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Challenges for Aircraft Recovery Teams of Airports

Aircraft Rescue and Fire Fighting Conference

27 – 29 February 2024

KUNZ Aircraft Equipment

ICAO Regulations



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ICAO Annex 14

Annex 14 to the Convention on the International Civil Aviation Organization for Aerodromes contains the basic standards and recommendations (SARPs) for Aerodrome Design and Operation.
Annex 14 refers to various manuals, procedures and circulars.



ICAO Doc 9774: Manual on Certification of Aerodromes

Purpose:

- Provide guidance for a state in establishing their regulatory system for the certification of aerodromes
- Provide guidance for on aerodrome certification procedures

ICAO Doc 9774: Manual on Certification of Aerodromes

What is mentioned in this document regarding the Disabled Aircraft Removal?

Chapter 4: Aerodrome Certification Procedures

Subchapter 4.4: **Assessment of a formal application** for an aerodrome certificate

Paragraph 4.4.4: A site visit should be undertaken for the purpose of **assessing the aerodrome facilities**, services and equipment to verify and ensure that they comply with the specified standards and practices. This should include:

...

14) **disabled aircraft removal equipment**

ICAO Doc 9774: Manual on Certification of Aerodromes

Who is in charge to ensure this?

All states have to establish an **entity within the CAA called the Directorate of Aerodromes Standards and Safety (DASS).**

It is the responsibility of the Directorate of Aerodromes Standards and Safety to **ensure that ICAO is getting informed about any differences between the International Standards contained in Annex 14, Volume I and national regulations.**

The **duties of aerodrome inspectors** should include

- **on-site verification and audits** of aerodrome operating procedures **including the removal of disabled aircraft and**
- **the on-site checking and testing** of aerodrome facilities and equipment **including the disabled aircraft removal plan.**

ICAO Doc 9774: Manual on Certification of Aerodromes

Appendix 1, Part 3: Particulars of the aerodrome required to be reported to the Aeronautical Information Service (AIS)

3.2. Aerodrome dimensions and related information
General information, including the following:

...

p) **disabled aircraft removal plan:**

- the telephone/telex/facsimile numbers and e-mail address of the aerodrome coordinator for the removal of a disabled aircraft on or adjacent to the movement area,
- Information on the capability to remove a disabled aircraft, expressed in terms of the largest type of aircraft which the aerodrome is equipped to remove

ICAO Doc 9774: Manual on Certification of Aerodromes

Appendix 1, Part 4: Particulars of the aerodrome operating procedures and safety measures

4.14. Removal of disabled aircraft

Particulars of the procedures for removing a disabled aircraft on or adjacent to the movement area, including the following:

- a) the roles of the aerodrome operator and the holder of the aircraft certificate of registration;
- b) arrangements for notifying the holder of the certificate of registration
- c) arrangements for liaising with the air traffic control unit
- d) arrangements for obtaining equipment and personnel to remove the disabled aircraft; and
- e) the names, role and telephone numbers of persons responsible for arranging for the removal of disabled aircraft.

ICAO Doc 9774: Manual on Certification of Aerodromes

Summary:

The ICAO Doc 9774: Manual on Certification of Aerodromes was **published in 2001** and if there are no deviating national guidelines existing, every airport should comply with the previously presented slides.

So far, so good



But....

ICAO is working on a Proposed Amendment to the Annex 14!

The following changes are discussed in the moment, which will lead to more detailed requirements for the airports.

ICAO Proposed Amendment to the Annex 14

9.3 Disabled aircraft removal

9.3.2 Recommendation.— The disabled aircraft removal plan should be based on the characteristics of the aircraft that may normally be expected to operate at the aerodrome, and include among other things:

...

- b) a list of equipment and personnel **on, or in the vicinity of, the aerodrome** which would be available for such purpose; and
- c) arrangements for the **rapid receipt of aircraft recovery equipment kits** available from other aerodromes.

ICAO Proposed Amendment to the Annex 14

10.2 Objectives

10.2.2 The aerodrome's disabled aircraft removal plan shall contain:

- ...
- b) the **available capabilities to remove disabled aircraft**;
- c) procedures and measures to reduce the risks posed by the disabled aircraft to personnel, facilities and equipment, including provisions for the **prevention of secondary damage** and environmental contamination;
- ...
- e) **details of any third parties** subcontracted to perform disabled aircraft recovery operations; and
- f) the **criteria to take over the disabled aircraft removal operation** when the aircraft operator fails to take the responsibility for the removal operation.

...

ICAO Proposed Amendment to the Annex 14

10.2.4 The aerodrome operator shall ensure that **all relevant personnel** involved in the aerodrome's disabled aircraft removal plan **are trained and competent** to perform their duties in a safe and efficient manner.

10.2.5 The aerodrome operator shall ensure that **personnel involved** in the aerodrome's disabled aircraft removal plan **participate in live aircraft recovery drills commensurate with the types of aircraft and recovery equipment in use** at the aerodrome.

10.3.10 The aerodrome operator should ensure that **theoretical and practical disabled aircraft removal training is provided to all personnel involved in the aerodrome's disabled aircraft removal plan.**

Note. — In the case where the disabled aircraft removal operations are performed primarily by an aircraft operator, the responsibility for ensuring theoretical and practical training should lie with the aircraft operator.

ICAO Proposed Amendment to the Annex 14

10.3.11 **Theoretical disabled aircraft removal training** should include as a minimum:

- a) planning the operation;
- b) aircraft specific removal procedures;
- c) legal responsibilities;
- d) weight and balance principles;
- e) recording and reporting procedures; and
- f) leading an aircraft recovery operation.

10.3.12 **Practical training** should be conducted based **different credible scenarios using all available equipment listed in the disabled aircraft removal plan.**

Practical training can also include training with various types of equipment available in the market.

ICAO Proposed Amendment to the Annex 14

10.3.14 When conducting disabled aircraft removal operations, **prevention of secondary damage** to the aircraft should not generate further delays for the timely and efficient aircraft removal operation.

10.3.15 Details of the aircraft removal operation should be recorded and reported. These details should include but are not limited to the following:

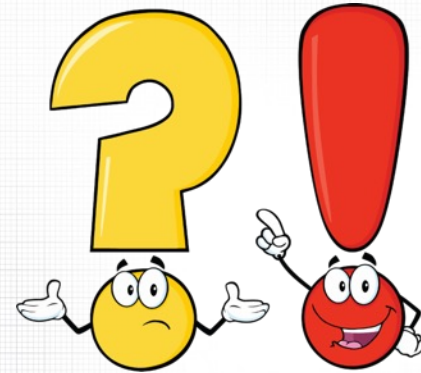
...

- d) the **technique used** to level and lift the aircraft, such as jacks, cranes, lifting bags or combination thereof;
- e) the **loads imposed** during levelling and lifting;
- f) the **loads imposed** on tethers;
- g) the **loads imposed** on the landing gear during the movement of the aircraft to a hard surface;

...

Now it is getting interesting....

- a list of equipment and personnel on, or in the vicinity
- arrangements for the rapid receipt of aircraft recovery equipment kits
- live recovery drills commensurate with the types of aircraft and recovery equipment in use
- theoretical and practical disabled aircraft removal training for the staff involved
- prevention of secondary damage
- technique used
- loads imposed



ICAO Annex 14

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ICAO Doc 9137: ASM Part 5 – Removal of Disabled Aircraft

Purpose:

- Provide assistance to identify relevant problems to remove the disabled aircraft
- Provide guidance in preparing and implementing and adequate plan of action to remove the disabled aircraft.

Now the issue starts...

ICAO ASM Part 5
Removal of Disabled Aircraft

Foreword

“This manual contains guidance on the removal of disabled aircraft and is intended to be used by airport and aircraft operators planning for the processes required to recover aircraft.”

Paragraph 1.4.4 a)

“It is imperative that the aircraft manufacturers’ Aircraft Recovery Manual be consulted prior to initiating the aircraft recovery process.”



ARMs and ARDs of Aircraft Manufacturers



Who has access to Aircraft Recovery Manuals?

- Normally only the aircraft operator

It seems like Boeing is now allowing airports to enter into licensing agreements

- Last week we have been notified that Boeing's IP department is considering to enter into licensing agreements with airports and potentially other involved parties like CAAs.

Point of Contact:

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Aircraft Recovery Manuals



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Load limits are relevant to prevent secondary damage

- Aircraft recovery manuals are listing a variety of limits of the aircraft that should not be exceeded, such as:
 - Skin pressure allowances
 - Vertical and horizontal forces to the jack point
 - Allowed forces to the frame structure
 - Pulling forces to the landing gear

Exceeding the allowed limits may result in secondary damage!

Lifting with Pneumatic Bags and Jacks

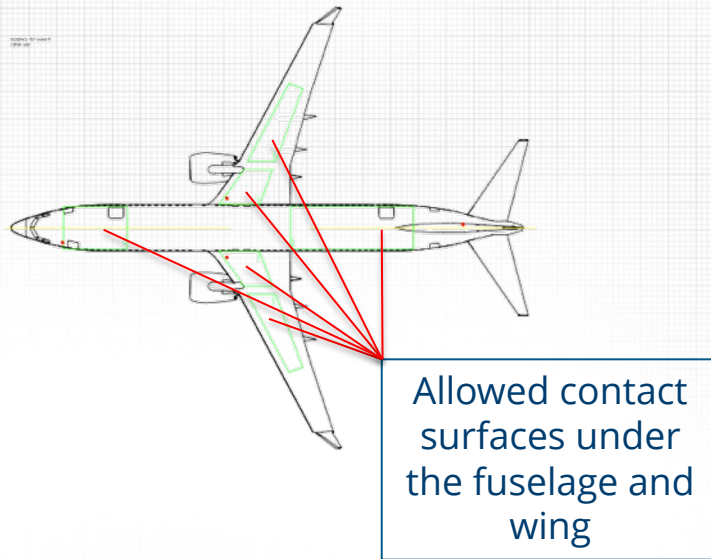


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Allowed areas for the use of low-pressure lifting bags and allowed forces

Standard placement options



Examples for the allowed skin surface pressure:

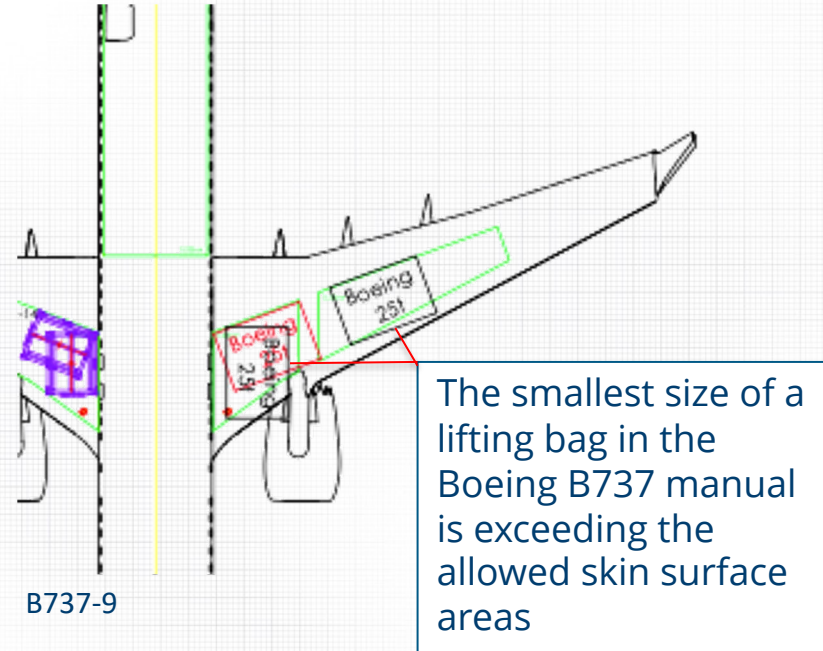
Boeing B737Max – between 3,5 and 4,5 PSI (0,25 or 0,32 bar)

Airbus A320 fam. – 7 PSI (0,48 bar)

The sizes and quantities of low-pressure lifting bags are determined by the net recoverable weight of the aircraft, the available aircraft surfaces, the allowed skin pressure in these areas and the required lifting heights.

Sizing of lifting bags

- Sizes of lifting bags in the market might not be compliant to allowed underwing areas
- Even dimensions of lifting bags provided in aircraft recovery documents are not suitable for the respective aircraft

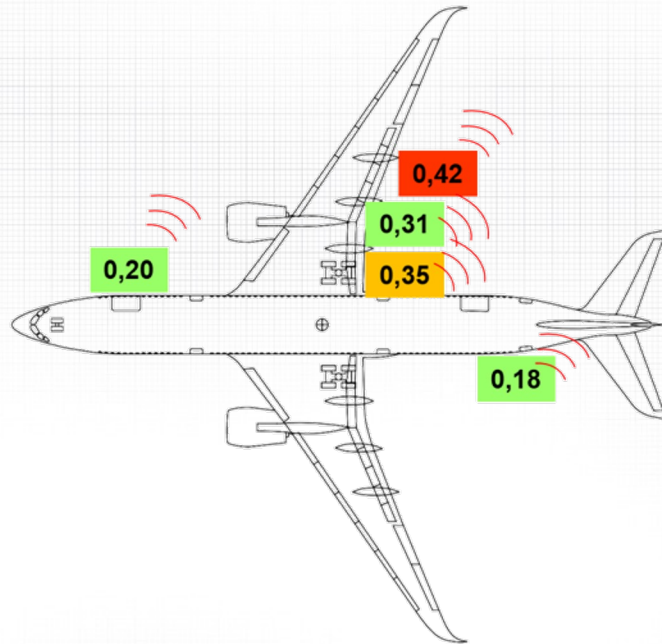


Low-Pressure Lifting Bags in contact with skin surfaces



KUNZ RLB Recovery Lifting Bags with max 0,5 bar operating pressure

Skin pressure monitoring

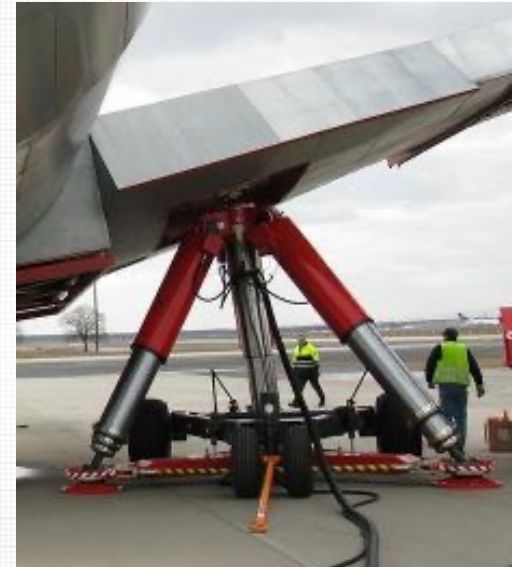


Visual signals indicate and record the arising loads!

The recovery manager has a permanent overview on all loads applied to the aircraft!
Measurements are getting recorded.

Potential use of jacking points for levelling

- Hydraulic recovery jacks or high-pressure pneumatic bags are available in the market that use the jacking point in recovery scenarios.
- In several aircraft recovery documents, the aircraft manufacturers are recommending the use of load cells and lifting devices with **side load measuring equipment**, that can accurately record the jacking point side loads.



Source: Hydro

Horizontal loads to the jack point that appear during the arc movement must be monitored, recorded and reported according to Airbus Recovery Manuals.

The use of pneumatic lifting bags for levelling



*“As for the angle, the answer is yes, I sent a message to your engineering team asking what was recommended and at the same time said that we did in Antarctica Recovery (C-130) with an angle of about **20 degrees!**”*
Marcelo Miranda – former LATAM Recovery Manager

Modern low-pressure lifting bags automatically adjust to arc-travel during the lifting process and the jack point can still be used to provide solid support after levelling

Lifting with Slings



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Design requirements for sling assemblies

Width adjustment

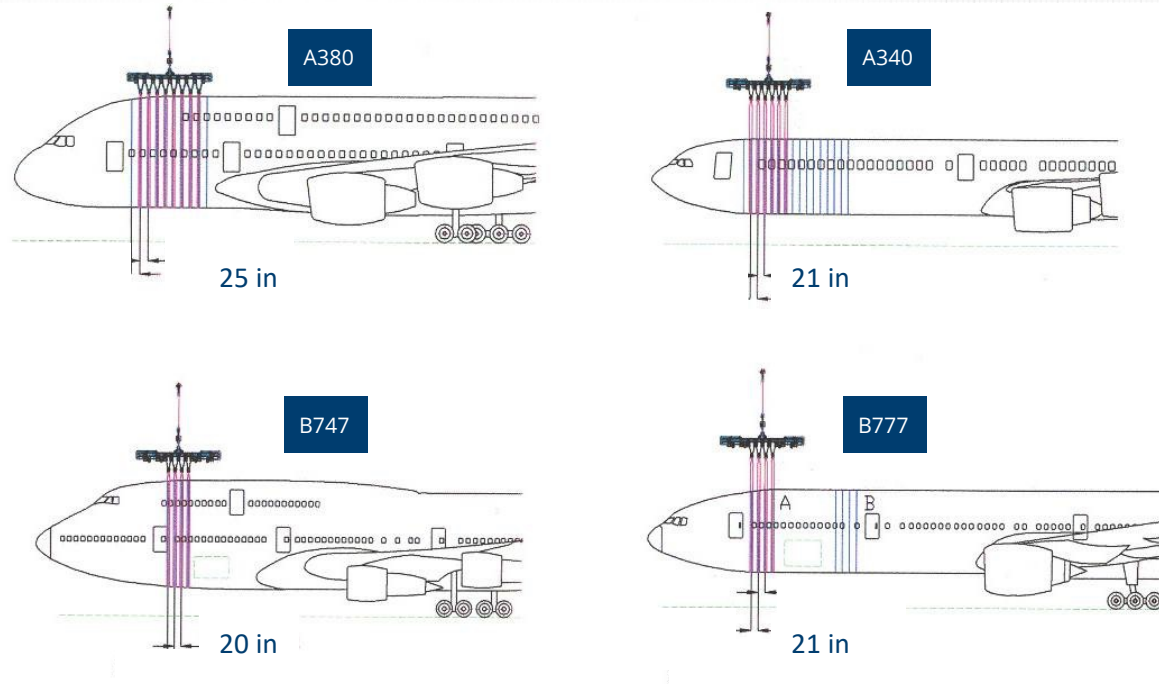
- The slings must be installed at the exact location of the frame and centered on the frame rivet line.
- Different aircraft types have different distances between the frames.

Length adjustment

- As per industry standard DIN EN 1492-2 textile slings can vary within in tolerance of 2% in length.
- Considering a length of 17,5m for the slings used for aircraft lifting, the length might vary up to 35cm.

Sling adapters must adapt individually to each aircraft type

Frame distances (Examples)

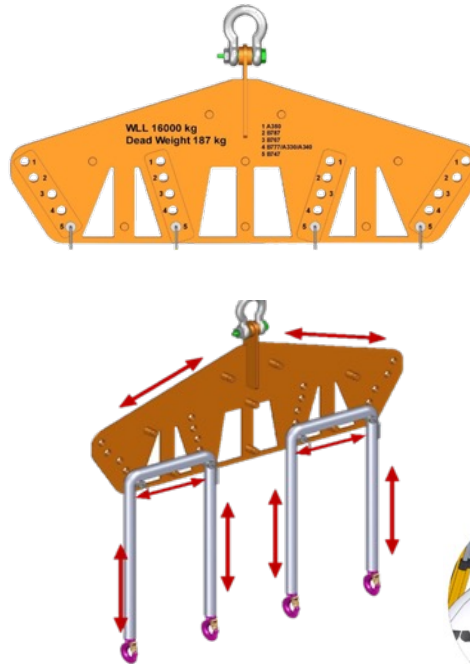


Example wording of an aircraft recovery manual:

“The multiple-sling adaptor makes a link between the fuselage slings. **The function of the adaptor is to make sure that the loads are equally applied to each sling** and to keep the same distance between the slings as the frame pitch.”

KUNZ Lifting Slings ALS CAT III and ALS-T CAT IV

- The distance of the sling assembly is manually adjustable by means of a “pin-plug”-system to match the different fuselage frame positions as specified by aircraft manufacturers like Airbus, Boeing, Embraer and others
- The effective sling length is self-adjusting for each component sling of the assembly



Debogging



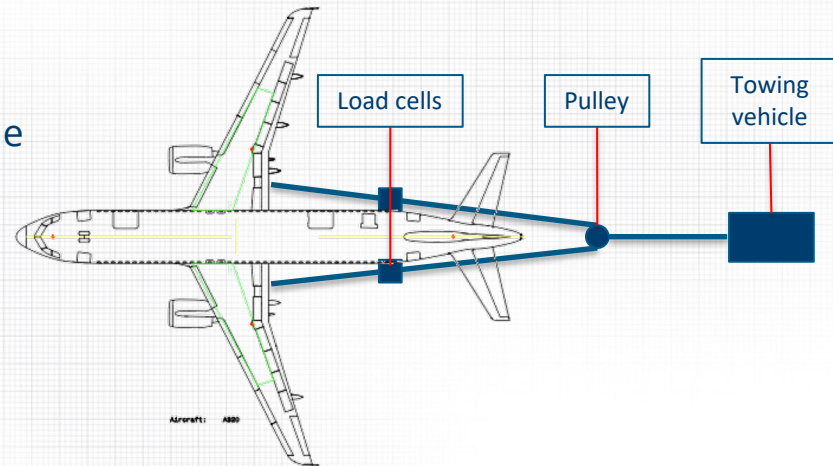
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Debugging requirements

Example wording of an aircraft recovery manual:

“Use slings or straps between the airplane and the tow vehicle or winch. The slings or straps must have applicable fittings and sufficient strength for the required load and safety factors. Use a load indicating device or equivalent between the gear and the slings or straps to prevent damage to the gear from a dangerous load.”



Load indication mentioned, no load recording.

Recording of pulling forces

KUNZ AETS Aircraft Emergency Towing Set - Debugging



Load Cells and Remote Control for monitoring of loads

Each debuging line is getting monitored and recorded

Moving



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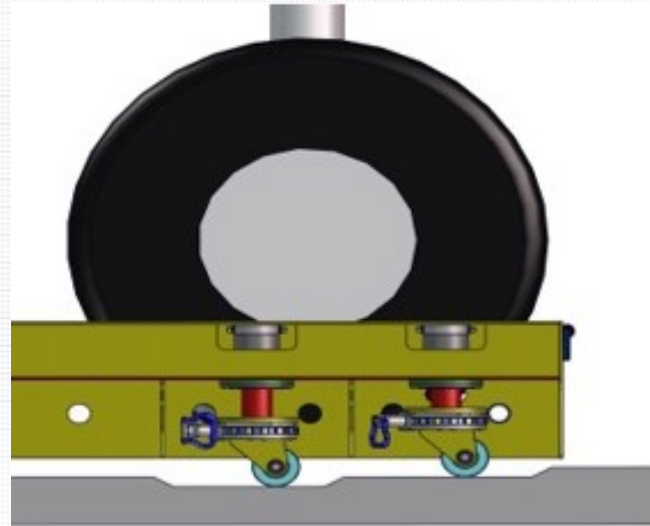
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Damaged Brakes and Burst Tire scenario



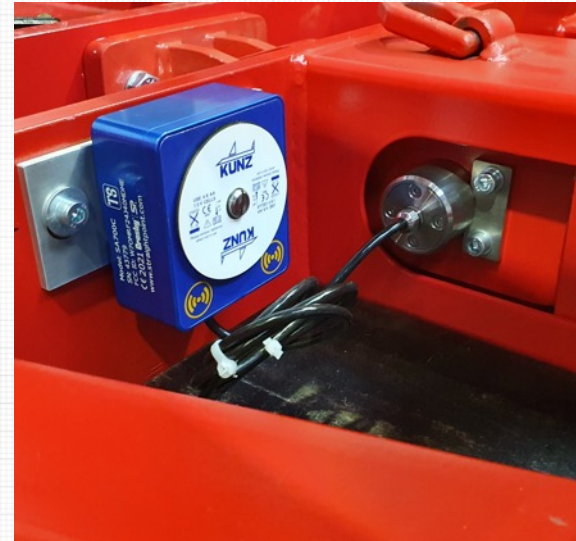
Equal weight distribution

The hydraulic suspension equalizes the pressure between all wheels to avoid damage to the apron.



Monitor pulling or pushing forces, peak recording

An integrated load pin into the tow bar is measuring the pulling forces to avoid damage to the undercarriage.

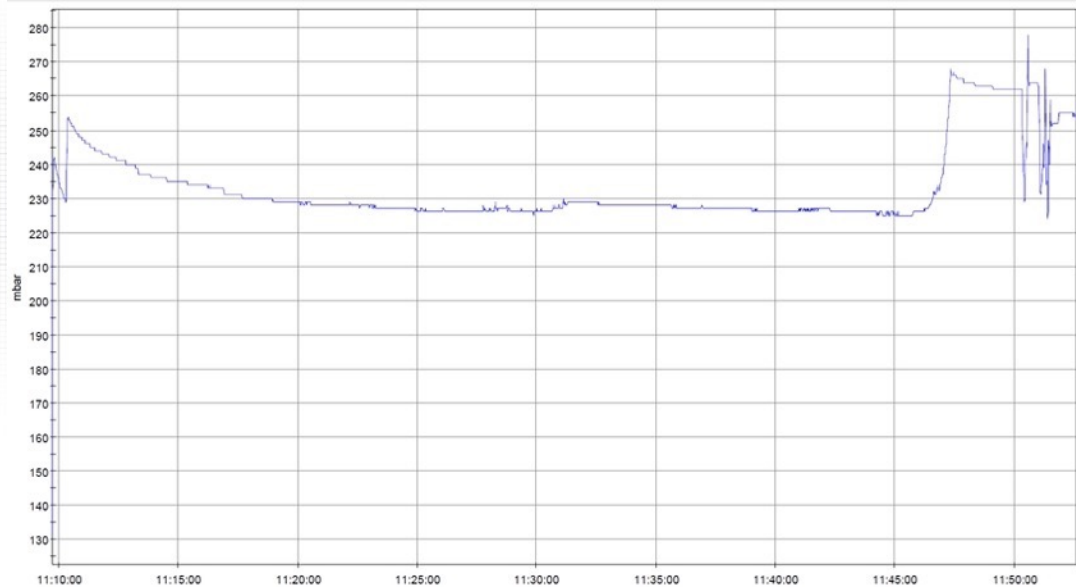


Skin pressure monitoring in action during the movement



KUNZ Aircraft Skin Pressure Control (SPC)

Recorded data can be exported to a USB flash drive for evaluation of the occurred skin pressure on a computer.



Training



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Training at KUNZ Aircraft Recovery School



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Thank you!

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