

**ORATEX®** Application Manual  
& Airplane Maintenance Manual Supplement

Doc. N°

ADxC-51-001-AMM Edition 6.0

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## Amendments

Issue	Date	Revised pages	Description
Edition 1	13-June-2013	all	First issue. Approved types: DR300/400 all variants
Edition 2	02-Jan-2014	all (1..74)	Inclusion of further types Improvement in trailing edge application detail Detailing on tooling Editorial changes
Edition 3	30-Apr-2014	all (1..100)	Editorial Changes Chapter 89-02 (new) Amplified information tooling (new) Chapter 90 (update)
Edition 3.1	14-May-2014	1,3, 97-101	Chapter 90 (update)
Edition 3.2	24-Aug-2014	3-7, 12, 14, 16-116	Further options and alternative materials; Clarification of Terminology Chapter 90 (update)
Edition 3.3	14-Jan-2015	3-4, 6-7, 12,15, 20, 24, 38, 70- 71, 75, 80, 99, 108-115	Editorial Changes Adhesive application and drying Chapter 90 (update)
Edition 3.4	20-Mar-2015	1, 3, 4, 41, 107-110	Chapter 04 and 90 (update)
Edition 3.5	25-Mar-2015	1, 3, 4, 41, 107-111	Chapter 04 and 90 (update)
Edition 3.6	14-Apr-2015	1, 3-7, 41-42, 108-113	Chapter 04 and 90 (update)
Edition 4	28-May-2015	All (1..112)	Editorial Changes Storage Conditions, Materials information, Bonding Check
Edition 4.1	14-July-2015	All (1..119)	Chapter 04 and 90 (update) Editorial Changes Format changes (all pages) Seams and Overlaps
Edition 5	2-Oct-2015	All(1..129)	Chapter 04 and 90 (update) intended use and responsibility clarified, editorial changes

Issue	Date	Revised pages	Description
Edition 5.1	11-Jan-2016	1, 4 - 138	Chapter 04 and 90 (update)
Edition 5.2	03-Mar-2016	1, 4, 6-9, 46-137	Chapter 04 and 90 (update)
Edition 5.3	10-May-2016	1, 4, 6-9, 47-133	Chapter 04 and 90 (update) Changes in TCDS number by EASA - no extension of AML
Edition 5.4	06-Jul-2016	1, 4, 6-9, 47-135	Chapter 04 and 90 (update)
Edition 6.0	24-Oct-2016	1 - 138	List of applicable coverings integrated in Chapter 04, product information updated, editorial changes

## List of Service Bulletins

SB No	Date	Title	Affected Serial no.'s	AD (EASA)

**NOTE**

This is the Service Bulletin list of STC<sup>1</sup> ADxC-DC-51-001 thru 199.  
For the aircraft SB list, refer to the TC holder documentation.

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<sup>1</sup> Refer to *02-20 Terminology and Abbreviations*

## List of Effective Pages

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# 01 Introduction

## 01-00 General

The **ORATEX®** cover and coating system is developed by **LANITZ-PRENA FOLIEN FACTORY GmbH**, Leipzig, Germany, to suit any fabric covered airplane, just as cotton, linen or other polyester based fabric systems. In addition it also serves as top coating in areas traditionally not fabric covered but paint top coated. Further the system offers corresponding material for striping and coloring.

Any other use of the **ORATEX®** system beyond this application, both in aviation but also in all other areas, has not been tested. Any liability and warranty of **LANITZ-PRENA FOLIEN FACTORY GmbH** and Aircraft Design & Certification Ltd. for improper use and unauthorized processing is excluded.

### NOTE

It must be noted that although developed to suit any type of airplane, the system has been technically evaluated for the airplanes listed in Chapter 90. Additionally, the airplanes for which a formal authority approval has been granted are identified there.

The core element is **ORATEX®** fabric which is a heat shrinkable, polyester fabric with polyurethane coating which is available in two grades (**ORATEX® 6000** and **UL600MK3**)

The system further includes:

- reinforcing tapes
- rib bracing tape
- top coat paint system
- striping foils
- rib-lacing cord
- degreaser
- adhesive remover
- protective wax
- cleaner
- decorative finishing materials
- adhesives

The **ORATEX®** as such, as well as tapes, cords, coatings and striping foil is available in a variety of colors.

The advantages of the **ORATEX®** cover system are:

- consistent area weight due to uniform automatic top coat application by coating technology
- a significant weight saving versus traditional cover & top coat systems
- colour-matching paint system
- easy and colour matching repair or rework
- homogeneous surface
- no need for (spray) paint application on top of the coating
- solvent free application
- time-saving, approx. half the time of a conventional covering necessary

## 01-10 Coverage

This manual only covers the airplanes listed in Chapter 90 for which installation approval must be obtained by means of an engineering order from EASA DOA.21.J.411. For all others the installer is responsible to receive the respective approval.

The manual also covers the quality control aspects the installer has to adhere to with respect to the materials ordered at and received from **LANITZ-PRENA FOLIEN FACTORY GmbH, Leipzig, Germany,**

All materials of the system are described and defined, however procedures are given only for the generic **ORATEX®** fabric. Other **ORATEX®** system materials such as the top coating and striping foil materials are to be used with standard practices.

## 01-20 Related Publications

AC43.13-1B 9/8/98

## 01-30      Addresses

Contact for ordering parts and material:

Firm	Address
<b>LANITZ-PRENA FOLIEN FACTORY GmbH</b>	Am Ritterschlösschen 20 D-04179 Leipzig <a href="http://www.ORATEX.eu">www.ORATEX.eu</a>

In case of change of ownership of the airplane, design deficiency or occurrence in relation with this STC, please contact:

Firm	Address
Aircraft Design & Certification Ltd.	Reichensteinstrasse 48 D-69151 Neckargemünd E-mail: <a href="mailto:stc@aircraftdc.de">stc@aircraftdc.de</a>

**LANITZ-PRENA FOLIEN FACTORY GmbH** developed the System and is the according STC Holder. The company has discharged the obligations with respect to Part 21. requirements to AD&C EASA DOA.21.J.411.

## 02 How to Use the Manual

### 02-00 General

The format and contents of this manual have been prepared in accordance with the GENERAL AVIATION MANUFACTURERS ASSOCIATION (GAMA) Specification No. 2.

The contents of this manual are organized in three levels:

- Group
- System/Chapter
- Subsystem (if needed)

#### Group

Groups used in this manual are:

Group	Chapters	Definition / Remark
General	01 & 02	General information
Aircraft	03 to 05	Complete operational unit, limitations
Airframe & Structure	20 & 51	All airframe systems except power plant
Miscellaneous	90	List of applicable airplanes and each with materials to be used
Supplementary information	To be collected in Appendix	Forms, Advanced maintenance instructions, Service bulletins etc.

#### System/Chapter

Systems are arranged numerically per GAMA Specification 2 (ATA 100) recommended number assignment. The first two numbers indicate the chapter or system; the second two indicate the sub-system or section (for example Chapter 02-10).

When a subsystem is further divided into units, a third element is added to the number sequence, e.g. 53-20-01

The table of content lists only those chapter numbers which are used in this supplement.

## 02-10 NOTES

Notes and safety notes in this handbook are marked by the words **NOTE, IMPORTANT, NOTICE, CAUTION, WARNING** or **DANGER** in the left margin column. The text of the note or safety note is printed in bold. See the following definitions:

- ⚠ DANGER** indicates a hazardous situation which, if not avoided, will result in death or serious injury.
- ⚠ WARNING** indicates a hazardous situation which, if not avoided, could result in death or serious injury.
- ⚠ CAUTION** indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
- NOTICE** is used to address practices not related to physical injury.
- IMPORTANT** represents an important hint.
- NOTE** represents a remarkable hint.


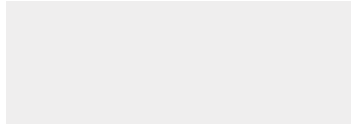

## 02-20 Terminology and Abbreviations

Term	Meaning
adhesive	within the <b>ORATEX®</b> system used materials: <b>ORATEX®</b> Dispersion and Hotmelt Adhesive
attach	generally means, that the following processes are finished: <ul style="list-style-type: none"> <li>• adhesive applied,</li> <li>• adhesive dried,</li> <li>• adhesive hardened while fabric pressed to the contact area,</li> <li>• and where required, fabric laced.</li> </ul> Refer to the applicable Chapters/Sections for detailed procedures.
inter-rib-bracing	Tapes crosswise attached between ribs to stabilize them.
lacing	Generally the attachment of fabric to the structure by means of threads.
reinforcing tape	straight edge or pinked edge (zig-zag) tape from: <b>ORATEX® UL600 MK3</b> (light grade) or <b>ORATEX® 6000</b> (heavy grade)
BVS	German certification specification for gliders
DDP	Declaration of Design & Performance
IR	Infrared
STC	Supplemental Type Certificate
TCDS	Type Certificate Data Sheet

## 02-30 Standard Elements

### Graphical Elements

The following graphical elements are generally used within this manual:

	20% black	structure
	5% black	fabric
	70% black	fabric layer

### Text Elements

The following text elements are generally used within this manual:

Normal text

- Itemization
- ▶ Instructions
- ▶ Instructions within a safety note

### Head Lines

*Head Lines* (when referenced)



## 20-40      Safety

- ▶ Make sure that you have all necessary ratings to begin your work. These ratings may be differently regulated in different countries. Before you start working, always contact your respective examiner. For applications in the scope of the EASA an approval by a Part 66 licensed examiner is imperative while in the scope of the FAA it has to be approved by an IA licensed A & P (airframe and powerplant mechanic with IA entry). In case of Annex II aircraft and microlights a responsible examiner has to be contacted. The approval is documented by a signature on the Engineering Order and a record in the logbook of the aircraft. In addition, a form 337 has to be filled in in scope of the FAA. Appropriate regulations of other countries must also be observed. With the approval, the compliance to the requirements of the STC is confirmed.
- ▶ Do not start fabric application or any related preparations without an explicit Engineering Order from Aircraft Design & Certification Ltd. or other relevant authority approval applicable to the respective airplane.
- ▶ Do not begin any work before completely having read and understood the contents of this manual.
- ▶ Remove adhesive and dope only in explosion proof rooms with exhaustion device.
- ▶ Wear ventilated protective clothing, protective goggles, chemical resistant gloves and respiratory mask when working with solvents or in dusty conditions.
- ▶ Wear safety gloves to protect yourself against high temperatures.
- ▶ Observe and follow the instructions of the products data and safety sheets (refer to [www.oracover.eu](http://www.oracover.eu)).

# 03 Description

## 03-01 Materials

The **ORATEX®** System consists of the following materials<sup>2</sup>:

ADxC-DDP Number	Material designation	Application	<b>LANITZ-PRENA</b> Product Code (xxx= colour, yyy=width in [mm] or [cm], zzz=length in [m])
ADxC-51-DDP-001	<b>ORATEX®</b> <b>6000</b>	Basic cover fabric 130 to 150g/m <sup>2</sup> depending on colour	14-xxx-yyy-zzz Standard width 90cm and 180cm yyy=width in [cm]
	<b>ORATEX®</b> rib bracing tape	Rib bracing	17-xxx-yyy-zzz Standard width 25mm yyy in [mm]
ADxC-51-DDP-002	<b>ORATEX®</b> <b>UL600 MK3</b>	Basic cover light fabric grade 90 - 110 g/m <sup>2</sup> depending on colour	13-xxx-yyy-zzz Standard width 90cm and 180cm yyy=width in [cm]
ADxC-51-DDP-003	<b>ORATEX®</b> DISPERSION HOTMELT ADHESIVE (separate components)	2K Adhesive system – unmixed <sup>3</sup>	0987 (1l), obsolete
			0988 (5l), obsolete
			0989 (10l), obsolete
	<b>ORATEX®</b> DISPERSION HOTMELT ADHESIVE (premixed)	Adhesive system, premixed <sup>2</sup>	0974 (50ml)
			0975 (100ml)
			0976 (500ml)
			0977 (1l)
			0978 (5l)
			0979 (10l)

<sup>2</sup> Shelf-life 5 years from delivery date for all **ORATEX®** fabric. If shelf-life is exceeded, material needs to be checked against requirements defined in Chapter 04-10.

<sup>3</sup> Shelf-life 3 months at 25 °C (77 °F), short time (max. 24 h) allowance 30 °C (86 °F)

ADxC-DDP Number	Material designation	Application	<b>LANITZ-PRENA</b> Product Code (xxx= colour, yyy=width in [mm] or [cm], zzz=length in [m])		
ADxC-51-DDP-004	<b>ORATEX® UL600</b> Pinked edge reinforcing tape (light grade)	Reinforcing tape <sup>4</sup> , zig-zag edge from <b>ORATEX® UL600 MK3</b> with thermo-plastic adhesive.	15-xxx-yyy Standard width 25, 50, 75, 100, 125, 150mm yyy in [mm]		
	<b>ORATEX® UL600</b> Straight edge reinforcing tape (light grade)	Dto <sup>4</sup> , straight cut	16-xxx-yyy Standard width 25, 50, 75, 100, 125mm yyy in [mm]		
ADxC-51-DDP-005	<b>EASYPLOT®</b>	UV-stabilized coloured polyester foil, with permanent pressure sensitive polyacrylate adhesive	150/152/153/154/160/162/ 163/164/182/187/188/189/ 195/197/198/199/1450/1452/ 1453/1454/1550/1552/1553/1554/- xxx-yyy		
			<b>ORALINE®</b>	Trim line for optical decoration made of <b>EASYPLOT®</b>	26-xxx-yyy Standard width: 5, 10, 15, 20; all other width by customer request yyy in [mm]
			<b>ORATRIM®</b>	Wide trim line for optical decoration made of <b>EASYPLOT®</b>	27-xxx-yyy Standard width 9,5 cm 2 and 5 m rolls, Standard width 12cm 25m length
ADxC-51-DDP-006	<b>ORACOLOR®</b>	Top coat paint system	1121/1122/1110-xxx-A (A=marking paint)		
			1121-xxx-B (B=permanently elastic)		
ADxC-51-DDP-007	<b>ORACOLOR®</b> Thinner	Thinner for <b>ORACOLOR®</b>	1100-996 (1000ml)		
ADxC-51-DDP-008	<b>ORACOLOR®</b> Hardener for Spraying	Hardener for <b>ORACOLOR®</b> (to be sprayed)	1100-997 (500ml)		

<sup>4</sup> serves as a cover for stichings as well as for overlaps and wholes caused by stitching. In the nose region also used as a sacrificial layer.

ADxC-DDP Number	Material designation	Application	<b>LANITZ-PRENA</b> Product Code (xxx= colour, yyy=width in [mm] or [cm], zzz=length in [m])
ADxC-51-DDP-009	<b>ORACOLOR®</b> Hardener for Brushing	Hardener for <b>ORACOLOR®</b> (to be brushed)	1100-998 (500ml)
ADxC-51-DDP-010	<b>ORACOLOR®</b> Filler	Surface treatment to prevent cracks	1100-999 (1000ml)
ADxC-51-DDP-011	<b>ORACOLOR®</b> Matt-Finishing Agent	To be added with hardener to <b>ORACOLOR®</b> for flattening	1100-995 (500ml)
ADxC-51-DDP-012	<b>ORATEX®</b> Cleaner	Liquid cleaner for all <b>ORATEX®</b> , <b>ORACOLOR®</b> , <b>EASYPLOT®</b> , <b>ORATRIM®</b> , <b>ORALINE®</b> products	08200 (500 ml) 08210 (1000 ml)
ADxC-51-DDP-013	<b>ORATEX®</b> Adhesive Remover	Remover for the <b>ORATEX®</b> DISPERSION HOTMELT ADHESIVE <sup>5</sup>	0957 (250ml) 0958 (500ml) 0959 (1000ml)
ADxC-51-DDP-014	UL600 Repair- Sheet (A4)	Repair of small damage	18-xxx-yyy (A4 sheet)
ADxC-51-DDP-015	Adhesive for <b>ORATEX®</b> <b>UL 600</b> selbstklebend	Adhesive film on repair sheet (DDP-014)	Not available as individual product
ADxC-51-DDP-016	<b>ORATEX® 6000</b> Straight edge reinforcing tape (heavy grade)	Reinforcing tape, straight cut from <b>ORATEX®</b> <b>6000</b> with thermoplastic adhesive.	19-xxx-yyy Standard width 25, 50, 75, 100, 125mm yyy in [mm]

<sup>5</sup> Application only on non-polymerized adhesive.

All material ordering codes use the same colour coding:

Colour	German	Code xxx
Natural white <sup>6</sup>	Naturweiß	000
White	Weiß	010
Antique <sup>5</sup>	Antik	012
Olive drab	Tarnoliv	018
Corsair blue	Corsairblau	019
Fokker red	Fokkerrot	020
Cub yellow	Cub gelb	030
Silver	Silber	091

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<sup>6</sup> uncolored **ORATEX®** does not feature the same level of UV protection and therefore has more stringent limits, see chapter 04.

## Amplified Information

This paragraph contains amplified information to some of the above presented materials.

### **ORATEX®** Dispersion Hotmelt Adhesive



Item number:

0974 (50ml)

0975 (100ml)

0976 (500ml)

0977 (1l)

0978 (5l)

0979 (10l)

When using **ORATEX®** Dispersion Hotmelt Adhesive the adhesive container must be closed in between applications to prevent the adhesive from drying. When you pause or break from the adhesive application process the brush must be put into cold water immediately to be cleaned, and it has to be dried with a dry cloth before reusing. Only after this process the brush can be used again. We strongly recommend that the adhesive container is closed after every single taking of adhesive with the brush to prevent an unnecessary drying of the adhesive at the rim and the inner sides of the container. Never use warm water for cleaning as the adhesive will be activated thereby, which makes the brush unusable.

#### NOTE

Please pay attention to the manufacturing date of the **ORATEX®** dispersion hotmelt adhesive. The shelf time is only 3 months from the date of manufacturing.

## **ORATEX®** Adhesive Remover



Item number:  
0957 (250 ml)  
0958 (500 ml)  
0959 (1 Litre)

The **ORATEX®** Adhesive Remover serves to remove fresh **ORATEX®** Dispersion Hotmelt Adhesive. You soak an uncolored (white) piece of natural fiber cloth (e.g. cotton) with the adhesive remover. With this moistened piece of cloth, you can lightly wipe two to three times over the surface to remove the excess adhesive.

### **WARNING**

Solvents can be harmful to health.

- ▶ Wear ventilated protective clothing, protective goggles, chemical resistant gloves and respiratory mask when working with solvents.
- ▶ Observe the instructions of the solvent security and data sheet.

### **NOTICE**

The **ORATEX®** Adhesive Remover is very aggressive. Repeated application can damage the coated surface of **ORATEX®** and even remove the coatings.

- ▶ Extra care should be taken using the **ORATEX®** Adhesive Remover on painted surfaces.

## **ORATEX®** Wash-Primer



Item number:  
0983 (100 ml)  
0984 (500 ml)  
0985 (1 Litre)

To pretreat metal surfaces of aircraft construction the use of **ORATEX®** Wash-Primer is essential as metal surfaces will oxidize and corrode without this protective coating. This applies to both, steel and aluminum. When dealing with open tubular structures care must be taken to ensure the inside of tubes are protected as moisture which condenses in the tube will lead to irreversible corrosion damage. Before applying the **ORATEX®** Dispersion Hotmelt Adhesive make sure the Wash-Primer has dried completely (24 h at room temperature, inside of open tube structures as the case may be considerably longer). The Wash-Primer can also be used as a base primer for varnishing metal surfaces with **ORACOLOR®** paint.

### NOTE

Before use clean all surfaces thoroughly!

The mixed Wash-Primer has a pot-life of 8 h at 18–22°C

### IMPORTANT

For tube structures, in particular open tube structures observe and follow the manufacturer's corrosion protection and ventilation provisions.



## Degreaser for **ORATEX®**



Item number:  
08245 (250 ml)  
08246 (500 ml)  
08247 (1 Litre)

The Degreaser for **ORATEX®** is mandatory for cleaning the surface of the fabric before applying straight edge reinforcing tape, pinked edge reinforcing tape, seams and overlaps, **ORATEX®** Dry Repair patches, **ORATEX®** Dispersion Hotmelt Adhesive or paint.

### *Proper Cleaning*

- ▶ Clean **ORATEX®** surfaces only with **ORATEX®** Degreaser.

Painted non-**ORATEX®** surfaces require 3 steps:

- ▶ Clean with **ORATEX®** degreaser
- ▶ Sand the surface
- ▶ Clean once more with **ORATEX®** degreaser

Always clean in two phases:

- ▶ Wet the surface with **ORATEX®** degreaser
- ▶ Absorb the residues with a clean paper towel

### **IMPORTANT**

The degreaser cannot dissolve residues (grease, silicone, dirt, etc.) in an evaporation process – as often assumed.

- ▶ You must absorb the residues with a clean paper towel.

The procedure in detail:

### **CAUTION**

The degreaser can harm your skin by depriving grease.

- ▶ Wear chemical resistant gloves, when working with the degreaser.
- ▶ Soak a paper towel with **ORATEX®** degreaser and wet the surface to be cleaned.
- ▶ Absorb residues with a clean paper towel by wiping only once and only in one direction over the wet surface. (Repeated wiping or wiping

back and forth would spread the degreaser with residues over the surface.)

**NOTE**

You can turn the paper towel when wiping so that you have the complete throughput to absorb the degreaser and the residues.

- ▶ If the surface did not become completely dry, repeat the absorbing procedure with a new paper towel.

**NOTICE**

Even finest traces of grease (e.g. from a fingertip) or dust on the cleaned area can corrupt the bonding.

- ▶ Never touch nor allow anything to contaminate the bonding area after cleaning.

### 2K-Filler



Item number:

08445 (100 ml)

08446 (500 ml)

08447 (1 Litre)

The 2K-Filler comes with good filling properties, dries fast and can be sanded easily. It has been developed to be the base for the **ORACOLOR®** Paint-system. The 2K-Filler is always supplied with the matching hardener.

## 2K-Combination-Filler



Item number:  
08440 (100 ml)  
08441 (500 ml)  
08442 (1 Litre)

The 2K-Combination-Filler has easy filling features and, after drying, can be sanded easily. It bonds well to all kinds of surfaces. It has been developed to be the base for the **ORACOLOR®** Paint-system.

Colour: matt light grey

## **ORATEX®** Dry Cleaner



Item number:  
08454 (500 ml)

The **ORATEX®** Dry Cleaner is to be used to clean contaminated surfaces. It can be used anywhere and is waterless. No water, bucket or washing-up is needed. For best results, two high-quality micro-fiber towels have to be used but only on cold surfaces and in the shade. Heavily soiled surfaces must be cleaned previously with water in order to remove the gross soiling.

Not suitable for matt surfaces.

**ORACOLOR**® top coat system, **EASYPLOT**®, **ORALINE**®  
and **ORATRIM**® striping foils material for trimming and  
decoration and Cleaners

Those materials do not require specific instructions, procedures or methods. Their usage falls within standard practices. Specifics are defined in data sheets supplied with the material or are available from the **LANITZ-PRENA** webpage.

The application of these materials is not limited to specific airplanes nor does the installer require an engineering order. However, permissible structural temperatures might limit the selection of (darker) colors and application area. The installer is advised to refer to the individual airplane type publications.

## 03-01-01 Storage Conditions

**ORATEX**® fabric and all related products must be stored at the following conditions:

Dry, ventilated, dark, light protected.

Never store any of the material on the ground.

Storage temperature: 5°C - 25°C (41 - 77 °F), short time (max. 24 h)  
allowance 30 °C (86 °F)

Humidity: 35% thru 65%

Observe life time limits. Never use materials after expiration date.

### NOTICE

**Fabric damage (stress whitening) due to kinks.**

- ▶ Never fold the fabric.
- ▶ Roll up the fabric for storage.
- ▶ Never use fabric with kinks or wrinkles or any evidence of stress whitening.

## 03-01-02 Material Characteristics

### Fabric

The fabric consists of polyester and has a polyurethane coating. The coating is always on the outside of the fabric rolls and is glossier than

the fabric itself. The inner side is a little rougher and the texture is slightly better visible.

On the straight edge reinforcing tapes and pinked edge reinforcing tapes the adhesive is already applied. That makes the inside smooth. It is covered with a protective siliconised paper.

**NOTE**

For the **ORATEX®** covering system the use of both straight edge and pinked edge reinforcing tapes are possible. Pinked edge tapes do not have a technical need in **ORATEX®**, they serve only to the visual appearance and to the nostalgic effect. On non-historical aircraft straight edge tapes are preferred. The pinked edge tape dates from the time, when cotton and polyester coverings available as raw fabric were used. The pinked edges prevented the thread from dropping out. **ORATEX®** however is coated, so dropping out of threads is not possible and therefore the pinked edges not necessary. This is generally valid for all fabric edges.

The fabric as well as tapes and foils shrink when applying temperatures between 100 °C (212 °F) and 200 °C (392 °F). Each 10 °C (18 °F) the fabric shrinks by approx. 1% biaxially.

**NOTICE**

**Fabric damage when applying temperatures above 200 °C (392 °F).**

- ▶ Never adjust the iron, heat gun or radiant heater to more than 200 °C (392 °F)!

Temperatures above 200 °C (392 °F) damage the fibers. Generally the destruction is not visible. In extreme cases the polyurethane coating will tarnish. In any case, when heated above 200 °C (392 °F) the fabric has to be replaced.

Temperatures above 250 °C (482 °F) will melt the fabric.

**NOTICE**

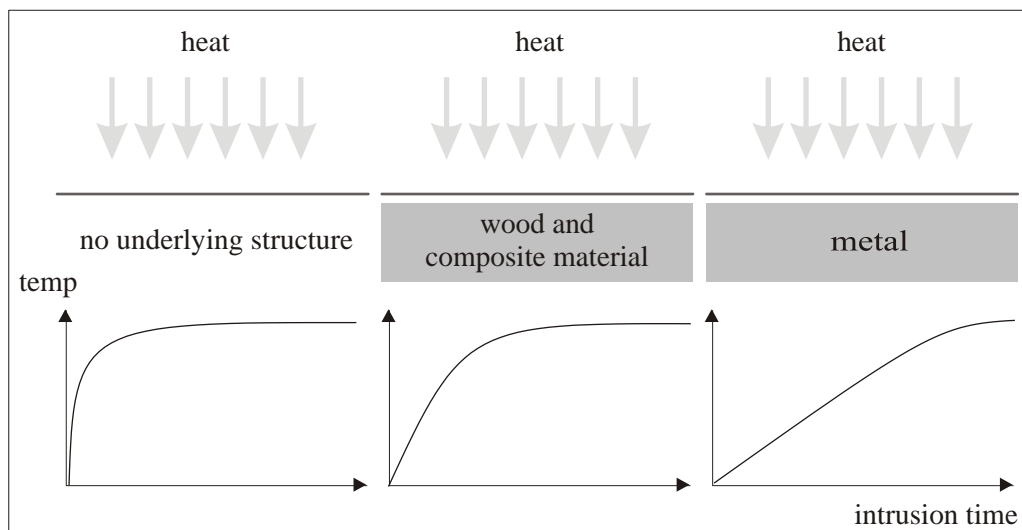
**Structure damage when applying to high temperatures.**

- ▶ Observe the temperature limits of the underlying structure.
- ▶ Never adjust the iron, heat gun or radiant heater to more than 180 °C (356 °F) when attaching fabric to wooden structure members!
- ▶ Never adjust the iron, heat gun or radiant heater to more than 90 °C (194 °F) when attaching fabric to composite structure members!

If shrinking and thus application of higher temperatures is necessary when attaching fabric to composite structures cover the structure with corrugated cardboard, e.g. if you shrink the open bay area between

carbon ribs, they must be covered with corrugated cardboard against the heat during the shrink process. Where double curved shapes are present shrink the fabric to size before bringing it into thermal contact with the structure.

Depending on the underlying structure the heat needs more or less time to intrude into the fabric. Different materials dissipate heat in different ways. The following figure shows typical intrusion behaviour. The intrusion times vary depending on fabric colour, structure material and thickness, used tools, humidity and temperature of environment. Check the behaviour of material (without adhesive) and tools you will use on diverse places of your aircraft with an IR thermometer. This will enable you to meet the temperature requirements later. It will also increase your skill in handling materials and tools.



The characteristics of **ORATEX®** fabric with respect to protection of underlying structure (namely wooden surfaces such as plywood covered fuselage) is comparable to a PU top coating. Both are in the same range of vapor diffusion permeability and have comparable UV protection characteristics. Hence an **ORATEX®** covered structure is adequately protected against both effects and does not need additional coating.

## Adhesives

Two types of adhesive are used.

The first type is a 2K 'structural' adhesive which bonds the base material to the underlying structure. This adhesive is called a "hotmelt" adhesive, however it is only a thermoplastic adhesive at low temperature, it polymerizes into a duroplast due to a hardener which is released at higher temperatures. The designation refers to the heat based activation of the 2K system. As premixed version therefore this adhesive has a stringent shelf life limit.

After application the hotmelt adhesive dries at room temperature. Temperatures above 50 °C (122 °F) initiate the polymerization. This process is not reversible.

**NOTE**

**Once heated above 50 °C (122 °F) fabric with hotmelt adhesive must be brought to the structure quickly and must not be removed. Removal of the fabric destroys the bonding. Slight adjustments are possible as long as the adhesive is hot.**

When cooled down before application, the adhesive turns useless after a short while (approx. 15 minutes). In this case new adhesive must be applied to the fabric.

If shrinking the fabric with adhesive applied attach the fabric immediately. If this is not possible, firstly shrink the fabric and apply adhesive later.

The second type of adhesive is indeed a thermoplastic adhesive. It makes the application of striping and reinforcement tapes and sacrificial leading edge layers easy. The adhesive is already factory coated on the backside of the striping and reinforcing tapes. It can be heated again and again while the fabric or tape can be newly positioned. So this adhesive qualifies for easy removal and repair.

However this adhesive must not be used between structure and fabric except for paddings (refer to Section 20–52).

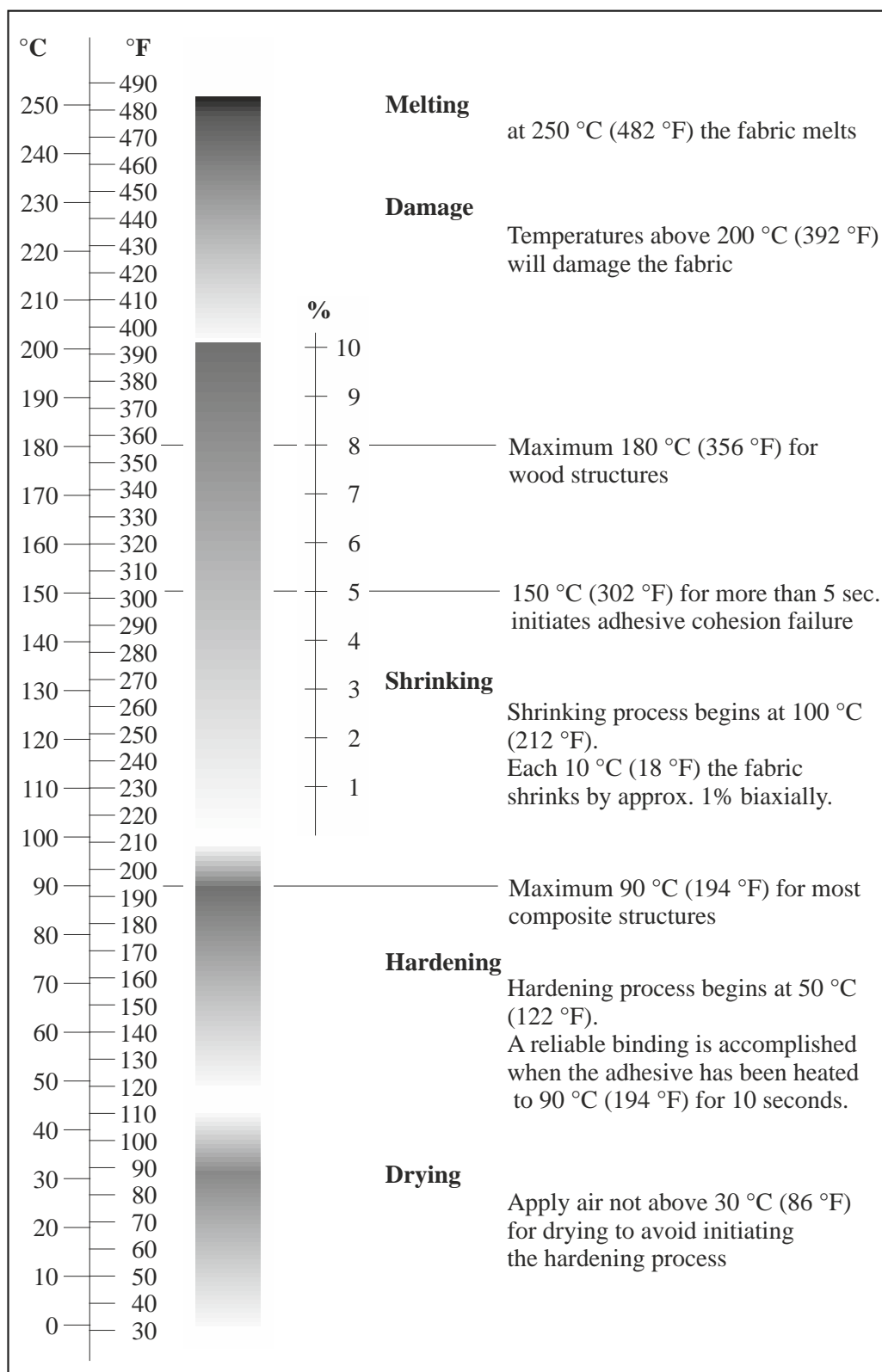
### **Adhesive Hardening**

The **ORATEX®** Dispersion hotmelt adhesive needs a temperature of 90 °C (194 °F) to harden applied for min. 10 seconds (residence time) to each point of adhesive. Fabric or tapes must be pressed to the structure or underlying fabric with a load of 3 kg (6.6 lb) as long as the adhesive is hot.

Thermo-adhesive coated products such as reinforcing tapes require a second pass at a temperature of approx. 120 °C (248 °F). The residence time of this second pass must be 5 to 10 seconds at a pressure of approx. 2 to 3 kg (4.4 – 6.6 lbs), to assure that the tapes are firmly heat-bonded to the surface. Insufficient heat or time may result in the tapes not to stay permanently bonded or to show air bubbles in between the tape and the surface.



The following figure summarizes the main characteristics of both the fabric and adhesive:



## 03-02 Ancillary Products

### Mandatory Products

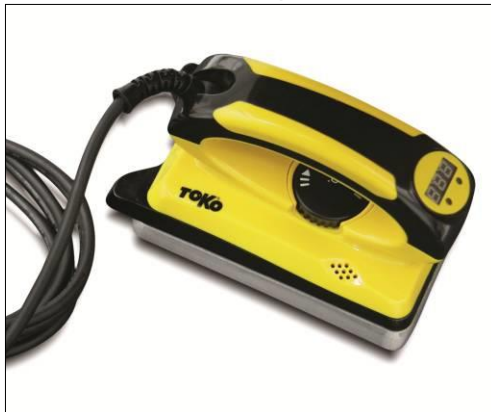
The following tools and ancillary products are mandatory when covering with **ORATEX®**. They

- have been checked for optimal usability,
- have passed the in-house inspection,
- received factory approval and
- meet all requirements for the application of **ORATEX®** aircraft covering in accordance with this **ORATEX®** Application Manual.

#### IMPORTANT

If tools, accessories and ancillary products are used which are different from those listed here as mandatory **LANITZ-PRENA FOLIEN FACTORY GmbH** cannot guarantee a successful job and cannot be held liable for the result.

### **ORATEX®** Sealing Iron



Item number:

08420

The temperature is digitally electronically controlled. It has an output of 1200 W and is available in 230 V and 110 V (US version).

## Heat Gun

The heat gun is used for shrinking and generating thermal bonds.



STEINEL Heat Gun HL 2010 E

Item number:

0949

The temperature is digitally electronically controlled. Adjustment and regulation of the airflow temperature is necessary to avoid overheating the fabric or the aircraft structure. The heat gun features a step switch for the air volume control (3 steps), so that it can be adjusted individually.

maximum output: 2000 W

maximum air flow: 500 L per minute

It is available in 230 V and 110 V (US version).

While covering the heat gun has to be set at 500 L per minute.



STEINEL Heat Gun HL 2020 E  
with case incl. reduction nozzle

Item number:

08470

Special features:

Hot air adjustment in 3 steps (150/ 150 – 300/ 300 – 500 l/min), residual heat indicator, joystick temperature adjustment and heat build-up warning.



STEINEL Heat Gun HG 2320 E  
with case and much equipment

Item number:  
08465

without case and equipment

Item number:  
08480

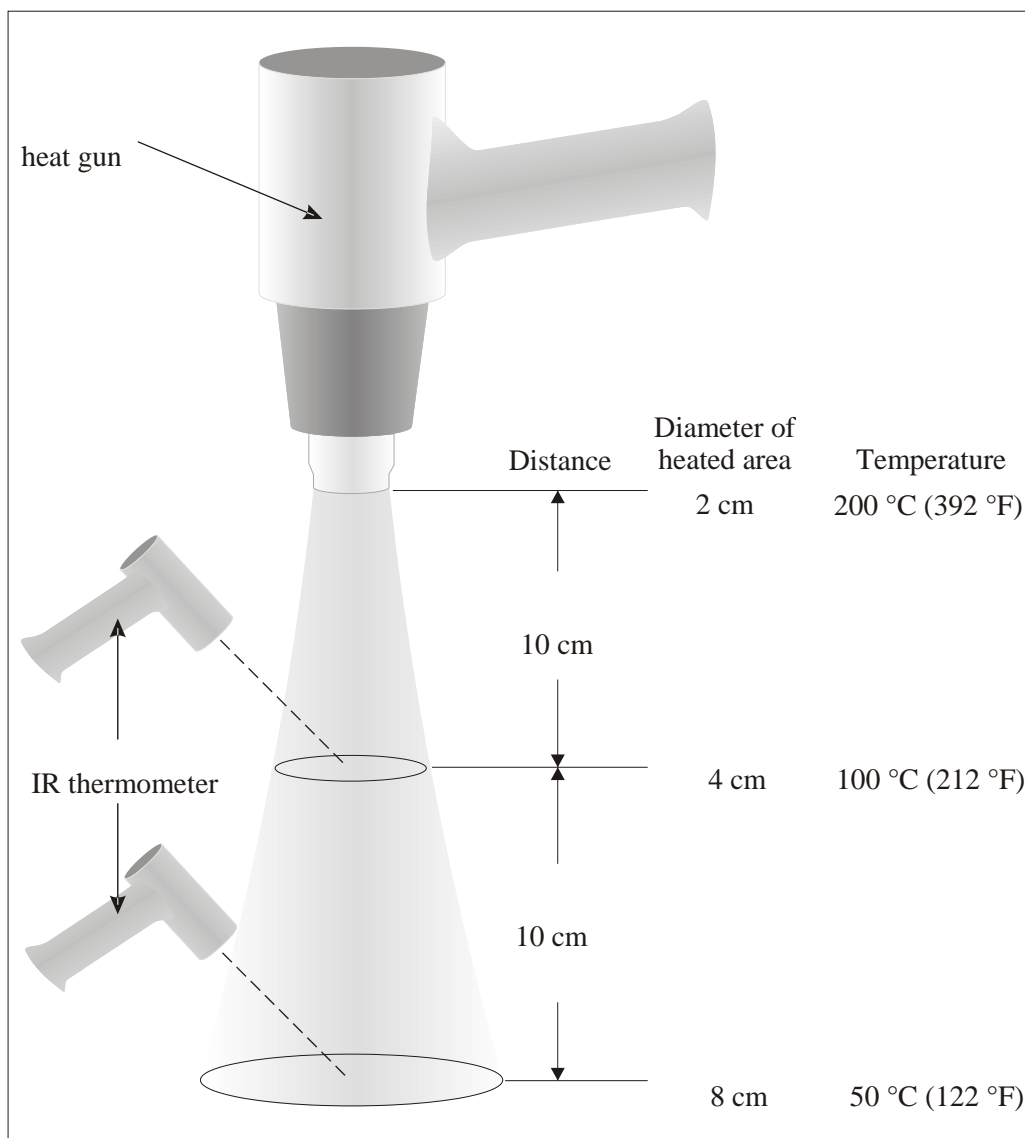
**Special features:**

2300-watt brushless motor, hot air adjustment in 2 steps (150–500 l/min), temperature adjustment from 80 thru 650 °C, residual heat indicator, joystick temperature adjustment and heat build-up warning, four individually adjustable operating programs, ergonomically shaped handle, LOCK function for all settings

It is supplied in a case complete with 50 mm surface nozzle, reflector nozzle, 9 mm reduction nozzle and shrink tubings.

*Typical Airflow Behaviour*

The following figure shows the typical behaviour of the hot airflow of a heat gun. Check this behaviour on your heat gun with an IR thermometer. This will enable you to estimate the correct distance to the fabric, when a certain temperature is desired. It will also increase your skill in handling this tool. Follow the instructions of the IR thermometer manufacturer to receive correct results.



### Press Roll



Item number:  
08150

The press roll is used to perform work under thermal loads.

### Special Brush for **ORATEX®** Dispersion Hotmelt Adhesive



Item number:  
08424 (80 mm wide)  
08425 (38 mm wide)  
08426 (25 mm wide)

These special brushes are to be used for the correct application of **ORATEX®** Dispersion Hotmelt Adhesive.

### **ORACOLOR®** Paint Brush



Item number:

08152 (40 mm wide)

08153 (60 mm wide)

08154 (80 mm wide)

These special paint brushes gives you the opportunity to achieve an excellent paint job.

The paint layer you will get is homogenous and without brush marks. Allows a professional finishing result even for unpracticed persons. Due to the hardener in the **ORACOLOR®**-System the brush should be used only once.

### **Pinking Shears**



Item number:

0906

The pinking shears is used for cutting of **ORATEX®** covering material and tapes.

### **ORATEX®** Felt Blade



Item number:

0915 (7 x 10 cm)

0948 (10 x 14 cm)

Felt blades are an important tool in order to bond **ORATEX®** fabric to the surface. The application of pressure by the felt blade to the heated fabric and to the surface will create a perfect joint without having trapped any air. If wrinkles occur during the covering process, they are removed by the large area shrinking process. These felt blades are specially made for this process.

### Silicon Release Paper



Item number:

12-100-002 (60 cm x 2 m)

12-100-005 (60 cm x 5 m)

To prevent the fabric from marking by a hot iron during covering, it is recommended that Silicon Release Paper be placed with the glossy side to the fabric while ironing. The iron should only slide on the dull side of the Silicon Release Paper and NEVER directly on the fabric as there is the possibility that the sole of the iron will create marks on the fabric.



### Fixing tape for **ORATEX®**



Item number:

08258 (19 mm x 50 m)

08259 (50 mm x 50 m)

The fixing tape can be used wherever it is necessary to fix **ORATEX®**, it serves for setting up cutting lines and as a masking tape for adhesive applications. It can be removed without a trace.

### Masking Tape



Item number:

08230-010 (10 mm x 66 m)

08230-030 (30 mm x 66 m)

08230-050 (50 mm x 66 m)

It is used to have clean edges after painting, as no paint can run in the depressions of the fabric when using our masking tape.

## **ORATEX®** Wax



Item number:  
08240 (500 ml)

To prevent dirt, flies and grass from sticking to the covering, to ease the cleaning and to give a maximum of colour protection the wax has to be applied onto the fabric. Before applying shake well. With an applicator pad or a cotton terry towel the wax is applied thoroughly and worked into the fabric. Followed by a polishing job with microfiber cloth. For best results turn the cloth from time to time to a clean part.

### **⚠ WARNING**

**Solvents can be harmful to health.**

- ▶ Do not inhale the vapours and keep the room well ventilated.
- ▶ Avoid skin contact.
- ▶ Wear ventilated protective clothing, chemical resistant, protective goggles, gloves and respiratory mask when working with solvents.
- ▶ Observe the instructions of the solvent security and data sheet.

### Grinding Wheel and Mounting Plate



Grinding Wheel  
for hardened **ORATEX®**  
Dispersion Hotmelt Adhesive

Item number:  
08490

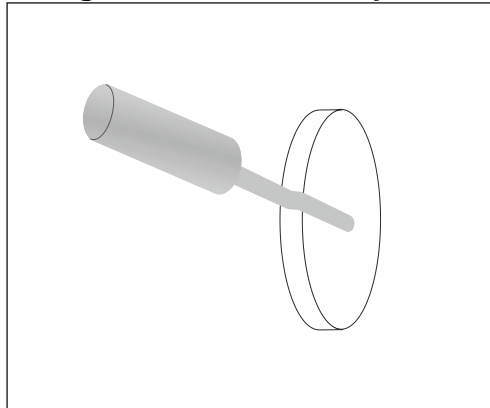


Mounting Plate  
for grinding wheel

Item number:  
08495

This grinding wheel and the corresponding mounting plate are the only tools approved by us for the effective removal of hardened **ORATEX®** Dispersion Hotmelt Adhesive. It can be used for surfaces made of wood, metal, fiberglass and carbon fibre. It also fits on commercial and **speed regulated** angle grinders. The diameter of the wheel is 125 mm.

### Fixing Bracket Tool (only for Antonov AN2)



Item number:  
08450

### Recommended Products

We recommend to use the following tools, accessories and ancillary products when covering with **ORATEX®**.

### Respirator Mask



Item number:  
08249

When working with organic solvents a respirator which is equipped with filters against organic solvent is essential personal protection equipment. Organic solvents can be found in **ORATEX®** Degreaser, **ORATEX®** Adhesive Remover, **ORACOLOR®** paint, hardeners, thinners and fillers, base coats, wash-primers etc. Always consider your personal safety and only work in well ventilated rooms. According to national safety regulations the use of a respirator mask is mandatory, protects your health and assures your safety when you handle the above mentioned chemicals.

### Dust Particle Filter (two pieces)



Item number:  
08250

Spare dust particle filter P2 R D according to EN 143:2000 against harmful dust. They are original replacement filters for the respirator mask.

### Filter for Solvents (two pieces)



Item number:  
08251

The replacement filters are an original accessory for the respirator mask. They protect you from organic solvents and are A2 gas filters according to EN 14387:2004 against organic gas and fumes.

### Dust Particle Filter Adapter (two pieces)



Item number:  
08252

Dust Particle Filter Adapter for P1 R D, P2 R D and P3 R D particle filters.

### Chemical Gloves



Item number:  
08431 (size M)  
08432 (size XL)

Chemical resistant Nitrile gloves are part of the personal protection equipment and they serve your safety and health. Use of protective gloves is mandatory when working with organic solvents, adhesives, paint, hardeners, thinners, fillers, primers, etc.

### Working Gloves



Item number:  
08428 (size 8)  
08429 (size 9)  
08430 (size 10)

Working gloves assist you to hold the covering while stretching. Thanks to the texture of the palms the covering can be gripped and stretched easily over the area to be covered, for ease of ironing. We strongly recommend the application of these working gloves for an easy handling.

### Applicator Pad for Waxing



Item number:  
08452 (two pieces)

This Applicator Pad is to be used to apply the **ORATEX®** protective wax in the optimal way.

### Corrugated Cardboard

The corrugated cardboard (best covered with silicone paper) is used to protect specific areas from hot air when working with the heat gun.

### Pencils



Item number:  
08433

To mark the inside of the fabric only these pencils of the type HB are to be used, as they are not bleeding when the dispersion hotmelt adhesive is applied.

### NOTICE

Ink can migrate deeply into the fabric and can show marks on the inner side of the top side.

- ▶ Do not use felt pens or liquid ink pens.

### Cutting knife



Item number:  
0916

For all cutting needs of the fabric the cutting knife is a recommended tool.



## Accessories



Other important tools, which we do not supply but which are generally available are:

- a well cutting and sharp pair of scissors
- a metal ruler of at least one meter length
- a plastic bowl with cover which serves as storage for the adhesive
- one plastic bowl with COLD WATER for cleaning the brush. When you interrupt your work the brush must be put into this bowl immediately.

## Temperature Scanner



STEINEL  
Temperature Scanner HL Scan  
Item number:  
08475

The STEINEL Temperature scanner HL Scan can be mounted on the heat gun. It allows total temperature control and prevents melting the fabric due to overheating. HL Scan measures the temperature at the workpiece surface while working on it with the hot air tool. An acoustic signal sounds as soon as the heat either exceeds or falls below the ideal temperature. The display also shows whether the workpiece surface is too hot or too cold. Red means “too hot”, green is “ideal temperature” and blue means “too cold”. The warning

tolerance range can be selected to suit individual needs. If chosen, the visual and acoustic warning can be deactivated.

### **IR Thermometer**

Use a conventional IR thermometer, of whose display accuracy you have assured yourself, to check the temperature of fabric when working with the iron or heat gun.

## 04 Limitations

### List of Approved Models and Applicable Covering

- Base Material **ORATEX® UL600MK3** can be replaced and repaired with **ORATEX® 6000** but not vice versa.

Where **ORATEX® UL600MK3** is specified one might still opt for **ORATEX® 6000** for instance to improve resistance against stone nicks when operating on gravel airstrips etc.

- **ORATEX® UL600MK3** can be used on all wooden fuselages, replacing the painting of the surface, if the fabric covering is foreseen by initial design.

Legend:

o = **ORATEX® 6000**

x = **ORATEX® UL600 MK3**

xo = both materials applicable

xou = both materials applicable, unstiched<sup>7</sup>

n/a = not applicable

TC holder	Model	Variants	TCDS	STC	Lifting Surfaces	Movables	Fuselage
A.G. für Dornier-Flugzeuge Bücker Flugzeugbau GmbH	Bücker Bü 133 Jungmeister	Bü 133 C, Bü 133-D 1	LBA 582	LBA EMZ SA 1468	o	o	o
Aero-Diffusion S.L.	Jodel DR 1190	D1190-5	LBA 671	LBA EMZ SA 1468	o	o	o
Aeronca Manufacturing Corporation	Aeronca 11	11 AC, 11 BC	LBA 529	LBA EMZ SA 1468	o	o	o
Aeronca Manufacturing Corporation	Aeronca 50-C	50-C, 65-C, 65-CA	LBA 550	LBA EMZ SA 1468	o	o	o
Air Tractor, Inc.	AT-300, -400 Series	AT-250, AT 300, AT-301, AT-302, AT-400, AT-400A	US A19SW	EASA STC 10045970	n/a	o	n/a
Aircraft Industries, a.s.	Z-37 Series	Z-37, Z37-2, Z-37A, Z-37A-2	EASA A.445	EASA STC 10045970	o	o	o

<sup>7</sup> See limitation in the first note of Chapter 04-10

TC holder	Model	Variants	TCDS	STC	Lifting Surfaces	Movables	Fuselage
Akademische Fliegergruppe Darmstadt e.V.	D 34	D 34c, D 34d	LBA 169	LBA EMZ SP0003	n/a	xo	xo
Akademische Fliegergruppe München e.V.	Mü 22	Mü 22, Mü 22b	LBA 141	LBA EMZ SP0003	o	xo	o
Alexander Schleicher GmbH&Co.	AS-K 13	AS-K 13	DE TC 267	EASA STC 10050167	o	o	o
Alexander Schleicher GmbH&Co.	AS-K 13	AS-K 13	DE TC 267	pending	xou	xou	xou
Alexander Schleicher GmbH&Co.	ASK 14	ASK 14	DE TC 684	EASA STC 10050167	o	o	xo
Alexander Schleicher GmbH&Co.	ASK 18	ASK 18, ASK 18B	DE TC 307	EASA STC 10050167	o	o	o
Alexander Schleicher GmbH&Co.	ASK 18	ASK 18, ASK 18B	DE TC 307	pending	xou	xou	xou
Alexander Schleicher GmbH&Co.	ASK-16	ASK-16, ASK-16 b	DE TC 758	EASA STC 10050167	o	o	o
Alexander Schleicher GmbH&Co.	ES 49	ES 49	LBA 102	LBA EMZ SP0003	o	xo	xo
Alexander Schleicher GmbH&Co.	K 10 A	K 10 A	DE TC 239	EASA STC 10050167	o	o	o
Alexander Schleicher GmbH&Co.	K 10 A	K 10 A	DE TC 239	pending	xou	xou	xou
Alexander Schleicher GmbH&Co.	K 7	K 7	DE TC 211	EASA STC 10050167	o	o	xo
Alexander Schleicher GmbH&Co.	K 7	K 7	DE TC 211	pending	xou	xou	xou
Alexander Schleicher GmbH&Co.	K 8	K8, K8B, K8C, Ka 6, Ka 6 B	DE TC 216	EASA STC 10050167	o	o	o
Alexander Schleicher GmbH&Co.	K 8	K8, K8B, K8C	DE TC 216	pending	xou	xou	xou
Alexander Schleicher GmbH&Co.	Ka 2	Rhönschwalbe	LBA 140	LBA EMZ SP0003	o	o	o
Alexander Schleicher GmbH&Co.	Ka 2 b	Ka 2 b Rhönschwalbe	LBA 203	LBA EMZ SP0003	o	o	o
Alexander Schleicher GmbH&Co.	Ka 3	Ka 3	LBA 154	LBA EMZ SP0003	o	o	o

TC holder	Model	Variants	TCDS	STC	Lifting Surfaces	Movables	Fuselage
Alexander Schleicher GmbH&Co.	Ka6	Ka6BR, Ka6BR-Pe, Ka6C, Ka6CR, Ka6CR-Pe, Ka6E, Ka6/O	DE TC 205	EASA STC 10050167	o	o	o
Alexander Schleicher GmbH&Co.	Ka6	Ka6BR, Ka6BR-Pe, Ka6C, Ka6CR, Ka6CR-Pe, Ka6E, Ka6/O	DE TC 205	pending	xou	xou	xou
Alexander Schleicher GmbH&Co.	Rhönlerche II	Rhönlerche II	LBA 164	LBA EMZ SP0003	o	xo	o
Alfons Pützer K.G.	Elster	Elster B, Elster C	LBA 584	LBA EMZ SA 1468	o	o	o
Amateurbau	SG 38	SG 38	LBA 14	LBA EMZ SP0003	o	o	o
Amateurbau	SG 38	SG 38	LBA 14	LBA EMZ SP0004	xo	xo	xo
Amateurbau	Baby III	Baby III	LBA 66	LBA EMZ SP0003	o	xo	xo
Amateurbau	Doppelraad- HANKUR 1	Doppelraad- HANKUR 1	LBA 796	LBA EMZ PS0014	o	xo	o
Amateurbau	Grunau Baby II b	Grunau Baby II b	LBA 49	LBA EMZ SP0003	o	o	o
Amateurbau	Grunau Baby II b	Grunau Baby II b	LBA 49/SP	LBA EMZ SP0004	xo	xo	xo
Apparatebau Lommatzsch	LOM 57 Libelle	Lom 57 Libelle	LBA 228	LBA EMZ SP0003	o	xo	xo
Avions Fairey S.A.	Tipsy Nipper T.66	T.66 MKI, T.66 MKII	LBA 617	LBA EMZ SA 1468	o	o	o
Binder -Aviatik K.G: Schempp-Hirth o.H.g.	CP 301 S "Smaragd"	CP 301 S	LBA 642	LBA EMZ SA 1468	o	o	o
BLANIK LIMITED	L-13 Blaník	L-13 Blaník, L-13 AC Blaník, L 13 A Blaník	EASA A.024	EASA STC 10050167	n/a	o	n/a
BLANIK LIMITED	L-23 Super-Blaník	L-23 Super- Blaník	EASA.A.044	EASA STC 10050167	n/a	o	n/a
BLANIK LIMITED	L-33 Sólo	L-33 Sólo	EASA A.045	EASA STC 10050167	n/a	o	n/a
C.E.A.P.R.	DR200 Series	DR 200, DR 250, DR 250-160, DR 250 B, DR 250 B-160	EASA A.510	EASA STC 10045970	o	o	xo

TC holder	Model	Variants	TCDS	STC	Lifting Surfaces	Movables	Fuselage
C.E.A.P.R.	ATL	ATL, ATL L, ATL S	EASA.A.374	EASA STC 10045970	o	o	n/a
C.E.A.P.R.	DR 200 Series (was: DR 220 Series)	DR 220, DR 220A, DR 220B, DR 220AB, DR221, DR 221B	EASA A.510	EASA STC 10045970	o	o	xo
C.E.A.P.R.	DR 200 Series (was: DR 253 series)	DR 253, DR 253 B	EASA A.510	EASA STC 10045970	o	o	xo
C.E.A.P.R.	DR300/400 (was: DR300 and DR400 series)	DR 315, DR 340, DR 360, DR 300/108, DR 300/120, DR 300/125, DR 300/140, DR 300/180R, DR 400/100, DR 400/120, DR 400/120 A, DR 400/120 D, DR 400/125, DR 400/125i, DR 400/140, DR 400/140 B, DR 400/160, DR 400/160 D, DR 400/180, DR 400/180 R, DR 400/180 S, DR 400/200 R, DR 400/500, DR 40072+2, DR 400/RP, DR 400 NGL	EASA A.367	EASA STC 10045970	o	o	xo
Centre-Est Aéronautique Société Aéronautique Normande	Jodel DR100	DR 100, DR 100A, DR 105, DR 105A, DR 1050, DR 1050A, DR 1050M1	LBA 585	LBA EMZ SA 1468	o	o	xo
Consolidated Vultee Aircraft Corporation	Stinson L-5	L-5, L-5 B, L-5 C	LBA 674	LBA EMZ SA 1468	o	o	o
Coopavia Aeravia	Piel CP 301 A	Piel CP 301 A	LBA 623 B	LBA EMZ SA 1468	o	o	o
Deutsche Forschungsanstalt für Segelflug e.V.	Habicht E	Habicht E	LBA 53	LBA EMZ SP0003	o	o	o
Dipl-Ing Wolf Hirth	Goevier III	Goevier III	LBA 112	LBA EMZ SP0003	o	xo	xo
Dr. Ulrich Hüttner	Hü 17b	Hü 17b	LBA 116	LBA EMZ SP0003	o	xo	o
Dr. Ulrich Hüttner	Hü 17b	Hü 17b	LBA 116	LBA EMZ SP0004	xo	xo	xo

TC holder	Model	Variants	TCDS	STC	Lifting Surfaces	Movables	Fuselage
E. Bruns	K 8 B/Stihl	K 8 B/Stihl	LBA 670	LBA EMZ PS0014	o	o	o
E. Bruns	Ka 6/Stihl	Ka 6/Stihl	LBA 692	LBA EMZ PS0014	o	o	o
E. Bruns	Ka 6/Stihl	Ka 6/Stihl	LBA 692	LBA EMZ PS0015	xo	xo	xo
E. Bruns	L-Spatz 55/Stihl	L-Spatz 55/Stihl, L-Spatz III/Stihl	LBA 694	LBA EMZ PS0014	o	xo	o
E.I.S. AIRCRAFT GMBH	RF 5	RF5, RF 5B "Sperber"	DE TC 695	EASA STC 10050167	o	o	xo
E.I.S. AIRCRAFT GMBH	RF3	RF 3, RF 4, RF4D	DE TC 666	EASA STC 10050167	o	o	xo
E.I.S. AIRCRAFT GMBH	SFS 31 Milan	L 25D	DE TC 755	EASA STC 10050167	o	o	xo
ECOFLY GMBH	FK 3	FK 3	DE TC 268	EASA STC 10050167	n/a	o	n/a
Edgar Percival	EP 9	EP 9	LBA 565	LBA EMZ SA 1468	n/a	o	o
EICHELSDOERFER GMBH	SB 5	SB 5 B, SB 5 E	DE TC 218	EASA STC 10050167	o	o	xo
Eichelsdörfer GmbH Flugzeugbau	Weihe 50	Weihe 50	LBA 68	LBA EMZ SP0003	o	xo	xo
Etablissement Wassmer	Fauvel AV-36	AV 36	LBA 159	LBA EMZ SP0003	o	o	o
ETUDES Aéronautiques & Commerciales	Jodel D 128	D128	LBA 631	LBA EMZ SA 1468	o	o	xo
EVEKTOR, spol. s r.o.	L 13 Vivat	L 13 SW Vivat, L 13 SE Vivat, L 13 SEH Vivat, L 13 SDM Vivat, L 13 SL Vivat, L 13 SDL Vivat	EASA A.046	EASA STC 10050167	n/a	o	n/a
F.B. Schmetz	hks-3	hks 3 - V 1	LBA 143	LBA EMZ SP0003	n/a	xo	xo
Fairchild Engine and Airplane Corporation	Fairchild M 62	M 62 A, A-3	LBA 552	LBA EMZ SA 1468	n/a	o	o
Fichtel & Sachs AG	K 8 B/KM 46	K 8 B/KM 46	LBA 691	LBA EMZ PS0014	o	o	o
Flugzeugbau Stark KG	Stark Turbulent D	Stark Turbulent D, D-1	LBA 537	LBA EMZ SA 1468	o	o	o
Flugzeugbau Teck Nabern	Fauvel AV-36	AV-36 C, AV-36 CR, AV-36 C1	LBA 159	LBA EMZ SP0003	o	o	o

TC holder	Model	Variants	TCDS	STC	Lifting Surfaces	Movables	Fuselage
Flugztechnische Arbeitsgemeinschaft Coburg	Ka 9	Ka 9	LBA 221	LBA EMZ SP0003	n/a	xo	xo
Focke-Wulf GmbH	Kranich III	Kranich III	LBA 111	LBA EMZ SP0003	o	xo	xo
Fritz Raab	Doppelraab	Doppelraab IV, Doppelraab V, Doppelraab VI	LBA 101	LBA EMZ SP0003	o	xo	o
Fritz Raab	Krähe II	Krähe II, Krähe III, Krähe IV	LBA 575	LBA EMZ PS0014	o	xo	xo
Grau	Rhönsperber	Rhönsperber	LBA 51	LBA EMZ SP0003	o	xo	xo
HB-FLUGTECHNIK GMBH	HB 21	HB 21, HB 21/2400, HB 21/2400 B, HB 21 V1, HB 21 V2	EASA A.434	EASA STC 10050167	n/a	xo	o
HB-FLUGTECHNIK GMBH	HB 23/2400	HB 23/2400, HB 23/2400 SP, HB 23/2400 Scanliner, HB 23/2400 V2	EASA A.433	EASA STC 10050167	n/a	xo	o
Ing. A. Vogt	Lo 100 Zwergreihler	Lo 100 Zwergreihler	LBA 129	LBA EMZ SP0003	o	xo	xo
Ing. A. Vogt	Lo 150	Lo 150, Lo 150 b	LBA 167	LBA EMZ SP0003	n/a	xo	xo
Josef Oberlerchner Segelflugzeugbau	MG 19a	Steinadler	LBA 377	LBA EMZ SP0003	o	xo	xo
Klemm Leichtflugzeugbau	Klemm L 25	L 25-1A, L 25D	LBA 573	LBA EMZ SA 1468	o	o	o
Maule Aerospace Technology	Maule	Bee Dee M-4, M-4, M-4 C, M-4 S, M-4 T, M-4-210, M-4-210 C, M-4-220 C, M-4-220 S, M-4-180V, M-5-180C, M-5-210C, M-5-235C, M-6-235, M-7-235, M-7-235B, MX-7-180, MX-7-180 A, MX-7-180 B, MX-7-180 C, MX-7-235, MXT-7-160, MXT-7-180, MXT-7-180A, MT-7-235	EASA.IM.A.0 18	EASA STC 10045970	o	o	o



TC holder	Model	Variants	TCDS	STC	Lifting Surfaces	Movables	Fuselage
MD Flugzeugbau GmbH&Co. KG	AVO 68 -v Samburo	AVO 68 - v Samburo, AVO 68 -s Samburo, AVO 68 -R Samburo, AVO -R 100 Samburo, AVO 68 -R 115 Samburo	EASA A.252	EASA STC 10050167	o	o	o
Mooney Aircraft Corporation	Mooney M 18 L	M 18 L	LBA 600	LBA EMZ SA 1468	o	o	o
Moravan, Orlican-Werke	L 60 (Brigadyr)	L 60 (Brigadyr)	L 566	LBA EMZ SA 1468	n/a	o	n/a
ORPHANED	Carman-Morelli M100	Carman-Morelli M100 S	EASA.SAS.A.0 06	EASA STC 10050167	o	o	xo
ORPHANED	RF-5 AJ-1 Serrania	RF-5 AJ-1 Serrania	EASA.SAS.A.0 92	EASA STC 10050167	o	o	xo
ORPHANED	T-51 Dart	T-51 Dart 15, T-51 Dart 17, T-51 Dart 17R	EASA.SAS.A.0 87	EASA STC 10050167	o	o	xo
ORPHANED	WA26 Squale	WA 26 CM, WA 26 P	EASA.SAS.A.0 15	EASA STC 10050167	n/a	o	o
ORPHANED	Wassmer WA 4 (was: Wassmer WA 40)	WA 40 Super IV, WA 40 B Super IV Sancy, WA 41 Baladou, WA 4/21 4/21/250 Super 4/21	EASA.A.SAS.0 48	EASA STC 10045970	o	o	o
ORPHANED	Yakovlew YAK-18T	YAK-18T	EASA.SAS.A.0 95	EASA STC 10045970	o	o	n/a
Piper Aircraft Corporation	PA-15	PA-15	LBA 576	LBA EMZ SA 1468	o	o	o
Piper Aircraft Corporation	PA-18	PA-18, PA-18 "105" Special, PA-18A, PA-18-125, PA-18-135, PA-18A-135, PA-18-150, PA-18A-150, PA-19	LBA 722	LBA EMZ SA 1468	o	o	o
Piper Aircraft Corporation	PA-20	PA-20, PA-20-135	LBA 727	LBA EMZ SA 1468	o	o	o
Piper Aircraft Corporation	PA-22	PA-22, PA-22-135, PA-22S-135, PA-22-150, PA-22S-150, PA-22-160	LBA 712	LBA EMZ SA 1468	o	o	o

TC holder	Model	Variants	TCDS	STC	Lifting Surfaces	Movables	Fuselage
Piper Aircraft Corporation	Piper J3 / PA11	J3C-40, J3C-50, J3C-65, J3F-50, J3F-60, J3F-65, J3L, J3L-65, PA-11	LBA 713	LBA EMZ SA 1468	o	o	o
PZL Mielec	Antonov AN2	AN2, AN-2T	LBA 2069/SA	LBA EMZ SA 1468	o	o	o
Rhein-Flugzeugbau GmbH	RW 3	RW 3-P65	LBA 509	LBA EMZ SA 1468	n/a	xo	o
Rudolf Kaiser	Ka 1	Ka 1	LBA 118	LBA EMZ SP0003	o	o	o
Scheibe Aircraft GmbH	Bergfalke	Mü 13 E Bergfalke, Bergfalke II, Bergfalke II-55, Bergfalke III, Bergfalke IV	EASA A.099	EASA STC 10050167	o	o	o
Scheibe Aircraft GmbH	Scheibe Falke SF25	SF25C with C.V.29 modification	EASA A.098	EASA STC 10050167	o	o	o
Scheibe Aircraft GmbH	SF 23 Sperling	SF 23 A, SF 23 A1, SF 23 B, SF 23 C	EASA A.579	EASA STC 10045970	o	o	o
Scheibe Aircraft GmbH	SF 26 A Standard	SF 26 A Standard	EASA A.099	EASA STC 10050167	o	o	o
Scheibe Aircraft GmbH	SF 27	SF 27 A, SF 27 B	EASA A.099	EASA STC 10050167	o	o	o
Scheibe Aircraft GmbH	SF 28 A Tandem Falke	SF 28 A Tandem Falke	EASA A.098	EASA STC 10050167	o	o	o
Scheibe Aircraft GmbH	SF 30 A Club Spatz	SF 30 A Club Spatz	EASA A.099	EASA STC 10050167	o	o	o
Scheibe Aircraft GmbH	SF25	SF25A, SF25B, SF25C, SF25D, SF25E, SF25K	EASA A.098	EASA STC 10050167	o	o	o
Scheibe Aircraft GmbH	Spatz	Spart A, L-Spatz, L-Spatz III, L-Spatz 55, Spatz B, Spatz 55	EASA A.099	EASA STC 10050167	o	o	o
Scheibe Aircraft GmbH	Specht	Specht	EASA A.099	EASA STC 10050167	o	o	o
Scheibe Aircraft GmbH	Sperber	Sperber	EASA A.099	EASA STC 10050167	o	o	o

TC holder	Model	Variants	TCDS	STC	Lifting Surfaces	Movables	Fuselage
Scheibe Aircraft GmbH	Zugvogel	Zugvogel I, Zugvogel II, Zugvogel III, Zugvogel III A, Zugvogel III B, Zugvogel IV, Zugvogel IV A	EASA A.099	EASA STC 10050167	o	o	o
Scheibe Flugzeugbau GmbH	LCF-2	LCF-2	LBA 289	LBA EMZ SP0003	n/a	xo	o
Scheibe Flugzeugbau GmbH	SF 27 M-A	SF 27 M-A	LBA 678	LBA EMZ PS0014	o	o	o
Scheibe Flugzeugbau GmbH	SF24 Motorspatz	SF24 A, SF 24 B	LBA 581	LBA EMZ PS0014	o	o	o
SCHEMPP HIRTH FLUGZEUGBAU	SHK-1	SHK-1	DE TC 258	EASA STC 10050167	o	o	xo
SCHEMPP HIRTH FLUGZEUGBAU	Standard Austria S	Standard Austria S, Standard Austria SH, Standard Austria SH 1	DE TC 235	EASA STC 10050167	o	o	xo
Schempp-Hirth o.H.G. Amateurbau	Emeraude	CP301, CP301A, CP301D, CP301E	LBA 564	LBA EMZ SA 1468	o	o	o
Sky International Inc.	Husky A-1	A-1, A-1A, A-1B, A-1C-180	EASA IM.A.294	EASA STC 10045970	o	o	o
Società Aviamilano	Aviamilano P.19	P.19	LBA 663	LBA EMZ SA 1468	n/a	o	o
Société Aéronautique Normande	Jodel D 140	Jodel D 140, Jodel D 140 A, Jodel D 140 B, Jodel D 140 C, Jodel D 140 R	LBA 628	LBA EMZ SA 1468	o	o	xo
Société Aéronautique Normande	Jodel D 150	150, D 150	LBA 659	LBA EMZ SA 1468	o	o	xo
Société Aéronautique Normande ALPAVIA-Aérodrome de TALLARD Amateurbau	Jodel D117	D117 A	LBA 632	LBA EMZ SA 1468	o	o	xo
Société Industrielle pour l'Aéronautique	Sipa 903	Sipa 903	LBA 703	LBA EMZ SA 1468	o	o	o
Société Nationale de Constructions Aéronautique du Nord	SV 4C	SV 4C1	LBA 633	LBA EMZ SA 1468	o	o	o
Société Scintex	CP 301 C "Emeraude"	CP 301 C	LBA 623 A	LBA EMZ SA 1468	o	o	o
Sportflugzeugbau Schempp-Hirth	Gö 3 Minimoa	Gö 3 Minimoa	LBA 59	LBA EMZ SP0003	o	o	o

TC holder	Model	Variants	TCDS	STC	Lifting Surfaces	Movables	Fuselage
Stampe et Renard Société Nationale de Constructions Aeronautique du Nord	SV 4C	SV 4C, SV 4A, SV 4B	LBA 622	LBA EMZ SA 1468	o	o	o
Stark Flugzeugbau Ag	Emeraude CP 301 A Stark Sonderausführung	Emeraude CP- 301 A Stark Sonderausführu ng	LBA 564A	LBA EMZ SA 1468	o	o	o
Strojirny Prvni Petiletky	Aero 145	Aero 145	LBA 629	LBA EMZ SA 1468	n/a	o	n/a
Unbekannt	Kranich II	Kranich II	LBA 30	LBA EMZ SP0003	o	xo	xo
Universal Aircraft industries	Stinson 108	108, 108-1, 180-2, 108-3	LBA 536	LBA EMZ SA 1468	o	o	o
VEB Apparatebau	Grunau Baby II b- DDR	Grunau Baby II b-DDR	LBA 49	LBA EMZ SP0003	o	o	o
VEB Apparatebau	Grunau Baby II b- DDR	Grunau Baby II b-DDR	LBA 49	LBA EMZ SP0004	xo	xo	xo
Walter Uetz, Flugzeugbau	Jodel D 11 - Swiss	D11-85	LBA 570b	LBA EMZ SA 1468	o	o	xo
Wassmer	Jodel D 120	D 112	none	LBA EMZ SA 1468	o	o	xo
Wassmer	Jodel D120	Jodel D 120, Jodel D 120 A, Jodel D 120 R	LBA 570A	LBA EMZ SA 1468	o	o	xo
ZAKLAD SZYBOWCOWY JEZOW	SZD-22C Mucha- Standard	SZD-22C Mucha Standard	PL 13/TL/60	EASA STC 10050167	o	xo	xo
ZAKLAD SZYBOWCOWY JEZOW	SZD-24 C Foka	SZD-24-4A Foka 4	PL 4/TL/64	EASA STC 10050167	o	xo	xo
ZAKLAD SZYBOWCOWY JEZOW	SZD-24 Foka	SZD-24 C Foka	EASA A.319	EASA STC 10050167	n/a	o	xo
ZAKLAD SZYBOWCOWY JEZOW	SZD-25A	SZD-25A Lis	PL 7/TL/61	EASA STC 10050167	n/a	o	xo
ZAKLAD SZYBOWCOWY JEZOW	SZD-30	SZD-30, SZD-30A	PL BG/32/2	EASA STC 10050167	o	o	xo
ZAKLAD SZYBOWCOWY JEZOW	SZD-30 Pirat	SZD-30 Pirat	PL BG 117/1	EASA STC 10050167	o	xo	xo
ZAKLAD SZYBOWCOWY JEZOW	SZD-36A Cobra 15	SZD-36A Cobra 15	PL BG 071/2	EASA STC 10050167	n/a	o	n/a
ZAKLAD SZYBOWCOWY JEZOW	SZD-45A Ogar	SZD-45A Ogar, SZD-45AM Ogar	PL BG 104/1	EASA STC 10050167	n/a	o	n/a

TC holder	Model	Variants	TCDS	STC	Lifting Surfaces	Movables	Fuselage
ZAKLAD SZYBOWCOWY JEZOW	SZD-9 bis Bocian 1D	SZD-9 bis Bocian 1D, SZD-9 bis Bocian 1E	PL L-225	EASA STC 10050167	o	xo	xo
Zlin Aircraft A.S.	Zlin Z26 Series	Z 126, Z 126 T, Z 226 B, Z 226T, Z 226 A, Z 226 M, Z 226 MS, Z 326, Z 326 A, Z 326 M, Z 526, Z 526 A, Z 526 F, Z 526 L, Z 526 AFS, Z 526 AFS-V, Z 526 M, Z 726, Z 726 K	EASA.A.353	EASA STC 10045970	o	o	o

## 04-10 General

All Limitations of the aircraft type remain valid.

Especially structural temperature limits which lead to colour or absorption coefficient limitations must be observed when choosing the colour code. In case of doubt contact the respective airplane TC holder.

There is no absolute elapsed time or flight hour limit of the **ORATEX**® system. The degrading factors are UV, temperature variations, mechanical abuse as well as chemical abuse. If the general conditions or appearance give reason of concern checks as presented in Section 05-20 have to be performed. A successful completion of these checks is condition for further release to service.

For colored **ORATEX**® a first strength test must be made after 5years for airplanes parked normally outside. For all others (normally parked in a hangar or trailer) after a maximum 8years. Strength must be verified versus limits as defined in AC43.13 Chapter 2 Table 2.1.

For non-colored **ORATEX**® (colour code 000 – natural white / 012 – antique) the first test has to be performed after 2years if parked normally outside, for all others after 4 years.

For **ORATEX**® **6000** the 700N/50mm (80lbs/in) limit applies  
For **ORATEX**® **UL600MK3** the 570N/50mm (65lbs/in) limit applies.

The fabric must be exchanged if the strength is below these values.

The next scheduled inspection is derived from the testing result:

For **ORATEX**® **6000** tested to more than 900N/50mm after 5 years, otherwise 2 years.

For **ORATEX**® **UL600MK3** tested to more than 635N/50mm after 5 years, otherwise 2 years.

For the test a sample piece of fabric minimum 70mm in spanwise direction and minimum 220 mm in cordwise direction has to be cut from the upper wing surface and supplied to AD&C for testing. The cord- and spanwise direction, the airplane type and serial number as well as date and location of the sample shall be marked on the sample.

**NOTE** For applications where change to type design integration method is implemented involving omission of the fabric stitching, limitation of 6000h is defined. Approved aircrafts for such application are marked with letter “xou” in the material applicability column of the approved model list from Chapter 04.

**NOTE** AD&C is developing a non destructive test method. Prior taking a sample as described check with AD&C for potential other approved options.

**NOTE** The commercial available 'Maule Fabric tester' has NOT been shown to yield correct results with the **ORATEX®** covering.

## 05 Inspection and Maintenance

### 05-10 Time limits and inspection program

The time limits and inspection program of the respective airplane type remain valid.

### 05-20 Scheduled maintenance

Scheduled Inspection	as specified	100h	Annual
Flight check: Observe all in flight visible wing cover carefully in flight for anomalies, looseness or vibrations or buffeting. All non visible surfaces are carefully to be inspected after a dedicated flight that explores the respective $V_{NE}$ of the airplane at bank angles approved for the airplane.			X
Perform <i>Bonding Check (22-55-08)</i> .			X
Perform <i>Fabric Tension Test (20-55-11)</i> .			X
If blisters, bumps or bubbles are present cut open the respective area and inspect for underlying corrosion (optical using a magnification of 10) and moisture. Repair as required according airplane manufacturer information. Patch up the area with <b>ORATEX</b> ® thereafter.			X
Apply <b>ORATEX</b> ® Wax on the complete fabric surface. Refer to Chapter 03-02.	X <sup>8</sup>		

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<sup>8</sup> After each fabric attachment and then recommended every 3 months



## 05-50      **Unscheduled Maintenance**

After extreme meteorological conditions perform *Bonding Check (22-55-08)* and *Fabric Tension Test (20-55-11)*.

# 20 Standard Practices–Airframe

## 20–51 General Preparations

### Delivery Criteria

When re-coating an airplane with fabric one must be aware that the fabric is the means to transmit all lifting surfaces forces to the airframe. Thus it serves an essential, safety critical function. Nevertheless the fabric is 'just' a material and no part for which a POA manufacturer issues a form ONE.

**LANITZ-PRENA FOLIEN FACTORY GmbH, Leipzig, Germany,** exercises stringent quality control. Usage of the material is only permissible if the installer checks:

- that the delivered good batch numbers (on package, respectively roller stamp on **ORATEX®** base material) corresponds to the batch listed in the delivery papers and the accompanying certificates.
- that the following quality criteria are met by the actual values listed in the accompanying delivery papers.

Material	Prüfmerkmal (Test quality)	Einheit (Unit)	Sollwert (Nominal value)
ADxC-51-DDP-001 <b>ORATEX® 6000</b>	Flächengewicht (Grammage)	g/m <sup>2</sup>	148 - 162*
	Schrumpf –K (Shrinkage, warp)	%	9,0 – 13,0
	Schrumpf –S (Shrinkage, weft)	%	9,0 – 13,0
	Höchstzugkraft-K (Max. pulling force, warp)	N/50mm	1300 - 1600
	Höchstzugkraft-S (Max. pulling force, weft)	N/50mm	1100 - 1400
	Höchstzugkraftdehnung-K (Max. pulling force elongation, warp)	%	12,0 – 20,0
	Höchstzugkraftdehnung-S (Max. pulling force elongation, weft)	%	11,0 – 19,0
	Weiterreißkraft-K, geschrumpft (Tear propagation force, warp, shrunk)	N	26 - 30
	Weiterreißkraft-S, geschrumpft (Tear propagation force, weft, shrunk)	N	28 - 32
	Chemische Beständigkeit (Chemical durability)	i.O./n.i.O. (ok/not ok)	i.O.

Material	Prüfmerkmal (Test quality)	Einheit (Unit)	Sollwert (Nominal value)
ADxC-51-DDP-001 <b>ORATEX®</b> rib bracing tape	Flächengewicht (Grammage)	g/m <sup>2</sup>	148 - 162*
	Schrumpf -K (Shrinkage, warp)	%	10,0 – 13,0
	Höchstzugkraft-K (Max. pulling force, warp)	N/25 mm	800 - 900
	Höchstzugkraftdehnung-K (Max. pulling force elongation, warp)	%	12,0 – 20,0
	Chemische Beständigkeit (Chemical durability)	i.O./n.i.O. (ok/not ok)	i.O.
ADxC-51-DDP-002 <b>ORATEX® UL600MK3</b>	Flächengewicht (Grammage)	g/m <sup>2</sup>	97 - 122*
	Schrumpf -K (Shrinkage, warp)	%	8,0 – 12,0
	Schrumpf -S (Shrinkage, weft)	%	8,0 – 12,0
	Höchstzugkraft-K (Max. pulling force, warp)	N/50mm	850 - 1150
	Höchstzugkraft-S (Max. pulling force, weft)	N/50mm	700 - 900
	Höchstzugkraftdehnung-K (Max. pulling force elongation, warp)	%	12,0 – 20,0
	Höchstzugkraftdehnung-S (Max. pulling force elongation, weft)	%	11,0 – 19,0
	Weiterreißkraft-K, geschrumpft (Tear propagation force, warp, shrunk)	N	20 -24
	Weiterreißkraft-S, geschrumpft (Tear propagation force, weft, shrunk)	N	18 - 22
	Chemische Beständigkeit (Chemical durability)	i.O./n.i.O. (ok/not ok)	i.O.
ADxC-51-DDP-003 <b>ORATEX®</b> DISPERSION HOTMELT ADHESIVE (premixed)	Auslaufzeit (Flow time)	s	21,0 – 27,0
	Feststoffgehalt (Solid content)	%	44,0 – 52,0
	Dichte (Density)	g/cm <sup>3</sup>	1,03 – 1,08
	Farbton u. ungel.Teile (Color and undissolved particles)	i.O./n.i.O. (ok/not ok)	i.O.
	Klebkraft (Adhesiveness)	N/25 mm	8,0 – 22,0

\* Area weight range also accounts for various colors

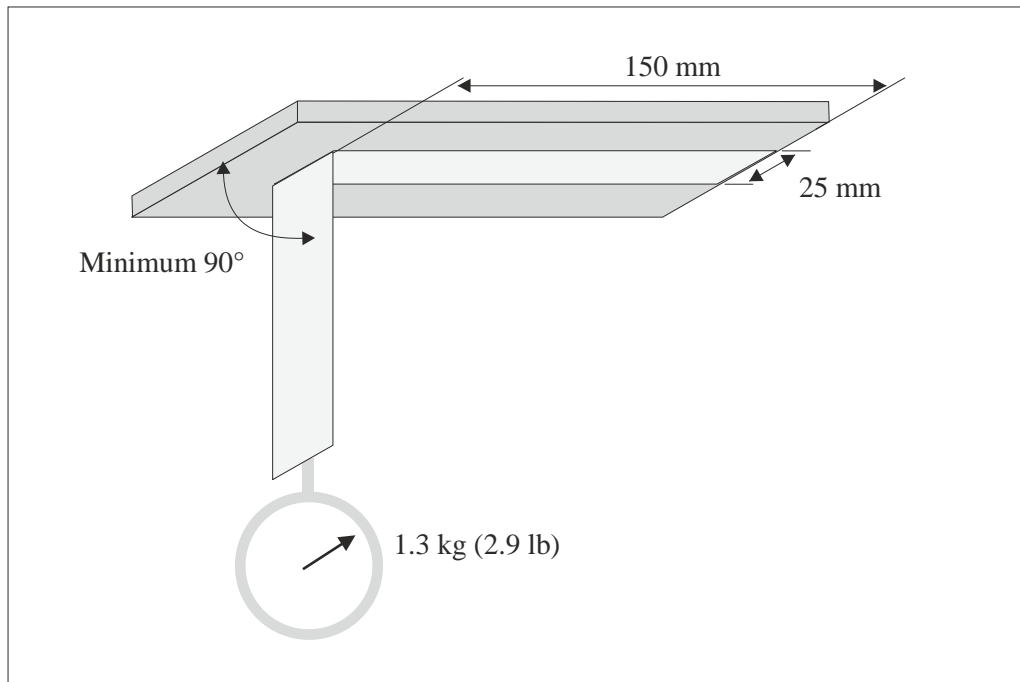
For all other **ORATEX®** system materials listed in Chapter 03 the safety criticality does not warrant a formal need for specific checks.

## Trial Attachment and Bonding Check

A leading cause for a faulty bonding is the non-observation of the **ORATEX®** adhesive storage instruction especially where temperature is concerned.

To ensure materials are in good condition and to test your skill in handling these materials, perform the following trial bonding as outlined in the figure below:

- ▶ Attach a 25 mm wide fabric strip to a substrate that equals the aircraft structure. Refer to Chapter *20-55 Fabric Application*. The adhesive area shall be 150 mm long.
- ▶ Pull the free end of the fabric strip with a weight of 1.3 kg (2.9 lb) in an angle of minimum 90°.



The bonding must carry this weight. If it doesn't: Check materials and attaching procedure. Repeat the trial bonding.

- ▶ Increase the weight until fabric strip starts to be ripped off and immediately reduce the weight to 1.3 kg (2.9 lb).

The bonding must again carry this weight. If it doesn't: Check materials and attaching procedure. Repeat the trial bonding.

- ▶ Repeat last step several times.

## Skill Development

It is advisable to start with a simple small wooden frame to learn handling the materials and tools. Then begin with smaller aircraft parts such as stabilizers or control surfaces before applying fabric to the wing or the fuselage.

## Ambient Temperature

For the correct application an according ambient temperature is necessary. Even the products can be used above 5 °C, we strongly recommend an ambient operational temperature of minimum 15 °C. It is difficult to work with cold hands and fingers. Also the drying times will be extremely extended at cold temperatures.

## 20–52 Structure Preparation

All old adhesive and dope remnants have to be removed from the structure to enable the **ORATEX®** Dispersion Hotmelt Adhesive to bond with the structure thoroughly.

### DANGER

**Explosion hazard due to abrasive dust and solvent vapors.**

- ▶ Remove adhesive and dope only in explosion proof rooms with exhaustion device.

### WARNING

**Poisoning hazard due to abrasive dust and solvent vapors. Thinners of approved dope and adhesive are poisonous and carcinogenic.**

- ▶ Wear externally ventilated protective clothing, protective goggles, chemical resistant gloves and respiratory mask when removing adhesive and dope.
- ▶ Remove old fabric, adhesive and covering following the procedures and safety instructions of the respective manufacturers.
- ▶ Debur the structure members.

## Steel or Aluminum Structures

- ▶ Clean surfaces with **ORATEX®** degreaser according to the *Proper Cleaning* paragraph on page 25.

Anodized structures do not need further treatment.

#### NOTICE

**Risk of destroying the protective anodized layer.**

- ▶ Never sand or roughen anodized structures.
- ▶ Apply anticorrosive coating, e.g. **ORATEX®** wash primer, to non-anodized structures as per manufacturer's security and data sheet.

### Wood Structures

#### IMPORTANT

Do not apply any solvents after roughing the surface. The suction effect of the wooden structure could reduce the carrying capacity of the surface. Always work in the order outlined below:

- ▶ Clean, degrease and impregnate wood structures with standard solvents as per manufacturer's security and data sheet.
- ▶ Rough the surface with P120 sandpaper.

### Composite Structures

- ▶ Remove form release agent where necessary and/or clean with standard solvents as per manufacturer's security and data sheet.
- ▶ Rough the surface with P120 sandpaper.

### Further Treatment

- ▶ After sanding clean the structure by means of a vacuum cleaner. Use a suitably equipped dust collection vacuum unit with necessary filters.
- ▶ Pad sharp edges and framework nodes with **ORATEX® UL600** straight edge reinforcing tape. Attach several layers if necessary.
- ▶ Cover the area by attaching a final patch.

## 20-52-01 Inter-rib Bracing

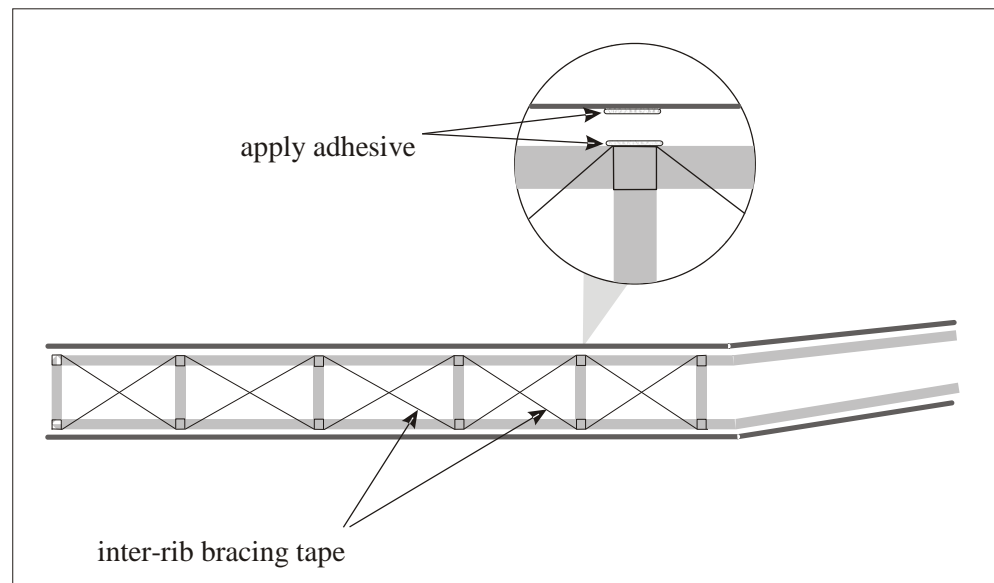
For inter-rib bracing **ORATEX®** rib bracing tape is used.

Inter-rib bracing is required whenever this is specified by the aircraft manufacturer. He also prescribes where and how inter-rib bracing has to be done.

If no aircraft manufacturer information is available, refer to AC43.13-1B § 2-6 for general information.

Observe the following additional rules:

- Attach the bracing tapes to the ribs as outlined in the *Fabric Application* Section.
- Heat-tighten the loop areas of the bracing tape as necessary to receive an even tension. Use a heat gun. Also refer to the *20-55-10 Heat Tightening* Section.
- Heat-tighten the complete bracing tape at 130 °C (266 °F) using a heat gun.  
Speed = heated area/5 sec
- Make sure that the tension on the rib bracing is built up uniform cordwise as well as spanwise.
- In the later attaching process the fabric must also be bonded to those areas, where it is in contact with the bracing tapes. So adhesive must be applied to both the bracing tape and the fabric in the contact areas. Also refer to Chapter *20-55-02 Adhesive Application*



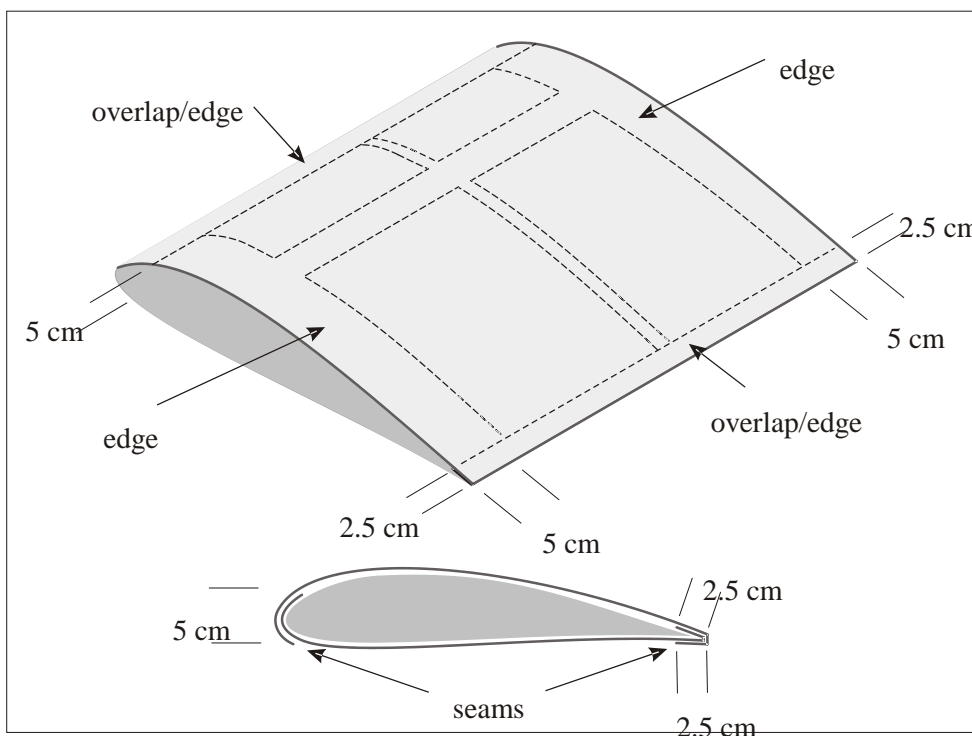
## 20-53 Principles of Fabric Application

One of the main concerns in fabric application is to avoid peeling off the fabric by air forces in flight.

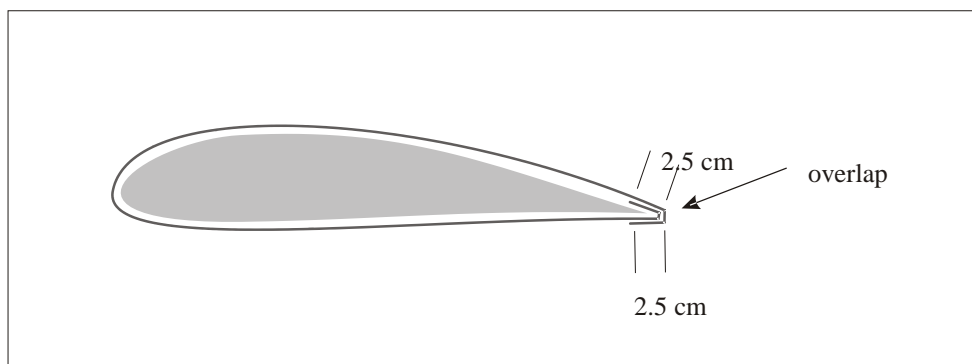
For that reason observe the following principles:

- Ensure that adhesive areas on the fabric edges and overlaps have a minimum width of 5 cm. Overlaps on leading and trailing edges shall

reach from the up side to the bottom side and vice versa. Ensure that surface seams are placed on the bottom side only.

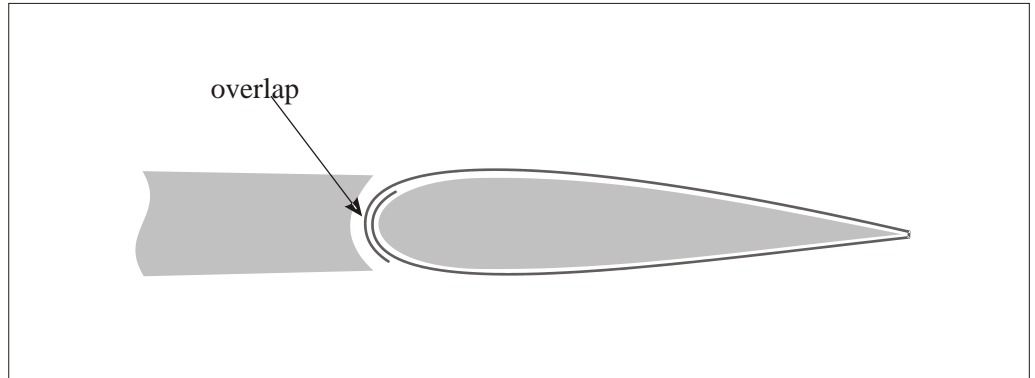


- Wherever possible the fabric must be applied as a complete envelope with only one overlap of minimum 5 cm. The overlap shall be placed on the trailing edge (up side and bottom side 2.5 cm).





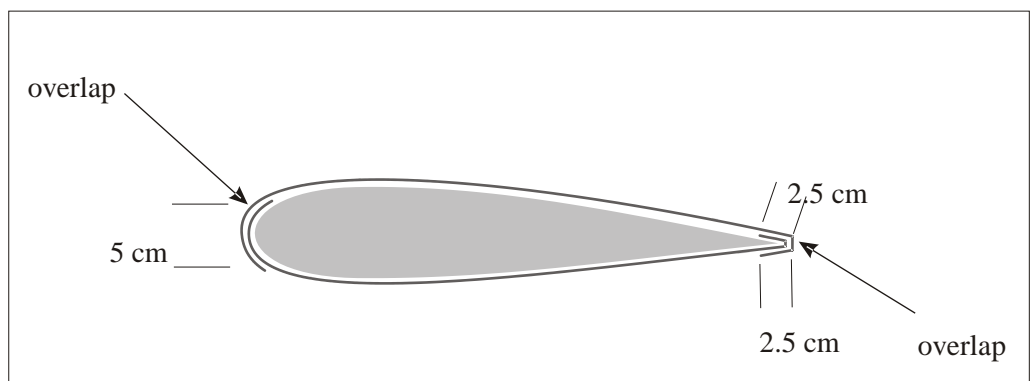
- The overlap can also be placed on the leading edge, which is advisable e.g. for control surfaces in the lee side of the wing or stabilizer.



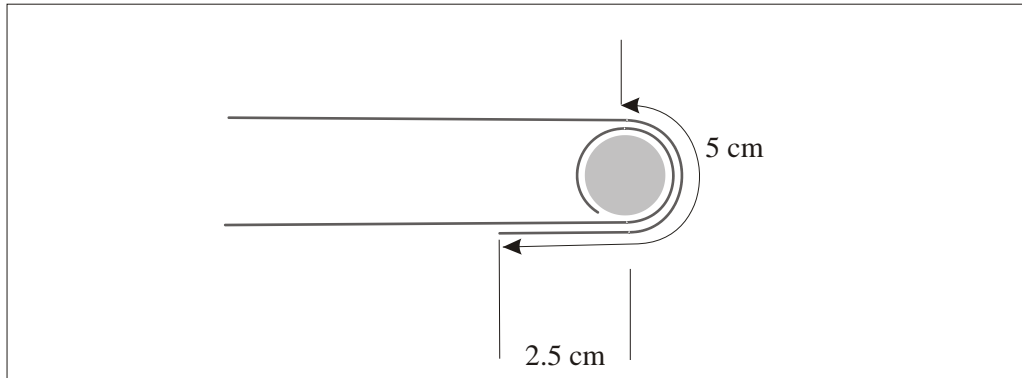
**IMPORTANT**

The **ORATEX®** system is NOT approved for traditional partial coverage of a surface. The only approved application is 'all around' as described in the following.

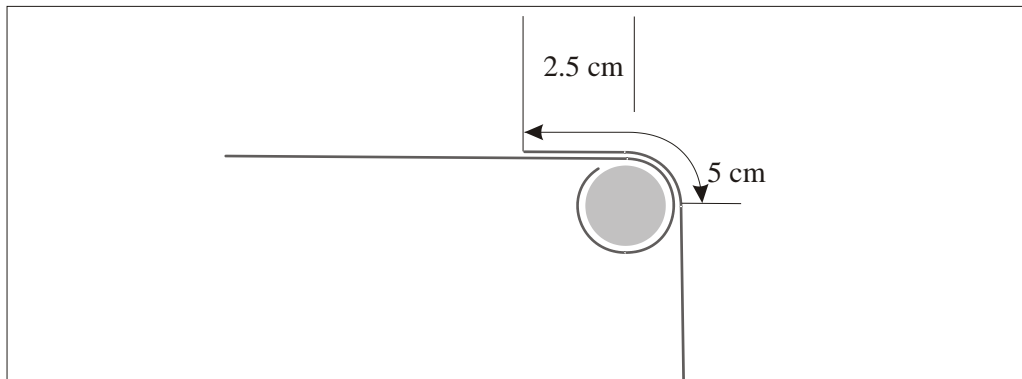
- Where a complete envelope is not possible apply the fabric in two (or more) separate layers. One on each side of the structure. In this case the fabric must always be attached to the leading edge and must reach to the trailing edge without interruption. Attachments and overlaps must be minimum 5 cm and reach from one structure side to the other (min. 2.5 cm each side).



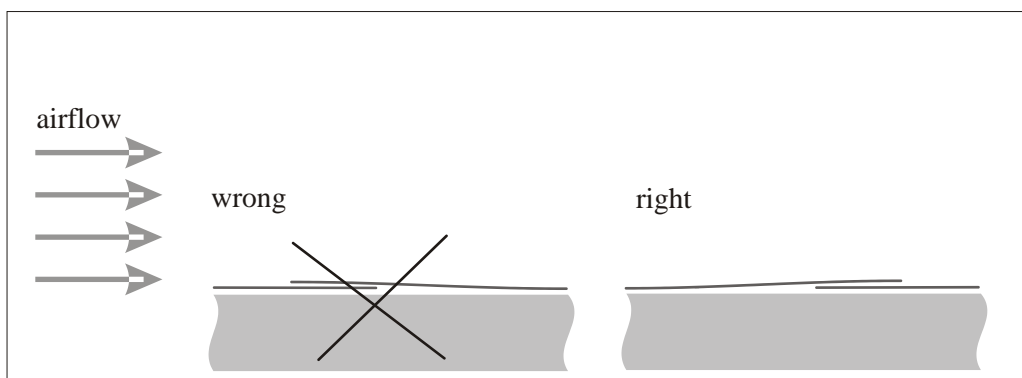
- Overlaps on tube structures must have a minimum width of 5 cm. The overlap must reach min. 2.5 cm to the bottom side.



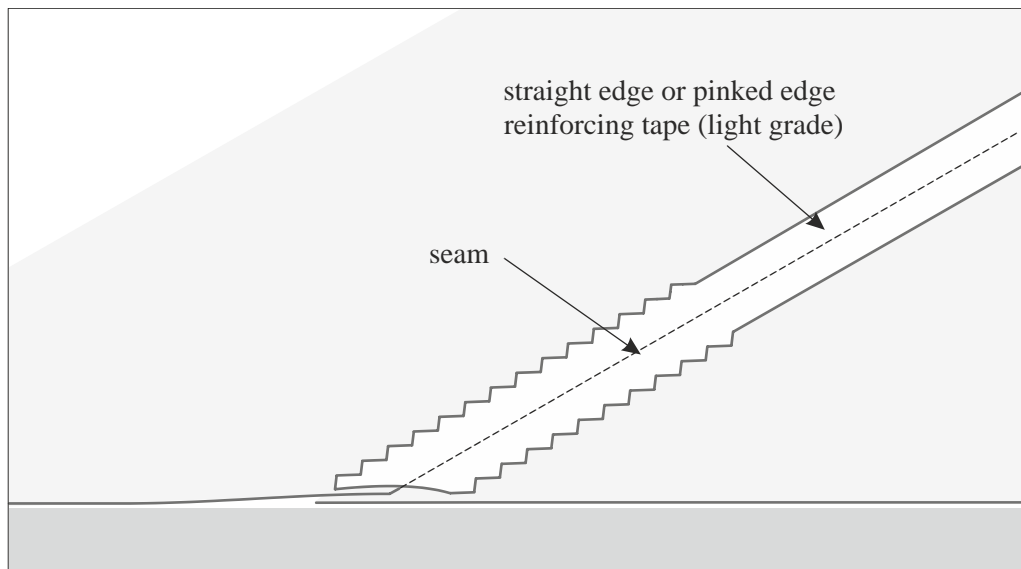
- On fuselage structures the overlap must have minimum width of 5 cm. The overlap must reach min. 2.5 cm to the other side.



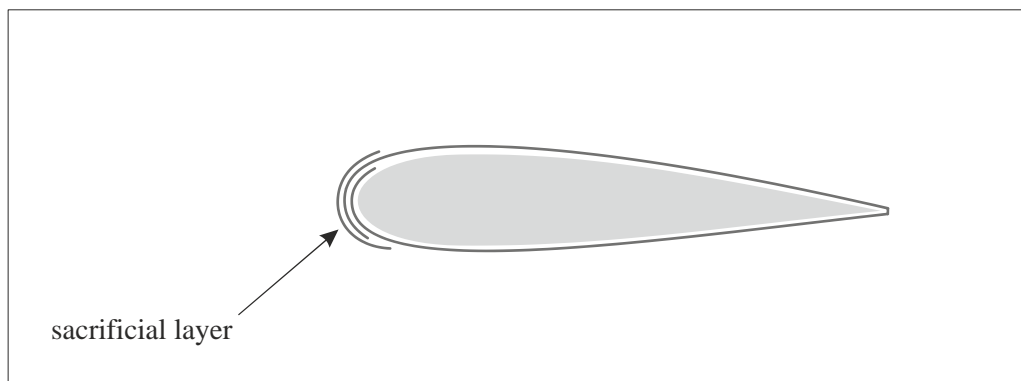
- Never place a seam into the air flow except on trailing edge. Span-wise seams must be on the lee side. Seams in air flow direction are not critical.



- Place an **ORATEX®UL600** reinforcing tape (straight edge or pinked edge) over each seam independent of the seam orientation. Exceptions are seams next to the trailing edge.



- Attach an additional, according to the nose thickness (ca 5 - 15 cm) wide **ORATEX®UL600** reinforcing tape (straight edge or pinked edge) to the leading edge to avoid damage to fabric by impacting particles. This layer is sacrificial and can be replaced in case of need.



- In areas where support is given by underlying surface structure (plywood or metal) and which are more than 5 cm away from unsupported areas a minimum overlap width is not prescribed.

## 20-54 Attachment of Fabric

Generally the fabric must be attached to the structure or an existing fabric layer wherever there are areas of contact with it. These can be

for example the leading edge, ribs, spars, trailing edge, skins, longerons etc.

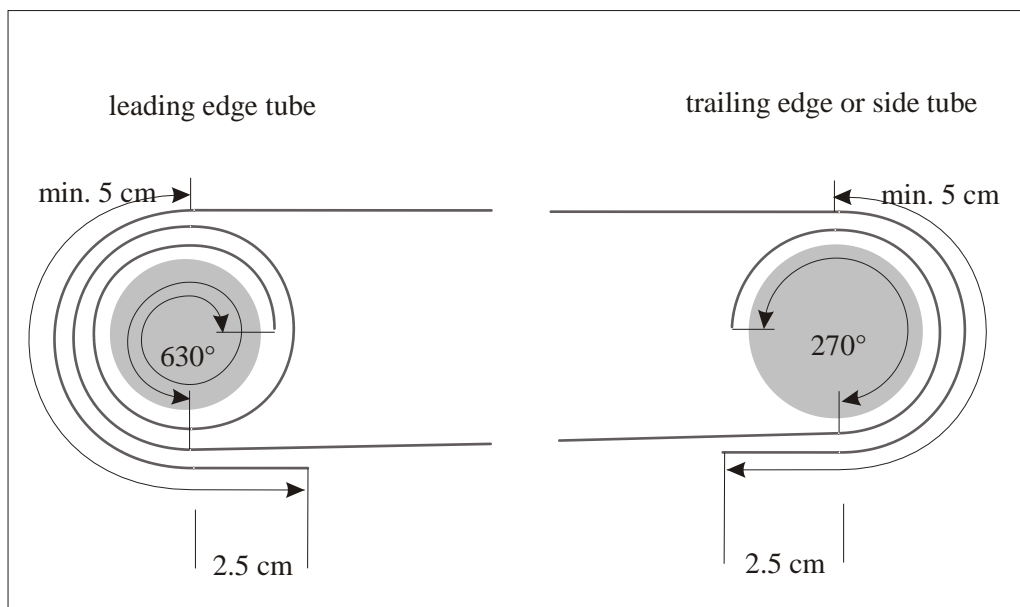
Special fastenings prescribed by the aircraft manufacturer can be an exception to this proposition. For example, if the fabric partly has to be fastened by clamping.

In addition to the contact areas, the fabric must be attached to the structure as follows:

## 20-54-01 Tubes

When fabric has to be attached to tubes, observe the following:

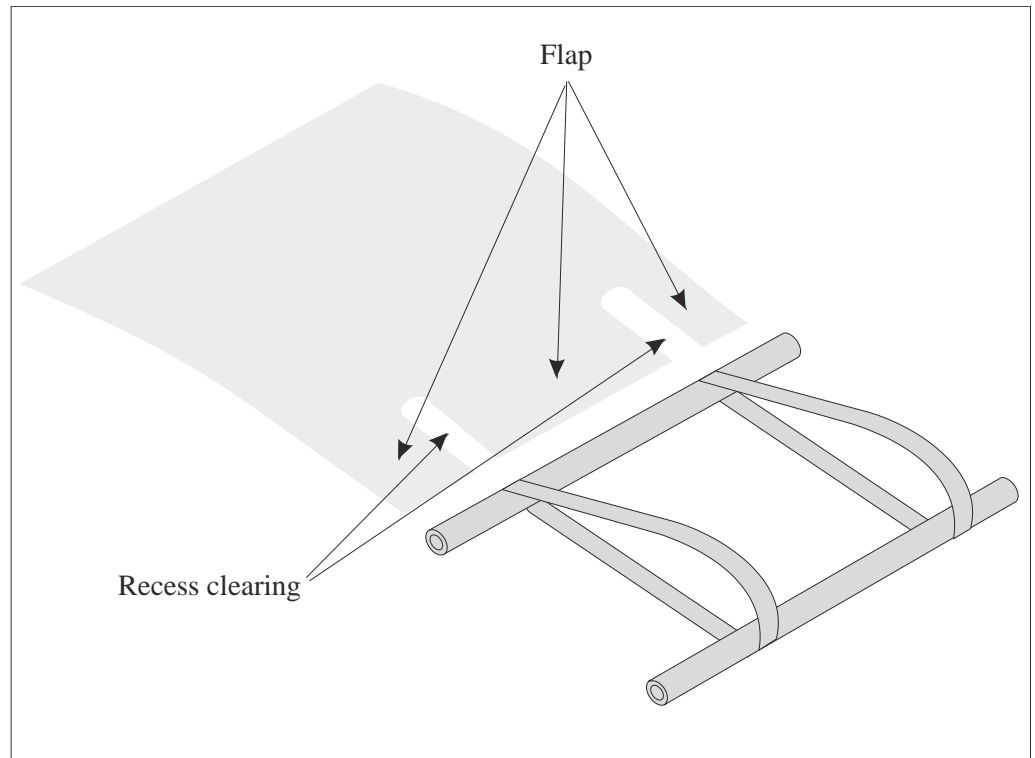
- ▶ Where possible, attach the bottom fabric layer making a 630° loop (e.g. on straight leading edge tubes), as outlined in the following *Typical Attachment with a 630° Loop* paragraph.
- ▶ Where a 630° loop is not possible, attach the bottom fabric layer making a 270° loop around the tube.
- ▶ Attach the outer fabric layer with an overlap of min. 5 cm. The overlap must reach min. 2.5 cm to the other/bottom side.



### Typical Attachment with a 630° Loop

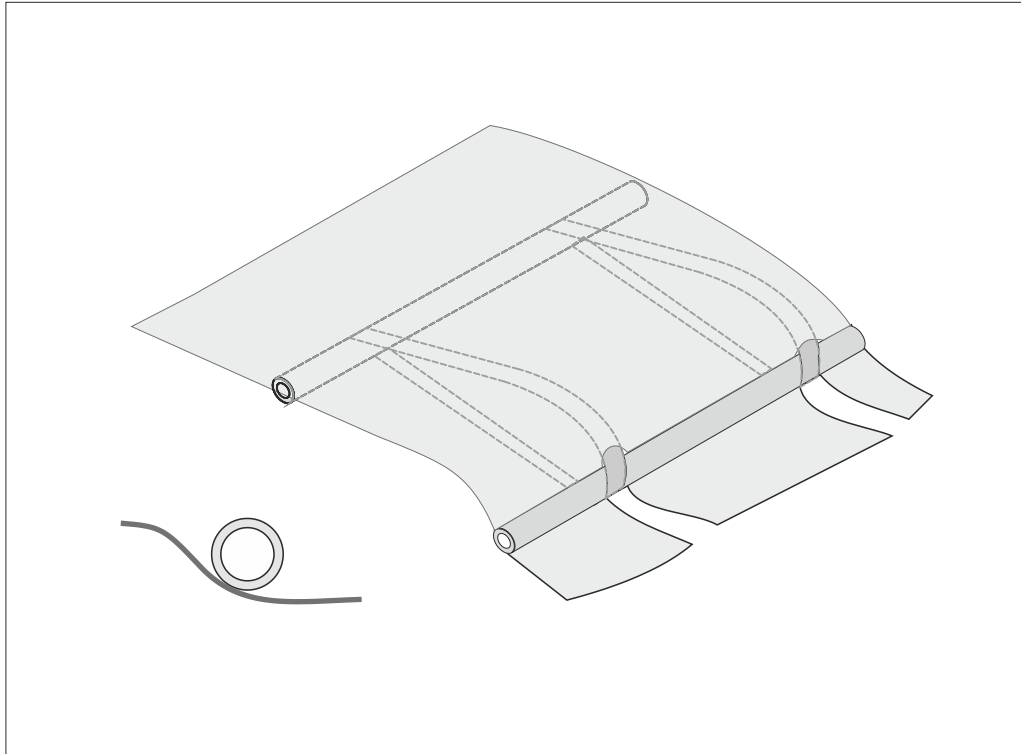
- ▶ Place the structure part with the side to be covered downward on the working surface.
- ▶ Place the fabric with the inner side (adhesive side) up on the working surface.

- ▶ Cut out "U" shaped recess clearings for the ribs with a length according to the winding length around the leading edge tube.  
By doing so you have produced flaps.

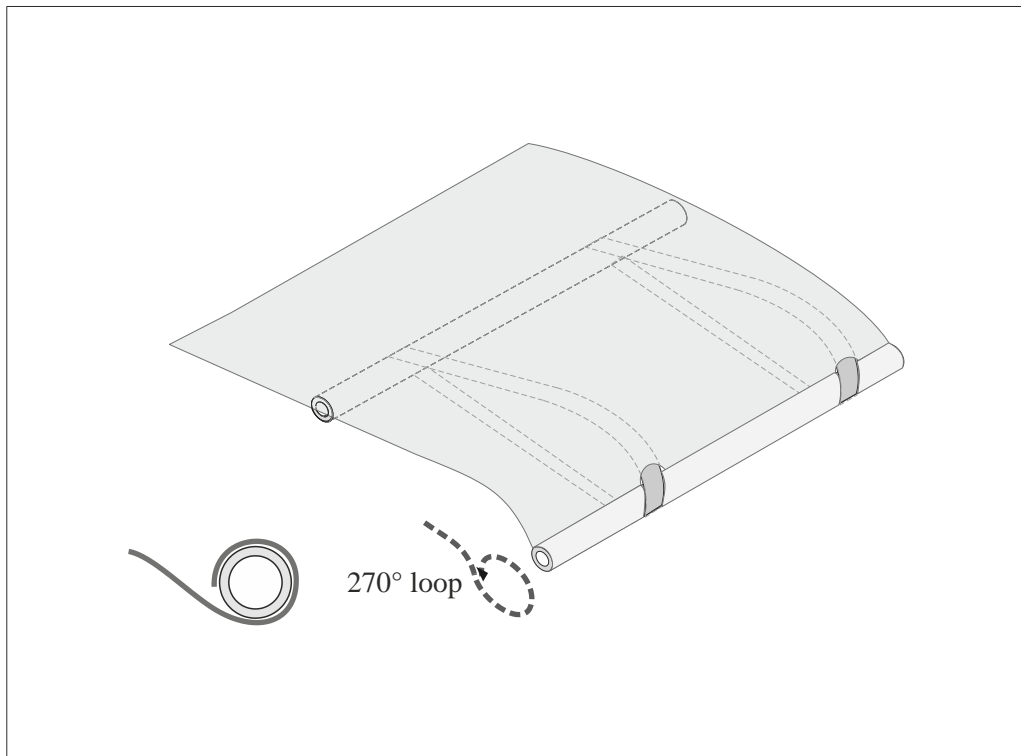


- ▶ Place the fabric with the inner side (adhesive side) up on the structure part.

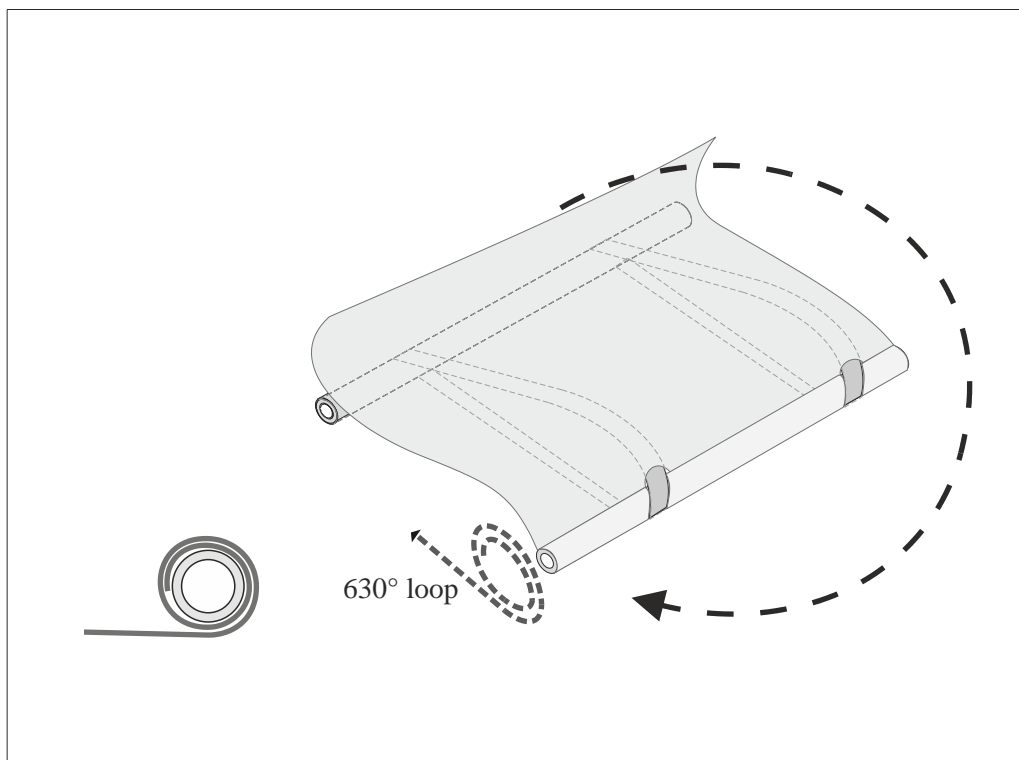
- ▶ Place the flaps under the leading edge tube.



- ▶ Attach the flaps to the leading edge tube by making a 270° loop.

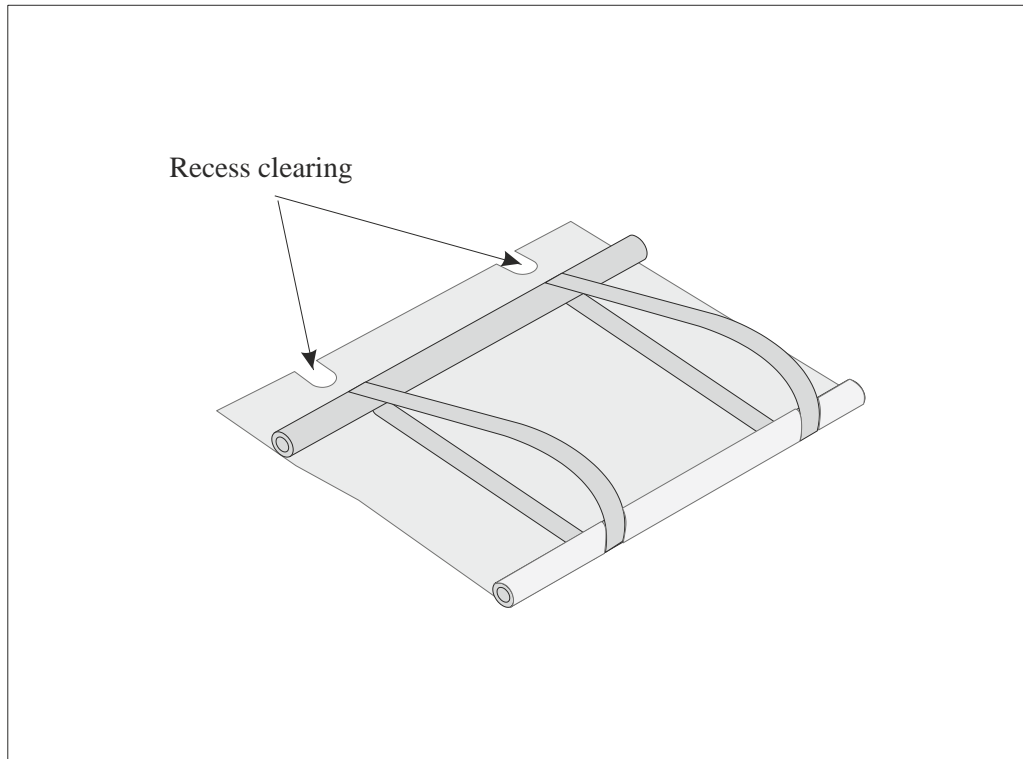


- ▶ Apply adhesive as per Chapter *20-55-02 Adhesive Application* to the outside of the fabric in the leading edge tube area up to the lowest point of the leading edge.
- ▶ Let dry the adhesive.
- ▶ Loop the fabric around the coated area of the leading edge tube.

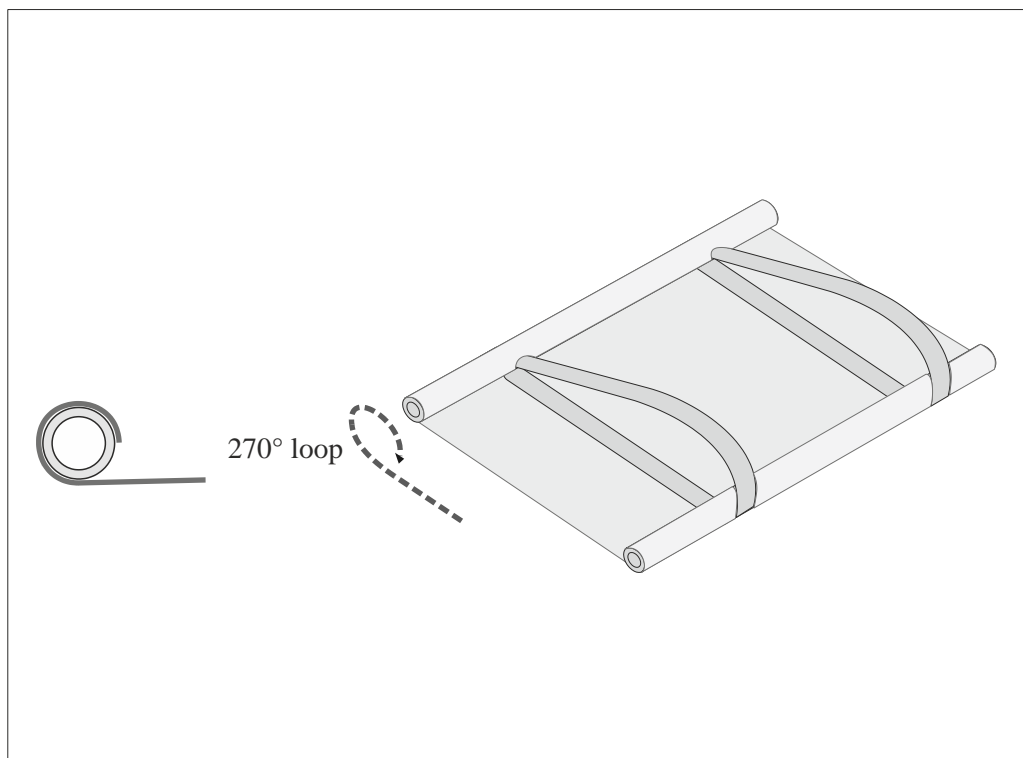


- ▶ Attach the fabric to the leading edge tube.
- ▶ Attach the fabric to the ribs.

- ▶ Cut out "U" shaped recess clearings for the ribs with a length according to the winding length around the trailing edge tube.



- ▶ Attach the fabric to the trailing edge tube making a 270° loop.





For such an attachment additional fabric is necessary. Calculate the margin for the pre-cut depending on the tube diameter using the following formula:

Example: tube diameter 2 cm, 270° loop (75% of complete loop):

$$\Pi \times \varnothing \times 75\% = 3.14 \times 2 \text{ cm} \times 0.75 = 4.7 \text{ cm}$$

Example: tube diameter 5 cm, 630° loop (175% of complete loop):

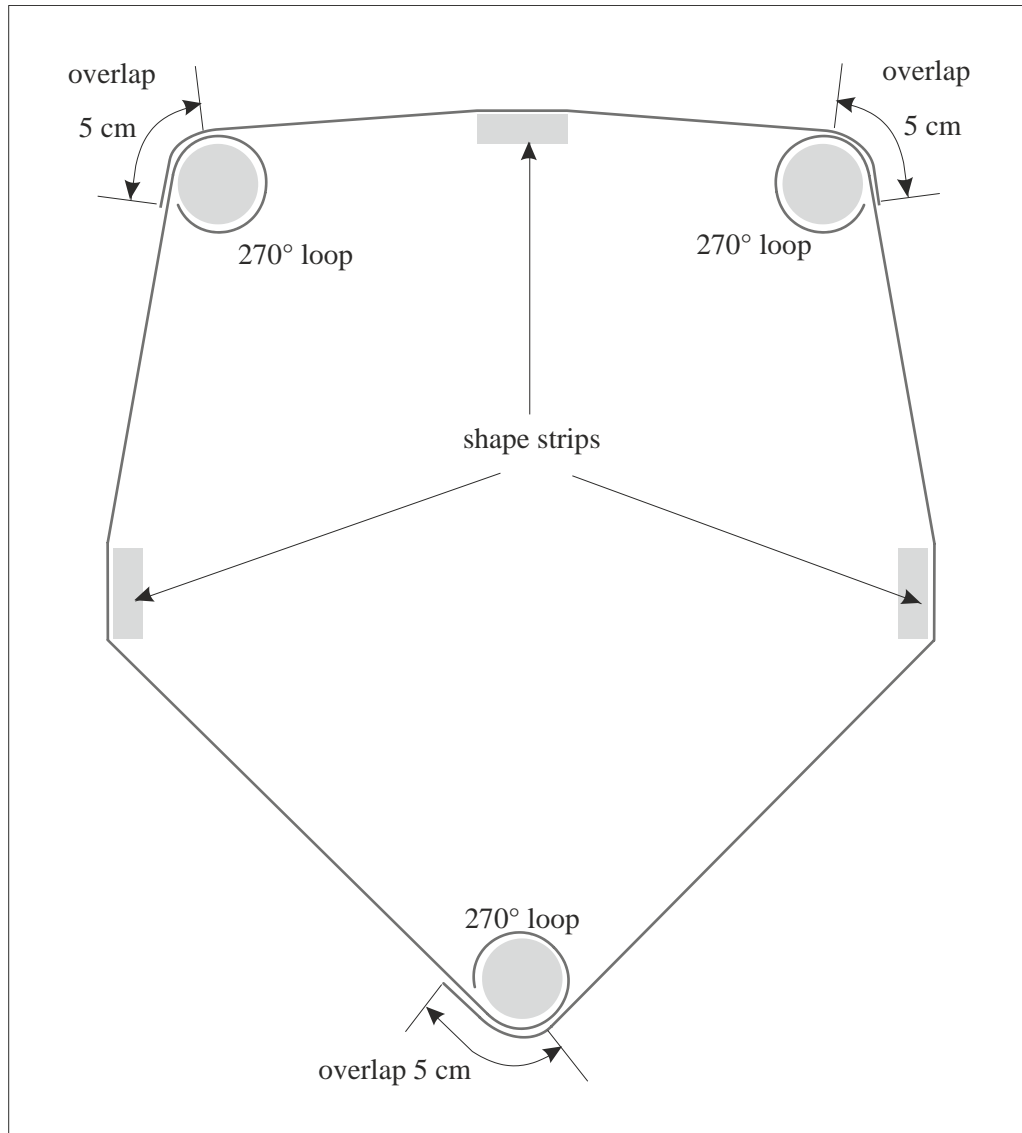
$$\Pi \times \varnothing \times 175\% = 3.14 \times 5 \text{ cm} \times 1.75 = 27.5 \text{ cm}$$

Example: tube diameter 2 cm, overlap (50% of complete loop + 2.5 cm):

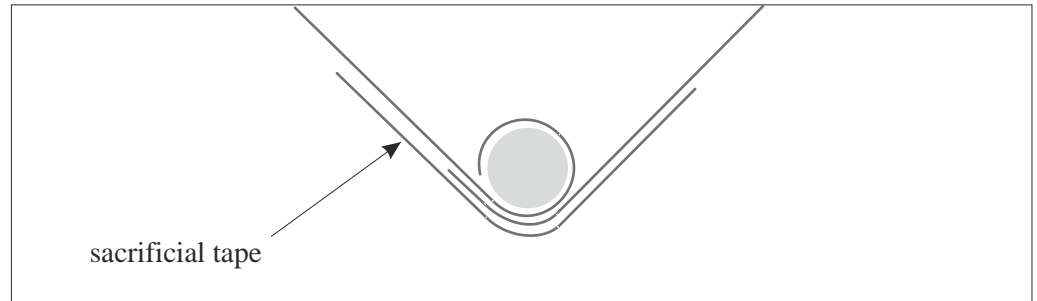
$$\Pi \times \varnothing \times 50\% + 2.5 \text{ cm} = 3.14 \times 2 \text{ cm} \times 0.5 + 2.5 \text{ cm} = 5.64 \text{ cm}$$

## Typical Steel Tube Design

The following figure shows fabric attachment on a typical steel tube frame with shape strips.

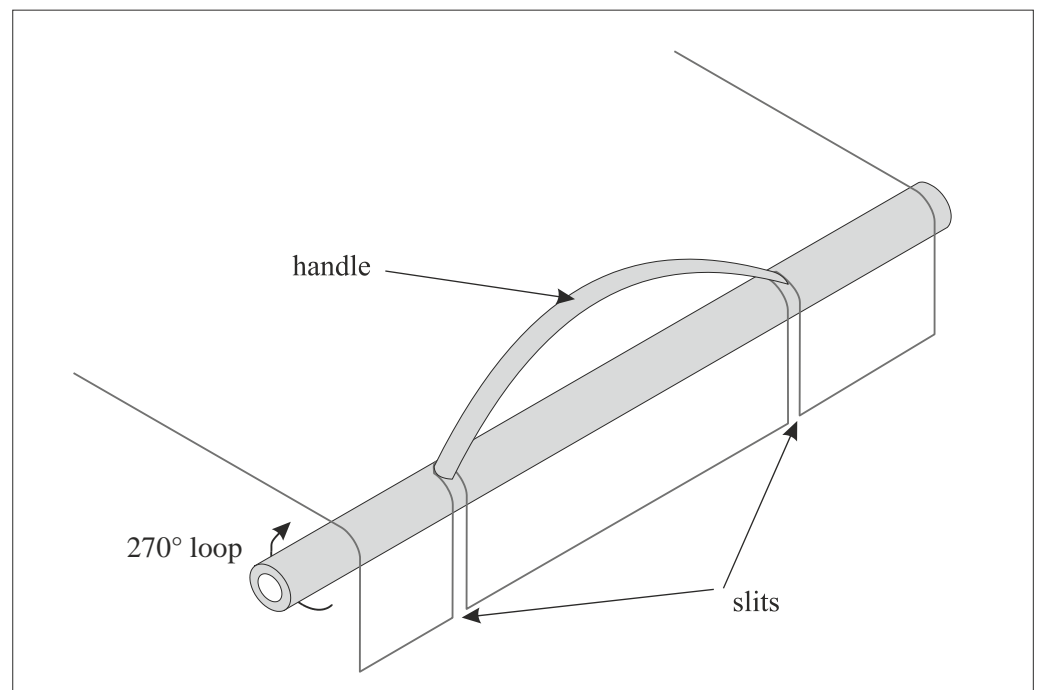


It is advisable to attach a sacrificial tape from **ORATEX® UL600** straight edge or pinked edge reinforcing tape in vulnerable areas (prone to stone nicks etc.) for easy exchange after damage.



### Tubes with Handle

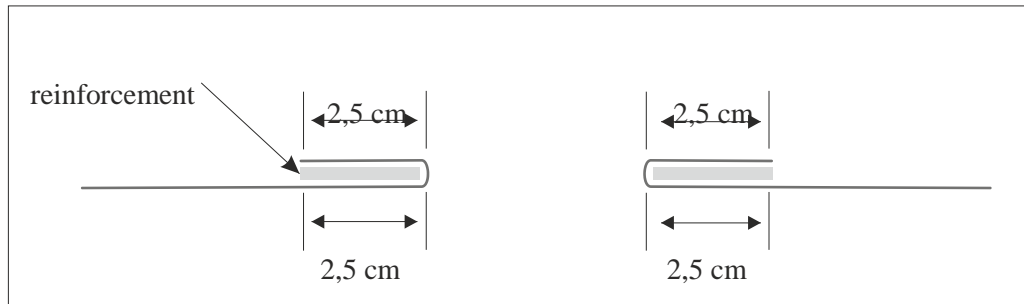
On tubes with handle or similar, mounting slits must be cut into the fabric so that they are perpendicular to the tube, to make 270° attachment loops possible. Never make slits parallel to the tube.



### Fabric embedded elements

Where possible embedded elements such as reinforcements for glider air tow or winch launch release hook openings the fabric shall be

bonded from both sides such that the accumulated minimum bond width is 5 cm.

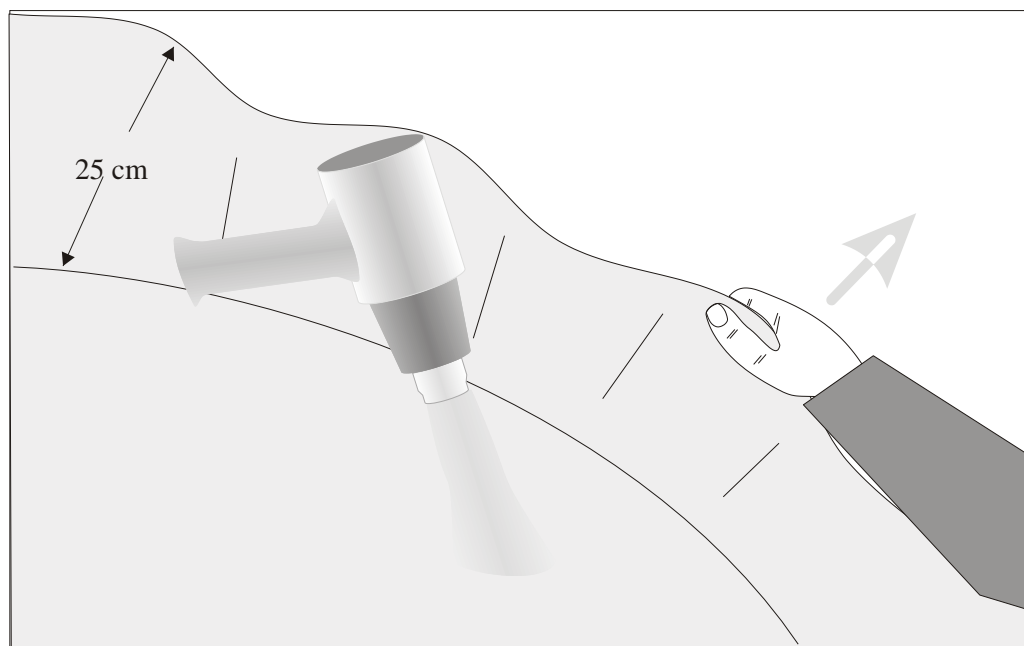


## 20-54-02 Convex Curved Areas and Edges

Such areas are for example

- curved wing tip bows
- the outside of a curved tube
- surface to root rib edge

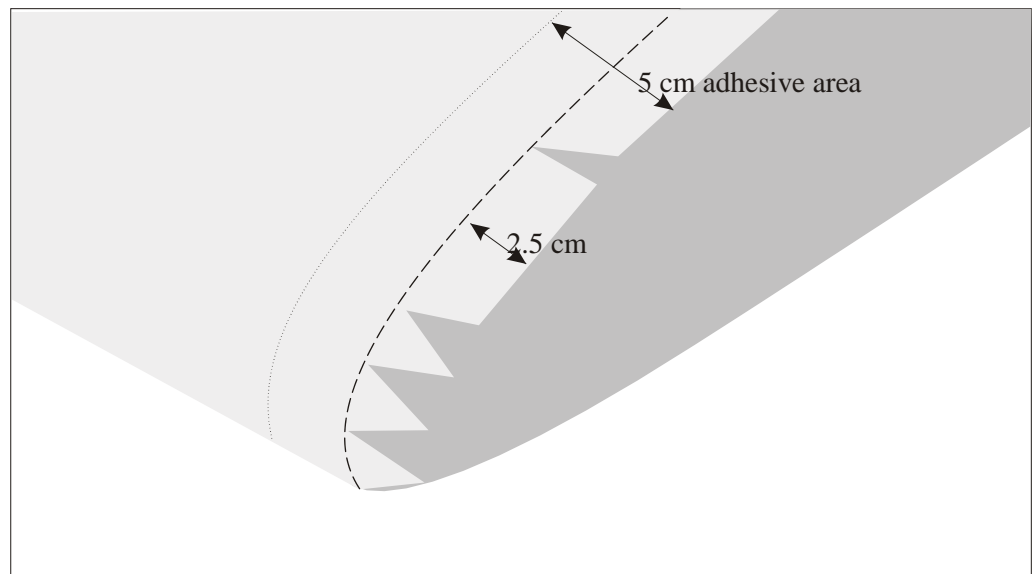
During fabric application to those areas it is necessary to tension and to shrink the fabric at the same time. Consider to provide an additional margin of min. 25 cm for the pre-cut, which allows holding the fabric in the later tensioning and shrinking process. The additional margin also allows keeping the hand away from the hot airflow of the heat gun.



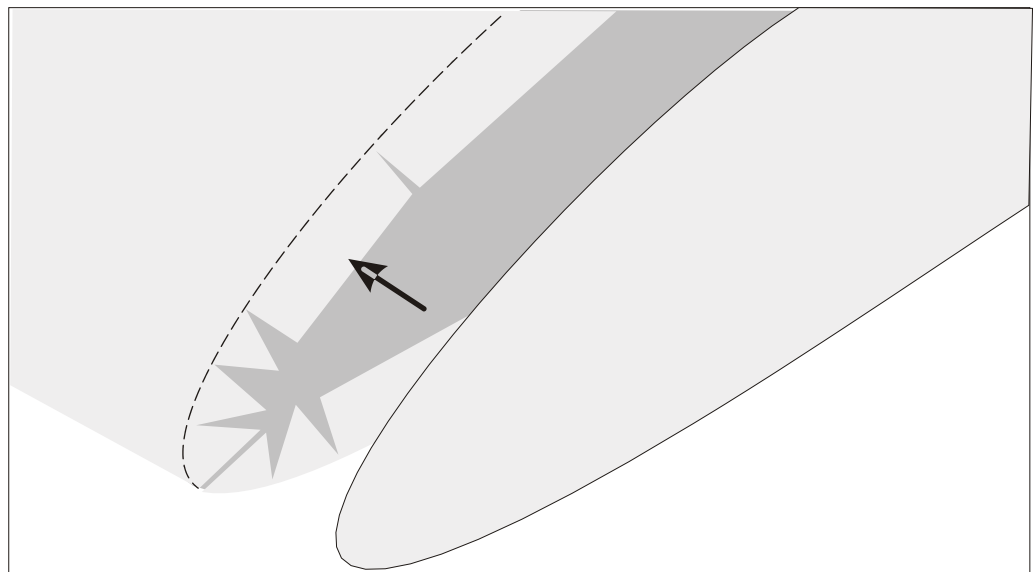
**NOTICE**

**Risk of adhesive cohesion failure when applying temperatures above 150 °C (302 °F).**

- ▶ Do not apply heat longer than 5 seconds to a fabric area.
- ▶ Apply adhesive after shrinking process is completed if applicable.
- ▶ Where shrinking is not sufficient to avoid wrinkling incise the fabric to get conical strips. The strips must not be narrower than a third of the curve radius. Avoid overlaps by triangle shaped strips. The strip length shall be min. 2.5 cm and shall not be longer than the curve radius. In any case the adhesive area must have a width of 5 cm. Ensure that the incisions do not come up to the areas of airflow.

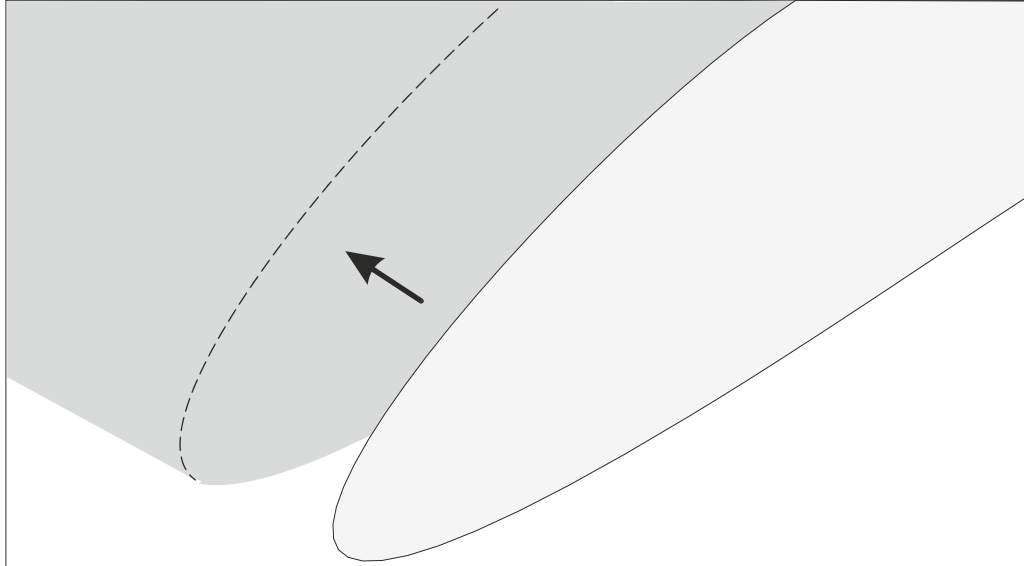


- ▶ Cover the area of strips by attaching an additional fabric layer 2 mm narrower than the area.

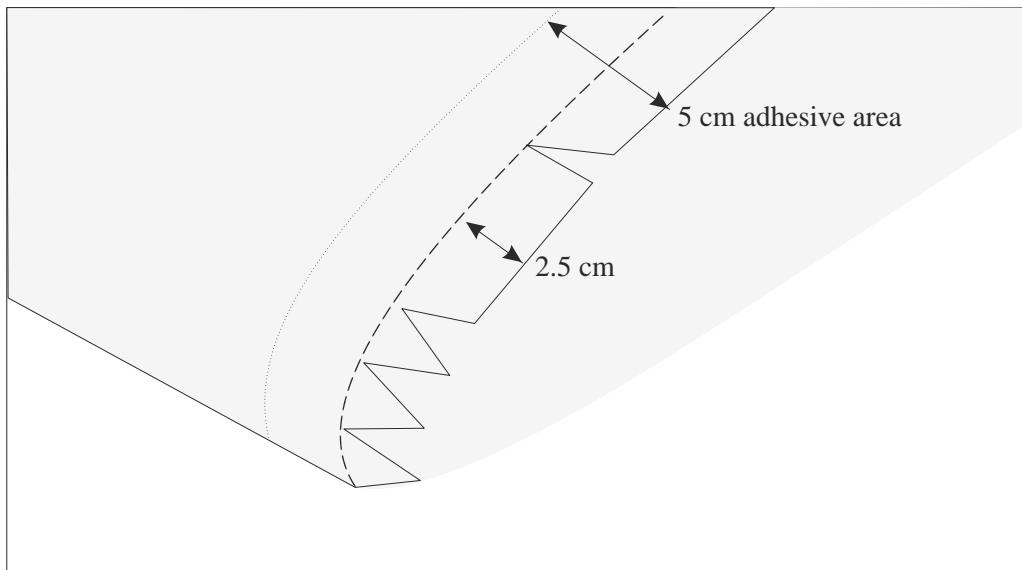


The order of the two last steps can also be changed:

- ▶ Attach a layer of fabric to the structure first.



- ▶ Then attach the fabric and the conical stripes as outlined above.



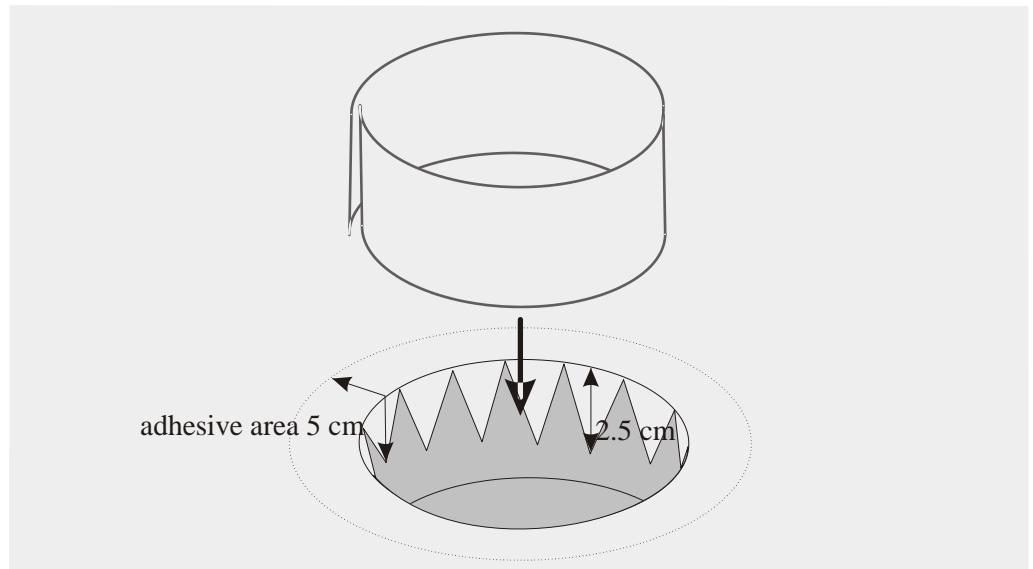
## 20-54-03 Concave Curved Areas and Edges

Such areas are for example:

- the inside of a curved tube
- wheel bays
- ▶ Where the fabric cannot be stretched as necessary, incise the fabric.
- ▶ On curved parts several slits may be necessary to get strips. The strips must not be narrower than a third of the curve radius. The strip

length shall be min. 2.5 cm and shall not be longer than the curve radius. In any case the adhesive area must have a width of 5 cm.

- ▶ Ensure that the incisions do not come up to the areas of airflow.
- ▶ Cover the inner surfaces with an additional fabric layer. The fabric must be about 2 mm narrower than the respective surface.



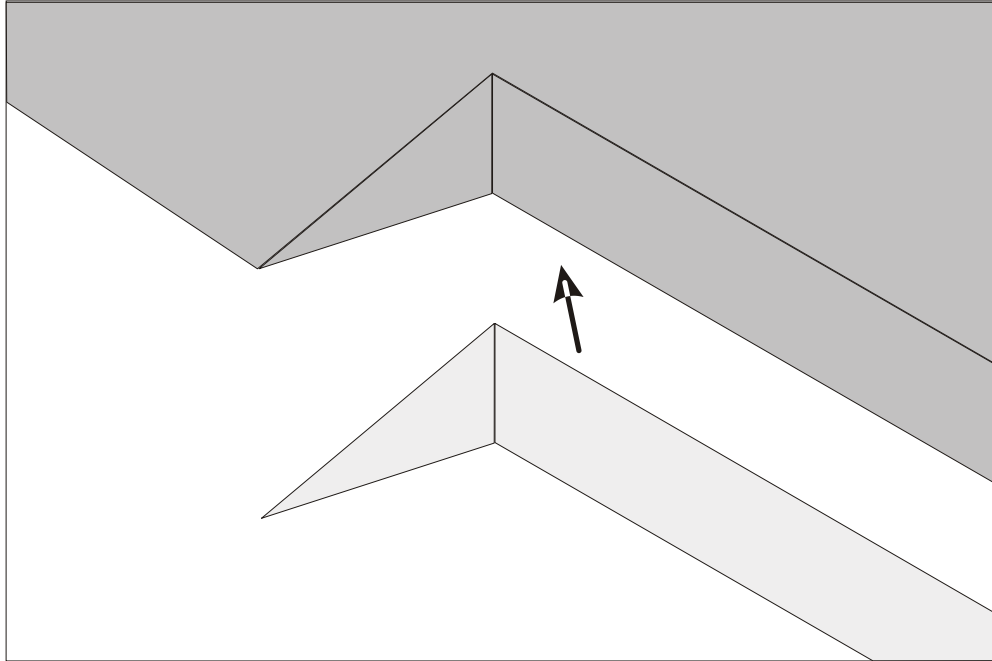
## 20-54-04 Corners

Such areas are for example:

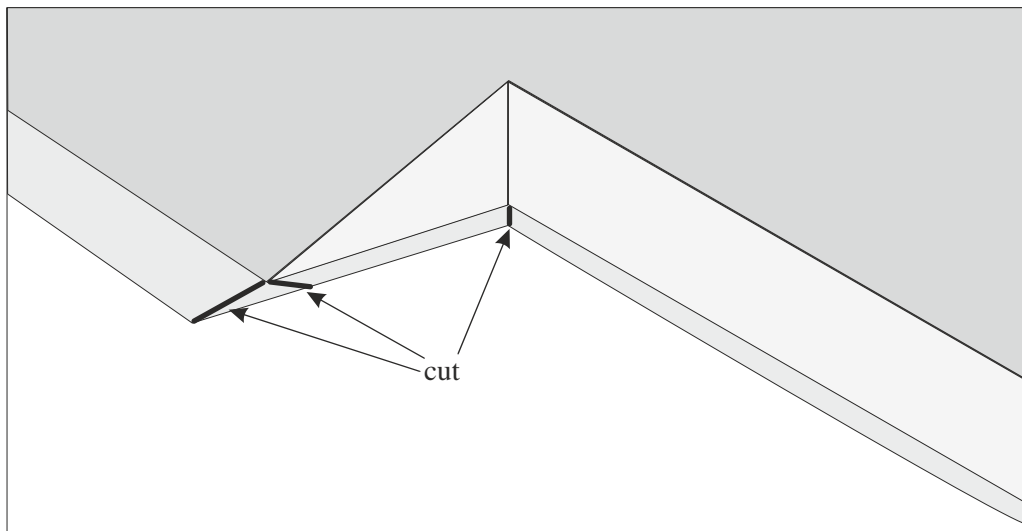
- aileron or flap recesses
- box-shaped openings

## Standard Procedure

- ▶ Cover the inner surfaces with an additional fabric layer.

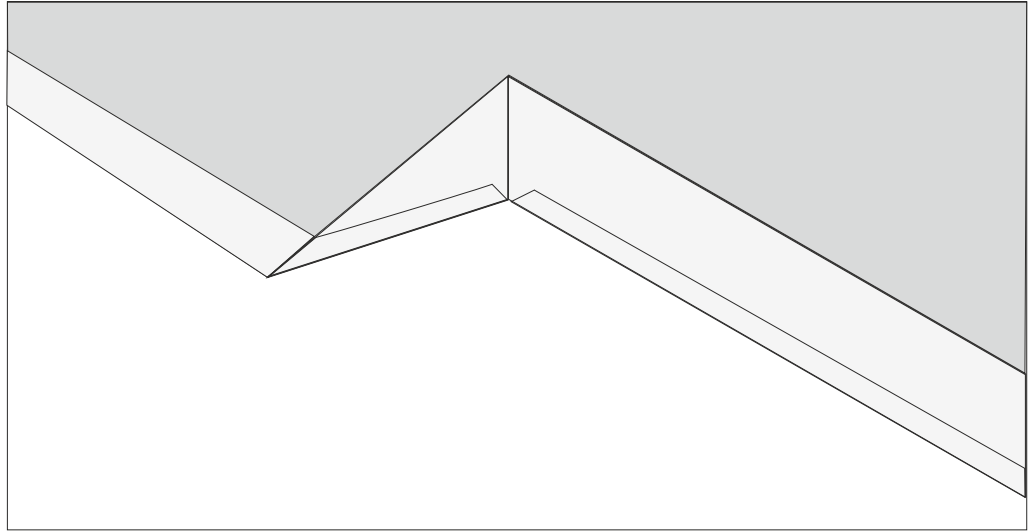


- ▶ Make cuts on the bottom fabric layer.

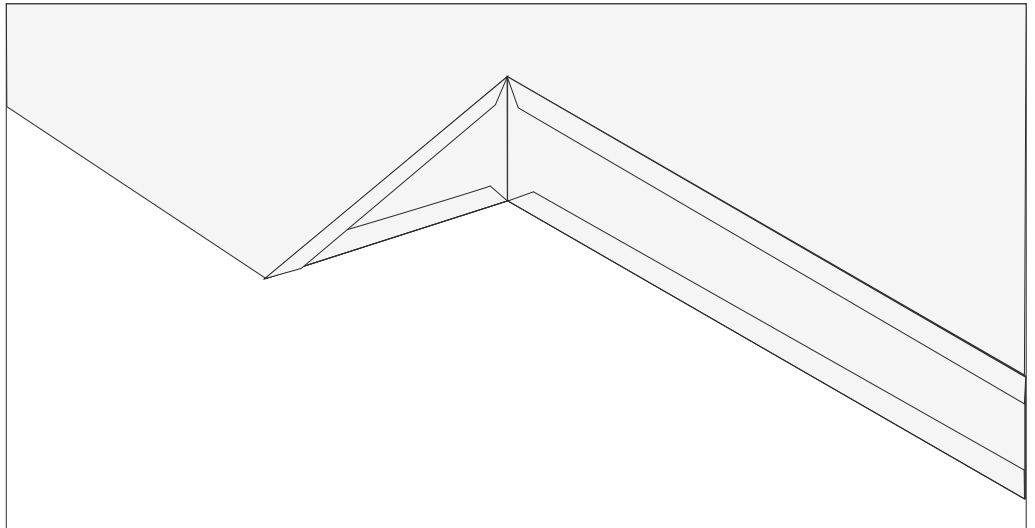




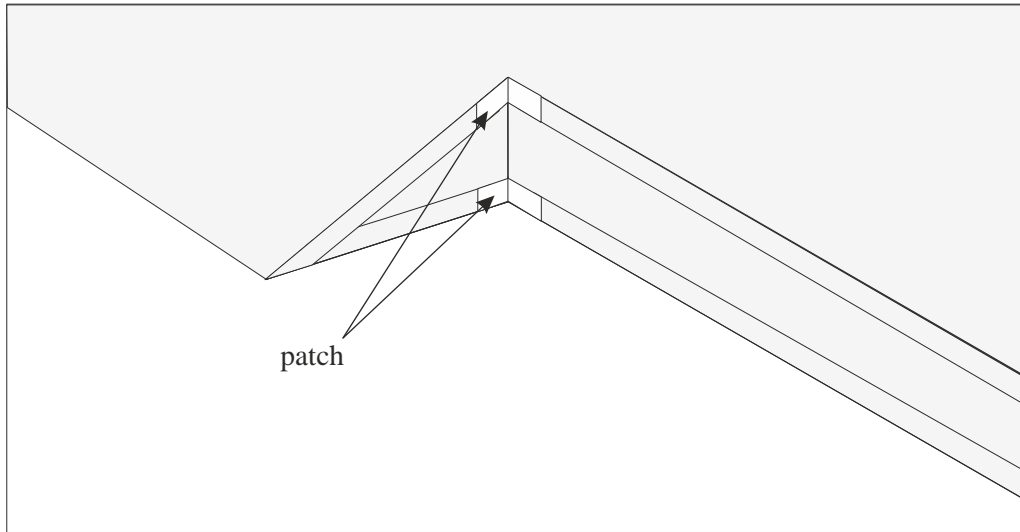
- ▶ Attach the margins to the inner surfaces.



- ▶ Proceed in the same manner for the top fabric layer.

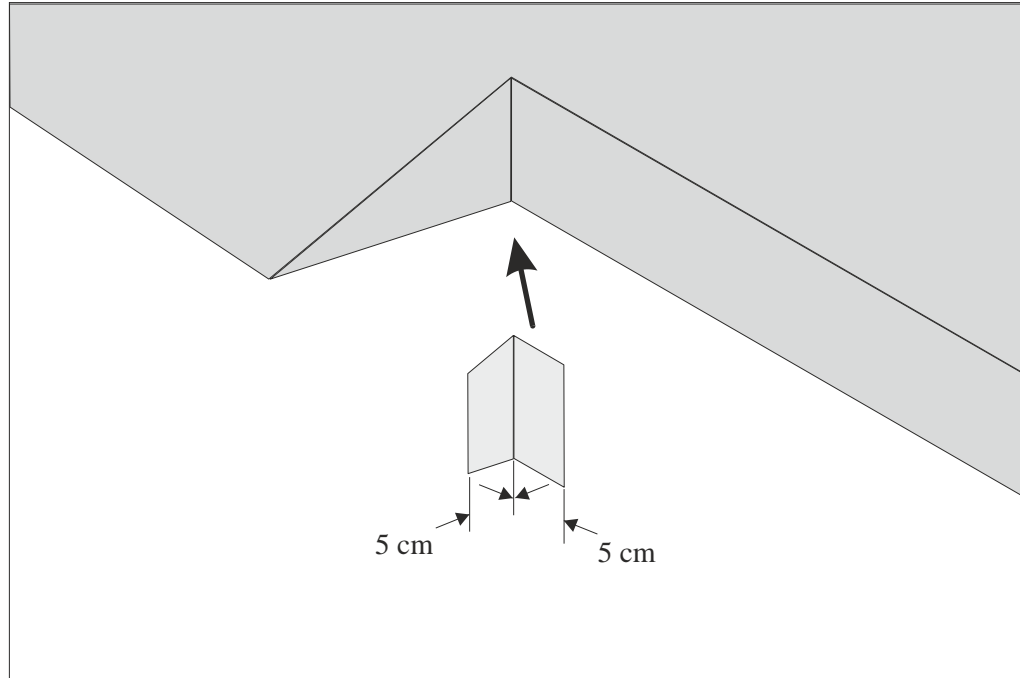


- ▶ Attach a small fabric layer patch to each corner.

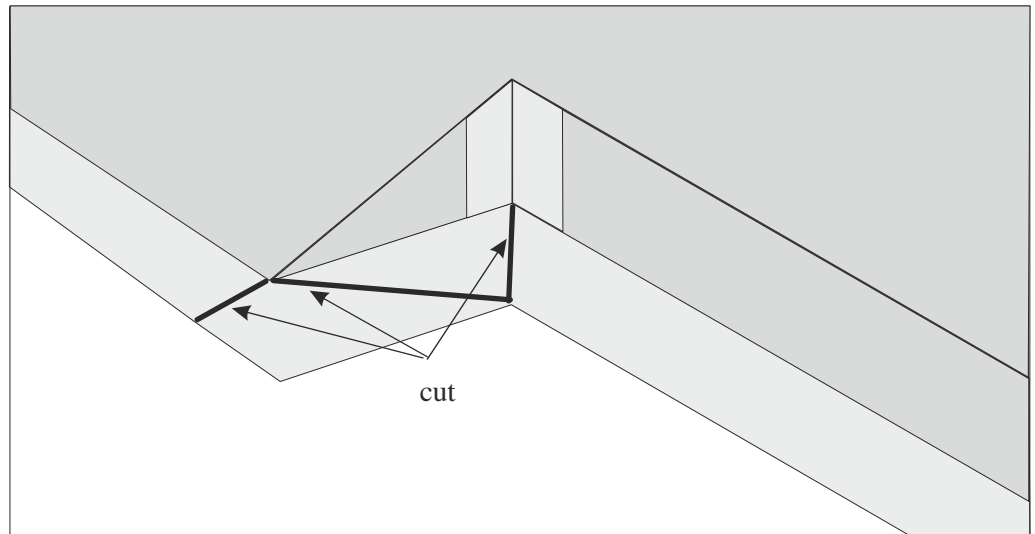


### Alternative Procedure

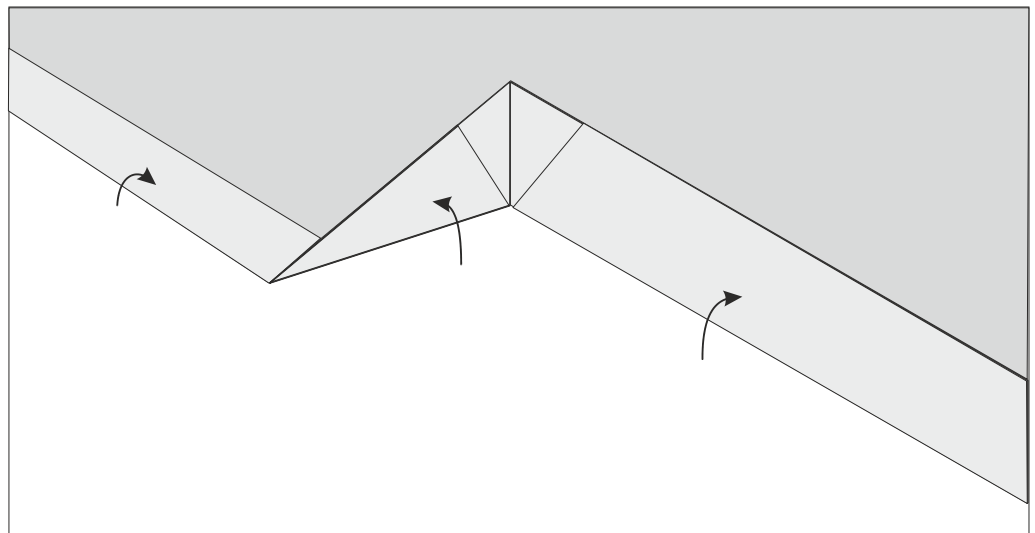
- ▶ Attach fabric layer patches to the corners as shown below. These patches must have the height of the wing structure in the respective areas.



- ▶ Make cuts on the bottom fabric layer.



- ▶ Attach the margins to the inner surfaces.



- ▶ Proceed in the same manner for the top fabric layer.

## 20-54-05 Seams and Overlaps

For proper applying seams and overlaps proceed as follows:

- ▶ Provide sufficient fabric for the seam/overlap plus some excess length (consider 5cm), which will be cut later.
- ▶ Clean the previously attached layer in the area of the seam/overlap with **ORATEX®** degreaser according to the *Proper Cleaning* paragraph on page 25.

- ▶ Mark the line, where the seam/overlap shall end, with small dots from a small HB pencil on the surface.



**NOTE** Do not touch the cleaned surface.

The following step can be done with felt blade. The dots have to stay visible and will later on be hidden by the seam/overlap.

- ▶ Apply **ORATEX®** fixing tape parallel to the marked dots by pressing down thoroughly.



- ▶ Apply adhesive to the previously attached layer in the area of seam/overlap.



- ▶ Apply adhesive to the seam/overlap.
- ▶ Let the adhesive dry.
- ▶ Iron on the seam/overlap up to a line of 5 mm below the fixing tape.
- ▶ To receive a proper mark for a cutting line, fold the seam/overlap back by 180° at a line 1 mm below the fixing tape and press firmly.
- ▶ Cut off the excessive material at this mark.
- ▶ Remove the fixing tape.
- ▶ Iron the final 5 mm of the seam/overlap thoroughly onto the surface

## 20–55      **Fabric Application**

The complete fabric application process consists of the following steps:

- Fabric pre-cut
- Adhesive application to the structure
- Adhesive application to the fabric
- Adhesive drying
- Positioning
- Fabric attachment
- Heat tightening of fabric

Generally the steps are to be performed in the order shown above. However in some cases the order must be changed; the following are examples for those exceptions:

- Sometimes it is necessary to shrink the fabric before adhesive application e. g. if it is not possible to attach the fabric while or immediately after shrinking.
- In some cases the exact contact areas of fabric and structure are not known before other parts of fabric are already attached. The application of adhesive to the fabric and another drying and fabric attachment process must then be performed later.

## 20-55-01 Fabric Pre-cut

The procedure to get the right pre-cut for the fabric consists of three steps:

- copy the contour of the structure to the inside of the fabric
  - add margins for attachments and overlaps
  - add excess for holding and tensioning the fabric during the attachment process.
- ▶ Transfer the structure contour on the inner (texture) side of the fabric by lightly tracing with a lead pencil type HB.

For copying the contour of shallow parts like a wing, stabilizer or control surface, roll out the fabric on a table, inner (texture) side up, and place the part on it. Mark all contact areas of the fabric with the part lightly with a lead pencil type HB.

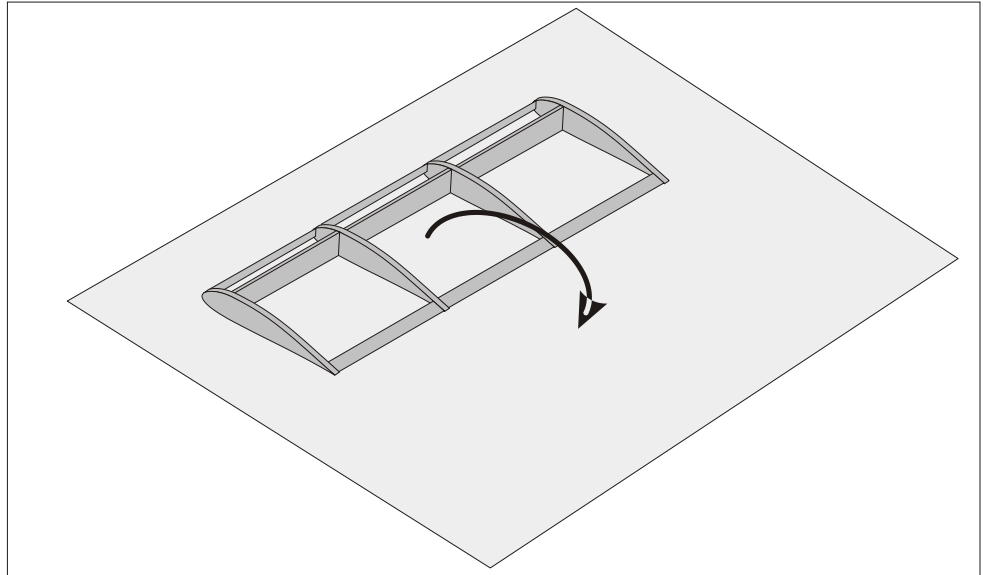
Alternatively, on symmetrical structure parts, you can place the fabric mirror inverted with the top side down on the opposite structure part. In this case potential production tolerances left/right need to be accounted for. To avoid wrinkles in the fabric, put it in place by rolling it off the roll.

### **NOTICE**

**Damage or unintended tightening of the fabric due to heat of work light.**

- ▶ Ensure sufficient distance of the work lamp to the fabric with the aid of an IR thermometer.
- ▶ Use an LED light if possible.

- ▶ Position a protected work light with sufficient power under the structure. This illumination will show the structure contour from the bottom side, which then can be easily traced.
- ▶ When you intend to make a complete envelope, pivot the part on one edge and continue marking the contact areas.

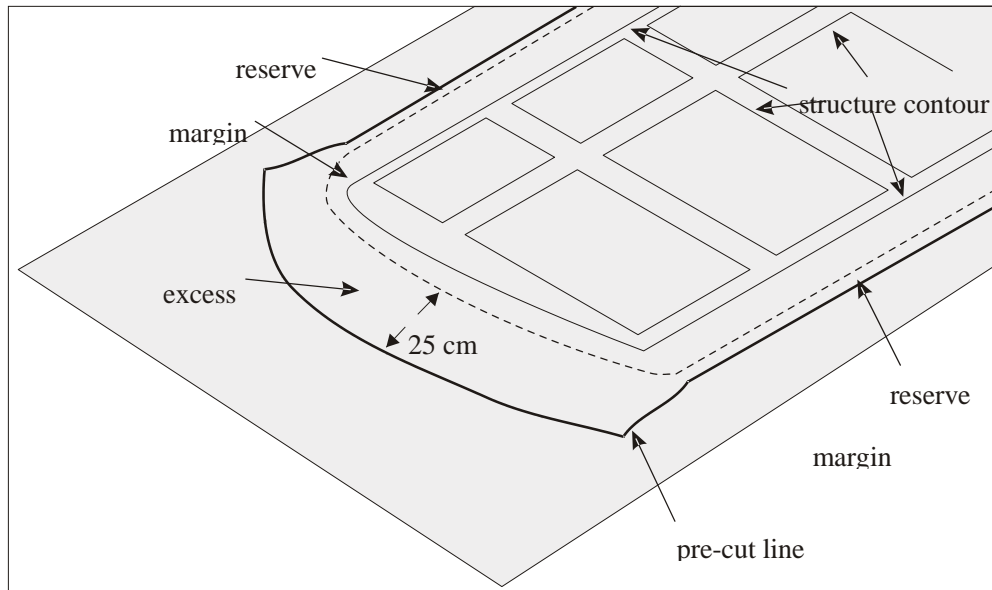


For copying the contour of bulky parts like a fuselage, pre-attach the fabric with fixing tape for **ORATEX®** to the part and then mark the contact areas.

- ▶ Mark margins for attachments and overlaps.
- ▶ Mark a reserve of about 2.5 cm.
- ▶ Mark additional excess (25 cm) to be able to tension the fabric while attaching, or if space for holding the fabric is desirable.

If a serial production shall be established, a template can be made at this particular time.

- ▶ Cut the fabric along the new outer line (pre-cut line).



- ▶ Make the final cuts and the slits just before attaching the respective fabric areas.

## 20-55-02 Adhesive Application

To prevent grease from being transferred from your hands to the airframe and covering, clean hands are essential, but you should not use hand cleaners, soaps, hand creams etc. that contain moisturizers, oil or grease. They are protective for your skin but these substances can be easily transferred to any surface just by touching them, also critically to both the bottom and surface of the covering.

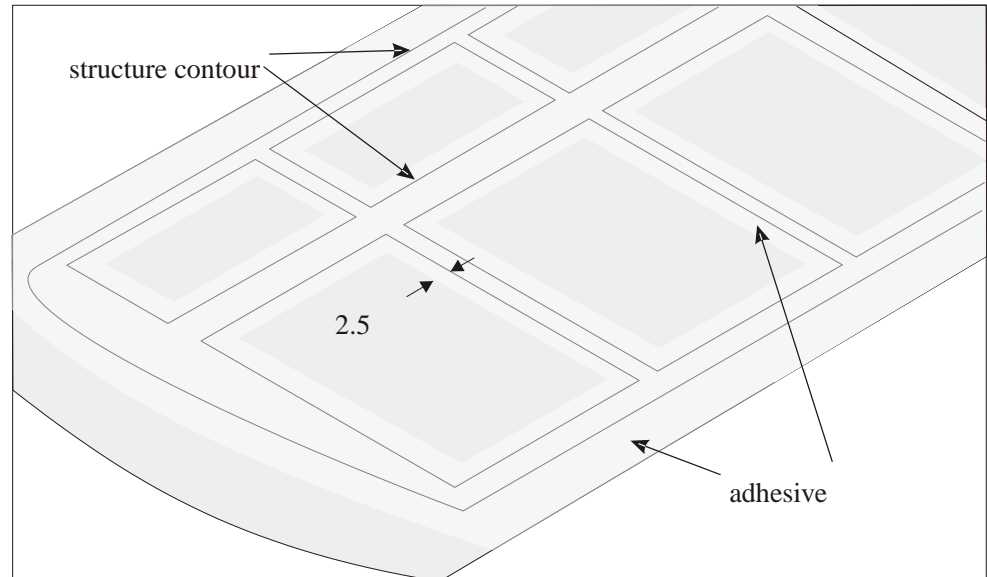
It is essential to remove these finger marks before you start application of adhesive. Otherwise, an optimal bond between fabric and airframe cannot be guaranteed.

Furthermore, before the adhesive is applied, you must ensure that the structure to be covered and the covering to be applied are completely free of dust and particles. Failure to do so will result in their incorporation into the adhesive film and they will show up after the ironing process as irregularities and affect the bond strength.

Use the special brush for **ORATEX®** dispersion hotmelt adhesive. When using other brushes, the adhesive could dry in the brush and form small particles, which would derange the surface.



Apply adhesive to the contact areas on both the structure (or an existing fabric layer or bracing tape) and the inner (matter) side of the new fabric including its margins for attachments and overlaps. Apply adhesive on the fabric 2.5 cm wider than necessary to have some reserve when positioning the fabric to the structure.



The adhesive must form a thin cohesive film. Visually check the integrity of the coating: the surface must look glittery. If you detect any uncoated (mat) areas, complete the adhesive coat.

**NOTE**

**Absorptive ground (such as wooden structure) generally requires more adhesive. One or more additional adhesive applications will be necessary to receive a thin cohesive film. This is extremely vital with moisture absorbing tropical wood, such as Okoume, as this kind of wood will completely absorb the first adhesive layer. For this reason we recommend minimum two adhesive applications on all surfaces. That means minimum two layers onto the structure and minimum two layers onto the fabric.**

Where Type Design does not require stitching or other mechanical interface on areas less than 50 mm wide, the adhesive must be applied at least twice on each bonding surface (also in case of metal ribs etc.).

Generally it is advisable to apply adhesive to the fabric before placing it to the structure.

However in the following cases the adhesive must be applied to the fabric, when parts of it already attached:

- If fabric has to be shrunk prior to adhesive application
- If contact areas are not exactly known before

Apply adhesive to these areas later but make sure you give sufficient drying time allowance.

## 20-55-03 Adhesive Drying

Drying depends on temperature, humidity and coat thickness. Check with your fingertips if the coat is dry. If you are in doubt a drying time of 12 hours is recommended to achieve a safe bonding quality.

Temperatures above 50 °C (122 °F) will initiate the hardening process of the glue and make the coat useless.

You can accelerate the drying process with warm air. Do not use air temperatures for drying above 30 °C (86 °F) in order to have a save margin to the temperature at which the invisible hardening process starts.

## 20-55-04 Positioning

- ▶ Position the fabric on the structure. Ensure that the adhesive surfaces match.

During the whole positioning process is advisable, that helping persons hold the fabric in place while tensioning it. The tension you can apply to the fabric in this phase of application will produce a reserve for the later shrinking process. Avoid unnecessary bumps and waves.

- ▶ Provisionally fix the fabric at several points using a heat gun with a felt scraper. Provisionally fixing shall be done with a relative short residence time at a temperature of 50 °C (122 °F).

Move the heat gun in the following speed. The speed is relative to the diameter of heated area:

Speed = diameter of heated area/2 sec

This technique allows later slight adjustment (several mm) by sliding the fabric over the structure when then heated to 90 °C (194 °F);

however the fabric must not be released from the structure. If this should be necessary, apply new adhesive and await the drying process.

Begin the provisional fixing process on critical areas and then work to the easier areas. Generally it is advisable to begin in the centre of the area and then to work to the outside to minimise alignment mistakes.

**NOTICE**

Never re-position the fabric, while the adhesive is cold. This could result in tearing of wooden fibres from the structure.

- ▶ Always heat the adhesive before re-positioning the fabric.

## 20-55-05 Attaching the Fabric

The attachment of fabric must be performed in two passes. Each pass is done with its own tool. The change of tool increases the liability of bonding.

For the first pass use

- a heat gun in combination with an **ORATEX®** felt blade or
- a heat gun while manually tightening the fabric

These practices allow easy change of temperature and size of heated area by distance. This is advantageous if fabric has to be shrunk while attaching. The use of a felt blade is flexible when applying fabric to grooves, crimps, inner edges or corners. This is also used to press the fabric tight onto the surface and to push trapped air out of the joint.

For the second pass use

- an **ORATEX®** iron

This practice allows higher control of load and residence time. It makes it also easier to maintain a scheme.

After each pass all seams have to be consolidated with the use of the press roll while they are hot. Special care must be taken to avoid the possible trapping of air. Also small wrinkles can be worked out easily by means of the press roll.

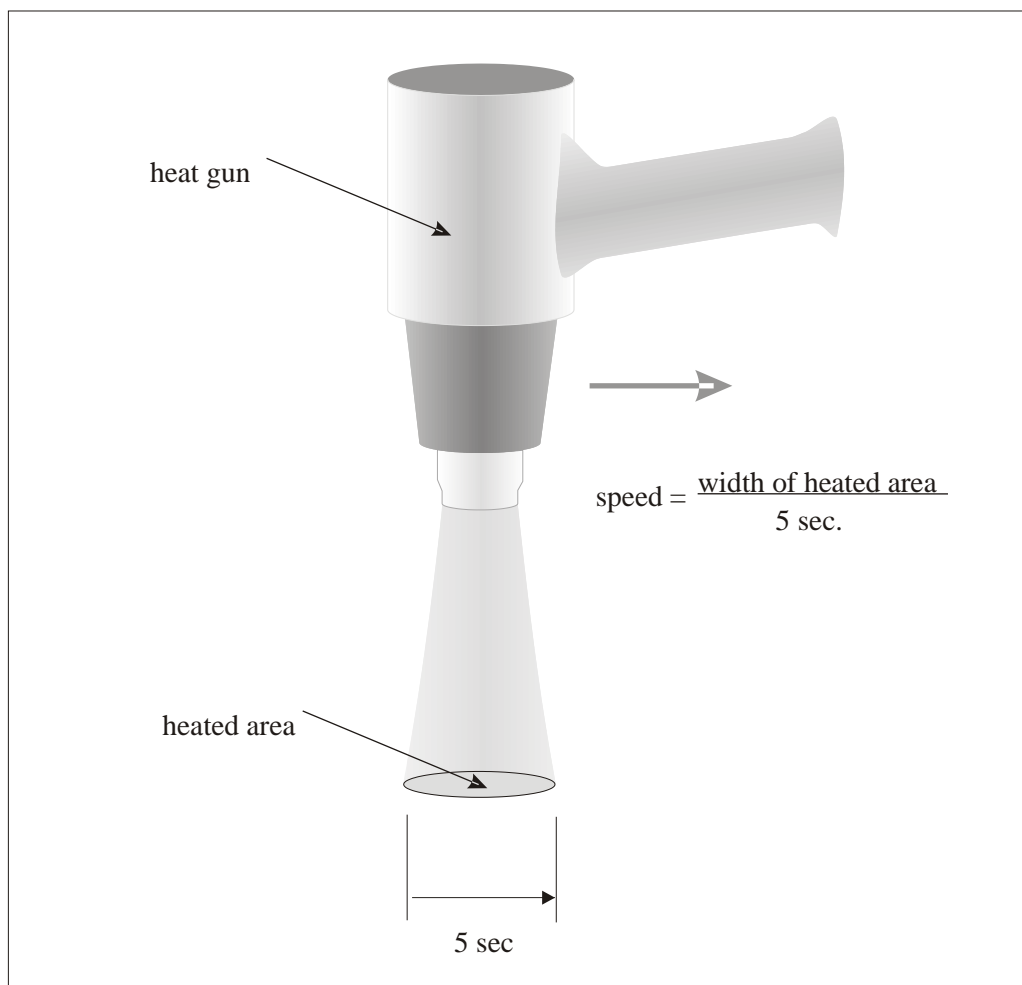
## Using a Heat Gun in Combination with an **ORATEX®** Felt Blade

Hold the heat gun in the distance necessary to apply the desired temperature.

Follow the heated area with the felt blade while applying pressure of 3 kg (6.6 lb). To get a feeling for the correct pressure, check the weight prior to work on a scale.

To meet the necessary residence time, move the heat gun in a certain speed. The speed is relative to the diameter of heated area:

Speed = diameter of heated area/5 sec



After application of heat and when used in grooves, crimps, inner edges or corners, keep the felt scraper in place for min. 20 sec. until adhesive has cooled down.

**NOTICE**

**Structure damage may occur due to high temperatures.**

- ▶ Observe the temperature limits of the underlying material.
- ▶ Cover the underlying material with corrugated cardboard if applicable.

If fabric shrinking is necessary during attachment increase the temperature to max. 200 °C (392 °F). When the required shrinking has been reached a final 10 sec process of 90 °C (194 °F) shall be executed.

### **Using a Heat Gun while Tightening the Fabric**

Follow this procedure when applying fabric to convex curved areas (such as wing tips, curved tubes etc.).

To apply sufficient pressure, tighten the fabric over the convex curved areas while heating the fabric.

**NOTICE**

**Structure damage may occur due to high temperatures. The temperature limits of the underlying material must be observed.**

- ▶ Cover the underlying material with corrugated cardboard if applicable.
- ▶ Hold the heat gun in the distance necessary to apply the desired temperature.

Usually the temperature is higher than 90 °C (194 °F) to initiate shrinking [Max. 200 °C (392 °F)].

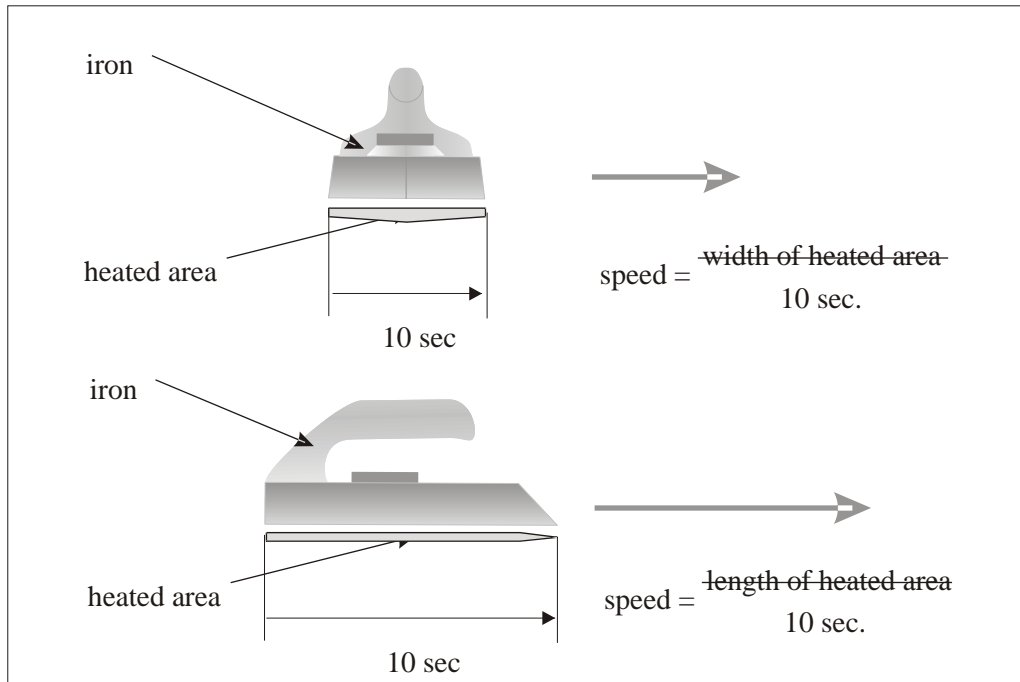
**NOTE**

**After application of heat, always hold the tension of fabric for min. 20 sec. until adhesive has cooled down.**

### **Using an Iron**

During ironing apply pressure to the fabric by the iron weight in combination with your forearm weight. To get a feeling for the correct pressure, check the weight prior to work with a cold iron on a scale. To meet the necessary residence time, move the iron with a certain speed. The speed is relative to the iron length or width:

Speed = iron length or width/10 sec



When ironing, always place silicon paper between the fabric and the iron to avoid scratches or iron marks on the fabric. The glossy side of the silicon paper faces the fabric.

## 20-55-06 Blisters and Bumps

Sometimes blisters and bumps can arise when attaching fabric to air-tight (in particular metallic) ground.

When applying the fabric, trapped air can be worked out by means of the heat gun and the felt blade.

If the cause is a non-homogeneously applied adhesive layer, it is well possible to melt it even, using the iron and silicon paper. In that case, the heat of the iron is increased to 140 °C (284 °F) and pressure is applied. Residence time: approx. 10 seconds.

If trapped air cannot be worked out perform the following:

- ▶ Stick a hole with a fine needle into the blister or bump to let air escape.
- ▶ Heat tighten the area of blister or bump as applicable (refer to Chapter 20-55-10 *Heat Tightening*).
- ▶ Attach the area of blister/bump as per Chapter 20-55-05 *Attaching the Fabric*.

## 20-55-07 Attaching Reinforcing Tape

- ▶ Before applying the reinforcing tapes to the airframe in the required areas, those areas must be cleaned with the **ORATEX®** Degreaser according to the *Proper Cleaning* paragraph on page 25.

**⚠ CAUTION** Burns possible due to high temperature.

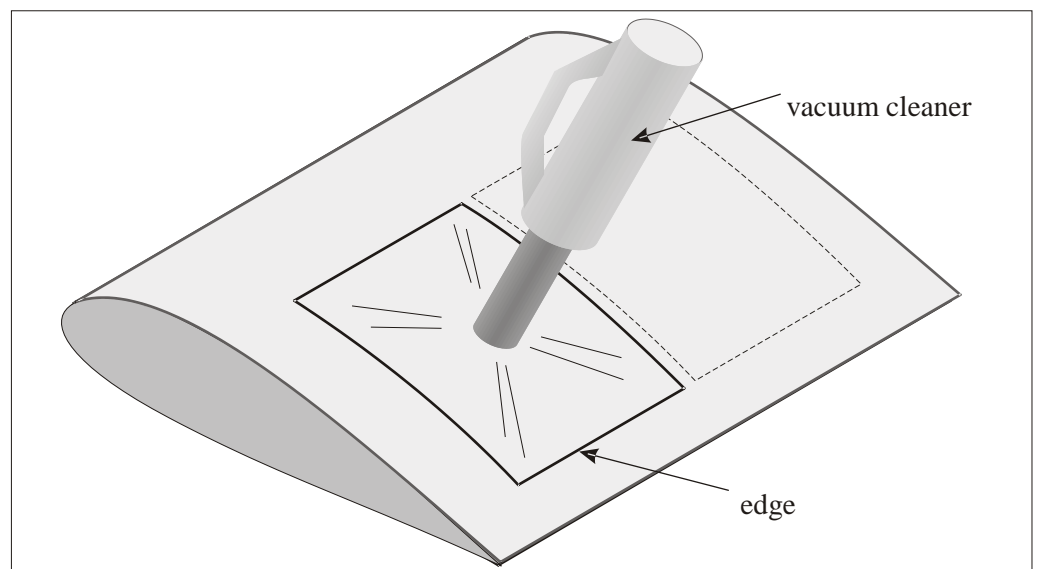
- ▶ Use security gloves against the high temperatures where necessary.
- ▶ Attach reinforcing tapes at 90 °C (194 °F) first pass and 120 °C (248 °F) second pass using the same practices as outlined in Section 20-55-05 *Attaching the Fabric*.

Due to the small areas it may be advisable to perform the first pass also with the iron.

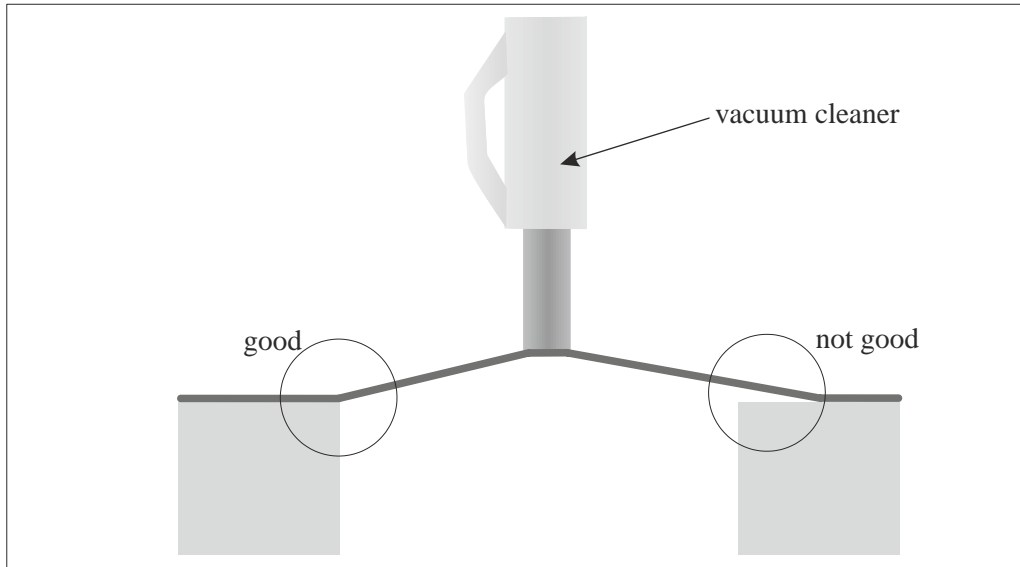
## 20-55-08 Bonding Check

This check is not a strength test. The fabric shall only be slightly lifted to be able to distinguish between bonded and non-bonded areas. The edge visible when lifting must match the structure edge.

- ▶ Lift the fabric in a field between ribs with a vacuum cleaner. Place the vacuum cleaner in the centre of the field for general inspection, closer to the respective edge for specific inspection.



- ▶ Check the integrity of the bonding at the field edge. No delamination allowed.



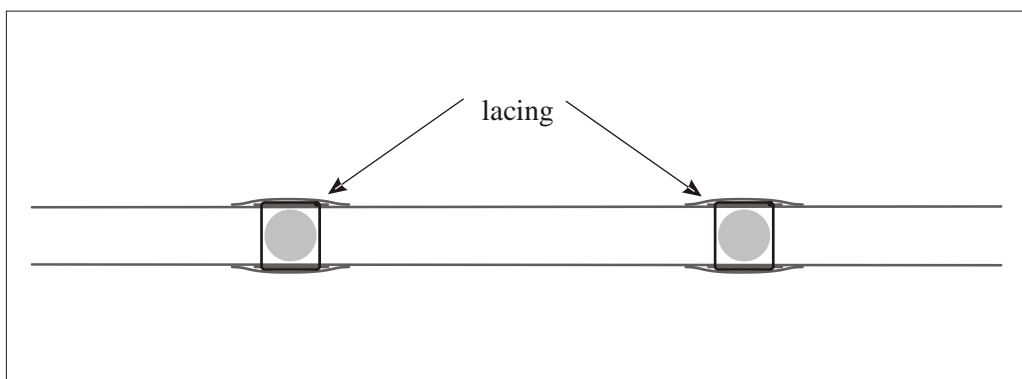
- ▶ If delamination is detected, cut out the delaminated area and repair as per Section *51-75-01 Repair of Fabric ("wet repair")*.

## 20-55-09 Lacing

Lacing is required whenever this is specified by the aircraft manufacturer. He also prescribes where and how (with which kind of knots) lacing has to be done.

If no aircraft manufacturer information is available, refer to AC43.13-1B § 2-10 for general information. On gliders certificated by BVS at least convex areas must be laced.

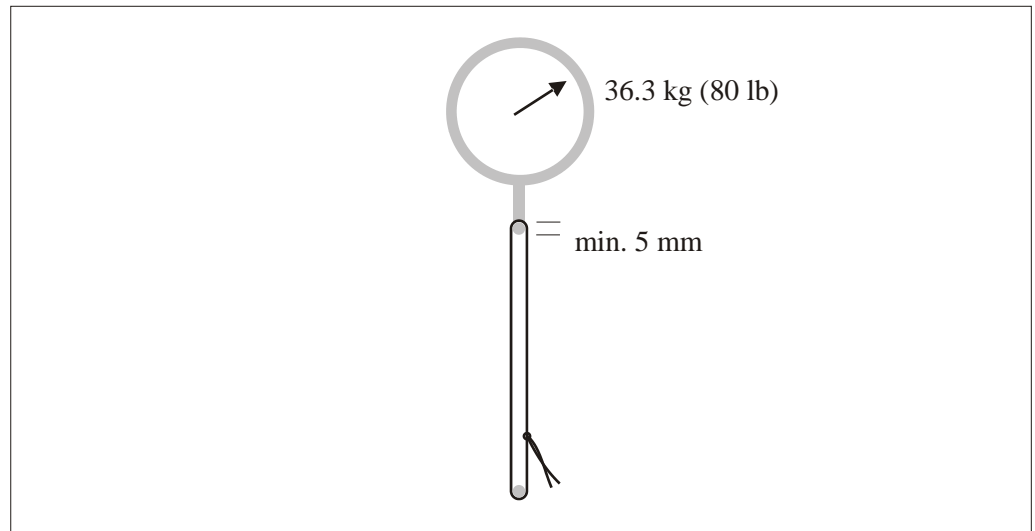
Lacing is also required wherever the contact of fabric with the structure is without pressure. For example: on even planes of a tube structure.





The strength of the lacing cord has to be tested for each roll used.

For the test a loop of the lacing is made with one knot and put under tension up to rupture. The load introduction elements may not be sharp edged (min d=5mm). Braking force may not be less than 36.3 kg (80 lb).



Perform the following additional steps:

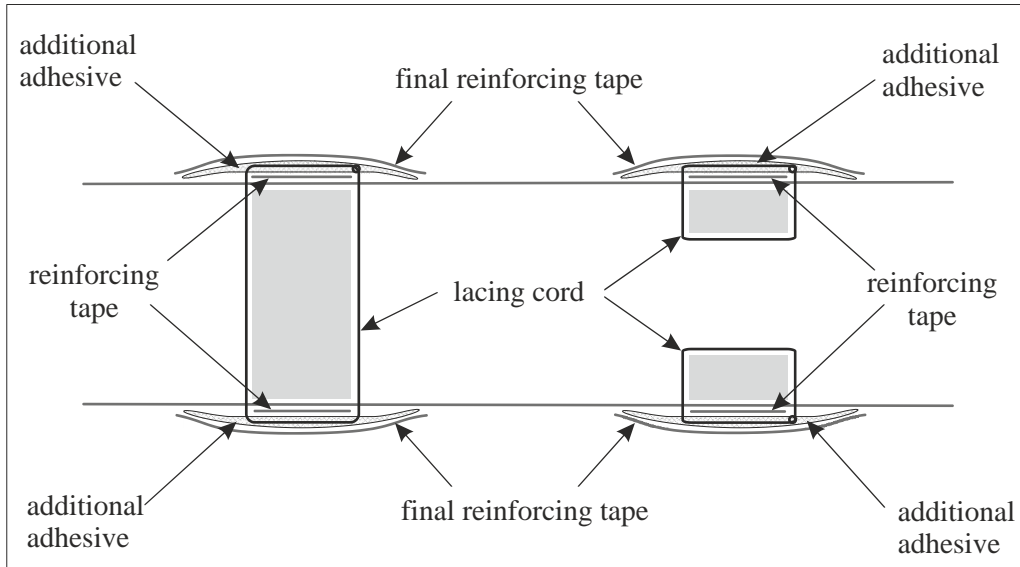
- ▶ Prior to lacing attach **ORATEX®6000** straight edge or pinked edge reinforcing tape to the lacing areas. The tape must not be wider than the ribs. No holes for lacing are allowed in this tape.

**NOTE**

It is important, that holes are melted by the radiation heat of the tip of the soldering iron, not by touching the fabric with the hot metal of the tip.

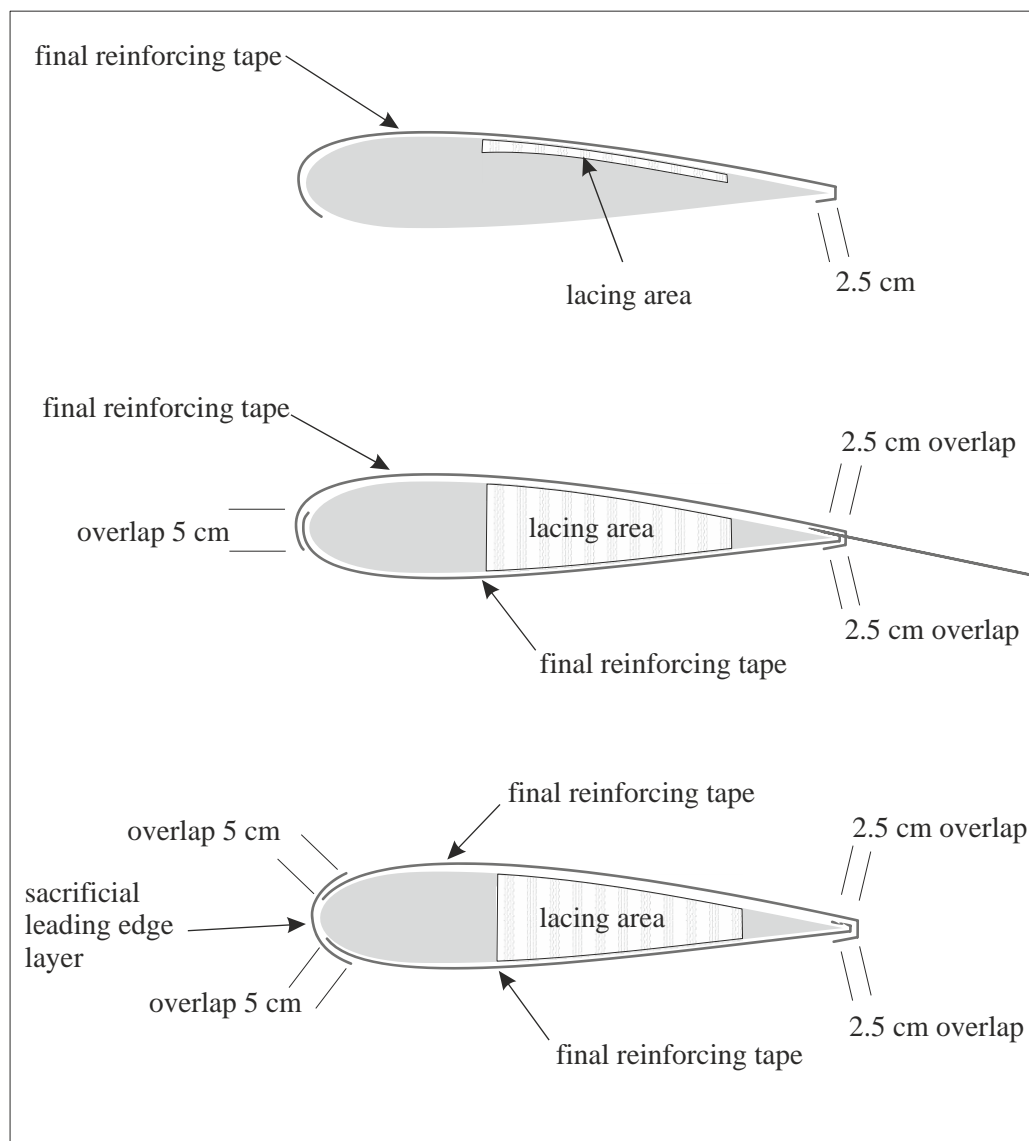
- ▶ Melt the holes for lacing through the fabric by using the tip of a hot soldering iron.

- ▶ After lacing apply **ORATEX®** DISPERSION HOTMELT ADHESIVE to the lacing area in the width of later final reinforcing tape (when using pinked edge tape except teeth) to obtain a reliable bonding of lacing cords and tapes. Mask the edges with fixing tape for **ORATEX®**. Remove tape after adhesive application.



**NOTE**

The final reinforcing tape must always reach from the leading edge to the trailing edge as shown in the following samples:



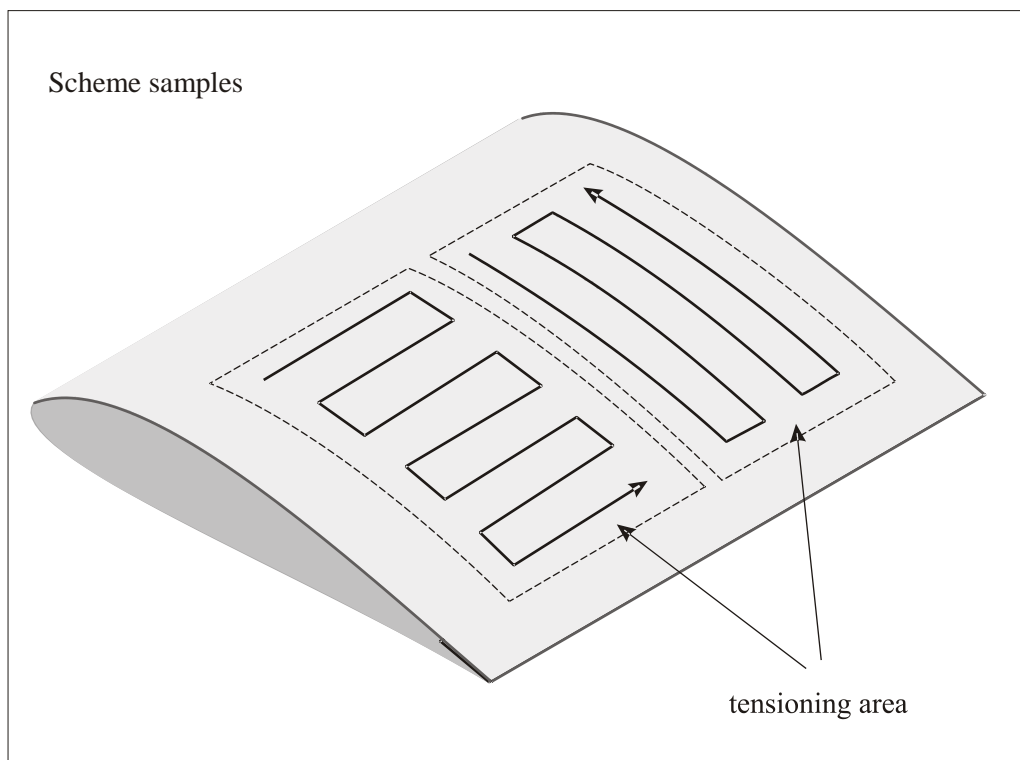
- ▶ Apply final **ORATEX®UL600** straight edge or pinked edge reinforcing tape, 25 mm wider than the straight edge tape (Use next bigger tape size). If placed in the prop wash the final reinforcing tape must be 50 mm wider than the previously attached tape.

## 20-55-10 Heat Tightening

The fabric, where not bonded to the structure, must be tightened by temperature and thus enabled to transfer aerodynamic forces to the aircraft structure.

Depending on the shrinking requirements, heat tightening needs a temperature between 110 °C (230 °F) and 190 °C (374 °F) applied for min. 5 seconds (residence time).

To achieve an equal and durable tension, the fabric must be shrunk all-over the tightening area. A punctual shrinking might let disappear the bumps and waves, but on the less shrunk areas new bumps could occur later. Use a scheme to ensure that the temperature is applied to each point of the fabric very evenly.



**NOTICE**

Ensure not to heat the bonded areas again. This could release the bond and the structure could be damaged by the higher temperatures.

Maximum temperature for composite material: 90 °C (194 °F)

Maximum temperature for wood: 180 °C (356 °F)

- ▶ Cover bonded or other endangered areas with thick corrugated cardboard.

**NOTICE**

Bending or other damage of filigree structure members (shape strips, ribs, etc.) possible due to heat tightening forces.

- ▶ Apply heat carefully and evenly.

Always perform at least two passes on the unsupported fields:

During the first pass (or passes) apply just as much heat as necessary to let disappear all bumps and waves in the fabric. NOTE the used temperature.

During the last pass apply 20 °C (36 °F) more heat than in the first pass (or passes) to achieve an even fabric tension. However the temperature must not exceed 190 °C (374 °F). For the last pass always use an iron.

If after hours or days bumps or waves occur (mostly due to inhomogeneous heating) an additional last pass can be performed [+20 °C (36 °F), Max. 190 °C (374 °F)]. This is possible at any time; for example if structure has shrunk in winter.

Heat tightening can be done by

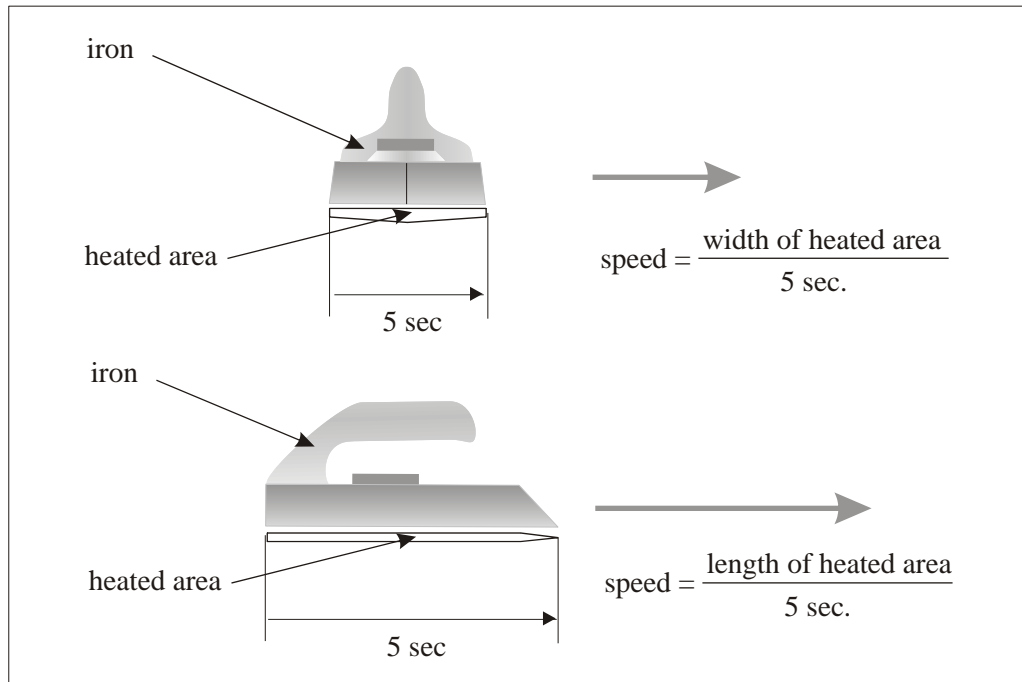
- using an iron
- using a heat gun
- using a radiant heater

### **Using an Iron**

When ironing, always place silicon paper (glossy side faces fabric) between the fabric and the iron to avoid scratches on the fabric. Work without load on the fabric.

For the first pass adjust the iron to 130 °C (266 °F). Usually this should even the surface. If not, increase temperature by 20 °C (36 °F).

Speed = iron length or width/5 sec

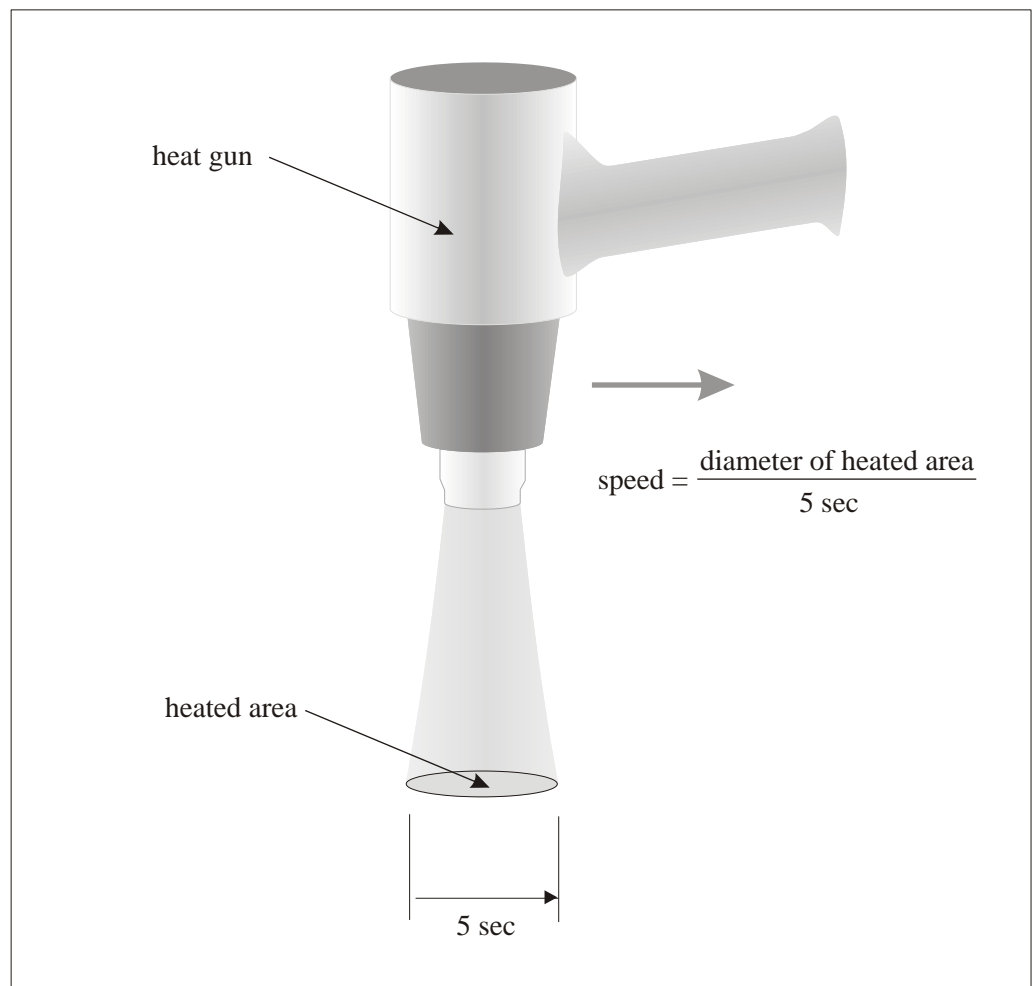


## Using a Heat Gun or a Radiant Heater

Observe the following rules:

- Begin at a large distance
- Complete your scheme before reducing the distance
- Never work punctually
- Work in large movements

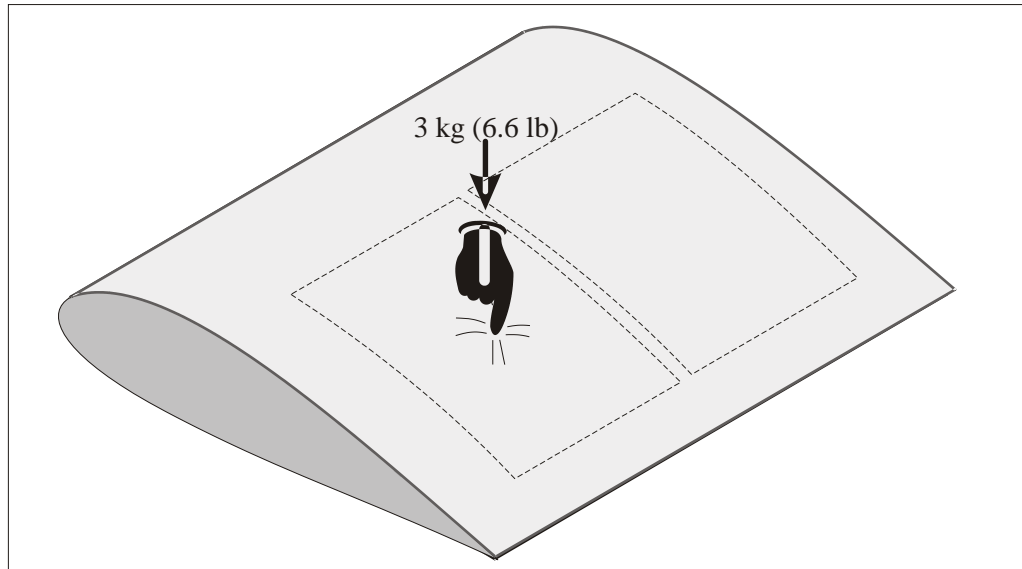
Speed = diameter of heated area/5 sec



## 20-55-11 Fabric Tension Test

To check, if fabric tension is sufficient, perform the following:

- ▶ Press a finger with a weight of 3 kg (6.6 lb) to the centre of a fabric field between ribs. (Check the weight prior to test on a scale).



At room temperature the fabric must completely recover (smooth and tensioned) within 4 seconds after release. Otherwise perform further *Heat Tightening*.

## 20-56 Reinforcements

### 20-56-01 Drain and Ventilation Holes

Install drain and ventilation holes, where prescribed by the aircraft manufacturer.

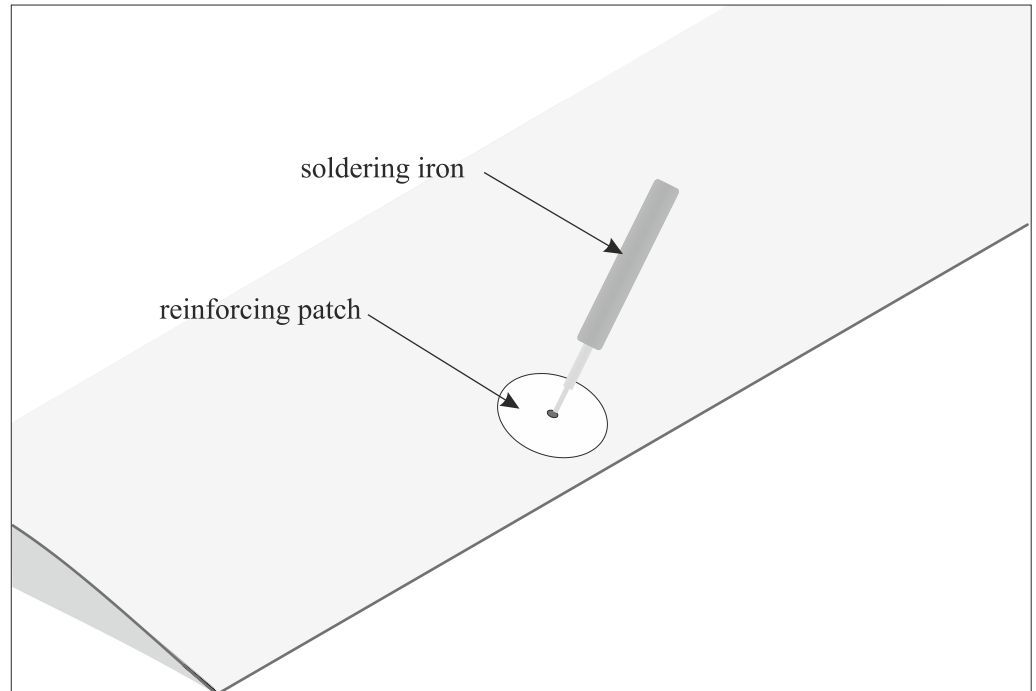
- ▶ Melt a hole of 5 mm diameter through the fabric at the specified location, sealing off the rim with a soldering iron.

If reinforcements at drain and ventilation holes are prescribed by the manufacturer for this type of aircraft, proceed as follows:

- ▶ Prepare a patch from **ORATEX® UL600** straight edge reinforcing tape with a diameter of 5 cm using pinking shears.
- ▶ Attach the patch to the fabric at the specified location.



- ▶ Melt a hole of 5 mm diameter in the center of the patch through both layers sealing off the rim with a soldering iron.



## 20-56-02 Fairleads

- ▶ Reinforce the fabric in the area of fairleads and melt a hole as outlined in Chapter *20-56-01 Drain and Ventilation Holes*.
- ▶ Additionally attach 0.8 mm plywood rings or use aluminium plates bolted against each other.

## 20-56-03 Inspection Openings

Install all inspection openings in correct size and location as defined by the aircraft manufacturer.

Openings of the size used for inspections must have an overlap of 5 cm.

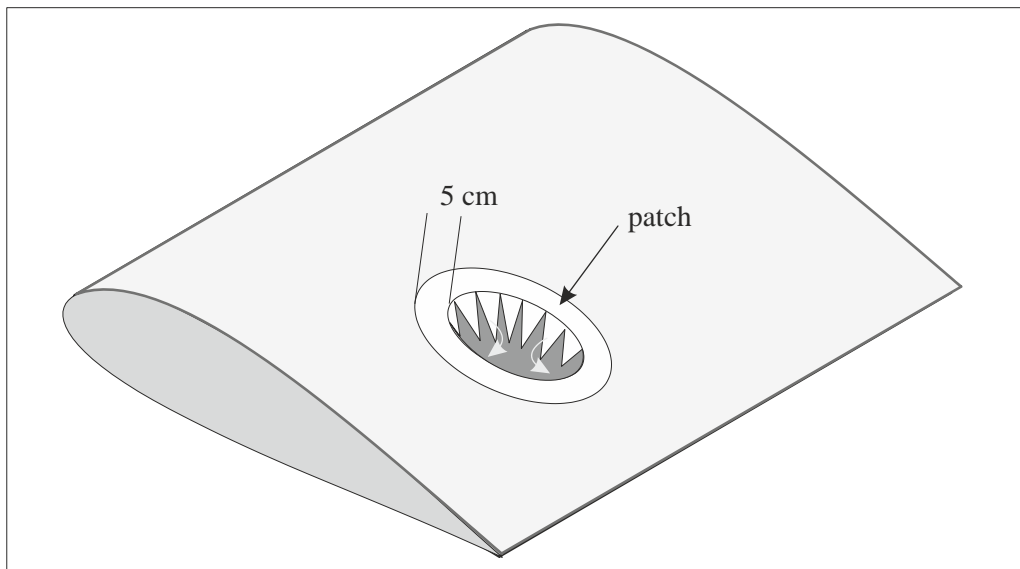
If the necessary materials and tools are available, the following procedure also can be performed not before an inspection is necessary.

- ▶ Melt a hole in the fabric as necessary using a soldering iron.
- ▶ Perform inspection (as applicable).
- ▶ Prepare a patch that allows an overlap of 5 cm using pinking shears.
- ▶ Attach the patch to the fabric.

- ▶ Make triangle shaped slits in the inspection opening area of the patch. The stripes shall have a width of a third of opening diameter.

**⚠ CAUTION** Burns possible due to high temperature.

- ▶ Use security gloves against the high temperatures.
- ▶ Attach the stripes to the inside of the fabric. To do so, in contrast to normal procedure, heat up the strips with the heat gun and press them to the inside with your fingers.

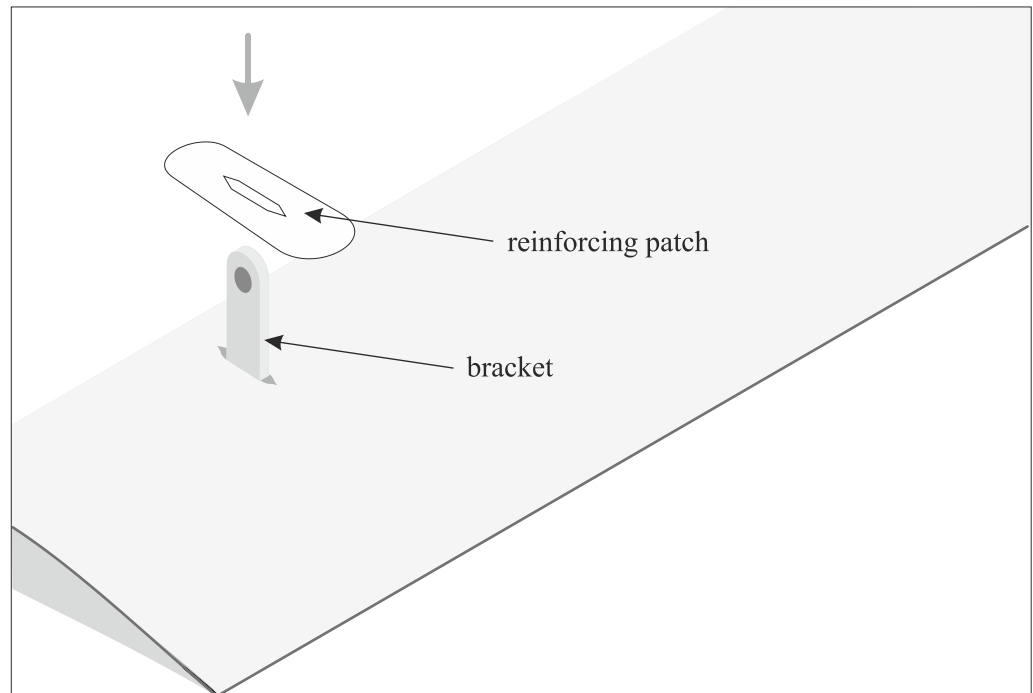


## 20-56-04 Brackets

Reinforce each area, where slits had to be made in the fabric due to penetrations of brackets or the like.

- ▶ Seal off the slit edges using a soldering iron.
- ▶ Prepare a reinforcing patch that allows an overlap of 5 cm using pinking shears. You can make the patch from **ORATEX®UL600** straight edge or pinked edge reinforcing tape.
- ▶ Repeat the slit and the sealing on the patch.

- ▶ Attach the patch to the fabric.



## 20-57 Removal of **ORATEX®** Fabric

Applying heat of more than 150 °C (302 °F) for more than 5 seconds initiates a cohesion failure inside the adhesive. This is a precondition for both the easy ripping off the fabric from the structure and the easy removal of residual adhesive from the underlying structure with **ORATEX®** Adhesive Remover.

On most composite structures an application of sufficient heat is not possible due to structure temperature limits. Thus the removal procedures differ depending on structure.

### Removal from wooden or metallic structure

**NOTICE** Damage to wooden structure can occur when ripping off cold fabric.

- ▶ Always apply sufficient heat (minimum 10 seconds) to soften the adhesive.

**NOTICE** Damage to the structure can occur by high temperatures.

- ▶ Observe the temperature limits of the structure.
- ▶ Apply heat using a heat gun or an iron and then rip off the fabric.

**⚠ WARNING** **ORATEX® Adhesive Remover vapour can be harmful to health.**

- ▶ Wear ventilated protective clothing, protective goggles, chemical resistant gloves and respiratory mask when working with **ORATEX®** Adhesive Remover
- ▶ Observe the instructions of the **ORATEX®** Adhesive Remover security and data sheet.
- ▶ Remove adhesive remains using **ORATEX®** Adhesive Remover.

**⚠ WARNING** **Solvents can be harmful to health.**

- ▶ Wear ventilated protective clothing, chemical resistant protective goggles, and respiratory mask when working with solvents.
- ▶ Observe the instructions of the solvent security and data sheet.
- ▶ Clean the surface using solvent.

### **Removal from composite structure**

- ▶ Rip off the cold fabric.

**⚠ DANGER** **Grinding dust can be explosive.**

- ▶ Remove adhesive only in explosion proof rooms with exhaustion device.

**⚠ WARNING** **Grinding dust can be harmful to health.**

- ▶ Wear ventilated protective clothing and respiratory mask when working with in dusty conditions.
- ▶ Vacuum the dust while grinding.
- ▶ Use an explosion proof vacuum cleaner.
- ▶ Remove adhesive remains by grinding.

**⚠ WARNING** **Solvents can be harmful to health.**

- ▶ Wear ventilated protective clothing, protective goggles, chemical resistant gloves and respiratory mask when working with solvents.
- ▶ Observe the instructions of the solvent security and data sheet.
- ▶ Clean the surface using solvent.

## 20-58 Coating

For top coating on **ORATEX®** materials only **ORACOLOR®** products are allowed. The materials are to be used with standard practises.

# 51 Standard Practices Structure

## 51-70 Repair

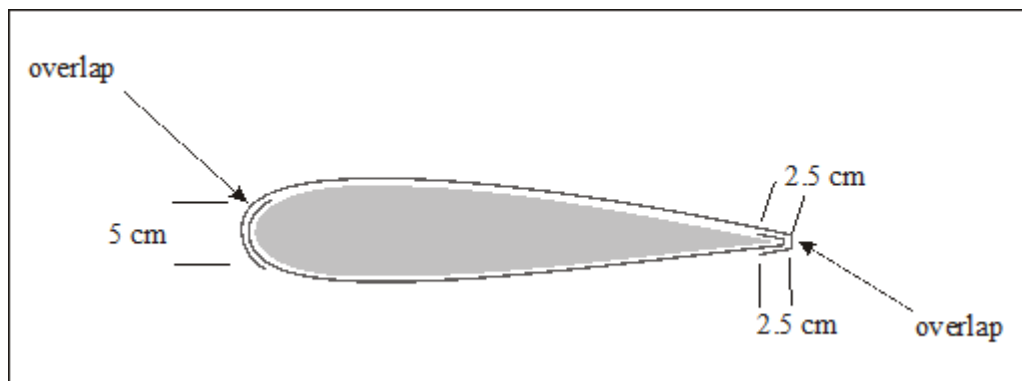
The **ORATEX**® fabric system knows two types of repair: Wet repair and dry repair. The dry repair is by means of a self adhesive patch with very limited application approval.

### 51-75-01 Repair of Fabric ("wet repair")

Smaller damage to the fabric (maximum 150 mm in any direction) can be repaired by attaching a patch with an overlap of 5 cm.

If damage makes it necessary to renew the fabric on a complete field between two ribs, the following applies:

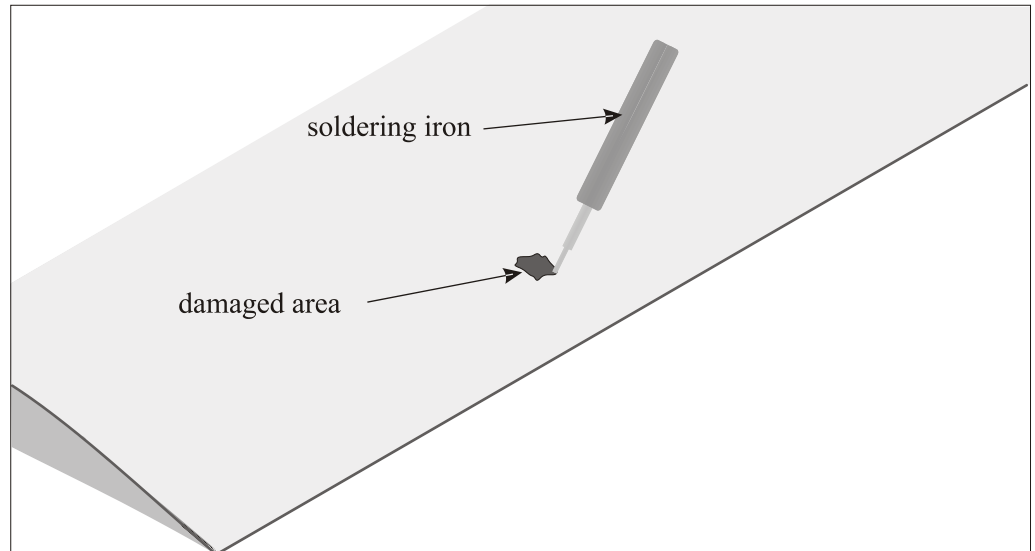
- The new fabric layer must always be attached to the leading edge and must reach to the trailing edge without interruption.



- The new fabric layer must have overlaps of min. 5 cm on the edges.
- Lacing the new fabric layer to the ribs is required.

## Small Damage

- ▶ Cut out damaged fabric.
- ▶ Seal off the edges of the damaged area using the radiant heat of a soldering iron.

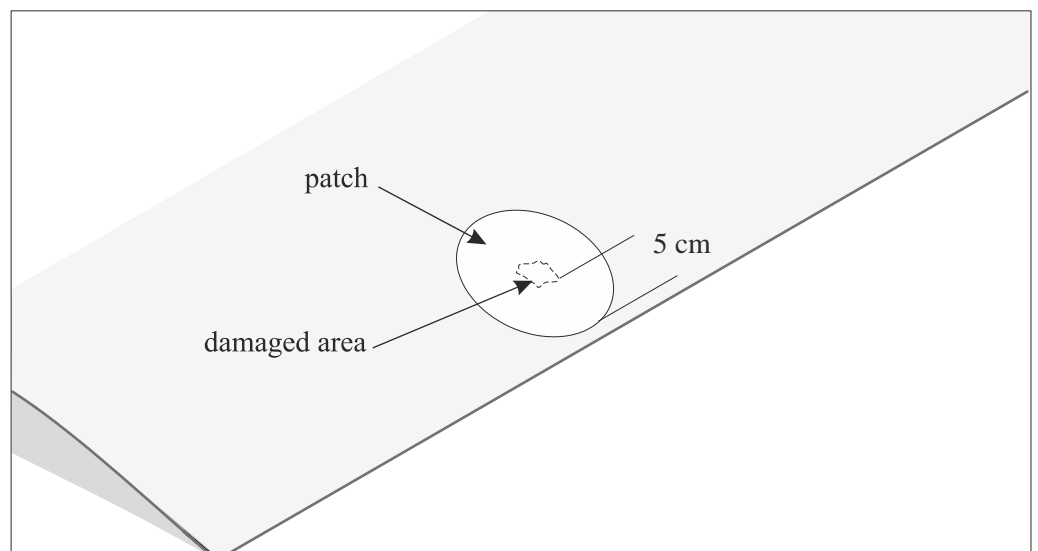


- ▶ If surface is lacquered, clean the surface with **ORATEX®** degreaser according to the *Proper Cleaning* paragraph on page 25.
- ▶ Rough the surface of later adhesive area with P240 sandpaper.
- ▶ Apply the **ORATEX®** degreaser for a second time.

### NOTE

**ORATEX®** surfaces (if not additionally lacquered) shall only be cleaned with **ORATEX®** degreaser.

- ▶ Prepare a patch that allows an overlap of 5 cm using pinking shears.



- ▶ Attach the patch to the damaged area.
- ▶ Perform Heat Tightening.

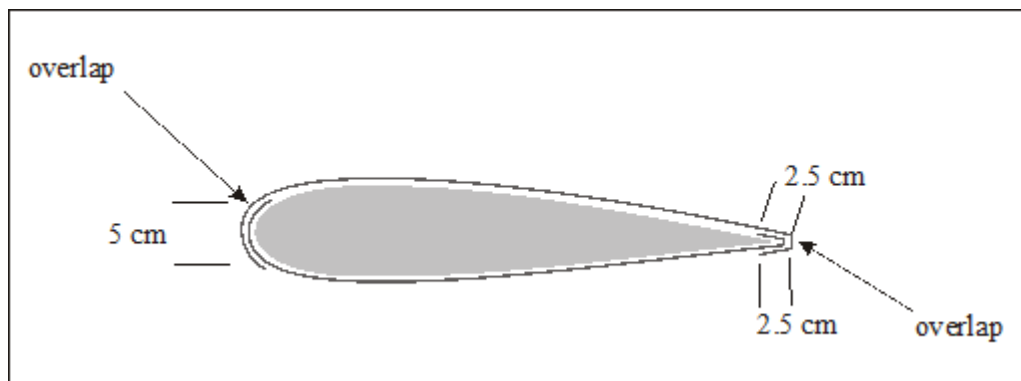
### Renewal of a Complete Field between Ribs

- ▶ Cut out damaged fabric.
- ▶ Seal off the edges of the damaged area using the radiant heat of a soldering iron.
- ▶ If surface is lacquered, clean the surface with **ORATEX®** degreaser according to the *Proper Cleaning* paragraph on page 25.
- ▶ Rough the surface of later adhesive area with P240 sandpaper.
- ▶ Apply the **ORATEX®** degreaser for a second time.

#### NOTE

**ORATEX®** surfaces (if not additionally lacquered) shall only be cleaned with **ORATEX®** degreaser.

- ▶ Prepare a patch that allows an overlap of 5 cm and that reaches from leading to trailing edge. Use pinking shears.



- ▶ Attach the patch to the damaged area.
- ▶ Remove old reinforcing tape if necessary.
- ▶ Perform *Lacing*. If the old fabric is already laced add a second seam.
- ▶ Perform Heat Tightening.

## 51-75-02 Repair of Fabric ("dry repair")

This repair is a minor repair using self-adhesive "**ORATEX®** dry repair sheet (A4)".

The following limits are applicable for repair in areas of unsupported damaged fabric (rib field). For repair of top coat damage without fracture of the underlying fabric no specific limitations apply.



The same holds true for repair of fabric in areas of underlying structural surface as long as the underlying structure itself is undamaged (for instance fabric covered plywood fuselage or wing leading edge).

### Limits of Repair Application

Maximum damage size:	40mm
Damage not extending over ribs or other structure.	
Only one (1) repair can be performed on the same covering rib field.	
Any damage to supporting structure (ribs, spar, seams etc.) invalidates this standard minor repair. In case of doubt contact AD&C.	
Approved underlying fabric:	
General according to:	(E)TSOC14b; AMS3804c; AMS3802
Product designations:	<b>ORATEX® UL600MK3</b> Ceconite 102 ,uncertified' Diatex 1500
Cotton fabric	LN9121 100g/m <sup>2</sup>
Maximum approved airplane never exceed speed V <sub>NE</sub>	260km/h; 140kts; 161 mph
Wing loading maximum	44kg/m <sup>2</sup> 9lbs/ft <sup>2</sup>

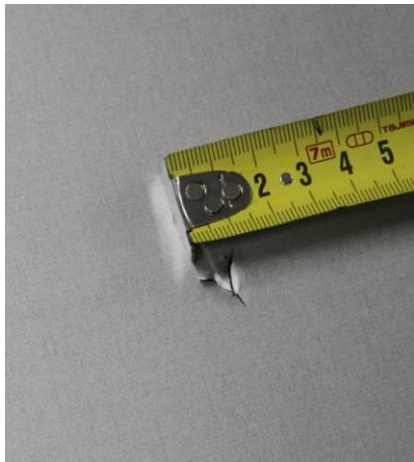
The installer is responsible that all limitations of the application are adhered to.

### Parts, Tooling or Material Required

<b>ORATEX®</b> Repair-Sheet (A4)	18-xxx-A4 (xxx = Color code, see 03-01 Materials)
<b>ORATEX®</b> cleaner	08200, 08201, 08220
<b>ORATEX®</b> degreaser	08245, 08246, 08247
Heat-gun	0949
Felt blade	0915, 0948
Sealing iron	08420

## Instructions

- ▶ Make sure the airplane and the damage is eligible for this repair type (limitations above)
- ▶ Airplane must be listed in chapter 90 as approved.
- ▶ Make sure the available repair material shelf life as marked on the package is not expired (three years).
- ▶ Make sure the ambient temperature is minimum 20°C.
- ▶ Cut out damaged fabric (maximum 40mm in any direction).



- ▶ Seal the edges of the damaged area using radiated heat of a soldering iron (not on cotton fabric covers). Avoid direct contact of the soldering iron with the surface.



- ▶ Clean the repair area using **ORATEX®** cleaner.
- ▶ Degrease the surface using **ORATEX®** degreaser according to the *Proper Cleaning* paragraph on page 25.

These are two independent mandatory process steps.

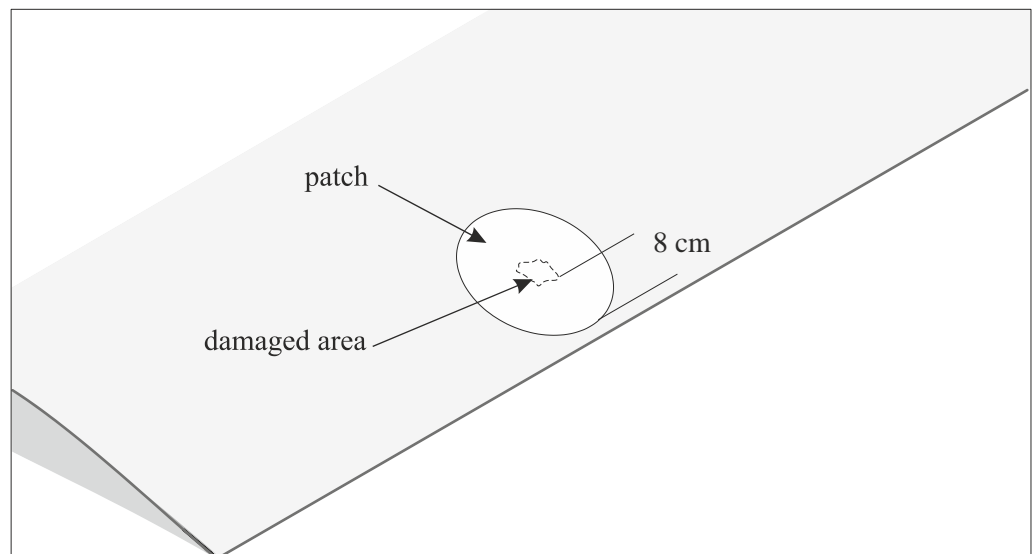
- ▶ If surface is lacquered, clean the surface with **ORATEX®** degreaser

- ▶ Rough the surface of later adhesive area with P600 sandpaper.
- ▶ Apply the **ORATEX®** degreaser for a second time.

**NOTE**

**ORATEX®** surfaces (if not additionally lacquered) shall only be cleaned with **ORATEX®** degreaser.

- ▶ After sanding the surface repeat the process of degreasing.
- ▶ Cut the repair patch circular according to the damage size with an overlap of minimum 80 mm, preferably using pinked edge scissors. Where no such tool is available make sure to round off the corners of the patch.



- ▶ Where 80 mm overlap are not possible due to proximity of a structural end, make sure to have at least 50 mm patch material extending over the respective edge.
- ▶ Mark the position of the patch on the surface using a soft pencil (grade HB).

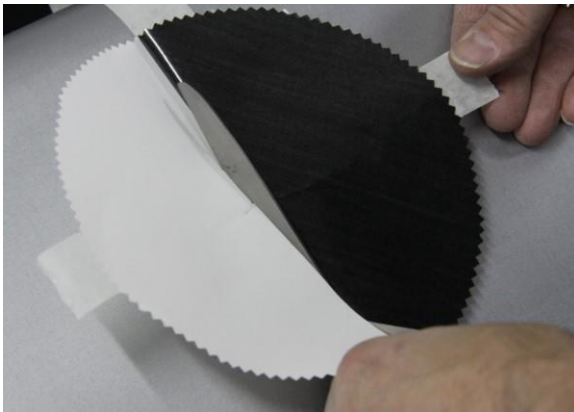
**IMPORTANT** Do not apply the patch in environmental temperature conditions below 20°C.

**IMPORTANT** Never touch the adhesive side of the patch.

- ▶ Therefore separate the patch and the backing paper using adhesive film tape after positioning the patch on the surface.



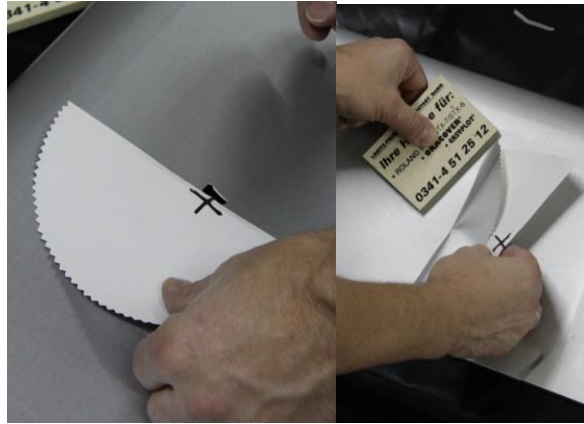
- ▶ Fold the backing paper back and remove the first half.



- ▶ Press the patch on using a felt blade.



- ▶ Apply the second half while removing the remainder of the backing paper.



The final adhesive strength is gained by temperature application of 80 °C for at least 30 sec at any given point.

**IMPORTANT**

A temperature regulation on the heat gun is mandatory

**IMPORTANT**

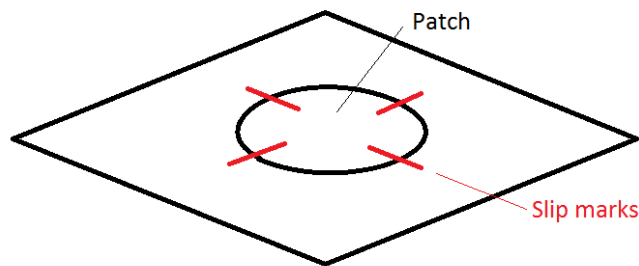
Make sure to not exceed this temperature at this stage. Otherwise the **ORATEX®** material starts to shrink before the adhesive strength is reached. To cross check the temperature you determine the adjustment needed to start the shrinking process. This is the case at 100 °C.

- ▶ Set the heat gun to 80°C.
- ▶ Move the heat gun very slowly over the area of the adhesive bond at a speed not exceeding 50mm/30sec to ensure complete heat up. The distance of the heat nozzle to the fabric shall be 5 to 10mm. During this process press the patch repeatedly on the underlying surface using the felt blade.



- ▶ Allow sufficient time to cool down completely.

- ▶ Apply slip marks along the perimeter of the applied patch prior the next process step. For repair in the area of the wing leading edge to 30% of the wing cord the slip marks have to be applied using a permanent marker otherwise use a soft pencil (HB). Slip marks do not need to be big, but clear.



- ▶ Restore the original surface tension by heating the patch only in the damaged area – not around the edges – in 10° increments to temperatures above 100°C using the **ORATEX®** sealing iron. Make sure to not undue heat the adhesive area. The temperature is increased only until the original surface tension is reached. Do not unnecessarily heat up more than required. Maximum temperature for this process step is 200°C.
- ▶ Inspect the slip markings to ensure the patch adhesive has not slipped.



- ▶ In case slipping is detected remove the patch and redo the process with a new piece of material.
- ▶ For repair which are NOT located in the area between the wing leading edge to 30% of the local cord the slip marks can be removed.
- ▶ NOTE release to service into aircraft log book

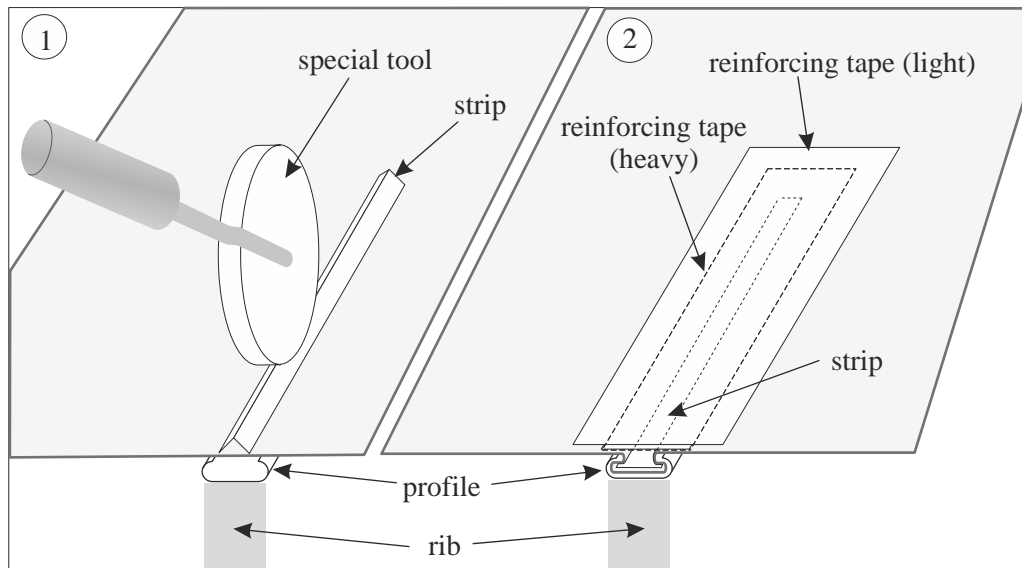
## 89 Information for Specific Airplanes

This Chapter presents information that apply to specific airplanes. The information herein exceed and sometimes supersede the general considerations and regulations in this manual and adds hands-on experience gained with the airplanes mentioned in the following.

Even if not referenced to your aircraft, read this Chapter in order to increase your understanding of the subject discussed in this Manual and to receive additional practical knowledge.

## 89-01 ANTONOV AN-2

ANTONOV uses a specific clamping technique as outlined in the following Figure to attach the fabric to the ribs. Where clamped the fabric will not be glued on.



For that reason, the order of work steps has to be changed:

- ▶ Perform the fabric pre-cut as per Chapter *20-55-01 Fabric Pre-cut*. Consider that the ANTONOV clamping technique will require 1 cm per rib additional fabric length in spanwise direction.
- ▶ Attach the fabric to the ribs following the ANTONOV instructions.

### NOTICE

#### Fabric damage when tilting the special tool.

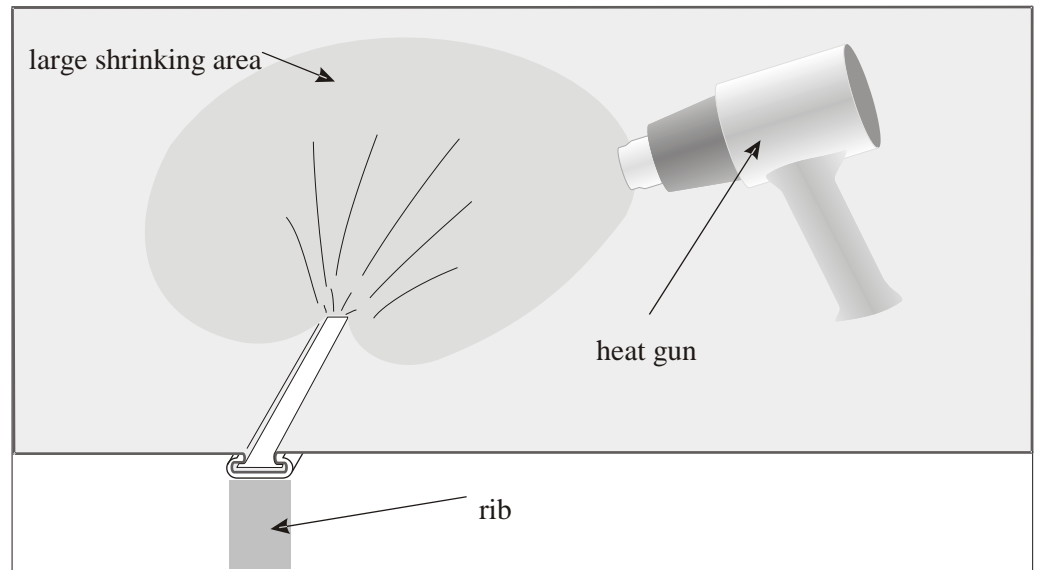
- ▶ Align the special tool parallel to the profile.
- ▶ Watch the fabric especially in the area of profile edges when using the special tool.

It is advisable to prepare a special tool as shown in the Figure above to press the strips into the profiles.

In the area of rib ends fabric bumps and waves will arise.



- ▶ Shrink the fabric around the rib ends heating a large area.



- ▶ Only now apply the adhesive to the remaining fabric and structure as per Chapter *20-55-02 Adhesive Application*.
- ▶ Proceed as outlined in this Manual.
- ▶ Attach **ORATEX® 6000** straight edge reinforcing tape on the clamping areas with a width of 30 mm as per Chapter *20-55-07 Attaching Reinforcing Tape*.
- ▶ Attach a further **ORATEX® UL600** straight edge or pinked edge reinforcing tape in a width of 50 mm on this reinforcing tape.

## 89-02 ROBIN DR200/300/400 Series

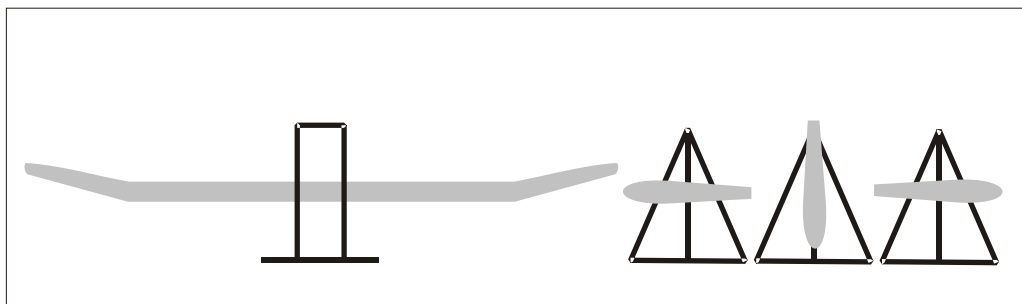
### Documents

Use the following Robin documents in combination with this Manual:

- DR400 Structural Repair Manual, Issue 2, Amdt 1, Doc. N° 1000853 GB
- Robin SB 122 and 154
- Robin NOTE NAV 97-1

### Wing Jig

If you have to cover Robin wings more frequently we recommend assembling a wing jig that holds the wing in the wing fixing brackets and can be turned by 90° and 180°. In the base position, wing top side up and in the 180° opposite position wing top side down, the adhesive is applied and the fabric is ironed on. In the 90° position (wing vertical) lacing is done.



### Special Lacing Technology

Due to the lacing technology that applies here the following considerations have to be done:

#### Working Order

- ▶ Attach the fabric on the top wing surface first. Lacing the top wing fabric is quite difficult with bottom wing fabric attached.

#### Rib Lacing

On some rib areas rib lacing is prescribed by the manufacturer. The rib lacing cords have to be picked up with a needle during the later fabric stitching process and must not be glued on the surface.

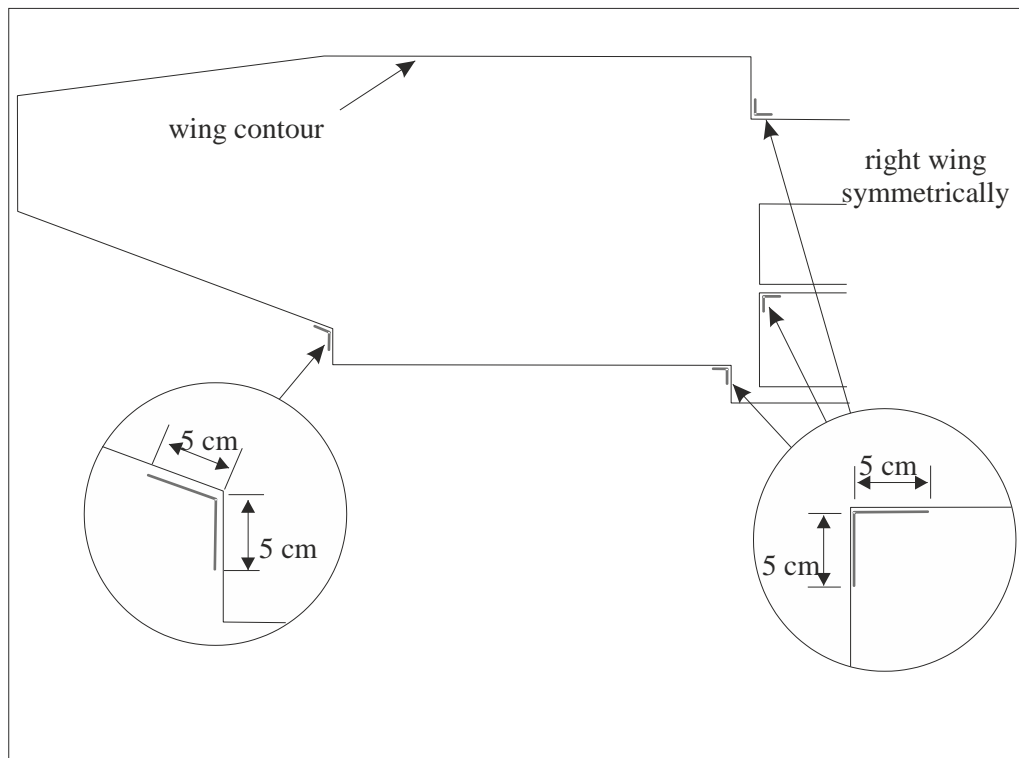
- ▶ Attach these areas not before fabric stitching is completed.

However **ORATEX® 6000** straight edge reinforcing tape must be attached to those areas prior to lacing. To prevent the fabric and the rib lacing cords from unintentional gluing proceed as follows:

- ▶ Prepare a cardboard strip of a suitable size.
- ▶ Firmly surround the cardboard strip with Silicon Release Paper, the silicon side outside.
- ▶ Push the cardboard strip in between the wing structure and the fabric.
- ▶ Attach the straight edge tape (refer to Chapter 20-55-07 Attaching Reinforcing Tape).
- ▶ After you have ironed on the straight edge tape and the whole has cooled off, remove the cardboard strip.

## Corners

Before commencing with the actual fabric application process attach fabric layers to the corners as outlined in the following figure. These layers must have the width of the wing structure in the respective areas. Also refer to Chapter *20-54-04 Corners*.

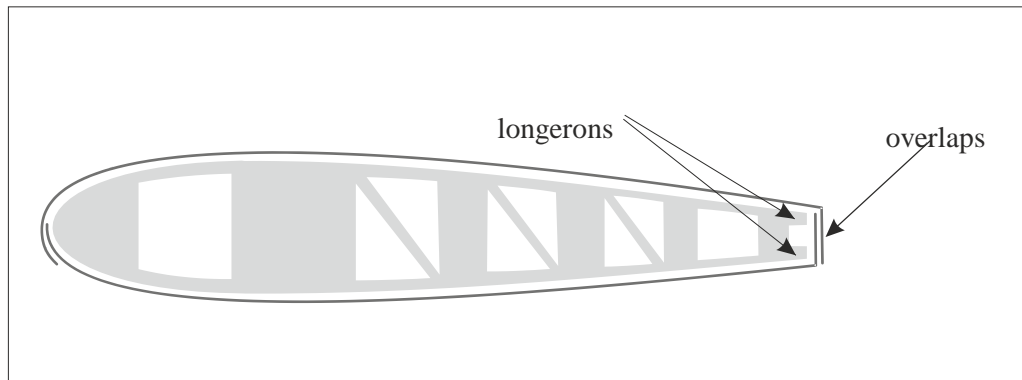


## Adhesive Application

In contrast to the instructions of the Robin NOTE NAV 97-1, the **ORATEX**® principle that fabric must be attached to all contact areas with the structure remains valid. Thus adhesive must be applied to all ribs and the corresponding fabric areas as outlined in *Chapter 20-55-02 Adhesive Application*.

## Fabric Attachment in the Longeron Area

- ▶ Attach the fabric in the longeron areas of the wing with overlaps as shown in the following figure:

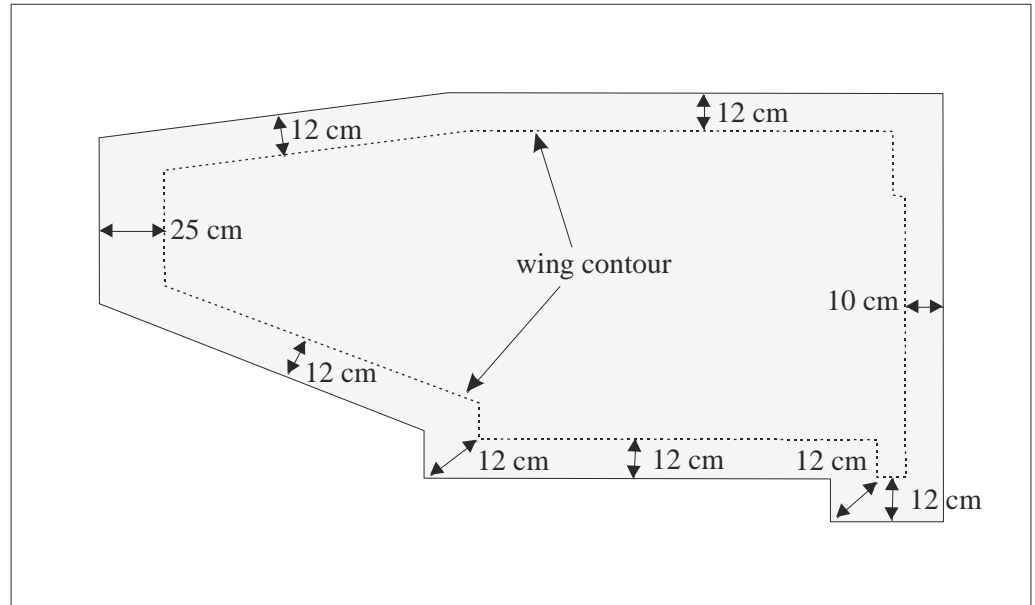


In the area of the leading edge proceed as outlined in *Chapter 20-53 Principles of Fabric Application*

## Fabric Pre-cut

We recommend the following margins and excesses (refer to *Chapter 20-55-01 Fabric Pre-cut*): leading edge area 12 cm, tip area 25 cm,

trailing edge 12 cm. In the area of the center rib the fabric should have a margin of 10 cm in the direction of the opposite wing.



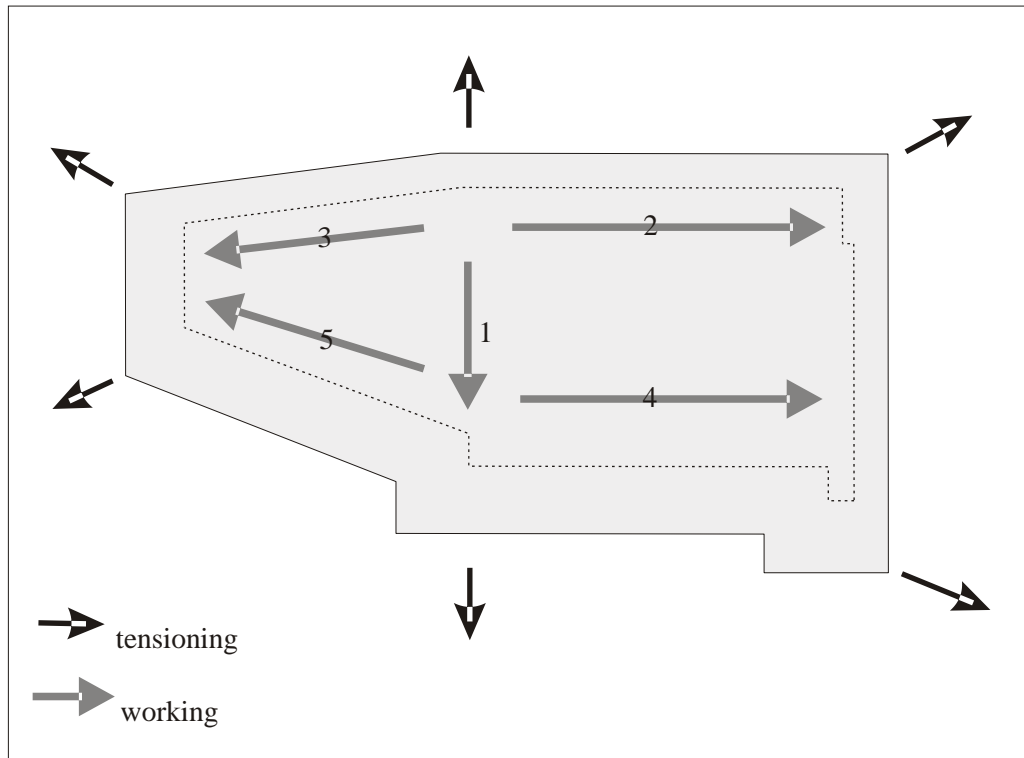
### Positioning

The recommended general working order and the direction to which the fabric shall be tensioned in the provisional fixing process is shown in the following figure. Also refer to Chapter *20-55-04 Positioning*.

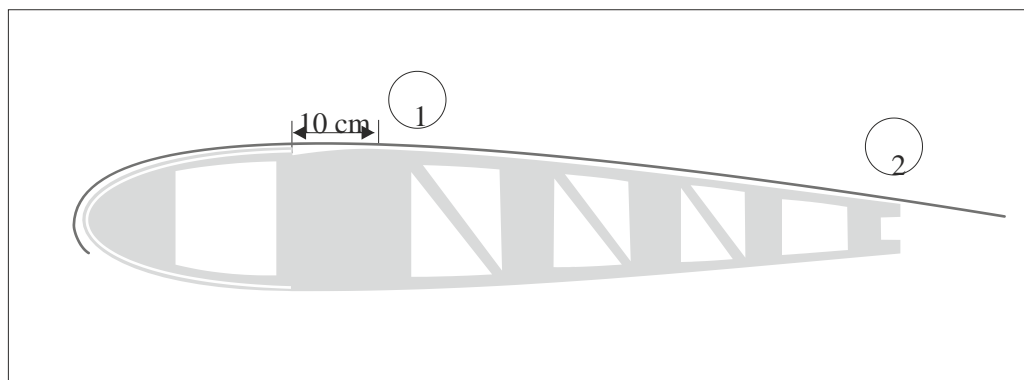
**NOTE**

Extra care must be taken not to fix the fabric in the area of the rib lacing cords at this process step.

- ▶ Start provisionally fixing the fabric first to rib 8 (dihedral rib), (working 1).



- ▶ Start approximately 10 cm behind the nose planking on the rib (1) where the rib contour matches the later fabric contour.
- ▶ Provisionally fix it then in the area of the trailing edge (2).



- ▶ Continue on the nose planking in the direction of the root rib (working 2) and then to the wing tip (working 3).
- ▶ Pull the fabric tight along the trailing edge and – starting from rib 8 – provisionally fix it to trailing edge and the root rib (working 4).
- ▶ Continue with all the other ribs in this area.

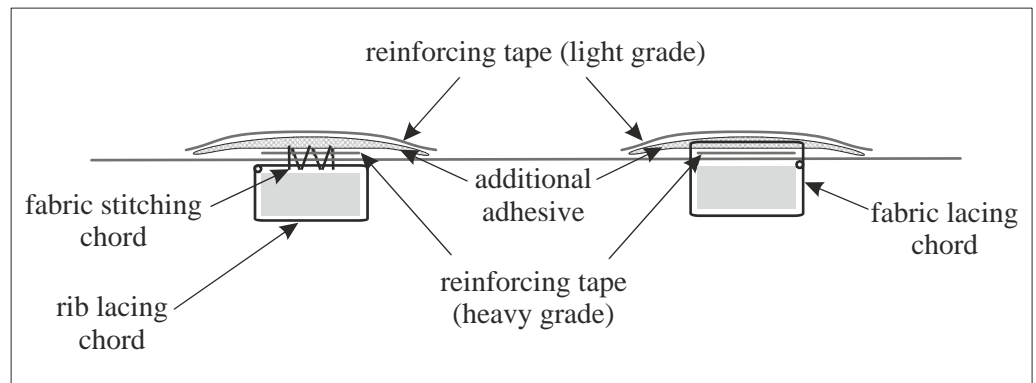
- ▶ Repeat these steps heading to the wing tip (working 5).

## Lacing

Refer to Robin terminology and instructions presented in the *DR400 Fabric Covering Stitching and Lacing Specification* paragraph of the DR400 Structural Repair Manual (applicable to DR200/300/400 Series).

- ▶ Use **ORATEX® 6000** straight edge reinforcing tape, which has exactly the width of the rib.

This is valid for both the rib lacing/fabric stitching technic and the fabric lacing technique.

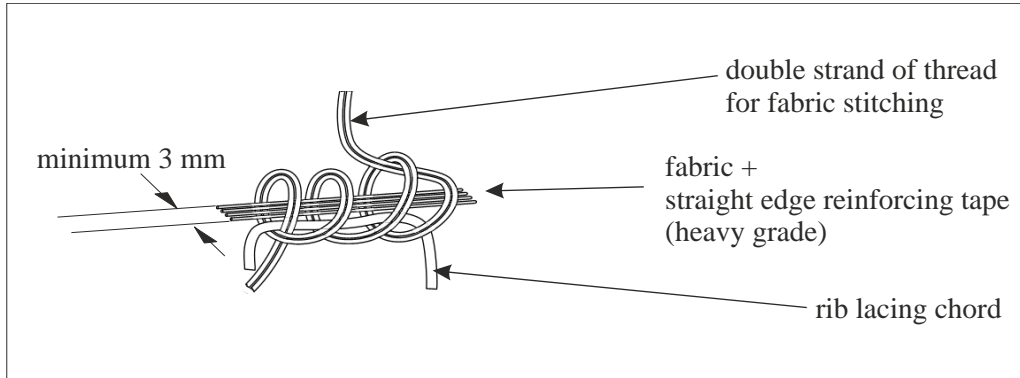


### IMPORTANT

Where the fabric lacing technique is applicable melt the holes for the fabric lacing cord with the radiant heat of a soldering iron prior to attaching the straight edge tape. This will avoid thermal exposure of the tape edges during the melting process of the holes or even melting parts of the tape edges.

The **ORATEX®** fabric is much finer than other fabrics. So it is not as easy to distinguish single fabric threads.

- ▶ When using stitching knots (both triple and quadruple loop) stitch around minimum 3 mm of fabric + **ORATEX® 6000** straight edge reinforcing tape.

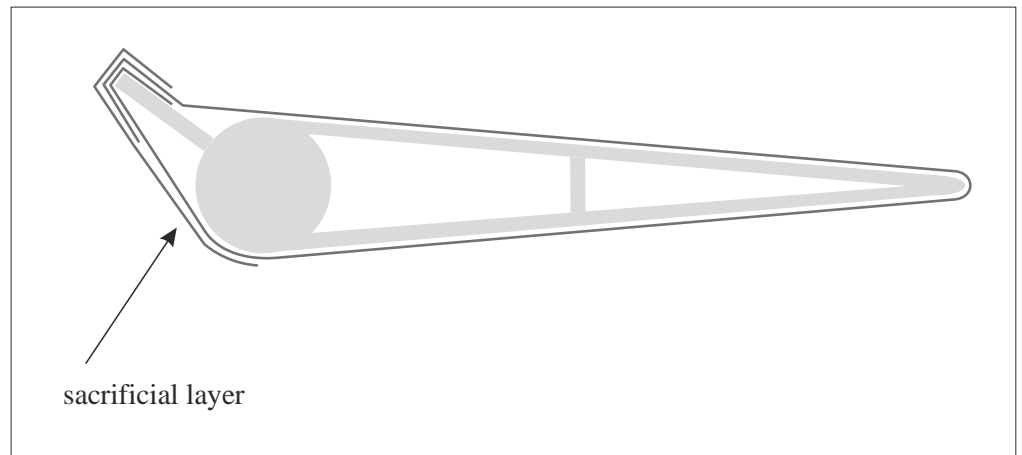




## 89-03      Scheibe Bergfalke

### Ailerons

- ▶ Attach the fabric to the ailerons of a Bergfalke as shown in the scheme below.



All other working steps are standard procedures as presented in this manual.

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