المجلس الأعلى
لجنة خدمة الإنتاج والجودة

إزالة معوقات التصدير أمام المنتجات النسجية

التقرير النهائى

مقدمة عامة

حيث أن دعم القدرة التنافسية للمنتجات النسيجية تعتمد على عنصريين هامين : ــ

أولهما : رفع الجودة والثانى يهدف إلى تحقيق المتطلبات البيئيــة فــى العمليات الإنتاجية والتى أصبحت مطلباً رئيسياً لقبول المنــتج فى الأسواق الخارجية .

ولذلك فإن هذا التقرير ينقسم إلى جزئيين :

الجزء الأول : يختص بإعداد ملف الجــودة وضــبطها فــى المراحــل المختلفة للتصنيع .

والجزء الثانى : يختص بالمتطلبات البيئية التى تحددها الأنظمة الدولية فى هذا المجال

الجزء الأول

ضبط الجودة فى العمليات الإنتاجية

مقـــدمـــة

تهدف هذه الدراسة إلى الرقى بالصناعات النسيجية المصرية و زيادة قدرتها التنافسية فى ظـــل نظـــام العولمة ، و إتفاقات الجات و الإشتراكات البيئية الصارمة ، خاصة تلك المتعلقة بـــالتصدير و المتمثلـــة فى نظم الإيكو المختلفة ، و ذلك من خلال ضبط الجودة فى المعالجات الكيميائية المبللة ، بما يضمـــن إستمرارية الحصول على نفس المنتج بنفس المواصفات و الجودة فى كل الأوقات .

و المشكلة التى تواجه صناعة النسيج المصرية هى ضبط الجودة ، خاصة خلال مراحـــل المعالجـــات الكيميائية المبللة ، و ذلك لتعدد خطواتها و كثرة و تنوع المواد الكيميائية المستخدمة فى كـــل خطـــوة منها ، و كذلك لتعدد مخارجها .

و لضمان تحقيق الجودة ، و خاصة فى المعالجات الكيميائية المبللة فإن ذلك يستلزم وجود مـــا يعـــرف بإسم (ملف ضبط الجودة) الذى يجب أن يحتوى على طرق إختبار و تقييم كل من :

أ – المدخلات بما تتضمنه من مواد خام و كيماويات .

ب – خطوط الإنتاج و ظروف التشغيل .

جـ– المنتج النهائى .

و نظراً لتعدد و تنوع و إختلاف المعالجات الكيميائية المبللة و من ثم تعدد و تنوع المـــواد الكيميائيـــة المستخدمة (الذى يربو عددها فوق ما يزيد عن ٨٠٠٠) و تنوع مصادرها فى ظل السوق المفتوحة ، و أيضاً لإختلاف الأنشطة و التخصصات للمصانع النسيجية فى مصر ، و لكن يمكن تحقيق المرجـــو على الوجه الأكمل فإن هذا العمل تم تقسيمه إلى ثلاث مراحل متمشية مع التتابع النمطـــي للمعالجـــات الكيميائية المبللة على مستوى الإنتاج الصناعى و هى :

المرحلة الأولى : إعداد ملف ضبط الجودة للمعالجات الأولية .

المرحلة الثانية : إعداد ملف ضبط الجودة للصباغة و الطباعة .

المرحلة الثالثة : إعداد ملف ضبط الجودة للتجهيز النهائى .

بحيث يمكن (من خلال هذه الملفات الثلاث) لشركات الصباغة و الطباعـــة و التجـــهيز فـــى مصـــر الإستعانة والإسترشاد بها فى إعداد الملفات الخاصة بها (و بما يتمشى مع طبيعة نشاطها) بما يضمـــن جودة منتجها ويضمن وجود الوثائق الرئيسية لنظم الجودة .

الجزء الثالث

دليل إرشادى إلى ملف ضبط الجودة
فى مراحل البوش و المعالجات الأولية
للمنسوجات المحتوية على السليلوز

٣ – ١ مقدمة :

نهدف عملية ضبط الجودة إلى إنتاج نفس المنتج بنفس الجودة فى كل الأوقات و كل لوطات التشغيل .

و عناصر ضبط الجودة فى المعالجات الكيميائية المبللة للصناعات النسيجية تتضمن ضبط جودة الخامات (ألياف و غزول و منسوجات) و ضبط جودة الكيماويات (كيماويات عامة و مواد مساعدة و أصباغ ... إلخ) و ضبط ظروف التشغيل ، و ضبط أداء العمالة و الماكينات ، و أخيراً إختبار جودة المنتج لضمان ثبات مواصفاته و خواصه الأدائية و كونهما فى الحدود القياسية المسموح بها .

و حيث أن ضبط أداء العمالة و الماكينات يخضع لمعايير خاصة لا دخل لملف ضبط الجودة بها ، فإن ملف ضبط الجودة – بوجه عام – يتضمن العناصر التالية :

أ – ضبط جودة الخامات و كيماويات التشغيل .
ب – ضبط خطوط الإنتاج و ظروف التشغيل .
جـ – إختبار جودة المنتج النهائى .

و كل عنصر من هذه العناصر يتضمن طرق الاختبار المختلفة التى تخضع لها مفردات هذه العناصر يتضمن طرق الإختبار المختلفة التى تخضع لها مفردات هذه العناصر لتوكيد جودتها و ضمان حسن ادائها .

و من الناحية التنظيمية لملف ضبط الجودة و لتداخل بعض الإختبارات التى تجرى على الخامات (ألياف و غزول و منسوجات) و المنتجات النهائية (غزول و منسوجات) ، فإن هذه الإختبارات تجمع فى قسم واحد من ملف ضبط الجودة ، و بالتالى يصير تنظيم ملف ضبط الجودة كما يلى :

أ – الكيماويات الواردة .
ب – خطوط الإنتاج و ظروف التشغيل .
جـ – إختبار الألياف و الغزول و المنسوجات .

و فيما يلى شرح لملف ضبط الجودة المدرج بالجزء الثانى من هذا التقرير ، و الخاص بعمليات البوش و المعالجات الأولية ، و هذا الملف ما هو إلا مثال عام ، ممكن الإحتذاء به لأى مصنع ، و ذلك لعمل ملف ضبط الجودة الخاص به فيما يتعلق بهذه العمليات .

٣ – ٢ القسم الأول : الكيماويات الواردة :

أول خطوة فى إعداد ملف ضبط الجودة هى حصر جميع الكيماويات الواردة و الداخلة فى عمليات التشغيل (و فى حالتنا هذه : البوش و المعالجات الأولية) و لسهولة الحصر تم تصنيف هذه الكيماويات إلى ثلاثة أصناف :

أ – كيماويات عامة General Chemicals :

و هى تضم كافة الكيماويات المحتمل إستخدامها فى مراحل البوش و المعالجات الأولية ، و تم حصرها فى ثلاثة عشر مادة كيميائية ، و ليس بالضرورة إستخدامها كلها فى كل المصانع ، وإنما على كل مصنع حصر ما يخصه منها .

ب - مواد بوش و مساعداتها Sizing Agents & Auxiliaries :

و هذه ضمت فقط خمس مواد تجارية ، ليس بالضرورة إستخدام كلها أو بعضها بالمصانع بل و يمكن إستخدام مواد أخرى غيرها تحت أسماء تجارية مختلفة و لكنها متشابهة فى التركيب الكيميائى و الخواص لتلك الواردة فى الملف ، و بالتالى يمكن تقييمها و إختبارها بنفس الطرق الواردة فى الملف .

جـ - مواد مساعدة للمعالجات الأولية Pretreatment Auxilliaries :

و هذه ضمت المواد المساعدة شائعة الإستخدام ، شاملة الإنزيم و المواد المختزلة و مواد البلل و مثبتات فوق أكسيد الهيدروجين و مواد الغليان بحيث تصير نموذجاً يسترشد به فى إختبار مثيلاتها التجارية التى لم يتم ذكرها فى الملف .

و تم تقسيم هذا القسم إلى ثلاثة أبواب كما يلى :

٣ - ٢ - ١ الباب الأول : المواصفات القياسية للكيماويات الواردة :

Standard for Testing of Incoming Chemicals

و فى هذا الباب يتم تجديد طرق الإختبار التى تجرى على العينات الواردة و مقارنة نتائج الإختبار بنتائج العينات القياسية (المواصفات القياسية) التى أتفق أن يكون التوريد على أساسها ، و بالتالى فإن المواصفات القياسية لمادة كيميائية ما قد تختلف من مصنع لمصنع ، فعلى سبيل المثال ، قد تأخذ القيم القياسية لتركيز حمض الخليك فيما قد تكون ١١% أو ٧٠% أو أكثر من ٩٠% أو غيرها ، و ذلك إعتماداً على ما تم الإتفاق عليه مع المورد .

٣ - ٢ - ٢ الباب الثانى : طرق إختبار الكيماويات الواردة :

Testing of Incoming Chemicals

و هذا الباب يعنى بكافة طرق الإختبار للكيماويات الواردة و طرق الحساب و المواصفات القياسية لكل إختبار .

٣ - ٢ - ٣ الباب الثالث : نماذج لسجلات إختبار الكيماويات الواردة . :

Testing Reports of Incoming Chemicals

حيث خصص لكل مادة كيميائية سجلاً يتضمن نتائج الإختبارات و مقارنتها بالمواصفات القياسية ، و بناء على هذه المقارنة يؤخذ قرار الرفض (إذا كانت غير مطابقة) أو القبول (إذا كانت مطابقة) للعينات الواردة .

٣ - ٣ القسم الثانى : إختبارات تجرى على خطوط الإنتاج و ظروف التشغيل :

Process Control Checks

بعد أن تم التأكد من ثبات جودة الكيماويات (كما هو موصوف فى الخطوة الأولى) تجىء الخطوة الثانية لتتضمن التأكد من ضبط جودة مراحل و ظروف التشغيل ، و ذلك بإجراء بعض الإختبارات فى نقاط محددة (على خطوط الإنتاج) و أوقات معينة (على ظروف التشغيل) و ذلك لضمان عدم حيودها عما هو مخطط لها .

و تشمل الخطوة الثانية حصر مراحل التشغيل على خطوط الإنتاج المختلفة و تسجيل ظروف التشغيل ، ثم وضع الإختبارات التى تجرى على العوامل المختلفة و وضع القيم القياسية للنتائج التى يفترض الحصول عليها من هذه الإختبارات بحيث يمكن إتخاذ التدابير المناسبة (فى حالة الحيود عن تلك القيم القياسية) لتصحيح مسار عمليات التشغيل إلى ما هو مخطط له .

و تم تقسيم هذا القسم إلى بابين مختلفين و هما :

٣ – ٣ – ١ الباب الأول : مراجعة ضبط جودة عمليات التشغيل :

Quality Control Checks

يبدأ هذا الباب بوضع أسس الإختبارات الكيميائية التى تجرى على خطوط التشغيل مثل تعيين تراكيز كربونات الصوديوم و هيدروكسيد الصوديوم (فى محاليل الغليان و المرسرة) و تراكيز هيبوكلوريت الصوديوم و فوق أكسيد الهيدروجين (فى محاليل التبييض) .

ثم إنتقل هذا الباب إلى كيفية إستخدام هذه الإختبارات (و كذلك فحص بعض العوامل الأخرى كدرجات الحرارة و السرعات و الزمن) فى ضبط جودة عمليات التشغيل على خطوط الإنتاج المختلفة .

و نتيجة لإختلاف خطوط الإنتاج و ظروف التشغيل من مصنع لمصنع ، فلقد تم حصر عمليات التشغيل النمطية لمراحل البوش و المعالجات الأولية على بعض الخطوط النمطية فى مصانع النسيج ، و طبقت عليها مبادئ مراجعة ضبط الجودة و ذلك لتكون مثالاً يسترشد به فى هذا المضمار للمصانع المختلفة .

و نورد فيما يلى العوامل المختلفة التى يجب مراجعتها فى كل مرحلة :

٣ – ٣ – ١ – ١ مرحلة البوش : Warp Sizing

تبدأ عملية البوش بطبخ مادة البوش و تحضير خلطة البوش ثم إجراء عملية تبويش السداة .

و لذلك فالعوامل التى يجب مراجعتها هى :

أ – في مرحلة الطبخ :

نوع الخلطة – درجة حرارة و زمن الطبخ ، و درجة حرارة حلة التخزين و لزوجة محلول خلطة البوش .

ب – في مرحلة التبويش :

رقم الماكينة و سرعتها – درجة حرارة خلطة البوش – ضغط درافيل العصر – ضغط البخار فى إسطوانات التجفيف – كمية البوش المضافة للسداة .

و يلاحظ أن القيم القياسية للعوامل السابقة تختلف بإختلاف نوع خلطة البوش و ماكينة التبويش ، ونوع الخيوط المبوشة و لذلك تحديدها يعتمد على الظروف الفعلية فى المصنع .

أما تكرارية مراجعة العوامل السابقة فيجب أن يكون مرة واحدة على الأقل فى الوردية .أما السجل الذى تدون فيه هذه المراجعات (أو القراءات) فتم تسميته بسجل A .

٣ – ٣ – ١ – ٢ المعالجات الأولية للخيوط Cone Pretreatment .

بوضح شكل (١) تتابعاً نمطياً للمعالجات الأولية للخيوط حيث تعبأ الخيوط (على هيئة كونات) فى قزان المعالجات و بنسبة سائل ١ : ١٠ ، حيث يتم دمج مرحلتى الغليان / التبييض فى مرحلة واحدة لمدة ساعة عند ١١٠° م و بالمكونات النمطية التالية :

أ – في حالة الغليان / نصف تبييض :

صودا كاوية	٤ جم / ل .
مادة إبتلال	٢ جم / ل .
فوق أكسيد هيدروجين	٢ جم / ل .

ب – في حالة الغليان / تبييض كامل :

صودا كاوية ٤ جم / ل .
مادة إبتلال ٢ جم / ل .
فوق أكسيد هيدروجين ٤ جم / ل .

ثم يبرد القزان إلى ٧٠° م قبل صرفه ، ثم تخضع المكونات بعد ذلك لثلاث عمليات غسيل ساخنة (عند ٩٠° - ٧٠° - ٥٠° م على التعاقب) و كل منها ١٥ دقيقة ، و بعد ذلك يمكن إجراء عملية التنعيم للخيوط .

و بالتالى فإن العوامل التى يتم مراجعتها (كما هو موضح تحت البند B بملحق ١ بالباب الأول بالقسم الثانى " 1 - 2 ") هى تراكيز كل من هيدروكسيد الصوديوم و فوق أكسيد الهيدروجين فى حالتى نصف التبييض و التبييض الكامل و درجة حرارة و زمن التشغيل ، و ذلك بالقيم القياسية الواردة ، و كذلك فحص درجة حرارة وزنى تشغيل عمليات الغسيل الثلاث ، و ذلك بتكرارية مرة واحدة على الأقل فى الوردية على أن تسجل البيانات فى السجل B .

٣ - ٣ - ١ - ٣ المعالجات الأولية لأقمشة التريكو على الأوناش أو الجيتات :

Pretreatment of Knitted Fabrics on Winches or Jets :

يوضح شكل (٢) تتابعاً نمطياً للمعالجات الأولية لأقمشة التريكو على الأوناش أو الجيتات ، حيث يجرى أولاً دمجا لعمليتى الغليان / نصف التبييض (عند ٩٥° - ١٠٠° م / ٩٠ ق) بإستخدام تركيبة ١ Formula 1 التالية :

هيدروكسيد الصوديوم	٣,٥	جم / ل .
مادة إبتلال	١	جم / ل .
فوق أكسيد الهيدروجين (٥٠ %)	٣	جم / ل .
مثبت عضوى	١	جم / ل .

ثم تجرى عملية تعويم (١٠ دقائق) و غسيل ساخن (٩٠° م / ٢٠ دقيقة) ثم عملية تبييض كامل / مظهر ضوئى (عند ٩٥ - ١٠٠° م / ٩٠ ق) بإستخدام تركيبة ٢ (Formula 2) التالية :

هيدروكسيد الصوديوم	١,٥	جم / ل .
مادة إبتلال	١	جم / ل .
فوق أكسيد هيدروجين	٥	جم / ل .
مثبت عضوى	١,٥	جم / ل .
مظهر ضوئى	٠,٥	جم / ل .

بعد ذلك تجرى عملية غسيل ساخن (٦٠°م / ٢٠ ق) ثم عملية تنعيم .

و بالتالى فإن العوامل التى يتم مراجعتها (بند ٢ / الباب الأول / القسم الثانى " 1 - 2 ") هى تركيز فوق أكسيد الهيدروجين و درجة حرارة خطوتى نصف التبييض و التبييض الكامل ، إضافة للأس الهيدروجينى للتبييض الكامل ، ودرجة حرارة التقييم ، و السجل المستخدم هو سجل C ، و تكرارية المراجعة مرة على الأقل / وردية .

٣ - ٣ - ١ - ٤ الطرد المركزى - التجفيف - و الكى لأقمشة التريكو :

Centrifugation , Drying and Calendering of Knitted Fabrics :

العوامل التى يجب مراعاتها فى هذه الحالة (بندى E - D بالباب الأول القسم الثانى " 1 - 2 ") هى زمن الطرد المركزى و سرعة القماش فى المجفف و درجة حرارته و ضغط بخار إسطوانات

الكى ، و بالقيم القياسية الموضحة (أو بقيم قياسية أخرى ملاءمة حسب نوعية الماكينـــات و ظـــروف المصنع) و يتم التسجيل فى سجل D و بتكرارية مرة على الأقل / وردية .

٣ – ٣ – ١ – ٥ تبييض الأقمشة المنسوجة على هيئة حبل على خط جاستون كاونتى :
Bleaching on Gaston County Range (Woven Fabric / Rope Form):

يوضح شكل (٣) تتابعاً نمطياً لمراحل المعالجات الأولية للأقمشة المنسوجة (على هيئة حبل) علـــى خط جاستون كاونتى ، حيث تبدأ المعالجات بإزالة النشا بالأنزيم و ذلك بتشبيع الأقمشة بمحلول الأنزيـــم (٦٥° – ٧٠° م) و ذلك بتركيبة ١ Formula 1 التالية .

أنزيم كميلاز	٤ جم / ل .
مادة إبتلال	٢ جم / ل .
كلوريد صوديوم	٢ جم / ل .
حمض خليك	١ مل / ل .

ثم تخزن الأقمشة فى غرف مبطنة بالقيشانى لمدة ١٨ – ٢٤ ساعة عند ٤٠° م و تعطى بعـــد ذلـــك غسيلاً ساخناً (٩٠°م / ٢٠ دقيقة) ، ثم تعطى الأقمشة خطوة الغليان بتشـــبيعها أولاً فـــى تركيبـــة ١ Formula 1 التالية :

صودا كاوية	٢٤ – ٢٦ جم / ل .
أسبيكون ١٠٣٠	٢ جم / ل
ريدكتول KB	٢ جم / ل

ثم تخزن الأقمشة فى صندوق جيه J – Box (٩٥° – ١٠٠° م / ٢,٥ ساعة) لإســـتكمال عمليـــة الغليان ، ثم تغسل على الساخن (٩٠° م / ٢٠ دقيقة) ثم على البارد (٢٠ ق) ثم يجرى لها عمليـــة نصف تبييض بتشبيعها أولاً بالتركيبة ٣ (Formula 3) التالية :

فوق أكسيد هيدروجين (٣٥%)	٧,٥ – ٨ جم / ل .
مثبت عضوى	١ جم / ل .
سليكات صوديوم	٣ جم / ل .
هيدروكسيد صوديوم	٥ جم / ل .

يلى ذلك التخزين فى صندوق جيه (٩٥° – ١٠٠° م / ٢,٥ ساعة) ثم غسيل ســـاخن (٩٠° م / ٢٠ دقيقة) فغسيل بارد (٢٠ دقيقة) ، و بعد ذلك تجرى عملية التبييض الكـــامل بتشـــبيعها بتركيبـــة ٤ (Formula 4) التالية :

فوق أكسيد هيدروجين	١٠ – ١٢ جم / ل .
مثبت عضوى	٢ جم / ل .
سليكات صوديوم	٢ جم / ل .
هيدروكسيد صوديوم	٣ جم / ل .

ثم تخزن فى صندوق جيه (٩٥° – ١٠٠° م / ٢,٥ ساعة) ، ثم تغسل على الساخن و على البـــارد ، و تجفف على مجففات شجرة .

و بالتالى فالعوامل التى يتم مراجعتها (بند F فى قسم 1 – 2) يتم تقسيمها طبقاً للمعالجات الأولية كما يلى :

أ – إزالة البوش بالأنزيم :

الأس الهيدروجينى – درجة حرارة محلول الأنزيم – إختبار اليود للأقمشة المزال منها البوش.

ب – الغليان :

تركيز هيدروكسيد الصوديوم فى حمام التشبيع و درجة حرارة صندوق جيه و ضغط البخار .

جـ – نصف التبييض :

تركيز فوق هيدروكسيد الصوديوم فى حمام التشبيع و درجة حرارة صندوق جيه و ضغط البخار .

ء – التبييض الكامل :

كما فى نصف التبييض .

هـ – التجفيف :

ضغط البخار و درجة الحرارة و زمن التجفيف .

أما القيم القياسية فهى تلك المنشقة من على خط التبييض ، و المدونة فى أماكنها المخصصة ، و بتكرارية مرة على الأقل فى الوردية ، و تسجل فى سجل F .

٣ – ٣ – ١ – ٦ المعالجات الأولية للأقمشة المنسوجة على الجيجرات (إزالة بوش بالأنزيم) :
Pretreatment on Jiggers for Woven Fabrics (Enzymatic Desizing) :

يوضح شكل (٤) تتابعاً نمطياً للمعالجات الأولية للأقمشة المنسوجة على الجيجرات (إزالة بوش بالأنزيم) بإستخدام نسبة محلول ١ : ٣ ، حيث تبدأ المعالجات بإزالة البوش بالأنزيم (٧٠° م / ٣٠ دقيقة) ثم عملية الغليان (٩٠° – ١٠٠° م / ٩٠ دقيقة) بإستخدام التركيبة التالية :

صودا كاوية	١٥ جم / ل .
سليكات الصوديوم	٦ جم / ل .
أسبيكون ١٠٣٠	١ جم / ل .
فوق أكسيد هيدروجين (٣٥%)	٥ جم / ل .

و ذلك عند ٩٥° – ١٠٠° م / ٣٠ دقيقة) ، يلى ذلك غسلتان ساخنتان (٩٠°م / ٣٠ دقيقة) ثم تتعيم و تجفيف .

و بناء على ذلك فالعوامل التى يتم مراجعتها (بند G قسم 1– 2) هى كما يلى :

أ – إزالة البوش بالأنزيم :

الأس الهيدروجينى – درجة الحرارة – إختبار اليود للأقمشة المعالجة .

ب – الغليان :

تركيز الصودا الكاوية و درجة الحرارة و درجة إبتلال الأقمشة المعالجة .

جـ– التبييض بالهيبو كلوريت :

تركيز الكلور الحر .

ء – التبييض بفوق أكسيد الهيدروجين :

تركيز فوق أكسيد الهيدروجين – درجة الحرارة – الأس الهيدروجينى .

و القيم القياسية للعوامل السابقة موضحة بالبند G بقسم 1 – 2 و هـى مشـتقة مـن شـكل (٤) و تكرارية المراجعة مرة على الأقل فى الوردية و تسجيل بالسجل G .

٣ – ٣ – ١ – ٧ المعالجات الأولية للأقمشة المنسوجة على الجيجرات (إزالـة البـوش بـالعوامل المؤكسدة):

Pretreatment on Jiggers for Woven Fabrics (Oxidative Desizing) :

يوضح شكل (٥) تتابعاً نمطياً للمعالجات الأولية للأقمشة المنسوجة على الجيجرات (إزالـة بـوش بالعوامل المؤكسدة) و بنسبة محلول ١ : ٣ ، حيث تبدأ المعالجات بغسيل علـى السـاخن (١٠٠° م / ٣٠ دقيقة) ثم خطوة مدمجة لإزالة البوش / الغليان (عند ٧٠° م – / ٦٠ دقيقة ثـم عنـد ١٠٠° م / ٦٠ دقيقة) بإستخدام التركيبة ١ (Formula 1) التالية :

لينونيل EB	٢,٢٣ جم / ل .
أسبيكون ١٠٣٠	١ جم / ل .
صودا كاوية	١٥ جم / ل .

يلى ذلك خطوتان للغسيل الساخن (١٠٠° م / ٣٠ دقيقة) ، ثم نضف تبييض (١٠٠° م / ٣٠ دقيقـة) باستخدام تركيبة ٢ (Formula 2) التالية :

صودا كاوية	٢ جم / ل
سليكات صوديوم	٦ جم / ل .
اسبيكون ١٠٣٠	١ جم / ل .
فوق أكسيد هيدروجين (٥٠%)	٥ جم / ل .

يلى ذلك غسلة ساخنة (١٠٠° م / ٣٠ دقيقة) فأخرى باردة (٣٠ دقيقة) ثم يمكن بعد ذلك إعطـاء القماش خطوة تبييض كامل بإستخدام التركيبة :

صودا كاوية	٣ جم / ل
سليكات صوديوم	٩ جم / ل .
اسبيكون ١٠٣٠	١ جم / ل .
فوق أكسيد هيدروجين	٨ جم / ل .

لمدة ٣٠ دقيقة عند ٩٥° م ، يلى ذلك غسيل ساخن (٩٥° م / ٣٠ دقيقة فغسيل بـارد (٣٠ دقيقـة و ينعم القماش و يجفف .

– و بالتالي فالعوامل التي يتم مراجعتها (بند H قسم 1– 2) هي كما يلي :

أ – إزالة بالأكسدة / الغليان :

" درجة حرارة / زمن " المرحلة الأولى " درجة حرارة / زمن " المرحلة الثانيـة و تركـيز الصـودا الكاوية .

ب – نصف التبييض :

الأس الهيدروجينى و تركيز فوق أكسيد الهيدروجين و درجة الحرارة .

جـ – التبييض الكامل :

كما فى نصف التبييض .

و كذلك فإن القيم القياسية لهذه العوامل مذكورة بالبند H بالقسم 1 – 2 ، علمـا بـأن تكراريـة المراجعة مرة على الأقل بالوردية و تسجل البيانات بالسجل H .

٣ – ٣ – ١ – ٨ المرسرة : Mercerization

العوامل التى من المهم مراجعتها فى عملية المرسرة هى تركيز الصودا الكاوية (٢٧٠–٣٠٠ جم/ل) و السرعة و زمن المعالجة ، و القيم القياسية للعاملين الأخيرين تعتمد على نوعية ماكينة المرسرة المتاحة بكل مصنع .

و كما سبق القول فتكرارية المراجعة هى مرة على الأقل فى الوردية و تسجل فى سجل I .

٣ – ٣ – ٢ الباب الثانى : نماذج لسجلات ضبط جودة عمليات التشغيل :
Records for Process Control Checks :

إشتمل هذا الباب على نماذج السجلات المعنية بضبط جودة عمليات التشغيل ، و أعطى كل سجل أسما على هيئة حرف ، و يحتوى على التاريخ و الوردية و أسم المراجع ، و كذلك يحتوى على وقت المراجعة و رقم الصنف / و رقم اللوط و الماكينة أو خط التشغيل ، و يضم أيضا كافة العوامل التى سبق مناقشتها فى الباب الأول من هذا القسم ، و به خانة للملاحظة فى حالة حيود القيم المراجعة عن القيم القياسية ، ذلك حتى يتسنى إبلاغها للمختص لإتخاذ التدابير اللازمة لضبط عمليات التشغيل حسب المواصفات القياسية المتفق عليها .

و يحتوى هذا الباب على السجلات الآتية :

السجل	مرحلة التشغيل
A – 1	طبخ البوش
A – 2	عملية التبويش
B	المعالجات الأولية للخيوط
C	المعالجات الأولية لأقمشة التريكو على الأوناش و الجيتات
D	الطرد المركزى – التجفيف و الكى لأقمشة التريكو .
F	المعالجات الأولية للأقمشة المنسوجة على خط جاستون كاونتى .
G	المعالجات الأولية للأقمشة المنسوجة على الجيجرات (إزالة بوش بالأنزيم)
H	المعالجات الأولية للأقمشة المنسوجة على الجيجرات (إزالة بوش بالعوامل المؤكسدة)
I	المرسرة .

٣ – ٤ القسم الثالث : الإختبارات الكيميائية و الميكانيكية للغزول و الأقمشة :
Chemical and Mechanical Testing of Yarns and Fabrics :

كما سبق القول فإن هذا القسم يعنى بإختبار المواد الخام (غزول و أقمشة) و المنتجات النهائية (غزول و أقمشة أيضا) و تم تقسيم هذه الإختبارات إلى قسمين ، إختبارات كيماوية و أخرى ميكانيكية ، و هى كلها إختبارات قياسية واسعة الإنتشار ، و ليس بالضرورة إجراء كل هذه الإختبارت بالمصانع ، و أنما يمكن إجراء بعضها (السهل و المتاح) فى المصانع ، أما البعض الأخر (الأكثر تعقيدا) فيمكن إجراؤه فى معامل الإختبارات المعترف بها مثل المركز القومى للبحوث و مصلحة الكيمياء و صندوق دعم القطن و غير ذلك من المعامل ، و لكن إذا توفرت الإمكانيات فإنه من المستحب إجراء هذه الإختبارات بالمصانع .

و سواء أجريت هذه الإختبارات بالمصنع أو فى جهة خارجية عنه ، فإنه من المهم أن يلم قسم ضبط الجودة بهذه الإختبارات القياسية و حدودها ، و لذلك فإن الطرق القياسية لإجراء هذه الإختبارات مذكورة بالكامل فى القسم الثالث من ملف ضبط الجودة ، و عند إعداد ملف ضبط الجودة الخاص بمصنع ما ، فإن الإختبارات التى تجرى بالمصنع فقط هى التى يتم ذكرها ، أما تلك التى يتم إجراؤها خارجة فينوه عن الجهة المتعاقد معها .

و فيما يلى نبذة عن الإختبارات المذكورة بالقسم الثالث من ملف ضبط الجودة .

٣ – ٤ – ١ الإختبارات الكيماوية: Chemical Testing

و هذه مستخرجة من " AATCC Technical Manual " و تضم الإختبارات القياسية التالية :

١ – التحليل الكيماوى للألياف لمعرفة نسبة إحتوائها على السليلوز فى خلطاته مع الألياف الأخرى (مثل الصوف – بولى أستر – نايلون أكريليك ...) .

٢ – تحديد نوع مادة البوش على الأقمشة الخام و ذلك لمعرفة أنسب طرق إزالة البوش منها .

٣ – المرسرة فى القطن :
لمعرفة هل الغزول أو الأقمشة (سواء مواد خام أو منتجات نهائية) قد تمت مرسرتها أم لا ، و هل تلك المرسرة كاملة أم ناقصة .

٤ – قابلية الأقمشة للإمتصاص :
للحكم على عمليات الغليان ، و لتحديد صلاحية الغزول و الأقمشة للعمليات اللاحقة كالصباغة و التجهيز .

٥ – الأس الهيدروجينى للمستخلص المائى للأقمشة المبيضة و ذلك لمعرفة مدى صلاحيتها للإستخدام الآدمى ، و كذلك تداخلها مع عمليات الصباغة و التجهيز .

٦ – تقدير درجة بياض الأقمشة للحكم على عمليات التبييض .

٣ – ٤ – ٢ الإختبارات الميكانيكية : Mechanical Testing

و هذه مستخرجة من ASTM و قليل منها من " AATCC Technical Manual " و تضم الإختبارات القياسية التالية :

١ – تحديد نمرة الخيوط .

٢ – تحديد متانة الخيوط .

٣ – تحديد عدد خيوط السداة و اللحمة لكل وحدة أطوال فى الأقمشة المنسوجة .

٤ – تحديد وزن وحدة المساحات للأقمشة المنسوجة .

٥ – المواصفات القياسية لأقمشة التريكو .

٦ – قوة القطع و إستطالة القطع للأقمشة المنسوجة .

٧ – مقاومة التمزق للأقمشة المنسوجة بطريقة المندروف .

٨ – مقاومة البرى للأقمشة .

٩ – قوة الإنفجار لأقمشة التريكو و الأقمشة غير المنسوجة .

Designation: D 3775 – 85 (Reapproved 1990)

Standard Test Method for Fabric Count of Woven Fabric[1]

This standard is issued under the fixed designation D 3775; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method covers the measurement of fabric count and is applicable to all types of woven fabrics.

NOTE 1—Other test methods for the measurement of fabric construction characteristics include the following:
D 3773 Test Methods for Length of Woven Fabric[2]
D 3774 Test Methods for Width of Woven Fabric[2]
D 3776 Test Methods for Mass Per Unit Area (Weight) of Woven Fabric[2]
D 3882 Test Method for Bow and Skewness in Woven and Knitted Fabrics[2]
D 3883 Test Method for Yarn Crimp or Yarn Takeup in Woven Fabrics[2]

1.2 *This standard does not purport to address the safety problems associated with its use. It is the responsibility of whoever uses this standard to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*
D 123 Terminology Relating to Textiles[3]
D 1776 Practice for Conditioning Textiles for Testing[3]
2.2 *Other Standard:*
MIL-STD-105D Sampling Procedures and Tables for Inspection by Attributes[4]

3. Terminology

3.1 *Definitions:*
3.1.1 *count, n—in woven textiles*, the number of warp yarns (ends) and filling yarns (picks) per unit distance as counted while the fabric is held under zero tension, and is free of folds and wrinkles.
3.2 For definitions of other textile terms used in this test method, refer to Terminology D 123.

4. Summary of Test Method

4.1 The number of warp yarns (ends) per unit distance and filling yarns (picks) per unit distance are determined using suitable magnifying and counting devices or by ravelling yarns from fabrics.

5. Significance and Use

5.1 This test method is considered satisfactory for acceptance testing of commercial shipments because of prior extensive use.

5.1.1 In case of a dispute arising from differences in reported test values when using Test Method D 3775 for acceptance testing of commercial shipments, the purchaser and the supplier should conduct comparative tests to determine if there is a statistical bias between their laboratories. Competent statistical assistance is recommended for the investigation of bias. As a minimum, the two parties should take a group of test specimens which are as homogeneous as possible and which are from a lot of material of the type in question. The test specimens should then be randomly assigned in equal numbers to each laboratory for testing. The average results from the two laboratories should be compared using Student's *t*-test for unpaired data and an acceptable probability level chosen by the two parties before testing is begun. If a bias is found, either its cause must be found and corrected or the purchaser and the supplier must agree to interpret future test results in the light of the known bias.

6. Apparatus

6.1 Use any suitable magnifying and counting device (such as pick glass, rule and pointer, microfilm reader, or projection equipment).
6.2 Use a rule to measure the length of fabric to be ravelled for a count of yarns.

7. Sampling

7.1 *Lot Sample*—As a lot sample for acceptance testing, take at random the number of rolls of fabric as directed in an applicable material specification or other agreement between the purchaser and the supplier, such as agreement to use MIL-STD-105D. Consider rolls of fabric to be the primary sampling units.
7.2 *Laboratory Sample*—As a laboratory sample, take a full width swatch at least 2 m (2 yd) long from each roll of fabric in the lot sample. Consider each point at which fabric counts are made as a test specimen.

NOTE 2—For specimens not obtained as directed in Section 7, the results should not be used for acceptance testing of a lot.

8. Conditioning

8.1 Condition specimens as directed in Practice D 1776.
8.2 Fabrics woven from yarns having a relatively low moisture regain in the standard atmosphere for testing

[1] This test method is under the jurisdiction of ASTM Committee D-13 on Textiles and is the direct responsibility of Subcommittee D13.59 on Fabric Test Methods, General.
Current edition approved July 26, 1985. Published September 1985. Replaces sections 28 to 34 of Methods D 1910 – 64 (1975). Originally published as D 3775 – 79. Last previous edition D 3775 – 84.
[2] *Annual Book of ASTM Standards*, Vol 07.02.
[3] *Annual Book of ASTM Standards*, Vol 07.01.
[4] Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

textiles and which are not significantly affected by minor variations in different atmospheric conditions, for example, nylons, acrylics, and polyesters, may be tested without preconditioning. Fabrics woven from yarns composed wholly or in part from wool, rayon, cotton, or acetate are more sensitive to atmospheric changes and must be conditioned prior to testing, except by agreement of all parties interested in the test results.

8.3 When full rolls or bolts of fabric cannot be properly conditioned in a reasonable time with available facilities, perform the test without conditioning and report the actual conditions prevailing at the time of the test. Such results may not correspond with the results obtained after testing in the standard atmosphere for testing textiles.

9. Procedure

9.1 *General:*

9.1.1 Unless otherwise specified in a prior agreement between purchaser and seller, make no count closer to a selvage than one tenth of the width of the fabric, or within 0.5 m (0.5 yd) from the end of the roll or piece.

9.1.2 Where the specimen size is sufficient, count the filling yarns (picks) in at least five different places so as to include as many shuttle changes as possible; if the specimen is not large enough to sample as many as five different shuttle yarns, count the yarns from as many different shuttles as possible. Note this fact on the report.

9.1.3 For fabrics less than 125 mm (5 in.) wide, count all the yarns in the width, including the selvage, and divide by the actual width at that point.

9.1.4 In fancy weaves where one or more yarns do not appear at regular, short intervals, make count measurements over at least one full pattern repeat of each design component.

9.2 *For Fabrics Containing Less Than 1 Yarn Per MM (25 YARNS PER IN.):*

9.2.1 Make the count over a 75-mm (3-in.) width in at least five randomly designated places across the width of the fabric sample. Successive filling yarn (pick) counts should be taken at five different random points along the length of the fabric laboratory sample (see 9.1.2).

9.3 *For Fabrics Containing More Than 1 Yarn Per MM (25 YARNS PER IN.):*

9.3.1 Count the number of yarns in 25 mm (1 in.) of fabric width in at least five randomly designated places across the width of the fabric sample so that a different set of yarns is counted each time. Successive filling yarn (pick) counts should be taken at five different randomly designated points along the length of the fabric laboratory sample (see 9.1.2).

9.4 *Optional Count Procedure*—For fabrics in which individual yarns cannot be readily distinguished for counting in fabric, there are two ways to do this.

9.4.1 Ravel a piece of fabric parallel to the direction to be counted to get a straight edge, then ravel and count the yarns in a 25 or 75-mm (1 or 3-in.) strip. Obtain the count in at least five random places across the width of the fabric. Successive filling yarn (pick) counts are to be taken at five different random points along the length of the laboratory sample (see 9.1.2).

9.4.2 The other procedure is to straight edge the fabric perpendicular to the direction to be counted, mark off the length in which the number of yarns is to be counted and then count the number of protruding yarns between the two marks.

10. Calculation

10.1 In both warp and filling counts, calculate the fabric count as the average of all observations made in integral units.

11. Report

11.1 State that the specimens were tested as directed in Test Method D 3775. Describe the material or product sampled and the method of sampling used.

11.2 Report the following information:

11.2.1 Average number of warp ends and filling picks per 25 mm (or per in.) calculated to the nearest individual yarn; stating the warp count first thus:

$$\text{Fabric Count} = 100 \times 40$$

(The result is to be read as "one hundred by forty" not as 4000.)

11.2.2 Size of the pattern repeat, size of each design component in the pattern, and the total yarns in each measured component for fabrics having fancy weaves,

11.2.3 Number of shuttle changes sampled if less than five, and

11.2.4 Atmospheric conditions under which the tests were conducted and whether the specimens were conditioned as directed in Practice D 1776.

12. Precision and Bias

12.1 *Summary*—In comparing two averages of five observations when measuring the warp or filling count of a woven fabric, the difference should not exceed about 0.42 ends or picks/in. in 95 out of 100 cases when all the observations were taken by the same well-trained operator using the same piece of equipment and specimens randomly drawn from the same sample of material. Larger differences are likely under all other circumstances. The procedure in Test Method D 3775 for counting ends and picks has no known bias and is used as a referee method.

12.2 *Interlaboratory Test Data*[5]—An interlaboratory test was run in 1981 in which randomly drawn specimens of four materials were tested in each of four laboratories. Two operators in each laboratory each tested two specimens of each material for both warp count and filling count. The first fabric was a 65 % polyester and 35 % cotton seersucker type basket weave. The second fabric was a 65 % polyester and 35 % cotton gingham check. The third fabric was an 88 % cotton and 12 % polyester corduroy. The fourth fabric was a 100 % cotton denim. Warp counts ranged from about 50 to 130 ends/in., and filling counts ranged from about 50 to 125 picks/in. The components of variance for warp count and for filling count expressed as standard deviations were calculated to be as follows:

[5] Supporting data are available on loan from ASTM Headquarters. Request RR: D-13-1067.

	Single-Operator Component	Within-Laboratory Component	Between-Laboratory Component
Single Material Comparisons:			
Warp or Filling Counts	0.337	0.000	0.458
Multi-material Comparisons[A]:			
Warp Counts	0.551	0.000	0.383
Filling Counts	0.000	0.000	0.736

NOTE 3—The square roots of the components are being reported to express the variability in the appropriate unit of measure rather than as the square of those units of measure.

12.3 *Precision*—For the components of variance reported in 12.2, two averages of observed values should be considered significantly different at the 95 % probability level if the difference equals or exceeds the critical differences in Table 1.

NOTE 4—The tabulated values of the critical differences should be considered to be a general statement, particularly with respect to between-laboratory precision. Before a meaningful statement can be made about two specific laboratories, the amount of statistical bias, if any, between them must be established with each such comparison being based on recent data obtained on specimens taken from a lot of material of the type being evaluated so as to be as nearly homogeneous as possible and then randomly assigned in equal numbers to each of the laboratories.

TABLE 1 Critical Differences for the Conditions Noted, 95 % Probability Level, Ends or Picks/in.[A]

Number of Observations in Each Average	Single-Operator Precision	Within-Laboratory Precision	Between Laboratory Precision
Single-material Comparison (warp or filling count)			
1	0.93	0.93	1.58
5	0.42	0.42	1.34
10	0.30	0.30	1.30
20	0.21	0.21	1.29
Multi-material Comparison (warp count only)			
1	1.79	1.79	2.08
5	1.58	1.58	1.91
10	1.56	1.56	1.88
20	1.54	1.54	1.87
Multi-material Comparison (filling count only)			
1	0.93	0.93	2.24
5	0.42	0.42	2.08
10	0.30	0.30	2.06
20	0.21	0.21	2.05

[A] The critical differences were calculated using $t = 1.960$ which is based on infinite degrees of freedom.

12.4 *Bias*—Test Method D 3775 for counting ends and picks in woven fabrics has no known bias and is used as a referee method.

13. Keywords

13.1 construction; woven fabric

[A] The single-operator components for multi-material comparisons are in addition to the single-operator components for single-material comparisons and are not reduced by replication.

Designation: D 3776 – 85 (Reapproved 1990)

Standard Test Methods for Mass Per Unit Area (Weight) of Woven Fabric[1]

This standard is issued under the fixed designation D 3776; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 These test methods cover the measurement of fabric mass per unit area (weight) and are applicable to all woven fabrics.

NOTE 1—Other test methods for the measurement of fabric construction characteristics include the following:

D 3773 Test Methods for Length of Woven Fabric[2]
D 3774 Test Methods for Width of Woven Fabric[2]
D 3775 Test Method for Fabric Count of Woven Fabric[2]
D 3882 Test Method for Bow and Skewness in Woven and Knitted Fabrics[2]
D 3883 Test Method for Yarn Crimp or Yarn Takeup in Woven Fabrics[2]

1.2 There are four approved procedures as follows:
1.2.1 *Option A*—Full Piece, Roll, Bolt or Cut (Section 7).
1.2.2 *Option B*—Full Width Sample (Section 8).
1.2.3 *Option C*—Small Swatch of Fabric (Section 9).
1.2.4 *Option D*—Narrow Fabrics (Section 10).

1.3 *This standard does not purport to address the safety problems associated with its use. It is the responsibility of whoever uses this standard to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*
D 123 Terminology Relating to Textiles[3]
D 1776 Practice for Conditioning Textiles for Testing[3]
D 3773 Test Methods for Length of Woven Fabric[2]
D 3774 Test Methods for Width of Woven Fabric[2]
2.2 *Other Standard:*
MIL-STD-105D Sampling Procedures and Tables for Inspection by Attributes[4]

3. Terminology

3.1 *Definitions:*
3.1.1 *weight, n—as used with fabrics*, mass per unit area.
3.1.1.1 *Discussion*—Fabric mass per unit area is expressed either as grams per square metre (ounces per square yard), or grams per linear metre (ounces per linear yard). Fabric mass is also sometimes expressed inversely as linear metres per kilograms (yards per pound) with the fabric width stated.

3.2 For definitions of other textile terms used in these test methods, refer to Terminology D 123.

4. Summary of Test Methods

4.1 Fabric mass is calculated from the weight of a sample, the length and width of which have been measured as directed in one of the procedures in Test Methods D 3773 and D 3774.

5. Apparatus

5.1 *Scale*, with a capacity and sensitivity sufficient to weigh the full piece, roll, bolt, or cut units to within ±0.1 % of their gross weight. The accuracy of the scale should be certified by a recognized authority.

5.2 *Balance*, having a capacity and sensitivity to weigh within ±0.1 % of the weight of the specimens being tested.

5.3 *Cutting Die*, either square or round with an area of at least 13 cm^2 or 4 $in.^2$.

6. Conditioning

6.1 Condition test specimens as directed in Practice D 1776.

6.2 All weighing tests should be made in the standard atmosphere for testing textiles after the specimens have been conditioned in the same atmosphere unless it is impractical to condition the specimens in Option A or if nonconditioned testing is agreed upon by the purchaser and seller. When the full rolls or bolts of fabric cannot be properly conditioned in a reasonable time with available facilities, perform the tests without conditioning and report the actual conditions prevailing at the time of the test. Such results may not correspond with the results obtained after testing adequately conditioned specimens in the standard atmosphere for testing textiles.

7. Option A—Full Piece, Roll, Bolt, or Cut

7.1 *Uses and Significance*—Option A for the determination of mass per unit area of woven fabrics may be used for acceptance testing of commercial shipments since it has been used extensively in the trade.

7.1.1 In case of a dispute arising from differences in reported test values when using Test Methods D 3776 for acceptance testing of commercial shipments, the purchaser and the supplier should conduct comparative tests to determine if there is a statistical bias between their laboratories. Competent statistical assistance is recommended for the investigation of bias. As a minimum, the two parties should take a group of test specimens which are as homogeneous as possible and which are from a lot of material of the type in question. The test specimens should then be randomly

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[1] These test methods are under the jurisdiction of ASTM Committee D-13 on Textiles and are the direct responsibility of Subcommittee D13.59 on Fabric Test Methods, General.

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[2] *Annual Book of ASTM Standards*, Vol 07.02.

[3] *Annual Book of ASTM Standards*, Vols 07.01.

[4] Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

assigned in equal numbers to each laboratory for testing. The average results from the two laboratories should be compared using student's t-test for unpaired data and an acceptable probability level chosen by the two parties before testing is begun. If a bias is found, either its cause must be found and corrected or the purchaser and the supplier must agree to interpret future test results in the light of the known bias.

7.2 *Sampling*—As a lot sample for acceptance testing, take at random the number of rolls of fabric as directed in an applicable material specification or other agreement between the purchaser and the supplier, such as agreement to use MIL-STD-105D. Consider rolls of fabric to be the primary sampling units. Consider the rolls of fabric in the lot sample as the laboratory sample and as the test specimens.

7.3 *Procedure:*

7.3.1 Measure the length of the full piece, roll, bolt, or cut by the hand procedure in Test Methods D 3773.

7.3.2 Measure the width by the tension-free alternative of Option A of Test Methods D 3774.

7.3.3 Weigh the fabric, with shell and holder, if any, to the nearest 0.1 % of its weight.

7.3.4 Weigh the holder, if any, to the nearest 0.1 % of its weight.

7.4 *Calculations:*

7.4.1 Determine the net weight of the fabric by subtracting the weight of the holder from the total weight.

7.4.2 Calculate the mass per unit area, mass per linear yard, or linear yards per pound to three significant figures, unless otherwise specified, using Eq 1, 2, 3, or 3a, as follows:

Mass per unit area:

$$\text{oz/yd}^2 = 576M/LW' \quad (1)$$

Mass per yard:

$$\text{oz/yd} = 16M/L \quad (2)$$

Linear yards per pound:

$$\text{yd/lb} = L/M \quad (3)$$

$$\text{yd/lb} = 16 \text{ oz/yd} \quad (3a)$$

where:

M = mass of fabric, in pounds,
L = length of fabric, in yards, and
W' = width of fabric, in inches.

7.4.3 If preferred, convert the U.S. customary units to SI units using Eq 4, 5, or 6, as follows:

$$\text{Mass, g/m}^2 = \text{oz/yd}^2 \times 33.906 \quad (4)$$

$$\text{Mass, g/m} = \text{oz/yd} \times 31.000 \quad (5)$$

$$\text{m/kg} = \text{yd/lb} \times 2.016 \quad (6)$$

7.4.4 Alternatively, dimensions and mass may all be determined in SI units and mass per unit area calculated using Eq 7, 8, or 9, as follows:

$$\text{g/m}^2 = 10^3M/LW' \quad (7)$$

$$\text{g/m} = 10^3M/L \quad (8)$$

$$\text{m/kg} = L/M \quad (9)$$

where:

M = mass of fabric, in kilograms,
L = length of fabric, in metres, and
W' = width of fabric, in metres.

8. Option B—Full Width Sample

8.1 *Uses and Significance:*

8.1.1 This procedure is applicable to a full-width sample cut from a full piece, roll, bolt, or cut. Unless otherwise specified, these results will include selvages and will be on the basis of conditioned fabric.

8.1.2 Option B is not recommended for the acceptance testing of commercial shipments, since Option A is regularly used for that purpose.

8.2 *Sampling:*

8.2.1 *Lot Sample*—As a lot sample for acceptance testing, take at random the number of rolls of fabric as directed in an applicable material specification or other agreement between the purchaser and the supplier, such as agreement to use MIL-STD-105D. Consider the roll of fabric to be the primary sampling units.

8.2.2 *Laboratory Sample*—From each roll or piece in the lot sample, cut—don't tear—at least one laboratory sample the full width of the fabric and at least 250 mm (10 in.) in length. The cut edges must be a straight line, free of indentations or bulges, unless both edges have been made to trace parallel filling yarns. In this procedure the complete laboratory sample is used as the specimen.

8.3 *Procedure:*

8.3.1 Measure the length of the conditioned specimen by the hand procedure of Test Methods D 3773.

8.3.2 Measure the width by the tension-free alternative of Option A of Test Methods D 3774.

8.3.3 Weigh the specimen in grams on a scale or balance to the nearest 0.1 % of its weight.

8.4 *Calculations:*

8.4.1 Calculate the mass per unit area, mass per linear yard, or linear yards per pound to three significant figures, unless otherwise specified, using Eq 10, 11, 12, or 12a, as follows:

Mass per unit area:

$$\text{oz/yd}^2 = 45.72G/L_sW' \quad (10)$$

Mass per linear yard:

$$\text{oz/yd} = 1.27G/L_s \quad (11)$$

Linear yards per pound:

$$\text{yd/lb} = 16/\text{oz per linear yd} \quad (12)$$

$$\text{yd/lb} = 12.6L_s/G \quad (12a)$$

where:

G = mass of specimen, in grams,
L_s = length of specimen, in inches, and
W' = width of specimen, in inches.

8.4.2 If preferred, convert the U.S. customary units to SI units using Eq 4, 5, or 6 in 7.4.3.

8.4.3 Alternatively, dimensions and mass may all be determined in SI units and calculated using Eq 13, 14, or 15, as follows:

Mass per unit area:

$$\text{g/m}^2 = 10^6G/L_sW' \quad (13)$$

Mass per linear metre:

$$\text{g/m} = 10^3G/L_s \quad (14)$$

Linear metres per kilogram:

$$\text{m/kg} = L_s/G \quad (15)$$

nent to the nearest whole number of loops.

12.7 *Calculations*—Calculate the average number of wale loops and course loops to the nearest 0.3 loop per cm (0.1 loop per inch).

12.8 *Report:*

12.8.1 State that the specimens were tested as directed in ASTM Specification D 3887. Describe the material or product sampled and the method of sampling used.

12.8.2 Report the following information:

12.8.2.1 Average number of wale loops and course loops per 2.5 cm (or per in.) calculated to the nearest individual yarn: stating the wale loop count first.

12.8.2.2 Size of the pattern repeat, size of each design component in the pattern, and the total yarns in each measured component for fabrics having fancy knits.

12.8.2.3 Ambient temperature and relative humidity conditions under which the tests were conducted and whether the specimens were conditioned as directed in Section 7.

12.9 *Precision and Accuracy:*

12.9.1 *Precision*—The precision of this method for counting wale loops and course loops in knitted fabrics is being established.

12.9.2 *Accuracy*—This method for counting wale loops and course loops in knitted fabrics has no known bias and is used as a referee method.

13. Bursting Strength

13.1 Determine the bursting strength of at least five specimens as directed in Test Method D 3786 using the diaphragm bursting strength tester or Test Method D 3787 using the CRT ball burst tester as agreed between all interested parties. In the case of controversy, the CRT ball burst tester method in Test Method D 3787 shall prevail.

13.1.1 The specimens may be tested under prevailing atmospheric conditions, except in the settlement of a dispute. In the latter case, tests shall be made on specimens conditioned as described in Section 7.

13.1.2 Calculate the arithmetic mean of the results of the ive tests as the average bursting strength of the fabric.

NOTE 4—There is no overall correlation between the results obtained with the CRT machine equipped with a bursting strength attachment nd the diaphragm bursting tester. Consequently, these two bursting testers cannot be used interchangeably.

14. Extractable Matter

14.1 Determine the extractable matter of the fabric as directed in Test Method D 2257.

NOTE 5—The bursting strength test specimens may be used for this test.

15. Fiber Composition

15.1 Determine the fiber composition of the fabric as directed in the methods for the quantitative analysis of textiles described in Methods D 629.

CONFORMANCE

16. Conformance

16.1 The purchaser and the seller may agree on a procedure to establish conformance, including control charts furnished by the seller, a sequential-sampling plan, or the double-sampling plan outlined in 16.2.

16.2 In the absence of a control-chart or sequential-sampling plan, proceed as directed in 16.3 through 16.5.

16.3 If the test results for the lot conform to the requirements for all characteristics specified in 4.1, consider the lot a valid delivery.

16.4 If the test results for one or more characteristics do not conform to the requirements, take a new laboratory sample from either the original lot sample or a new lot sample. Test the new sample for the characteristic(s) that did not conform to the requirements in the first test, and average the results of the first and second samples as if all results were from one test of double the original number of specimens. If the new average(s) conform(s) to the specified requirements, consider the lot a valid delivery.

16.5 If the test results obtained as directed in 16.4 do not conform to the specified requirements, consider the lot a nonvalid delivery.

17. Indexing Terms

17.1 This standard is indexed under the following terms: knitted fabric yield, mass, width, length, construction, bursting strength, extractable matter, and fiber composition.

where:
G = mass of specimen, in grams,
L_s = length of specimen, in millimetres, and
W = width of specimen, in millimetres.

9. Option C—Small Swatch of Fabric

9.1 *Uses and Significance:*

9.1.1 This procedure is applicable when a small swatch of fabric is sent to the laboratory to be used as the test specimen. The results are considered to be applicable to the sample only and not necessarily to the lot from which the sample was taken.

9.1.2 Measurements by this method do not include selvages and should be reported as such, unless a selvage allowance is specified.

9.1.3 Option C is not recommended for acceptance testing of commercial shipments since Option A is regularly used for that purpose.

9.2 *Sampling*—Since this option is used only when limited fabric is available and should not be used for acceptance sampling, prepare such specimens from small swatches as is possible.

9.3 *Preparation of Specimens*—Prepare a conditioned specimen having an area of at least 130 cm^2 (20 $in.^2$) or a number of smaller die cut specimens taken from different locations in the sample and having a total area of at least 130 cm^2 (20 $in.^2$) Do not take these specimens closer than one tenth of the fabric width to a selvage or cut edge. If insufficient fabric is available to meet these criteria, note that fact in the report.

9.4 *Procedure:*

9.4.1 Determine the area of the specimen(s) used. For die-cut specimens, the area of the die is normally given. For other specimens, multiply the length by the width.

9.4.2 Weigh the specimen(s) to within ±0.1 % of weight on a balance. Specimens of a fabric may be weighed together.

9.5 *Calculations:*

9.5.1 Calculate the weight in ounces per square yard, ounces per linear yard, or linear yards per pound to three significant figures using Eq 10 (8.4.1), 16, or 17, as follows:

Mass per linear yard:

$$\text{oz/yd} = 1.27GW/L_sW_s \quad (16)$$

Linear yards per pound:

$$\text{yd/lb} = 12.6L_sW_s/GW \quad (17)$$

where:
G = mass of specimen, in grams,
W = width of fabric, in inches,
W_s = width of specimen, in inches, and
L_s = length of specimen, in inches.

9.5.2 If preferred convert the U.S. customary units to SI units by using Eq 4, 5, or 6 in 7.4.3.

9.5.3 Alternatively, dimensions and mass may be determined in SI units and calculated using Eq 13 (8.4.3), 18, or 19, as follows:

Mass per linear metre:

$$\text{g/m} = 10^3GW/L_sW_s \quad (18)$$

Linear metre per kilogram:

$$\text{m/kg} = L_sW_s/GW \quad (19)$$

where:
G = mass of specimen, in grams,
W = width of fabric, in millimetres,
L_s = length of specimen, in millimetres, and
W_s = width of specimen in millimetres.

10. Option D—Narrow Fabrics

10.1 *Uses and Significance:*

10.1.1 This procedure is intended for use with narrow fabrics as so designated by the trade. These fabrics are usually 300 mm (12 in.) in width or less, have a selvage on both sides and are woven on multishuttle looms.

10.1.2 Option D is not recommended for acceptance testing of commercial shipments since Option A is regularly used for that purpose.

10.2 *Sampling:*

10.2.1 *Lot Sample*—As a lot sample for acceptance testing, take at random the number of rolls of fabric as directed in an applicable material specification or other agreement between the purchaser and the supplier, such as agreement to use MIL-STD-105D. Consider the rolls of fabric to be the primary sampling units.

10.2.2 *Laboratory Sample*—From each roll or piece in the lot sample, cut a conditioned laboratory sample 1 m ± 3 mm (36.0 ± 0.10 in.) long perpendicular to the selvages. Take a minimum of three such laboratory samples from different places, distributed as evenly as practicable along the length of the roll or piece. In this procedure a complete laboratory sample is used as a specimen.

10.3 *Procedure:*

10.3.1 Measure the width of the fabric to the nearest 1 mm (0.125 in.) by the tension-free alternative of Option A of Test Methods D 3774.

10.3.2 Weigh each specimen to within ±0.1 % of its weight on a scale or balance.

10.4 *Calculations:*

10.4.1 Calculate the average mass as ounces per linear yard or linear yards per pound using Eq 11, 12, or 12a from 8.4.1.

10.4.2 If preferred, convert the U.S. customary units to SI units using Eq 5 or 6 in 7.4.3.

10.4.3 If all measurements are made in SI units, use Eq 14 or 15 in 8.4.3.

11. Report

11.1 State that the tests were made as directed in Option A (or B or C or D) in Test Methods D 3776. Describe the material or product sampled and the method of sampling used.

11.2 Report the following information:

11.2.1 Option used to measure fabric mass per unit area.

11.2.2 Fabric mass in ounces per square yard, or ounces per linear yard, or in yards per pound, to three significant figures.

11.2.3 Fabric mass in grams per square metre, or grams per linear metre, or metres per kilogram, to three significant figures.

11.2.4 Fabric width if mass is reported as mass per linear metre (yard) or metres per kilogram (yards per pound).

11.2.5 State whether the fabric weight includes or does not include selvages, and

11.2.6 Atmospheric conditions under which the tests were conducted and whether the specimens were conditioned as directed in Practice D 1776.

12. Precision and Bias

12.1 *Summary*—In comparing two averages of four observations when using Option B of Test Methods D 3776, the difference should not exceed the following amounts in 95 out of 100 cases when all of the observations were taken by the same well-trained operator using the same piece of equipment and specimens randomly drawn from the same sample of material:

Seersucker	0.125 oz/yd²
Gingham	0.080 oz/yd²
Corduroy	0.330 oz/yd²
Denim	0.105 oz/yd²

Larger differences are likely under all other circumstances. The procedure in Option B of Test Methods D 3776 has no known bias and is used as a referee method.

12.2 *Interlaboratory Test Data*—An interlaboratory test was run in 1981 in which randomly drawn specimens of four materials were tested in each of four laboratories using Option B of Test Methods D 3776. Two operators in each laboratory each tested two specimens of each material for mass per unit area. The first fabric was a 65 % polyester and 35 % cotton seersucker type basket weave. The second fabric was a 65 % polyester and 35 % cotton gingham check. The third fabric was an 88 % cotton and 12 % polyester corduroy. The fourth fabric was a 100 % cotton denim. The components of variance for fabric mass per unit area expressed as standard deviations were calculated to be as follows:

	Average Mass per Unit Area	Single-Operator Component	Within-Laboratory Component	Between-Laboratory Component
Seersucker	6.11 oz/yd²	0.091	0.000	0.023
Gingham	2.90 oz/yd²	0.029	0.000	0.031
Corduroy	10.42 oz/yd²	0.119	0.073	0.082
Denim	7.45 oz/yd²	0.038	0.000	0.066

NOTE 2—The square roots of the components are being reported to express the variability in the appropriate unit of measure rather than as the square of those units of measure.

12.3 *Precision*—For the components of variance reported in 12.2, two averages of observed values should be considered significantly different at the 95 % probability level if the difference equals or exceeds the critical differences in Table 1.

TABLE 1 Critical Differences for the Conditions Noted, 95 % Probability Level, Option B, Mass per Unit Area[A]

Fabric	Number of Observations in Each Average	Single-Operator Precision	Within-Laboratory Precision	Between-Laboratory Precision
Seersucker (6.11 oz/yd²)	1	0.249	0.249	0.257
	4	0.125	0.125	0.140
	8	0.088	0.088	0.109
	16	0.062	0.062	0.089
Gingham (2.90 oz/yd²)	1	0.080	0.080	0.118
	4	0.040	0.040	0.095
	8	0.028	0.028	0.090
	16	0.020	0.020	0.088
Corduroy (10.42 oz/yd²)	1	0.330	0.387	0.449
	4	0.165	0.261	0.346
	8	0.117	0.234	0.326
	16	0.082	0.218	0.315
Denim (7.45 oz/yd²)	1	0.105	0.105	0.211
	4	0.053	0.053	0.190
	8	0.037	0.037	0.187
	16	0.026	0.026	0.185

[A] The critical differences were calculated using $t = 1.960$ which is based on infinite degrees of freedom.

NOTE 3—The tabulated values of the critical differences should be considered to be a general statement, particularly with respect to between-laboratory precision. Before a meaningful statement can be made about two specific laboratories, the amount of statistical bias, if any, between them must be established with each comparison being based on recent data obtained on specimens taken from a lot of material of the type being evaluated so as to be as nearly homogeneous as possible and then randomly assigned in equal numbers to each of the laboratories.

12.4 *Bias*—Option B in Test Methods D 3776 for measuring mass per unit area (weight) of full width samples has no known bias and is accepted as a referee procedure. The accuracy of the other procedures in Test Methods D 3776 has not been established. Fabric weights of unconditioned fabric will be affected by the past history of the product.

13. Keywords

13.1 mass per unit area; woven fabric

Designation: D 3887 – 80[ε2]

Standard Specification for Knitted Fabrics[1]

This standard is issued under the fixed designation D 3887; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

[1] NOTE—Section 3.3 was changed and Section 17 was added editorially in May 1986.
[2] NOTE—Section 3.1 was changed editorially in August 1988.

1. Scope

1.1 These specifications and methods apply to the following properties associated with knitted fabrics: yield, weight (mass), width, length, fabric count, bursting strength, moisture regain, thickness, extractable matter, and fiber composition.

1.2 When a fabric requires special treatment, specific methods will be described as they are developed for that material, and such special tests will have precedence over these general requirements.

NOTE 1—The values stated in the SI are to be regarded as the standard.

2. Referenced Documents

2.1 *ASTM Standards:*
D 123 Terminology Relating to Textiles[2]
D 629 Test Methods for Quantitative Analysis of Textiles[2]
D 1777 Method for Measuring Thickness of Textile Materials[2]
D 1909 Table of Commercial Moisture Regains for Textile Fibers[2]
D 2257 Test Method for Extractable Matter in Textiles[2]
D 2494 Test Method for Commercial Mass of a Shipment of Yarn or Man-Made Staple Fiber or Tow[2]
D 2654 Test Methods for Moisture Content and Moisture Regain of Textiles[2]
D 2720 Practice for Calculation of Commercial Weight and Yield of Scoured Wool, Top, and Noil for Various Commercial Compositions[2]
D 2905 Practice for Statements on Number of Specimens for Textiles[2]
D 3773 Test Methods for Length of Woven Fabric[3]
D 3774 Test Methods for Width of Woven Fabric[3]
D 3776 Test Methods for Mass per Unit Area (Weight) of Woven Fabric[3]
D 3786 Test Method for Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics—Diaphragm Bursting Strength Tester Method[3]
D 3787 Test Method for Bursting Strength of Knitted Goods—Constant-Rate-of-Traverse (CRT), Ball Burst Test[3]

2.2 *Other Documents:*
Textile Fiber Products Identification Act[4]
Wool Products Labeling Act of 1939[5]

3. Definitions

3.1 *bursting strength, n*—the force required to rupture a fabric by distending it with a force, applied at right angles to the plane of the fabric.

3.2 *commercial allowance, n*—an arbitrary value equal to the commercial moisture regain plus a specific allowance for finish, formally adopted for use with the oven-dry weight when calculating the commercial weight of a shipment or delivery (for explanation, see Test Method D 2494).

3.3 *commercial mass, n*—billed weight (mass) as determined by a generally accepted method or as agreed to by the purchaser and the seller.

3.3.1 *Discussion*—The basis for determining the commercial weight (mass) of a shipment of textile product is generally one of the following:

3.3.1.1 *Man-Made Fibers:*

(*a*) *CMRU Basis* (commercial moisture regain with unscoured material)—the weight (mass) of unscoured, moisture-free textile product plus the weight (mass) corresponding to its commercial *moisture regain*.

(*b*) *CMRS Basis* (commercial moisture regain with scoured material)—the weight (mass) of moisture-free textile product after scouring by definite prescribed methods plus the weight corresponding to its commercial *moisture regain*.

(*c*) *CAS Basis* (commercial allowance with scoured material)—the weight (mass) of moisture-free textile product after scouring by definite prescribed methods plus the weight corresponding to its *commercial allowance*.

(*d*) *UN Basis* (unadjusted net)—the weight (mass) of unscoured textile product with no adjustment for the amount of moisture, finish, or both.

3.3.1.2 *Wool:*

(*a*) *CC Basis* (commercial composition)—the weight (mass) of wool base as determined by definite prescribed methods plus the weights (masses) of moisture and other

[1] This specification is under the jurisdiction of ASTM Committee D-13 on Textiles and is the direct responsibility of Subcommittee D13.56 on Performance Standards for Textile Fabrics.
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[2] *Annual Book of ASTM Standards*, Vol 07.01.
[3] *Annual Book of ASTM Standards*, Vol 07.02.

[4] Act of Congress, "Textile Fiber Products Identification Act," 85th Congress, Second Session, approved Sept. 2, 1958.
[5] Act of Congress, "Wool Products Labelling Act of 1939," 76th Congress, Third Session, approved Oct. 14, 1939.

components corresponding to the commercial composition of the commercially designated material (for explanation, see Recommended Practice D 2720).

(*b*) *UN Basis* (unadjusted net)—the weight (mass) of unscoured textile product with no adjustment for the amount of moisture, finish, or other components.

3.4 *commercial moisture regain, n*—an arbitrary value formally adopted as the regain to be used with the oven-dry weight when calculating the commercial weight of a shipment or delivery (see Table D 1909).

3.5 *finished fabric weight, n*—mass per unit area expressed in grams per square metre (ounces per square yard), grams per linear metre (ounces per linear yard), or inversely as metres per kilogram (linear yards per pound), or square metres per kilogram (square yards per pound).

3.5.1 *Discussion*—When weight (mass) is based on metres or linear yards, the fabric width must be stated.

3.6 *finished yield, n—in knitted fabrics*, the number of finished square yards per pound (square metres per kilogram) of finished fabric.

3.7 *greige yield, n—in knitted fabrics*, the number of finished square yards per pound (square metres per kilogram) of griege fabric.

3.8 *knitted fabric, n*—a structure produced by interlooping one or more ends of yarn or comparable material.

3.9 *knitted fabric count, n*—the number (counted units) of wale loops and course loops per 25 mm (per inch).

3.10 *length, n—in fabric*, the distance from one end to the other, measured parallel to the selvage or flattened tube edge of fabric that is under zero tension and free of folds and wrinkles.

3.11 *tolerances, n—in mathematics*, prescribed limits of variation for specified properties of a particular material based on observed values obtained by specified test methods and on samples that are representative of the material.

3.12 *width, n—in flat knit*, the perpendicular distance between the selvages when the fabric is under zero tension and free from folds or wrinkles.

3.13 *width, n—in circular knit*, twice the perpendicular distance between the enclosed edges of a flattened tube of fabric that is under zero tension and free from folds or wrinkles.

3.14 For definitions of other textile terms used in this specification, refer to Terminology D 123.

4. Specification Requirements

4.1 The properties of knitted fabrics shall conform to the following specification requirements:

Characteristic	Requirements	Section
Yield		
Weight (mass)	±5.0 %	8
Width	±5.0 %	9
	−0 to +25 mm (1 in.)	10
Length	±2.0 %	11
Fabric count	±5.0 %	12
Bursting strength (ball burst)	±10.0 %	13
Extractable matter	1.0 %, max	14
Fiber composition	pass[4]	15

[4] Those products to which the Wool Products Labeling Act of 1939[5] apply, shall conform to the requirements of that act. Other fabrics shall conform to the requirements of the Textile Fiber Products Identification Act of 1958.[6]

5. Uses and Significance

5.1 These specifications and methods furnish a guide in case of dispute and also serve as a basis for determining whether or not the material meets the specification for each property tested. The variations in requirements of knitted fabrics are wide and the requirements listed represent, in general, the variations in a property that are acceptable in the trade.

5.1.1 The requirements listed in Specification D 3887 are considered to be applicable only within one laboratory, for example, the laboratory of the purchaser, the seller, or a mutually agreed upon testing facility.

5.2 Requirements agreed upon by the purchaser and the seller for a specific lot or lots shall take precedence over those listed in these specifications and methods.

6. Sampling

6.1 Tests shall be performed on the fabric as it will reach the consumer. Any "partially finished" fabrics should first be processed in accordance with the fabric manufacturer's instructions.

6.2 Unless otherwise agreed upon, as when specified in an applicable material specification, take the number of specimens directed in each of the applicable test methods.

6.2.1 If there has been no prior agreement and the test method does not specify the number of specimens, use the procedures in Practice D 2905 to determine the number of specimens, such that the user may expect at the 95 % probability level that the test result is no more than half of the tolerance for the property of interest above or below the lot average (that is, the average that would be obtained by applying this method to the entire lot) when using a reliable estimate of variability of individual observations on similar materials in the specified laboratory under conditions of single-operator precision.

7. Conditioning

7.1 For tests made on conditioned material, precondition the specimens by bringing them to approximate moisture equilibrium in the standard atmosphere for preconditioning, then bring the specimens to moisture equilibrium for testing in the standard atmosphere for testing. It shall be considered that moisture equilibrium for testing has been reached when, after free exposure to air in motion, the change in weight (mass) of the specimen at successive intervals of not less than 2 h does not exceed 0.1 % of the specimen weight (mass).

7.2 Properties not significantly affected by minor variations in atmospheric conditions may be tested in prevailing room atmospheres by agreement of all parties concerned.

7.3 If the samples comprise whole rolls or bolts of fabric which cannot be properly conditioned in a reasonable time with the facilities available, perform the test determinations on the material without conditioning. When tests are carried out under conditions which vary from the standard, report the actual conditions prevailing at the time of test. It must be recognized that such results may not correspond with the results obtained after testing in the standard atmosphere for testing textiles.

TEST METHODS

8. Yield

8.1 Determine the representative yield on scoured fabric as agreed between the purchaser and the seller by dividing the commercial weight (mass) of the greige fabric, as directed in Test Method D 2494, into the total finished square metres (square yards), as calculated from the invoiced width and linear metres (linear yards).

8.1.1 It is frequently a practice in the trade to determine the yield on unscoured fabric. When this is the case, report that the yield was determined on the basis of unscoured fabric.

8.1.1.1 When it can be shown that extractable matter alone gives the same results, or results that have a constant ratio to those secured by the scour procedure, adjust the weight (mass) and report the yield on the basis of scoured fabric. For the determination of extractable matter refer to Section 14.

8.1.2 Determine moisture regain by taking three specimens weighing 5 g or more and representative of the lot when the weight (mass) of the lot is determined, place promptly in separate airtight containers, and weigh to the nearest 1 mg. Determine the regain of these specimens as directed in Test Methods D 2654.

8.1.2.1 The percentage moisture regain of the fabric shall be the arithmetic mean of the results of the three determinations.

NOTE 2—Yield is useful to the fabric manufacturer for cost purposes. This property is unknown to the purchaser of the dyed and finished fabric unless the information on yield is supplied by the seller.

9. Weight

9.1 Determine the fabric weight (mass) as directed in Test Method D 3776 as agreed between the purchaser and the seller (see Note 3).

9.1.1 The test results from Sections 7 or 8 of Test Method D 3776 will include selvages, except in the case of circular knit fabrics.

9.1.2 The test results obtained from Section 7 of Test Method D 3776 are not on a conditioned basis since there is no practical means to determine the actual moisture content of a full roll or piece.

9.1.3 In case of controversy, the procedure in Section 8 of Test Method D 3776 shall prevail.

10. Width

10.1 Determine the maximum usable width, exclusive of gummed or taped selvages and of minor irregularities in width, as directed in Section 6 or 7 of Test Method D 3774 as agreed between the purchaser and the seller. In case of circular knit fabrics see 3.7.

NOTE 3—Test Methods D 3776 for determining weight (mass), Test Method D 3774 for determining width and Test Method D 3773 for determining length are intended to be used with woven fabrics. The precision of these methods when used to determine these properties for knitted fabrics is being determined.

10.1.1 The test results obtained from Section 6 of Test Method D 3776 are not on a conditioned basis since there is no practical means to determine the actual moisture content of a full roll or piece.

10.1.2 In case of controversy, the procedure in Section 7 of Test Methods D 3774 shall prevail.

11. Length

11.1 Determine the fabric length as directed in Section 6, 7, 8, or 9 of Test Methods D 3773 as agreed between the purchaser and the seller (see Note 3).

11.1.1 The test results obtained from Section 7, 8, or 9 of Test Methods D 3773 are not on a conditioned basis since there is no practical means to determine the actual moisture content of a full roll or piece.

11.1.2 In case of controversy, the procedure in Section 6 of Test Methods D 3773 shall prevail.

12. Fabric Count

12.1 *Summary of Method*—The number of wale loops per unit distance and course loops per unit distance are determined using suitable magnifying and counting devices.

12.2 *Uses and Significance*—This method is considered satisfactory for acceptance testing of commercial shipments because of prior extensive use. In case of disagreement arising from differences in values reported by the purchaser and the seller when using this method for acceptance testing, the statistical bias, if any, between the laboratory of the purchaser and the laboratory of the seller should be determined with each comparison being based on testing specimens randomly drawn from one sampling unit of material of the type being evaluated.

12.3 *Apparatus*—Use any suitable magnifying and counting device (such as pick glass, rule and pointer, microfilm reader or projection equipment).

12.4 *Sampling:*

12.4.1 Take a lot sample as directed in Section 6 or as agreed between the purchaser and the seller.

12.4.2 In sampling from rolls or pieces in the lot sample, cut one laboratory sample the full width of the circular or flat knit fabric and at least 2 m (2 yd) in the length of the circular knit fabric or along the selvage of the flat knit fabric.

12.5 *Conditioning*—Condition specimens as directed in Section 7.

12.6 *Procedure:*

12.6.1 Unless otherwise specified in a prior agreement between purchaser and seller, make no count closer to a selvage than one-tenth of the width of the fabric, or within 0.5 m (0.5 yd) of the end of the roll or piece.

12.6.2 Lay the specimen out on a horizontal surface under zero tension and free of folds and wrinkles.

12.6.3 For fabrics containing 10 yarns per linear cm (25 yarns per linear in.) or more determine the number of wale loops and course loops per 2.5 cm (1 in.) by counting the number in a space not less than 5 cm (2 in.) at five different places in the piece, equally spaced both across the width and throughout the length to the nearest whole number of loops.

12.6.4 For fabrics containing less than 10 yarns per 1 cm (25 yarns per 1 in.), make the count over a 10-cm (4-in.) width and repeat in at least five randomly designated places across the width and throughout the length to the nearest whole number of loops.

12.6.5 In fancy knits where one or more yarns do not appear at regular, short intervals, make count measurements over at least one full pattern repeat of each design compo-

APPROVED AS ANSI L14.184-1965
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Standard Method of Test for

Breaking Load And Elongation Of Textile Fabrics[1]

ASTM Designation: D 1682 - 64 (Reapproved 1970)

This Standard of the American Society for Testing and Materials is issued under the fixed designation D 1682; the final number indicates the year of original adoption as standard or, in the case of revision, the year of last revision.

1. Scope

1.1 These methods describe procedures for determining the breaking load and elongation of textile fabrics using the Grab, Ravelled Strip, and Cut Strip methods, presented in two sections as follows:

1.1.1 *Part I* describes aspects of the procedure which are common to all three methods.

1.1.2 *Part II* describes those details of procedure especially applicable to the method under discussion.

PART I. GENERAL

2. Definitions

2.1 *Grab Test.*—A test in which only a part of the width of the specimen is gripped in the clamps. For example, if the specimen width is 4 in. (100 mm) and the width of the jaw faces 1 in. (25 mm), the specimen is gripped centrally in the clamps.

2.2 *Strip Test.*—One in which the full width of the specimen is gripped in the clamps.

2.3 *Modified Grab Test.*—One in which only a part of the width of the specimen is gripped in the clamps and in which lateral slits are made in the specimen to sever all yarns bordering the portion whose strength is to be tested, reducing to a practical minimum the "fabric assistance" inherent in the grab method.

2.4 *Ravelled Strip Test.*—A strip test in which the specified specimen width is secured by ravelling away yarns.

2.5 *Cut Strip Test.*—A strip test in which the specimen width is secured by cutting the fabric.

2.6 *Constant - Rate - of - Extension Tensile Testing Machine (CRE).*—A testing machine in which the rate of increase of specimen length is uniform with time.

2.7 *Constant-Rate-of-Traverse Tensile Testing Machine (CRT).*—A testing machine in which the pulling clamp moves at a uniform rate and the load is applied through the other clamp which moves appreciably to actuate a weighing mechanism, so that the rate of increase of load or elongation is dependent upon the extension characteristics of the specimen.

2.8 *Constant-Rate-of-Load Tensile Testing Machine (CRL).* — A testing machine in which the rate of increase of the load being applied to the specimen is uniform with time after the first 3 sec.

2.9 For definitions of other terms used in this method, refer to ASTM Definitions D 123, Terms Relating to Textile Materials.

3. Summary of Method

3.1 A continually increasing load is applied longitudinally to the specimen, and the test is carried to rupture in a specific time. Values for the breaking load and elongation of the test specimen are obtained from machine scales or dials or autographic recording charts.

4. Uses and Significance

4.1 Most woven, nonwoven, or felted textile fabrics may be tested by at least one of the methods. The methods are not recommended for knitted fabrics. Some modification of the techniques is likely to be necessary for any fabric having a strength in excess of 1000 lb per in. (179 kg per cm) width. Special precautionary measures are provided for use when necessary with strong fabrics or fabrics made from glass fibers, to prevent them from slipping in the clamps or being damaged as a result of being gripped in the clamps.

4.2 All of the procedures are applicable for testing fabrics either dry or wet. They may be used with constant-rate - of - traverse, constant - rate - of-load, or constant-rate-of-extension type tension machines. The results obtained may, however, depend upon the type of machine used for the test. Constant-time-to-break has been specified because it is the best known way of providing good agreement between the results from different types of tensile testers. However, data obtained on constant-rate-of-load testers may differ from that obtained on constant-rate-of-traverse or constant-rate-of-extension testers when testing fabrics made from fibers whose behavior is strongly dependent upon the rate of extension used, for example, high-density polyethylene. An optional procedure for the constant-rate-of-traverse tester using a machine speed of 12 ± ½ in. (305 ± 10 mm) per min is permitted whenever a constant-time-to-break is not specified.

4.3 *Grab Method.*—The grab method is applicable whenever it is desired to determine the "effective strength" of the fabric in use, that is, the strength of the yarns in a specific width together with the additional strength contributed by adjacent yarns. The breaking load determined by the grab method is not a reflection of the strength of the yarns actually gripped between clamps and cannot be used for direct comparison with yarn strength determinations. Grab tests are as precise as ravelled strip tests and the specimens require much less time

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[1] Under the standardization procedure of the Society, these methods are under the jurisdiction of the ASTM Committee D-13 on Textile Materials, and are the direct responsibility of Subcommittee B-9 on Fabric Test Methods. A list of committee members may be found in the ASTM Yearbook.

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[2] Appears in this publication.

to prepare though they require more fabric per specimen. There is no simple relationship between grab tests and strip tests since the amount of fabric assistance depends on the type of weave, fabric count, mobility of yarns, etc.

4.4 *Ravelled Strip.*—The ravelled strip method is applicable whenever it is desired to determine the breaking load requied to rupture a specific width of fabric. The information is particularly useful for comparison of the effective strength of the yarns in the fabric with their strength before weaving. The method is not recommended for fabrics having less than 20 yarns across the width of the specimen. If the specimen cannot be obtained with a 1-in. (25.4-mm) strip, a 2-in. (50.8-mm) strip should be used. If a fabric cannot be ravelled readily, use either a grab or cut strip test.

NOTE 1.—The 2-in. (50.8-mm) strip may be used for any fabric if a machine of sufficient capacity is available.

NOTE 2.—The observed load of a 2-in. (50.8-mm) specimen, in general, is not double the observed load of a 1-in. (25.4-mm) specimen and the results should accordingly be reported as observed on a 2-in. (50.8-mm) strip, without mathematical adjustment to a 1-in. (25.4-mm) basis.

NOTE 3.—If, by mutual consent, it is agreed to perform a test on strips containing less than 20 yarns across the width to be tested, the actual number of yarns shall be stated in the report.

NOTE 4.—Tape, ribbons, and other narrow fabrics less than 2 in. (50.8 mm) wide, not covered by ASTM Methods of Testing and Tolerances D 259, for Woven Tapes, D 580, for Woven Glass Tapes,[3] or ASTM Specification and Tolerances D 315, for Woven Asbestos Tape[3] are tested full width.

4.5 *Cut Strip.*—The cut strip method is applicable instead of the ravelled strip method for heavily fulled fabrics, felted fabrics, or any fabric that cannot be readily ravelled. It can be used when the fabric can be ravelled, but this procedure is not recommended. The recommendation regarding the minimum number of yarns in a specimen discussed in 4.4 for ravelled strips applies equally to cut strips.

4.6 *Modified Grab.*—The modified grab method is applicable where it is desired to determine the breaking load required to rupture a specific width of fabric for those constructions in which the application of testing stress on ravelled strip specimens produces further unravelling. This method is particularly applicable to high strength fabrics.

[3] *1969 Book of ASTM Standards*, Part 25.

5. Apparatus

5.1 *Tensile Testing Machine (CRE, CRT, or CRL).*—One of the three types of testing machines described in ASTM Specifications D 76, for Tensile Testing Machines for Textile Materials,[2] shall be used.

5.2 *Speed Adjuster*, for varying the speed of operation of the testing machine in order to break the specimens in 20 ± 3 sec.

5.3 *Stopwatch*, for measuring the time required to break each specimen.

6. Sampling, Selection, and Number of Specimens

6.1 Take samples as directed in any applicable material specifications or in their absence secure two or more samples separated by several yards along the length of each cut of fabric to be sampled. Each sample shall extend the width of the fabric and ½ yd (450 mm) along the selvage (Note 5).

NOTE 5.—Results secured on small hand samples should be considered merely as representative of the sample submitted and cannot be assumed to be representative of the fabric piece from which the hand sample was taken.

6.2 Unless otherwise agreed upon (for example, provided for by an applicable material specification), the number of test specimens shall be such that the mean of the test results will, with a 95 per cent probability, be no more than 5 per cent below the "true" average breaking load (as would be determined by an infinite number of tests). This is equivalent to a precision of ±5 per cent at a probability level of 90 per cent.

$$n = 0.11\,v^2$$

where:

n = number of test specimens, and
v = coefficient of variation of individual test results, determined from extensive past records on similar material (Note 6).

NOTE 6.—The variability of elongation likely to be encountered is not sufficiently well known at the present time to be able to estimate the degree of precision to be expected. Variability of elongation is likely to be somewhat higher than variability of breaking load, however, and the precision of the result for the same number of tests is likely to be lower.

6.3 If v is not known, make five tests on warpwise specimens and eight tests on fillingwise specimens (Notes 7 and 8).

NOTE 7.—This number of tests is based on a coefficient of variation of breaking load of 6.5 per cent for the warp and 8.5 per cent for the filling. This is a somewhat higher value of v than will be found in practice. Knowledge of the actual value of v for the fabric under test is therefore likely to permit making fewer tests than prescribed in this section. If fewer tests are performed without knowing the "true" value of r, it must be presumed that the result is obtained with reduced precision, that is, a figure higher than 5 per cent. The estimated precision must then be calculated as follows and quoted in the report:

For warpwise tests,

$$E = \frac{10.7}{\sqrt{n}} \qquad (1)$$

For fillingwise tests,

$$E = \frac{14.11}{\sqrt{n}} \qquad (2)$$

where:

E = precision, and
n = actual number of tests.

NOTE 8.—It is desirable to prepare two or three extra specimens which may be required to establish the proper time when dealing with unfamiliar materials, using the constant-time-to-break technique.

7. Conditioning

7.1 Precondition the specimens by bringing them to approximate moisture equilibrium in the standard atmosphere for preconditioning, then bring the specimens to moisture equilibrium for testing in the standard atmosphere for testing. Equilibrium is considered to have been reached when the increase in weight of the specimen in successive weighings made at intervals of not less than 2 hr does not exceed 0.1 per cent of the weight of the specimen (Note 9).

NOTE 9.—It is recognized that in practice textile materials are frequently not weighed to determine when moisture equilibrium has been reached. While such a procedure cannot be accepted in cases of dispute, it may be sufficient in routine testing to expose the material to the standard atmosphere for testing for a reasonable period of time before the specimens are tested. As a guide, the following conditioning periods are suggested:

Fiber	Minimum Conditioning Period, hr[a]
Animal fibers (for example, wool) and regenerated proteins	8
Vegetable fibers (for example, cotton)	6
Viscose	8
Acetate	4
Fibers having a regain less than 5 per cent at 65 per cent relative humidity	2

[a] These periods are approximate and apply only to fabrics spread out in single thickness which are exposed freely to

moving air in the standard atmosphere for testing. Heavy fabrics may require conditioning periods longer than those suggested above. If a fabric contains more than one fiber, it should be conditioned for the longest period of time required by any of its components (for example, 8 hr for blends containing wool or viscose).

7.2 Specimens to be tested in the wet condition shall be immersed in water until thoroughly wetted (Note 10). In order to obtain thorough wetting it may be desirable to add not more than 0.05 per cent of a nonionic neutral wetting agent to the water. A test of any specimen shall be completed within 2 min after its removal from the water.

NOTE 10.—The conclusive evidence that the time of immersion has been sufficient to wet the fabric thoroughly is that further immersion does not produce any additional changes in breaking strength. This method of determination must be used in cases of dispute. However, for routine testing in the laboratory it may be sufficient to immerse the material for 1 hr. The method should be used with caution when testing fabrics that do not wet out uniformly and thoroughly because of the presence of sizing, oil, protective coatings, or water repellents.

Where the strength of wet specimens is required in the absence of sizing, water repellents, etc., subject the cloth to suitable desizing treatments that will not affect the normal physical properties of the fabric, before preparing the test specimens (see ASTM Methods D 629, for Quantitative Analysis of Textiles).[4]

8. Preparation of Test Specimens

8.1 For woven fabrics, cut specimens with their long dimensions parallel either to the warp or to the filling or cut specimens of both types, as may be required. In general, no two specimens cut parallel to the warp should contain the same set of warp ends, and no two specimens parallel to the filling should contain the same set of filling picks, and when possible, specimens should come from different bobbins. Unless otherwise specified, take specimens no nearer to the selvage or edge of the fabric than one tenth of the width of the fabric.

8.2 For nonwoven fabrics, prepare the specimens as described in ASTM Methods D 1117, Testing Nonwoven Fabrics;[2] for felt, see ASTM Methods D 461, Testing Felt.

9. Procedure

9.1 Make all tests in the standard atmosphere for testing.

9.2 Use clamps provided with jaws having smooth, flat, metallic faces. For all tests, set the distance between the clamps at the start of the test at 3 ± 0.05 in. (75 ± 1 mm). Select the load range of the testing machine such that the break occurs between 10 and 90 per cent of full scale load. Set the machine so that the expected breaking load is reach in 20 ± 3 sec, unless otherwise specified.

9.3 Secure the specimen centrally in the clamps of the testing machine, taking care that the long dimension is as nearly as possible parallel to the direction of application of the load. Be sure that the tension in the specimen is uniform across the clamped width.

9.4 If a measure of the elongation of the specimen is required, the initial length and therefore the measured elongation depend upon the pre-tension applied in placing the specimen in the clamps of the machine. In this case, secure the specimen in one clamp of the machine, and apply a pre-tension to the specimen of approximately ½ per cent of the breaking load, or other initial load specified for the particular material in question, before gripping the specimen in the other clamp.

9.5 *Measurement of Breaking Load.* —Operate the machine and read the breaking load, and elongation if required, from the mechanism provided for such purpose. Note the actual time to break for the first three specimens, and if the average of these three lies within the limits 20 ± 3 sec, break all the remaining specimens under the same conditions. Record the time to break each specimen, and if the average time for the required number of specimens falls outside the limits 20 ± 3 sec, discard the results, readjust the rate of operation of the testing machine, and repeat the breaks until a series having a satisfactory average time to break is obtained. If the average of the three tests meets the time criterion set up, these observations shall be considered as completed tests and shall make up part of the required number of tests. Record and report the tests in each direction separately.

9.6 If a specimen slips in the jaws, breaks at the edge of, or in, the jaws, or if for any reason attributed to faulty operation the result falls markedly below the average for the set of specimens, discard the result and take another specimen. Continue this procedure until the required number of acceptable breaks have been obtained (Notes 11, 12, and 13).

NOTE 11.—The decision to discard a break shall be based on observation of the specimen during the test and upon the inherent variability of the fabric. In the absence of other criteria for rejecting a so-called jaw break, any break occurring within ¼ in. (5 mm) of the jaws which results in a value below 50 per cent of the average of all the other breaks shall be discarded. No other break shall be discarded unless it is known to be faulty.

NOTE 12.—It is difficult to determine the precise reason why certain specimens break near the edge of the jaws. If this is caused by damage to the specimen by the jaws, then the results should be discarded. If, however, it is merely due to randomly distributed weak places, it is a perfectly legitimate result. In some cases, it may also be caused by a concentration of stress in the area adjacent to the jaws because they prevent the specimen from contracting in width as the load is applied. In these cases, a break near the edge of the jaws is inevitable and shall be accepted as a characteristic of the particular method of test. This is often the case when testing fabrics using the grab method.

NOTE 13.—For instructions regarding the preparation of specimens made from glass fiber to minimize damage in the jaws, see ASTM Specifications and Methods of Test D 579, for Woven Glass Fabrics.[3]

9.7 If a fabric manifests any slippage in the jaws or if more than 25 per cent of the specimens break at a point within ¼ in. (5 mm) of the edge of the jaw, then (1) the jaws may be padded; (2) the fabric may be coated under the jaw face area; or (3) the jaw face may be modified. If any of the modifications listed above are used, state the method of modification in the report.

9.8 *Measurement of Apparent Elongation.* — Unless otherwise specified, measure the elongation of the fabric at any stated load by means of a suitable autographic recording device, at the same time as the breaking strength is determined. Measure the elongation from the start of the load-elongation curve as shown on the graphic record.

10. Calculation

10.1 *Breaking Load.* — Calculate the average of the breaking load observed for all acceptable specimens, that is, the maximum load to cause a specimen to rupture as read directly from the testing instrument.

10.2 *Apparent Elongation.*—Calculate the average of the elongations observed for all acceptable specimens, expressed as the percentage increase in length, based upon the initial nominal gage length of the specimen. Report this as the apparent elongation (Note 14).

NOTE 14.—The observed elongation calculated as a percentage of the initial nominal gage length of the specimen should be referred to as "apparent elon-

[4] Discontinued; see *1968 Book of ASTM Standards*, Part 25.

gation." Because the actual length of fabric stretched is usually somewhat greater than this initial length, due to pull-out of fabric from between the jaws, elongation calculated on initial length may be somewhat in error, depending upon the amount of this pull-out.

10.3 *Corrected Breaking Load of Wet Specimens:*

10.3.1 If for any reason it is desired to make allowances for shrinkage in obtaining wet breaking strength by the grab method only, calculate the wet strength according to Eq 3:

$$\text{Corrected breaking load of wet specimens} = \frac{\text{breaking load of conditioned specimens} \times \text{yarn count of conditioned specimens}}{\text{yarn count of wet specimens}} \quad \text{-------(3)}$$

10.3.2 A similar correction may be needed when comparing the breaking strength of conditioned specimens of a fabric after a wet finishing treatment with that of the same fabric before finishing, if the finishing has caused shrinkage.

11. Identification of Test Method Used

11.1 These methods describe procedures for carrying out fabric tension tests using six types of specimen and three alternative types of testing machine. In order to provide easy reference to the specific method used in any instance, the following system of identification is suggested:

11.2 Type of test specimen used:

G—Grab test
1R—1-in. (25.4-mm) ravelled strip test
2R—2-in. (50.8-mm) ravelled strip test
1C—1-in. (25.4-mm) cut strip test
2M—2-in. (50.8-mm) cut strip test
MG—Modified Grab test

11.3 Type of testing machine used:

T—Constant-rate-of-traverse (CRT)
L—Constant-rate-of-load (CRL)
E—Constant-rate-of-extension (CRE)

11.4 All the possible combinations can be identified as follows:

Test Specimen	Type of Tester		
	Constant-Rate-of-Traverse	Constant-Rate-of-Load	Constant-Rate-of-Extension
Grab	G-T	G-L	G-E
1-in. (25.4-mm) revelled strip	1R-T	1R-L	1R-E[1]
2-in. (50.8-mm) ravelled strip	2R-T	2R-L	2-RE
1-in. (25.4-mm) cut strip	1C-T	1C-L	IC-E
2-in. (50.8-mm) cut strip	1C-T	1C-L	1C-E
2-in. (50.8-mm) cut strip	2C-T	1C-L	2C-E
Modified Grab	MG-T	MG-L	MG-E

[1] *Example:* Method 1R-E refers to a 1-in. ravelled strip test carried out on a constant-rate-of-extension tester.

12. Report

12.1 Report all of the following applicable items:

12.1.1 The average breaking load for specimens cut in each direction, for all specimens giving acceptable breaks.

12.1.2 The average per cent apparent elongation of specimens cut in each direction, for all specimens giving acceptable breaks, if required. Identify this as "apparent breaking elongation," or "apparent elongation at x lb load," as required by the test specifications,

12.1.3 Description of material tested,

12.1.4 Number of specimens cut in each direction,

12.1.5 Test method used, identifying both the type of specimens and the type of testing machine,

12.1.6 Maximum load obtainable in the range used for testing,

12.1.7 Size of jaw faces used, if grab test,

12.1.8 Type of padding used in jaws, modification of specimen gripped in the jaws, or modification of jaw faces, if used,

12.1.9 Number of yarns in the width of the strip, if less than 20,

12.1.10 Average time required to break all specimens, giving acceptable breaks,

12.1.11 Condition of specimen (conditioned or wet),

12.1.12 In the case of tests on wet specimens, state whether allowance was made for shrinkage, and

12.1.13 Whether sizing or finishes have been removed and, if so, by what procedure.

Part II. Requirements for Specific Test Methods

13. Scope

13.1 The general instructions given in Part I of these methods apply to all of the methods described in Part II herein. These instructions are therefore not repeated in the description of each separate method. Only those aspects of preparation and procedure that apply specifically to each individual method are included here.

14. Selection of Test

14.1 The test to be used in any particular case should be specified or decided by mutual agreement. In the absence of such specification, the type of test to be used may be selected with the aid of the information given in Part I. The selection of the type of testing machine will be dictated primarily by the availability of the various types. The procedures described are intended to minimize differences between the results obtained from the three types of machine.

15. Grab Tests, G

15.1 *Size of Test Specimens.*—Cut each specimen 4 ± 0.1 in. (100 ± 1 mm) wide by at least 6 in. (150 mm) long (Note 15) with the long dimension parallel to the direction for which the breaking load is required. Draw a line 1.5 in. (37 mm) from the edge of the specimen, running its full length. This must be accurately parallel to the lengthwise yarns (Note 15).

Note 15.—The length of the specimen depends upon the type of clamps being used. It must be long enough to extend through the clamps and project at least 0.5 in. (10 mm) at each end. For jaw faces measuring 1 in. (25 mm) in the direction of pull, the specimen length will therefore be at least 6 in. (145 mm) (3-in. gage length plus 2 × 1 in. in clamp plus 2 by 0.5 in. projecting) (75-mm gage length plus 2 by 25 mm in clamp plus 2 by 10 mm projecting).

15.2 When the wet breaking load of the fabric is required in addition to the dry breaking load, cut each test specimen at least twice as long as is required for a dry test (Note 16). Number each specimen and then cut crosswise into two parts, one for determining the conditioned breaking load, and the other for determining the wet breaking load, each portion shall bear the specimen number. In this manner perform each paired break on test specimens containing the same yarns (Note 16).

Note 16.—For fabrics which shrink excessively when wet, it shall be necessary to cut the test specimens for obtaining wet load longer in dimension than that for dry load.

15.3 *Size of Jaw Faces.*—Each clamp shall have one jaw face measuring 1 in. (25.4 mm) perpendicular to the direction of application of the load, and not less than 1 nor more than 2 in. (25 nor more than 50 mm) parallel to the direction of application of the load (Note 17). The other jaw

face of each clamp shall be at least as large as its mate. Each jaw face shall be in line both with respect to its mate in the same clamp and to the corresponding jaw of the other clamp (Note 17).

NOTE 17.—Faces measuring 1 by 2 in. (25.4 by 50 mm) will not necessarily give the same value as 1 by 1-in. (25.4 by 25-mm) faces. The former may in some cases be preferable because of the larger gripping area which tends to reduce slippage. While both sizes of gripping surface are permitted, the size used for carrying out the test must be recorded in the report.

15.4 *Insertion of Specimen in Clamps.*—Insert the specimen in the clamps so that approximately the same length of fabric extends beyond the jaw at each end. Locate the jaws centrally in the widthwise direction by having the line which was drawn 1.5 in. (37 mm) from the edge of the specimen run adjacent to the side of the upper and lower jaw which is nearest this edge. This ensures that the same lengthwise yarns are gripped in both clamps.

16. One-Inch Ravelled Strip Test, 1R

16.1 *Size of Test Specimen.*—Cut each specimen 1½ in. wide or 1 in. (35 mm or 25 mm) plus 20 threads, whichever is the larger; the length shall be at least 6 in. (150 mm) (Note 18). Ravel ¼ in. (5 mm), or 10 threads, from each side, so that the resulting specimen has a width, excluding fringe, of 1 in. (25.4 mm) (see 4.4 and Notes 3 and 19).

16.2 When the breaking load of wet specimens is required, the specimen length must be modified as directed in 15.2.

NOTE 18.—Neither the raveled strip nor the modified grab test is suitable for measuring the breaking load of "dipped" fabrics.

NOTE 19.—It may be desirable under some circumstances to ravel the strip to a constant number of yarns instead of a constant width. This number shall never be less than 20 and the width never less than ½ in. (15 mm). This technique is particularly useful when it is desired to compare the breaking load of a conditioned fabric after a wet finishing operation with that of the same fabric before finishing, if the finishing has caused shrinkage. Such a procedure may be used by mutual consent of the interested parties.

16.3 *Size of Jaw Faces.*—For all strip tests or for narrow fabrics and tapes being tested full width, use clamps having jaw faces at least ½ in. (10 mm) wider than the specimen being tested. The faces shall measure at least 1 in. (25 mm) in the direction of application of the load.

17. Two-Inch (50.8-mm) Ravelled Strip Test, 2R

17.1 *Size of Test Specimen.*—Cut each specimen to a width of 2½ in. (65 mm) or 2 in. (50 mm) plus 20 threads, whichever is the larger; the length shall be at least 6 in. (150 mm) (Note 15). Ravel ¼ in. (5 mm) or 10 threads from each side so that the resulting specimen has a width, excluding fringe, of 2 in. (50 mm) (see 4.4 and Notes 2, 3, and 19).

17.2 When the breaking load of wet specimens is required, the specimen length must be modified as directed in 15.2.

17.3 *Size of Jaw Faces.*—See 16.3.

18. One-Inch (25.4-mm) Cut Strip Test, 1C

18.1 *Size of Test Specimen.*—Cut each specimen 1 in. wide by at least 6 in. (25.4 mm by 150 mm) long (Note 15), taking care that the long dimension is accurately parallel to the direction for which the breaking load is required (see 4.5).

18.2 When the breaking load of wet specimens is required, the length must be modified as directed in 15.2.

18.3 *Size of Jaw Faces.*—See 16.3.

19. Two-Inch (51-mm) Cut Strip Test, 2C

19.1 *Size of Test Specimen.*—Cut each specimen 2 in. wide by at least 6 in. long (50.8 mm by 150 mm) (Note 15) taking care that the long dimension is accurately parallel to the direction for which the breaking load is required (see 4.5).

19.2 When the breaking load of wet specimens is required, the length must be modified as directed in 15.2.

19.3 *Size of Jaw Faces.*—See 16.3.

20. Modified Grab Test, MG

20.1 *Size of Test Specimen.*—Cut each specimen 4 ± 0.1 in. (100 ± 2 mm) wide by at least 8 in. (200 mm) long. The specimen must extend through the jaws and project at least ½ in. (10 mm) at each end. Specimens for insertion using alternative high-strength fabric method (Note 20) must be cut at least 16 in. (400 mm) long. Draw a line 1.5 in. (37 mm) from the edge of the specimen, running its full length. Cut slits at the center of each specimen, perpendicular to the yarn component being tested, severing all yarns except those comprising the central 1 in. (25.4 mm), as shown in Fig. 1.

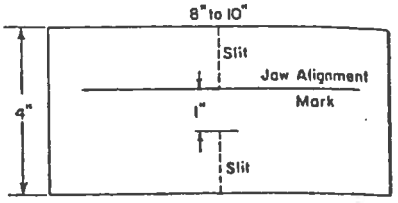


FIG. 1.—Illustration of Modified Grab Test Specimen.

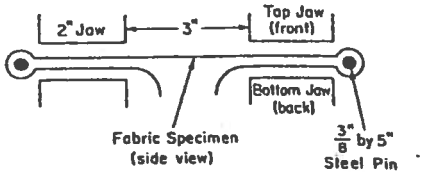


FIG. 2. — Illustration of Specimen Placement for Modified Grab Method.

NOTE 20.—*Where yarns per inch are less than 25,* the nearest whole number of yarns just less than those comprising 1 in. (by physical count) shall be left uncut and the test results shall be interpolated to the actual 1-in. count.

20.2 *Size of Jaw Faces.*—The top (or front) jaw faces shall measure 1.25 in. by 2 in. (30 by 50 mm) or more, the longer dimension parallel to the direction of application of load. The bottom (or back) jaw faces shall measure 2 by 2 in. (50 by 50 mm) or more.

20.3 *Procedure.*—For fabrics that can be satisfactorily gripped and held in the manner prescribed for the grab method, follow the procedure described in 15.4. For high-strength fabrics where the specimen cannot be satisfactorily held in clamps, use the following procedure:

20.3.1 Place each specimen between the jaws as illustrated in Fig. 2, using jaw padding if desired.

20.3.2 Tighten clamps to afford distribution of holding pressure along the surface of top (front) jaw and around pin. Clamps too tight will produce breaking at front of jaws; clamps too loose, breaking at back of jaws at pin.

20.3.3 Mark across the specimen at the front edge of each jaw to observe specimen slippage.

20.3.4 If the break occurs in the jaws or at the edge of the jaws, if some yarns fail to break, if specimen slippage is not uniform between either pair of jaws evidenced by distortion of jaw marks or angular displacement of either pin, or if rupture follows any other than random pattern, discard the test result and break another specimen.

APPROVED AS ANSI L14.200-1966
BY AMERICAN NATIONAL STANDARDS INSTITUTE

Standard Method of Test for

Tear Resistance Of Woven Fabrics By Falling-Pendulum (Elmendorf) Apparatus[1]

ASTM Designation: D1424-63 (Reapproved 1970)

This Standard of the American Society for Testing and Materials is issued under the fixed designation D 1424; the final number indicates the year of original adoption as standard or, in the case of revision, the year of last revision.

NOTE—Figure 1 was revised editorially in June, 1967.

Scope

1. (*a*) This method covers a procedure for the determination of the average force required to propagate a single-rip tongue-type tear starting from a cut in a woven fabric by means of a falling-pendulum (Elmendorf) apparatus.

(*b*) This method is applicable to treated and untreated woven fabrics, including those heavily sized, coated or resin-treated (for example, wash-wear), provided the fabric does not tear during the test in the direction crosswise to the direction of the force applied. If the tear is not lengthwise, the fabric shall be described as untearable in that direction by this test.

(*c*) This method is not suitable for knit fabrics, felts, or nonwoven fabrics, with the possible exception of machine direction tears in some lightweight nonwoven fabrics.

Definitions

2. (*a*) *Length of Tear, n.*—The length of fabric torn, as measured on the fabric before tearing.

(*b*) *Tearing Force, n.*—The average force required to continue a tear previously started in a fabric. It is the work done in tearing the specimen divided by twice the length of tear.

(*c*) *Tearing Energy, n.*—The work done in tearing the specimen.

(*d*) *Warp Tests, n.*—Tests in which the warp yarns are torn.

(*e*) *Filling Tests, n.*—Tests in which the filling yarns are torn.

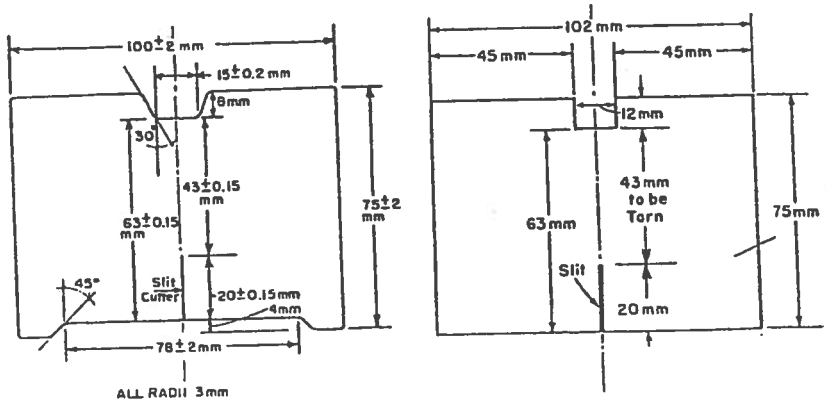
(*f*) For definitions of other terms used in this method, refer to the Definitions of Terms Relating to Textile Materials (ASTM Designation: D 123).

Summary of Method

3. The average force required to continue a tongue-type tear in a fabric is determined by measuring the work done in tearing it through a fixed distance. The tester consists of a sector-shaped pendulum carrying a clamp which is in alignment with a fixed clamp when the pendulum is in the raised, starting position with maximum potential energy. The specimen is fastened in the clamps and the tear is started by a slit cut in the specimen between the clamps. The pendulum is then released and the specimen is torn as the moving jaw moves away from the fixed one. The scale attached to the pendulum is graduated so as to read directly the tearing force in grams (or the percentage of the original potential energy of the pendulum consumed in tearing the specimen, from which the tearing force can be calculated).

Uses and Significance

4. Results obtained with this method are similar to those obtained by other methods for tongue-type tears but differences in level of test occur. The level of test will depend in part on the rate of tearing. This method has the advantages of simplicity and speed in testing since specimens are cut with a die and results are read directly from the scale on the pendulum. The specimens are relatively small in area and, thus, require less fabric. The reading obtained is directly proportional to the length of the material torn, so it is essential that the specimen be prepared to the exact size specified. The ca-



(*a*) Improved Model. (*b*) Original Model.

FIG. 1.—Die for Cutting Notched Specimens.

[1] Under the standardization procedure of the Society, this method is under the jurisdiction of the ASTM Committee D-13 on Textile Materials, and is the direct responsibility of Subcommittee B-9 on Fabric Test Methods. A list of committee members may be found in the ASTM Yearbook.

Current edition accepted Sept. 30, 1963. Originally issued 1956. Replaces D 1424 - 59.

pacity of the tester must be selected so that the specimens tear between 20 and 60 per cent of the scale value.

Apparatus

5. (*a*) *Falling-Pendulum (Elmendorf) Type Tester*,[2] as described in the Appendix. The tester should have three capacities, 0 to 1600, 0 to 3200, and 0 to 6400 g, and a scale reading directly in hectograms (100-g units) for each capacity, so as to provide for a wide range of fabrics and convenience in reading results. The tester must be securely fixed in position to prevent movement during a test.

(*b*) *Cutting Die*, having essentially the shape and dimensions shown in Fig. 1 (*a*) or (*b*). Either die provides the basic rectangular test specimen 100 ± 2 mm long by 63 ± 0.15 mm wide, along with additional fabric at the top edge of the specimen to ensure the last yarns being torn during the test by preventing or minimizing their raveling. The critical dimension of the test specimen is the distance 43.0 ± 0.15 mm which is to be torn during the test (Note 1).

NOTE 1.—The improved die model shown in Fig. 1(*a*) has two new features not found in the original model Fig. 1(*b*), namely a cutout for the bottom of the specimen to aid in centering it in the clamps, and (optional) provision for cutting the 20.0-mm slit prior to inserting the specimen in the tester. These dies can be made to order by most die manufacturers.

Preparation of Apparatus

6. (*a*) Check the level, zero point, and length of tear before each set of tests. Make any necessary adjustments, as prescribed in the Appendix, Section A2.

(*b*) Select the capacity such that the specimens will tear between 20 and 60 per cent of the scale value.

Sampling, Selection, and Number of Specimens

7. (*a*) Take the bulk and laboratory samples according to any applicable material specifications, or in their absence, take the laboratory sample in such a manner that it is representative of the lot to be tested.

(*b*) Take warp specimens that have different warp yarns in each specimen for a warp test and filling specimens which come from a different filling bobbin in each specimen for a filling test. If there is insufficient material or if for any other reason, it is impossible to meet these requirements, report this fact. Take no specimen nearer the selvage than one tenth the width of the fabric.

(*c*) Unless otherwise specified or agreed upon, and if the variability is known, take the number of specimens required to give a precision of ± 5 per cent at a probability level of 90 per cent, as follows:

$$\text{Number of specimens, } n = 0.108\, v^2$$

where:

v = the coefficient of variation of individual test results determined from experience with similar material.

(*d*) Unless otherwise specified or agreed upon, and if the variability is not known, take at least five specimens for both the warp and filling directions. This number is based on long practice, since the precision of the method is not known.

Conditioning

8. For tests made as directed in Section 10, bring the specimens from the prevailing atmosphere to moisture equilibrium for testing in the standard atmosphere for testing (Method of Conditioning Textiles and Textile Products for Testing (ASTM Designation: D 1776)[2]). If the relative humidity of the prevailing temperature is above that of the standard atmosphere for testing, precondition specimens composed in whole or part of cotton, rayon, or wool, before bringing them to moisture equilibrium for testing in the standard atmosphere for testing.

Preparation of Specimens

9. Prepare the warp and filling specimens, using a cutting die as directed in Section 5(*b*) and shown in Fig. 1(*a*) and (*b*). Cut the warp set with the short dimension parallel to the filling yarns and the filling set with the short dimension parallel to the warp yarns. In cutting the specimens, take care to align the yarns running in the short direction parellel with the die so that when the slit is cut, the subsequent tear will take place between these yarns and not across them. This precaution is most important when testing bowed fabrics.

Procedure

10. (*a*) Test the conditioned specimens in the standard atmosphere for testing.

(*b*) Raise the pendulum to the starting position and set the pointer against its stop. Fasten the conditioned specimen securely in the clamps so that it is well centered with the bottom edge carefully set against the stops and so that the upper edge is parallel to the top of the clamps and the widthwise yarns are exactly perpendicular to them. Close the clamps by tightening the set screws, using approximately the same tension on both clamps. The specimen should lie free with its upper area directed toward the pendulum so as to ensure a shearing action.

(*c*) If the slit has not been cut by the die, use the knife blade (Fig. 2 (6)), to cut a 20-mm slit in the specimen extending from the bottom edge and leaving a length of fabric 43.0 ± 0.15 mm to be torn.

(*d*) Depress the pendulum stop as far as it will go, thus releasing the pendulum. Hold down the stop until after the tear is completed and catch the pendulum on the return swing by the hand without disturbing the position of the pointer. Read the scale to the nearest whole scale division for the capacity used.

(*e*) Reject readings obtained where the specimen slips in the jaw or where the tear deviates more than 6 mm away from the projection of the original slit. Note whether puckering occurs during test.

Calculation of Results

11. (*a*) Calculate the average force in grams to tear the specimen in each direction.

(*b*) When a tester is used in which the scale is graduated to indicate the percentage of the original potential energy of the pendulum consumed in tearing the specimen, multiply the scale reading by the appropriate factor shown in Appendix, Section A4, Table I, to obtain the tearing force in grams.

Report

12. The report shall include the following:

(*1*) Individual values and the average tearing force in grams, calculated to the nearest whole scale division, for each direction of tear (Section 2(*d*) and (*e*)),

(*2*) The capacity of the tester that was used,

(*3*) Puckering, if it occurs during the test, and

(*4*) Number of tests rejected because of crosswise tearing.

Precision and Accuracy

13. The precision and accuracy of this method as applied to textiles have

[2] The Thwing-Elmendorf Tear Tester meets these requirements and is obtainable as Textile Model 60-400 from Thwing-Albert Instrument Co., Philadelphia, Pa.

not been determined. The interlaboratory study of its application to paper may be pertinent (5).[3]

References

(1) F. T. Carson and L. W. Snyder, "Increasing the Capacity of the Elmendorf Tearing Tester," *Paper Trade Journal*, Vol. 86, No. 13, pp. 57-60 (1928).

(2) James D'A. Clark, "Calibration of the Elmendorf Tearing Tester," *Paper Trade Journal*, Vol. 94, No. 1, pp. 33-34 (1932).

(3) Armin Elmendorf, "Strength Test for Paper," *Paper*, Vol. 26, April 21, 1920, index folio pp. 302, 304, 306, 308.

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(5) T. W. Lashof. "APPO-TAPPI Reference Material Program. I. Inter-Laboratory Investigation of TAPPI Standard T 414 m-49, Internal Tearing Resistance of Paper," *T A P P I*, Vol. 45, pp. 656-663 (1962).

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(7) E. V. Painter, C. C. Chu, and H. M. Morgan, "Testing Textiles on the Elmendorf Tear Tester," *Textile Research Journal*. Vol. 20, pp. 410-417 (1950).

(8) P. W. Harrison, "The Tearing Strength of Fabrics, I. A. Review of the Literature," *Journal of the Textile Institute*, Vol. 51, pp. T91-131 (1960).

APPENDIX

Description, Adjustment, and Verification of Apparatus

Description of Apparatus

A1. (*a*) The Elmendorf Tear Tester provides means for holding the specimen with two clamps, one stationary and one movable, and for tearing it by the fall of the pendulum due to the force of gravity. The Textile Model, shown diagrammatically in Fig. 2, is basically the standard Elmendorf "Tester," but is provided with two augmenting weights—the NBS Augmenting Weight which increases the capacity from 1600 to 3200 g, and the Textile Augmenting Weight which further increases it to 6400 g—and with three scales graduated in hectograms (100-g units) corresponding to the three capacities. The instrument includes the following parts (Fig. 2):

(*1*) *Stationary Clamp.*

(*2*) *Movable Clamp* carried on a pendulum formed by a sector of a circle free to swing on a ball-bearing.

(*3*) *Sector-Shaped Pendulum* carrying a circumferential scale graduated to read the tearing force directly in hectograms (Note 2). The pendulum section has a cutout in the region adjacent to the clamp so that the specimen does not rub against the sector during the test.

NOTE 2.—In some models (for example Thwing-Elmendorf Tear Tester Model 60-100, capacity 1600 g and Model 60-200, capacity 3200 g), the scale is graduated so as to indicate the percentage of the original potential energy of the pendulum consumed in tearing the specimen (Section A4).

(*4*) *Means for Holding the Pendulum in a Raised Position, and Means for Releasing it Instantaneously.*

(*5*) *Pointer and Pointer-Stop* for registering the maximum arc through which the pendulum swings when released. The pointer is mounted on the same axis as the pendulum with constant friction just sufficient to stop the pointer at the highest point reached by the swing of the section. The adjustable pointer stop provides means for setting the zero of the instrument.

(*6*) *Knife* mounted on a stationary post for initial slitting of the specimen. It is centered between the clamps and adjusted in height so that the tearing distance is 43.0 ± 0.15 mm; that is, the distance between the end of the slit made by the knife and the upper edge of the specimen is 43.0 ± 0.15 mm when the lower edge of the 63.0-mm wide specimen rests against the bottom of the clamp.

(*7*) *Leveling Screw.*

(*8*) *NBS Augmenting Weight,* to double the capacity of the tester.

(*9*) *Textile Augmenting Weight,* used in conjunction with the NBS Augmenting Weight to quadruple the original capacity of the tester.

(*b*) With the pendulum in its initial position ready for a test, the two clamps are separated by a distance of 2.8 ± 0.3 mm, and are so aligned that the specimen clamped in them lies in a plane parallel to the axis of the pendulum, the plane making an angle of 27.5 ± 0.5 deg with the perpendicular line joining the axis and the horizontal line formed by the top edges of the clamping jaws. The distance between the axis and the top edges of the clamping jaws is 103 ± 0.1 mm.

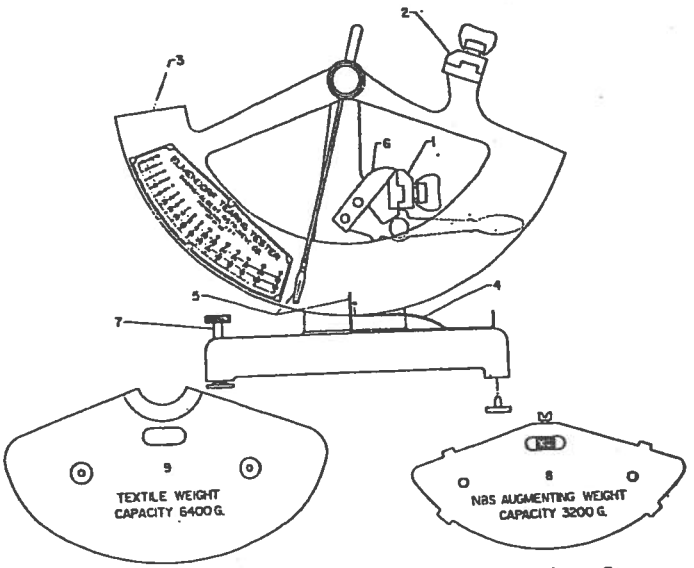
(*c*) The clamping surface in each jaw is 36 ± 1 mm wide and 16.0 ± 0.08 mm deep.

Adjustment of Apparatus

A2. (*a*) Rest the pendulum sector against its stop, and check the alignment of the clamps. Adjust the pendulum stop if necessary. Verify by visual check that the knife is centered between the clamps, and adjust it if necessary (Note 3). Check the sharpness of the knife. A dull knife will result in a *V*-notch near the top of the cut and will push the fabric out. If necessary, sharpen the knife with a rough stone (a rough edge is better than a razor edge) or replace it with a new sharp knife.

NOTE 3.—If the die is used to cut the initial slit, the instructions pertaining to the knife and its use are obviously not applicable.

(*b*) Check the tearing distance by



1—Stationary Clamp
2—Movable Clamp
3—Sector-Shaped Pendulum
4—Means for Holding the Pendulum in a Raised Position
5—Pointer and Pointer-Stop
6—Knife
7—Leveling Screw
8—NBS Augmenting Weight
9—Textile Augmenting Weight

FIG. 2.—Falling-Pendulum (Elmendorf) Tear Tester, Textile Model with Augmenting Weights.

[3] The boldface numbers in parentheses refer to the list of references appended to this method.

TABLE I.—FACTORS FOR CALCULATING TEARING FORCE IN GRAMS FROM SCALE READINGS IN PER CENT AND TESTING RANGE.

Elemendorf Tear Tester	Capacity (grams)	Factors for Calculating Tearing Force in grams from Scale Readings in per cent	Testing Range 20 to 60 per cent Capacity (grams)
Standard Instrument, without Augmenting Weights	1600	16	320 to 960
Standard Instrument, with NBS Augmenting Weight	3200	32	640 to 1920
Standard Instrument with NBS and Textile Augmenting Weights	6400	64	1280 to 3840

using the die to cut a specimen from coordinate paper graduated in millimeters. Apply a small amount of graphite to the cutting knife or the edge of the die used for cutting the slit (from an ordinary lead pencil) so that when the cut is made some of the graphite transfers to the paper; this serves to contrast the cut from the uncut portion of the paper and facilitates the measurement. Make this measurement either with a good quality steel rule graduated in 0.2 mm or better and under magnification, or alternatively, by use of a go, no-go gage available from the manufacturer of the instrument. If necessary adjust the height of the knife. Do *not* change the dimensions of the specimen.

(*c*) Level the instrument so that, with the sector free, the line on the sector indicating the vertical from the point of suspension is bisected by the edge of the pendulum stop mechanism. Movement of the instrument during the swinging of the pendulum is a significant source of error. Therefore, securely anchor the instrument to a heavy table or bench (Note 4). Use a table sufficiently rigid that there will be no perceptible movement of the table or instrument during the swing of the pendulum.

NOTE 4.—Threaded bolt holes are usually provided in the base of the instrument and may be used to secure the instrument to the table. An alternative procedure is to place the instrument on a guide which ensures that the instrument always has the same position on the table. A so-called "floor-strip" is available from the manufacturer for this purpose.

(*d*) Check the friction in the main bearing as follows: Draw a pencil line on the pendulum-stop mechanism 25 mm to the right of the sector stop. Raise the sector and holding the sector stop down, pointer against its stop. On releasing the sectr and holding the sector stop down, the sector should make at least 20 complete oscillations before the edge of the sector which engages the stop no longer passes to the left of the pencil line. Otherwise, clean, oil, and adjust the bearing.

(*e*) Check the zero pointer stop as follows: Operate the leveled instrument several times with nothing in the clamps, the movable clamp being closed. If zero is not registered, adjust the pointer stop until the zero reading is obtained. Do *not* change the level to adjust the zero.

(*f*) Check the friction of the pointer as follows: Set the pointer at the zero reading on the scale before releasing the sector, and after release see that the pointer is not pushed *more than three scale divisions* (4 *mm*) *nor less than two scale divisions* (2½ *mm*) beyond the zero. If the pointer friction does not lie between two and three divisions, remove the pointer, wipe the bearing clean, and apply a trace of good clock oil to the groove of the bearing. Reassemble and check pointer friction. Recheck zero and readjust the pointer stop if necessary.

Verification of Scale

A3. (*a*) The scale may be verified either by the relatively simple method which uses Elmendorf check weights obtainable from the manufacturer; or alternatively by the procedure described in the Method of Test for Internal Tearing Resistance of Paper (ASTM Designation: D 689),[4] which is relatively time consuming and more complicated. The same accuracy and effectiveness are claimed for the two methods.

(*b*) Once the scale has been verified, it is unnecessary to repeat this step provided the tester is kept in adjustment and no parts are changed or become worn.

(*c*) Anchor and level the tester as described in Section A2.

(*d*) *Check Weight Method:*

(*1*) Use a set of five check weights calibrated for five values of the Elmendorf Tester, namely 320, 560, 880, 1200, and 1440 g (that is 20, 35, 55, 75 and 90 per cent of the scale value of the 1600-g scale); and so constructed that each weight can be inserted in the clamps by the procedure used for a fabric specimen.

(*2*) With pendulum in the raised position, open the clamp of the pendulum, slide the weight into position, and fasten it securely in the clamp. Depress the pendulum stop, thus releasing the pendulum. Hold down the stop until after the tear is completed and catch the pendulum on the return swing. Read the scale to the nearest division. See Section 10(*d*).

(*3*) Repeat this procedure with each of the check weights.

(*e*) *ASTM Method D 689 Procedure:*

(*1*) Clamp a known weight in grams, W, to the radial edge of the sector beneath the jaws, the center of gravity of the weight (including means of attachment) having been previously marked by a punched dot on the face of the weight that is to be to the front of the instrument.

(*2*) Raise and set the sector as for tearing a specimen and, by means of a surface gage or cathetometer, measure in centimeters to the nearest 0.01 cm the height, H, of the center of gravity of the weight above a fixed horizontal surface. Then release the sector, allow it to swing, and note the pointer reading. Without touching the pointer, raise the sector until the edge of the pointer just meets with its stop, in which position again determine the height, h, of the center of gravity of the weight above the fixed surface.

(*3*) The work done is $W(h - H)$ gram-centimeters. The pointer reading should be $KW(h - H)$, where K is 1/8.6 cm (that is 1 divided by twice the distance torn) (Note 5).

NOTE 5.—The value of this K differs from that given in ASTM Method D 689 because the latter is based on tearing 16 sheets of paper; and therefore, the distance torn is 16 times greater (that is 137.6 versus 8.6 cm).

Instrument Factors for Calculation and Testing Range

A4. (*a*) For instruments with scales calibrated in per cent, use the factors given in Table I for calculating the tearing force in grams. These factors take into account the capacity of the tester.

(*b*) The acceptable testing range of between 20 and 60 per cent of the scale value is shown for the direct-reading scale in Table I.

[4] 1969 Book of ASTM Standards, Part 15.

Abrasion Resistance of Fabrics: Accelerotor Method

Developed in 1959 by AATCC Committee RA29; revised 1966; editorially revised 1969, 1972; reaffirmed 1970.

1. Purpose and Scope

1.1 This test is intended for evaluating the resistance of fabrics and other flexible materials to abrasion (see 13.1).

2. Principle

2.1 An unfettered fabric specimen is driven by an impeller (rotor) along a zigzag course in a generally circular orbit within a chamber, so that it repeatedly impinges the walls and abradant liner of the chamber, while at the same time it is being continually subjected to extremely rapid, high velocity impacts. The specimen is subjected to flexing, rubbing, shock, compression, stretching, and other mechanical forces during the test. Thus abrasion is produced throughout the body of the specimen by rubbing of yarn against yarn and fiber against fiber, as well as by rubbing of surface against surface and surface against abradant.

2.2 Evaluation is made on the basis of weight loss of the specimen, or grab strength loss of the specimen broken at the abraded edge, or on the basis of change in other characteristics such as air permeability, light transmission, visual appearance, hand, etc., depending on the type of fabric and its intended end use. Generally, flat woven fabrics should be tested by the grab breaking strength loss method, while tufted and other "3-dimensional" fabrics should be tested by the weight loss method.

3. Uses and Limitations

3.1 The results of the test are affected by its duration, the size, shape, and angular velocity of the rotor, and by the type of liner used. These effects are interrelated and may be varied to produce the desired degree of abrasion in the test specimen. For example, it may require only 2 or 3 minutes at 2000 rpm to produce a reasonable degree of abrasion in a delicate or fragile fabric, while a heavier or more durable fabric may require 10 minutes at 3000 rpm.

3.2 The results of this test should not be equated with service life.

4. Apparatus and Materials

4.1 Accelerotor (Fig. 1) (see 13.2).

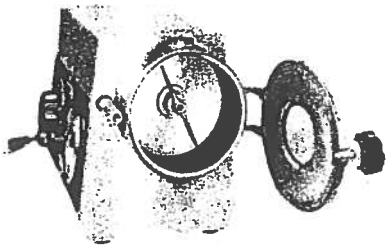


Fig. 1—Accelerotor Fitted with Abrasive Liner over Foam Rubber Cushion and with 4½" S-Shape Rotor.

4.1.1 Rotor, offset (elongated S-shape), 4½ in. (114.3 mm) (Fig. 2) (see 13.3).

Fig. 2—Elongated S-Shape Rotor.

4.1.2 Collar insert, plastic, lined with ⅛ in. (3.175 mm) polyurethane foam (see 13.4).

4.2 Liner, abrasive No. 250 (see 13.2 and 13.5).

4.3 Neon Lamp or another stroboscopic device (see 13.2).

4.4 Timer, automatic, accurate to ±1 second.

4.5 Adhesive (see 13.6).

4.6 Tape, coated one side (Permacel P-691 (see 13.2).

4.7 Tape, coated both sides (Permacel P-50) (see 13.2).

4.8 Brush, nylon (see 13.2).

4.9 Thread, size E, Type I, Class 1 or 2, Fed. Spec. V-T-295 (see 13.7).

5. Sampling

5.1 The specimens must be representative of the whole sample to be tested.

6. Specimens

6.1 Number.—A minimum of three replicates is required.

6.2 Size.

6.2.1 Method A (for evaluation by the weight loss method).—Specimens of heavier or bulkier fabrics should be cut smaller than those of lighter fabrics. Table I is a guide to the relationship between fabric weight, in ounces per square yard, and specimen size.

Table I

Selection of Specimen Size

Weight Range of Fabrics oz per sq yd (g per sq m)	*Size of specimens*
9-12 (300-400)	3-3/4 in. (95 mm) sq.
6- 9 (200-300)	4¼ in. (115 mm) sq.
3- 6 (100-200)	5¼ in. (135 mm) sq.
less than 3 (100)	6 in. (150 mm) sq.

6.2.2 Method B (for evaluation by the grab breaking—strength loss method).—The specimen size is 4 in. x 6 in. (100 mm x 150 mm) with the greater length in the direction of the yarn to be broken (see 7.1.2).

7. Preparation

7.1 Specimens.

7.1.1 Method A—Cut a specimen with pinking shears (see 13.8). Place it on paper (to protect bench top) and apply a thin coating of adhesive to each pinked edge (Fig. 3) (see 13.6). Allow the adhesive to dry at room temperature.

7.1.2 Method B—Cut Specimens 4 x 12 in. (100 x 300 mm) (twice the length required for the grab breaking test). Number each specimen at both ends, and then cut in half, one half for determining the original grab breaking strength, and the other for determining grab breaking strength after abrading. The specimen to be abraded should then be prepared as in Method A. Then fold each specimen across the long dimension 2 inches from an end, making it into a 4 x 4 in. (100 x 100 mm) square. Attach the 2 x 4 in. (50 x 100 mm) flap with a seam ¼ in. (6.4 mm) from its edges including the folded edge to the body of the specimen (Fig. 4). Use 11 stitches to the inch (see 13.7).

7.2 Adjustment of Tachometer on Accelerotor.

7.2.1 Neon Lamp.—To check the accuracy of the tachometer, the neon lamp is used as a simple stroboscope to view the spinning rotor. With the test chamber door *closed* and the neon

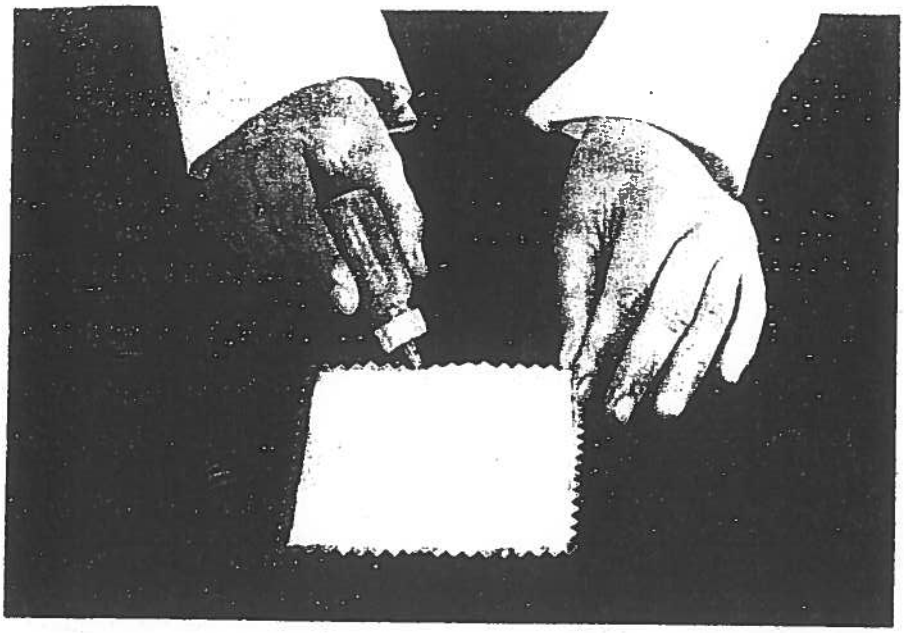


Fig. 3—Application of Ubabond Replacement Adhesive to Pinked Edges of Specimen from Plastic Squeeze Bottle.

bulb held close to the window of the door, the rotor gives distinct patterns at several useful speeds. With some practice, the following patterns will be recognized: 1800 rpm—the rotor appears as a stationary distinct two-bladed figure; 3600 rpm—the hub of the rotor appears as a stationary blur with two slight lobes apparent on the sides of the hub. If the tachometer does not read the appropriate speed, turn the small screw on the dial face to correct it.

7.2.2 Stroboscope.—Set the stroboscope dial at 3000 rpm. *Close the door.* Start the Accelerotor and bring the speed of the rotor to a point at which it appears as a stationary, two-bladed figure. If the tachometer does not read 3000 rpm turn the small screw on its dial face to correct it.

7.3 Liners (see 13.9).

7.3.1 Installation of Liners—Cut a 16½ in. (420 mm) long strip of No. 250 abrasive liner and fit it *snugly* inside a foam-lined collar. This results in about ½ in. (12.7 cm) overlap. Draw a line along the overlap edge and trim to form a close butt. Join the butt ends by pressing a 2¾ x 1 in. (76.2 x 25.4 mm) piece of single-face tape (Permacel P-691) along the underside of the abrasive liner at the butt joint. Replace the liner and fasten it to the collar by means of a 1 x ½ in. (25.4 x 12.7 mm) tab of single-face tape, at each end of the butt (the tape beginning from ¼ in. (6.4 mm) in on the abrasive liner face and lapping over the edge to the underside of the collar as illustrated in Figure 5).

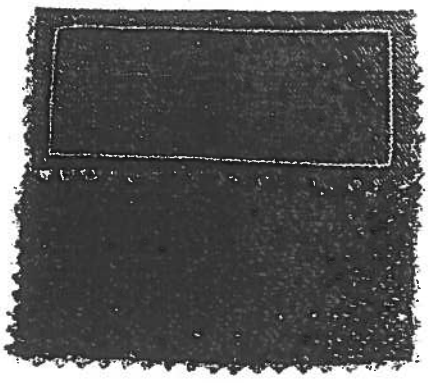


Fig. 4—Specimen Prepared for Testing by Method B.

7.3.2 Break-in of Fresh Liner—Insert the prepared collar into the Accelerotor equipped with the selected rotor. Break in the abrasive liner by running a 4½ in. (115 mm) square specimen of 80 x 80 finish-free cotton (preferably Airplane Cloth), edged with adhesive. *Close the door,* start the Accelerotor and maintain rotor speed at 3000 rpm for 12 minutes. If difficulties are encountered in running one specimen 12 minutes, two specimens may be run, one after the other, for 6 minutes each. Stop the Accelerotor and remove the specimen. Brush the abrasive liner to remove detritus.

7.3.3 Reversal of Liner—For greater reproducibility, it is recommended that after six test specimens have been run the collar assembly be removed from the Accelerotor and replaced in such a way that the rim which was next to the door goes to the back of the chamber.

7.3.4 Change of Liner—It is recommended that an abrasive liner be discarded after 12 specimens have been run (see 13.10).

8. Conditioning

8.1 Preconditioning. Let specimen reach moisture equilibrium in a standard atmosphere for preconditioning prior to conditioning it in the standard atmosphere for testing (see 13.11).

8.1.1 Moisture equilibrium for preconditioning is defined as having been attained when the change in weight does not exceed 0.5% of the weight of the specimen per 2 hr of exposure.

8.1.2 The standard atmosphere for preconditioning is an atmosphere of low relative humidity (5-25%) at a temperature not exceeding 120F (49C).

8.2 Testing. Let specimen reach moisture equilibrium in the standard atmosphere for testing: 70 ± 2F (21 ± 1C) and 65% ± 2% RH.

8.2.1 Moisture equilibrium for conditioning at the standard atmosphere is defined as having been attained when progressive gain in weight does does exceed 0.1% of conditioned weight per 2 hr of exposure.

9. Safety Precaution

9.1 For safety, the door of the Accelerotor must be kept closed whenever the motor is running.

10. Testing Procedures

10.1 Method A—Weight Loss.

10.1.1 Weigh the conditioned specimen (see 8.1) on an analytical balance to ±0.001 gram.

10.1.2 Set up Accelerotor with the elongated, S-shaped, offset, 4½-in

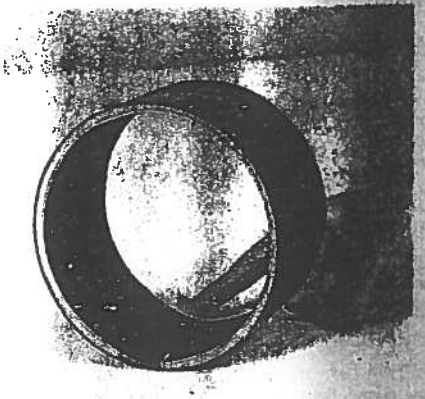


Fig. 5—Securing Abrasive Liner to Foam-Lined Collar.

(114.3 mm) long rotor, and No. 250 grit liner (13.3 and 13.9).

10.1.3 Crumple the test specimen and place it in the chamber.

10.1.4 *Close the door* (see 9), start the Accelerotor and maintain accurately at a selected speed for the desired time.

10.1.5 Stop the Accelerotor, and remove the test specimen.

10.1.6 Brush the liner to remove detritus.

10.1.7 Shake the specimen free of detritus.

10.1.8 Condition the tested specimen (see 8.2 and 8.2.1).

10.1.9 Reweigh the specimen on an analytical balance to ±0.001 gram.

10.2 Method B—Strength Loss.

10.2.1 Perform Steps 10.1.2 through 10.1.7.

10.2.2 Remove stitching thread to restore specimen to 4 x 6 in. (100 x 150 mm) dimension.

10.2.3 Condition specimen as in 8.2 and 8.2.1.

10.2.4 Determine breaking strength by the Grab Method ASTM D 1682, placing the worn edge of the test specimen between the jaws of the tensile tester (see 13.12). The specimen must break at the abraded edge for a valid test.

10.2.5 Determine breaking strength on conditioned (see 8.2) original (unabraded) (see 7.1.2) specimen.

11. Calculation and Evaluation

11.1 Method A.—Weight Loss. Calculate the percent loss in weight for each specimen to ±0.1%.

11.2 Method B.—Strength Loss. Calculate the percent strength loss for each pair (see 7.1.2) of specimens.

11.3 Additional tests. Additional evaluations may be made by determining abrasion-caused changes in air permeability, light transmission, thickness, visual appearance, hand, stiffness, etc.

12. Report

12.1 Method A—Report the average percent weight loss for the three replicate test specimens.

12.2 Method B—Report the average percent tensile strength loss for the three test specimens.

12.3 The report must state the exact conditions employed, *i.e.*, speed, time, size and type of rotor, and type of liner.

13. Notes

13.1 For additional information see: "Abrasion Testing with the Accelerotor-Reproducibility in Interlaboratory Tests." *Am. Dyestuff Reptr.* 47, No. 20, 679-83 (1958). "The Accelerotor for Abrasion Testing and Other Purposes." *Ibid.* 45, No. 19, 685-700 (1956).

13.2 For procurement write to Atlas Electric Devices Co., 4114 North Ravenswood Avenue, Chicago, Illinois 60613.

13.3 For special applications, pitched-blade rotors 4¼ in. (107.95 mm), 4½ in. (114.3 mm) and 4¾ in. (120.65 mm) and a shorter, 4¼ in. (107.95 mm) offset S-shaped rotor are available.

13.4 For special applications, a ¼ in. (6.4 mm) neoprene sponge liner, which can be used in place of the collar, is available.

13.5 For special applications, abrasive liner No. 180 is available.

13.6 To prevent fraying, Ubabond Replacement Adhesive is applied to pinked edges of the specimen with a plastic squeeze bottle (see Fig. 3) to form a thin coating on edges. Penetration of adhesive into edges of specimen can be aided by use of small stiff brush. For unusual fabrics which cannot be pinked, specimens may be ravelled ⅛ in (3.2 mm) along each edge and adhesive applied as above.

13.7 For procurement information regarding a suitable thread, write to: AATCC Technical Center, P. O. Box 12215, Research Triangle Park, N. C. 27709.

13.8 It is convenient to mark specimens for cutting by means of square templates made of metal, plastic or cardboard. If available, cutting dies of appropriate dimensions may also be used; however, died specimens should be ravelled prior to the edge sealing (see 13.6).

13.9 The No. 250 grit liner is used in most tests, but for special applications the No. 180 grit liner, and the no-grit (¼ in. or 6.4 mm neoprene sponge) liner may be used. The No. 180 grit liner is installed the same way as the No. 250 liner. When the neoprene sponge liner is used, no collar insert is needed, instead the liner is secured in the chamber by placing a small piece of a double-face tape (Permacel No. P-50) between the butt joint of the liner and the chamber wall. No break-in of this type of liner is necessary.

13.10 If the liner has not been subjected to severe duty, it may be used for more than 12 tests. The effective life of a liner may be checked by determining the weight loss of a control fabric, such as 80 x 80 cotton at the beginning of a series of tests and after intervals of 5 or 6 test specimen runs.

13.11 Preconditioning time, temperature and relative humidity are important for measurements in which regain is critical, as in weight change measurements.

13.12 Tensile strength tester as described in ASTM D 76.

Designation: D 3786 – 87

Standard Test Method for Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics—Diaphragm Bursting Strength Tester Method[1]

This standard is issued under the fixed designation D 3786; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method covers the determination of the resistance of textile fabrics to bursting using the Hydraulic Diaphragm Bursting Tester. This test method is generally applicable to a wide variety of knitted goods and nonwoven fabrics (see 8.1).

1.2 This test method is not recommended for general use on uncoated woven fabrics, which are generally tested for breaking strength (load) as directed in Test Methods D 1682.

NOTE 1—For the measurement of the bursting strength by means of a ball burst mechanism, refer to Test Method D 3787.

1.3 *This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

D 123 Terminology Relating to Textiles[2]

D 1682 Test Methods for Breaking Load and Elongation of Textile Fabrics[2]

D 1776 Practice for Conditioning Textiles for Testing[2]

D 3787 Test Method for Bursting Strength of Knitted Goods—Constant-Rate-of-Traverse (CRT) Ball Burst Test[3]

2.2 *Other Standard:*

TAPPI T 403, OS-74 Bursting Strength of Paper[4]

3. Definitions

3.1 *bursting strength, n*—the force or pressure required to rupture a textile by distending it with a force, applied at right angles to the plane of the fabric, under specified conditions.

3.2 *knitted fabric, n*—a structure produced by interlooping one or more ends of yarn or comparable material.

3.3 *nonwoven fabric, n*—a textile structure produced by bonding or interlocking fibers, or both, accomplished by mechanical, chemical, or solvent means, and combinations thereof.

3.3.1 *Discussion*—The term does not include paper or fabrics that are woven, knitted or tufted.

3.4 For definitions of other textile terms used in this test method, refer to Terminology D 123.

4. Summary of Method

4.1 A specimen of the fabric or garment is clamped over an expandable diaphragm. The diaphragm is expanded by fluid pressure to the point of specimen rupture. The difference between the total pressure required to rupture the specimen and the pressure required to inflate the diaphragm is reported as the bursting strength.

5. Uses and Significance

5.1 This method for the determination of diaphragm bursting strength of knitted goods and nonwoven fabrics is being used by the textile industry for the evaluation of a wide variety of fabrics.

5.2 Although test results obtained using the procedures in Test Method D 3786 have not been correlated with actual performance, Test Method D 3786 is considered satisfactory for acceptance testing of commercial shipments of knitted fabrics for bursting strength since the method has been used extensively in the trade for acceptance testing. In cases of disagreement arising from differences in values reported by the purchaser and the seller when using Test Method D 3786 for acceptance testing, the statistical bias, if any, between the laboratory of the purchaser and the laboratory of the seller should be determined with comparison based on testing specimens randomly drawn from one sample of material of the type being evaluated.

NOTE 2—The kind of load transfer and stretch that occur when knitted goods and nonwoven fabrics are worn are prevented by clamping them as described in this method.

6. Sampling

6.1 *Lot Sample*—As a lot sample for acceptance testing, take at random the number of rolls of fabric directed in an applicable material specification or other agreement between the purchaser and the supplier. Consider rolls of fabric to be the primary sampling units.

NOTE 3—An adequate specification or other agreement between the purchaser and the supplier requires taking into account the variability between rolls of fabric and between specimens from a swatch from a roll of fabric to provide a sampling plan with a meaningful producer's risk, consumer's risk, acceptable quality level, and limiting quality level.

6.2 *Laboratory Sample*—As a laboratory sample for acceptance testing, take a full width swatch 1 m (1 yd) long

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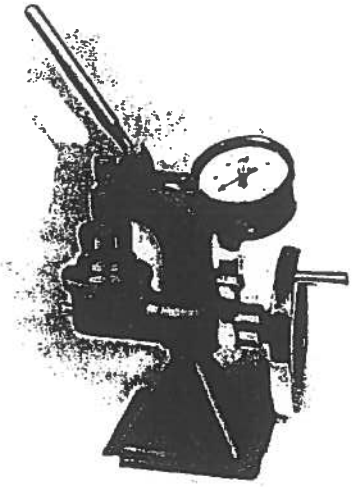
[1] This test method is under the jurisdiction of ASTM Committee D-13 on Textiles and is the direct responsibility of Subcommittee D13.59 on Fabric Test Methods, General.

Current edition approved July 31, 1987. Published September 1987. Originally published as D 3786 – 79. Last previous edition D 3786 – 80a.

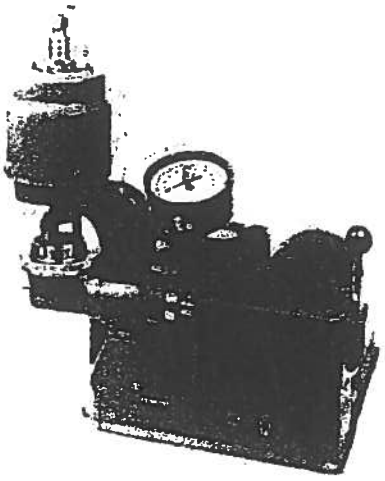
[2] *Annual Book of ASTM Standards*, Vol 07.01.

[3] *Annual Book of ASTM Standards*, Vol 07.02.

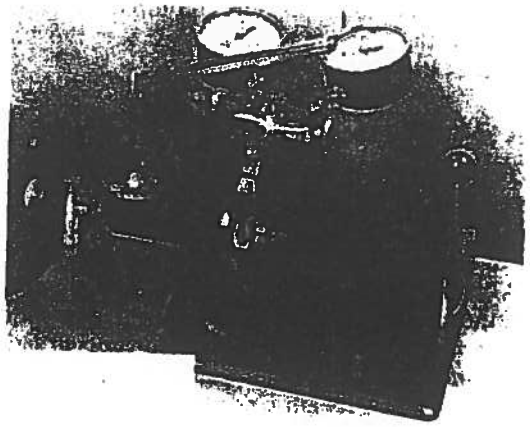
[4] Available from Technical Association of the Pulp and Paper Industry, 1 Dunwoody Park, Atlanta, GA 30341.



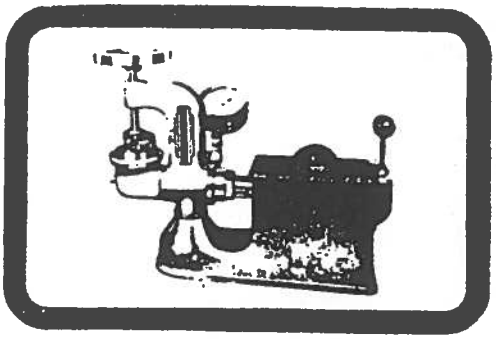
(a) Model LC (hand-driven)



(c) Model C-A (motor-driven)



(b) Model C (motor-driven)



(d) Model A (motor-driven)

FIG. 1 Hydraulic Diaphragm Bursting Tester

from the end of each roll of fabric in the lot sample, after first discarding a minimum of 1 m (1 yd) of fabric from the very outside of the roll. From each roll or piece of circular knit fabric selected from the lot sample, cut a band at least 305 mm (1 ft) wide.

6.3 *Test Specimens*—Cut ten test specimens from each swatch in the laboratory sample with each specimen being 125 mm (5 in.) square.

7. Conditioning

7.1 Bring the specimens (or laboratory samples) from the prevailing atmosphere to moisture equilibrium for testing in the standard atmosphere for textile testing as directed in Practice D 1776.

8. Apparatus and Materials

8.1 *Hydraulic Diaphram Bursting Tester*[5]—A testing machine that meets the requirements of 8.1.1 through 8.1.4. In cases of dispute, a motor-driven tester shall be used unless the purchaser and the supplier agree otherwise. See Fig. 1.

8.1.1 *Clamps*, for firmly and uniformly securing the test specimen between two annular, plane, parallel, and preferably stainless steel surfaces, without slippage during the test. Use sufficient pressure to effect the practicable minimization of slippage.

8.1.1.1 The upper and lower clamping surfaces shall have a circular opening at least 75 mm (3 in.) in diameter and coaxial apertures of 31 ± 0.75 mm (1.22 ± 0.03 in.) in diameter. The surfaces of the clamps between which the specimen is placed shall have concentric grooves spaced not less than 0.8 mm (1/32 in.) apart and shall be of a depth not less than 0.015 mm (0.0006 in.) from the edge of the aperture. The surfaces of the clamps shall be metallic and any edge which might cause a cutting action shall be rounded to a radius of not more than 0.4 mm (1/64 in.). The lower

[5] The Hydraulic Diaphragm Bursting Testers, hand driven Model LC (Fig. 1A) and motor driven Models C (Fig. 1B) and (Fig. 1C), and accessories, manufactured by B. F. Perkins & Son, Inc., G.P.O. 366, Chicopee, MA 01021, have been found satisfactory. The motor driven Model A (Fig. 1D) has been found to be satisfactory for heavyweight fabrics, but may be unsuitable for some lightweight fabrics. Model C and Model A have different pumping rates and different diaphragms; therefore, it is not likely these two machines will give the same result. The testers also can be obtained from Testing Machines, Inc., 400 Bayview Ave., Amityville, NY 11701.

clamp shall be integral with the chamber in which a screw shall operate to force a liquid pressure medium at a uniform rate of 95 ± 5 mL/min against the rubber diaphragm.

NOTE 4—Since the clamping mechanism and clamping surfaces are subject to considerable wear and distortion, they should be examined periodically and repaired or replaced when necessary. The effectiveness of grooving the clamping surfaces in the manner specified has not been determined.

8.1.2 *Diaphragm*[5]—A diaphragm of molded synthetic rubber, 1.80 ± 0.05 mm (0.070 ± 0.002 in.) in thickness with reinforced center, clamped between the lower clamping plate and the rest of the apparatus so that before the diaphragm is stretched by pressure underneath it the center of its upper surface is below the plane of the clamping surface. The pressure required to raise the free surface of the diaphragm plane shall be 30 ± 5 kPa (4.3 ± 0.8 psi). This pressure shall be checked at least once a month. To test, a bridge gage[5] may be used, the test being carried out with the clamping ring removed. The diaphragm should be inspected frequently for permanent distortion and renewed if necessary.

8.1.3 *Pressure Gage*—A maximum-reading pressure gage of the Bourdon type of appropriate capacity graduated in pounds and accurate throughout the entire range of its scale to within a value of 1% of its maximum capacity. The capacity of the gage shall be such that the individual readings will be not less than 25 % nor more than 75 % of the total capacity of the gage.

8.1.4 *Hydraulic Pressure System*—A means of applying controlled increasing hydrostatic pressure to the underside of the diaphragm until the specimen bursts through a fluid displaced at the rate of 95 ± 5 mL/min. The fluid is displaced by a piston in the pressure chamber of the apparatus. The recommended chamber fluid is USP chemically pure 96 % glycerin. The hydraulic system, including the gages shall be mounted so as to be free of externally induced vibrations. Means shall be provided at the instant of rupture of the specimen for stopping any further application of the loading pressure and for holding unchanged the contents of the pressure chamber until the total bursting pressure and the pressure required to inflate the diaphragm indicated on the gage have been recorded.

NOTE 5—Ethylene glycol may be substituted for the glycerine if desired.

8.1.5 *Aluminum Foil for Calibration of Tester*[6]—Pieces of pretested aluminum sheet having a known bursting strength in the range of 70 to 790 kPa (10 to 115 psi) are used for checking the overall performance of the tester.

9. Calibration

9.1 *Routine Verification of Testing Machine*—Check the operation of the testing machine at least once each month by bursting five specimens of standard aluminum sheet. The average of the indicated bursting resistance for the five specimens of aluminum sheet should be between ±5 % of that marked on the package of the pretested aluminum shee standard.

9.2 *Calibration of Gage*—Calibrate the gage, while inclined at the same angle at which it is used, by means of a dead-weight tester of the piston type, or by means of a column of mercury. Such calibration is preferably carried out with the gage in its normal position in the tester.

9.3 Where agreement is not attained, check the tester according to the instructions given in Tappi Method T-403 OS-74.

NOTE 6—Possible causes of low readings are gage error (bias or nonlinearity), gage expansivity too high, excessive gage pointer friction, air in hydraulic system or gage, diaphragm collapsed too far at zero, and low pumping rate (hand-driven tester). Possible causes of high readings are: gage error (bias nonlinearity), loose gage pointer (overshoot), gage pointer bent by stop-pin, insufficient clamping force (slipping), nonuniform clamping (partial slipping), stiff or inelastic diaphragm, diaphragm above clamping plate at zero, multiple sheet testing, high pumping rate (hand-driven tester), and double bursts. If a gage is accidently used beyond its capacity, it must be recalibrated before it is used again.

10. Selection and Number of Specimens

10.1 Unless otherwise agreed upon, as when specified in an applicable material specification, take ten specimens of the laboratory sample(s) of fabric. Each specimen shall be at least 125 mm (5 in.) square, or a circle 125 mm (5 in.) in diameter. Specimens need not be cut for testing. No two specimens from knitted fabric should contain the same wale or course yarns. Take no specimens nearer the selvage than one tenth the fabric width. This restriction does not apply to tubular knitted fabric.

11. Procedure

11.1 Unless otherwise specified, make all tests on specimens conditioned in the standard atmosphere for testing textiles as directed in 7.1.

11.2 *Hand Driven Tester:*

11.2.1 Insert the conditioned specimen under the tripod, drawing the fabric taut across the plate, and clamp fabric in place by bringing the clamping lever as far to the right as possible.

NOTE 7—For fabrics with considerable stretch, it may be necessary to extend the fabric uniformly over the plate to remove some of the stretch before clamping.

11.2.2 Rotate the hand wheel, clockwise at a uniform speed of 120 rpm until the sample bursts.

11.2.3 Stop turning the hand wheel at the instant of rupture of the specimen (see Note 8).

11.2.4 Immediately after rupture and in rapid succession, release the clamping lever over the specimen. Immediately release the strain on the diaphragm by turning the wheel counterclockwise to its starting position and record the pressure required to inflate the diaphragm (tare pressure). Record the total pressure required to rupture the specimen.

NOTE 8—If the pressure stops increasing, as indicated by the dial, and the specimen has not broken, push the operating lever to remove the pressure. Record that the stretch of the fabric exceeds the dimensional limitations of the tester. If slippage of the specimen is noted, discard the result and use a new specimen.

11.3 *Motor-Driven Tester:*

[6] Standardized aluminum sheets for this purpose, bursting over the range from 51 to 150 psi (350 to 1035 kPa) may be obtained from the Pulp and Paper Research Institute of Canada, 3420 University St., Montreal, Canada; from Testing Foil Service, 304 N. Stevens St., Rhinelander, WI 54501; and from Testing Machines, Inc., 400 Bayview Ave., Amityville, NY 11701.

TABLE 1 Components of Variance for Bursting Strength Expressed as Standard Deviations, Percentage Points

	Single-Operator Component	Within-Laboratory Component	Between-Laboratory Component
Spun yarns in circular knit	6.8	1.1	2.5
Filament yarns in tricot knit	2.3	3.1	2.6

11.3.1 Insert the conditioned specimen under the tripod, drawing the fabric taut across the plate, and clamp fabric in place by bringing the clamping lever as far to the right as possible (see Note 6).

11.3.2 Inflate the diaphragm by moving the operating handle to the left.

11.3.3 While the diaphragm is inflating, take hold of the latch that is located below, or to the right, of the operating handle. At the instant of rupture of the specimen, swing the latch as far as it will go to bring the operating handle to an idling (neutral) position (see Note 8). Record the total pressure required to rupture the specimen.

11.3.4 Immediately after rupture, and in rapid succession, release the clamping lever over the specimen. Immediately relieve the strain on the diaphragm by dropping the latch back to its normal position, throw the operating handle to the right, and record the pressure required to inflate the diaphragm (tare pressure).

12. Calculation

12.1 Calculate the bursting strength of each specimen by subtracting the tare pressure required to inflate the diaphragm from the total pressure required to rupture the specimen.

12.2 Calculate the average of all specimens tested.

13. Report

13.1 State that the specimens were tested as directed in Test Method D 3786 using the Hydraulic Diaphragm Bursting Tester. Describe the material or product sampled and the method of sampling used.

13.2 Report the bursting strength of each individual specimen and their average in kPa (psi).

13.3 Report the type of bursting tester used.

14. Precision and Bias

14.1 *Summary*—In comparing two averages of ten observations each, the difference should not exceed the following critical differences in 95 out of 100 cases when both sets of observations are taken by the same well-trained operator using the same piece of test equipment and specimens randomly drawn from the same sample of material.

Spun yarn in circular knit	41 kPa (6.0 psi)
Filament yarn in tricot knit	14 kPa (2.0 psi)

Larger differences are likely to occur under all other circumstances. The value of the bursting strength of knitted goods can only be defined in terms of a specific test method.

TABLE 2 Critical Differences for Bursting Strength for the Conditions Noted, Percentage Points[A]

	Number of Observations in Each Average	Single-Operator Precision	Within-Laboratory Precision	Between-Laboratory Precision
Spun yarns in circular knit	5	8.4	9.0	11.3
	10	6.0	6.7	9.6
	20	4.2	5.2	8.7
	40	3.0	4.3	8.1
Filament yarns in tricot knit	5	2.9	9.1	11.6
	10	2.0	8.8	11.4
	20	1.4	8.7	11.3
	40	1.0	8.7	11.3

[A] The critical differences were calculated using $t = 1.645$, which is based on infinite degrees of freedom.

Within this limitation, the procedure for bursting strength in Test Method D 3786 has no known bias. Sections 14.2 through 14.4 explain the basis for this summary and for evaluations made under other conditions.

14.2 *Interlaboratory Test Data*[7]—An interlaboratory test was run in 1977 in which randomly drawn specimens of six fabrics were tested in each of four to five laboratories. Three fabrics were circular knit fabrics containing spun yarns and three of the fabrics were tricot knit fabrics containing filament yarns. The components of variance for bursting strength results expressed as standard deviations were calculated to be the values reported in Table 1.

NOTE 9—The difference in variability between the two groups of fabrics is thought to be the result of the differences between the source yarns rather than the type of equipment on which the fabrics were knit. There is no objective evidence to substantiate this belief.

NOTE 10—The interlaboratory test data were obtained with motor-driven testers. The precision of the method using a hand-operated tester has not been determined.

14.3 *Critical Differences*—For the components of variance reported in 14.2, two averages of observed values should be considered significantly different at the 95 % probability level if the difference equals or exceeds the critical differences listed in Table 2 (Note 9).

NOTE 11—The tabulated values of the critical differences should be considered to be a general statement particularly with respect to between-laboratory precision. Before a statement can be made about two specific laboratories, the amount of statistical bias, if any, between them must be established, with each comparison being based on recent data obtained on specimens randomly drawn from a sample taken at random from a lot of the material to be evaluated.

14.4 *Bias*—The bursting strength of knit goods can only be defined in terms of a specific test method. Within this limitation, the procedure in Test Method D 3786 for bursting strength has no known bias.

15. Indexing Terms

15.1 This standard is indexed under the following terms: knitted fabric, nonwoven fabric, and bursting strength.

[7] ASTM Research Report No. RR:D13-1061. A copy is available on loan from ASTM Headquarters, 1916 Race St., Philadelphia, PA 19103.

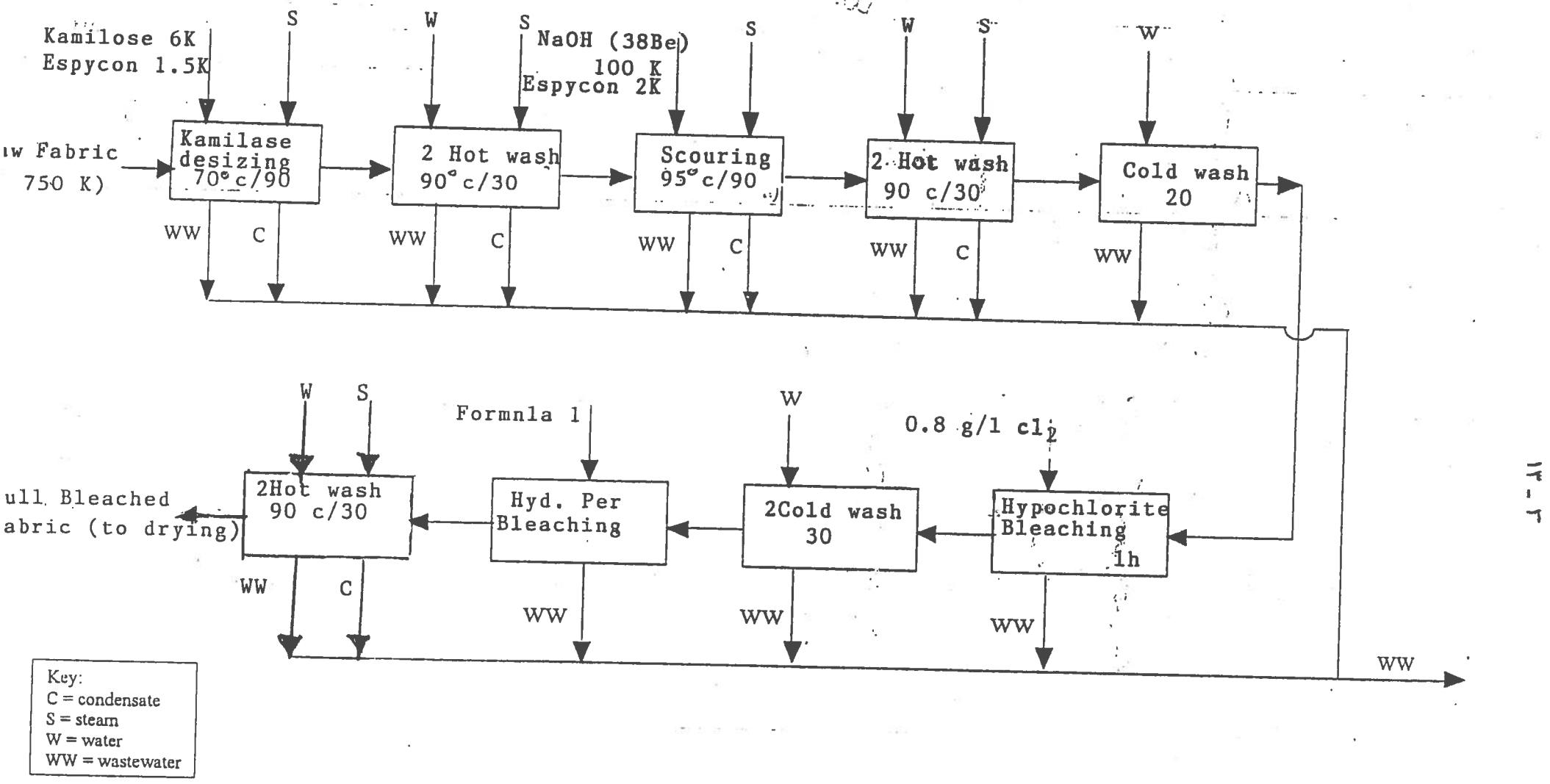


Fig. 4 Typical Process Flow Diagram of Woven Fabric Pretreatments on Jiggers (Enzymatic Desizing)

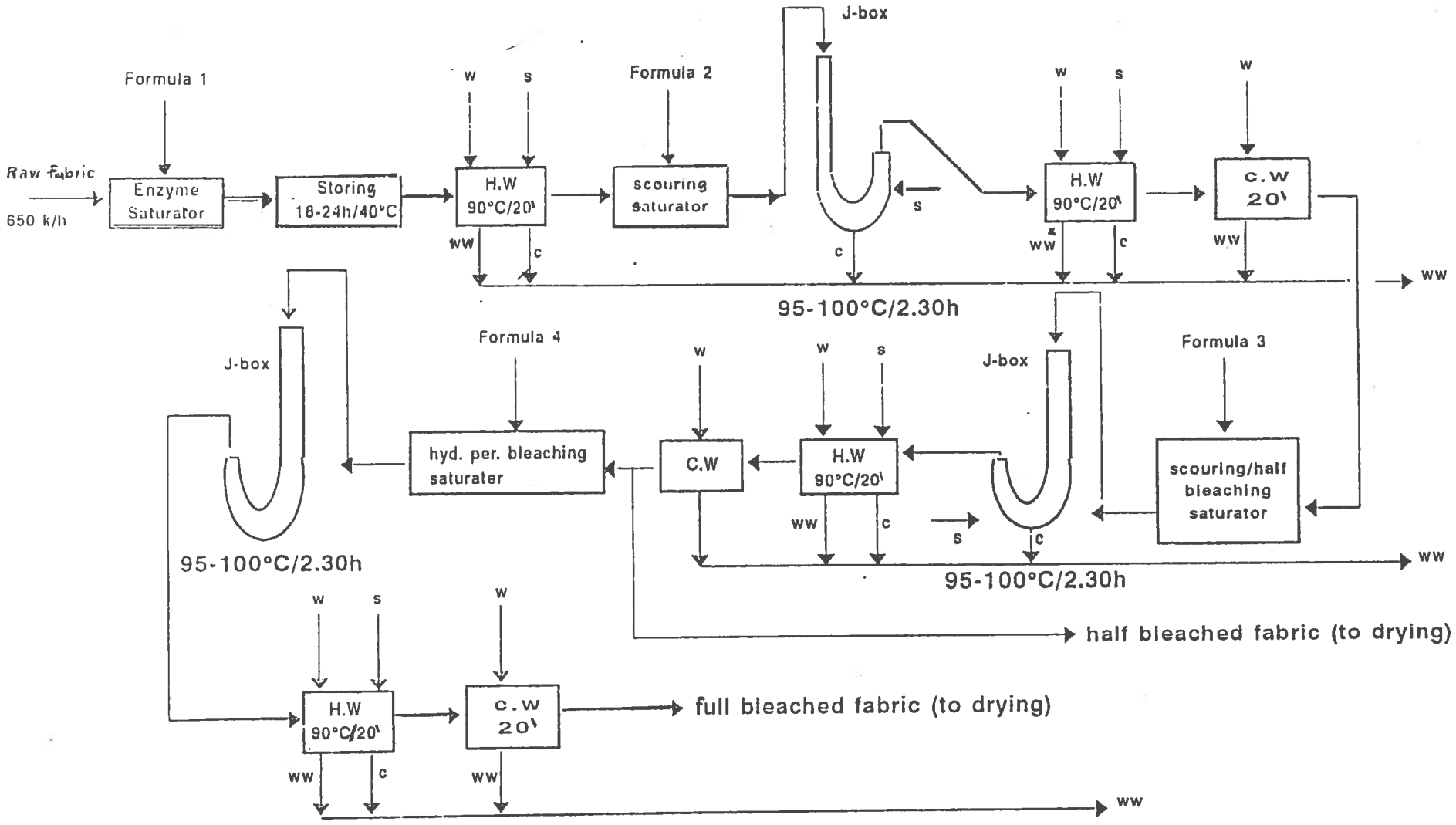


Fig. 3 Typical Process Flow Diag. of Pretreatment of Woven Fabrics on Gaston County Range (Rope Form).

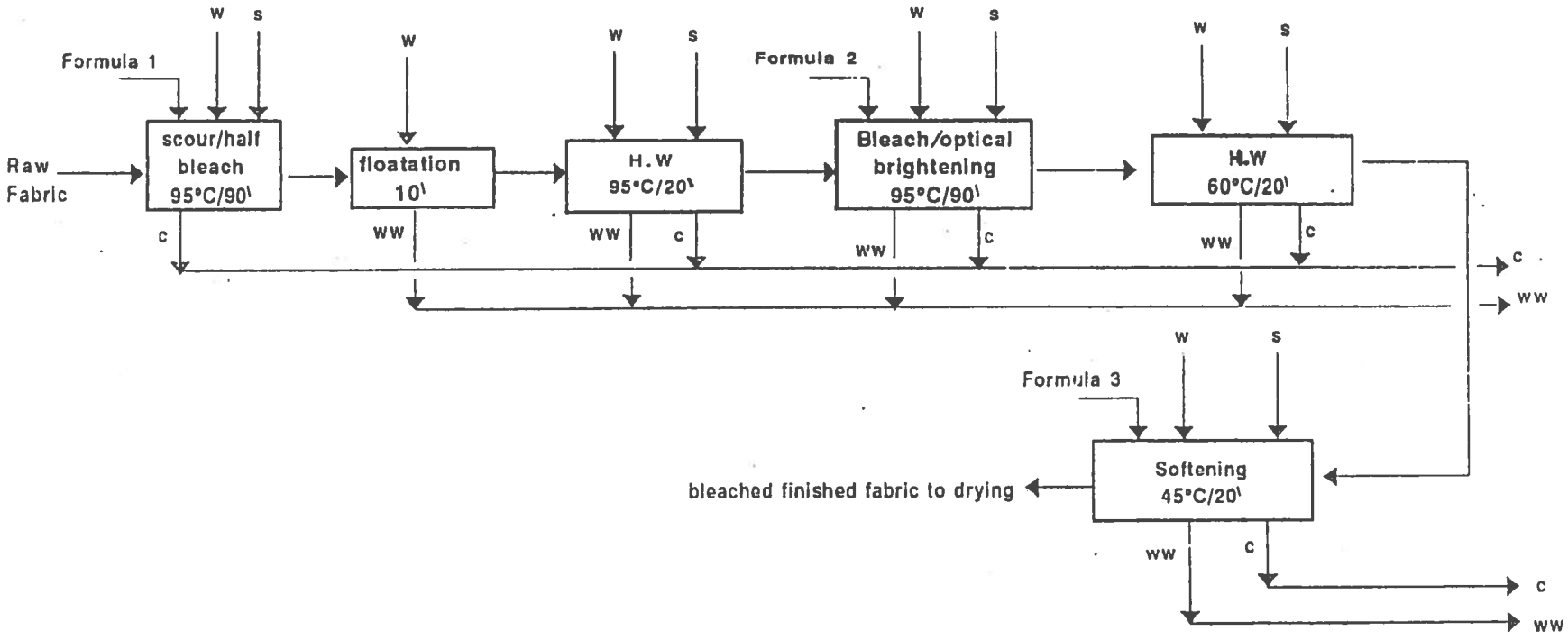


Fig. 2 Typical Process Flow Diag. of Pretreatment of Knitted Fabrics on Winches or Jets.

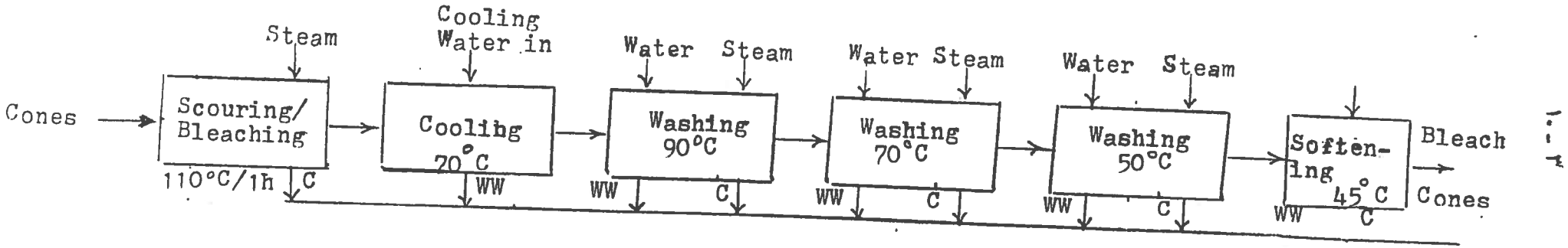


Fig 1 Typical process Flow Diag .
of cene pretreatment and
Softening.

الجزء الثانى

مراعاة المتطلبات البيئية فى عمليات الإنتاج

بسم الله الرحمن الرحيم

الباب الأول

صناعة النسيج فى مصر
الوضع الراهن والتحديات

١-١ صناعة النسيج فى مصر

تعد الصناعات النسجية فى مصر من أعرق وأهم الصناعات المصرية، وذلك لبعدها التاريخى والصناعى والاقتصادى، كما أنها تعد بحق أحد الركائز الأساسية للإقتصاد الوطنى من حيث:

* **حجم الاستثمارات** : حيث بلغ عدد المنشآت العاملة بهذا القطاع حوالى ٢٣٥٠ منشأة (سواء كانت قطاع أعمال عام ، استثمارى وخاص) حيث وصل حجم الاستثمارات فى هذا القطاع حوالى ٢٨,٥ مليار جنيه مصرى.

* **كم وتنوع الإنتاج** : ويتضح ذلك من توزيع الطاقات الإنتاجية بين القطاعات المختلفة على النحو التالى:

نوع الصناعة	قطاع أعمال عام	قطاع خاص واستثمارى
غزل	٩٠٪	١٠٪
نسيج وتجهيز	٦٠٪	٤٠٪
تريكو	٤٠٪	٦٠٪
ملابس جاهزة	٣٠٪	٧٠٪

مع العلم بأن القيمة التقديرية الإجمالية للإنتاج المحلى وصلت إلى حوالى ٨ مليار جنيه عام ١٩٩٥/٩٤.

* **حجم الصادرات** : حيث تمثل حوالى ٢٥٪ من إجمالى الصادرات المصرية، وبلغت القيمة الإجمالية لصادراتها حوالى ٥٠٠ مليون دولار أمريكى ، وذلك بالمقارنة بالسنوات الماضية، ويوضح جدول (١-١) إجمالى الصادرات المصرية من المنتجات النسجية عن عامى ٩٦/٩٥ و٩٧/٩٦، بينما يوضح جدولى (١-٢ ، ١-٣) حجم هذه الصادرات إلى كل من أوروبا والولايات المتحدة الأمريكية.

* **حجم العمالة** : حيث يبلغ تعداد العاملين بهذه الصناعة حوالى مليون عامل وفق احصائيات الغرف الصناعية باتحاد الصناعات.

١-٢ المشاكل التى تعوق انطلاق هذه الصناعة

تتعرض صناعة الغزل والنسيج المصرية للعديد من الأخطار والتحديات فى ظل نظام عالمى جديد للتجارة الدولية -إتفاقية الجات- يعتمد على آليات السوق والمنافسة المفتوحة وإلغاء أية قيود على انسياب السلع والخدمات بين دول العالم إلى جانب إنتهاء تصدير الملابس والمنسوجات وفقاً لقطاع الحصص وتخفيض الرسوم الجمركية على تلك السلع تدريجياً، وذلك فى حيز الفترة الإنتقالية والتى ستنتهى بنهاية ديسمبر ٢٠٠٤، هذا بالإضافة إلى أن هناك اشتراطات بيئية جديدة يجب توافرها بدءاً بالموارد الخام المستخدمة، ومروراً بمراحل التصنيع المختلفة، وإنتهاءاً بتصنيع منتج صديق للبيئة وبما يتمشى مع متطلبات السوق العالمى وخاصة الأسواق الأوروبية.

ومن ثم فإن زيادة القدرة التنافسية للمنتج المصرى سواءً على نطاق السوق العالمى أو السوق المحلى لن تتأتى إلا من خلال التغلب أولاً على العديد من المشاكل التى تعانى منها صناعة النسيج فى مصر وتتمثل فى:

- ليس هناك سعر محدد لشراء القطن المصرى.
- الإرتفاع الكبير فى أسعار الغزول المحلية مع العلم بأن هذه الغزول تمثل أكثر من ٥٠٪ من التكلفة فى المتوسط.
- عدم الإستخدام الأمثل للخامات (الأقطان فائقة الجودة، الغزول طويلة التيلة) بما يتمشى مع طبيعة المنتج المطلوب.
- سياسة الإغراق سواء على مستوى السوق المحلى، وكذلك على المستوى العالمى بالعديد من الخامات والمنتجات بأسعار أقل من قيمتها الحقيقية وخاصة من دول شرق آسيا.

جدول (١-١): حجم الصادرات المصرية من المنتجات النسجية خلال عامى ٩٥/٩٦ - ٩٦/١٩٩٧

Item	July 95-June 96		July 96-June 97		%	
	Ton	LE 1000	Ton	LE 1000	Value	Volume
Cotton yarns	41444	692606	53846	806280	+ 29.9	+ 16.4
Cotton textiles	13108	210008	19621	291814	+ 49.7	+ 39.0
Cotton knitted products	15583	591415	17802	682789	+ 14.2	+ 15.5
Cotton terry products	2762	55623	3233	65405	+ 17.1	+ 17.6
Cotton clothes	13654	514529	11495	452960	- 15.8	- 12.0
Cotton bed-sheets	9596	171611	8464	159808	- 11.8	- 6.9
Medical cotton & sash	1234	9503	568	5174	- 52.2	- 45.6
Total	97831	2245295	115047	2464230	+ 18.1	+ 9.8
Man-made & synthetic fibers	346	2477	256	1511	- 26.0	- 39.0
Man-made & synthetic Rayon filaments	147	2062	97	1008	- 34.0	- 51.1
Man-made & synthetic yarns	455	4834	2554	21289	+ 461.3	+ 340.4
Man-made & synthetic clothes	12	120	804	31132	0.0	0.0
Man-made & synthetic bed-sheets	2690	63357	3893	121529	+ 44.7	+ 91.8
Total	3650	72850	7604	176469	+108.3	+ 142.2
Blended yarns	4826	57783	7418	76369	53.7	+ 32.2
Blended textile	2964	50786	5101	76322	+ 72.1	+ 50.3
Blended clothes	199	7211	433	17397	+ 117.6	+ 141.3
Blended bed-sheets	n.a.	24	2	160	0.0	+ 566.7
Total	7989	115804	12954	170248	+ 62,1	+ 47.0
General total	109020	2433949	135605	2810947	+ 24,4	+ 15.5

جدول (١-٢) : حجم الصادرات المصرية من المنتجات النسجية إلى أوروبا.

جدول (١-٢-١): بالوزن (طن).

Product	1992	1993	1994	1995	1996
Yarns	36909	35070	61169	39984	27790
Fabrics	9765	14946	19180	12719	14294
Knitted Products	3382	5150	5828	7416	7924
Towels	612	1039	1298	1906	1906
Made-Ups	1312	2196	1157	2365	2416
Bed-Linen	2043	2561	4811	6567	6812
Cotton-Wool	229	215	151	486	69
Total	54261	61177	93594	71443	61211

N.B. Other textile products are not subject to quota system.

جدول (١-٢-٢): بالسعر (مليون دولار).

Product	1992	1993	1994	1995	1996
Yarns	151	122	220	185	121
Fabrics	38	55	76	62	62
Knitted Products	40	57	61	76	88
Towels	4	5	7	11	12
Made-Ups	16	21	11	25	25
Bed-Linen	10	12	24	37	40
Cotton-Wool	0.5	0.5	0.5	1	0.5
Total	259.5	272.5	399.5	397	348.5

- الإفتقار إلى الكفاءات الإدارية والخبرات الفنية ونظم مراقبة الجودة.
- عدم مواكبة التطور العالمى فى إدخال تكنولوجيات حديثة.
- تدهور جودة المنتج والإفتقار إلى برامج تسويقية واعية ومدروسة مما ساعد على تراكم المخزون وضعف القدرة على التنافس.
- عدم الإهتمام بالبعد البيئى والآثار السلبية الناجمة عن هذه الصناعة الملوثة.
- التشريعات الجديدة التى ظهرت فى الأسواق العالمية بشكل عام، وفى أوروبا بشكل خاص، والتى تهدف إلى حماية المستهلك من الأخطار التى قد تنجم عن إحتواء المنتجات النسجية على بعض أو بقايا المواد الكيماوية الداخلة فى تجهيزها وصباغتها، وتنامى الوعى البيئى لدى المستهلكين فى الأسواق التصديرية بحثاً عن منتج آمن فى الإستعمال وآمن على البيئة عند إنقضاء عمره الإفتراضى.

١-٣ كيفية مجابهة هذه المشاكل وتنمية الصادرات من المنتجات النسجية

للتغلب على المشاكل التى تعوق انطلاق المنتجات النسجية المصرية إلى أسواق التصدير العالمية، وتحسباً للمنافسة الشرسة التى ستجابهها هذه المنتجات فى الأسواق المحلية بعد التطبيق الكامل لإتفاقية الجات، لابد من العمل على المحاور الرئيسية التالية:

أ- **التكلفة** : حيث يجب أن تخفض تكاليف الإنتاج من خلال توفير الخامات اللازمة والمناسبة بالسعر العالمى، وكذلك تحرير الصادرات من الأعباء المالية والضرائبية إلى جانب الأخذ بسياسة ترشيد الإستهلاك فى مراحل الإنتاج والتصنيع المختلفة.

ب- **الجودة** : وذلك من خلال بث مفهوم إدارة الجودة الشاملة ورفع الكفاءة الإنتاجية للأفراد والمعدات.

جـ- **التسويق الجيد** : واضح المعالم وبناءاً على دراسات فعلية لمتطلبات الأسواق العالمية والمحلية.

د- **أمان المستهلك والبيئة** : من خلال منتج نظيف لايحتوى على مواد كيميائية ضارة بصحة الإنسان والبيئة، طبقاً للمعايير والتشريعات البيئية فيما يسمى بمعايير الإيكو.

وهذه المحاور تهدف إلى الحصول على منتج "آمن للمستهلك وصديق للبيئة، عالى الجودة معقول التكلفة" ليكون قادراً على المنافسة.

ولايمكن الحصول على منتج آمن للمستهلك وصديق للبيئة إلا من خلال التأهل لشهادة الإيكو.

ويجب ان نعى دائما ونضع نصب أعيننا انه لا تصدير لاوروبا فى الوقت الحالى وباقى بلاد العالم (فى المستقبل القريب) بدون الحصول على علامة الايـــكو.

الباب الثانى

الخامات والمعالجات والكيماويات المستخدمة فى الصناعات النسجية المصرية

٢-١ الخامات النسجية

هناك العديد من الخامات سواء كانت طبيعية (مثل القطن والصوف) ، نصف صناعية (مثل الفسكوز وأسيتات السليلوز) ، وألياف تركيبية (مثل البولىأستر، البولىأميد ، البولىأكريلليك) تستخدم فى تصنيع المنسوجات سواء كانت منفردة أو مخلوطة. ويوضح شكل (٢-١) التصنيف العام لهذه الخامات.

٢-٢ عمليات التصنيع والمعالجات الرطبة

من خلال شكل رقم (٢-٢) يمكن تتبع العمليات المختلفة سواء كانت ميكانيكية أو كيميائية بدءاً من الشعيرة وانتهاءاً بالمنتج النهائى واستخدامه ثم التخلص منه.

وللتعرف على المعاجات الكيميائية الرطبة الأساسية ومن ثم المواد الكيميائية المستخدمة (سواء كانت مواد كيميائية تقليدية، مواد مساعدة، أصباغ، مواد تجهيز) فى معالجة الخامات المختلفة فإن ذلك يمكن تتبعه من خلال الأشكال التالية :

شكل رقم (٢-٣) يوضح المعالجات الكيميائية الرطبة للخيوط القطنية.

شكل رقم (٢-٤) يوضح المعالجات الكيميائية الرطبة للأقمشة القطنية المنسوجة.

شكل رقم (٢-٥) يوضح المعالجات الكيميائية الرطبة لأقمشة التريكو القطنية.

شكل رقم (٢-٦) يوضح المعالجات الكيميائية الرطبة للصوف.

شكل رقم (٢-٧) يوضح المعالجات الكيميائية الرطبة للبولىأستر.

شكل رقم (٢-٨) يوضح المعالجات الكيميائية الرطبة للسجاد.

شكل رقم (٢-٩) يوضح المراحل المختلفة لتشغيل المواد الغير منسوجة.

جدول رقم (٢-١) يوضح الخامات المختلفة والاصباغ المناسبة لها.

٣-٣ الكيماويات المستخدمة

ملحق (١) يوضح نوعيات مختلفة من الكيماويات المستخدمة فى الصناعات النسجية فى مصر، ولقد روعى تصنيفها طبقا لطبيعة استخدامها، حيث صنفت إلى كيماويات عامة، وكيماويات العمليات الجافة (غزل ونسيج) ومواد بوش ومواد معالجات أولية ومظهرات ضوئية والمواد المساعدة للصباغة والطباعة ومواد التجهيز النهائى ومواد أخرى تستخدم فى المنسوجات الصناعية.

Fig. 2-1 Fibers Used in the Manufacture of Textile Products

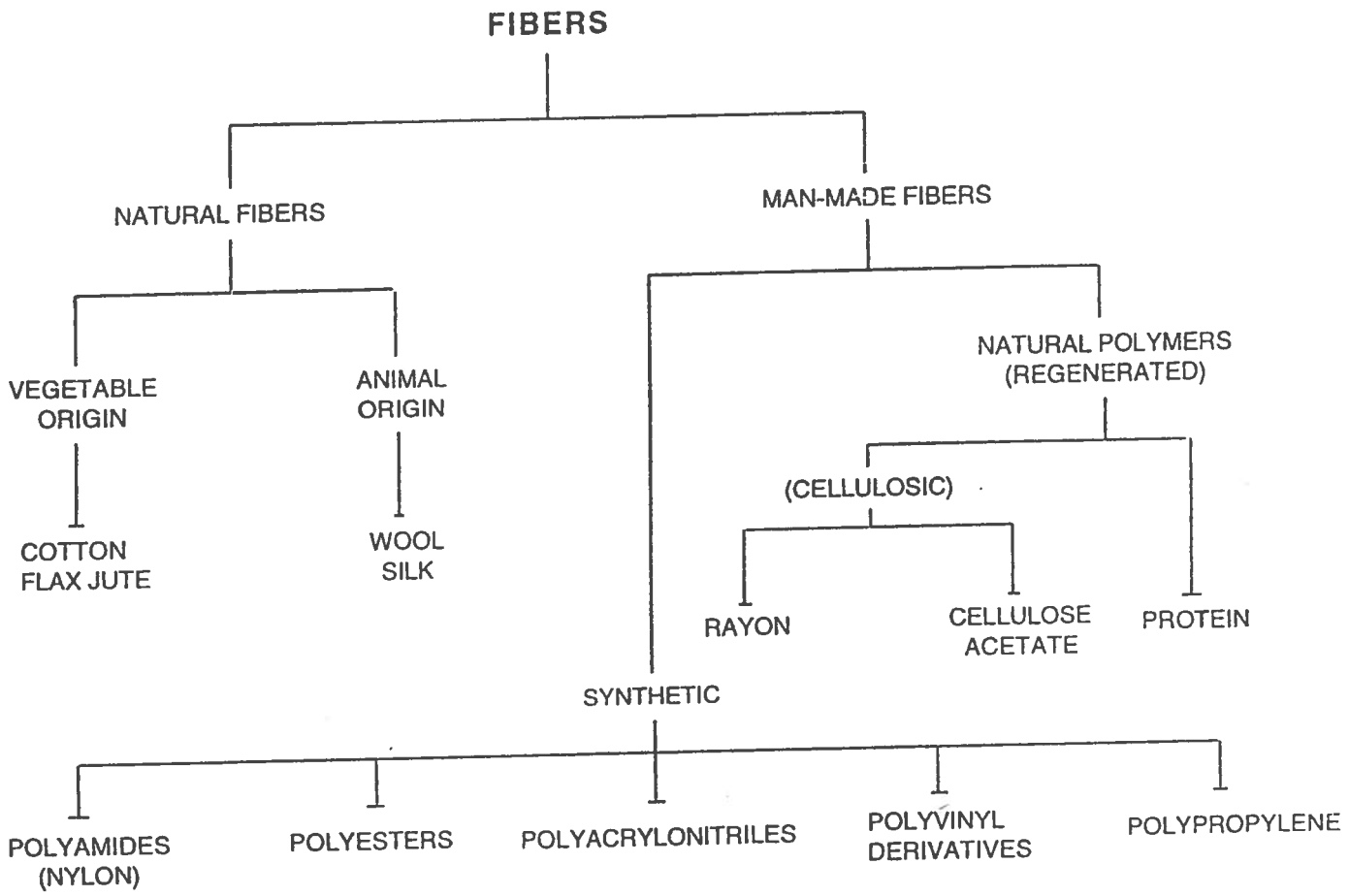


Fig. 2-2. The textile chain : from fiber to textile end product

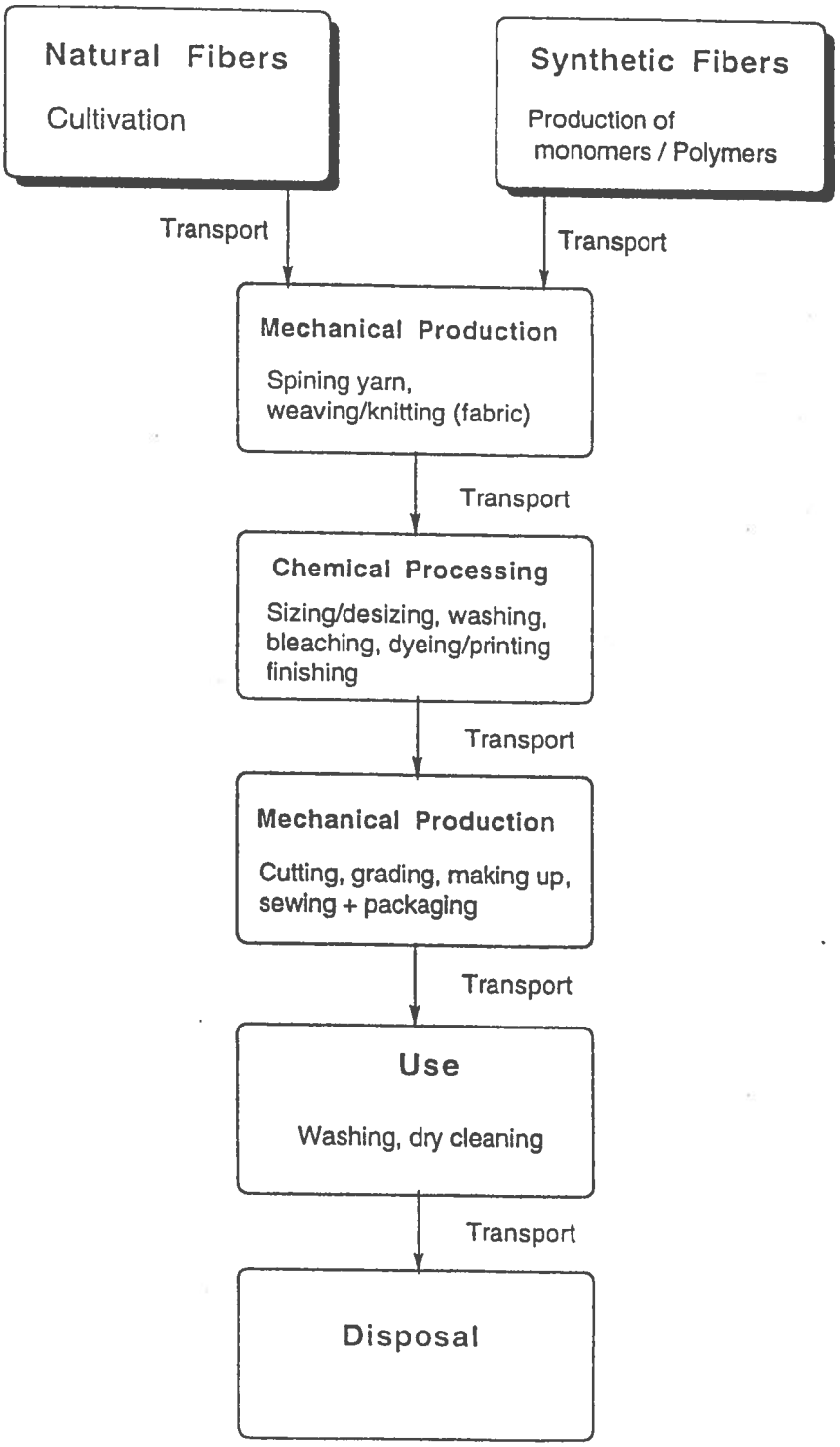


Fig. 2-3 Typical Flow Diagram of Yarn Finishing

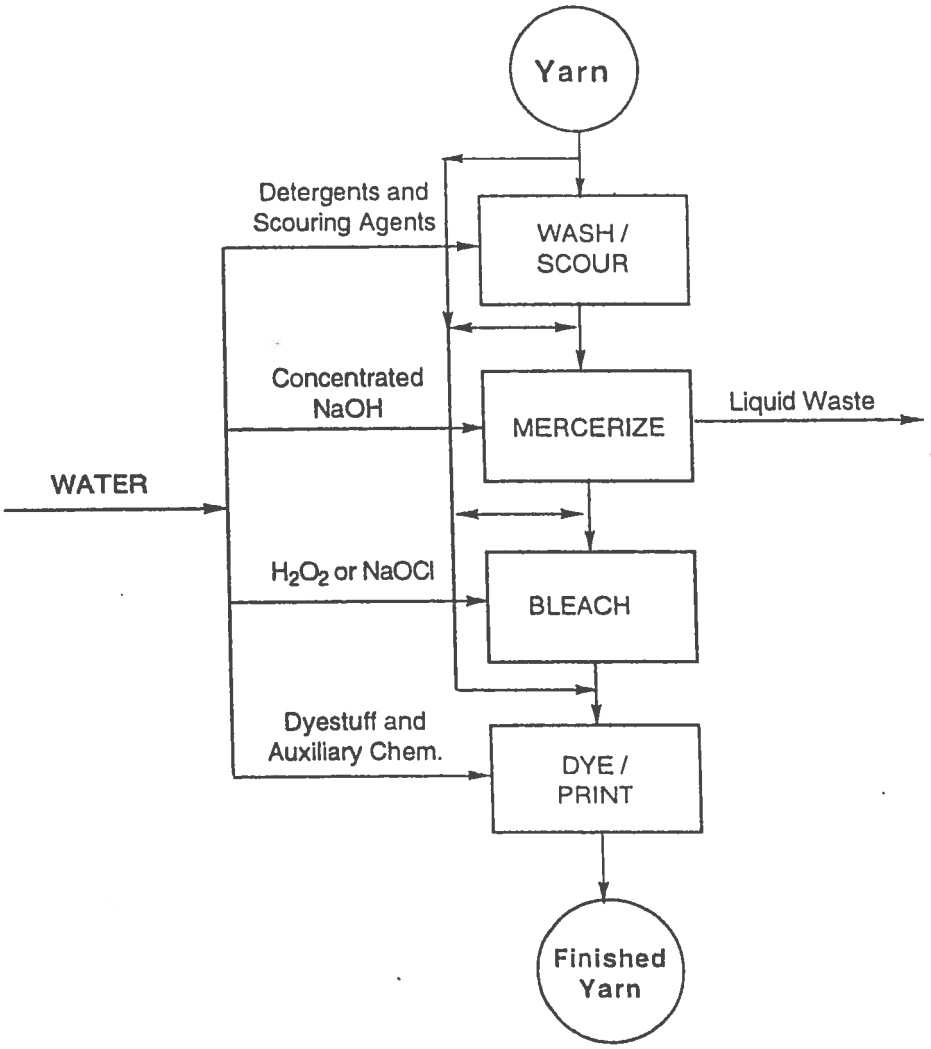


Fig. 2-4 : Typical flow diagram of woven fabric finishing

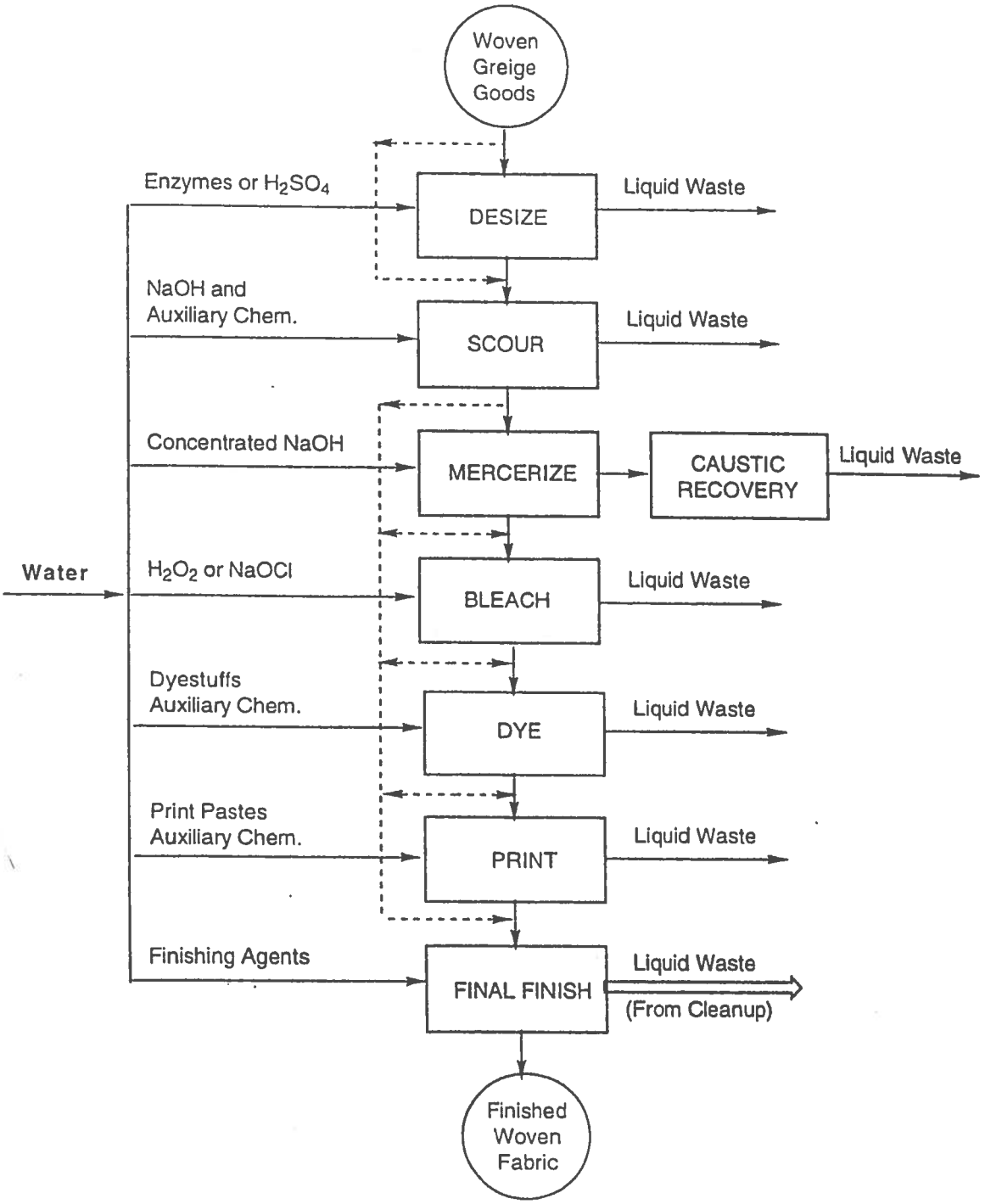


Fig. 2-5 Typical Flow Diagram of Cotton Knitted Fabric Finishing

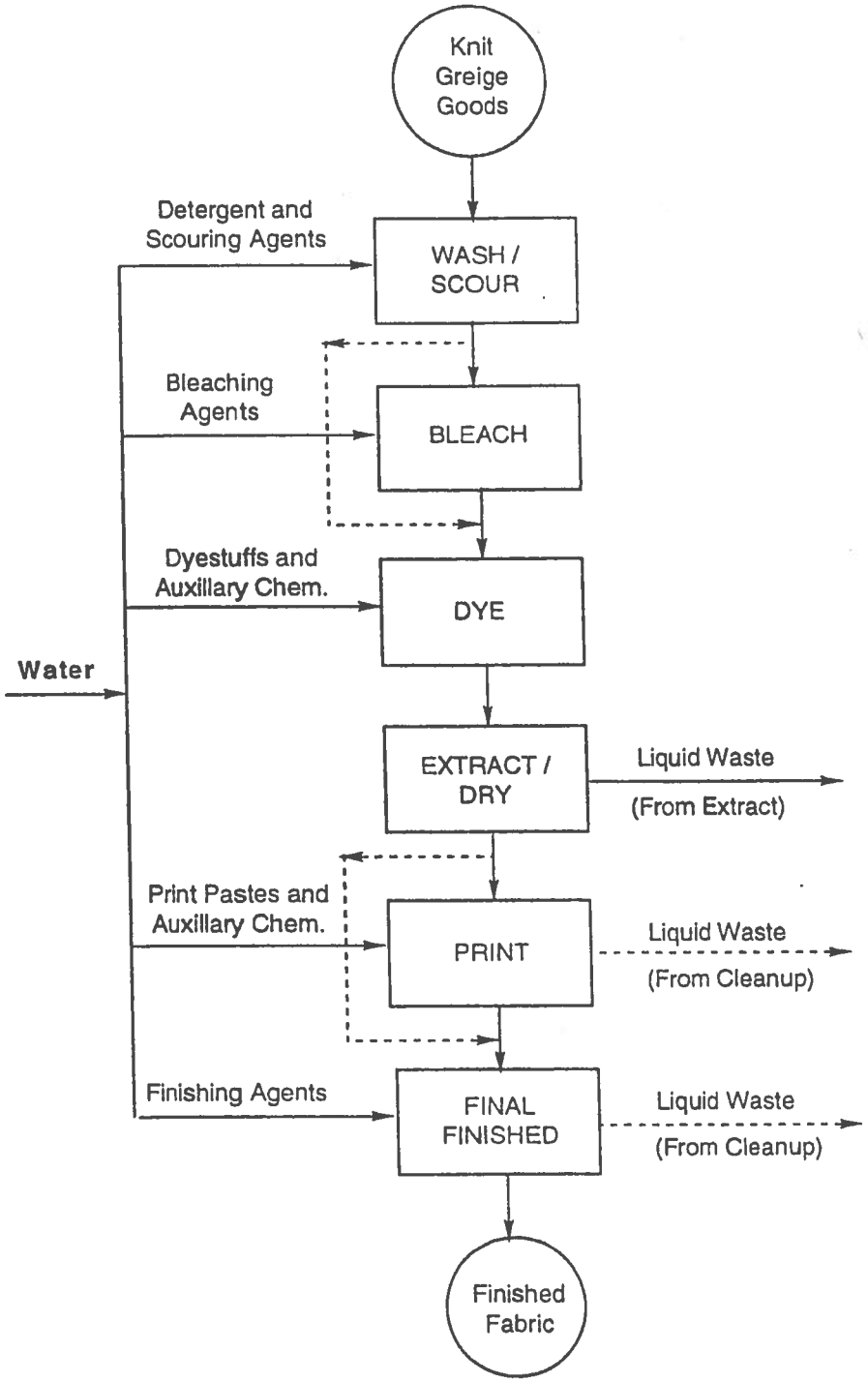


Fig. 2-6 Typical Flow Diagram of Wool Finishing

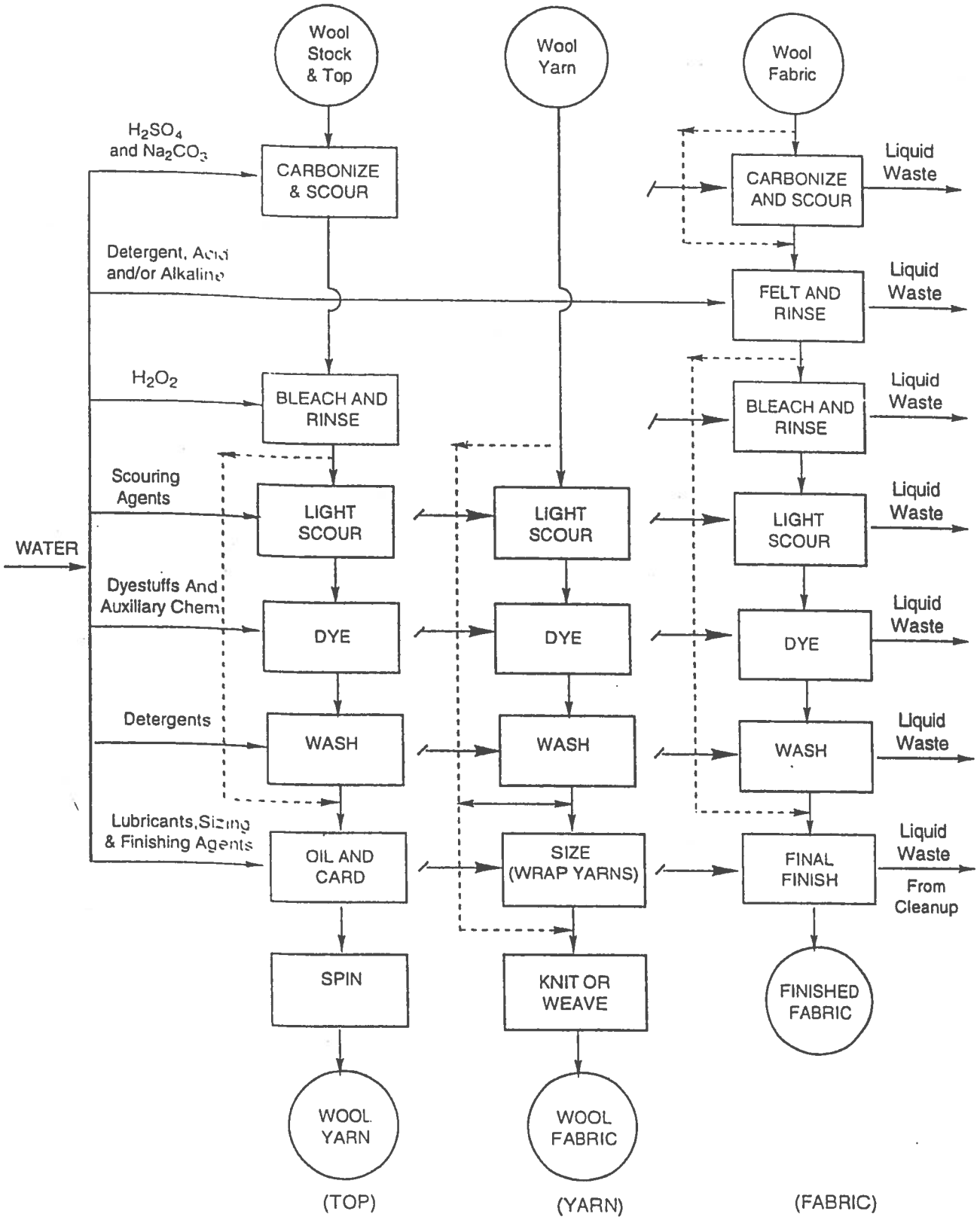


Fig. 2-7 : Typical Flow Diagram of Polyester Finishing and Making-up

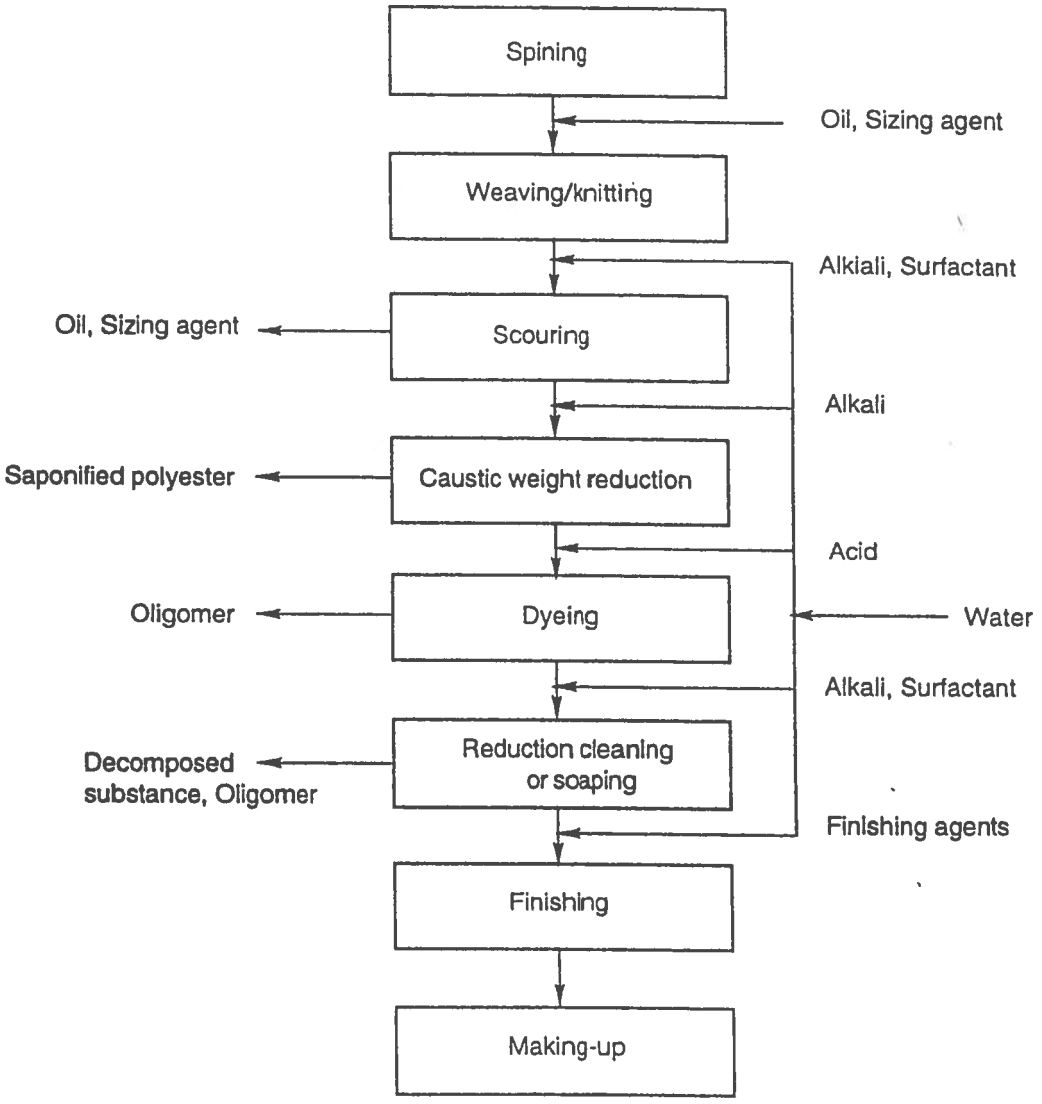


Fig. 2-8 Typical Flow Diagram of Carpet Finishing

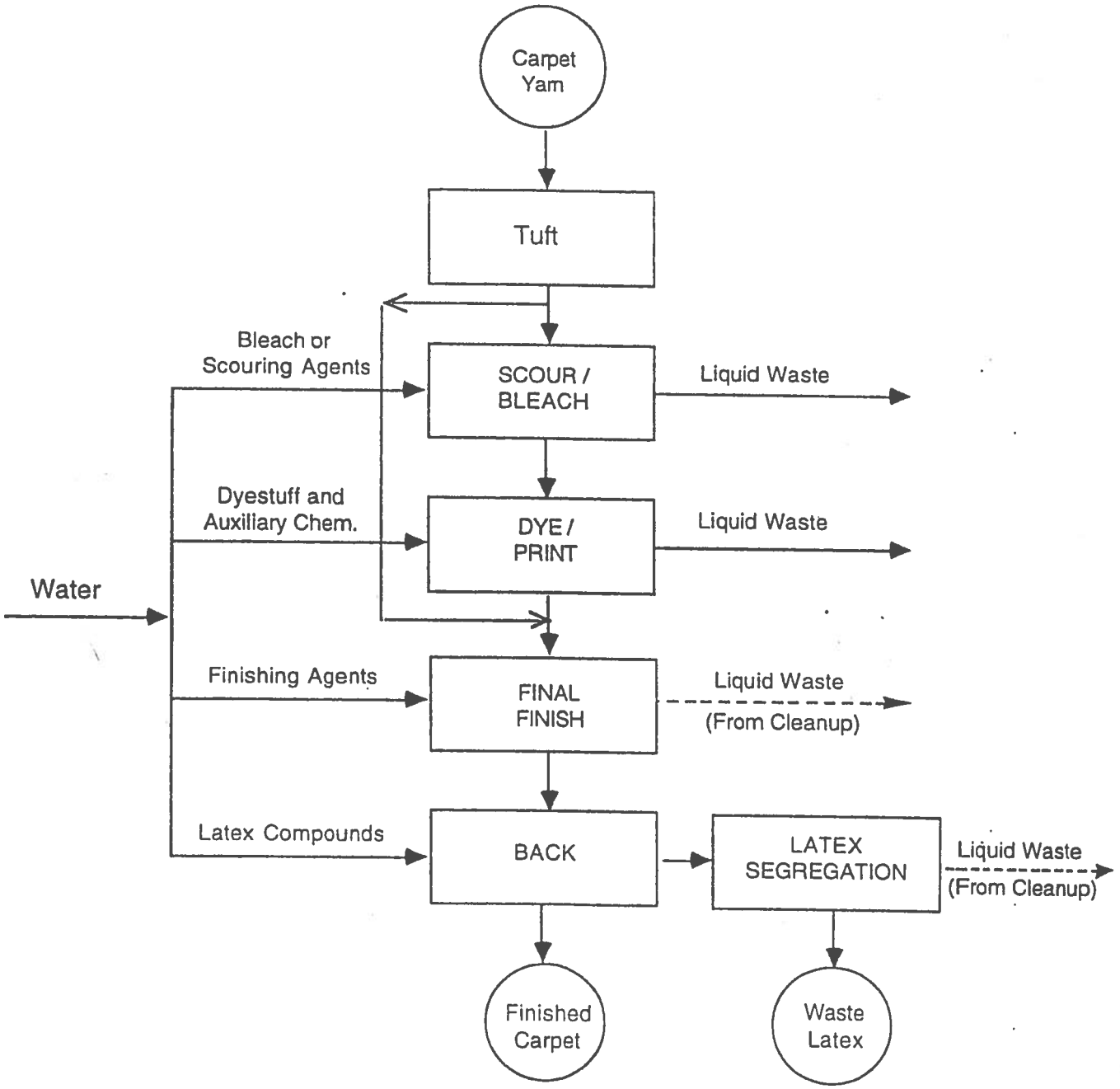


Table 2.1: Suitability of different classes of dyestuffs for textile fibers.

Class	Wool	Cotton	Cellulose derivatives	Polyamide PA	Polyester PE	Acrylic PAN
Basic	X	X	X	X	X	X
Direct		X				
Sulfur		X				
Azoic		X	X		X	
Ingrain						
Vat		X	X			
Acid levelling	X			X		
Acid milling				X		
Mordant	X	(X)		X		
Metal complex	X			X		X
Disperse			X	X	X	X
Reactive	(X)	X				
Pigment	X	X	X	X	X	X

X = suitable; (X) = of secondary importance. Pigments may be applied to any substrate by the use of adhesives.

البـــاب الـثالث

بعض الصبغات وألوان البجمنت المحظورة فىالصناعات النسجية

الباب الثالث

بعض الصبغات وألوان البيجمنت المحظورة فى الصناعات النسجية

يعتبر حظر تصنيع بعض صبغات وألوان البيجمنت المحتوية على مجموعات الآزو أو استخدامها فى تلوين المنتجات النسجية من أكبر التحديات التى تواجه صناعة النسيج فى البلدان النامية بوجه عام وفى مصر بوجه خاص، لما يترتب عليه من منع دخول هذه المنتجات إلى أسواق التصدير الأوروبية فى الوقت الحالى وباقى أسواق العالم (فى المستقبل القريب)، حيث تتميز هذه الصبغات وألوان البيجمنت برخص ثمنها وسهولة استخدامها وزهاء ألوانها وتمتعها بقدر مقبول من الثبات.

إلا أن الأمر يتطلب مواكبة هذا الوضع والتكيف مع هذا الحظر والتمشى مع تشريعات أسواق التصدير والتقيد بها، وذلك حتى لايخسر المنتج النسجى المصرى سوقاً بذل الكثير من الجهد فى اكتسابها.

ويوضح هذا الباب بعض تلك التشريعات المعنية، والمنتجات التى شملتها، وتواريخ الحظر، والأهم من ذلك كله مجموعة الأمينات الضارة التى تصنع منها الصبغات المحظورة، ثم قائمة من فصائل مختلفة من الصبغات وألوان البيجمنت مستخرجة من دليل الألوان وتحتوى على هذه الأمينات الضارة.

ولقد خصص هذا الباب للصبغات والألوان المحظورة، أما الباب الرابع فيناقش حظر أو تحديد استخدام بعض المواد الخطرة فى المنتجات النسيجية، ولقد كان من الأولى أن يتم دمج موضوع الصبغات والمواد الخطرة فى باب واحد، إلا أن الرغبة فى عدم الإطالة دعتنا إلى وضعها فى بابين منفصلين.

٣-١ الأمر الرسمى الألمانى وتعديلاته حتى الرابع

أثبتت الدراسات أن بعض الأمينات المستخدمة فى تصنيع بعض صبغات الآزو يمكن ادراجها تحت بند مسببات الحساسية أو المواد السامة أو المسرطنة للإنسان، مما حدا بالحكومة الألمانية إلى منع إنتاج بعض صبغات الآزو المستخدم فى تصنيعها هذه الأمينات منذ عام ١٩٧٤.

وفى العاشر من إبريل ١٩٩٢ صدر الأمر الرسمى الألمانى الشهير والخاص بالمنتجات الإستهلاكية German Commidity Goods Ordinance، والذى تلاه تعديلات عدة هى الثانى والثالث والرابع والخامس، حيث ينص الأمر الرسمى وتعديلاته حتى الرابع على "حظر استخدام كل صبغات الآزو وبيجمنت الآزو - والتى ينتج من تحلل واحدة أو أكثر من مجموعات الآزو الخاصة بها أى من الأمينات العشرين التى ثبت ضررها على الإنسان- فى تصنيع أى من المنتجات الإستهلاكية التى تلامس جسم الإنسان مباشرة حتى لو كان التلامس وقتياً". أما المنتجات الإستهلاكية التى حددها الأمر الرسمى فهى:

أ- الملبوسات المختلفة ومواد تصنيعها.

ب- أطقم الأسرة والبطاطين والوسائد وأكياس النوم.

جـ- الفوط ومراتب البحر ومراتب الهواء.

د- الأقنعة والباروكات والشعر المستعار والرموش الصناعية.

هـ- الإكسسوارات الحريمى الملامسة للجلد وأستيك الساعات والإنسيال.

و- أكياس النقود وحقائب الظهر.

ز- أغطية المقاعد المستخدمة فى مقاعد الإسترخاء ومقاعد الأطفال ومشايات الأطفال.

ن- مرايل الأطفال والفوط الصحية وبطانات الملابس الداخلية.

ويقصد بالملبوسات (سواء نسجية أو جلدية) معناها الواسع الذى يضم الداخلية والخارجية والرياضية وأغطية الرأس والقفازات والكوفيات وأربطة العنق والأحذية والأحزمة وحمالات البنطلونات. كما يقصد بالبطاطين معناها الواسع الذى يضم كل أنواع الأغطية التى تلامس الجسم.

أما الأمينات العشرين المحظورة فهى مدرجة فى جدول (٣-١) أما صبغات الآزو المذكورة بهذا الأمر الرسمى فهى فى حدود المائة والعشرين وتضم أصنافاً مختلفة من الصبغات الحمضية والقاعدية والمباشرة والمنتشرة والأزويك بالإضافة لبعض المظهرات developers ،

والفثالوجين الأزرق phthalogen blue وغيرها ، علاوة على كثير من بيجمنت الآزو المصنعة من أى من الأمينات العشرين المذكورة.

والقوائم الموضحة بملحق ٢ تضم العديد من صبغات وبيجمنت الآزو بفصائلها المختلفة والمستخرجة من دليل الألوان Colour Index مع أرقامها فى الدليل والأمين المحتوية عليه (ماأمكن) وبعض الأسماء التجارية لها.

٣-٢ التعديل الخامس للأمر الرسمى الألمانى

وجاء التعديل الخامس فى السابع عشر من إبريل ١٩٩٧ ليؤكد حظر صبغات الآزو المصنعة من الأمينات العشرين المذكورة وليعفى بعض بيجمنت الآزو من هذا الحظر برغم كونها مصنعة من هذه الأمينات، ولتأكيد تواريخ منع تصنيع أو استيراد بعض المنتجات الإستهلاكية (الموضحة بالتعديل الرابع) أو مد المهلة المتاحة لذلك، ويمكن إجمال ذلك كما يلى:

أولا : تأكيد حظر صبغات الآزو المصنعة من الأمينات العشرين المحظورة: جاء هذا التأكيد بناءاً على نتائج طرق التحليل الرسمية الألمانية للكشف عن أى من الأمينات العشرين المحظورة، وتم استنباط طريقة الكشف هذه بعد جهود مضنية باستخدام طريقة "كروماتوجرافيا الغاز- اختيار الكتلة" Gas Chromatography-Mass Selection (GC-MS) Detector، وذلك في ١٤ فبراير ١٩٩٦، ووجد أنه يمكن الكشف عن هذه الأمينات إذا وجدت بتركيزات أكبر من ٣٠ مجم/كجم منتج (أى ٣٠ جزء فى المليون) وبإستخدام "وسط حمضى ضعيف به محلول منظم من السترات" ، وبناءاً عليه فلقابلية صبغات الآزو للذوبان فى الوسط المذكور فإنها تتحلل لتعطى تركيزاً أعلى من ٣٠ جزء فى المليون (فى حالة كونها مصنعة من الأمينات المحظورة) ، ومن ثم تم تأكيد حظرها.

جدول (٣-١) قائمة بالامينات العشرين المحظورة فى الامر الرسمى الالمانى

(Banned Amines)

Sr. No.	Aryl amine	Other names	CAS No.
1	4-Amino biphenyl	p-Amino diphenyl xenyl amine	92-67-1
2	Benzidine B	p-Diamino Diphenyl, Fast Corinth B, BR	92-87-5
3	4-Chloro-o-toluidine	2-Amino -5-chloro toluene 4-Chloro-2-methyl aniline Red TR Base	95-69-2
4	2-Naphthyl amine	β-Naphthyl amine Fast Scarlet β–Base	91-59-8
5	o-Amino azotoluene	2-Amino-5-azotoluene Fast Gamet GBC base	97-56-3
6	2-Amino-4-nitro-toluene	Fast Scarlet G base 5-Nitro-o-toluidine	99-55-8
7	p-Chloro aniline	p-Aminochlorobenzene	106-47-6
8	4-Methoxy-m-phenylene-diamine	2,4-Diaminoanizole 2,4-Diaminophenyl methyl ether	615-05-4
9	4,4`-Diaminodiphenylmethane	4,4`-Methylenedianiline	101-77-9
10	3,3`-Dichlorobenzidine	---	91-94-1
11	3,3`-Dimethoxybenzidine	o-Dianisidine Di-para-aminodimetamethoxy-diphenyl Fast Blue B-Base	119-90-4
12	3,3`-Dimethylbenzidine	o-Toluidine Diaminoditolyl	119-93-7
13	3,3`-Dimethyl-4,4`-diamino-diphenylmethane	4,4`-methylene-bis(o-toluidine)	838-88-0

تابع .. جدول (٣-١)

Sr. No.	Aryl amine	Other names	CAS No.
14	2-Methoxy-5-methyl aniline	p-Cresidine 5-Methyl-o-anisidine m-Amino-p-cresol methyl ether	120-71-8
15	4,4`-Methylene-bis (2-chloro aniline)	3,3`-Dichloro-4,4`-diamino-diphenyl methane 4,4`-methylene bis(o-chloro aniline)	101-14-4
16	4,4`-Oxydianiline	4,4`-Diamino diphenyl ether	101-80-4
17	4,4`-Thiodianiline	4,4`-Diamino diphenyl sulphide	139-55-1
18	o-Toluidine	o-Amino toluene	95-53-4
19	4-Methyl-1,3-phenylene diamine	Toluene-2,4-diamine 4-meta toluylene diamine	95-53-4
20	2,4,5-Trimethyl aniline	Pseudo cumidine 1,2,4-Trimethyl-5-amino benzene	137-17-7

ثانياً: إعفاء بعض بيجمنت الآزو المصنعة من الأمينات العشرين من الحظر: وجاء هذا الإعفاء نتيجة للملاحظة أن بعض بيجمنت الآزو المحظورة شحيحة الذوبان للغاية فى الماء، وبالتالى فإنها تحت ظروف الإختبار فى الوسط الحامضى الضعيف فإنها تعطى كميات من الأمينات المحظورة أقل من حدود حساسية أجهزة الكشف (أى أقل من ٣٠ جزء فى المليون) وبالتالى فهى لاتمثل خطراً على صحة المستهلك، فى حين أن بعض بيجمنت الآزو الأخرى التى شملها الحظر السابق تعطى كميات من الأمينات أكبر من ٣٠ جزء فى المليون، وبالتالى تم تأكيد حظرها.

(ملحوظة: لم يعطى التعديل الخامس قائمة بيجمنت الآزو المعفاة من الحظر، وإنما ترك ذلك لنتائج تحليل العينات، وتعقيباً على هذا التعديل فلقد أصدر اتحاد إيتاد ETAD فى يوليو ١٩٩٧ قائمة بالوضع القانونى لبعض بيجمنت الآزو فى ظل هذا التعديل بناءاً على تحاليل مصنعى هذه البيجمنت الذين هم فى نفس الوقت أعضاء بهذا الاتحاد، وبناءاً على هذه القائمة يرى الاتحاد أن هناك بعضاً من البيجمنت قد شملها العفو وقليل منها قد تأكد حظرها وبعضها الآخر نتائج تحاليلها غير متاحة لكون منتجيها غير أعضاء بالاتحاد، وقائمة الإيتاد مذكورة بملحق (٣). وينصح واضعوا هذا التقرير بتجنب كل بيجمنت الآزو المحظورة فى الامر الرسمى الأصلى واستبدالها ببدائل آمنة لتجنب متاهات التحليل التى قد تعطى نتائج مضللة، ونصيحتنا هذه تستند على الاحتمال أن قد تتحلل بيجمنت الآزو جزئياً أثناء عملية تحميض البايندر binder باستخدام العامل المساعد الحامضى المعتاد المتمثل فى فوسفات الامونيوم ثنائية الهيدروجين لتعطى كميات من الأمينات المحظورة قد تكون فى حدود حساسية أجهزة الكشف).

ثالثاً : تأكيد تواريخ منع تصنيع أو استيراد أو بيع بعض المنتجات الاستهلاكية (المحتوية على الألوان المحظورة) أو مد المهلة لفترة أطول عن تلك المتاحة بالتعديل الرابع:

أ- تصنيع أو استيراد المنتجات الإستهلاكية

* باستخدام صبغات الآزو المحظورة تأكد حتى ٣١ مارس ١٩٩٦.
* باستخدام بيجمنت الآزو المحظورة تأكد حتى ٣١ مارس ١٩٩٨.
* الجلود ومنتجاتها حتى ٣١ مارس ١٩٩٨.
* ملابس الحماية والملابس اليونيفورم تأكد حتى ٣١ مارس ١٩٩٦.
* الأنسجة التى يعاد تصنيعها تأكد حتى ٣١ ديسمبر ١٩٩٩.

ب- بيع المنتجات الإستهلاكية داخل ألمانيا

* المحتوية على صبغات الآزو المحظورة إمتد حتى ٣١ ديسمبر ١٩٩٨.
* المحتوية على بيجمنت الآزو المحظورة تاكد حتى ٣٠ سبتمبر ١٩٩٨.
* الجلود ومنتجاتها إمتد حتى ٣١ ديسمبر ١٩٩٨.
* المنتجات المستعملة إمتد بلا حدود.
* ملابس الحماية واليونيفورم إمتد بلا حدود.
* الأنسجة التى يعاد تصنيعها تأكد حتى ٣١ ديسمبر ١٩٩٩.

٣-٣ **حظر نفس الصبغات والبيجمنت فى دول أخرى**

تم حظر بعض أو كل صبغات الآزو التى سبق حظرها فى ألمانيا فى العديد من الدول الأوروبية والإتحاد الأوروبى والهند والباكستان وكوريا وكندا واليابان وتركيا وهونج كونج وغيرها، ويلاحظ أن بعض هذه الدول يمثل أسواقاً لتصدير المنتجات النسجية المصرية مثل الإتحاد الأوروبى وكندا واليابان، والبعض الآخر منافس قوى لنا فى التصدير مثل الهند والباكستان وتركيا وهونج كونج.

ومن المنتظر أن تحظر كل أسواق التصدير المصرية استخدام تلك الصبغات إن آجلاً أو عاجلاً، وتنضم لألمانيا، وذلك للأسباب التالية :

١- إزدياد الوعى بالمشاكل البيئية الحالية والمستقبلية التى تنتج عن الصناعات النسجية ومنتجاتها.
٢- الزيادة الملحوظة من حالات الحساسية المرتبطة بعدد من الملبوسات النسجية.
٣- تقلص الأفكار لدى مصممى الأزياء ومسوقى المنتجات النسجية، والبحث عن فكرة جديدة لزيادة مبيعاتهم.
٤- المشاكل المرتبطة بالتخلص من المواد النسجية المستعملة.
٥- الرغبة فى الحد من التدفق الهائل للنسجيات الرخيصة إلى أسواق أوروبا سواء من الصين أو الهند أو البرازيل أو دول شرق آسيا، خاصة وأن ذلك يمثل تهديداً لصناعة النسيج المحلية فى الدول الأوروبية.

الباب الرابع

بعض المواد الكيميائية المحظورة أو محددة الاستخدام فى الصناعات النسجية

كما سبق القول ان دول الاتحاد الأوروبى تعتبر من الأسواق الهامة للمنتجات النسجية المصرية، ولقد صدرت فى هذه الدول بعض التشريعات التى تتناول المواد الخطرة، سواءً بحظر استخدامها أو تحديد أقصى تركيز لها على المنتجات النسجية، وعلى المصدر المصرى أن يراعى جيداً هذه التشريعات وألا يخرقها إذا أراد أن يحتفظ بسوق منتجاته فى تلك الدول، ومن أمثلة المواد الخطرة المعنية ما يلى:

أ- الفينول خماسى الكلور Pentachorophenol (PCP)

ب- بعض مواد التجهيز ضد الحريق Certain Flame Retardants

جـ- عديد كلور ثنائى أو ثلاثى الفينيل Polychlorobiphenyls or triphenyls

د- الأسبستوس Asbestos

هـ- الكادميوم Cadmium

و- الفورمالدهيد Formaldehyde

ز- النيكل Nickel

ى- مواد التعبئة Packaging

وجدول (٤-١) يوضح الوضع القانونى (سواءً بالحظر أو بتحديد أقصى تركيز) لهذه المواد فى الاتحاد الأوروبى ودول مثل ألمانيا وهولندا والسويد.

جدول ٤-١ : حظر استخدام أو تحديد أقصى تركيز (جزء فى المليون-حـ ف م) لبعض المواد الخطرة فى المنتجات النسجية فى الاتحاد الأوروبى وبعض دول أوروبا طبقاً للتشريعات الخاصة بها

المادة	الاتحاد الأوروبى	ألمانيا	هولندا	السويد
- فينول خماسى الكلور	١٠٠٠ حـ ف م	٥ حـ ف م	٥ جـ ف م	١٠٠٠ حـ ف م
- بعض مواد التجهيز ضد الحريق	حظر	حظر	حظر	حظر
- عديد كلور ثنائى أو ثلاثى الفينيل	حظر	حظر	حظر	حظر
- أسبستوس	حظر	حظر	حظر	حظر
- كادميوم	١٠٠ حـ ف م*	١٠٠ حـ ف م**	٥٠ حـ ف م*	حظر***
- فورمالدهيد	-	أ	-	-
- نيكل (ملامس للجسم)	٠,٥مجم/سم٢/اسبوع	٠,٥مجم/سم٢/اسبوع		٠,٥مجم/سم٢/اسبوع
- مواد التعبئة	تشريع خاص	تشريع خاص		تشريع خاص

* البويات والمثبتات ** مثبتات *** ملونات ومثبتات

أ- إذا زاد التركيز عن ١٥٠٠ حـ ف م وجب وضع بطاقة على المنتج توضح هذا.

حـ ف م : (ppm)

وفيما يلى عرض سريع لوضع هذه المواد مع ذكر بدائلها (ما أمكن) الآمنة أو الأقل ضرراً.

٤-١ فينول خماسى الكلور Pentachlorophenol (PCP)

وهو مادة حافظة يتركز استخدامها فى الصناعات النسجية لمنع النمو الفطرى أو التحلل البكتيرى لخلطات البوش المحتوية على النشا أو عجائن الطباعة المحتوية على المثخنات الطبيعية كصمغ الجوار، وهذا المركب (وأملاحه) شديد السمية على الأحياء المائية وشديد الضرر على صحة الانسان ومثابر (أى صعب التحلل البيولوجى) فى البيئة، والمواد المحتوية عليه إذا تم التخلص منها بالحرق تنتج مواد أخرى شديدة السمية، وعملياً فإن ضآلة أقصى تركيز لهذه المادة المسموح به فى ألمانيا وهولندا يتضمن أن استخدامه فى المعاجات النسجية محظور إذا تم تصدير النسجيات المعالجة به لهذين البلدين، ويلاحظ أن الفينولات الكلورية الأخرى مثل فينول رباعى الكلور لم تحظر بعد برغم كونها مساوية تقريباً فى الأضرار البيئية والصحية، ولذا يجب تجنب هذه المواد أيضاً.

البدائـــل

يمكن استخدام بدائل لمادة PCP فى الصناعات النسجية مثل بنزوثيول Benzothiol أو مشتقات البيريميدين (Pyrimidine derivatives) ، أو سيلكوفلوريد الصوديوم (Sodium silicofluoride) ، أو ساليسيل أنيلايد (Salicylanilide).

٤-٢ بعض مواد التجهيز ضد الحريق Some fire retardants

وهذا يشمل حظر المواد التالية:

1. Tri-(2,3-dibromepropyl)-phosphate (TEPA)
2. Tris-(aziridinyl)-phosphineoxide (TRIS)
3. Polybromebiphenyl (PBB)

وهى تستخدم فى تجهيز الأقمشة ضد الحريق، وسبب الحظر أن الأولى والثانية من المسرطنات ومشوهات الأجنة (أى تغير التركيب الجينى والوراثى)، فى حين أن المادة الثالثة علاوة على كونها شديدة السمية فهى مسرطنة أيضاً، اضافة لتأثيرها الضار على جهاز المناعة والجهاز العصبى.

ويجب أيضاً ملاحظة أن مواد التجهيز ضد الحريق الأخرى مثل تلك المحتوية على مركبات البروم العضوية (Organobrome compounds) وثالث اكسيد الأنتيمون (Antimone trioxide) لها أيضاً آثار سلبية للغاية على البيئة، ومن ثم يجب تجنبها، وتعتبر الأملاح غير العضوية والفوسفونات (Phosphonates) بدائل أقل ضرراً على البيئة منها.

٤-٣ عديد كلور ثنائى أو ثلاثى الفينيل
Polychlorinated biphenyles (PCB) and polychlorinated triphenyles (PCT)

هذه المواد لا تستخدم بكثرة فى الصناعات النسجية، وإن كان من المحتمل استخدامها كمواد تنعيم Softeners، وهى مواد سامة وتسبب كثير من المشاكل البيئية، ولقد حظرت التشريعات فى الاتحاد الأوروبى وألمانيا وهولندا والسويد استخدامها، ويجب عدم استخدامها البتة، ويمكن الحصول على بدائلها من الموردين المعتمدين.

٤-٤ الأسبستوس Asbestos

الأسبستوس من المسرطنات، ومن النادر استخدامه فى النسجيات، وقد يستخدم فى ملابس الحماية (للحماية من النيران) وبعض أنسجة المقاعد والتنجيد.

البدائـــل

يمكن استبدال الأسبستوس بمواد التجهيز ضد الحريق، على أن يختار منها ما هو آمن ما أمكن.

٤-٥ الكادميوم ومركباته Cadmium and compounds

الكادميوم ومركباته من المسرطنات، وقد تتواجد فى بعض الصبغات، ومركبات الكادميوم قد تستخدم أيضاً فى عمليات التثبيت للصبغات. ومعظم التشريعات المتعلقة بالكادميوم تتناول استخدامه فى البلاستيك والبويات، ولكن التشريع السويدى نص صراحة على حظر الاستخدام فى المنتجات النسجية، وفى حالة استخدام البلاستيكات الملونة (مثل بولى بروبيلين) فى انتاج الألياف التركيبية Synthetic fibres أو فى اكسسوارات الملابس الجاهزة يحظر استخدام الكادميوم فى تلوينها، وفى حالة استخدام عديد فينيل الكلوريد (Polyvinyl chloride) فى الألياف التركيبية

أو كمادة تغطية Coating agent فإن التشريع يحظر استخدام هذه المواد إذا استخدم الكادميوم كمادة تثبيت أو كملون.

البدائـــل

لابد من تجنب استخدام المواد المحتوية على الكادميوم، وفى حالة احتواء الصبغات أو المواد المساعدة على الكادميوم (السويد) أو بتركيز أعلى من ٥٠ حـ ف م (هولندا) أو أعلى من ١٠٠حـ ف م (ألمانيا والاتحاد الأوروبى) لابد من استخدام البديل المناسب، وفى هذه الحالة لابد من استشارة المورد المعنى بهذه المواد.

٦-٤ الفورمالدهيد Formaldehyde

تستخدم راتنجات الفورمالدهيد فى تجهيزات العناية السهلة (ضد التجعد) وللمعالجات ضد الانكماش وفى بعض الأحيان لزيادة ثبات الألوان، وتحتوى أيضاً بعض البينـدر المستخدمة فى عجائن الطباعة على الفورمالدهيد، وعادة ما تستخدم مركبات الفورمالدهيد لمعالجات القطن والفسكوز والكتان وخلطاتها مع الألياف التركيبية.

وهناك شكوك قوية على قدرة الفورمالدهيد على احداث السرطانات، فضلاً عن كون الفورمالدهيد الحر مهيج للأغشية المخاطية وقد يسبب التهابات فى العيون علاوة على قدرته على احداث حساسيات مختلفة، وإذا زادت نسبة الفورمالدهيد فى منتج نسجى ما عن ١٥٠٠ حـ ف م تحتم التشريعات فى ألمانيا وضع بطاقة على المنتج توضح هذا على أن يكتب فى هذه البطاقة ما يلى " المنتج يحتوى على الفورمالدهيد " ، وينصح بغسل المنتج قبل أول استعمال لتخفيف الوطأة على الجلد " .

البدائـــل

يمكن تحسين مقاومة التجعد والانكماش بالوسائل الميكانيكية، مما يتطلب كميات أقل من راتنجات الفورمالدهيد للمعالجة، علاوة على أن هناك مواد تجهيز فى الأسواق قليلة المحتوى من الفورمالدهيد أو حتى لا تحتوى فورمالدهيد على الاطلاق، ومن أمثلتها: السيلوكسلات Siloxales، والجليوكسلات Glyoxales، وأيضاً الأحماض عديدة الكربوكسيل Polycarboxylic acids.

٤-٧ النيكل Nickel

النيكل من الفلزات الثقيلة والذى قد يستخدم أحياناً فى اكسسوارات الملابس الجاهزة، وهو من المواد السامة والمسببة لعديد من المشاكل البيئية.

البدائل

يجب التقليل من استخدام الفلزات الثقيلة بوجه عام والنيكل بوجه خاص، وإذا وجد النيكل فى الاكسسوارات النسجية فإنه من الصعب معرفة أن تركيزه فى الحدود المسموح بها (٠,٥ميكروجرام/سم^{٢}/اسبوع) لأنه لا توجد وسيلة اختبار متاحة حالياً يعتمد عليها، ولذلك فإن أفضل بديل للنيكل هو تجنب استعماله على الاطلاق.

٤-٨ مواد التعبئة Packaging materials

مواد التعبئة تعتبر من الأمور البيئية الهامة فى معظم دول أوروبا، وهناك تشريعات بيئية خاصة بمواد التعبئة فى بعض بلدان أوروبا، وفى معظم الأحوال فإن التشريعات المعنية لا تمس المصدر الأجنبى لآن تلك هى مسئولية المستورد، ولكن المصدر الذى يريد الحفاظ على عميله (المستورد) لابد له من مراعاة تلك الاعتبارات. والاتجاه العام فى أوروبا هو تسهيل اعادة استخدام أو تدوير مواد التعبئة إما بالحوافز أو الغرامات والضرائب ومن خلال القيود المفروضة أو التطوعية.

والتشريعات المرتبطة بمواد التعبئة أو مخلفاتها إما أنها تطبق حالياً أو فى طور الاصدار فى بلدان أوروبا، ولكى يحدث التناغم بين هذه التشريعات فإن الاتحاد الأوروبى أصدر "دليل التعبئة ومواد التعبئة" الذى تم تطبيقه فى الدول الأعضاء قبل ٣٠ يونيو ١٩٩٦ والذى روعى فيه تحديد المواصفات فى أقل عدد ممكن لسهولة التطبيق. وللدول الأعضاء أن تضيف لتلك المواصفات ما تشاء طالما أنها لا تعوق التجارة بين باقى الأعضاء.

وفيما يلى ملخص للتشريع الخاص بالاتحاد الأوروبى بالنسبة لمواد التعبئة:

أ- متطلبات الفلزات الثقيلة :

أقصى تركيز مسموح به لاى من الرصاص والكادميوم والزئبق والكروم السداسى فى مواد التعبئة ما يلى:

- ٦٠٠ حـ ف م بعد ٣٠ يونيو ١٩٩٨.
- ٢٥٠ حـ ف م بعد ٣٠ يونيو ١٩٩٩.
- ١٠٠ حـ ف م بعد ٣٠ يونيو ٢٠٠١.

ب- متطلبات استرجاع مخلفات مواد التعبئة:

قبل ١ يوليو ٢٠٠١ يجب على كل مستورد ومصنع أن يسترجع ما بين ٥٠-٦٥٪ من مواد التعبئة التى نزلت فى الأسواق، ووسائل الاسترجاع الممكنة قد تكون:

- اعادة استخدام مواد التعبئة فى الحدود من ٢٥-٤٠٪ لكل منها على حدة.
- استخدامها فى تصنيع المتراكبات.
- الحرق مع استعادة الطاقة المنطلقة.

جـ- المتطلبات العامة لتصنيع وتركيب مواد التعبئة

- يجب أن يكون حجم ووزن مادة التعبئة فى أقل حد ممكن لمراعاة مستويات الصحة والسلامة اللازمة مع ضرورة أن يكون ذلك مقبولاً من جانب المستهلك.
- يجب مراعاة أن يكون تصميم وتصنيع وتسويق مواد التعبئة بطريقة تسمح باعادة استخدامه أو استرجاعه (شاملاً تدويره) ومراعاة البعد البيئى حتى يتم التخلص منه.

وعلاوة على ذلك لابد من مراعاة وجود المواد المزعجة والخطرة فى مواد التعبئة فى أقل الحدود حتى لا تشكل انبعاثاتها الغازية (فى حالة حرقها) أو السائلة المتسربة (فى حالة دفنها) تهديداً للبيئة.