

COMPARISON OF GLOBAL STANDARDS FOR CHAINSAW PROTECTIVE LEGWEAR



LET'S START WITH THE BASICS

Broadly speaking there are 2 global standards:

- European EN381
- North American ASTM F1897



THE EUROPEAN STANDARD EN381

This standard has several parts to it covering footwear, legwear, hand and upper body protective garments.

Part 1 - The construction of the test rig for performing chainsaw cut tests

Part 2 - The test methods to be performed on leg protectors

Part 5 - The requirements for leg protectors

i.e. the coverage areas, general construction details, the performance testing needed and the labelling and marking information required.





THE EUROPEAN STANDARD EN381

The differences between EN381.5 and the Australian/New Zealand standard, AS/NZS4453.3, are:

- EN381.5 only allows for trouser type garments incl. leggings, not chaps that buckle at the rear of the leg, whereas **AS/NZS4453.3 allows for both types.**
- **EN381.5 includes 3 different classes of chainspeed testing;** Class 1 at 20 m/s, Class 2 at 24 m/s and Class 3 at 28 m/s. AS/NZS4453.3 only has one level of chainspeed testing which is 20 m/s.
- **EN381.5 outlines the coverage areas for three different designs of trousers,** Design A, Design B and design C, whereas AS/NZS4453.3 has adopted Design A only with one very minor modification.

THE NORTH AMERICAN STANDARD ASTM F1897-14

This standard outlines the requirements for leg protection, i.e. general requirements for design and how they are made, the protective coverage areas, the performance testing needed, the certification process, the care and maintenance guidelines and the labelling and marking information required.

The test methods for testing to this standard are given in ASTM F1414 – 13.

COMPARISON OF THE REQUIREMENTS AND THE TEST METHODS FOR BOTH OF THESE STANDARDS

The requirements and the test methods employed by both standards will be shown to you .

While these differences may appear insignificant, **the two standards produce completely different results** and the meaning of the results are not comparable, consequently **there is no direct correlation between them.**



COMPARISON OF THE REQUIREMENTS AND THE TEST METHODS FOR BOTH OF THESE STANDARDS

	EN381	ASTM F1897 & F1414
VARIOUS TEST REQUIRED	<ul style="list-style-type: none"> • Dimensional change (shrinkage) • Chainsaw cut testing • Protective area checking • Attachment strength of chainsaw pad to garment 	Chainsaw cut testing
PRECONDITIONING OF TEST SAMPLES	5 times specified washing and drying procedure	5 times specified washing and drying procedure
REQUIREMENTS FOR DIMENSIONAL CHANGE	Less than 6% for both length and width	No requirement
REQUIREMENTS FOR PROTECTIVE AREA	<ul style="list-style-type: none"> • Trousers Design A: covers from 20cm above crotch to 5 cm above hem with an extra 5 cm of protection wrapping around on the left side of each leg. • Trousers Design B: as for Design A but with an extra 5 cm wrapping around 5cm to the right of the left leg • Trousers Design C: Front protection from 20 cm above the crotch to 5 cm above the hem with rear protection from 5 cm below the crotch to 5 cm above the hem. 	<ul style="list-style-type: none"> • Pants/Trousers: a minimum length of 700 mm (28") covering from the crutch to 7.5 cm (3") above the hem with an extra 0.524 rad (30°) or 100mm (4") wrapping around to the left of each leg. (Note that 30° equates to approx 6 cm at the top of the thigh. • Chaps: a minimum length of 700 mm (28") covering from the crutch to 25mm (1") above the carrier garment. Minimum width of 350mm (14") at the midpoint of the pad and 250mm (10") at the bottom of the pad.
REQUIREMENTS FOR PAD ATTACHEMENT STRENGTH	200N force	No requirement

REQUIREMENTS FOR CHAINSAW CUT TESTING

	EN381	ASTM F1897 & F1414
DRIVE UNIT FOR TEST RIG	Electrically powered motor with a clutch and flywheel of specified inertia	Standard gasoline powered chainsaw with standard clutch mechanism.
PERFORMED ON	Actual garments	Rectangular pads made up in the materials intended to be used. Calibration pads are specified as 200mm x 700mm however actual test pads are accepted in varying dimensions.
NUMBER OF TESTS	6 cuts: <ul style="list-style-type: none"> • 3 on each leg for Design A • 2 cuts on each leg on both front and rear for Design C. 	As many as are required to determine the threshold chainspeed, usually 24.
ANGLE AND POSITION OF CUT TESTS	All cuts after preconditioning, 45° in the knee area with the chain moving upwards from left to right of the leg.	In the centre of the test pads. Usually, those performed are: <ul style="list-style-type: none"> • 6 cuts without preconditioning at 45° • 6 cuts without preconditioning at 90° • 6 cuts after preconditioning at 45° • 6 cuts after preconditioning at 90°
STATUS OF POWER AT POINT OF RELEASE	Power released	Power remains on
HEIGHT ABOVE PAD AT POINT OF RELEASE	3 mm	50mm (2")
DISTANCE FROM POINT OF CONTACT TO CENTRE OF DRIVE SPROCKET	130mm	130 mm

REQUIREMENTS FOR CHAINSAW CUT TESTING

	EN381	ASTM F1897 & F1414
DOWNWARD FORCE AT POINT OF CONTACT	15N	15N
CHAIN TYPE	8mm, 0.325" pitch	10mm, 0.375" pitch
BAR	330mm, (13") with 11 tooth nose sprocket	500mm (20") with 11 tooth nose sprocket
DRIVE SPROCKET	7 tooth	7 tooth
METHOD OF FIXING OF TEST SPECIMEN	3 mm	50mm (2")
CHAINSPEED REQUIREMENTS	20 m/s or 24 m/s or 28 m/s	2750 ft/min
REPORTING METHODS	<p>Pass or fail at the specified chainspeed. Cut-through is deemed to be if there is a cut of greater than 10mm in the lining material.</p>	<p>There are two reporting methods.</p> <ul style="list-style-type: none"> The first method is to evaluate a simple pass/failure at a specified chainspeed e.g. 2750 ft/min. All 24 pads tested must show no cut-through at this chainspeed. The second determines a threshold chainspeed or CS50 which is the speed at which the probability of cut-through is 50%. Cut-through is deemed to be any cut in the lining fabric



CONSIDERATIONS OF THESE COMPARISONS

- **The European standard reports** the results of cut-testing simply as a **pass/fail to a minimum level of chainspeed**. The CS50 determination as reported under **F1897 does give a direct comparison of the performance of different garments** which is useful.
- The main differences between the two standards, power status, height above test specimen, fixing methods, size of chain and angle of cuts, all mean that **there is no correlation between the two**.



CONSIDERATIONS OF THESE COMPARISONS

- **The European standard** cut testing is **performed on an actual garment.**

The ASTM standard cut tests are performed **on test pads** which are only representative of the final product.

- It is noted that there are **no tests performed to determine how well the protective pad is held in place in the carrier garment with the ASTM F1897 standard.**



THE CANADIAN STANDARD BNQ 1923-450-M91

This standard was actually withdrawn some years ago but has continued to be used as the main Canadian standard. **As of August 2018, a replacement has been issued, ASTM F3325 – 18.**

Apart from some minor differences **F3324 is identical to F1414** so testing performed is interchangeable between standards.

THE CANADIAN STANDARD BNQ 1923-450-M91

The main differences between the BNQ 1923 standard and ASTM F1897 are:

- BNQ 1923 provides for **3 different designs for both chaps and trousers with varying coverage areas.**
 - Category A covers the frontal area from the crutch to 75mm above the hem plus the rear of the leg from the knee to the ankle.
 - Category B is just the front only from the crutch to 75mm above the hem.
 - Category C is the frontal area from the crutch to 75mm above the hem plus an area wrapping around to the left of both legs of 100mm.
- BNQ 1923 requires **a minimum chainspeed of 3000 ft/min** when tested according to BNQ 1923-450-M90, compared to F1897 with 2750 ft/min.





THE CANADIAN STANDARD BNQ 1923-450-M91

The new Canadian standard **F3325** gives a lot more detail to the coverage areas specified than its predecessor.

The wording resembles F1897 so that the two standards are much more closely aligned.

F3325 adds another category to the possibilities for coverage area, Category D which is a combination of A and C.

It also includes some **specification around the placement of straps on chaps.**





THE CANADIAN STANDARD, WORKSAFE BC SCHEDULE 8-A, SECTION 8.21

This standard **has been adapted from the original WCB** (Workers Compensation Board) **standard PPE 1 – 1997.**

This Worksafe BC standard is **similar to BNQ 1923**, however it only allows for one design of garment which is the equivalent of Category C.



THE CANADIAN STANDARD, WORKSAFE BC SCHEDULE 8-A, SECTION 8.21

Unusually, it allows for four different ways of complying with the cut test requirements:

- Achieving a threshold chainspeed of 3600 ft/min when tested using the test rig for WCB PPE 1 – 1997
- Achieving a threshold chainspeed of 3300 ft/min when tested according to ASTM F1414.
- Meeting EN381-5 at the chainspeed level of 24 m/s
- Meeting ISO 11393-2 (same as EN381-5) at the chainspeed level of 24 m/s.

THE CANADIAN STANDARD, WORKSAFE BC SCHEDULE 8-A, SECTION 8.21

It is to be noted that **chainsaw operators and companies generally refer to the minimum chainspeed needed to comply as 3600 ft/min.**

What is not understood is that this speed has reference to a test method that is no longer available.

The applicable test speed is 3300 ft/min when tested according to F1414.



CONCLUSION

In summary, there are **very significant differences** between standards globally and the results obtained using one test method **cannot be translated** over to the other.

Both test methods are designed to create a benchmark test by which to compare different manufacturer's product and this they do.

While neither are perfect, both standards are designed to outline the minimum requirements of leg protectors with the object of protecting chainsaw users from horrific accidents.



HOW CHAINSAW PROTECTIVE FABRICS WORK

Learn more about what protects you





THE SCIENCE BEHIND THE FABRICS AND THE FIBRES USED

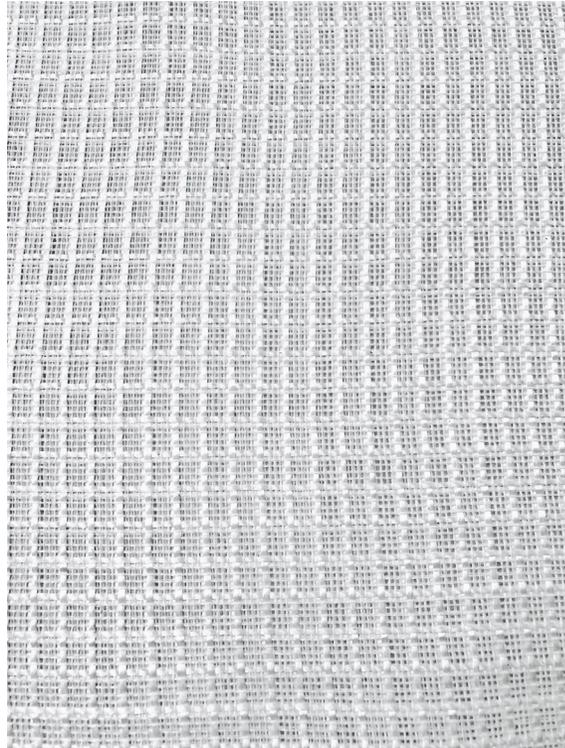
- When a chainsaw is running, it creates forces and develops an energy of movement.
- Kinetic energy increases exponentially as speed increases.
- So, **to stop a fast-moving chain requires something that will absorb all this energy.**

THE SCIENCE BEHIND THE FABRICS AND THE FIBRES USED

There are **three different fibres** available currently that have very high cut resistant properties and they are:

- Para-aramid, of which a well-known example is Kevlar
- Polyarylate, the main brand name for this is Vectran
- UHMWPE. You might be familiar with Dyneema, which is one brand name of UHMWPE.

HOW CAN A PPE STOP A FAST-MOVING CHAIN AND ABSORB ALL THIS ENERGY?



Clogger's chainsaw protective mat
Arrestex HP

- Chainsaw protective fabrics are **loosely weave or knit hundreds of fibres** into a mat.
- Chainsaw fabrics now incorporate **cut resistant fibres** which enhances its ability to absorb the energy of the chain.

HOW CAN A PPE STOP A FAST-MOVING CHAIN AND ABSORB ALL THIS ENERGY?



When a chainsaw chain hits this mat **the teeth act like hooks**, dragging these fibres out, which then get tangled around the sprocket, **choking it**.

DOES THE NUMBER OF LAYERS IN A CHAINSAW PROTECTIVE CLOTHING ACTUALLY MATTERS?

- **9-layers pad** constructed from a mix of polyester and polypropylene fibres only, **without cut-resistant fibres**, stopped a chainsaw in **0.05 seconds**
- **6-layers pad**, constructed from a fabric that includes UHMWPE as the **cut resistant fibre** in the weave, stopped the chainsaw in **0.04 seconds**
- Chainsaw garments made with the first fabric will be **thicker, heavier and consequently hotter** to wear than garments made with the second fabric. Their advantage is that they will be considerably less expensive.

WHY ONCE AN ACCIDENT OCCURS, THE GARMENT CUT INTO BY A CHAINSAW NEEDS TO BE DISCARDED?

- When the chainsaw initially hit the chainsaw protective pad, the **fibres have been pulled out** of the weave in both directions
- In a case of another accident, users who haven't change their initial chainsaw protection will very likely **have serious cut-through** because the first few layers have already been destroyed in the area by the first cut.

HOW TO TAKE CARE OF A CHAINSAW PROTECTIVE CLOTHING

#1 CAN I SAFELY WASH MY TROUSERS OR CHAPS?

Yes!

But make sure to remove all the sawdust from the pockets and to fasten the clips of your chaps.



#2 HOW SHOULD I WASH THEM?

You can try to do it by hand if you want but a **gentle, warm machine wash** (max 100°F/40°C) should do the job!

Use **gentle detergents** only and **cold rinse** thoroughly.

Do not use bleach on your trousers it will obviously affect your overall look but it might also remove some of the important finishes that are built into the fabrics.



#3 HOW DO I DRY MY CHAINSAW PROTECTIVE CLOTHING?

Air drying your gear is definitely the way to go. Avoid drying the the sun.

Do not tumble dry or dry-clean. And do not iron!





#4 AND WHAT IF I DON'T WASH THEM?

Despite the smell and the discomfort of climbing into dirty trousers or chaps, **it won't have a significant effect on the wearability or protection of the product.**

However, if you work in an environment where significant quantities of oil get splashes onto your gear you will have to wash it. The oil can clog the fibers of the chainsaw protective fabric and reduce its protective abilities.

Also, if you have to wear fire resistant chainsaw protection and it gets impregnated with flammable products, you will have to wash it to get fire protection you need.



#5 IF I AM NOT WEARING MY CHAINSAW PROTECTIVE CLOTHING, HOW SHOULD I STORE THEM?

Make sure they are **completely dry** before storing them so that no mould and other nasties can develop.

And it is good practice to keep them **out of direct sunlight**.

Other than that, it is completely up to you!

When you want to wear your trousers or chaps again you should **inspect them thoroughly** (preferably you should do this after each time of use).

If there is any damage, any broken or defective buckles, straps or zips they should be repaired before use.



#6 I HAVE A TEAR IN THE OUTER FABRIC, WHAT SHOULD I DO?

If the tear is on the front of your trousers or covering the chainsaw fabric, the best option would be to send a picture of it to Clogger so they can advise you.

This type of tear can be repaired by hand-stitching, but make sure you only stitch through the outer covering.

Because it is **a no-no to stitch through the protective material.**

The other way involves specialist gear, Clogger can advise once they see a photo!



#7 I HAVE A TEAR ON MY TROUSERS OR CHAPS, AND A BIT OF CHAINSAW PROTECTIVE FABRIC IS COMING OUT; WHAT SHOULD I DO?

Once again, the best option is to send a picture to Clogger.

If the apparel has sustained a cut from a chainsaw, you must discard the garment as it will not protect you from chainsaw cuts anymore.



#8 I HAVE A BURN ON MY TROUSERS OR CHAPS. WHAT NOW?

Burns can be a bigger problem.

The surface material may look okay but the chainsaw protection material could be damaged from the heat.

Get in touch with Clogger on that one also.



BEFORE YOU GO

Manufacturers of chainsaw protective gear use a variety of materials. So what is true for Clogger might not be for competitor's products.

Make sure you check the specific instructions for your apparel.



THE CLOGGER GUIDE TO CHOOSING THE BEST CHAINSAW SAFETY GEAR





FIRST THE BASICS...

Your chainsaw safety gear is important. Really important.

There are two main types of chainsaw safety apparel, **chainsaw trousers or chainsaw chaps**. Both have the special fabric permanently sewn into the garment. Within each of these styles of garment there are variations designed to meet the differing needs encountered by those who use a chainsaw.





#1 HOW OFTEN YOU USE THE CHAINSAW

If you are **using a chainsaw frequently** as part of your normal daily work, you should consider wearing **chainsaw pants rather than chaps**.

From a company's perspective, if the staff are all wearing chainsaw trousers, you will have **peace of mind knowing that good safety practices are being followed**.

In summary, if you are a **professional chainsaw operator** using a chainsaw as part of your everyday work, **trousers** far outweigh chaps as the product of choice.

If you only **use a chainsaw occasionally**, then **chaps** are an excellent choice.





#2 THE TYPE OF WORK YOU ARE DOING

- **Groundwork:** For this you need good functional gear. **Either chaps or trousers** will provide the protection you need.
- **Climbing:** Chaps should not be used for this type of work. Select **good quality trousers** that are purposely designed for climbing.
- **Utility work:** If your work involves vegetation management for power or gas utilities, then you should consider chainsaw garments that are also **fire resistant and arc resistant**.
- **Wildland firefighting:** For this type of work you must use a **fully fire-resistant product**.
- **Forestry work:** Either **chaps or trousers** may be used in this industry.



#3 THE ENVIRONMENT YOU ARE WORKING IN

Some environments are very harsh on Chainsaw PPE garments such as undergrowth in forests. This material tears outers meaning that **highly durable and tough materials need to be used.**

Other environmental factors are heat and humidity or extreme cold and wet conditions. If working in **hot, humid climates, choose lightweight, breathable products** to combat heat exhaustion.

Where work must be done in **extreme cold**, use garments made using **heavier, insulative fabrics.**





#4 THE QUALITY/DURABILITY YOU DESIRE

When choosing chainsaw safety gear, look for things like **quality of construction, quality of hardware, where it has been made and what the outer fabric is made from.**

Garments made from synthetic fibres (e.g. nylon and polyester) will offer much better durability than cotton based materials.

Regular washing and proper maintenance protects your investment and can extend the useful life of the garment.





#5 THE STANDARDS AND/OR REGULATIONS GOVERNING THE WORK YOU ARE DOING

These vary from country to country **so be aware of the standard that applies in your country**. Then look for the label that certifies that the chainsaw protective garment meets that standard.

Some global standards include provision for **different levels of protection**. If you are an occasional user you may opt for the lowest level of protection as this normally comes at the lowest price and any protection is better than no protection. A professional operator or a safety conscious company should be purchasing product with a higher rating as safety performance is paramount.





#6 YOU/YOUR COMPANY'S BUDGET AND SAFETY CULTURE

Every organization has a culture.

If your organization focuses on just providing the minimum of gear for compliance purposes it is likely that entry level chainsaw protective gear is specified.

However, those organizations that believe in investing in their staff and are prepared to provide comfortable, specialist gear will find that **their staff will perform better, will be loyal, and will be more engaged.**



#6 YOU/YOUR COMPANY'S BUDGET AND SAFETY CULTURE

There are two main types of chainsaw safety fabrics; let's call them 'Standard' and 'Advanced'

- Standard protection consists of multiple layers of chainsaw fabric, each of which is constructed using hundreds of loosely woven fibres. The fibres used are mainly **inexpensive nylons, polyesters or polypropylenes** and **rely on bulk or mass** to stop the saw. **Low cost or entry level chainsaw clothing uses 'standard' protective fabric.**
- Advanced protective fabrics incorporate cut-resistant fibres into the fabric construction. Advanced protective fabrics require **less layers and therefore less bulk to achieve the same level of protection** as standard protective fabrics. However, cut resistant fibres are expensive, so **advanced protection will always cost more.**

Arrestex HP and Arrestex FR are both advanced protective fabrics and are part of the secret behind Clogger's lightweight chainsaw protective clothing range.



COMPARING CHAINSAW PROTECTIVE FABRIC SYSTEMS

A. NUMBER OF LAYERS

The number of layers is not necessarily an indication of how effective the protection is; the **number of layers should not be used as a measure of effectiveness.**

B. USE OF CUT RESISTANT FIBRES

Some advanced chainsaw fabrics have the cut-resistant fibres woven in one direction only. Arrestex HP and Arrestex FR have the cut-resistant fibres in both the vertical and the horizontal directions. This ensures that the fabric will perform regardless of which direction the chainsaw bar hits it.

C. KEVLAR

Advanced chainsaw safety material that uses Kevlar will have a limited useful life as Kevlar **degrades over time.** It is preferable to **choose a protection system that doesn't use Kevlar.**

D. CHAIN SPEED RATING

Look for a tested speed rating: The NZ and Australian Standard, AS/NZS4453, only has one chain speed, 20m/s, and garments are rated against this as a simple pass/fail. The North American Standard states a threshold chain speed, so you can use this as a very clear indication of effectiveness.



SUMMARY

The right chainsaw safety gear depends on your unique circumstances.

Be aware of the particular hazards that you will encounter and ensure that you are adequately protected against that hazard.

Be aware too of the regulations that govern your PPE choice and only purchase product that complies with that.

Always view your PPE as an investment in your safety not as a cost. Look at the lifetime cost, not the initial upfront cost. Weigh the higher initial cost of garments with advanced protection against the daily benefits of better work productivity, less fatigue and less heat exhaustion.

There is no 'best' in chainsaw protection, but there is a best choice for you and for your work environment.

