

# *Safety in Your Hands*



## **A Hand Injury Prevention Training Module**

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## Table of Contents

- 1.0 Overview
  - 1.1 Industry Statistics
    - Figure 1.1: Nature of Hand Injuries
    - Figure 1.2: Experience Groups
    - Figure 1.3: Time of Day
    - Figure 1.4: Occupation Groups
- 2.0 Strains & Sprains
  - 2.1 Severity
  - 2.2 Signs & Symptoms
  - 2.3 Causes
  - 2.4 Prevention
  - 2.5 Treatment
- 3.0 Carpal Tunnel Syndrome
  - 3.1 Signs & Symptoms
  - 3.2 Causes
  - 3.3 Prevention
  - 3.4 Treatment
- 4.0 Tendonitis
  - 4.1 Signs & Symptoms
  - 4.2 Causes
  - 4.3 Prevention
  - 4.4 Treatment
- 5.0 Dislocations
  - 5.1 Signs & Symptoms
  - 5.2 Causes
  - 5.3 Prevention
  - 5.4 Treatment
- 6.0 Fractures
  - 6.1 Signs & Symptoms
  - 6.2 Causes
  - 6.3 Prevention
  - 6.4 Treatment
- 7.0 Wounds
  - 7.1 Open Wounds (Types & Causes)
  - 7.2 Closed Wounds (Types & Causes)
  - 7.3 Prevention
- 8.0 Amputations
  - 8.1 Pinch Points
  - 8.2 Case Studies
  - 8.3 Prevention
- 9.0 Burns
  - 9.1 Physiology
  - 9.2 Frostbite
  - 9.3 Electrical Burns
  - 9.4 Thermal Burns
  - 9.5 Chemical Burns
- 10.0 Root Causes of Hand Injuries
- 11.0 General Prevention Guidelines
  - 11.1 Tools & Fasteners
  - 11.2 Containers, Materials & Structural Elements
  - 11.3 Machinery
  - 11.4 Other Hand Safety Guidelines
  - 11.5 Gloves
  - 11.6 Hand Care
  - 11.7 First Aid Reminders

## 1.0 Overview

We obviously use our hands everyday to perform a multitude of tasks ranging from menial to complex operations to earn a living and mold our futures. Yet, the majority of people take them for granted. Minor skin abrasions or pinched fingernails are often overlooked while the difference between that and an amputation is sometimes only a couple of millimeters. A hand is many times stronger and more useful than the sum of its parts. So, losing the use of just one part of one hand would prove detrimental to practically everything you do.

Hand injuries have been historically common in our industry from the beginning. There's a long and ever-changing list of exposures in our day-to-day tasks with the types of materials, tools and equipment we use. The industry's nature for multiple temporary operations means that most of it is ultimately assembled, operated or used, disassembled, transported, stored, and serviced many times throughout its life. This translates to a lot of moving equipment, manual handling, a variety of energy sources, and in almost all conditions. The result is the creation of pinch points, a need for repetitive motions and other ergonomic challenges, and a potential for contact with sharp objects, chemicals and temperature extremes.

We believe all injuries are preventable, and that all levels of management, supervisors and workers are responsible for safety. As such, hazards are addressed in the design of tasks and equipment such as proper placement, guarding, handling considerations, inspection programs, on-the-job training, procedures, supervision and daily hazard assessments. This module has been additionally developed as an analysis of hand and wrist injuries from a variety of sources including incident investigations, WCB statistics, industry and international studies. While this module contains some diagnostic and treatment information, it is not intended to set policy, replace operational procedures, medical advice, First Aid training or sound judgment. Its aim is to share learnings and recommendations, equip you with awareness, ... to put safety in your hands.



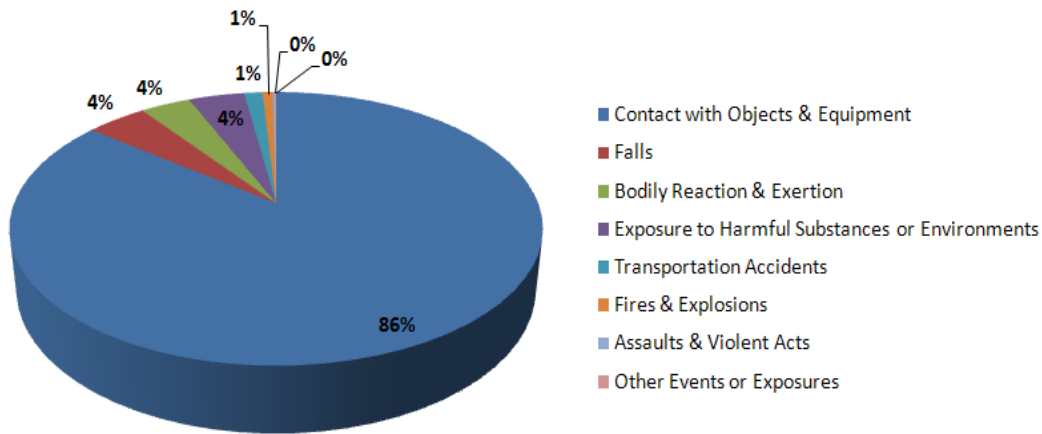
### 1.1 Oil & Gas Industry Stats (WCB, Downhole Services Group, Enform 2011)

For the complete report, go to:

[http://www.pfac.ca/images/pdf/h&s/hand\\_injuries\\_in\\_oilfield\\_downhole\\_services.pdf](http://www.pfac.ca/images/pdf/h&s/hand_injuries_in_oilfield_downhole_services.pdf)

Between 2004 and 2011, injuries to the hand accounted for 1,358 WCB claims in the Downhole Services industry of Alberta. Hand injuries resulting in claims accounted for 19.1% of all claims, \$1,980,278.21 in claims costs, and 3,964 days lost (10.3% of total claims costs and 9.0% of total days lost).

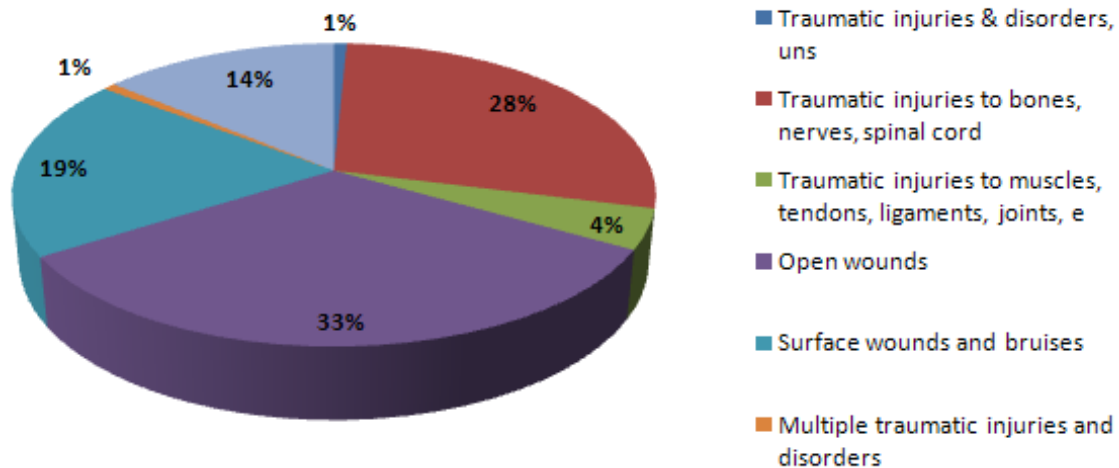
In the Downhole Services industry, hand injuries resulting from contact with objects or equipment accounted for the majority of hand injuries (86%). For this reason, this category was the focus of investigation and were broken into 3 secondary groups. The number and percentage of hand injury claims associated with each event or exposure group are described in the pie graph below.



#### Secondary Groups (2004 – 2010)

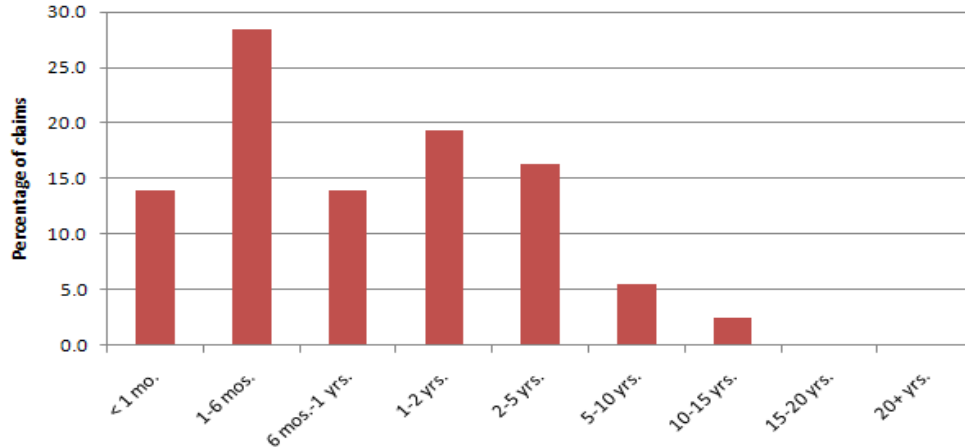
- Hand Injuries resulting from contact with tools and fasteners: 400.
  - Non-powered hand tools: 189. (I.e. Hammer: 77)
  - Other tools, instruments & equip: 57.
  - Fasteners, connectors, ropes & ties: 54
- Hand injuries resulting from contact with containers, materials and structural elements: 386.
  - Building Materials: 163.
  - Pipe, tubing, duct: 77.
- Hand injuries resulting from contact with machinery: 59.

**Nature of Hand Injuries** (Figure 1.1, percentage of all claims resulting from contact with tools and fasteners)



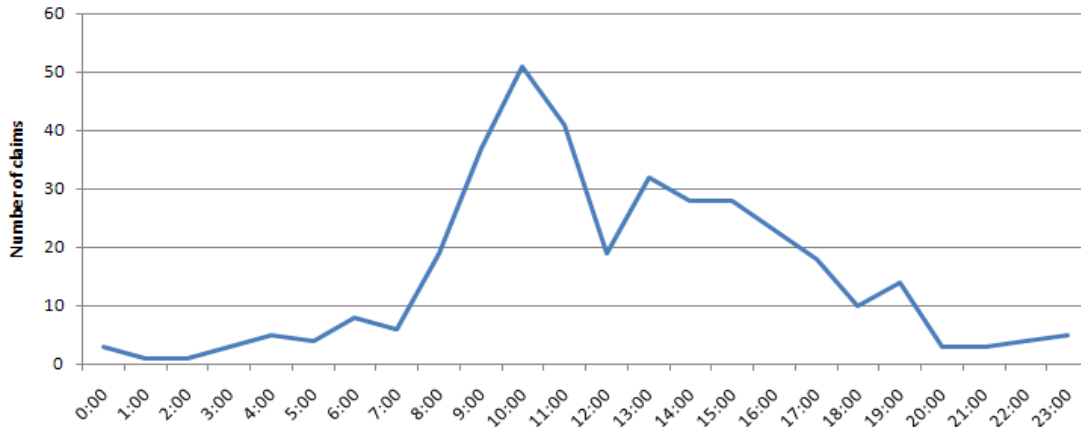
The next 2 graphs (Figures 1.2 and 1.3) have been chosen from the “contact with tools and fasteners” section of Enform’s report as representative samples for the purpose of this module.

**Experience Groups (Figure 1.2)**



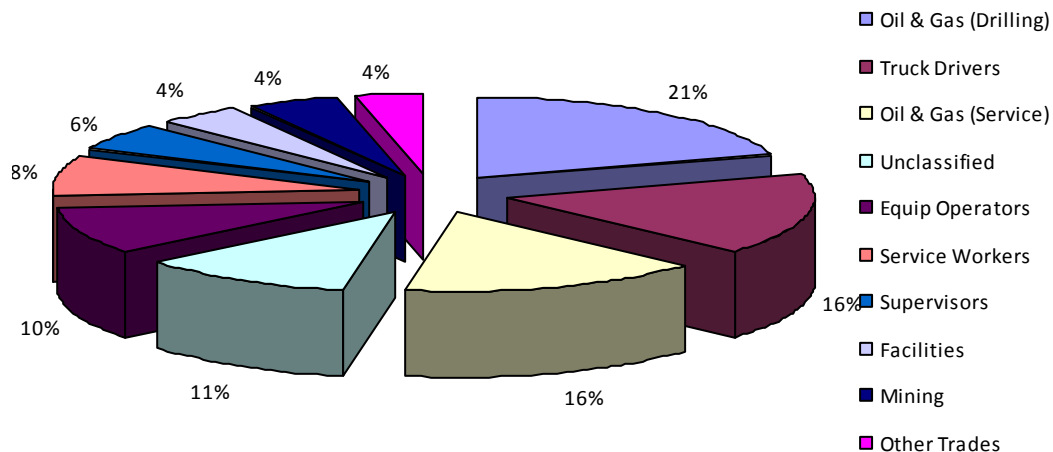
Note: relative to the size of each category (1 – 6 months) risk decreases dramatically with knowledge gained by experience. Early training is critical.

**Time of Day (Figure 1.3)**



Note: the greatest risk is between 9:00am and 11:00am.

**Percentage of all WCB claims by Occupation (Figure 1.4)**



Note: More than half of the injuries are represented by only 3 occupations.

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And so we can see, injuries to the hands and wrists are a real risk in our industry. Our company is not unique in this way. Almost half (44%) of all recordable injuries at High Arctic through 2008 to 2011 have been to the hands, fingers or wrists.

Contact with Objects, Tools and Equipment should remain a strong focus. And to examine hand injuries as a whole, their symptoms and causes, to implement preventative measures and recommend treatments, we will break the types down into categories of Strains & Sprains, Dislocations, Fractures, Open & Closed Wounds, Amputations and Burns.

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## 2.0 Strains and Sprains

Let's start with one of the most overlooked types of hand and wrist injuries: strains and sprains. Carpal Tunnel Syndrome and Tendonitis also fit in this category. All of them are distinct, although they all have similar causes, characteristics and treatment concepts.

There are differences between a strain and a sprain injury, for example. A strain is usually a torn or overstretched muscle or tendon leading to muscle weakness, swelling, pain of the affected area, or inability to use the affected part. This injury can lead to Tendonitis, and is most often caused by repetitive movement, improper techniques, or an acute blow to an area causing muscle and ligament to pull or twist away from the bone it is attached to.

### 2.1 Severity

- **Grade I Strain:** This is a mild strain and only some muscle fibers have been damaged. Healing occurs within two to three weeks.
- **Grade II Strain:** This is a moderate strain with more extensive damage to muscle fibers, but the muscle is not completely ruptured. Healing occurs within three to six weeks.
- **Grade III Strain:** This is a severe injury with a complete rupture of a muscle. This typically requires a surgical repair of the muscle; the healing period can be up to three months.

A **Sprain**, on the other hand, is an injury to a ligament; the tough, fibrous tissue that connects bones to other bone. Ligament injuries involve a stretching or a tearing of this tissue, usually associated with finger and thumb dislocations. While finger sprains are rare, wrists are often sprained after a fall, landing on an outstretched hand.

- **Grade I Sprain:** A grade I (mild) sprain causes overstretching or slight tearing of the ligaments with no joint instability. A person with a mild sprain usually experiences minimal pain, swelling, and little or no loss of function. Bruising is absent or slight, and the person is usually able to put weight on the affected joint.
- **Grade II Sprain:** A grade II (moderate) sprain causes partial tearing of the ligament and is characterized by bruising, moderate pain, and swelling. A person with a moderate sprain usually has some difficulty putting weight on the affected joint and experiences some loss of function. An x-ray or MRI may be needed.
- **Grade III Sprain:** A grade III (severe) sprain results in a complete tear or rupture a ligament. Pain, swelling, and bruising are usually severe, and the patient is unable to put weight on the joint. An x-ray is usually taken to rule out a broken bone. This type of a muscle sprain often requires immobilization and possibly surgery. It can also increase the risk of future sprains in that area.

## 2.2 Signs and Symptoms

The usual signs include pain, swelling, bruising, and the loss of ability to move and use the joint. Sometimes people feel a pop or tear when the injury happens. However, these signs and symptoms can vary in intensity depending on the severity.

### When to See a Doctor for a Sprain or Strain

- You have severe pain and can't move or put any weight on the injured joint.
- The area over the injured joint or next to it is very tender when you touch it.
- The injured area looks crooked or has lumps and bumps that you do not see on the uninjured joint.
- You cannot walk more than four steps without significant pain.
- Your limb buckles or gives way when you try to use the joint.
- You have numbness in any part of the injured area.
- You see redness or red streaks spreading out from the injury.
- You injure an area that has been injured several times before.
- You have pain, swelling, or redness over a bony part of your hand.

## 2.3 Causes

Ultimately, when these injuries occur to a hand, wrist or finger, they are usually caused by some type of over-exertion in one of a few ways.

- A fall in which the hand and arm are extended to protect from landing
- Improper lifting / material handling
- Repetitive movement, poor ergonomics / techniques
- Dislocation injury incidents
- Inadequate physical conditioning, warm-ups, pre-existing health conditions
- Sports injuries
- Overuse and/or repetition

## 2.4 Prevention

To avoid this type of injury, precaution should be taken to limit the type of movement by changing tasks, such as switching from using a wrench to turning a screwdriver, or from shoveling snow to using a hammer. Another precautionary measure is to take micro-breaks, just to stretch and get circulation flowing before resuming tasks.

Since the mechanisms of strains and sprains vary so widely, you need to look at all the possible mechanisms and exposures on a job by job basis. Here are some of the most common examples of your most likely exposures, and some recommended prevention measures for each.

| <b>Hazard</b>      | <b>Mechanism</b>  | <b>Prevention</b>   |
|--------------------|---|---|
| Uneven ground      | Slip / Trip / Fall, over-extension of wrist or arm  | Designate safe path<br>Secure footwear with ankle support<br>Adequate lighting  |
| Heights            | Fall from stairs, ladders and elevated surfaces, over extension   | Handrails<br>Fall Restraint Equipment<br>Inspections<br>Policy & Procedures<br>Housekeeping   |
| Lifting & Handling | Heavy tools & equipment in an awkward position<br>Pinch Points trapping finger in over extending position | Use mechanical advantage<br>Secure nearby moving equipment<br>Use designated handles<br>Get assistance<br>Proper storage/placement<br>Reduce loads / reach<br>Use gloves<br>ABBI (Above, Below, Behind, Inside) |

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## 2.5 Treatment of Strains & Sprains

The RICE method is the usual method: Rest, Ice, Compression and Elevate. Ice is used for acute or recent injuries (within 48 hours) to reduce swelling. Ice can also be used for chronic conditions such as overuse injuries immediately after the activity, never before.

Heating pads should be used for chronic conditions to help relax and loosen tissues before activities as this will simulate an increased blood flow. However, only moderate heat should be used for a limited time, not while sleeping for example.

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## 3.0 Carpal Tunnel Syndrome

Carpal tunnel syndrome describes an irritation of membranes around the tendons in the carpal tunnel. This inflammation results in pressure on the median nerve. The median nerve travels from the forearm into the hand through a 'tunnel' in your wrist. The bottom and sides of this tunnel are formed by wrist bones and the top of the tunnel is covered by a strong band of connective tissue or ligament. This tunnel also contains 9 tendons that connect muscles to bones and bend your fingers and thumb. These tendons are covered with a lubricating membrane which may enlarge and swell under some circumstances. If the swelling is sufficient, it may cause the median nerve to be pressed up against this strong ligament which can result in numbness, tingling in your hand, clumsiness or pain.



### 3.1 Signs and Symptoms

- Numbness and tingling in the hands
- Decreased sensation in the thumb, and fingers
- Tingling over the wrist
- Pain when holding the wrist in a bent position for a period of time

### 3.2 Causes of Carpal Tunnel Syndrome

Carpal tunnel syndrome can be caused by anything that irritates the membranes around the tendons of the hands, and in turn causes pressure on the median nerve. Some common causes include:

- Repetitive grasping with the hands or bending of the wrist
- Increases in the intensity and duration of exercise (racket sports are common)
- Overuse, sometimes combined with improper or ill-fitted equipment
- Broken or dislocated bones in the wrist which produce swelling
- Conditions such as diabetes or arthritis, especially the rheumatoid type

### 3.3 Prevention

The techniques that prevent this condition are largely the same as those that prevent tendonitis, which are covered thoroughly in the next chapter. However, other positions in the company that are exposed to this specific risk are administrative positions due to their extensive use of computers. Please see the Ergonomics section of the HSE Manual for more information.

### 3.4 Treatment

R.I.C.E is the first line of treatment for carpal tunnel syndrome. Rest, Ice, Compression and Elevation are all proper treatment plans. Mild cases may be treated by applying a brace or splint which is usually worn at night and keeps your wrist from bending. Resting your wrist allows the swollen and inflamed synovial membranes to shrink, and it relieves the pressure on the nerve.

Anti-inflammatory can help reduced inflammation and pain. In more severe cases, your doctor may recommend a cortisone injection. This medicine spreads around the swollen synovial membranes surrounding the tendons and shrinks them, which relieves the pressure on the median nerve. The effectiveness of non-surgical treatment is often dependent on early diagnosis and treatment. In patients who do not gain relief from these non-surgical measures it may be necessary to perform surgery.

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## 4.0 Tendonitis

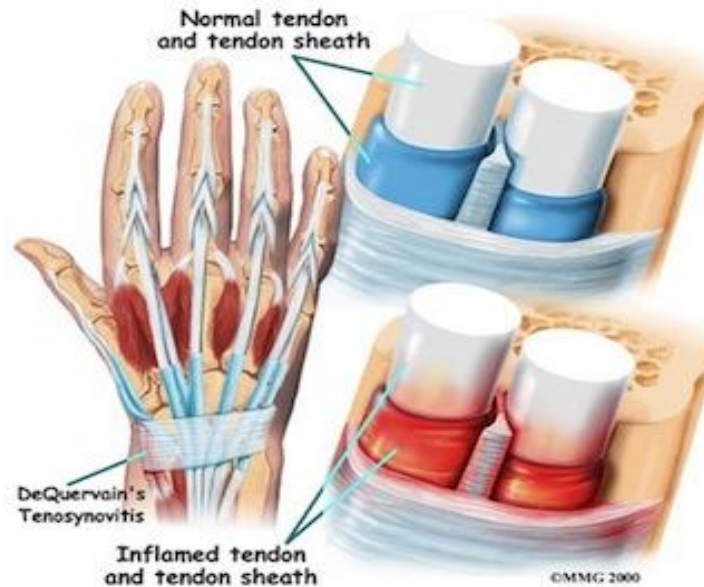
This is probably the most important strain-type injury to understand. Snubbers are directly exposed in 2 main areas; Assistants are required to remove thread protectors, and Operators occasionally need to start pipe threads. Both of these tasks require strenuous and repetitive wrist and forearm activities that can lead to tendonitis. Your understanding of this injury and its causes will help you prevent it.

A tendon is a tough yet flexible band of fibrous tissue. The tendon is the structure in your body that connects your muscles to the bones. Muscles contract to pull on the tendons and move your bones, enabling you to grab onto and maneuver things. The same concept applies at every muscle-to-bone connection in your body.



And so tendons come in many shapes and sizes. Some are very small, like the ones that cause movements of your fingers, and some are much larger. When functioning normally, these tendons glide easily and smoothly. Sometimes the tendons become inflamed for a variety of reasons, and the action of pulling the muscle becomes irritating. If the normal smooth gliding

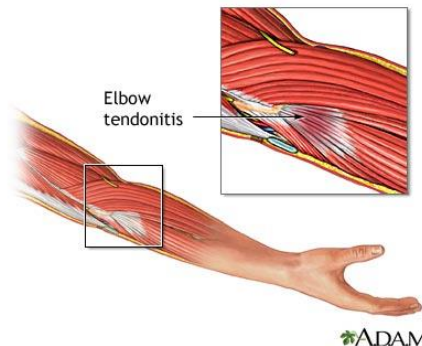
motion of your tendon is impaired, movement will become painful. This is called **tendonitis**, and literally means inflammation of the tendon.



#### 4.1 Sign & Symptoms of Tendonitis

Tendonitis is almost always diagnosed on physical examination. Findings consistent with tendonitis include

- Tenderness directly over the tendon
- Pain with movement of muscles and tendons
- Swelling of the tendon



#### X-rays & MRIs

While they are not needed for diagnosis, x-rays may be performed to ensure there is no other problem, such as a fracture, that could be causing the symptoms of pain and swelling.

MRIs are also unnecessary for the diagnosis, but are good tests that identify swelling, and will show supporting evidence of tendonitis, but are usually only performed if there is a suspicion of another problem that could be causing the symptoms.

Once confirmed, proper treatment depends on the type of tendonitis. The main types include:

- **Wrist Tendonitis**

A common problem that can cause pain and swelling around the wrist. Wrist tendonitis is due to inflammation of the tendon sheath. Treatment of wrist tendonitis usually does not require surgery.

- **Tennis Elbow (Lateral Epicondylitis) Tendonitis**

A type of tendonitis that causes pain over the outside of the elbow. Commonly associated with people who play tennis, lateral epicondylitis can occur in people who perform other sports or repetitive activities of the wrist and elbow.

Other unrelated but common types include:

- **Achilles Tendonitis.** Causes pain and swelling in the back of the heel.
- **Posterior Tibial Tendonitis.** Occurring near Achilles tendonitis. Untreated, can result in a flat foot.
- **Patellar (Kneecap) Tendonitis.** A condition often called Jumper's Knee.
- **Rotator Cuff Tendonitis**

## 4.2 Causes of Tendonitis

The small handful of specific tendons that cause problems usually have an area of poor blood supply that leads to tissue damage and poor healing response. The further away from the heart, the more risk for tendonitis, such as the hands and feet. In these “watershed” zones, the body has a harder time delivering the oxygen and nutrients necessary for tendon healing. That's why we see tendonitis in common parts of the body.

Tendonitis is most often an overuse injury as people begin a new activity or exercise that causes the initial irritation. The most common examples in our business being new workers removing thread protectors, and Operators starting threads in the basket while running pipe in the hole. Particularly after long periods of time off, if the task is relatively new, or the worker fails to recognize early symptoms. The irritation is often confused with the sensations of muscle building, and so the worker may be inclined to continue the task and tough it out. It's important to monitor these tasks; ease into them, alter positions, mind the ergonomics of all repetitive motions, trade duties and take breaks.

It's worth noting that tendons lose some of their elasticity as we age, and so tendon problems are most common in the 40+ ages.

Occasionally, there is an anatomical cause for tendonitis. If the tendon does not have a smooth path to glide along, it will be more likely to become irritated and inflamed. In these unusual situations, surgical treatment may be necessary to realign the tendon.

## 4.3 Prevention

- **Take Breaks**

Alternate repetitive tasks with short breaks to relieve stress on the tendons. Don't perform one activity continuously for hours at a time. Vary your work to relieve the stress of a single activity.

- **Recognize Symptoms**

If your hand, wrists or forearms start to feel sore and weak after a prolonged period of the same motions repeatedly, stop what you're doing. Change your position or report to your supervisor to change your duties. A simple adjustment in position could improve the comfort of some tasks.

- **Protect the Tendons**

Some will find relief by protecting the affected area when performing certain activities. For example, wrist splints can be worn while operating tongs or playing sports.

- **Strengthening and Physical Therapy**

Proper strengthening techniques can help you avoid tendonitis by using your muscles in a safe and more efficient manner. Strengthening takes time, however. Ease into tasks that require repetitive motions and maintain your health. But do not begin exercises until the inflammation of tendonitis has resolved.

The steps listed above are usually adequate tendonitis preventative measures and responses to symptoms. Most people will notice a quick decline of symptoms if the condition is identified early and these suggestions are taken. Learning to avoid activities that may cause a flare-up is the most important.

#### 4.4 Treatment

If symptoms persist and a strain injury is imminent, below is some advice for tendonitis treatment and avoiding recurrences of this problem. As with any formal treatment program, talk with your doctor before you begin tendonitis treatment. In order to aid healing you should:

- **Rest and Protect The Area**

Tendonitis treatment must begin by avoiding aggravating movements. This may mean a simple alternating of tasks, taking a break from a favorite activity, or modifying your duties for a period of time, but it's a necessary step to allow the tendon to heal. A splint or brace can also help protect the area during and after recovery.

- **Apply an Ice Pack**

Icing the area of inflammation is an important aspect of tendonitis treatment. The ice will help to control the inflammation and decrease swelling. By minimizing inflammation and swelling, the tendon can return to its usual state and perform its usual function.

- **Anti-Inflammatory Medications**

Non-steroid anti-inflammatory medications (NSAIDs) include a long list of possibilities such as Ibuprofen, Motrin, Naprosyn, Celebrex, etc. Treatment can be improved by these medications to decrease pain and swelling. Be sure to talk to your doctor before starting these medications.

- **Cortisone Injections**

If the symptoms of tendonitis are persistent, an injection of cortisone may be considered. Cortisone is a powerful anti-inflammatory medication, but instead of being given by mouth, it is injected directly to the site of inflammation. This can be extremely helpful for situations that are not improved with rest.

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## 5.0 Dislocations

Finger dislocation occurs when the bones of the finger are moved (dislocated) from their normal position. It can happen to any of the joints of any finger, but it occurs most often in the middle knuckle of the little, ring, middle, or index finger. The thumb is also commonly dislocated where it attaches to the wrist, mostly among women over 40 years old, and another very painful type of dislocation.

Ligaments are damaged in almost all dislocations, and sometimes require surgery to repair.

### 5.1 Signs & Symptoms

A dislocated finger is usually obvious. The finger appears crooked, swollen, and is very painful. It may be bent upward or at strange angles. With severe dislocations, you may have numbness or tingling, and it may appear a pale color.

### 5.2 Causes

Incidents can cause a "jamming" force to be applied to the end of the finger, or the finger may be forcefully overextended. Either of these situations, or a combination of both, can result in a dislocation.



A worker placing his hand near moving equipment or in a line of fire may get the tip of a finger struck by something. Your finger might get caught in equipment or clothing. Or you might fall onto your outstretched hand.

A person can sometimes put the bones back in place on their own, although this isn't recommended as there is a risk of trapping small tendons in the joint when doing so. A severe dislocation may cause a break in the skin where the injury has occurred. If this occurs, you should get medical attention right away.

### 5.3 Prevention

- Wear protective gloves when possible as they can reduce the impact of strikes and minor pinches.
- They also improve gripping strength and can provide protection from chemicals.
- Remove rings or other jewelry when working with your hands, particularly around machinery.
- Always observe the line of fire of moving objects and stored energy.
- Most importantly, prevent the mechanisms of injuries.

### 5.5 Treatment

A dislocated joint will sometimes be very temporary as the bones fall back into place immediately and on their own, although this is very rare. If the joint falls back into place and there is no sharp pain remaining, a doctor should still be consulted to ensure no bones or tendons were damaged in the incident.

A finger dislocation is usually a more severe injury to the ligament than it is to the bone. When a joint is dislocated, the normal alignment of the finger is altered, and the joint must be put back into place.

When the joint is dislocated, the ligaments and joint capsule surrounding the injured joint are usually torn. Sometimes, these ligaments do not heal adequately and surgery is needed to repair the injured structures.

Most finger dislocations can be treated with a simple splint to allow the ligaments and joint capsule to heal. Ice and elevation also helps to reduce pain and swelling. The joint should be x-rayed to ensure the joint is aligned, and that there was no fracture that occurred at the time of the injury. Then follow your doctor's recommendations for when to begin finger motion.

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## 6.0 Fractures

Without proper treatment a fractured bone can cause major problems. The bones in your hand obviously provide the framework which must line up precisely. They are all quite small, and equally important to the next. They let you perform all the specialized functions you need, such as grasping a pen or manipulating small objects in your palm. When you fracture a finger bone, it can cause your whole hand to be out of alignment.

Your hand contains 27 bones. There are 8 called, the 'carpals' in your wrist. The palm of your hand contains 5 bones called the metacarpals. The 14 bones in your fingers are called the phalanges. Fractures to the metacarpal bone that lead to your little finger accounts for about one-third of all hand fractures in adults.

### 6.1 Signs & Symptoms

- Swelling, tenderness and bruising at the fracture site.
- Inability to move the injured finger completely.
- Deformity of the injured finger.
- Overlapping fingers (fist / extended)
- Finger appears too short



### 6.2 Causes

Generally, fractured wrists or fingers occur as the result of a pinch or crush injuries; being in the line of fire of an object; or when trying to break a fall. Carelessness when working with tools and pipe can also easily result in a fractured bone.

### 6.3 Prevention

- Maintain your tools and equipment. Guards, OEM parts, Handrails, Inspections.
- Use the right tool for the job, ensure it's in good condition, and use it correctly.
- Safety Meetings. Train and supervise.
- Secure objects from moving inadvertently. Falling, rolling, shifting, tipping.
- Pay attention. If something changes, stop and reassess.
- Wear finger-guarded gloves for appropriate tasks.
- Housekeeping & Lighting conditions.
- Procedures and JSA's
- Footing and proper footwear. Slippery, elevated and uneven surfaces.

### 6.4 Treatment

If you think you fractured your finger, tell your doctor exactly what happened and when it happened. Your doctor must determine not only which bone you fractured, but also how the bone broke. Bones can break in several ways. They can break straight across the bone, in a spiral, into several pieces, or shatter completely.

Your doctor may want to see how your fingers line up when you extend your hand or make a fist. Your doctor may X-ray both of your hands to compare the injured finger on your uninjured finger on your other hand.

- **Nonsurgical**

Your doctor will put your broken bone back into place, usually without surgery. You'll get a splint or cast to hold your finger straight and protect it from further injury while it heals, sometimes to a neighboring finger for additional support. Usually a splint on a fractured finger is worn for about three weeks. You may need more X-rays as you heal so your doctor can check on the progress of the alignment.

- **Surgical**

Depending on the type and severity of the fracture, you may need surgery to have pins, screws, or wire put in place to hold your fractured bones together until they have fused. Injuries that require this level of treatment have long recovery times and some level of permanent effect.

Begin using your hand again as soon as your doctor determines it is okay to move your fingers. Doing simple rehabilitation exercises each day will help reduce the finger's stiffness and swelling. You may be required to see a physical therapist to assist you in these exercises.

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## 7.0 Open & Closed Wounds

### 7.1 Open Wounds

- **Penetrations, Incisions or incised wounds**, caused by a clean, sharp-edged object such as a knife.
- **Lacerations**, irregular tear-like wounds caused by blunt trauma. Lacerations and incisions may appear linear (regular) or stellate (irregular).
- **Abrasions** (grazes), superficial wounds in which the topmost layer of the skin (the epidermis) is scraped off. Abrasions are often caused by a sliding fall onto a rough surface such as grip strut floors or wooden catwalks, or an unsafe use of a hand tool.
- **Puncture wounds**, caused by an object puncturing the skin, such as a nail, valve stem, valve handle, cable wicker.

**7.2 Closed wounds** have fewer categories, but are just as dangerous as open wounds. The types of closed wounds are:

- **Contusions**, more commonly known as bruises, caused by a blunt force trauma that damage tissue under the skin.
- **Hematomas**, also called a blood tumor, caused by damage to a blood vessel that in turn causes blood to collect under the skin.
- **Chronic and Acute** or traumatic wounds are the result of injuries that disrupt the tissue. Chronic wounds are those that are caused by a relatively slow process that leads to tissue damage. Chronic wounds include pressure, venous, and diabetic ulcers. Typically, an insufficiency in the circulation or other systemic support of the tissue causes it to fail and disintegrate. Infection then takes hold of the site and becomes a chronic abscess. Once the infection hits a critical point, it can spread locally or become systemic (sepsis).

### 7.3 Prevention

Prevention of wounds, dislocations and fractures always starts in the engineering of equipment and operating procedures. Potential for being struck by objects, or pinch points such as with rotating equipment should be guarded or enclosed, or otherwise eliminated from the outset.

The design of procedures and placement of energy sources should consider any need for human interaction with hazards, or eliminate the need for manual handling wherever possible.

The safe use of tools can be aligned with training, supervision, inspection & maintenance programs, and worker behaviors.

Other guidelines include:

- Keep your work area tidy to prevent hidden hazards just as sharp objects, falling items and punctures.
- Handles should be installed in a safe position, clearly identified and ergonomically correct. Supervisors should enforce their use, and workers trained to use them.
- Each task is worthy of its own assessment before engaging in it. Use the ABBI method to evaluate the environment or load (A: Above, B: Below, B: Behind, I: Inside)
- Equipment must be locked out, secured from movement and in a safe area before servicing it.
- Use the right tool for the right job and ensure it's in good condition. Never attempt otherwise.
- Use safety knives, or force the blade in a safe direction.
- Use a hand-over-hand method when handling cable, or a sliding tool to protect from wickers.
- Inspect equipment regularly to identify and eliminate sharp edges, missing or damaged guards, loose items, housekeeping and placement hazards.
- A proper selection of gloves can reduce the impact of wounds such as minor pinch pinches, cuts and abrasions.
- Ensure a good grip and use proper lifting techniques.

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## 8.0 Amputations

Although most of this topic is covered indirectly in previous sections, the pinch points that can cause these types of injuries need special consideration. Pinch points are the leading mechanism of partial and full finger amputations.

**8.1 Pinch Point:** created in the space between any 2 objects if one or both of the objects move in a way that could trap a body part.

**Pinch or Crush injuries** are caused by a force applied over a very short or long period of time between any 2 objects.

Look for stickers like these. They indicate an identified pinch point in the area.



These injuries can lead to permanent effects, more so if any part of the bone has been amputated. There are some very high risk types of crush points associated with moving vehicles and suspended loads. As for hands, operating the snubbing jack, closing doors, handling pipe and working with tools are just some examples of where common pinch points can be created.

## 8.2 Case Studies

1. A Snubbing crew was running pipe into a well. The spring on the tong door had fallen off, allowing the door to swing open as pipe was rotated. A worker was standing near the tongs and reached toward the tongs for balance while guiding the next joint up to the basket with the winch. His hand went into the front of the rotating tongs, severing 3 fingers completely off.

- A hydraulic lockout device must be operational on all tongs to prevent their operation if the door is open.

2. A Nitrogen Pump Operator was disassembling line pipe after a job. While closing a sweep, his finger was positioned between the hammer union and a nearby valve. He suffered a partial amputation, which was stitched back on and healed.

- Material handling must be combined with self awareness and proper positioning. Work with heavy items in a safe area and wear finger-guarded gloves for appropriate tasks.

3. A Snubbing crew was assembling a 10K BOP stack. The space between the stud and the body of the Annular didn't allow for the nut to pass, so the nuts needed to be pre-started while the Annular was suspended over the BOP. After starting all the nuts, the crew began lowering the Annular with the picker. A worker noticed that one of the nuts wasn't down far enough, so he reached in to turn the nut. The Annular pinched his finger between the nut and the body, causing a compound fracture.

- Communication is imperative in all heavy lifts. Use the proper stud lengths to eliminate the need to interact with pinch points wherever possible. Reduce the need for assembly/disassembly with the proper size picker.

4. A Snubbing Assistant was pulling the pin from the bracket of a Load Manager to drop the leg. His other hand was on the top of the leg above the bracket for support. The leg dropped with his hand still holding the top of it as it passed through the bracket, amputating the tip of his thumb.

- Load Managers legs can be spotted in advance to lessen the distance it needs to be dropped, or the picker used to control the descent. Keep fingers out of holes.

## 8.3 Prevention

As always, the best prevention is to eliminate pinch points altogether wherever possible. We must never lose sight of the hierarchy for hazard control.

### Engineering Controls

- Design equipment to operate without creating pinch points
- Design pinch points to only occur in enclosed areas
- Design the operation of equipment in a manner that prevents the need for human interaction in specific areas
- Install barriers between body parts and the hazard, or otherwise prevent entry.
- Never tamper with machine guards. Lockout before removing guards, and always replace them after making repairs or adjustments to equipment.
- Secure objects from moving before placing your hand in a pinch point.
- Secure materials so it cannot fall or roll. Stacked materials should be strapped, racked or interlocked so they cannot shift.
- Lockout energy sources, such as gravity, trapped pressure, mechanical, electrical, etc before conducting maintenance.

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### Administration Controls

The recommendations below are also very important, although they are less effective since they don't actually eliminate the hazard.

- Perform hazard analysis on jobs to identify pinch points. Use the Step Back 5 X 5 and ABBI methods.
- Review JSA's as they will help identify some pinch points, and develop task or site specific JSA's to help workers understand the precautions needed.
- Communicate clearly and on-the-fly of changing conditions that create pinch points.
- Train and supervise. Awareness is a major factor. Give workers information and feedback to enforce proper procedures.
- Identify specific pinch points with labels, signs, instructions, high visibility colors, etc.
- Travel only in designated traffic areas, and be constantly alert for moving equipment.
- Be careful when handling all metal items. Metal vs. flesh, metal always wins.
- Beware of rolling hazards. This includes wheels, pulleys, pipe on racks and other circular or cylindrical equipment.
- Know how to turn off machinery in your work area in case of an emergency – seconds count.
- Don't wear jewelry or loose clothing when you are working near moving equipment.
- Use doorknobs and drawer handles, to prevent slamming your finger in a pinch point.



### PPE

- Wear the right kind of gloves for the job. Wearing the wrong ones around moving equipment may be an additional hazard.

### 8.4 Treatment

Apply pressure to the injured area immediately. Preserve the amputated part in a plastic bag and put it in ice water or ice, but Do Not allow the amputated part to come in contact with the ice.

Surgery can often re-attach the amputated part. Chances of recovery increase with the speed and quality of response, cleanliness of the wound, and depending on the mechanism of injury (shape and severity). Long term recovery can involve expensive physical therapy, especially if new forms of grasping must be learned.

## 9.0 Burns

These injury types deserve a category of their own, but the good news is that they are relatively rare. They are a risk nonetheless due to the inherent hazard of an almost unlimited supply of highly flammable and pressurized gases and liquids at our worksites. Burns are rare because the risks are easily understood, and we would do almost anything not to get burned. For the purpose of this module, we only need to know that burns are mostly only associated with the epidermis (skin), and so the information is generally the same regardless which part of the body we're talking about.

Burn injuries account for an estimated 700,000 annual Emergency Room visits per year in the U.S., down from the previous statistic of 2 million per year. Most burns are not life threatening, but due to extreme pain, they can cause psychological trauma. At temperatures greater than 49°C, a child's skin is burned enough in 3 seconds to require surgery. Follow-up for even superficial burns is imperative, particularly when involving the hands or other sensitive areas.

We introduce the potential for burns with daily use of electrical devices, combustion engines, boilers and chemicals. A chemical commonly known as “frac oil” is widely used in our industry, which is one example of a flammable (and toxic) fluid that your gloves could be soaked in, and possibly ignite.

To effectively evaluate, treat and prevent burns, understanding the different sources and types is helpful because interventions must be appropriately tailored to the underlying cause. Types of burns include frostbite, electrical, thermal and chemical burns. Thermal burns can be further classified according to skin depth and percentage of total body area burned.

### 9.1 Burn Physiology

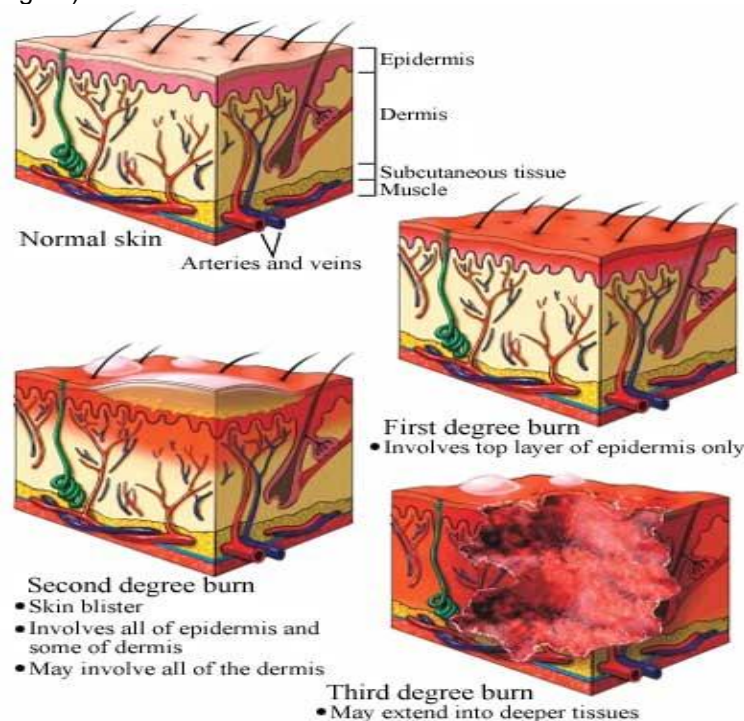
The skin is the largest organ of the body. Although not very active, the skin serves multiple functions essential to the survival which may be compromised by a burn, including the following:

- Thermal regulation and prevention of fluid loss by evaporation
- Barrier against infection
- Sensory receptors that provide information about the environment

The skin is divided into 3 layers, as follows:

- **Epidermis:** This is the outermost layer of skin composed of epithelial cells. Outer surface cells die and are sloughed off as newer cells replace them.
- **Dermis:** This is the middle layer of skin composed of primarily connective tissue. It contains capillaries that nourish the skin, nerve endings, and hair follicles.
- **Hypodermis:** This is a layer of adipose and connective tissue between the skin and underlying tissues.

Burn depth is described as superficial, partial thickness, or full thickness (corresponding to first, second, or third degree).



The most common types of thermal burns are the result of an exposure to a heat source such as a flame, hot surface or fluid. Soft tissue is burned when it is exposed to temperatures above 46°C (115°F). The extent of damage depends on surface temperature and contact duration. A thermal burn causes coagulation of soft tissue. Burns may cause a hyper metabolic state manifested by fever and cardiac problems. Patients need support in this state, which continues until wounds are closed. To a large degree, how the individual responds to the increased energy demands will determine recovery.

## 9.2 Frostbite

Thermal burns are usually understood as contact with heat, but a contact with a temperature extreme also meets the definition of frostbite, so let's start there.

The skin of human body is approximately 80% water. We know that water freezes at 0°C. Frostbite is the actual freezing of the water in your skin, and the subsequent damage. Fortunately, our body expels heat as we spend energy. That heat dissipates outward from the body, providing a cushion between our skin and the surrounding air that prevents most direct contact with freezing temperatures. But as temperatures drop and wind blows, the cushion deteriorates and our skin has less protection. As a result, the weather feels colder than it really is. The calculation that gives us the degree of this effect (in comparison to no wind), is known as the "wind chill factor." Gloves decrease the effect of wind on the hands, but also decrease the ability for the hand to stay warm as a whole. For this reason, mittens provide better protection than gloves although dexterity is lost.

Because of this natural cushion, objects you touch in cold weather are colder than the air surrounding your skin. So don't be fooled. It's also worth noting that all materials take time to equalize their temperatures with the surrounding atmosphere. Some materials will hold heat or stay cold for longer than others. Nonetheless, exposing any material that is mostly water (such as your skin) directly to air or cold materials that are below freezing will freeze the water over enough time. The resulting injury is very similar to a burn.

### Signs & Symptoms

Frostbite is identified at first by a tingling sensation, increasing to a stinging and burning feeling, and eventually followed by no feeling at all. For this reason, a person may have frostbite without knowing, so workers should also observe each other.

Areas of the body that are at most risk of frostbite are where skin is exposed and where blood circulation is lower further away from the heart. Therefore, frostbite occurs in the hands, ears, nose and feet first. It appears as a white spot on sensitive and/or exposed skin such as the tips of your fingers. It's white because it's literally frozen and needs immediate attention.

### Prevention

- Keep exposed skin to a minimum, although beware; the skin doesn't need to be exposed to get frostbitten.
- Wear dry and insulated gloves and avoid touching cold materials with your bare hands.
- Wear mittens for tasks that don't require fine handling.
- Take regular breaks.
- Observe co-workers for symptoms and maintain self awareness.
- Follow policies on cold weather operations.
- Wear appropriate clothing and use shelters such as wind breaks.
- Maintain heating equipment and appliances.
- Stay active and maintain your health for good circulation.

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**Treatment of Frostbite**

DO NOT rub an area suspected to have frostbite. This will damage the skin. Move to a warm area, and slowly thaw the affected area. Consult a physician for ointment or other procedures to mitigate damage as necessary.

**9.3 Electrical Burns**

- Electrical burns produce heat injury by passing through tissue.
- Most problems from these burns present in patients exposed to more than 1000V.
- Ignition of clothing may produce some flame burn, but most of the injury is deep in the skin.
- Cardiac injury is prominent, and patients must be monitored for 4-72 hours depending on the strength of the voltage and the age of the patient.

Electrical hazards present themselves with the use of some tools, electrical storms in an elevated conductor (snubbing basket) in open spaces (lease sites), mobile generators, underground and overhead installations, and several day to day industrial and domestic devices (computers, coffee machine, lights, PLC's, etc). There is a potential for you to be handling something electrically powered at any point in your job. Here are some graphic examples of the types of injuries that can be caused if electricity isn't respected.

**Entrance Wound:** High resistance of skin transforms electrical energy into heat by contact or arc attracted to perspiration. Resistance produces burns around the entrance point (dark spot in center of wound). This man was lucky; the current narrowly missed his spinal cord.



**Exit Wound:** Current flows through the body from the entrance point, until finally exiting where the body is closest to the ground. This foot suffered massive internal injuries, which weren't readily visible, and had to be amputated a few days later.



### Internal Injuries

This worker was shocked by a tool he was holding. The entrance wound and thermal burns from the overheated tool are apparent



Same hand a few days later, when massive subcutaneous tissue damage had caused severe swelling (swelling usually peaks 24-72 hours after electrical shock). To relieve pressure which would have damaged nerves and blood vessels, the skin on the arm was cut open.



### Involuntary Muscle Contraction

This worker fell and grabbed a power line to catch himself. The resulting electric shock mummified his first two fingers, which had to be removed. The angle of the wrist was caused by burning of the tendons, which contracted, drawing the hand with them.



## 9.4 Thermal Burns

- **Flame burns**
  - Contact with open flames cause direct injury to tissue. Stored gases, domestic fires, torches.
  - Flame may ignite gloves and clothing, especially if soaked in flammable fluids. Although natural fibers tend to burn, synthetic fibers may melt or ignite, adding a contact burn component to the injury.
- **Contact burns**
  - Contact burns result from direct contact with a hot object such as exhaust pipes, burners, steam lines.
  - These injuries are confined to the point of contact unless a fire is created by the presence of gloves that are soaked in a flammable fluid.
  - Examples are burns from cigarettes and tools (e.g., soldering irons, cooking appliances, curling irons).
- **Scalds**
  - Scalds result from contact with hot liquids such as oil or water

- The more viscous the liquid and the longer the contact with the skin, the greater the damage.
- Accidental scalds often show a pattern of splashing, with burns separated by patches of uninjured skin



- **Steam burns**
  - Steam burns most often occur in industrial incidents associated with boilers or radiators.
  - These burns produce extensive injury from the high heat-carrying capacity of steam and the dispersion of pressurized steam and liquid.
  - Boilers also use a dangerous chemical, compounding the hazard.
- **Flash burns**
  - Flash burns are a subset of flame burns and are a result of rapid ignition of a flammable gas or liquid.
  - The body parts involved are those exposed to the agent when it ignites.
  - Areas covered by gloves, coveralls and a non flammable outer layer are usually spared.
  - A classic example of this type of injury occurs when a person pours gasoline on a trash or leaf fire to increase the flame and is burned by the subsequent fireball.

### 9.5 Chemical burns

Alkaline substances (such as boiler chemical) and acid substances can burn the skin and can be associated with systemic toxicity. Alkaline burns produce liquefactive necrosis and are considered higher risk burns due to their likelihood to penetrate deeper. Acid burns are the result of coagulation necrosis, limiting the depth and penetration of the burn.

- **Tar Burns**

Hot tar burns usually occur in workers in the paving and roofing industries but would be similar to being soaked in hot oil, so it's worth mentioning. Because of oil's tendency to absorb heat, it can be heated to high temperatures and cause deep burns, and is difficult to remove.



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## 10.0 Root Causes of Hand Injuries

By understanding what types of injuries that are happening, we can also get a general picture of what is causing them. While each incident has its own specifics, all are preventable although there is no single issue. However, as we look at the big picture, we start to realize some commonalities, and root causes can be grouped together, such as:

- Inadequate guards, exposures to projectiles, rotating and moving equipment
- Using the wrong tool for the job, a faulty tool, or the right tool incorrectly
- Attempts to save time or effort, shortcuts, deviation from procedures
- Inattention or inadequate identification of an exposure (Unsafe positioning)
- Inexperience, lack of knowledge, training or supervision
- Inadequate inspection, maintenance and replacement

All causes are within our control to correct. All of them ultimately boil down to a human behavior somewhere in the system, often more than one. In absence of awareness and support for safe operations, people will tend to make uneducated decisions about normalized hazards, analyze tasks incorrectly, or take shortcuts.

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## 11.0 General Prevention

Prevention should be straight forward at this point. Let's review what we've learned and what we can do about it.

We now know that hand injuries are a risk throughout our industry, and that almost half of all injuries at High Arctic since 2008 have been hand, finger or wrist injuries. We can all agree that it's a real concern that needs to be raised.

We know the types of injuries that are happening, to what experience levels, in which occupations, and even the approximate times of day. So we can concentrate our awareness and initiatives in these areas.

Drilling down, we know most hand injuries occur by contact with tools, fasteners, containers, materials, structural elements and machinery. We also know that not every contact with these things will cause an injury. 99% of the time, they are handled safely, so all of the injuries are preventable. We know what's causing them, so we should obviously know how to prevent them. People that experience severe hand injuries are usually eager to talk about their injury for this reason. Most people want to share what they've learned so that it doesn't happen to you.

Below are some general guidelines on how to prevent injuries in all categories.

### 11.1 Tools & Fasteners

- Disconnect power tools when not in use and before changing bits, blades, and other accessories.
- If a power tool binds STOP and reassess the job.
- Wear anti-vibration gloves when using power tools that vibrate excessively.
- Never remove guards!
- Ground power tools unless double insulated
- Don't wear gloves that can get caught on rotating parts.
- Secure work in a or on a bench - Don't hold it in your hand!



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**Screwdrivers**

- When using screwdrivers, place the object on a flat surface or in a vice.
- Don't use screwdrivers as chisels or pry bars
- Use the correct size driver for the screw
- Don't use screwdrivers with chipped tips

**Knives**

- Use safety knives whenever possible.
- Keep knife blades sharp.
- Cut away from your body.
- Do not use knife blades as screwdrivers.
- Avoid working on the same object when a coworker is using a knife.

**Hammers**

- Never use a hammer with a splintered, cracked or loose handle
- Don't use hammers with rounded striking faces
- Use the correct hammer for the job.
- Don't strike a hammer face with another hammer
- Don't use claws as a pry bar

**Hand Saws**

- Use moderate pressure on hack saws to prevent blade failure
- Spray saw blades lightly with lubricant prior to use
- Keep blades sharp

**Chisels**

- When possible use a safety chisel
- Never use a screwdriver as a chisel
- Don't use chisels with mushroomed heads
- Use the correct chisel for the job
- Don't use chisels as pry bars

**Wrenches**

- Use the correct sized wrench for the job
- Maintain jaws and heels for a sharp bite
- Don't use pliers or crescent wrenches on tight bolts and nuts
- Pull on wrenches rather than pushing them
- Avoid using a snipe or cheater bar



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**Shop Tools**

- Unplug or Lockout tools before changing blades
- Keep tools sharp
- Never remove guards
- Use a drill press vise when drilling – Don't hold parts with your hands!

**Grinders**

- Don't wear gloves when operating bench grinders
- Never remove guards
- Maintain proper clearances on tool rests and tongue guards
- Use vice grips when grinding small parts

**11.2 Containers, Materials and Structural Elements**

- Use the handles
- Use the appropriate gloves (MSDS and task based)
- Practice safe storage practices
  - Reduce the need for manual handling
  - Label hazards
  - Safe height or use a forklift
  - Housekeeping
- ABBI method
- Hand-over-hand method with cable

**11.3 Machinery**

- Lockout / Tagout
  - Secure equipment from movement before maintaining it.
  - See Lockout / Tagout procedures in Section 2 of the HSE Manual for more information.
- Guards on rotating equipment (belts & pulleys, drive shafts, rotaries, tong doors)
- Use the Preventative Maintenance Program
- Ensure adequate lighting for the operation
- Label hazards and dangerous areas
- Training, procedures, supervision and enforcement

**11.4 Other guidelines****Bites and Stings**

- Use caution when moving debris piles or equipment which has been sitting for a long time. Don't stick your hands in holes, crevasses and other secluded places, including work boots which have been sitting for awhile.

- Avoid areas where insects nest or congregate (garbage cans, stagnant pools of water, uncovered foods and areas where flowers are blooming)
- Avoid dressing in clothing with bright colors, scented soaps, perfumes or hair sprays
- Observe Workplace Hygiene Policy – no pets

### Disposal

Never dispose of used razor blades, broken glass, or other sharp objects in regular trash cans. Use a metal or other hard shell container for disposal of sharp objects.

### Jewelry

Remove jewelry before using power tools or working on machines, and keep sleeves buttoned.



### 11.5 Which Glove is Best?

Unfortunately, there is no single solution. Many gloves offer superior protection from one hazard while sacrificing the quality of protection from another. The user should have access to a variety of gloves, and select the most appropriate glove for the task.



- Chemical gloves must be chosen for the specific chemical being used with info from the MSDS. Rubber, nitrile, neoprene, PVC, PVA and other synthetic gloves do not provide puncture protection, and are usually slippery when wet.
- Kevlar or Wire mesh are ideal for working with sheet metal, glass, or heavy cutting.
- Shock absorbing gloves are ideal for operating rotary hammers, pneumatic tools and other vibrating equipment.
- Insulated leather gloves are recommended for extreme high and low temperatures.
- Leather gloves are usually best for equipment handling, general construction, heavy cleanup, welding, moderately hot or cold material handling.

- Cotton Green Kings are the popular choice for light duty material handling and cleanup work. They provide some insulation from hazards while maintaining some grip, and can be washed and re-used a few times.
- Gloves with finger guards can help decrease the impact of objects and materials, and are generally the most durable.
- Tighter fitting gloves are best for handling small items but lack insulation qualities.

### 11.6 Hand Care

- Avoid washing your hands with solvents, harsh soaps, or abrasives.
- Clean and bandage all cuts and abrasions. Protect abrasions and open wounds from hydraulic oil and other chemicals.
- Immediately remove any imbedded foreign materials (splinters, wickers).
- Wash immediately after using any chemical, even if you did not detect leakage.
- Pay attention to skin rashes. Get an immediate medical evaluation.
- A barrier cream can be used for some level of protection from some types of chemicals, but beware of other routes of entry such as inhalation.

### 11.7 First Aid Reminders

- Sprains: Apply cold compresses to reduce pain and swelling. R.I.C.E.
- Cuts: Apply direct pressure to a large or bleeding cut and elevate the hand above the shoulder. Clean a small cut with soap and warm water and cover it with a sterile bandage. Some types of glue is sometimes used to help close small cuts.
- Minor pinches: lance blackened finger nails with a clean needle to relieve blood pressure that causes throbbing. To prevent infection, do not remove the dead nail until the new one has grown.
- Broken bones: Keep the hand still and get professional help.
- Amputations: Apply pressure to the injured area immediately. Preserve the amputated part in a plastic bag and put it in ice water or ice, but Do Not allow the amputated part to come in contact with the ice!
- Chemical burns: Rinse with running water for at least 15 minutes.
- Heat burns: Soak minor burns in cold water. Then apply a sterile bandage. A burn that is charred or blistered requires medical attention.

Additional video material:

*Hand Injuries: The Gory Story*

<http://www.youtube.com/watch?v=KupKQ7fUEO8&feature=related>

*Hands On Safety*

<http://www.youtube.com/watch?v=tHkwyV8dW0E>

You need your hands, and we are committed to your safety. There is a control measure available against every hazard so that every job can be done safely. Prevention of hand injuries relies on full participation, awareness and safe behaviors to put Safety in Your Hands.