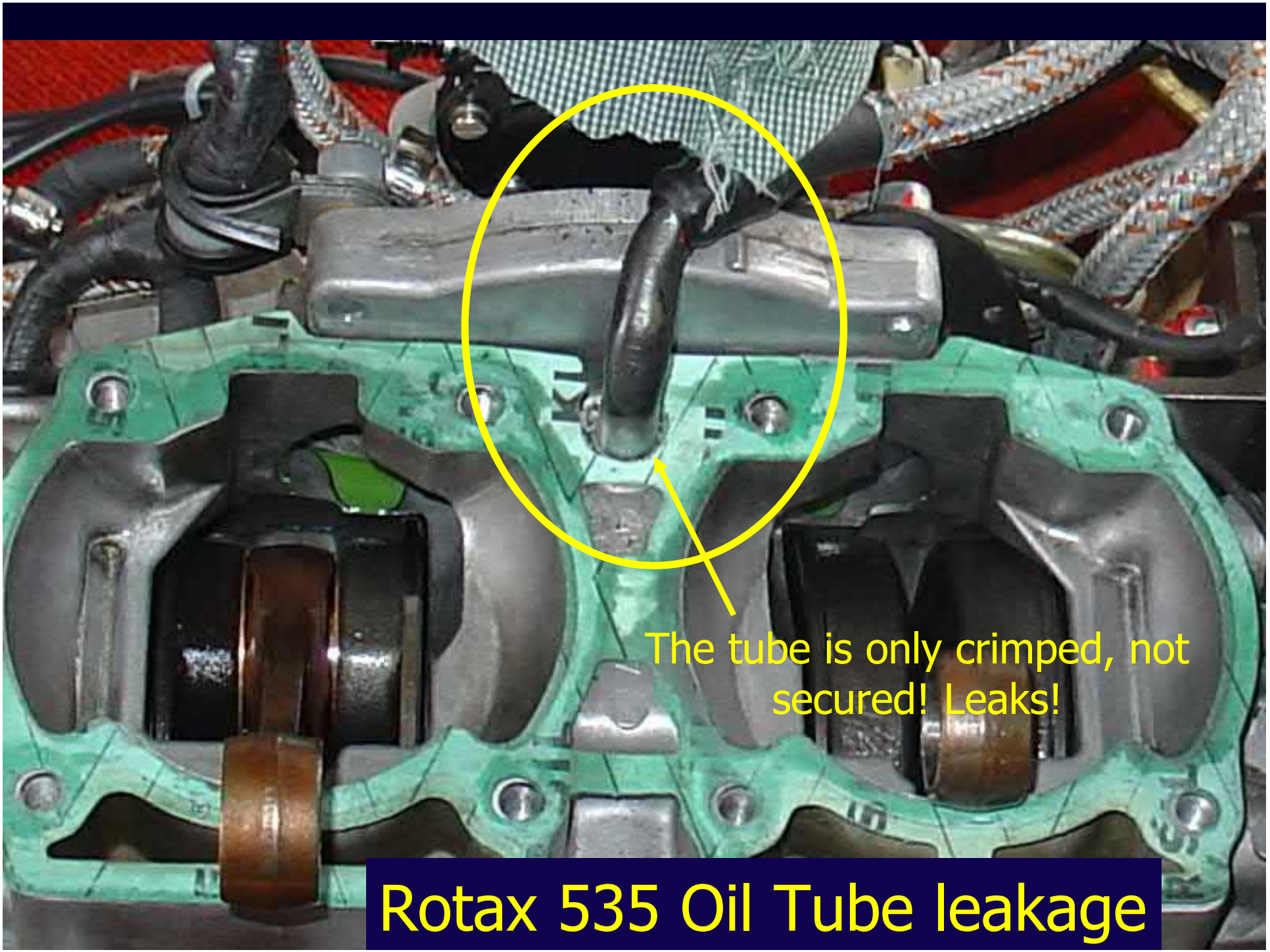
Why not use the 582? Thousands are running perfectly!

- ✓ ignition coils and pick-up changed to Bosch
- ✓ e-boxes original location totally wrong (lost in flight)
- ✓ belt change requires opening halth of the cylinder head screws

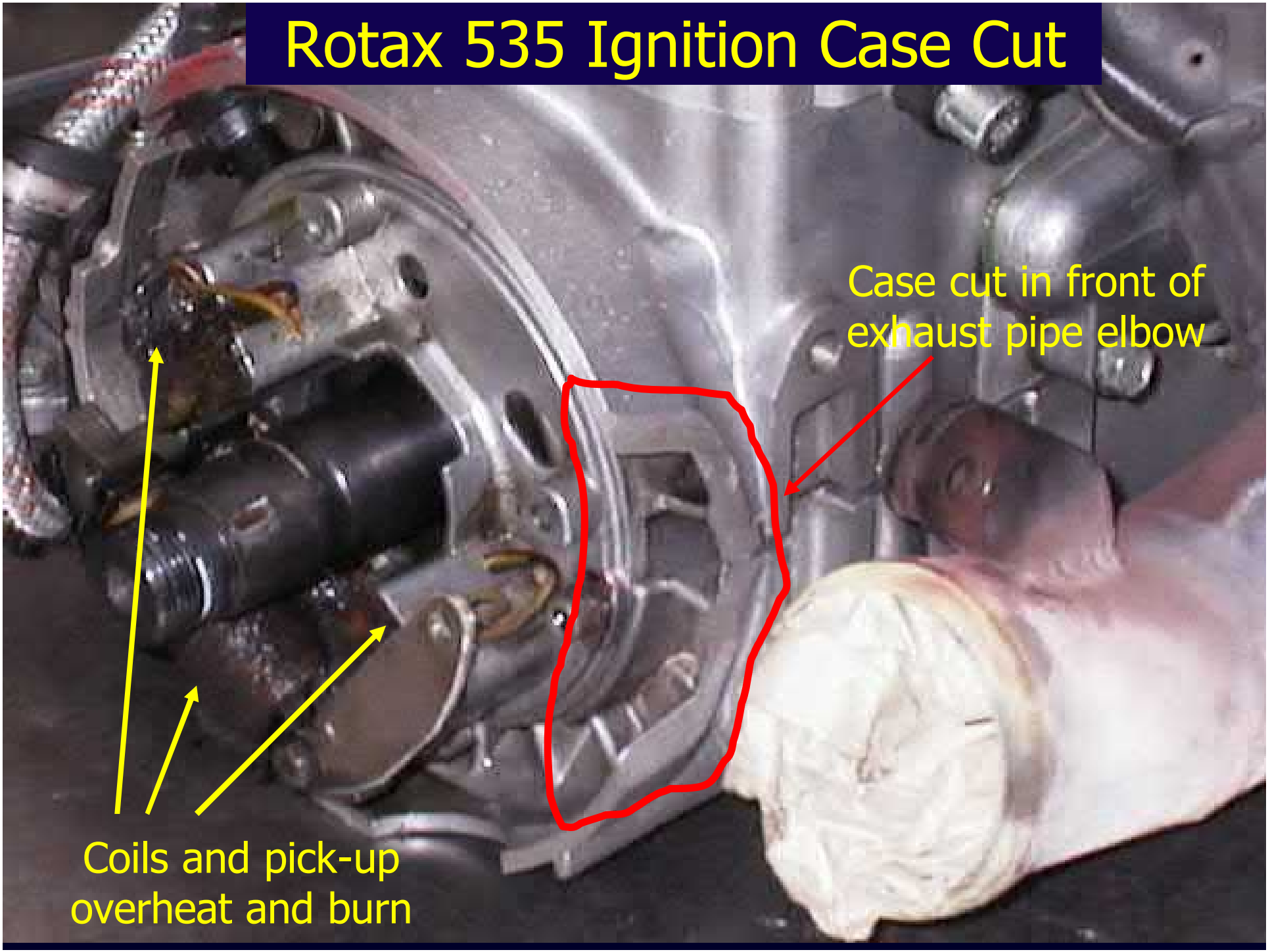
How can LBA cerify such a mess? On which criterion?

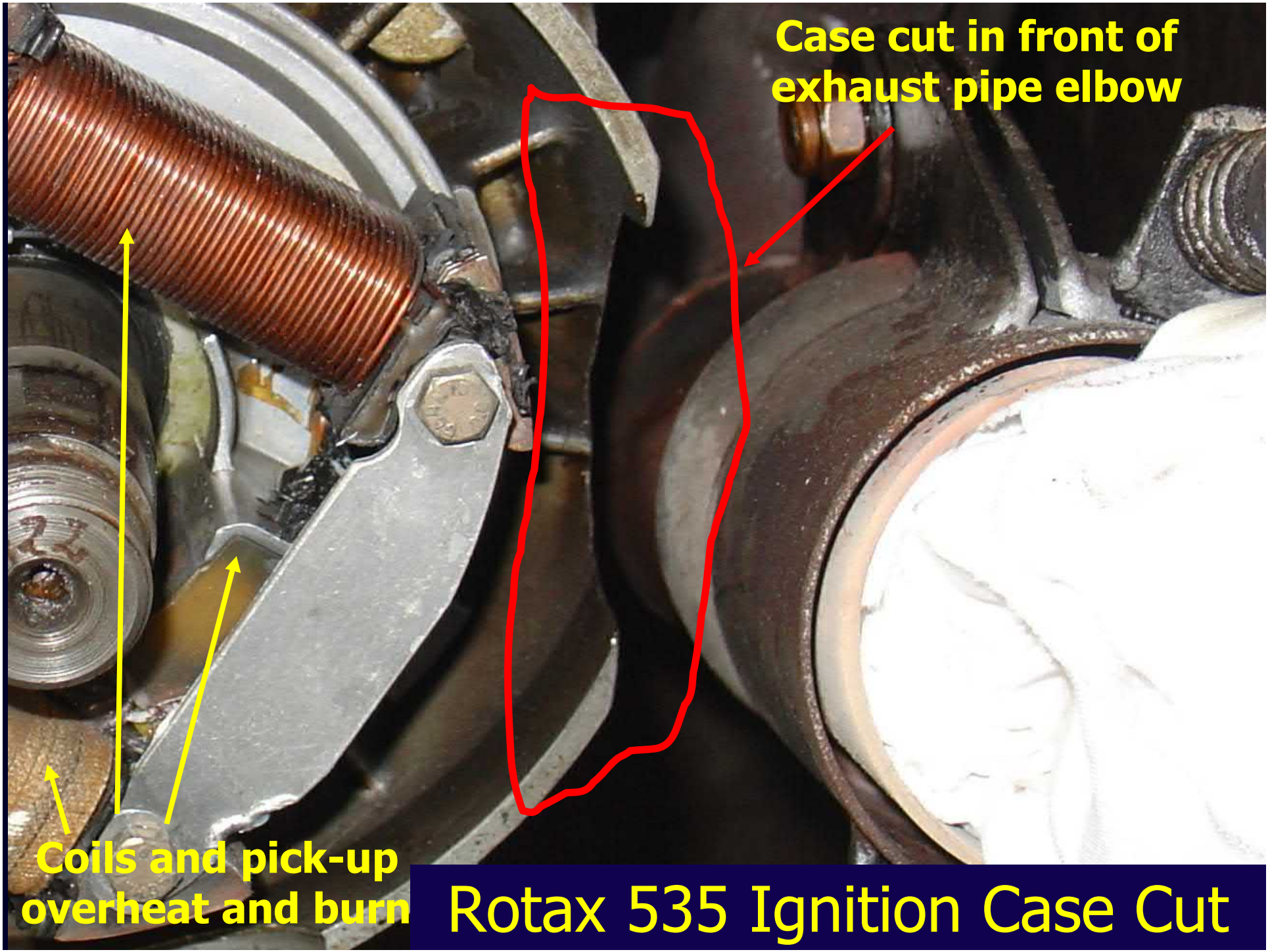
Rotax 535 Piston Ring position error and result (25 hours since supposedly new)





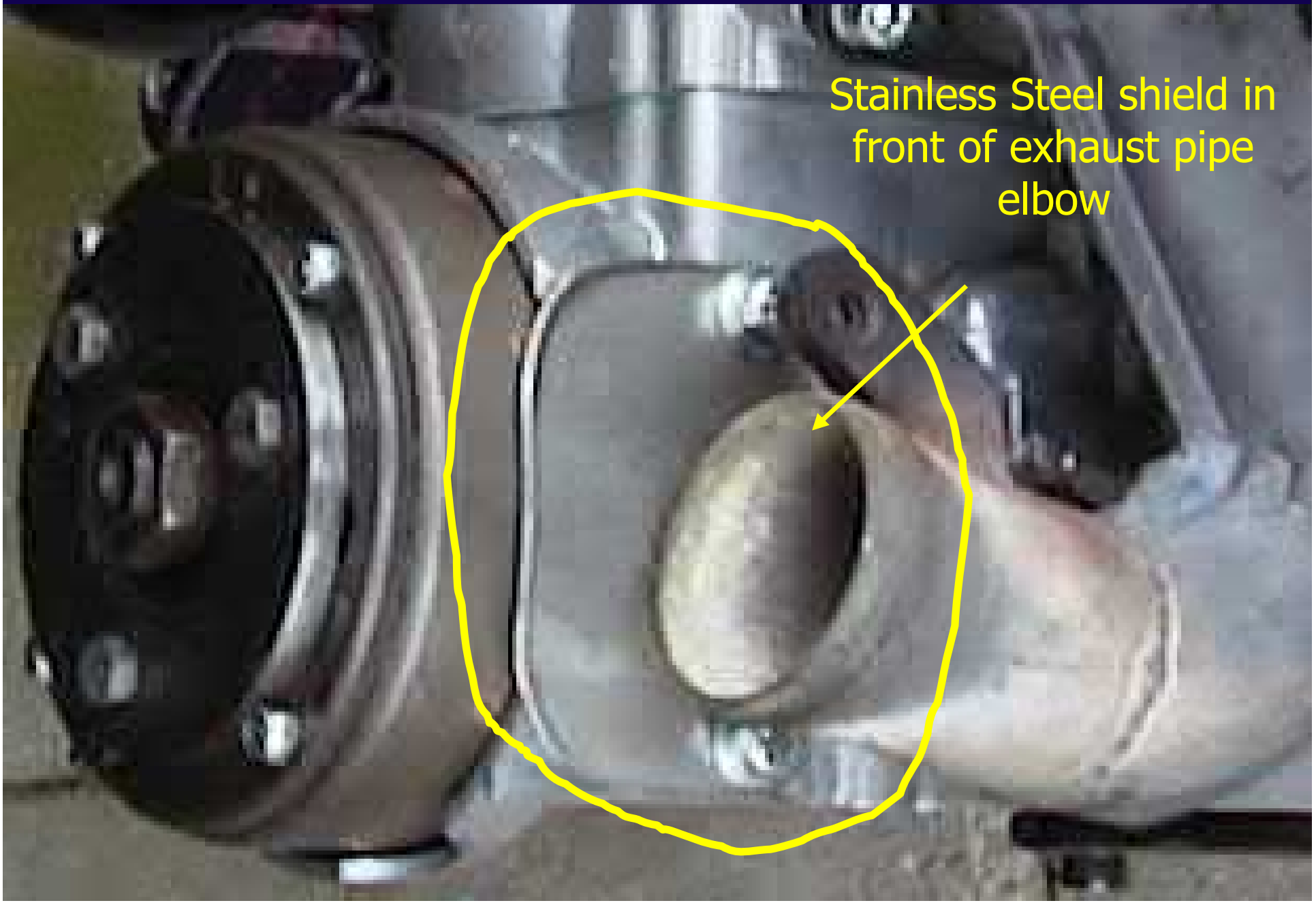
Rotax 535 Oil Tube leakage


Rotax 535 Ignition Case Cut
Case cut in front of exhaust pipe elbow
Coils and pick-up overheat and burn



Rotax 535 Ignition Case Cut

Rotax 535 Ignition Case Cut Shield



2-stroke SOLO:

- Near to zero problem with the small “turbo”
- After initial start-up in 1998, situation is now “acceptable”, manufacturer is collaborating, spares available (only from Solo)
- BUT: still a “special” design for aircrafts. Very small production.

Why not use a fully standard and proven product?

Rotating Wankel, ex Midwest, now Diamond:

- Delicate, any work requires sending the engine to the manufacturer: high risk in remote countries.
- Very variable results: some pilots had their engine out 6 months several times, other have never experienced any problem.
- Requires running every 2 to 3 weeks, not 4 weeks as per manual. Anyhow too much for a sea shipment to Argentina.

Original Midwest spark plugs are not any more available.

New ones are bigger and all engines require machining

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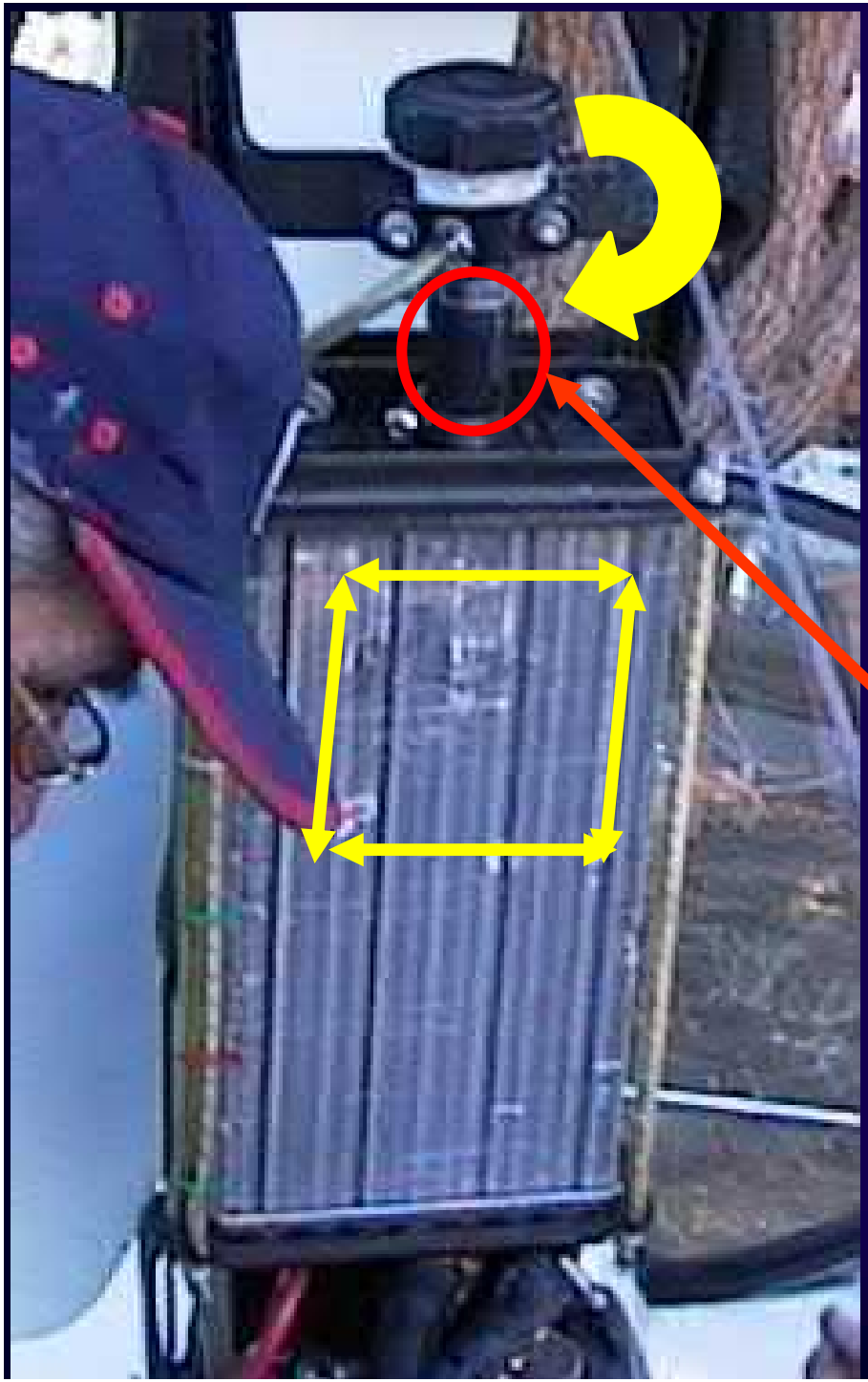

Cooling system:

The vibration planes of radiator and plug are perpendicular

= breakage of the rubber hose! Very dangerous.

Always a spare on board!

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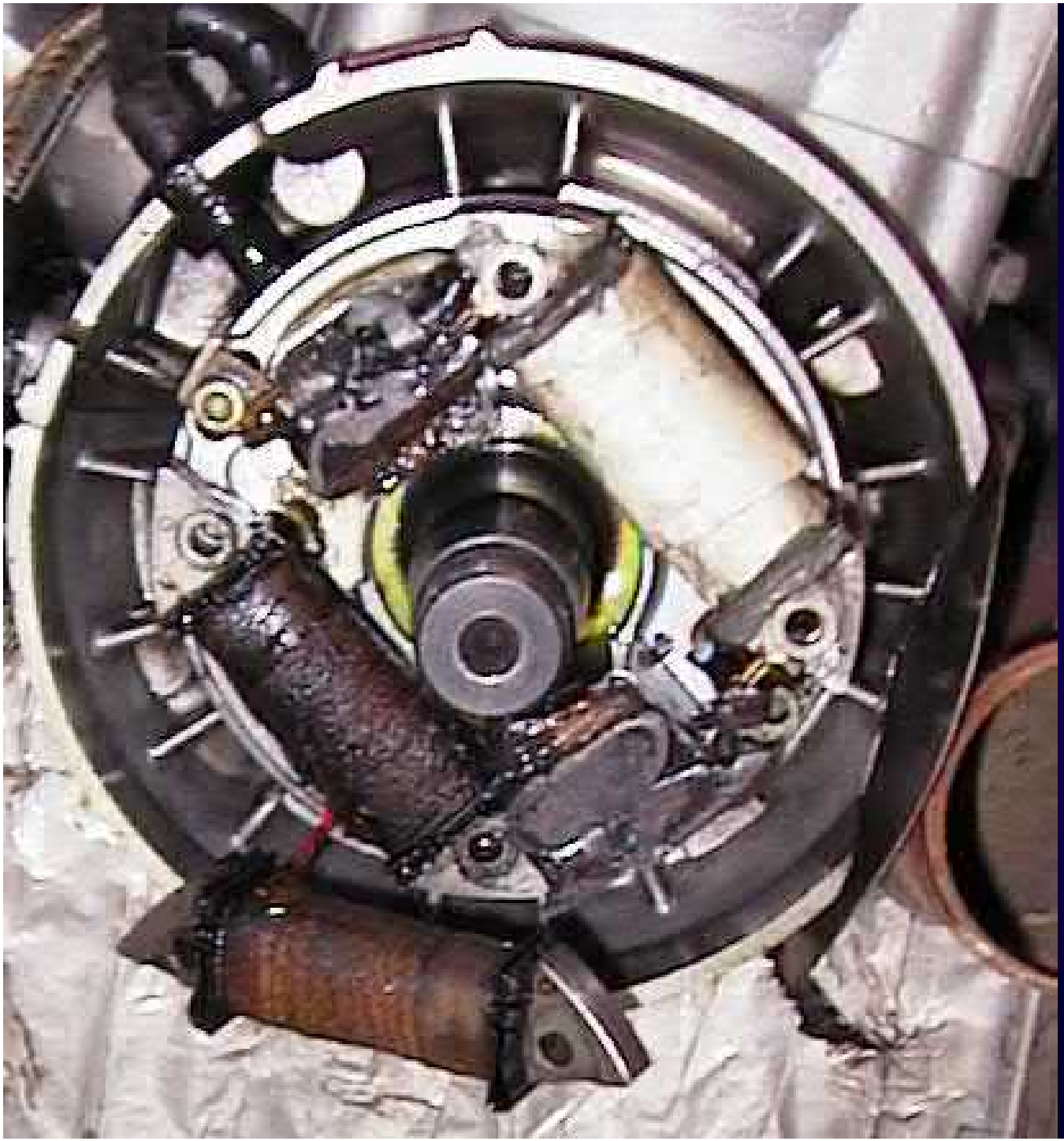
Rotax 535 iginition plate

Coils (generator and ignition) have burnt out several times

Heat and

vibrations



Rotax 535 iginition plate after 17 hours since revised at SHK.

Then I decided to invest into the Solo

conversion

- Electronic Ignition (E-boxes)

-Ducati modified to fit Bosch ignition. Why not keeping the original which works beautifully on ULM?

-Every owner looking for a solution

-Both boxes lost in flight (vibrations)

-Spare connectors and a welder always on board!

Original 1998 (Rotax) and again 2005 (Solo)

Both boxes lost in flight!

Modified by owner: no connectors and e-boxes at centerline of vibrations

Modified by owner: original connectors and e-boxes at centerline of vibrations

Modified by owner: no connectors and e-boxes at centerline of vibrations

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- FUEL TANKS:

-6 tanks in 6 years

-Extremely dangerous: requires derigging with the hands and arms swimming in the gasoline!

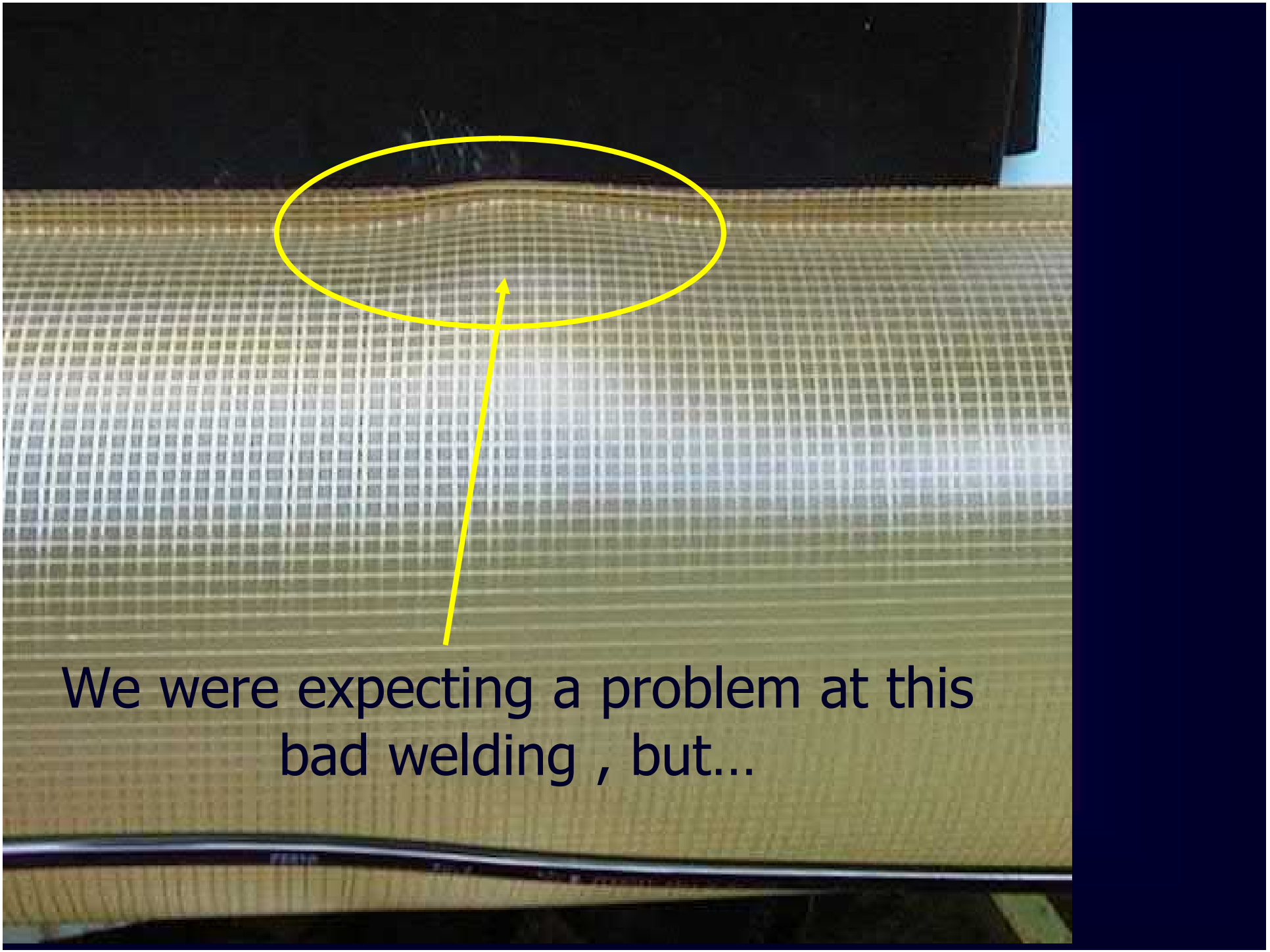
-After 4 years, manufacturer said to have found the reason, but not true.

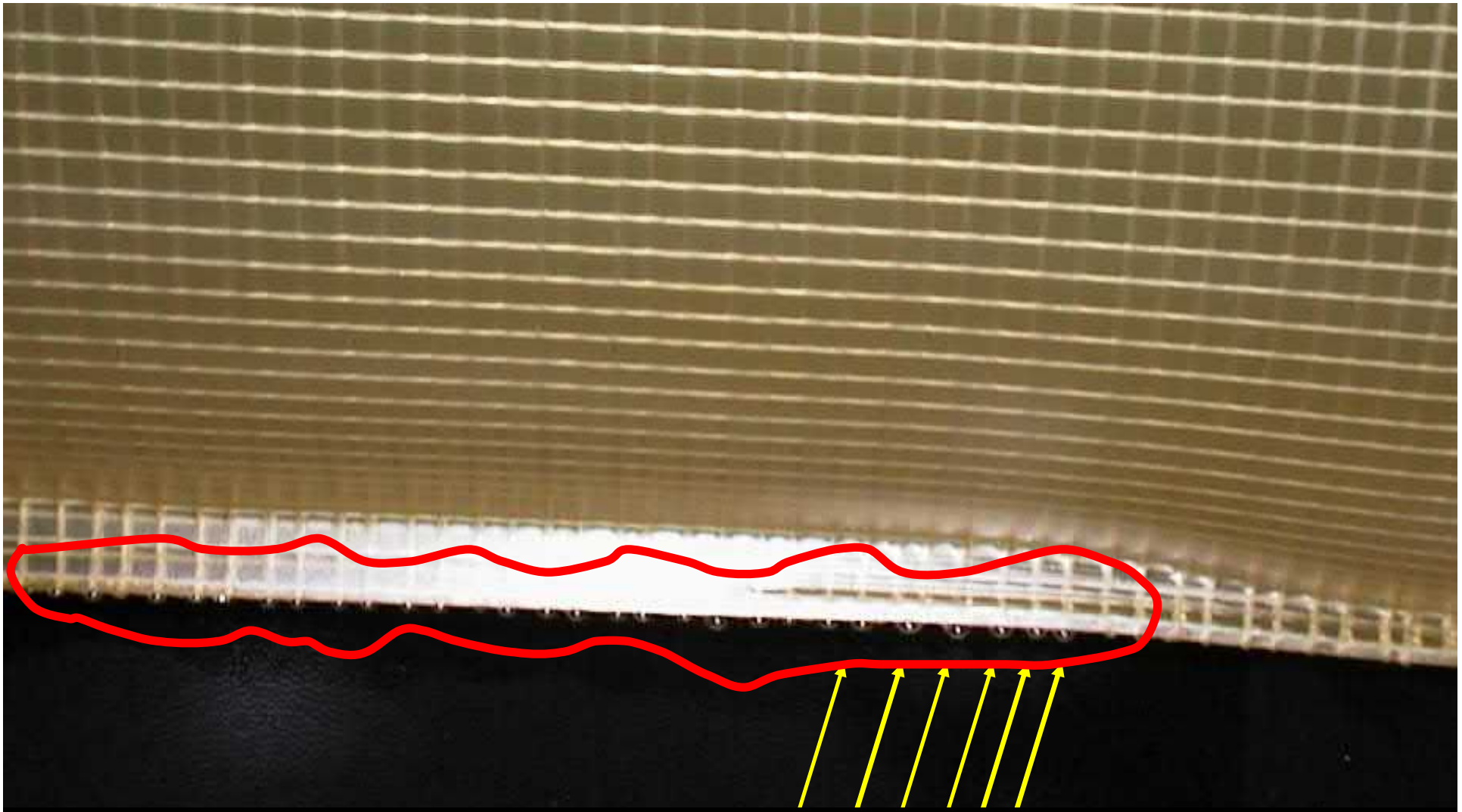
-Steve Fossett: brand new ASH25Mi, already leaking (used my spare for WR)

PRESSURE TEST

According to the manufacturer

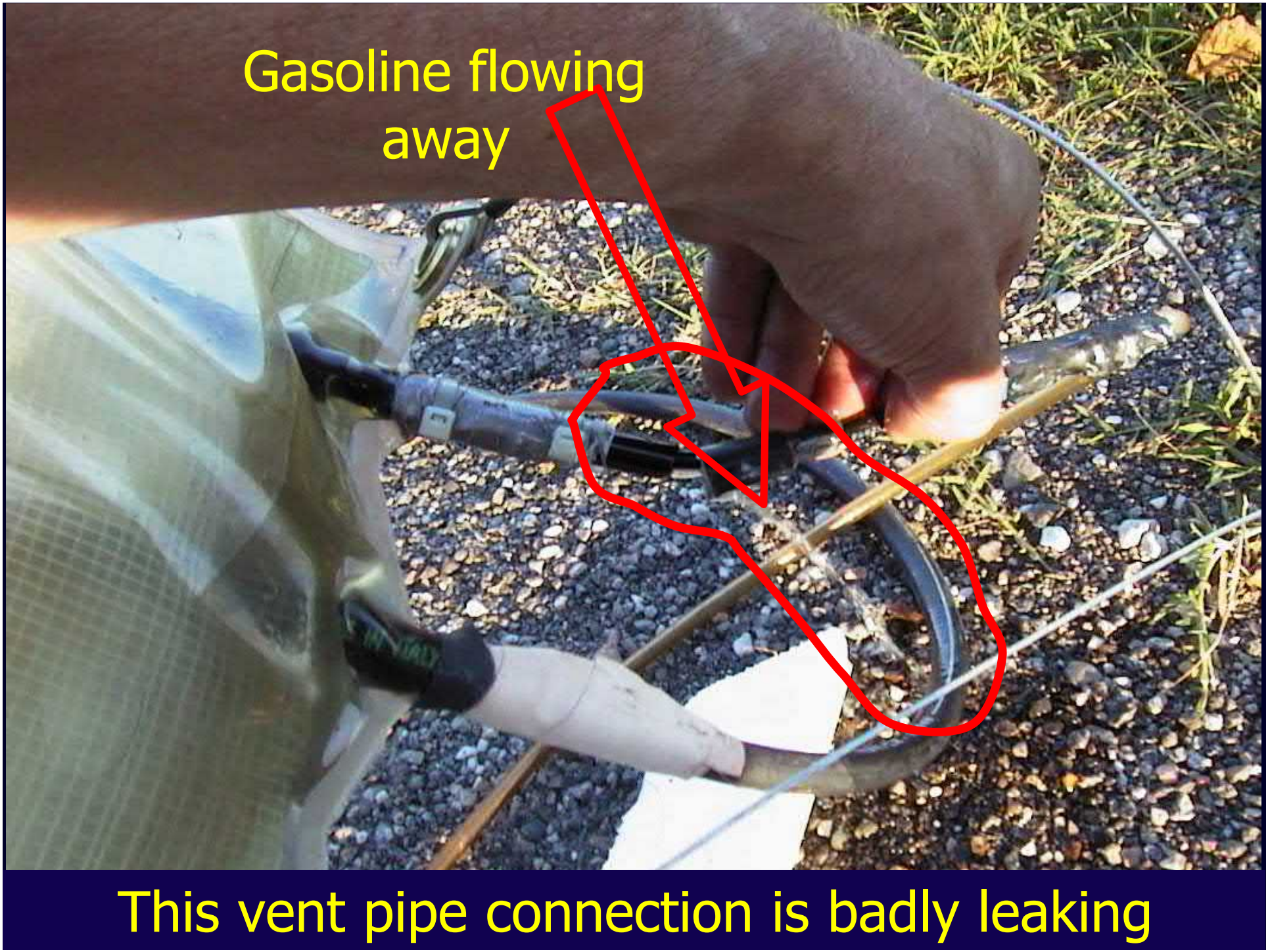
at 1,5 mWC pressure


We were expecting a problem at this bad welding , but…



Every reinforcing yarn was leaking.

A drop can be seen on each one, except on the bad weld!



This vent pipe connection is badly leaking

At every refilling, all quick couplings have to be open and gasoline drops onto the electric switch.

- GASOLINE TUBES:

  - What about the resistance to fire or squeeze of clear polyurethane tubes (Newly adopted)?

  - Why not applying aircraft aluminium safe tubes and nipples?

Garden type quick couplings are applied on gasoline on Stemme S10! About JAR Form 1 ?

FUEL TANKS:

Cessna has been using rubber flexible tanks since 50 years on thousands of most popular and trouble free aircraft.

Why not first looking to what the others are doing?

How can LBA certify such a mess?

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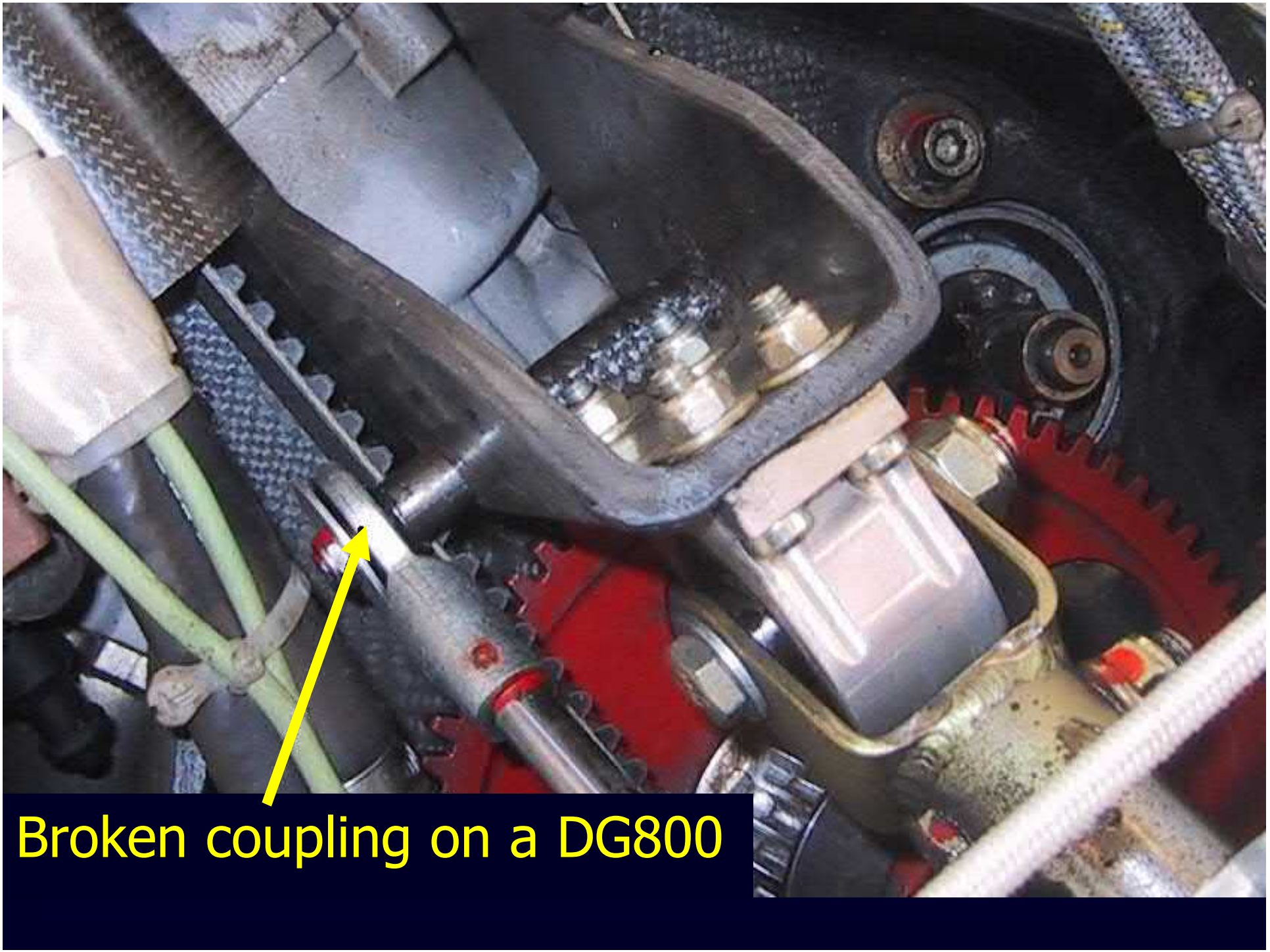
Broken coupling on a DG800

SHK Spindle support: Until September 2000, the (4) screws of the spindle drive were not secured. One fell away!

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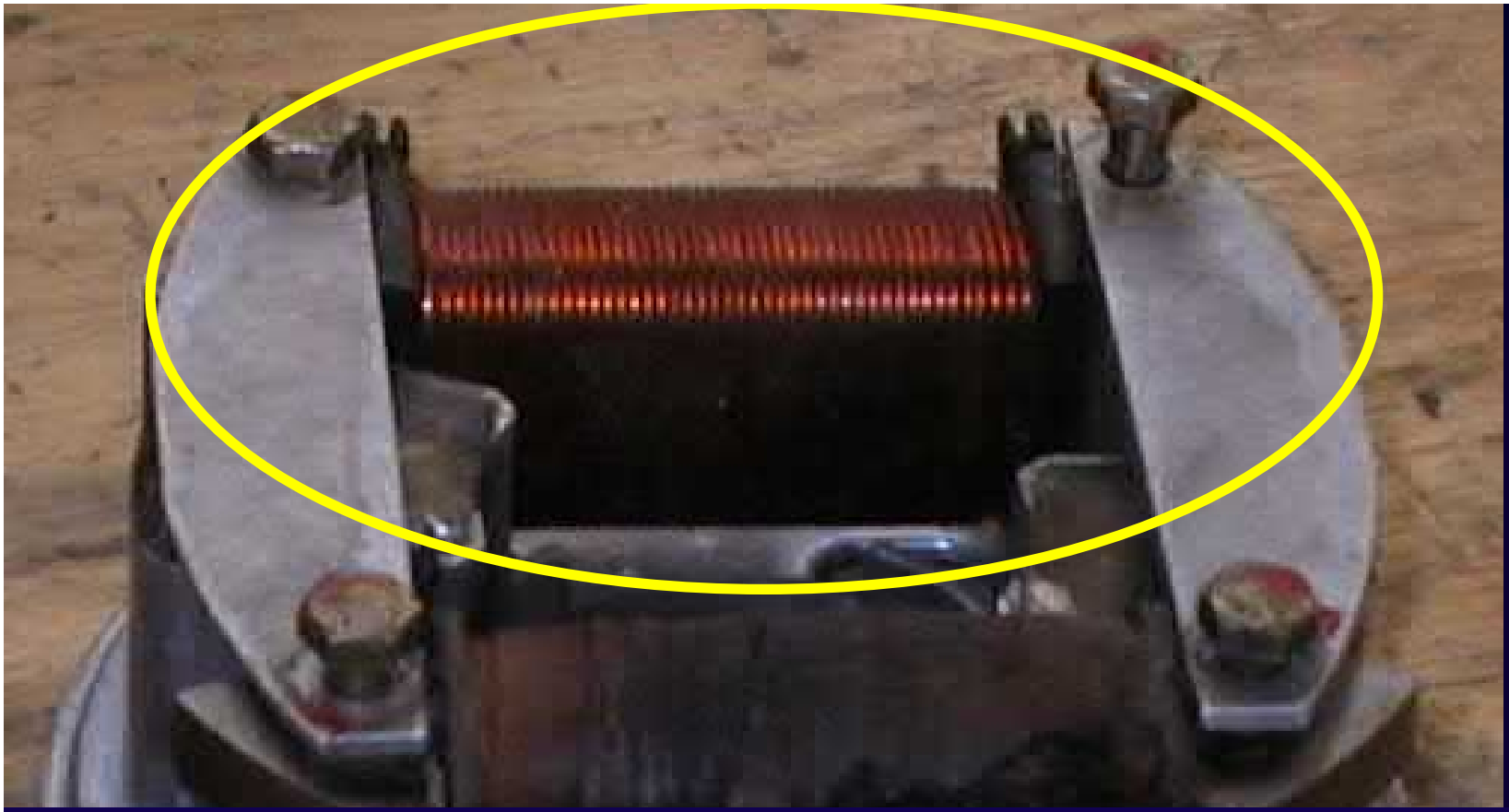
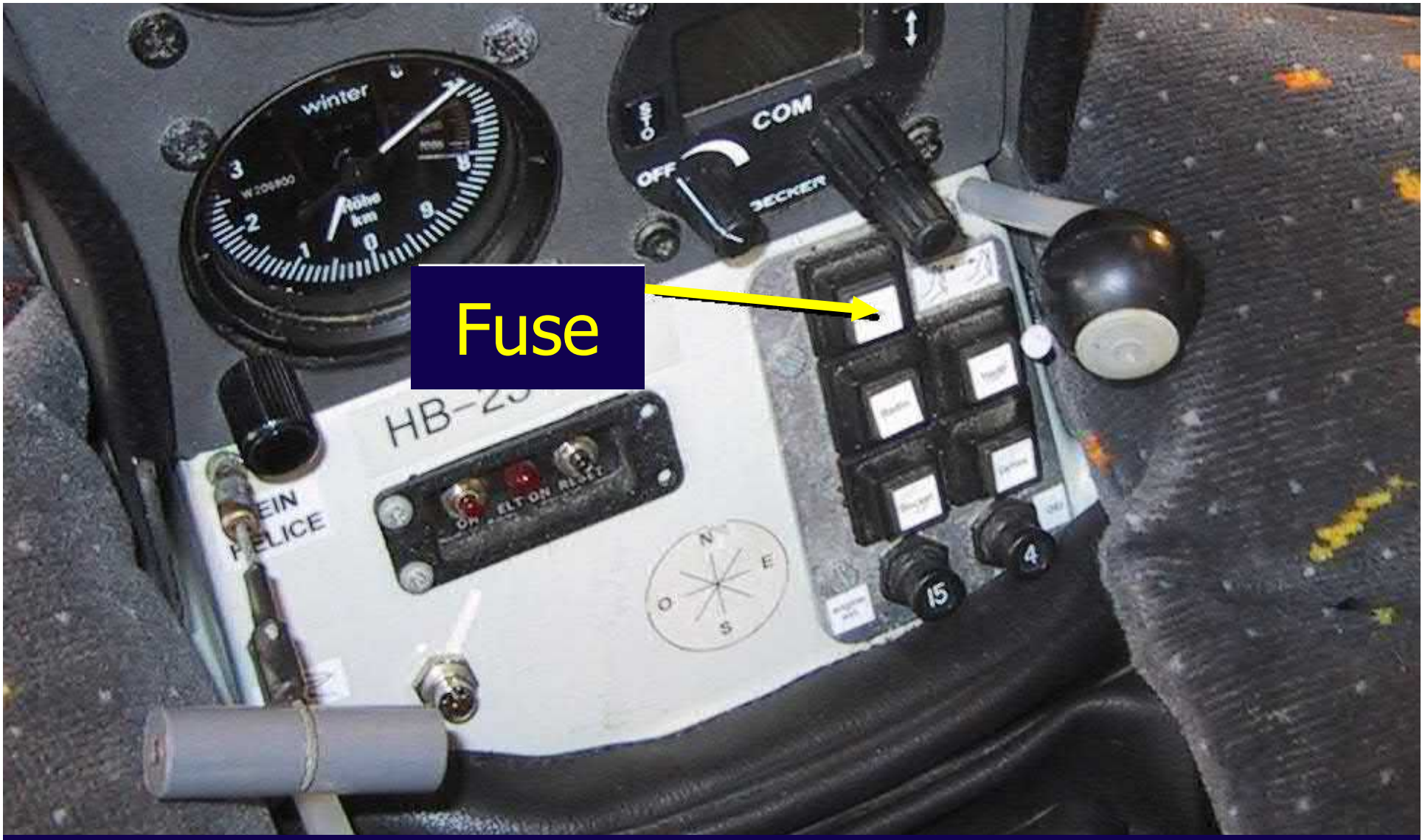


- The generator coil is submitted to the same vibrations and heat than the ignition coils. Same result:
  - 2 failures in 120 hours with Rotax
  - 1 failure after 10 hours with Solo



DG 800: the same fuse is used for charging in flight and on the ground: no more charging possible.
Engine may not move!

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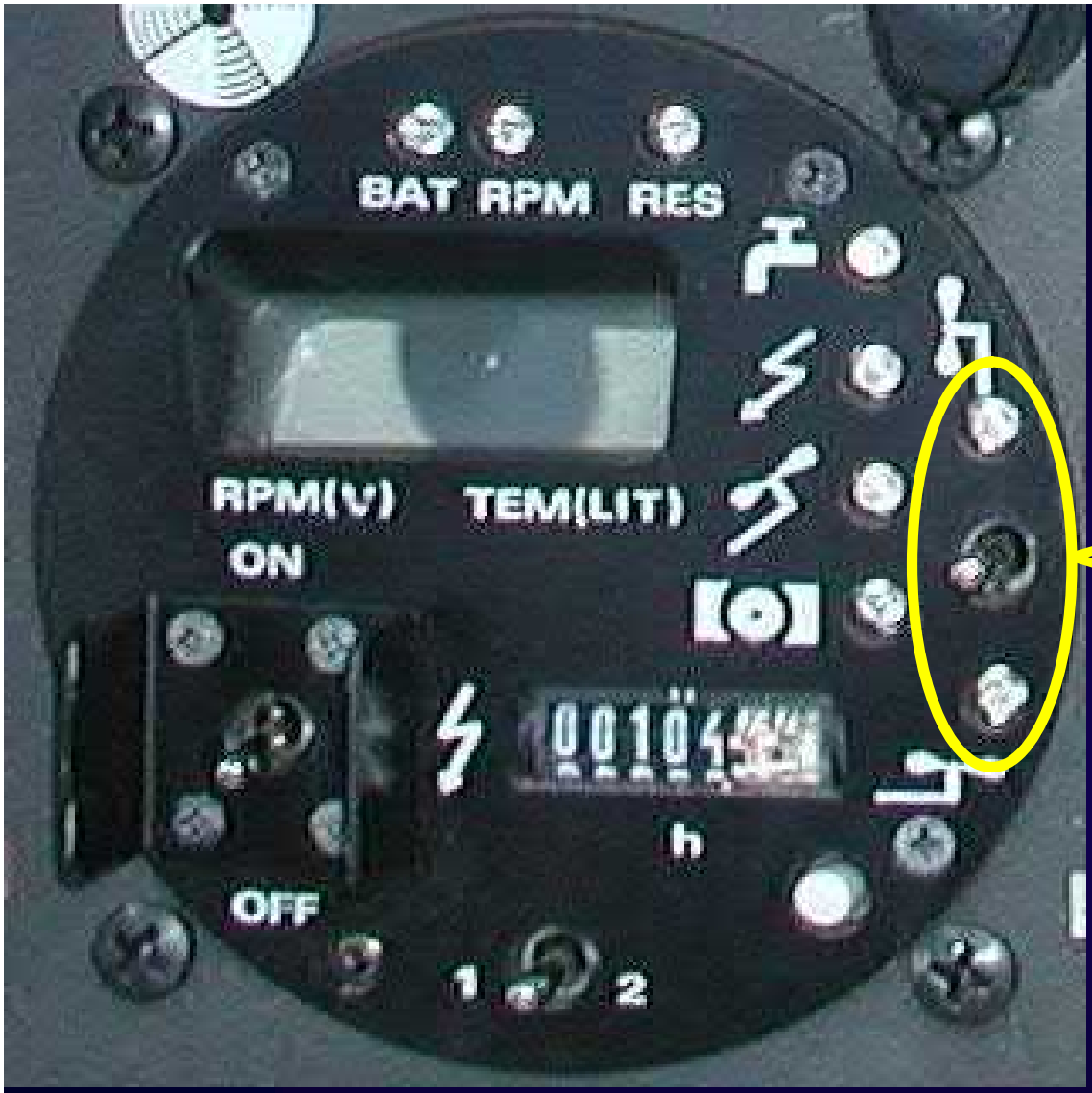
CONTROL BOX

ILEC with Binder (SHK)

DEI with DG

Many have shown problems, mainly due to vibrations and use of standard not aviation inadeguate accessories

- Broken switch: engine does not move!
- Pylon limit switch seezed: idem.
- Connector not secured, falls during flight: engine does not stop and does not move!
- Fuel quantity never correct



This 1 € switch failed, impossible to retract the engine!

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9. Control system and interlocks
10. Exhaust gas ducts and muffler

- EXHAUST GAS

  - ASH25E: springs often fail

  - On Rotax 535, the elbow is too near the ignition case opening (see chapter on ignition)

  - High temperature near fuselage and wires

  - Almost all engines: untuned mufflers means a lot of waste power

What remains of the electric starter cable binders after 120 hours.

VIBRATIONS – Low Frequency

- Almost (not all) belt breaks occur at start on the ground. Had 4 belt breaks in 7 years

- Engine iginition firing is optimized at 6.500 rpm

- Initial firing occurs at 500-1000 rpm = engine tends to start reverse!

VARIABLE FIRING TIMING?


Décollage matinal avec Diego

VIBRATIONS – High Frequency

In 7 years, lost:

- 1 Radio
- 3 Turn & Banks
- 2 Artificial horizons
- 2 IGC loggers
- 1 Transponder
- 2 Strobe lights
- 2 Solar cell regulators

NO SHOCK ABSORBER ON THE INSTRUMENT PANEL !!

Result of vibrations: the instrument panel broke on both weaker sides.

WHOSE FAULT FOR ALL THESE TROUBLE?

THE DESIGNER

- for inventing “crazy” solutions
- not making proper testing
- insufficient return of experience
- not following the specifications of the manufacturers of accessories
- using inadeguate or low cost equipement
- not developing the culture of high risk equipment

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THE CUSTOMER

- for buying crazy systems
- paying twice its value
- keeping a low profile when a problem occurs
- not disseminating the info (with exception of the USA)

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THE CERTIFYING BODY (LBA)

- Certifying crazy or obviously unsafe solutions (e.g. ignition, gasoline, wiring, engine modifications, etc.)
- Certifying workshops showing a clearly poor workmanship
- Certifying without knowledge

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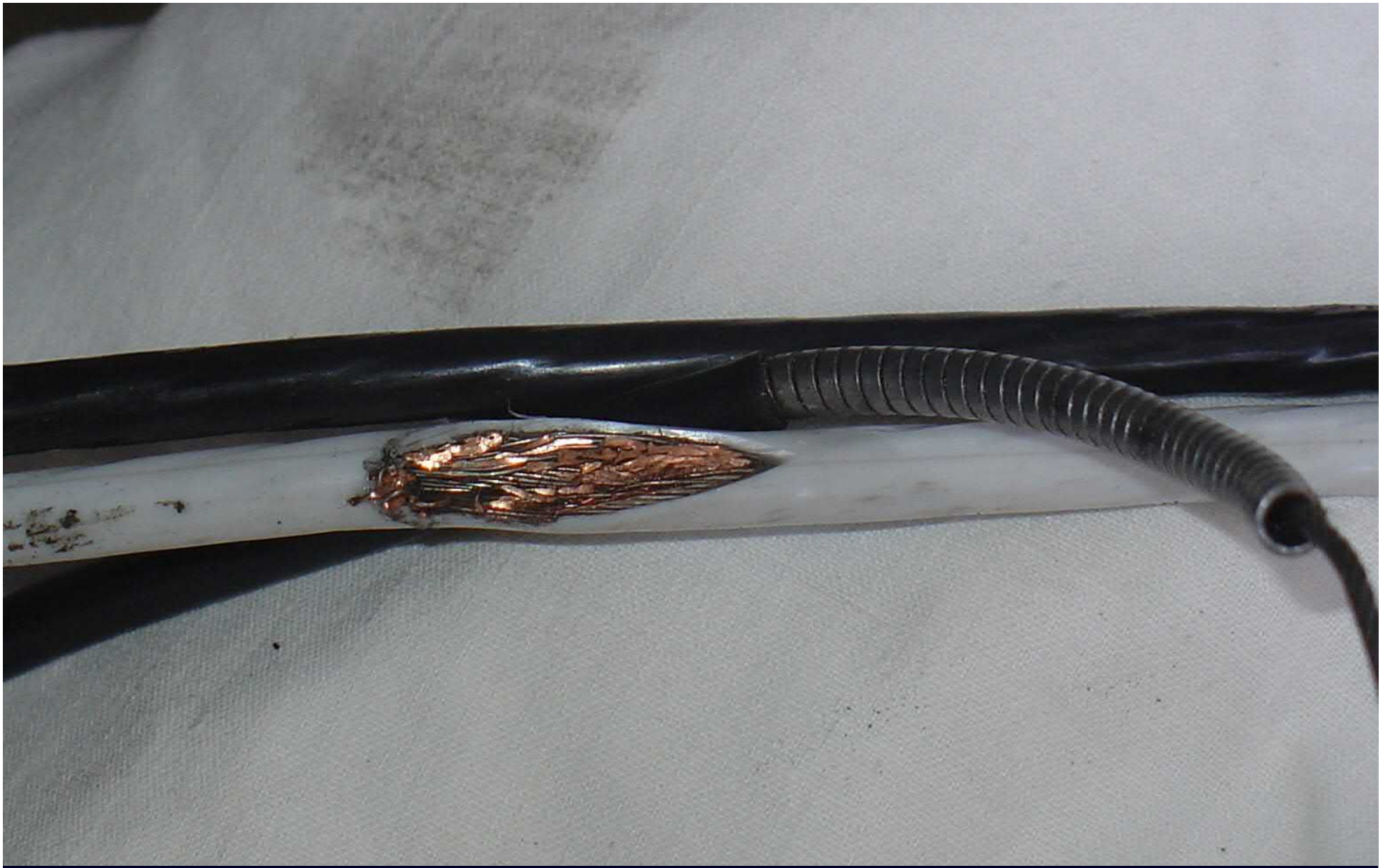
THE WAY FOR PROGRESS IS FREEDOM

- Create a special category for the motorization of gliders
- Issue recommendations for design criterion, accessories
- Allow owners and reliable mechanics to apply modifications when reasonably sound

THE WAY FOR PROGRESS IS FREEDOM

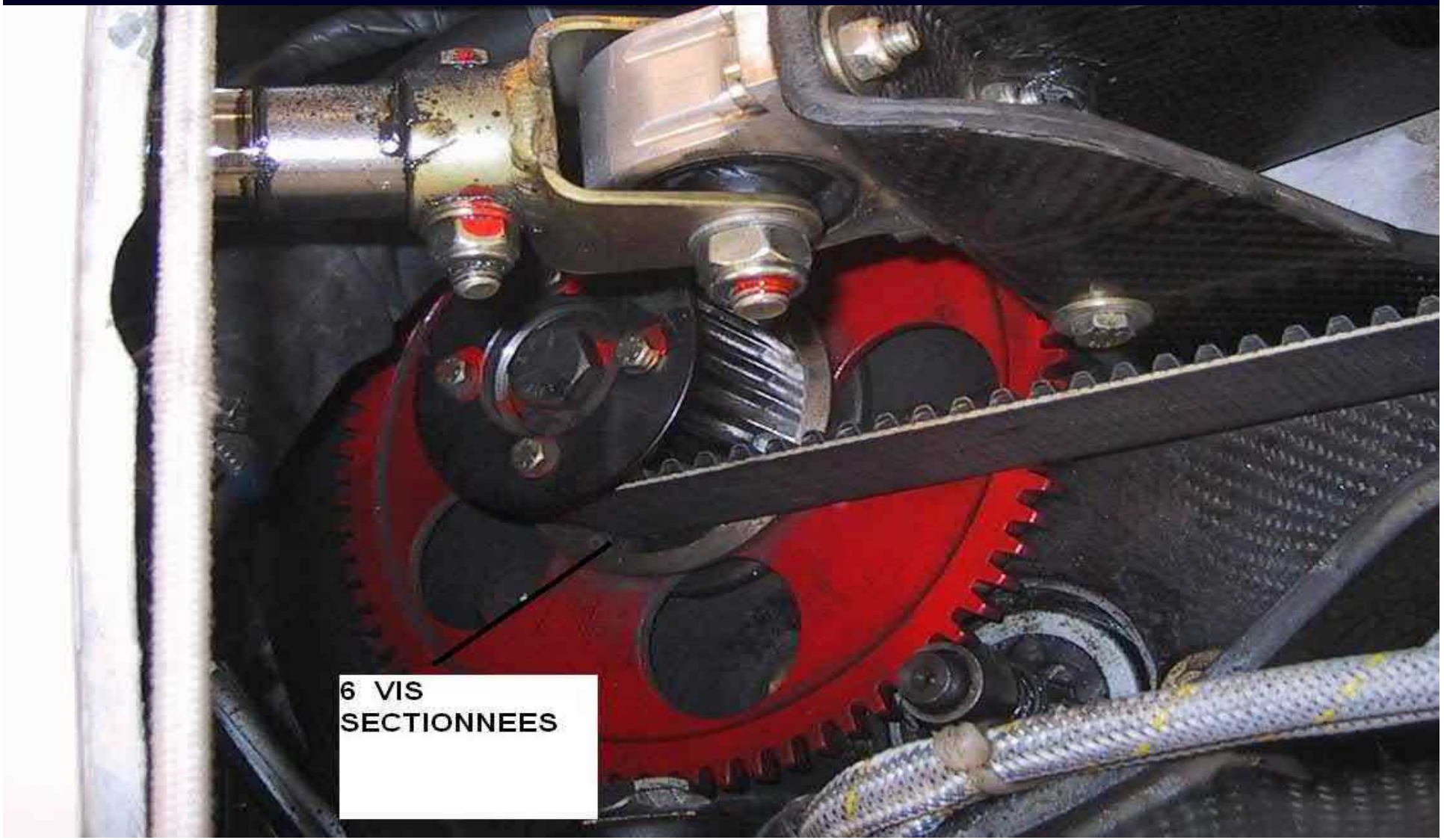
- Cancel the monopoly of so-called "certified" workshops (the worse result ever seen!)
- Transfer responsibility to the owner.

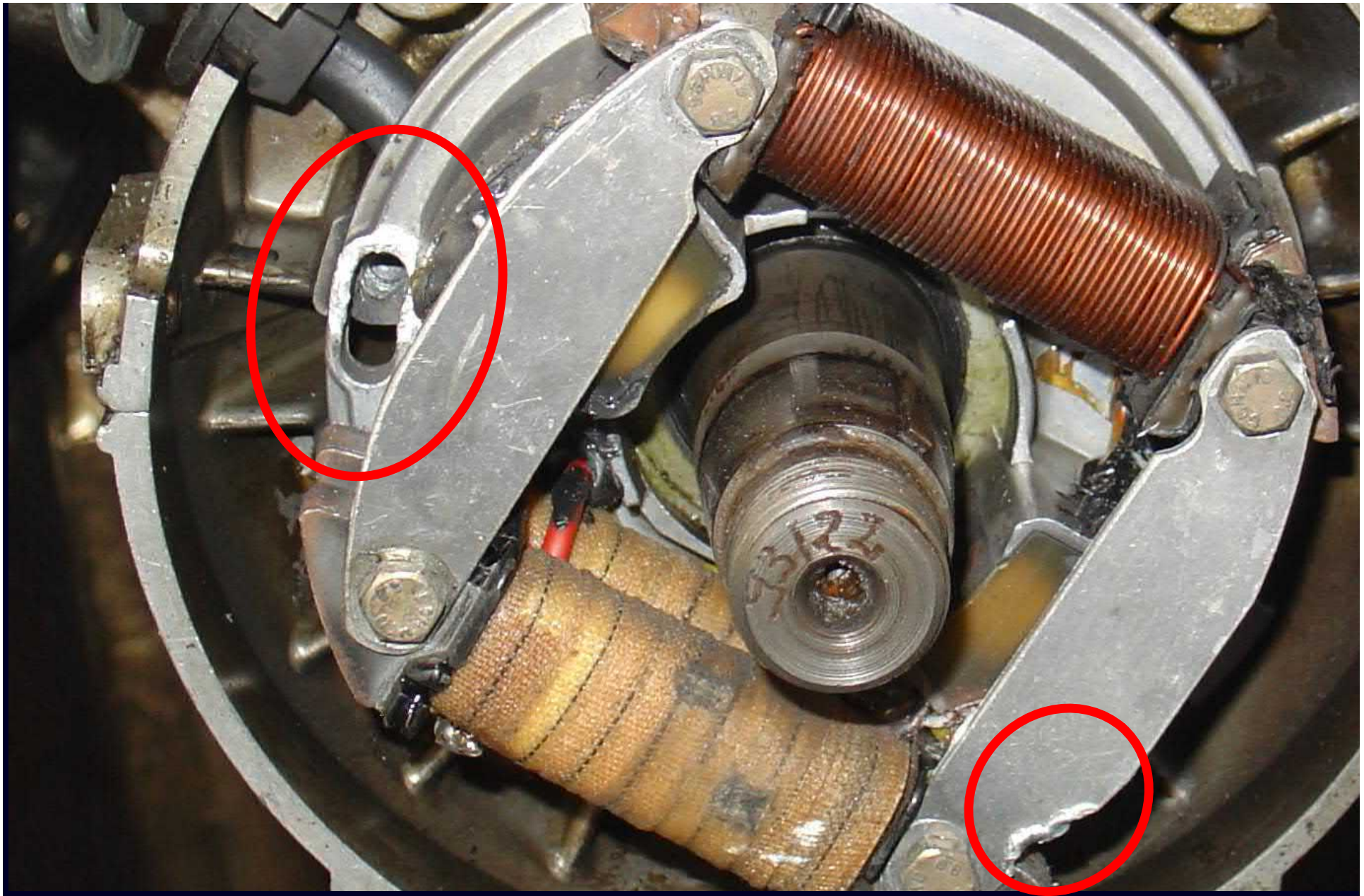
Return from a “certifed” german workshop: a nut was found within the magnet group...



Starter cable (POSITIVE) few hours after return from a “certified” german workshop.

The gear was painted before tightening the screws: vibrations made all unscrewed away, gear lost.





Engine back from Total Overhaul by German "certifed" workshop:
timing screws unsecured went away, glider grounded for months

HELP CUTTING COSTS!

- Why should we pay the standard belt 182 € at Binder's and 128 € (+ 42%) at the corner's shop?
- Why should we pay 3.000 € for a mandatory TBO when the engine was OK before and fails right after
- Why not a guarantee in hours, not calendar, like for cars?

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HOLIDAY

IN

PATAGONIA


NEVER FORGET THAT
YOU ALWAYS NEED AN ENGINE...
THANK YOU FOR YOUR ATTENTION !