

Certification rules for P-marking of Agri-stretch film for round-bale ensiling



Abstract

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A product can be granted permission to display SPs certification symbol, the **P**-mark after appropriate certification by SP. Agri-stretch film for round-bale ensiling is such a product. The certification includes verification of the product's compliance with the technical requirements set out in chapter 3 and a verification of the quality control procedure.

Technical requirements are verified by testing in accordance with the method described in appendix 1, developed by SP Technical Research Institute of Sweden and Swedish Machinery Testing Institute (SMP). The requirements consider both biological and technical aspects.

Continuous inspection consists essentially of manufacturer's inspection and surveillance inspection. The manufacturer's inspection can in fact be performed by the manufacturer, the importer or the distributor. This requirement in respect of manufacturer's inspection complies essentially with SS-ISO 9001:2000. Supervisory inspection is performed by SP by means of inspection visits to the manufacturer, importer or distributor of the product. During these visits, SP will be concerned to see that the quality control procedures are operating as intended. In addition, samples of the finished products will be taken for testing.

Key words: Certification, Stretch film for round-bale ensiling, SP marking, P-mark, Requirements, Quality control.

SP Sveriges Tekniska Forskningsinstitut
SP Technical Research Institute of Sweden

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Postal address:
Box 857,
SE-501 15 BORÅS,
Sweden

Telephone +46 10 516 50 00
Fax +46 33 13 55 02
E-mail: info@sp.se
Internet: www.sp.se

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Preface

These certification rules set out the terms and conditions for certification, technical requirements and requirements in respect of ongoing inspection of stretch film for round-bale ensiling.

Technical requirements in accordance with Section 3, together with the requirements in respect of continuous inspection as set out in Section 4, have been developed by the Swedish Machinery Testing Institute (SMP) in conjunction with the Swedish University of Agricultural Sciences (SLU), SP and manufacturers of stretch film. SP Certification, as described in Section 2, performs the certification.

These certification rules are based on current standards, but may be revised in the future, e.g. to harmonise them with European standards. They may also need to be revised if new regulations are introduced, or as a result of experience of their application. This issue replaces issue dated February 2004.

Borås, February 2008

SP Technical Research Institute of Sweden Certification



Lennart Månsson
Manager, Certification

1. Introduction

1.1 General

Certification involves confirmation by an independent third party that a product fulfils requirements specified in standards or in some other form of specification. Within SP, certification is performed by a special department, SP Certification, that is organisationally completely separate from the other testing and inspection departments. It is responsible to a Certification Board, comprising representatives of various industry sectors. The Board can appoint expert groups for various product areas, e.g. as technical committees. Certification of products by SP is performed in accordance with EN 45011.

The requirements that must be fulfilled are set out in special certification rules (SPCR), developed for each product sector. Before certification starts, the certification rules must have been discussed with interested parties and then have been approved by SP's Certification Board.

Products that, after initial assessment that includes testing, show that they fulfil specified requirements, can be certified by SP. This is confirmed by the issue of a certificate, which usually represents permission (a licence) to use a certification symbol. Ongoing inspection, consisting of the manufacturer's own inspection and SP's surveillance inspection, is intended to ensure that the requirements continue to be fulfilled during the validity of the certificate.

SP's Certification department certifies products etc. for a range of certification symbols, such as the CE symbol when the regulations are based on EU directives.

These certification rules refer to SP's own certification symbol, the P-mark, and are linked only to SP's own certification system.

Certified products are presented in listings on SPs web site, www.sp.se

1.2 Applicability of these Rules

These certification rules relate to stretch film (see test methods 3.1.3 in appendix 1 for definition of colour), with nominal widths between 500 mm and 750 mm, intended for use in ensiling round bales.

2. Conditions for certification of agri-stretch film

2.1 General

Certification consists of an initial appraisal of the product and of the manufacturer's procedures for ongoing inspection. When the requirements are fulfilled, a certificate can be issued. The certificate can afterwards be applied provided that the products continuously fulfil the requirements and that the ongoing inspections continues to operate correctly. See Appendix 2 for a model form of certificate. Other terms and conditions are set out in Section 6 (below).

2.2 Application for certification

Applications for certification shall be submitted in writing, and shall be accompanied by:

- technical data included manufacturing process;
- a detailed description, list of basic chemicals, UV stabilisers or equivalent constituents;
- a description of the manufacturer's, importer's or distributor's own inspection procedures;
- agreement between the manufacturer, importer or distributor and SP concerning surveillance inspection,
- a description of the manufacturer's/distributor's experiences from ensiling with stretch film *and*
- proposals for marking in accordance with Section 2.3.3.

Details of the above documents etc. are described below.

2.3 Initial assessment

Initial assessment involves examination of the *technical data, continuous inspection procedures and marking procedures*, in accordance with the requirements set out below. The initial assessment can also include inspection of the place of manufacture, the manufacturer's own inspection procedures etc.

2.3.1 Requirements in respect of technical data

The applicant shall submit technical data for the product concerned, in the form of test report(s), product descriptions and instructions for use.

2.3.1.1 Test report

The test report(s) shall show that technical requirements in accordance with Section 3 are fulfilled. The reports may not be more than two years old at the time of application for certification, unless the product has been subject to continuous inspection in accordance with the requirements of Section 4.

2.3.1.2 Product description

The description shall include all relevant data and specification of the product, as well as specification of the production process.

2.3.1.3 Instructions for use

The instructions shall include the following information:

- The P-mark,
- The name or designation of the product,
- Certificate information:
 - The certificate number,
 - The name and address of the certificate holder
 - SPs name and address - as the issuer of the certificate
 - other details, if any, of the conditions for which the certificate is granted, such as:
 - The number of layers (wraps) and overlaps,

- The recommended interval for stretching the film, as measured on the bale, minimum-maximum,
- Requirements in respect of handling and storage
- The name of the certificate holder and/or contact organisation
- The issue date or number or revision of the instruction for use

The instructions for use shall be put inside the packaging or printed at the packaging, with the title "Instructions".

As a minimum, the instructions shall be written in Swedish. Details must be given of how the instructions reach the end-user. For other markets than the Swedish, the instructions shall be available in the official language of the actual country.

2.3.2 Requirement for continuous inspection

The manufacturer, importer or distributor shall submit documentation concerning continuous inspection, as described in Section 4.1. The manufacturer of the stretch film shall have a third-party certified quality management system according to SS-EN ISO 9001:2000.

A valid agreement must be in force between SP and all parties - the manufacturer, importer or distributor - involved in continuous inspection. Before this agreement can be reached, SP shall have visited the manufacturer's, importer's or distributor's premises to determine whether the manufacturers continuous inspection procedures, as described, fulfil the requirements in accordance with Section 4.1.

2.3.3 Marking requirements

The stretch film or the packaging of the stretch film shall be clearly marked with the following:

- The P-mark,
- Certificate number
- Name or designation of the product
- The certificate holders name or logo and contact details (at least a web address)
- Length in meters
- Thickness in millimetres or μm
- Manufacturing batch or serial number (May be placed on the core)
- The number of layers (wraps) and overlaps,
- The recommended interval for pre-stretching the film, as measured on the bale, minimum-maximum,

The first four clauses shall be shown on the same label (or equivalent).

It is possible to have the six first clauses shown on the same label together with the text "for further information, see the enclosed instructions". The instructions shall, at least, contain the information stated in 2.3.1.3.

Note: A package can be a single roll package or a pallet batch package



SP's P-mark.

2.4 Validity of the certificate

The validity of the certificate is normally five years. Depending on the content of reports from surveillance inspection and on other factors, the validity time may be extended after application from the holder of the certificate. If the certificate holder have more then one certificate for the same product (other product name, but identical manufacturing process and recipe) shall the validity time of that or these extra certificates be the same as the validity time of the originally certificate.

2.5 Changes to certified products

The holder of the certificate is required to notify SP of his intentions before making any changes to the composition of the product. SP will decide whether the changes can be approved: if so, this will normally be notified by a revision of the certificate.

2.6 Recycling of used stretch film

The use of stretch film affects the environment. It is important that the user of the film has the opportunity to recycle the used film to minimize the impact on the environment. The working group for SPCR 063 recommend the certificate holder to join recycling systems in Sweden.

3. Technical requirements

Stretch film for round-bale ensiling shall fulfil the requirements as set out below in order to allow it to be marked as described in Section 2.3.3. The requirements are presented in detail in appendix 1.

3.1 Type testing, requirements and follow-up testing

Type testing shall be performed for each product, i.e. for each variation of UV stabiliser system, base chemicals, design, production method and adhesive, in accordance with the methods as set out in the following table:

At the type test, all characteristics shall be tested. Follow-up tests, on samples collected at the surveillance inspections, shall be carried out with a frequency stated in the last column.

Table 1

Characteristics Numbering refers to appendix 1	Unit	Requirements	Test method	Test frequency, continuous inspection
3.1.1 Spectroscopy*		No significant change from type testing	Suitable for the material	1)
3.1.2 Induction temperature*		No significant change from type testing	Suitable for the material	1)
3.1.3 Solar reflectance	%	>28	Appendix 1, Annex A	1)
3.2 Width	mm	Nominal ± 5	ISO 4592	1)
3.2 Length	m	>99.0 %	Appendix 1, 3.2	1)
3.2 Core inner diameter	mm	76-79	Appendix 1, 3.2	1)
3.2 Core protrusion	mm	3-10	Appendix 1, 3.2	1)
3.3.1 Thickness, average	%	- 8, + 12	Appendix 1, 3.3.1	1)
3.3.2 Thickness, spot	%	- 20, + 28	ISO 4593	1)
3.4 Tensile stress at break	MPa	≥ 25 in MD ≥ 23 in TD	EN ISO 527-3 and EN ISO 527-1	1)
Stress at yield	MPa	≥ 9 in MD and TD		
Tensile strain at break	%	≥ 400 in MD ≥ 600 in TD		
3.5 Impact resistance	g	≥ 120	ISO 7765-1 Method A	1)

Characteristics Numbering refers to appendix 1	Unit	Requirements	Test method	Test frequency, continuous inspection
3.6 Perforation test -Maximum force -Total energy	N J	≥ 4.0 ≥ 0.04	EN 14932 Annex C	1)
3.7 Tightening force	N	≥ 1.75	EN 14932 Annex D	1)
3.8 Tear resistance	cN	≥120 in MD ≥400 in TD	ISO 6383-2	1)
3.9 Adhesion (Peel cling)	cN	> 300	EN 14932 Annex E	1)
3.10 UV-durability -Change in elongation (MD)	%	< 50	ISO 4892-2, EN ISO 527-3 and EN ISO 527-1	2)
3.11 Oxygen permeability	litres	<6.0	Appendix 1, Annex B	2)
3.12 Airtightness	minutes	>60	Appendix 1, Annex B	2)
3.13.1 Width (measured on test bale)		At least an overlap of 50%	Appendix 1, Annex B	2)
3.13.2 Stretching (measured on test bale)		Between -10% and +25% of their pre-stretching	Appendix 1, Annex B	2)

1) Every year

2) The test shall be performed during the third and final year of the validity period of the certificate

* A material analysis shall be performed for each product in connection with type testing. The results constitute the 'zero values' to be used for continuous inspection.

For stretch film based on other material than polythene, a separate investigation is required, which can demand other tests than those in Table 1.

3.2 Assessment of test results

Results obtained from tests as listed above in Table 1 can be applied to stretch film of any width, except in respect of those for oxygen permeability, airtightness, width and strain, which cannot be applied to tested films that are narrower than the one from which the test results were obtained.

4. The manufacturer's own inspection procedures

4.1 General

The manufacturer shall operate inspection procedures to ensure that products marked with SP's certification symbol fulfil the requirements set out in these certification rules. These procedures shall be described in a quality manual, inspection instructions or corresponding document(s), and shall fulfil the requirements set out in this section 4.

If the manufacturer has an ISO 9001 quality management system that has been certified by an accredited certification body, it can be accepted without further examination as fulfilling the following requirements in respect of organisation, management reviews, document management, processing of defective products, corrective actions, handling of completed products and complaints

4.2 Organisation

The organisation of the manufacturer's own inspection system shall be described, with the names of those persons responsible for inspection and details of their authority to act in order to prevent sub-standard quality.

The manufacturer shall appoint a person to represent him for the purpose of contact with SP concerning manufacturer's own inspection procedures. He/she shall be responsible, and shall have the necessary authority, for ensuring that the intended quality of the certified products is fulfilled and maintained. All personnel shall be thoroughly familiar with, and trained for, their duties, and shall also be provided with sufficient instructions and resources.

4.3 Management reviews and internal auditing

The management shall conduct documented reviews of the company's inspection procedures at reasonably regular intervals in order to ensure that the procedures are remaining effective.

4.4 Document management

Only the correct editions of documents may be available to persons concerned within the company. There shall be a list of the documents and a distribution list for them, together with written procedures for the preparation of new documents, changes to existing documents and the collection of invalid or replaced documents.

4.5 Inspection and testing

4.5.1 Reception inspection (materials inward inspection)

Reception inspection (materials inward inspection) shall be performed to the extent necessary in order to verify that incoming materials etc. conform to specified requirements.

4.5.2 Manufacturing inspection

Manufacturing inspection shall be performed to the extent regarded as necessary in order to ensure that manufactured products fulfil the specified requirements.

4.5.3 Inspection of finished products

Finished products shall be inspected to the extent regarded as necessary in order to ensure that they fulfil the specified requirements. A sampling plan shall indicate the procedures for sampling, the methods of testing employed and state what measures are taken to deal with products or processes that fail inspection.

4.5.4 Equipment

Equipment shall be calibrated, inspected, adjusted and maintained as appropriate.

4.6 Actions if products fail manufacturer's own inspection

Products that do not meet specified requirements shall be separated, while deciding what is to be done with them. Non-compliant products may not be sold under the same name or designation as certified products.

4.7 Corrective actions

Any non-compliances detected by the manufacturer's own inspection and/or by SP's surveillance inspection shall be investigated by the supplier, and appropriate corrective action shall be taken as needed to prevent a repetition.

4.8 Marking

The marking (see Section 2.3.3) shall be applied to the product when the company's own inspection has shown that the requirements are fulfilled.

4.9 Handling of finished products

Damage and deterioration in connection with handling, storage, packing and delivery shall be prevented.

4.10 Traceability

It shall be possible to trace products that have been supplied back to the relevant production batch, materials batch etc.

4.11 Complaints

Complaints from customers or others in respect of certified products, marking, marketing etc., shall be documented, together with details of the action taken in response thereto, with the documentation being kept available for inspection by SP.

4.12 Quality documents – Keeping of records

The manufacturer shall be able to confirm, by means of collecting and retaining relevant documents, that the products fulfil specified requirements.

Inspection and testing shall be documented to such an extent that the necessary traceability can be assured. Records shall contain comments when results depart from those expected, together with descriptions of actions taken in response thereto.

Archiving times shall be stated for documents relating to manufacturer's own inspection. Test and inspection records shall be kept available for inspection by SP, and shall be retained for at least three years.

5. SP's surveillance inspection

5.1 Execution

Surveillance inspection will be carried out at least once a year, in the form of a visit, at times to be determined by SP.

On these visits, SP will inspect to determine whether the supplier's described inspection procedures are operating as intended, and will take samples of products, as described in Section 5.1.1 (below). Testing and inspection will be carried out by, or arranged by, SP as described in Section 5.1.2. below. Other testing and inspection may also be performed, depending on the extent of the manufacturer's own inspection, and this will be set out in the agreement concerning surveillance inspection.

The supplier shall grant SP's representative(s) unrestricted access as needed in order to perform the surveillance inspection. If the manufacturer has a quality management system that is certified by an accredited certification body, SP's examination of the manufacturer's inspection procedures can normally be restricted to inspection of audit reports and documentation from inspection and testing.

5.1.1 Sampling

Material will be taken randomly from stores or from production.

5.1.2 Testing

Each product shall be tested in accordance with the methods described in Section 3.1 during the validity period of the respective certificates, in accordance with table 1.

5.2 Actions if SP's surveillance inspection results in failure

If inspection testing and/or surveillance inspection of the supplier's own inspection procedures results in failure, the reasons for the failure shall be investigated. The results of this investigation may lead to a further surveillance visit, further testing or failure to approve the manufacturer's/supplier's own inspection procedures.

5.3 Reporting

The results of SP's surveillance inspection shall be reported in writing to the supplier and, if the supplier is not the holder of the certificate, also to the holder of the certificate.

6. Other terms and conditions for certification

6.1 General

The terms and conditions in these certification rules, Chapters 2 and 6, are based on principles set out in SP's Quality Manual for Certification. Sub-contractors for type-testing and surveillance inspection shall be approved by SP Certification.

6.2 Responsibilities of the certificate holder

The holder of the certificate is responsible for ensuring that the products covered by the certificate and which are marked with SP's P-symbol conform in all respects with the certified product in accordance with the certificate, and that the products are suited for their purposes and cannot in any way cause damage or harm. This applies even if the holder of the certificate is not the manufacturer of the product, although the agreement on surveillance inspection has been signed by the manufacturer and SP.

6.3 Use of SP's certification symbol by the certificate-holder

The holder of the certificate shall be entitled to mark the products covered by the certificate with SP's certification symbol, and shall also be entitled to use the symbol in connection with advertising or marketing of the products. Advertising shall not be performed in such a way that there is any risk of confusion between marked and unmarked products.

6.4 Recall of the certificate

With immediate effect, SP can recall certificates definitively or temporarily if:

- a) the holder of the certificate has applied SP's certification symbol to, or used it in connection with, products that do not fulfil the requirements, *or*
- b) the holder of the certificate has applied SP's certification symbol to, or used it in connection with, products not covered by the certificate, *or*
- c) surveillance inspection has ceased, or has resulted in failure, *or*
- d) the holder of the certificate has in some other way failed to comply with the terms and conditions associated with the certificate, *or*
- e) the holder of the certificate has not paid fees within the prescribed time, *or*
- f) the holder of the certificate has been declared bankrupt, has gone into liquidation or has transferred the business, *or*
- g) the certificate has been found to have been issued incorrectly. However, the holder of the certificate shall be granted a reasonable time for adjusting to changed circumstances, unless there are special reasons to the contrary. *or*
- h) the product shows itself to be unsuitable for its purpose or in another way can cause harm or nuisance.

In addition to recall of the certificate, misuse of SP's certification symbol or certificate can result in legal action.

6.5 Obligations of the certificate-holder in the event of recall of the certificate

The holder of a certificate who has been notified that the certificate has been recalled, whether definitively or temporarily, shall:

- a) immediately cease making any reference to the certificate in advertisements or other publicity material for the product(s) concerned;
- b) ensure that SP's P-symbol is removed from all products that are in stock, if so required by SP;
- c) meet all costs associated with replacing the sub-standard products by products that fulfil the requirements in the certification rules, if so required by SP.

6.6 Re-issue of the certificate

The same rules apply to re-issue of a certificate that has been temporarily recalled as applied to the original issue of the certificate, as described in Section 2.3. The same material may be used as was used for type examination in connection with the original issue of the certificate if a period of less than two years has passed since the certificate was recalled, unless the rules for certification, or production conditions, have been changed.

6.7 SP's responsibility

SP is responsible for ensuring that the technical requirements in these certification rules are based on available knowledge and experience, such as accepted standards or corresponding specifications, and also for ensuring that the rules reflect what is generally regarded by the interested parties as a relevant quality level.

SP is responsible for ensuring that assessment of the certified products against the requirements in these rules has been carried out with all due care and in accordance with the procedures set out in SP's quality system.

SP is not responsible for certified/P-marked products (see Section 6.2).

6.8 Confidentiality

With the following exceptions, all information obtained by SP will be regarded as commercially confidential:

- Certificates and, if relevant, associated documents
- SP - or other parties working with SP - maintain(s) registers of guilty certificates. These registers contain details of the names and addresses of the holders of each certificate, the certificate number, certified products, classification, date of issue and validity period of the certificate. The registers are published on SP's web site for certified products, www.sp.se/cert. The registers can also be published in publications, issued by for instance trade associations.
- SP shall be entitled to publish decisions concerning recall of certificates and misuse of certificates or marking.

6.9 Revised certification rules

SP reserves the right to modify certification rules. In the event of extension of the validity of certificates issued under older rules, the holder of the certificate will be required to comply with the revised rules. However, unless special reasons to the contrary apply, the holder of the certificate shall be allowed a reasonable time for adjustment to the revised rules.

6.10 Fees

Fees for initial assessment (certification) and for review and extension of the validity of a certificate are given in a separate price list, and shall be paid by the applicant / holder of the certificate.

Fees for surveillance inspection are regulated by agreement between SP and the supplier.

Costs of other inspection, as set out in Section 6.11, will be billed to the holder of the certificate only if the results of such inspection show that the requirements in the certification rules are not being fulfilled.

6.11 Other inspection

SP shall be entitled, at any time and in/at any place, to carry out other inspection of the products, to ensure that the products are continuing to fulfil the requirements set out in the relevant certification rules.

6.12 Appeals

Appeals against SP's decisions shall be submitted in writing. Action in response to such appeals will be decided by SP's Certification Board.

7. References

EN 45011	General requirements for bodies operating product certification systems.
EN ISO 9001:2000	Quality management systems – Requirements.
ISO 527-1	Plastics - Determination of tensile properties: General principles
ISO 527-3	Plastics - Determination of tensile properties: Test conditions for films and sheets
ISO 4592	Plastics - Film and sheeting-Determination of length and width
ISO 4593	Plastics - Film and sheeting-Determination of thickness by mechanical scanning
ISO 4892	Plastics - Methods of exposure to laboratory light Part 1: General guidance
ISO 6383-2	Plastics - Film and sheeting-Determination of tear resistance Part 2: Elmendorf Method
ISO 7765-1	Plastics - Film and sheeting-Determination of Impact Resistance by the Free-Falling Dart Method – Part 1: Staircase method
ISO 9845-1	Solar energy - Reference solar spectral irradiance at the ground at different receiving
EN 14932	Plastics - Stretch thermoplastic films for wrapping bales – Requirements and test methods

1 Introduction

This document is an extract from a proposal for an international standard for requirements and test-methods for stretch-film which has been worked out by the Swedish National Machinery Testing Institute in cooperation with the Swedish University of Agricultural Sciences (Department of Animal Nutrition and Management), a number of manufacturers of film in Sweden and in the rest of Europe as well as the Nordic Testing Institutes.

The requirements have been devised, taking into consideration the biological and practical requirements for the film in its interaction with the machinery used for the wrapping and handling of round-bales. The standard states and describes test-methods and equipment for evaluating the properties of the film.

2 Normative references

- ISO 527-1 Plastics - Determination of tensile properties: General principles
- ISO 527-3 Plastics - Determination of tensile properties: Test conditions for films and sheets
- ISO 4592 Plastics - Film and sheeting-Determination of length and width
- ISO 4593 Plastics - Film and sheeting-Determination of thickness by mechanical scanning
- ISO 4892 Plastics - Methods of exposure to laboratory light Part 1: General guidance
- ISO 6383-2 Plastics - Film and sheeting-Determination of tear resistance Part 2: Elmendorf method
- ISO 7765-1 Plastics - Film and sheeting-Determination of Impact Resistance by the Free-Falling Dart Method – Part 1: Staircase method
- ISO 9845-1 Solar energy - Reference solar spectral irradiance at the ground at different receiving
- EN 14932 Plastics – Stretch thermoplastic films for wrapping bales – Requirements and test methods

3 Requirements

3.1 Material analysis

The composition of the type approved product may not be changed. This is checked by spectroscopic and thermoanalytic methods.

3.1.1 Spectroscopy

A "finger print" of the material is determined by a IR or UV-VIS-NIR spectroscopy method.

3.1.2 Thermal analysis

Concentration of the effective stabilizer is checked by the determination of oxidative induction temperature.

3.1.3 Solar reflectance

The solar reflectance shall be tested according to Annex A.
The minimum reflectance value R_s shall be 0.28 or 28 %.

3.2 General measurements of the film and properties of the package

The width of the film measured on the film roll according to ISO 4592 (with at least three measurements on each roll equally distributed). The mean value must be within ± 5 mm from nominal width.

The length of the film shall be at least 99,0 % of the nominal length stated by the manufacturer. Length measurement shall be performed in accordance with issue 9.4 EN 14932.

The inner diameter of the bobbin shall be between 76 and 79 mm.

The bobbin shall protrude at minimum 3 mm and maximum 10 mm from each side of the film roll. The package in which the film is delivered shall be such that the film is protected against mechanically caused damages.

3.3 Thickness

3.3.1 Average thickness

The average thickness of the film shall be determined by measuring the length and width of the film and by weighing the roll. The manufacturer shall state the density of the film and the average thickness shall be calculated using equation 1.

$$\text{Equation 1. } d = \frac{m}{l * w * \rho} * 10^6$$

where:

- d = the mean thickness of the film (μm)
- m = the weight of the film roll, excluding the bobbin (kg)
- l = the total length of the film (m)
- w = the mean width of the film, measured on the film roll (m)
- ρ = the density of the film as stated by the manufacturer (kg/m^3)

The average thickness must not deviate more than -8 % or +12 % from the thickness stated by the manufacturer.

3.3.2 Variation

The variations in thickness shall be determined in accordance with ISO 4593, method A. Three strips cut in transverse direction shall be used, sampled at random from the roll.

None of the separate measurements shall give results that deviate more than -20 % or +28 % from the nominal thickness stated by the manufacturer.

3.4 Tensile strength, yield-point and break elongation

The tensile strength, yield-point and break elongation shall be determined in accordance with ISO 527-1 and ISO 527-3 using test pieces type 2. Five test specimens in each direction of the film (manufacturing direction and transverse manufacturing direction MD/TD) shall be sampled at random from the roll.

Test speed:	500 mm/min
Distance between grips:	50 mm
Width of the test-specimen:	20 mm
Length of the test-specimen:	150 mm

Requirements

The tensile strength MD:	≥ 25 Mpa
The tensile strength TD:	≥ 23 Mpa
Stress at yield MD and TD:	> 9 Mpa
Tensile strain at break MD:	≥ 400 %
Tensile strain at break TD:	≥ 600 %

3.5 Impact resistance

The impact resistance of the film shall be determined in accordance with ISO 7765-1, method A. The test is performed on the film with the inside of the film, as seen from the reel, facing up in the testing apparatus.

The impact failure mass shall be at least 120 grams.

3.6 Perforation test

The slow perforation test shall be performed according to EN 14932 Annex C. The minimum allowable breaking force is 4.0 N and minimum total energy 0.04 J.

3.7 Tightening force

The tightening force test shall be performed according to EN 14932 Annex D. The minimum allowable tightening force is 1.75 N.

3.8 Tear resistance

The tear resistance shall be performed according to ISO 6383-2. The tear resistance shall be at least 120 cN in machine direction and 400 cN at least in transverse machine direction.

3.9 Adhesion (Peel cling)

The adhesion (peel cling) shall be determined according to EN 14932 Annex E. The minimum allowable adhesion is 300 cN (3.0 N).

3.10 UV-durability

The UV-durability shall be tested in a weather-o-meter in accordance with ISO 4892, Part 2, up to a total radiant exposure in the bandpass 300-400 nm of 30.5 kW/cm² with a xenon arc lamp.

Spraycycle:

- Time of spraying	18 min
- Dry interval between spraying	102 min

Relative humidity:	50 ± 5%
Black standard temperature:	65 ± 3°C

5 test specimens, with a width of min. 30 mm and length, in the direction of manufacturing, of min. 150 mm, shall be sampled at random from the roll. The specimens shall be put on to a specimen holder. The holder must be wrapped with the actual film, to avoid distortions from unknown materials.

Orientation: The test specimen shall be oriented so that the inside of the film, as seen from the reel, is turned towards the lamp.

After the UV-durability test, the specimens shall be cut to a width of 20 mm, and the break elongation shall be tested in accordance with 3.4. The elongation at break in the direction of manufacturing must not have decreased by more than 50% of the original test-value.

3.11 Oxygen-permeability

The oxygen-permeability of the film shall be tested in accordance with the description in Annex B, using a test bale, which is wrapped with the number of layers stated by the manufacturer, and in accordance to the description in Annex B.

During the measuring period, no more than 6.0 litres of oxygen must leak into the bale at the specified temperature and at the air-pressure prevailing during the test.

3.12 Airtightness

The film's ability to provide an airtight wrapping shall be tested using the artificial bale as described in Annex B. The time for the pressure in the bale to increase from -500 Pa to -100 Pa shall be measured. The measured time must be longer than 60 minutes.

The method is described in Annex B.

3.13 Width and stretching of the film

3.13.1 Width

When an artificial bale is wrapped, in accordance with Annex B, the film must always remain wide enough to ensure an overlap of at least 50 %. The properties of the wrapping machine are specified in Annex B.

3.13.2 Stretching

The stretching of the film, measured on the test-bale, must not be lower than 10%-units of the theoretical pre-stretching. Nor must it exceed the theoretical pre-stretching with more than 25%-units.

ANNEX A

Solar reflectance

Determination of solar reflectance of silage bale stretch film

Introduction

The method is made to simulate the colour influence on the temperature in a stretch film covered bale. The temperature of the stretch film should not be too high because high temperatures lead to high permeation rates of oxygen and carbon dioxide through the film and a consequently increasing microbiological activity inside the bale. Normally, moderately increased temperatures, of course, also promote microbiological activities.

The temperature of the stretch film in a bale wrap is affected not only by the ambient air temperature, but also by solar irradiation, see fig. A2. Different stretch film bale wraps reach distinct surface temperatures when exposed to sunshine dependant on the ability of the film to reflect solar irradiation. In this respect it is desirable to use a highly reflecting film. Examples of factors that influence the reflectance of a stretch film are the colour, type and amount of filler material.

A 1. Scope

In this standard is described an appropriate method for determine the solar reflectance, R_s , of stretch films. The method is based on reflectance spectra acquired by UV-VIS-NIR spectroscopy using an integrating sphere attachment (Fig. A1). The solar reflectance, R_s , can be calculated according to methods described in ISO 9845-1. The calculation is based on direct solar irradiance data for air mass 1,5 also presented in ISO 9845-1

A 2. Definitions

For the purposes of this standard, the following definitions apply.

A 2.1 air mass: Ratio of the mass of atmosphere in the actual observer-sun path to the mass that would exist if the observer was at the sea level, at standard barometric pressure, and the sun was directly overhead.

A 2.2 diffuse reflectance: The incoming beam is reflected in all directions by the sample.

A 2.3 direct solar irradiance: On a given plane receiver surface, the ration of the radiant flux received from a small solid angle centred on the sun's disk to the area of that surface (unit: watts per square metre, Wm^{-2}).

A 2.4 integrating sphere: A sphere that inside is covered with a highly reflecting material. It is a device that collects diffusively reflected light from a surface. Specular reflected light could also be collected. The specular part can often also be ignored if appropriate.

A 2.5 spectral solar irradiance (E_λ): Solar irradiance E per unit wavelength interval at a given wavelength λ (unit: watts per square metre per micrometer, $\text{Wm}^{-2} \text{nm}^{-1}$).

$$E_\lambda = dE/d\lambda$$

A 2.6 specular reflectance: The incoming light beam is reflected without scattering at an angle to the normal that is the same as the angle of the incoming light beam.

A 3. Determination of solar reflectance, R_s

A 3.1 Reflectance spectra acquisition.

The measurements are performed using an UV-VIS-NIR-spectrophotometer equipped with an integrating sphere collecting both the specular and the diffusively reflected part of the light. The film sample is placed at the exit port of the sphere, i.e., at the rear of the sphere. The outside of the stretch film is directed towards the sphere. Behind the samples a radiation trap (a cavity having a black internal surface) is placed in order to absorb all light, which is not absorbed or reflected by the sample. It is assumed that in a real bale, the silage inside the bale absorbs all light that is not reflected or absorbed by the stretch film wrapping. See fig. A1.

A reflectance spectrum is acquired between 0,3 and 2500 nm on one layer of film. The contribution from wavelengths longer than 2500 μm can be neglected.

A 3.2 Calculation of R_s

Solar reflectance, R_s , is defined as the fraction of the total direct solar irradiation that is reflected by a body - in this case a stretch film. R_s -values are defined according to:

$$R_s = \int_0^\infty R(\lambda)E_\lambda(\lambda)d\lambda / \int_0^\infty E(\lambda)_\lambda d\lambda$$

where $E_\lambda(\lambda)$ represents the solar spectral irradiance and $R(\lambda)$ the absolute reflectance values.

Reflectance spectra, $R_{\text{spec}}(\lambda)$, that are acquired by the spectrophotometer are measured relative a reflectance standard with known absolute reflectance values, $R_{\text{ref}}(\lambda)$.

$R(\lambda)$ is calculated from reflectance spectra according to:

$$R(\lambda) = R_{\text{spec}}(\lambda)R_{\text{ref}}(\lambda)$$

An example of a reflectance standard is pressed Eastman barium sulphate (BaSO_4). $R_{\text{ref}}(\lambda)$ for BaSO_4 can be obtained from National Physical Laboratory. Other reflectance standards exist. The manufacturers provide the absolute reflectance values.

R_s is calculated according to ISO 9845-1. Two different methods are presented: Weight ordinate method and selected ordinate method.

Fig. A1 Integrating sphere

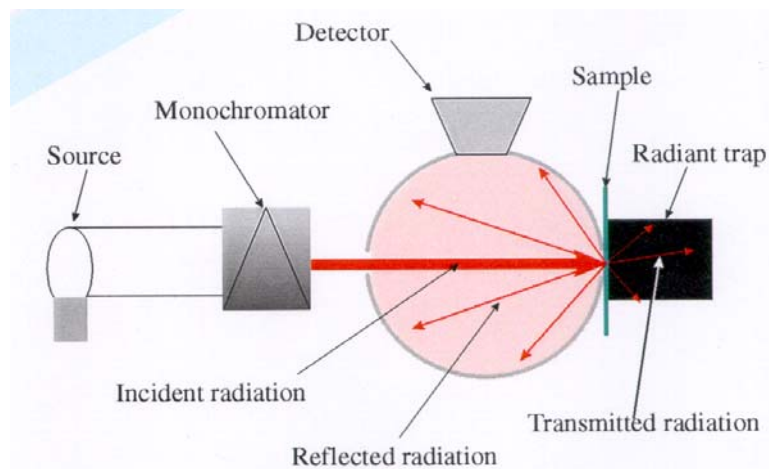
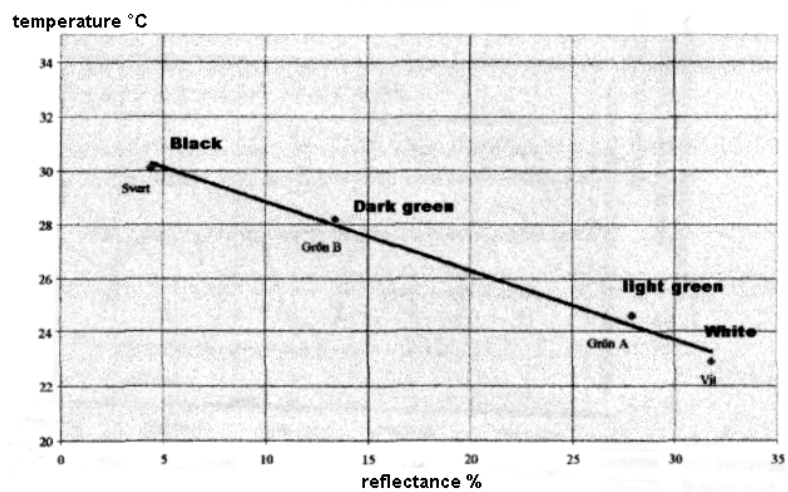


Fig. A2. Sample of the correlation between bale surface temperature and reflectance measured with this method compared to field trials made on stretchfilm with different colour



ANNEX B

Description of test-methods and equipment for measuring oxygen-permeability and airtightness.

Areas of use

Oxygen-permeability

The method makes it possible to determine the amount of oxygen that, during a specified period of time, leaks into an artificial silage-bale which has been wrapped with film.

The oxygen can leak into the bale in 3 different ways:

- permeation
- leaks in joins
- holes in the film

Airtightness

The method described below makes it possible to determine how fast a difference in pressure, between the inside and the outside of a wrapped bale, decreases to a certain level. This is a measure of how well a wrapped bale can withstand pressure-variations, caused by variations in temperature and/or air-pressure. The airtightness depends on how well the layers adhere to each other and on the smoothness of the film on the wrapped bale.

Wrapping of test-bales

During a test, 3 test-bales shall be wrapped by a wrapping machine with specified properties.

Unless the manufacturer states otherwise, the wrapping shall be carried out in accordance with the following specifications:

- overlapping c. 55%, see note 1
- theoretical pre-stretch 53%, see note 2

Note 1: the number of layers which the manufacturer can specify is 2, 2+2, 2+2+2 and so on, since the overlapping is fixed.

Note 2: the stretching of the film, measured on the bale, will be c. 70% due to a certain degree of stretching between the pre-stretcher and the bale. This stretching varies between different types of film and depends also on the film temperature. The stretching shall be measured as an average and at 20 r/min on the wrapping machines rotation-table, see Annex A.

Before wrapping, which shall be performed with a newly opened film roll, the film shall be checked for obvious flaws that may affect the test-result. The first 5 meters of the film shall be discarded.

Conditioning of the film

Before the film to be tested is wrapped on the bale, it shall be kept for at least 48 hours in a place with the same temperature as that, at which the oxygen-permeability tests will be performed.

After the wrapping of the test-bales, the bales shall be kept for at least 24 hours and at the most 48 hours before the oxygen-permeability tests are performed. During this time the bales shall be kept in a test-room with the intended temperature.

Before the wrapping machine is used it shall be kept for at least 24 hours in the same room as that in which the wrapping will be performed.

Measuring

Oxygen-permeability

Before the measurements are performed the bales shall be filled with 99.9% pure nitrogen. The bales shall be filled so that the concentration of oxygen is at the most 1.0 volume-%.

The concentration of oxygen in the bales shall be registered once every hour. Before each registration the gas-mixture in the bale shall be pumped through the oxygen-analyzer for at least 15 minutes. A fan shall be installed in each bale in order to ensure that the measurements are carried out on a homogeneous gas-mixture.

When the concentration of oxygen has risen to 2.0 volume-%, the registrations shall continue for another 100 hours.

Airtightness

When the oxygen-permeability tests have been carried out, every bale shall be connected to a device that can create a pressure of -500 to -600 Pa. The time for the pressure to increase from -500 Pa to -100 Pa shall be measured in order to establish the airtightness of the bale. When a pressure of between -500 and -600 Pa has been created inside the bale, all connections, apart from the measuring pipe, shall be shut off in order to ensure that only the volume and airtightness of the bale effects the measurements.

Stretching

The average stretching of the film shall be measured. The measurement shall be carried out during wrapping of the test bales. The length of the unstretched film needed to cover the bale with a specified number of layers shall be noted. Given the number of rotations of the bale and the bales circumference (measured in the direction of wrapping) the average stretching can be calculated.

Temperature

The temperature shall be measured at 2 points on each test-bale with sensors attached to the film. The sensors shall be placed on the highest point of each test-bale as well as in the middle of the long-side, c. 30 cm from the floor, on each test-bale.

Air-pressure

The air-pressure shall be registered continuously throughout the test-period.

Calculation and presentation of results

Oxygen-permeability

The results from the oxygen-permeability tests shall be presented as the amount of permeated oxygen (from the atmosphere) through a 1.27x1.19 m bale/100 h. The result shall be expressed in l O₂/100 h.

The amount of permeated oxygen shall be calculated, using the volume of the bale and the concentration of oxygen in the bale 100 hours after the concentration of oxygen has reached 2.0 volume-%.

In order to calculate at what time (T1) the concentration of oxygen is 2.0 volume-%, and to calculate the concentration of oxygen in the bales 100 hours after T1, (i.e at T2), linear regression shall be performed around both points (T1 or T2 respectively).

The regressions shall be performed so that 5 registrations are included in each regression. This means that the regression will cover 5 hours in both cases. The registration points shall be located so that at least 2 but at the most 3 points are included in the regression on either side of T1 or T2.

The result shall be presented as an average for the 3 test-bales. If the result for any bale deviates by more than 15 % from one of the other 2 test-bales it shall be excluded from the average unless there is a "natural" cause due to the properties of the film.

Airtightness

The time for the pressure to increase from -500 Pa to -100 Pa shall be measured. The result shall be expressed in minutes.

The results shall be presented in the same way as those from the oxygen-permeability tests.

Stretching

The average stretching of the film shall be presented as the quotient of the theoretical and the true length of film needed to cover the bale with a specified number of layers (equation 2).

Equation 2.
$$\frac{l_t - l_o}{l_o} \times 100$$

where

$l_t = c \times n$ = the theoretical length of unstretched film needed to cover the bale with a specified number of layers

l_o = the observed length of unstretched film needed to cover the bale with a specified number of layers

and where

c = the circumference of the test-bale

n = the number of turns of the test-bale during wrapping

Temperature

The temperatures during the test-period shall be presented as the average-, maximum- and minimum temperatures from the 2 sensors on each bale.

Air-pressure

The air-pressure shall be presented as the highest and lowest air-pressure registered during the time that has elapsed between point T1 and point T2. The sum of the pressure-increase during this period shall also be presented.

Equipment

Oxygen-measurements

The measurements of the oxygen-concentrations shall be carried out with an instrument with an accuracy greater than 0.2 volume-%. The instrument reading shall be automatically compensated for changes in air-pressure.

Before any measurements are carried out, the instrument shall be calibrated with nitrogen (99.9%) for a correct zero-point, and with atmospheric air that is considered to contain 20.95 volume-% oxygen. The instrument shall thereafter be calibrated daily during the test-period and when the test is completed. If the deviation at any calibration is more than 0.2 volume-% the reason shall be found and the test be repeated.

Airtightness

The equipment shall make it possible to register the pressure inside the bale with an accuracy greater than 10 Pa.

Stretching

The equipment shall make it possible to determine the true length of the film, needed to cover the bale, with an accuracy greater than $\pm 0.5\%$.

Wrapping

The wrapping shall be performed with a wrapping machine equipped with a rotation table that will give a theoretical overlapping of 55% at stretched film widths of 400 mm or 600 mm (i.e. 500 or 750 mm unstretched). The rollers at the active parts of the pre-stretcher shall clean and smooth on surface so it does not affect the pre-stretching in a negative way.

At testing at SMP, the ratio between the two rolls is 1:1,75 (e.g Kverneland A/S, UN7556 with a theoretic 75% pre-stretching with rubber rolls).

Test-room

The wrapping shall be performed in a room in which the temperature is 20 ± 2 °C.

During the tests of permeability and airtightness, the temperature shall be 23 ± 1 °C.

Test-bales

3 test bales shall be used for the measurements. The bales shall consist of an air-tight inner container through which passes a pipe for filling of nitrogen. In one end of the pipe there shall be a fan that transports the gas-mixture. The stated capacity of the fan shall be $18 \text{ m}^3/\text{h}$ at free flow (no pressure) Outside the inner container there shall be a steel-net with a 10 mm mesh. On the net a double layer of glass fibre fabric shall be placed in order to protect the film from mechanical damage during the process of wrapping. The glass fibre fabric shall have a density by area of $128 \text{ g/m}^2 \pm 7\text{g}$. The total volume between the inner container and the steel-net shall be 150 ± 5 litres.

Air-pressure

The air-pressure shall be measured with an instrument with an accuracy greater than 100 Pa.

Temperature

The temperature shall be measured directly on the bales with sensors attached to the film. The accuracies of the temperature measurements shall be at least $0.2 \text{ }^\circ\text{C}$.

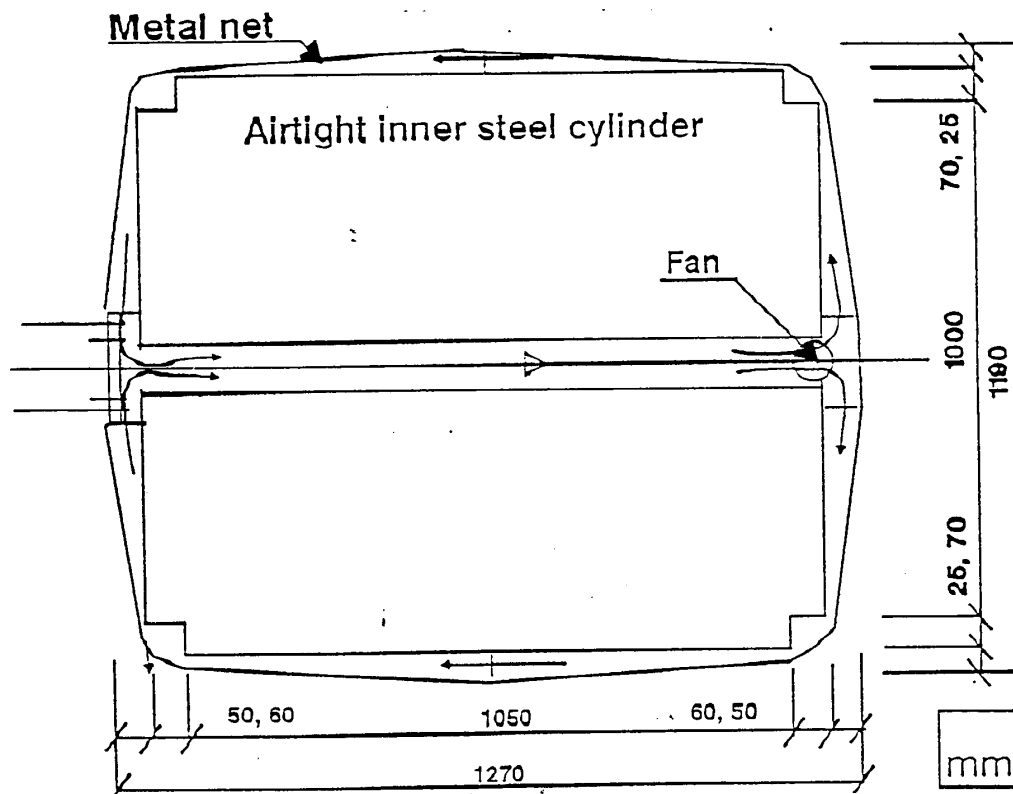


Figure 2. Test-bale seen from the side.



CERTIFIKAT

No 10 00 00

Stretch film for round bale ensiling

Holder/Issued to

Company Ltd, X-street, SE-123 45 TOWN, Country

Product name

X-film

Product description

White stretch film with thickness 25 µm and width 500 mm and nominal length 1800 m, or width 750 mm and nominal length 1500 m. The film shall be applied with 6 layers and with 50% overlapping.

Performance specification

The product described above fulfils the requirements set out in SP's *Certification rules for P-marking of Agri-stretch film for round-bale ensiling, SPCR 063*

Instructions for use and marking of products

The products may display SP's P-mark according to above mentioned certification rules. Detailed requirements for the instructions for use is presented in clause 2.3.1.3 in SPCR 063. Detailed requirements for marking is presented in clause 2.3.3 in SPCR 063.

Validity

This certificate is valid until not later than 28th February 2013.

Miscellaneous

The manufacturer's own inspection procedures are under surveillance by SP in accordance with section 4 and 5 in SPCR 063. This is the second issue of this certificate, and it replaces earlier certificate with the same number. The certificate was first issued on 15th February 2003.

Borås, 15th February 2008

SP Technical Research Institute of Sweden Certification

NN
Certification Manager

NN
Certification Officer

This is an English version of *Certifikat nr 10 00 00*, in Swedish, dated 15th February 2008



Certificate issued by SP

SP Technical Research Institute of Sweden

Postal address	Phone / Fax	Reg.number	E-mail / Internet
SP Box 857 SE-501 15 Borås SWEDEN	+46 10 516 50 00 +46 33 13 55 02	556464-6874	info@sp.se www.sp.se

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