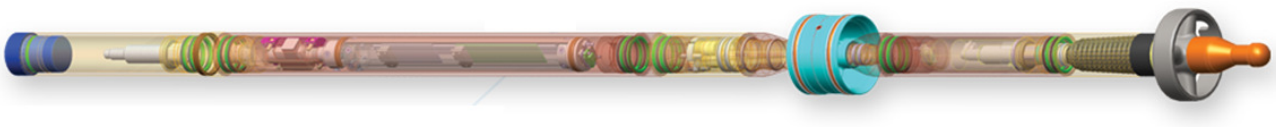
EXTREME™ ENGINEERING

XEM™



OPERATIONS MANUAL

CHAPTER 1 HSE

REV A: 2013 July27

XFLD-0001

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1. STANDARDS AND POLICIES

1.1. QHSE POLICY

Extreme requires the active commitment to and accountability for, QHSE from all employees and contractors. Line management has a leadership role in the communication and implementation of, and ensuring compliance with, QHSE policies and standards. We are committed to:

- Protect, and strive for improvement of, the health, safety and security of our people at all times;
- Eliminate Quality non-conformances and HSE accidents;
- Meet specified customer requirements and ensure continuous customer satisfaction;
- Set Quality & HSE performance objectives, measure results, assess and continually improve processes, services and product quality, through the use of an effective management system;
- Plan for, respond to and recover from any emergency, crisis and business disruption.
- Minimize our impact on the environment through pollution prevention, reduction of natural resource consumption and emissions, and the reduction and recycling of waste;
- Apply our technical skills to all HSE aspects in the design and engineering of our services and products;
- Communicate openly with stakeholders and ensure an understanding of our QHSE policies, standards, programs and performance. Reward outstanding QHSE performance;
- Improve our performance on issues relevant to our stakeholders that are of global concern and on which we can have an impact, and share with them our knowledge of successful QHSE programs and initiatives.

1.2. HAZARD ASSESSMENT AND RISK CONTROL (HARC)

A **hazard** is a situation that poses a level of threat to life, health, property, or environment. Hazards need to be identified and the associated risk level has to be determined prior to the job.

Risk is a combination of 2 components:

- Likelihood
- Severity

Likelihood is the probability of an event occurring and is classified as:

- Very Low (1)
- Low(2)
- Medium(3)
- High(4)
- Very High(5)

The likelihood of a highly poisonous rattle snake confined in a cage, biting a human being is very low, but the likelihood of a green snake loose in the jungle biting you when provoked can be high. Control measures are normally put in place to **prevent** a dangerous activity from occurring. The act of putting the snake behind a cage prevents the snake from biting is a preventive measure that reduces the likelihood of the snake bite.

Severity: Severity is described as the consequence of an event occurring and is classified as:

- Light(1)
- Serious(2)
- Major(3)
- Catastrophic(4)
- Multi-catastrophic(5)

The severity of a highly poisonous rattle confined in a cage biting a human being can be catastrophic, but the severity of a “green” snake bite can be light particularly if treated on time. Control measures are put in place to **mitigate** the severity once an event has occurred. In the above, activity the availability of treatment for the snakebite is a measure that reduces the severity of the bite.

Risk = Severity x Likelihood

Risk levels should be determined for all activities at the well site based on likelihood and severity. In the matrix below risk level is calculated from 1 (very low) to 25 (Extreme). Control Measures can be put in place to reduce the severity and likelihood of that activity so that the overall risk level is reduced. This is indicated by the white arrow.

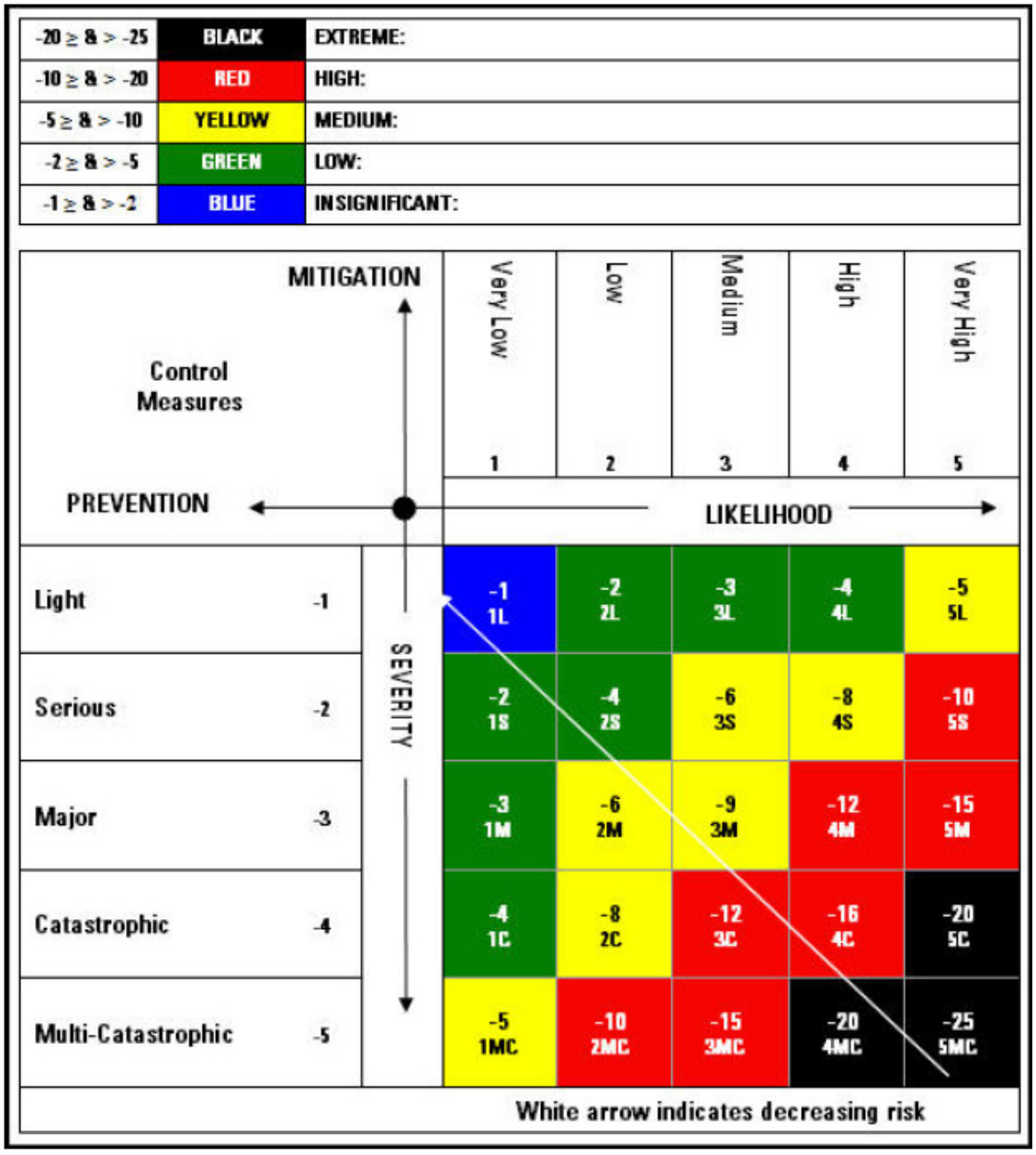


Figure 1 Risk Matrix

The HARC (Hazard assessment and risk control) is a template which allows you to classify hazards, determine the associated risk and put in place control measures to reduce the severity and likelihood of hazards.

A Hazard record such as the one below can be completed for service quality or HSE related events

Hazard Analysis and Risk Control Record

Revision:	1.1	**Task/Process Assessed:**	Surveying Procedures in Western Canada with Extreme XEM tool
Date:	16 April 2013	**Location:**	Pathfinder- Extreme shop and site location in Western Canada
Operation:	Planning and drilling	**Assessment Team:**	Tinuke Chineme, Djamal Bouchou, Trevor Ceh, Haidar Alkhalisi, Clint Chase, Pola Cifuentes, Randy Meller.

	HAZARD		INITIAL RISK			CONTROL MEASURES		RESIDUAL RISK		
						List all Current and Planned Control Measures, taking into Account all Contributing and Escalating Factors				
Activity Steps	**Hazard Description and Worst Case Consequences with no Prevention or Mitigation Measures in Place**	**Loss Category/ Population Affected**	**Likelihood**	**Severity**	**Risk Level**	**Current and Planned Prevention Measures to reduce Likelihood**	**Current and Planned Mitigation Measures to reduce Severity**	**Likelihood**	**Severity**	**Risk Level**
Job Planning - Well profile - BHA - Tool calibration - Offset wells noted and scanned against -Geomagnetic model is confirmed -EDI is run	**Machinery/Equipment/ Hand Tools** - Improper calibration - Influence of direction & Azimuth on the tool measurement is not considered (EDI) - OST is unavailable for verification of tool tests - Failed sensor goes unnoticed because calibration is not done with varying temperatures -Wrong magnetic parameters are used	**Reputation** **Process** **Assets** Results in inaccurate surveys i.e. surveys out of FAC and uncorrectable	Probable (5)	Major (-3)	Intolerable (-15)	- Design BHA for required NM spacing as well as closest sensor spacing (As per EDI) - Organize a *pre job meeting*: decide on the chain of command and the point at which assistance will be escalated to the survey specialist. - *Pre job meeting*: decide on the chain of command and the point at which the tool will be switched for a backup	- Go through the AC exemption process, if flagged, to ensure drilling is monitored by OSC and have mitigation measures implemented prior to start of the well - Ensure MWD tool calibration is current (send to site)	Unlikely (2)	Serious (-2)	Acceptable (-4)
Rig site preparation - Inventory and strip tools (send data to town) - Check equipment - Programming tool on site and setting it up with Maxwell acquisition system	**Machinery/Equipment/ Hand Tools** - Rig down time from incorrect/incomplete tools - Improper programming of the tool for the conditions -Improper setup of XEM	**Assets** **Reputation**	Unlikely (2)	Catastrophic (-4)	Undesirable (-8)	- Document/communicate geomagnetic model of choice in field pack - Use the same frame sent from town. Have the OSC and field check compare the details and ensure that it is a match (QC). - Tool spec and inspection sheets should be at rig site - Have Extreme field engineer **ONLY** program tool	- Inventory tools as soon as they arrive on location	Likely (4)	Serious (-2)	Acceptable (-4)

Figure 2 HARC form surveying procedures

For each Hazard an initial risk is determined based on likelihood and severity. Control measures are applied to reduce the likelihood as well as to mitigate against the severity. A residual risk is then calculated based on the control measures put in place. Refer to **SLB-QHSE-S020** Hazard Analysis for more information.

A Blank HARC can be downloaded from the Extreme Intranet at the resources link for the manual.

1.3. JOB SAFETY ANALYSIS

A more elaborate Job safety analysis may be required for certain applications. A Job Safety Analysis (JSA) is a step by step review of the process or procedure to be performed at the job site. The JSA clearly identifies the safety issues during each step of that process. It requires the development of a plan for safely completing each step of the process.

To help with the planning of a JSA, make a quick mental risk analysis of the required task by answering the following questions:

- What is the task? (Identify task)
- Why do I need to do the task? (Identify requirements)
- Who is going to carry out the task? (Personnel required)
- Where will I carry out the task? (Location satisfactory)
- When will I do the task? Is time available? (Time satisfactory)
- How am I carrying out the task? (Attention to job at hand)

1.4. INJURY PREVENTION PROGRAM

The (SIPP) Injury prevention program provides guidance on improving work habits to prevent injuries to the field staff. Posters below show the techniques in the SIPP program that can be used in the field to prevent Injury.

HAND INJURY PREVENTION

Figure 3 Hand Injury prevention

WARM UPTO WORK

PHASE 1 | Isolated Movements
Small isolated movements intended to increase blood flow to the contracting muscles while shifting focus from an activity to your body movements.

PHASE 2 | Full-Body Movements
Movements that progress toward the simultaneous use of more muscle groups, which in turn increases internal body temperature.

PHASE 3 | Full Range of Motion Movements
A short series of full range-of-motion movements used to prepare the body for more forceful activity and to use each muscle group's full range-of-motion in a slow, controlled manner.

Neck Stretch
With eyes looking forward, slowly bend the head to the right. Return to the starting position and bend head to the left. (CAUTION: Do not pull too hard to one side.)

Folding Shoulders
Standing upright, fold the shoulders forward, rounding the back. Return to start position and squeeze shoulder blades together.

Looking Up and Down
Lower and tilt the head forward, tucking chin in. Return to the starting position. Put one or both hands behind the head and gently tilt the head backward. Return to starting position. (CAUTION: Do not tilt the head backward too much.)

Chest Stretch
Stand upright with hands placed on lower back or hips, and pull both arms backward.

Back Extension
Stand upright with hands placed on lower back or hips. Slightly lean back, keeping eyes focused on ceiling. Return to upright position.

Knee Raises
Standing with back straight, hold the chair back with one hand for support. Raise right knee as high as you can and fully extend leg behind you. Return to start position and repeat exercise with opposite leg.

Seated in chair with back straight, hold armrest. Alternate raising left and right knees.

Shoulder Rotations
Slightly fold shoulders backward, lift up and then rotate shoulders forward. Slightly fold shoulders forward, lift up and rotate shoulders backward.

Wrist Rotations
Rotate wrists inward. Then, rotate wrists outward.

Toe Point
Standing–Hold chair back or table with one hand for support. Stand on one leg and lift the heel of other foot off ground. Alternate pointing toes up and down. Return to start-position and repeat exercise with opposite leg.

Seated–Lift heels off ground, alternate pointing toes up and down.

Shoulder Stretch
Place right hand on left shoulder. With right elbow up and parallel to the floor, use left hand to pull right elbow across chest. Return to the start position and repeat exercise with left hand.

Wrist Stretch
Extend right arm with palm facing out. Use left hand to pull right hand backward gently. Return to start position and repeat the wrist stretch with palm facing in.
Return to start position and repeat with left hand.

Lower Leg Stretch
Hold chair back or table with both hands for support. Lunge forward, keeping back leg straight and pointing toes forward. Return to start position and repeat exercise with other leg.

Figure 4 techniques to warm up

STAND BACK 5 X 5

Stand Back 5 x 5 – DO YOUR JOB SAFELY

Take FIVE minutes.....
Stand back FIVE paces.....
Look up, down, around and behind.....

Managing the hazards in your workplace is based on the principle of 'ENGAGING THE MIND BEFORE THE HANDS'

Before the job:

- Stop and think
- Observe the work area and surroundings
- Step through your mind what you are going to do
- Think about what else is happening in the area or nearby
- Identify what else could go wrong
- Satisfy yourself that the hazards are controlled before starting the work

After the job:

- Observe the work area
- Take action to control any hazards that may have been created by the work
- Reflect on how well the job went and the mental planning process you used
- Did you feel safe doing the job?
- Were others around you working safely?
- Can any improvements be made next time?

Figure 5 stand back 5x5

BODY CONTROL TECHNIQUES

- Line of Strength
- Side Stepping
- Safe Working Zones
- Smart Grip
- Watch Your Head
- Bracing and Spinal Alignment

Figure 6 Body control techniques employed at the well site

The key to maintaining control is by understanding how to use the body to improve our Power, Balance and Stability. We can improve each of these areas by utilizing good techniques.
The Body Control Techniques will decrease the stress and strain our bodies feel when we work.

LINE OF STRENGTH

Orient your feet based on the direction of the force, to avoid working in Points of Weakness; use a staggered stance to work in the forward direction.

- Everyone has a “Line of Strength” and two “Points of Weakness”; they are always with us, and shift depending on how we place our feet.
- We need to place our feet in a position that enables us to eliminate working in a Weak Point, while shifting our work closer to our Line of Strength.
- It is important to realize that with a SMALL change in stance, you can make a LARGE change in your strength and stability.

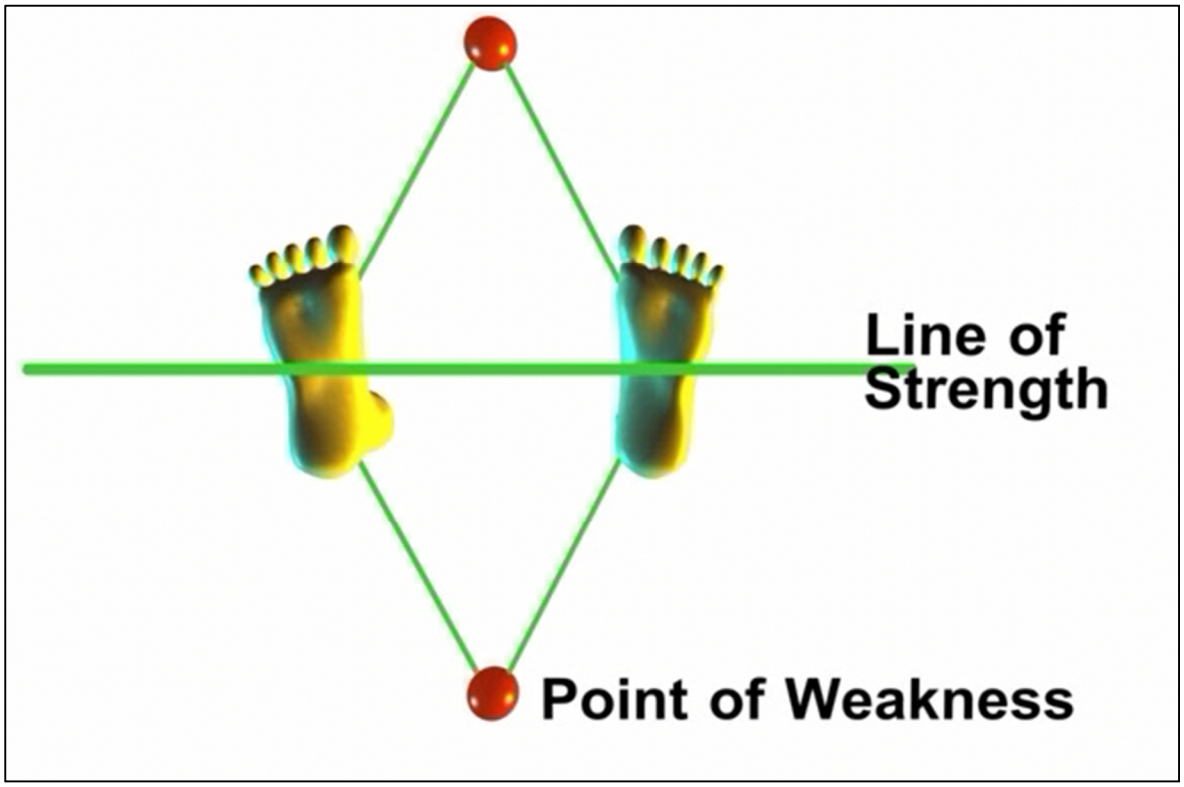


Figure 7 Line of strength

SIDE STEPPING

Maintaining stability and control by stepping into the Line of Strength. This technique can be applied in a variety of situations…for example, stepping down from a height, including stairs, and over obstacles, especially when carrying something.

Figure 8 Side stepping while coming down from the rig floor

PLEASE NOTE: It is better to remove the gloves while going up coming down from stair case if the gloves have grease or oil on them.

- Side Stepping is nothing but taking the line of Strength and putting it into motion. Use a side step when you need extra balance and stability.
- If you think about it, the act of walking is nothing but picking the foot up and falling into your Point of Weakness. This would be great if we always walked on smooth flat surfaces and never encountered any obstacles. But the locations we work in are inherently dangerous and we must maintain balance as we maneuver in that environment.
- A SMALL change in step can make a LARGE change in apparent strength and stability (over hazards, changing elevation or decline, narrow spaces, or pulling/pushing power).

SAFE WORKING ZONE

Adjust position & equipment to work in the green zone.

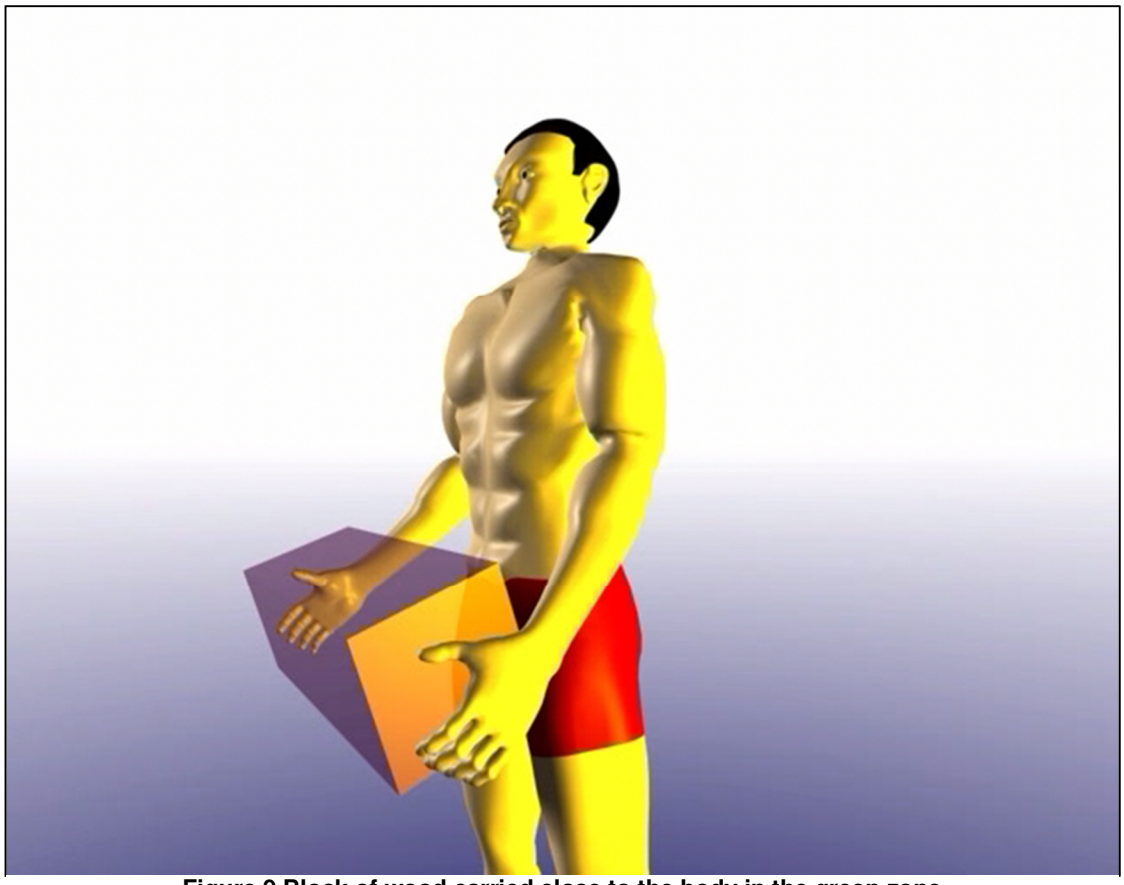


Figure 9 Block of wood carried close to the body in the green zone

- Get close to your work or bring your work closer to you.
- Green and Orange zones are safe work zones; avoid working in the Red Zone whenever possible. Working in the Red Zone isolates stress on our shoulders and back, while working closer engages more muscles of the body.
- Where we position ourselves in relationship to the tools and equipment we use determines how hard our bodies have to work.
- Remember that by working in our Green and Orange zones we use strength and stability to help us maintain control.

SMART GRIP

Use the strength fingers: These are the two bottom fingers:

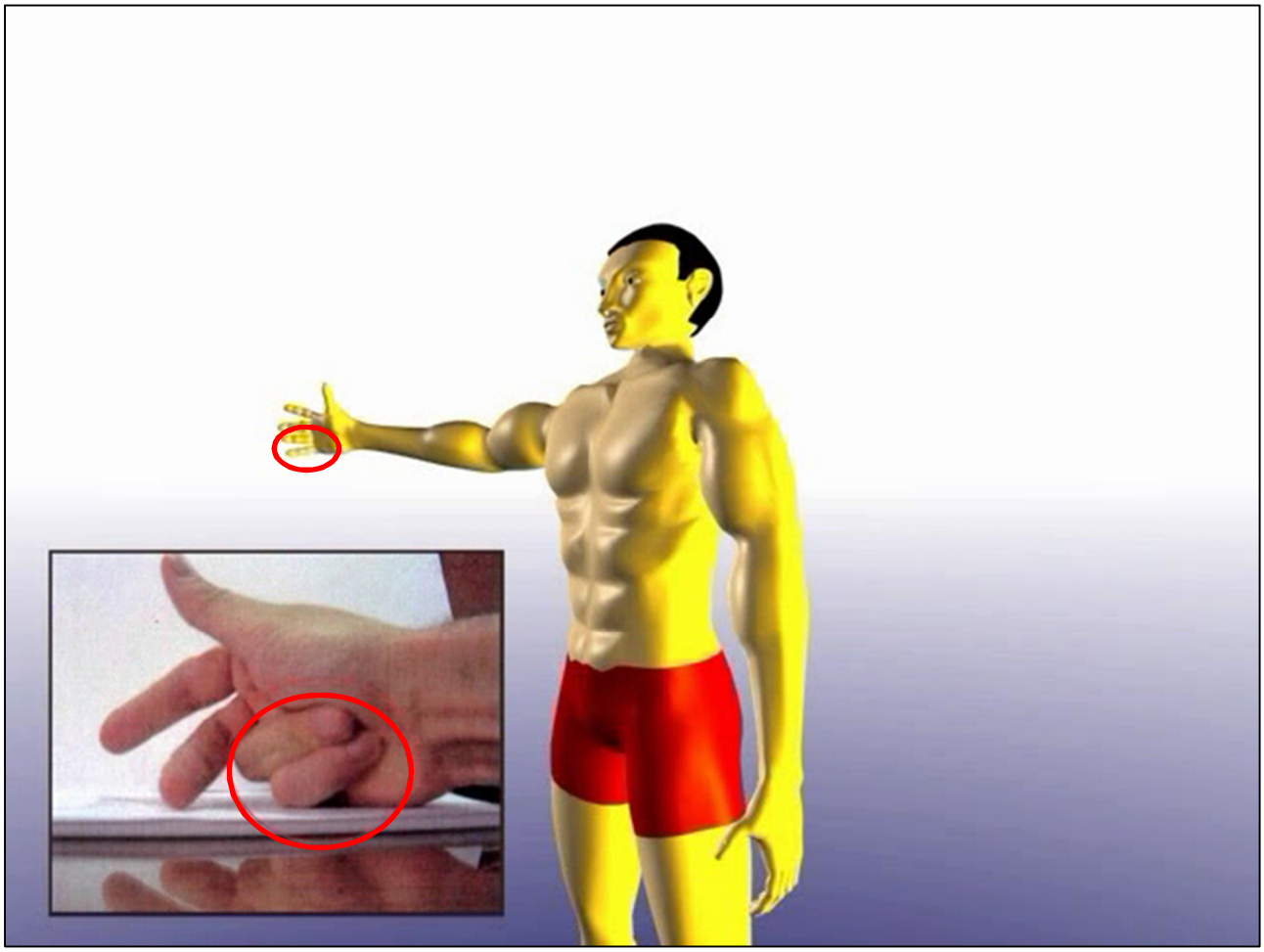


Figure 10 strength fingers

- Strength fingers activate the muscle groups of the lower arm, back, hips, and the muscles of the legs. You are using muscle groups that are spread throughout the body.
- We get more power from the use of the bottom two fingers or the “Strength Fingers”. Concentrating on the strength fingers also improves your balance and stability by causing the large muscle groups to activate.
- It is important to realize that even an INVISIBLE change in your muscle use can make a LARGE change in your strength and stability.

WATCH YOUR HEAD

Keep center of gravity within your stance.

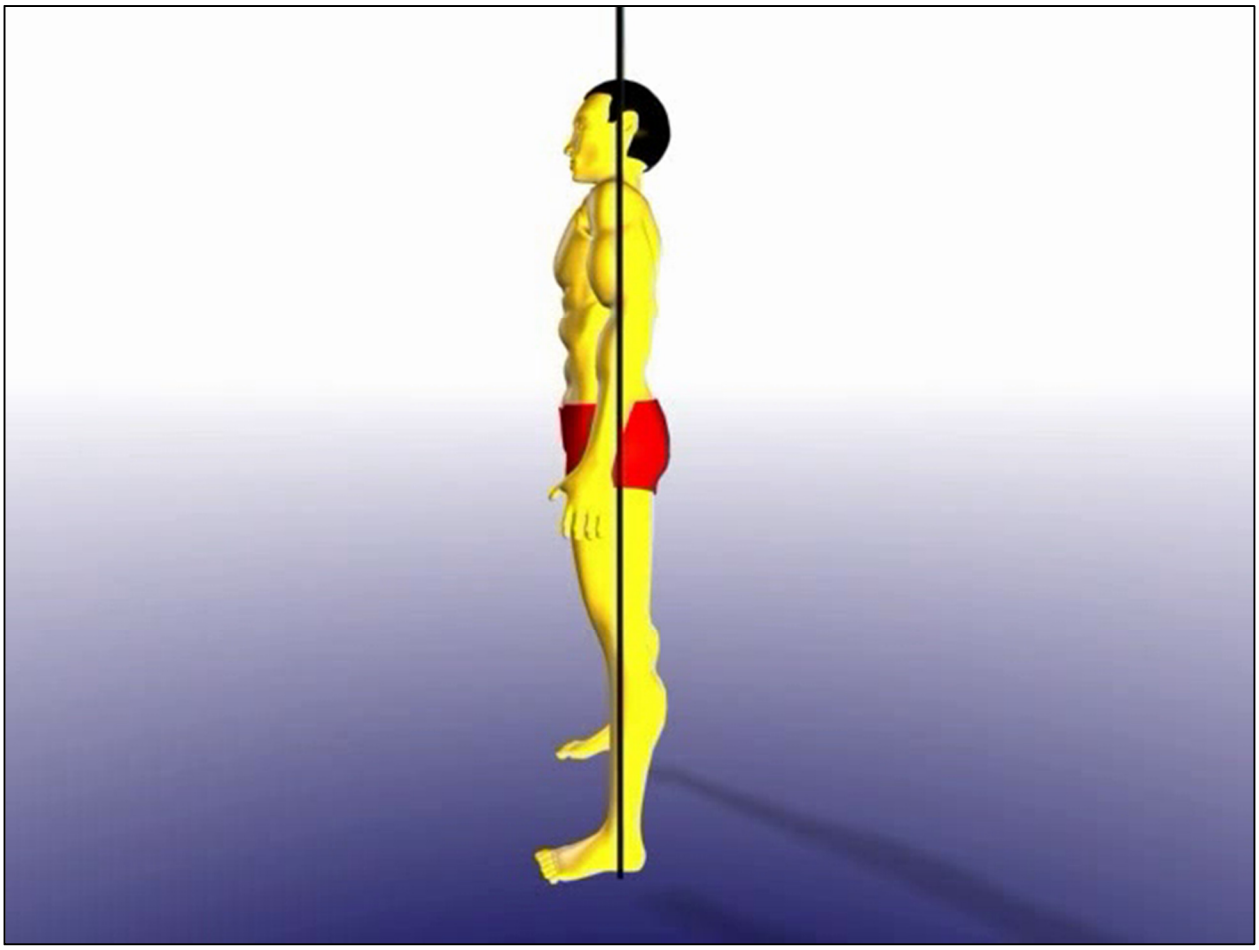


Figure 11 keeping the center of gravity within your stance

- Watch your Head is about both balance and posture.
- The head is heavy and as it tilts up or down it shifts our center of gravity; our head position also influences the position of our lower spine.
- If we maximize our eye movement while minimizing our head movement, we can make a LARGE change in our balance and stability, while also promoting neutral alignment of the spine.

BRACING AND SPINAL ALIGNMENT

This involves correct body posture and neutral alignment.

Figure 12 correct Posture and neutral alignment

- By maintaining our neutral S-curve, and by bracing, we cut down on the forces across the discs of the spine.
- In regards to bracing, placing your hand in your point of weakness as it falls in relationship to your line of strength creates the strongest position; consider the position of a bipod versus tripod.

2. RIG SITE

2.1. ARRIVAL AT THE WELLSITE

Upon arrival to the Rig Site:

- Report immediately to the person in charge and sign the log.
- Take a Rig Site orientation of the working environment by the person in charge. This will help identify potential drilling hazards such as overpressure, H2S, etc.
- Attend all rig safety meetings.
- Read the Station Bill and know the location of your accommodations.
- Walk around and learn the location of the work areas.
- Understand all emergency signals, escape routes, smoking areas, and other Rig Site safety rules.
- Set up logging unit so that the rig alarms can be heard clearly inside.

2.2. PPE (PERSONAL PROTECTIVE EQUIPMENT)

Wearing fit-for-standard PPE is a requirement of employment and safety at the rig site or work area. PPE has been selected with job function, activity, and environment in mind. PPE is used as a mitigating factor after preventative engineering and administrative controls have been put in place. The purpose of PPE is not to **prevent** injury, but to reduce the severity of injuries to employees, contractors, 3rd parties, visitors. The following is a list of **Mandatory** PPE at the well site.

Figure 13 safety glasses

Figure 14 Hard hat

Figure 15 flame retardant wear or coveralls

Figure 16 steel Toe Shoes

Figure 17 Plugs

Figure 18 Gloves

2.3. MECHANICAL LIFTING

All mechanical lifting operations shall be conducted in a way that minimizes these risks to an acceptable level, through careful planning, management of required equipment.

Careful planning is key to ensuring safe lifts. For this reason, a **Lift Plan** is required for every lift such as lifting the Tool to and from the Catwalk at the well site

Routine tasks may require a generic Lift Plan based on the Job Safety Analysis (JSA). The FST at the well site will determine the appropriate plan for activities**.** A pre-lift meeting held prior to conducting any lifting operations. This should include:

- Load details
- Personnel requirements
- Operational restrictions
- Equipment certifications and suitability
- Work Instructions
- Communication modes
- Emergency plans
- Restrictions on lift
- Simultaneous operations
- Permit to Work (PTW) requirements

For more information on mechanical lifting, see the QHSE-S013 policy.

PICKUP SLINGS

Ensure that the Pickup sling used to lift the XEM tool from inside the collar is rated to**750lb force**. In "Slings" or the Slimpulse style pick up plates should be used instead of the Legacy plate.

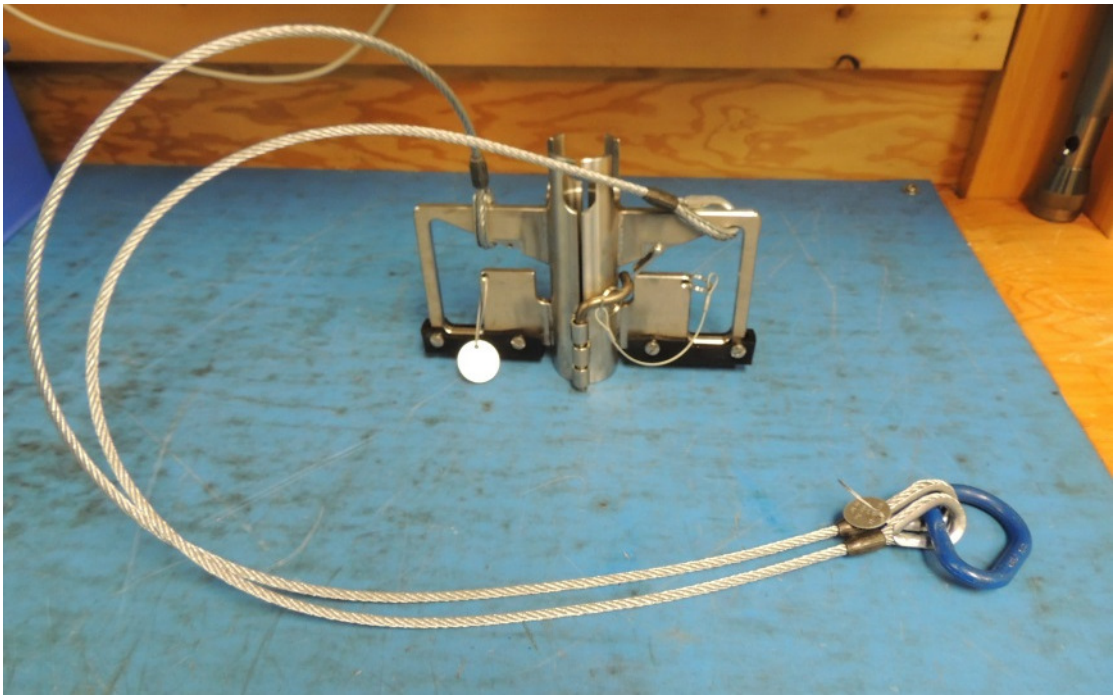


Figure 19 Legacy Pickup sling

2.4. WELL INTEGRITY

Well Integrity is of principal concern to all personnel working at a well site, Personnel working at well sites shall have an adequate understanding of Well Barriers, as well as the competence to establish and maintain the necessary physical Well Barriers that are part of the Extreme provided services.

All personnel working directly or indirectly on wells or with the Well Barrier equipment shall ensure the following:

- Compliance with and understand of this standard via Level 1 Awareness training
- Required certifications well integrity - competency
- **All Extreme employees have an obligation to stop work that is regarded as being unsafe (Q-stop).**

2.5. HAZARD AREA REGULATIONS

Perform rig up of surface equipment according to the Extreme client, and regulatory agency policies and procedures. Failure to do so may result in a violation of hazardous zone regulations. Never

violate hazardous area regulations. Ensure that all required work permits have been obtained, and that safety inspections have been performed prior to commencing the task.

Permits include:

1. Hot Work Permits: Work which involves the use of, or possible creation of, any source of ignition within a hazardous area. Hot work permits are mandatory when picking up the XEM to the rig floor due to Spark Hazard.

2. Cold Work Permits: This includes Work that is not capable of producing a source of ignition, under any circumstances. Any work affecting the integrity or availability of safety, or emergency systems (such as fire pumps, fire mains, shutdown systems, and fire and gas detection) requires a cold work permit.

2.6. ELECTRICAL

SURFACE EQUIPMENT

Within rigging up the surface equipment

- Verify the incoming power supply voltage
- Ensure all the Power supply sources are grounded
- Ensure the Rig Equipment including Top Drive, Compressors, Mud Pumps are grounded
- Lock out and tag out any switches you must leave unattended while you work
- Routinely check for any signs of wear (i.e. fraying, cracking, melting or cords being pinched); replace worn cords immediately.
- Protect all the cables from being crushed or damaged (it may be necessary to run Sensor cables across the ground). There is a little risk of electrical shock from damage to the cables, but cable damage will affect system reliability.
- Keep all liquids away from copiers, fax machines, computers, etc.
- Never slice electrical cords or remove the grounding prong from a three-prong plug,
- Always unplug equipment at the outlet. Ensure equipment is unplugged if maintenance is to be done.

SHOCK HAZARD FROM TOOL

The XEM tool transmits its signal via a potentially high current and voltage. Any time the tool is in transmitting mode and not completely in the hole, there is the potential for shock situations. The primary risk mitigation minimizes the need and possibility for the tool to be in transmitting mode while on the surface.

The operating mode of the tool has been structured so that the pressures sensors need to see a **pressure >100 psi** and the vibration sensors need to **detect vibration** for the tool to provide data.

There is a risk of shock when the tool is being programmed, so do not make contact above and below the landing spider at the same time as shown in the figure below.

Figure 20 Shock hazard when programming the tool

When loading/unloading the tool from the Drill collar, If the tool is transmitting, a voltage potential exists across the landing spiders.

Do not touch the areas circled in the figure below at the same time.

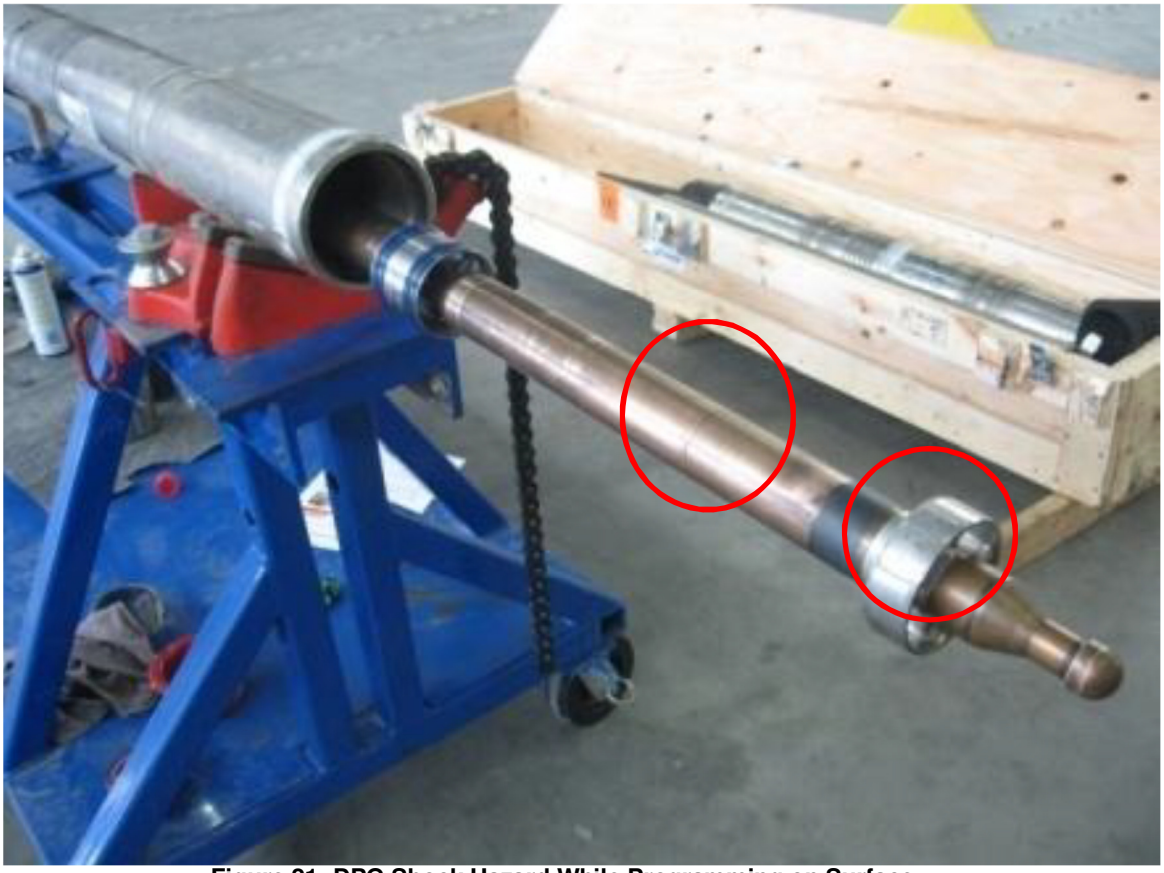


Figure 21: DPG Shock Hazard While Programming on Surface

2.7. PRESSURE

At the well site

- Pay attention to the pressure hoses and flexible control lines which contain fluid under pressure.
- Pay attention to trapped pressure when dis-assembling a tool that has come out of surface.
- Ensure that the pressure at the well site does not exceed the equipment specifications.

Additional guidelines for working in pressure can be found in the OFS Pressure Standard (Standard 14).

2.8. BATTERIES

2 different types of batteries can be used in the XEM Battery probe.

Lithium Thionyl chloride batteries:

These are potentially volatile batteries used for most applications due to high energy and life capacity. They have a 50 Ampere Hours capacity and can be used for longer durations. There is however a risk that the batteries can rupture in severe or very harsh drilling conditions.
Lithium batteries are available in 150°C and 165°C packs.

When using Lithium battery ensures that the Manufacturer MSDS Material Safety data sheet and the battery event kits are available. Additional information on the batteries is given in the specifications chapter.

Alkaline batteries

Alkaline batteries are similar to the batteries commonly used in appliances at home and are typically non-volatile and are used for high shock and vibration work (typically air drilling applications),

While the Alkaline Battery Pack is still susceptible to damage from high shock and vibration levels, any resulting “battery incident” is relatively benign compared to a Lithium pack, which drastically reduces the severity of any resulting HSE issues.

The Extreme Engineering Alkaline battery pack is designed to work with the battery manager much like a lithium battery pack. However, because the alkaline battery pack can run to a lower voltage without the same safety concerns of a lithium pack, special firmware is needed that removes the 8V battery protection cut off voltage for use with Alkaline.

Alkaline batteries have a 15-20 Ampere Hour capacity. The capacity however is affected if the battery has undergone shock and vibration even if not used up. Any pack with a loaded voltage (running the tool but not transmitting) of 9V or less should be considered depleted.

2.9. MSDS LITHIIUM BATTERY

Electrochem Solutions, Inc.
A Subsidiary of Greatbatch, Inc.
670 Paramount Drive
Raynham, MA 02767 USA
Tel: 781.830.5800 Fax: 781.575.1545

MATERIAL SAFETY DATA SHEET

Issued: 8/30/2011

Section 1 – IDENTIFICATION

Product Name:

LITHIUM THIONYL CHLORIDE CELLS AND BATTERIES

Hermetically-Sealed Lithium Thionyl Chloride Cells & Batteries

All Electrochem 100, 150, 150/165MR, 180/180MR, 200/200MR series, QTC, MWD, VHT Cells and Batteries

Section 2 – COMPOSITION/INFORMATION ON INGREDIENTS

Thionyl Chloride	**OSHA: 1.0ppm (5.0mg/m3) ceiling**
7719-09-7	**ACGIH: 1.0ppm (5.0mg/m3) ceiling**
Lithium	**TLV/PEL N/A**
7439-93-2	
Carbon	**ACGIH: 3.5 mg/m3 TLV/TWA**
1333-86-4	

Section 3 – HAZARDS IDENTIFICATION

****DANGER**** INTERNAL CONTENTS ARE EXTREMELY HAZARDOUS. LEAKING FLUID IS CORROSIVE AND DANGEROUS UPON INHALATION. BATTERY MAY BE EXPLOSIVE AT HIGHER TEMPERATURES.

Do not expose to temperatures above the maximum rated temperature as specified by the manufacturer due to leak hazard.

If cell or battery leaks or vents

Primary Routes of Entry: Inhalation.
Carcinogenicity: Not listed by NTP, IARC, or regulated by OSHA.
Health Hazards: **Acute –** Vapors are very irritating to skin, eyes, and mucous membranes. Inhalation of thionyl chloride or sulfuryl chloride vapors may result in pulmonary edema.
Chronic – Overexposure can cause symptoms of non-fibrotic lung injury.
Signs and Symptoms of Exposure: Eye and mucous membrane irritation.
Medical Conditions Generally Aggravated by Exposure: Asthma, other respiratory disorders, skin allergies, and eczema.

Section 4 – FIRST AID MEASURES

Eye Contact: Flush with running water for at least 15 minutes. Hold eyelids apart. Seek immediate medical attention. Contact results in acidic burns.
Skin Contact: Rinse with large amounts of running water. Avoid hot water and rubbing skin. If burns develop, seek medical attention. Contact results in acidic burns.
Inhalation: Remove to fresh air. If breathing is difficult, administer oxygen. If not breathing, give artificial respiration. May result in pulmonary edema.
Ingestion: Drink copious amounts of water (or milk if available). Do not induce vomiting. NEVER GIVE ANYTHING BY MOUTH TO AN UNCONSCIOUS PERSON. Immediately seek medical attention.

MSDS Page 1/4

Section 5 – FIRE FIGHTING MEASURES

Flash Point: N/A **Auto-Ignition Temp:** N/A **Flammable Limits:** N/A
Extinguisher Media: Copious amounts of water. Lith-X powder, Class D fire extinguisher, Dry Lithium Chloride, Graphite Powder, Pyrene G-1 may not be effective on resulting secondary fires.
Special Fire Fighting Procedures: Cover with Lith-X powder, Class D fire extinguisher, dry lithium chloride, or graphite powder. DO NOT USE CO_2, Class ABC, or soda ash extinguisher. Wear protective breathing apparatus; a positive pressure Self Contained Breathing Apparatus (SCBA), or Air Purifying Respirator (APR). Be aware of secondary fires.
Unusual Fire and Explosion Hazards: Do not short circuit, recharge, over discharge (discharge below 0.0 Volts), puncture, crush or expose to temperatures above the maximum rated temperature as specified by the manufacturer. Cell may leak, vent, or explode. If a bright white flame is present, lithium content is exposed and on fire.

Section 6 – ACCIDENTAL RELEASE MEASURES

Accidental Releases: Do not breathe vapors or touch liquid with bare hands (see section 4).
Waste Disposal Methods: Evacuate area. If possible, a trained person should attempt to stop or contain the leak by neutralizing spill with soda lime or baking soda. A NIOSH Approved Acid Gas Filter Mask or Self-Contained Breathing Apparatus should be worn. Seal leaking battery and soda lime or baking soda in a plastic bag and dispose of as hazardous waste.
Other: Follow North American Emergency Response Guide (NAERG) #138 for cells involved in an accident, cells that have vented, or have exploded.

Section 7 – HANDLING & STORAGE

Storage: Cells should be stored at room temperature, approx. 21°C (70°F). Do not store batteries in high humidity environments for long periods. High Temperature storage will degrade performance.
Precautions: Do not short circuit or expose to temperatures above the maximum rated temperature as specified by the manufacturer. Do not recharge, over discharge, puncture or crush.
Other Conditions: Do not store cells in close proximity of other combustible / flammable materials.

Section 8 – EXPOSURE CONTROLS / PERSONAL PROTECTION

When handling internal components:

Respiratory Protection: NIOSH Approved Acid Gas Filter Mask, or Self-Contained Breathing Apparatus.
Protective Gloves: Nitrile or PVC, Gloves should be 15 ml (0.015 in), or thicker.
Eye Protection: Chemical Worker Safety Glasses or face shield.
Ventilation To Be Used: Negative pressure chemical fume hood.
Other Protective Clothing & Equipment: Chemical Laboratory Safety Glasses, Protective Apron, Acid Resistant Protective Clothing, and face shield.
Hygienic Work Practices: Use good chemical hygiene practice. Do not eat or drink when handling contents. Avoid unnecessary contact.

Section 9 – PHYSICAL/CHEMICAL CHARACTERISTICS

Boiling Point:	Thionyl Chloride: 77oC
Vapor Pressure:	Thionyl Chloride: 92mm @ 20 °C
Vapor Density:	Thionyl Chloride: 4.1 (air = 1)
Solubility in Water:	Thionyl Chloride: Decomposes violently on contact with water.
Specific Gravity:	Thionyl Chloride: 1.63 g/cm3
Melting Point:	Thionyl Chloride: -105 °C
Evaporation Rate:	No Data
Water Reactive:	Thionyl Chloride hydrolyzes to form SO2 and HCl gasses and strongly acidic wastewater.
Appearance & Odor:	Thionyl Chloride – Colorless to pale yellow; sharp, pungent odor.
Other:	Internal contents contain Bromine and Chlorine.

Section 10 – STABILITY & REACTIVITY

Stability: Stable **Incompatibility:** N/A **Hazardous Polymerization:** Will not occur.
Conditions to Avoid: Temperatures above the maximum rated temperature as specified by the manufacturer due to leak hazard. High humidity for extended periods.
Hazardous Decomposition Products: Sulfur Dioxide $_{(g)}$, Hydrogen Chloride $_{(g)}$, Hydrogen $_{(g)}$

MSDS Page 2/4

Section 11 – TOXICOLOGICAL INFORMATION

Acute Toxicity (as applicable):

Thionyl Chloride		**Sulfuryl Chloride**	
LC_{50} (Inhalation):	500 ppm (rat 1-hr)	**LC_{50} (Inhalation):**	130-250 ppm (rat 1-hr)
LD_{50}:	N/A	**LD_{50}:**	N/A
Eye Effects:	Corrosive	**Eye Effects:**	Corrosive
Skin Effects:	Corrosive	**Skin Effects:**	Corrosive

Section 12 – ECOLOGICAL INFORMATION

Aquatic Toxicity: Do not let internal components enter marine environments. Avoid releases into waterways, wastewater or groundwater.

Section 13 – DISPOSAL CONSIDERATIONS

Proper Shipping Name: Waste Lithium Batteries
UN Number: 3090
Hazard Classification: Class 9 (Misc.)
Packing Group: II
Labels Required: MISCELLANEOUS, HAZARDOUS WASTE
Waste Disposal Code: D003
Other: All lithium thionyl chloride batteries should be disposed of by a certified hazardous waste disposal facility.

Section 14 – TRANSPORT INFORMATION

US DOT (per 49 CFR 172.101) and IATA/ICAO
Proper Shipping Name: Lithium Metal Batteries
UN Number: UN 3090 (UN 3091 for *Lithium Metal Batteries Contained in Equipment or Lithium Metal Batteries Packed With Equipment)*
Hazard Classification: Class 9 (Misc.)
Packing Group: II
Labels Required: MISCELLANEOUS HAZARD CLASS 9, LITHIUM BATTERY LABEL (IATA 7.4.8)
Other: CARGO AIRCRAFT ONLY (Forbidden as cargo aboard passenger aircraft)
Shipping Requirements:
DOT: Lithium batteries and cells are subject to shipping requirements exceptions under 49 CFR 173.185.
IATA: Shipping of lithium batteries in aircrafts are regulated by the International Civil Aviation Organization (ICAO) and the International Air Transport Association (IATA) requirements in Special Provisions A48, A88, A99, A154, and A164 and Packing Instruction 968, 969, or 970.

Section 15 – REGULATORY INFORMATION

OSHA Status: This product is considered an "Article" and the internal component (thionyl chloride / sulfuryl chloride) is hazardous under the criteria of the Federal OSHA Hazard Communication Standard 29 CFR 1920.1200.

Section 16 – OTHER INFORMATION

Lithium Battery Safety
With proper use and handling, lithium batteries have demonstrated an excellent safety record. The success and wide use of lithium batteries is partially due to the fact that they contain more energy per unit weight than conventional batteries. However, the same properties that result in a high energy density also contribute to potential hazards if the energy is released at a fast-uncontrolled rate. In recognition of the high-energy content of lithium systems, safety has been incorporated into the design and manufacture of all Electrochem batteries. However, abuse or mishandling of lithium batteries can still result in hazardous conditions. The information provided here is intended to give users some guidelines to safe handling and use of Electrochem lithium batteries.

Cell Abuse
In general, the conditions that cause damage to cells and jeopardize safety are summarized on the label of each cell. These conditions include:

- Short Circuit
- Charging
- Forced Over discharge
- Excessive heating or incineration
- Crush, puncture or disassembly
- Very rough handling or high shock and vibration could also result in cell damage.

Cell Handling and Inspection Guidelines
The most frequent forms of cell abuse can easily be identified and controlled in the workplace. It is our experience that inadvertent short circuits are the largest single cause of field failures.

Problems associated with shorting as well as other hazardous conditions can be greatly reduced by observing the following guidelines:

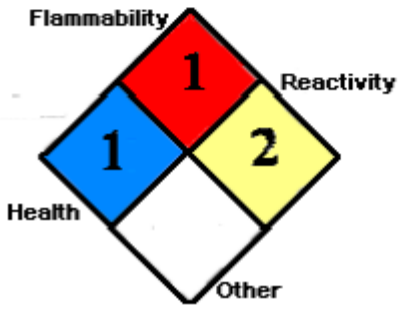
- Cover all metal work surfaces with an insulating material.
- The work area should be clean and free of sharp objects that could puncture the insulating sleeve on each cell.
- Never remove the shrink-wrap from a cell or battery pack.
- All persons handling cells should remove jewelry items such as rings, wristwatches, pendants, etc., that could come in contact with the battery terminals.
- If cells are removed from their original packages for inspection, they should be neatly arranged to preclude shorting.
- Cells should be transported in plastic trays set on pushcarts. This will reduce the chances of cells being dropped on the floor, causing physical damage.
- All inspection tools (calipers, rulers, etc.) should be made from non-conductive materials, or covered with a non-conductive tape.
- Cells should be inspected for physical damage. Cells with dented cases or terminal caps should be inspected for electrolyte leakage. If any is noted, the cell should be disposed of in the proper manner.

Cell Storage
Cells should be stored in their original containers. Store cells in a well ventilated, cool, dry area. Store cells in an isolated area, away from combustible materials. Never stack heavy objects on top of boxes containing lithium batteries to preclude crushing or puncturing the cell case.

Handling During Product Assembly
All personnel handling batteries should wear appropriate protective equipment such as safety glasses.

- Do not solder wires or tabs directly to the battery. Only solder to the leads welded to the cell by the manufacturer.
- Never touch a cell case directly with a hot soldering iron. Heat sinks should be used when soldering to the tabs, and contact with the solder tabs should be limited to a few seconds.
- Cells should not be forced into (or out of) battery holders or housings. This could deform the cell causing an internal short circuit, or fracturing the glass to metal hermetic seal.
- All ovens or environmental chambers used for testing cells or batteries should be equipped with an over-temperature controller to protect against excessive heat.
- Only precision convection ovens should be used for cell testing. Lesser ovens may exhibit uneven heating and hot spots that can exceed the rated temperature of the battery.
- Do not connect cells or batteries of different chemistries together.
- Do not connect cells or batteries of different sizes together.
- Do not connect old and new batteries together.
- Consult Electrochem before encapsulating batteries during discharge. Cells may exceed their maximum rated temperature if insulated.
- Although we have provided a general overview of lithium battery safety and handling, we urge you to call us with any questions. Our technical services staff will be pleased to assist you with your questions.

NFPA RATING



- For cells or battery packs involved in an accident, cells that have vented, or exploded, follow the North American Emergency Response Guide (NAERG) #138.
- 24-HOUR EMERGENCY RESPONSE PHONE NUMBER:
  (800) 255-3924

Rev. 2010A
Date: 05/05/2010

2.10. LITHIUM BATTERY EVENT KIT

CONTENTS

You **MUST** have a Battery event kit (Extreme Engineering part number 04BATT0001 00B) onsite whenever Lithium batteries are used. The Battery event kit contents are illustrated in the figure below.

Figure 22 Battery Event kit contents

INVENTORY

The part number and the quantity of the items in the battery event kit are given in the figure below.

ITEM	DESCRIPTION PART NUMBER REVISION	Qty	ITEM	DESCRIPTION PART NUMBER REVISION	Qty
	Yellow 1500 Pelican Case 20BOXP0002 00A	1 each		PVC rubber gloves 91SAFE0013 00A	1 pair
	Respirator Mask 91SAFE0008 00A	1 each		Splash goggles 91SAFE0005 00A	1 each
	OV & AG respirator cartridges pkg 91SAFE0006 00A	2 each		500g Baking Soda 91SAFE0003 00A Plastic Jar 91SAFE0011 00A	2 each 2 each
	Plastic tube, 2 ea 40ft length min 91SAFE0012 00A	80 feet		Chemical Apron 91SAFE0014 00A	1 each
	Danger stickers, 20 maximum minimum of 10 91SAFE0004 00A	20 each		Laminated Battery Event Quick Reference Procedure 07-OPDC-0005-00-A2-batt-event-proc-quick	1 each
	Roll of red PVC tape – ¾" x 66 feet minimum of 1 unwrapped roll 91SAFE0007 00A	1 each		This Laminated Inventory card 07-OPDC-0004-00-A3-batt-event-kit-inv	1 each
	Utility knife c/w spare blades 91HAND0008 00A	1 each		Battery event kit label, affixed to exterior lid of Pelican Case 41LABL0004-00A	1 each
	Ziplock debris bags 91SAFE0015 00A	2 each		MSDS Sheets 07-MSDS-0001-00-A1-tracer-lith-batt	1 each

Figure 23 Battery event kit inventory

INSTRUCTIONS

The following guidelines describe how to use the Battery Event kit in the event of an incident.

If a battery has exploded down-hole there will be obvious damage to the probe itself, if a battery has failed and vented it may not be noticeable until the tool string is broken apart, and you will see a black carbonaceous material and/or smell an acrid odor, in either event:

Follow this general procedure when dealing with a battery probe that has exploded or vented down-hole

Never apply water to compromised lithium batteries as they will react violently with water exposure!

1) Clear the immediate area of all personnel and keep them up-wind of the tool, as further venting or leakage could occur.

2) Contact your Supervisor or the Support Centre to determine how to proceed.
IF YOU ARE UNABLE TO CONTACT A SUPERVISOR OR THE SUPPORT CENTER AND:

A) You *DO NOT* have a current battery event ticket – you *MUST NOT* proceed any further with this procedure and you must continue your attempts to make contact with a supervisor or the Support Center to advise of the situation.

B) You *DO* have a current battery event ticket, and you have analyzed the situation, you may proceed from step 3, but only if you feel comfortable in doing so. You must also continue your attempts to contact a Supervisor or the Support Centre to advise of the situation.

3) Put on *ALL* PPE supplied in the battery event kit – gloves, goggles, respirator with filters installed, and the protective apron.

4) If deemed safe to do so, move the tool string down-wind of the rig.

5) Neutralize any spillage and/or the battery probe itself with baking soda from the battery event kit.

6) Carefully separate the battery probe from the rest of the tool string, disturbing the contents of the probe as little as possible. If the probe cannot be separated the entire string can be sleeved using the full 40' length of plastic jacket as in step 7.

Figure 24 Battery event kit instructions to use 1/2

7) Provided the battery probe is not hot to the touch, sleeve it in the supplied plastic jacket from the battery event kit, cutting the length required, and sealing *one* end of the sleeve with the supplied tape.

8) Neutralize any additional spillage from this process with more baking soda and add the remaining baking soda to the sleeved battery probe and seal the other end removing as much air as possible.

9) Clean up the baking soda and spillage and place into the supplied ziplock bags, taking care to produce as little airborne particulate as possible.

10) If you have additional plastic jacket available, sleeve the probe a second time and seal again, taking care to remove as much air as possible.

11) Apply the supplied danger stickers to all packages containing the debris, used baking soda, and battery probe.

12) Secure the battery probe and debris packages in the back of your truck, isolating these items as much as possible from other items in your truck. In the event an entire string had to be sleeved, alternate transportation arrangements will be made.

Under no circumstances is any of the packaged debris or battery probe to be placed in the cab of the truck, including any contaminated PPE!

13) Once back at the shop remove the packages from your truck and store these items securely outside, until proper handling of this material can take place.

14) Fill out the appropriate failure reports and notify your supervisor of the compromised battery probe and its current location.

15) Clean and restock all items used from your Battery Event Kit, verifying contents and minimum quantities using the enclosed inventory card.

Never apply water to compromised lithium batteries or any resulting spillage as it will react violently with water exposure. Only use baking soda to absorb and clean up spills!

Figure 25 Battery Event kit instructions 2/2

2.11. LITHIUM BATTERY SHIPMENT AND STORAGE

The battery probes should be secure in kit boxes when not in use. When used in the tool string on surface place in a designated clean area. Refer to section 4.2 on transporting the Lithium batteries.

2.12. LITHIUM BATTERY CONTENTS

When used properly, lithium batteries present no hazard to personnel. However, under certain circumstances, lithium batteries can pose serious health risks. During normal operations (such as connecting probes at surface, and testing), no protective equipment is required. If proper precautions are not taken, the internal components of the battery cell can pose a very serious health threat.

Lithium batteries contain lithium metal. When this metal is exposed to water, it produces hydrogen gas and heat; this combination will ignite. The battery also contains thionyl chloride. When thionyl chloride is exposed to humid air, it produces corrosive hydrochloric acid (HCl) mist, and toxic sulphur dioxide (SO_2 gas).

Due to the presence of these materials, a ruptured lithium battery can be hazardous to you, other equipment, and the environment. The material safety data sheet (MSDS) for a lithium / thionyl chloride cell should be reviewed by all personnel who are working in a location where lithium batteries are stored or used.

CHEMICAL COMPONENTS

Lithium Metal (Li) anode + Water: Spontaneously ignite, forming heat and hydrogen gas (H_2).

Lithium Metal (Li) anode + Heat above 180°C (356°F) = Fire and explosion, with the latter releasing shrapnel. Addition of Magnesium (Mg) increases the temperature rating.

Thionyl Chloride ($SOCl_2$) cathode + Water or Humid Air: Decomposes immediately into sulfur dioxide ($S0_2$) and hydrochloric acid (HCl); sulfur dioxide further reacts with water to produce sulfurous acid.

Thionyl Chloride ($SOCl_2$) cathode + Heat above 140°C (284°F): Decomposes to release chlorine and sulfur monochloride gases, slow reaction rate inside cell allows use at higher temperatures safely. The hazards outlined in the table below are only present in case of a venting or ruptured battery:

Toxic ingredients	Toxic level (ppm)	Comments
Sulphur Dioxide (SO_2)	500	Dangerous to life
Sulphur Dioxide (SO_2)	50-500	Acceptable for periods less than 30 minutes
Hydrochloric Acid (HCl)	1000-2000	Highly toxic and will cause severe respiratory distress
Hydrogen Gas (H_2)	Not Applicable	Flammable
Thionyl Chloride ($SOCl_2$)	10-100	Higher toxicity than SO_2

Table-1 Toxic Ingredients

Entry Path for Vapour and Liquids	
Potential Severity:	Serious
Potential Loss:	Personnel

Table-2 Toxic Ingredients

2.13. LITHIUM BATTERY INCIDENTS

VENTING

Venting occurs when internal heat and pressure build up, causing a crack to form in the external structure. This exposes internal corrosive and toxic ingredients.

RUPTURING

Rupturing occurs when a battery cell is broken apart due to external force such as crushing, cutting, or puncturing. This exposes the internal corrosive and toxic ingredients.

EXPLOSION

Explosions can occur when a rapid build-up of internal heat and pressure cause a violent release of the internal corrosive and toxic ingredients. Explosions project shrapnel, and may result in a dangerous lithium fire. The chemical vapors released from a lithium battery rupture are toxic by inhalation. Additionally, the vapor and liquid forms of these chemicals are very corrosive and irritating to the eyes (may cause blindness), skin (may cause blistering burns), respiratory tract, and mucous membranes—nose, mouth, and throat. Prolonged exposure to the vapors may cause lung damage and/or eye, skin, and mucous membrane irritation.

REPAIR AND DISPOSAL

Field repair of lithium batteries should not be performed at any time. The battery probe should be properly isolated and shipped back for proper repair. All battery probes should be shipped back to Extreme for proper disposal.

In the event of a battery emergency, such as a rupture, or if you suspect that the lithium batteries have vented or exploded, contact Extreme Engineering. Remove all personnel from the tool area, and keep them upwind, if possible.

Never attempt to clean the exploded/vented probe with water, as lithium can react violently with water, and produces ignitable hydrogen gas. Allow trained employees to handle damaged lithium batteries.

FIRE

In the unlikely event that there is a fire with a lithium battery, the hazard in a fire is of explosion due to internal heat build-up. Explosion releases toxic, corrosive vapors and (possibly) small quantities of liquid lithium. The danger from these quantities of lithium metal in a fire is minor compared to the energy of the battery explosion.

- Evacuate the area immediately.
- Do not attempt to fight a fire involving lithium batteries due to explosion hazards, unless loss of life is imminent.
- Use the information provided in the MSDS sheet for the type of extinguishers to be used. Unless the housing is ruptured there should be no particular hazard associated with using any specific type of media. The judgement should be made by qualified professional firefighters.
- Do not fight this type of fire from close range, as elevated temperatures may cause the lithium battery packs to explode.
- If a pack explodes, exposing lithium metal, do not use water, CO2, or halogen extinguishers, and avoid fume inhalation. Lithium, if exposed, has a vigorous reaction with water forming corrosive alkaline liquid and hydrogen gas. These types of gas are toxic, corrosive and explosive in the right concentrations.
- Spread baking soda over all exposed parts which are not burning

LITHIUM BATTERY OVER DEPLETION

Battery hours/ usage must be properly tracked. Do not deplete the battery beyond normal tool EOL (end-of life) voltage. **Over-depletion can lead to build up of pressure inside the housing, venting, and possible explosion.**

LEAKAGE

Electrolyte may leak from a battery due to rupture downhole. The electrolyte in the lithium battery is either thionyl chloride or sulfuryl chloride. Both are corrosive and react violently with many substances, including human tissue, producing corrosive by-products.

Special care should be taken with cells that are warm to the touch, swollen, or which have leaked electrolyte. Gloves, goggles, common rubber lab-apron, and rubber boots should be worn when handling leaking or ruptured batteries. Any cells that are damaged should be neutralized, wrapped in plastic and sealed for transport.

If leakage occurs, the electrolyte may be neutralized with baking soda ($NaHCO_3$). Flushing with fresh water is beneficial to dilute the chemical, but does not neutralize electrolyte, and must be avoided if there is any risk of contact with lithium metal.

SURFACE AND DOWNHOLE EXPLOSIONS

Surface explosions might happen either due to crushing or accident conditions, or if they are fully depleted on surface (i.e., forced over discharge).

There are many possible explanations for down hole explosions of lithium batteries:

- Excessive shock or vibration to the equipment, inducing internal short circuits;
- Erosion of the battery probe due to abrasive mud and/or high flows;
- Fluid from another point in the tool string migrating to the battery probe; This causes a short circuit of the battery; This would also raise the battery probes internal pressure to down hole hydrostatic pressure, causing compression of the cells and internal short circuits;
- Excessive run times with a single battery may lead to total battery depletion and a risk of cell explosion. This may also occur if the tool is stuck in the hole.

When tripping out, take appropriate safety precautions and disconnect the tool from the batteries as soon as possible. When the load is removed, the battery is safe.

When any of the above scenarios occur during operations, a significant explosion may occur, causing rupture of the battery probe. Well fluid will enter the probe, and will react with the lithium and flush out the corrosive liquid cathode fluids from all exposed cells.

Thus, on retrieval to surface, there is little danger of either continued explosion or venting of toxic fumes. However, in all cases, the batteries should be handled using the lithium battery emergency kit.

TOOL RECOVERY FROM COLLAR

If a tool is suspected to have suffered a battery failure or have been fully depleted, the following procedures can be used to minimize risk to personnel at the well site.

IF TRIPPING OUT

1. Clear the Rig Floor of non-essential personnel and inform the client and your Command Centre of possible safety hazard before tripping out.
2. Explain the situation to the rig crew and put on full PPE (splash suit, gloves, goggles, and respirator). Only personnel equipped with PPE should be on the Rig Floor.
3. Carefully remove the MWD collar from the drill string and lay it down on the catwalk.

LAYING DOWN THE COLLAR

1. Move the collar to a safe work area. Place a PVC sheet under the collar to be disassembled, in order to retain any fluid. The collar should be horizontal and on the ground if possible.
2. Temporarily post an observer wearing PPE a safe distance from the tool to prevent access to the area where the tool will be disassembled.
3. If required, others can resume normal Rig Floor activity (including installing a backup tool) without PPE. However, an MWD tool with the suspect battery must be attended to with the highest priority. The quicker the battery is disconnected, the lower the risk is for explosion due to over-depletion.

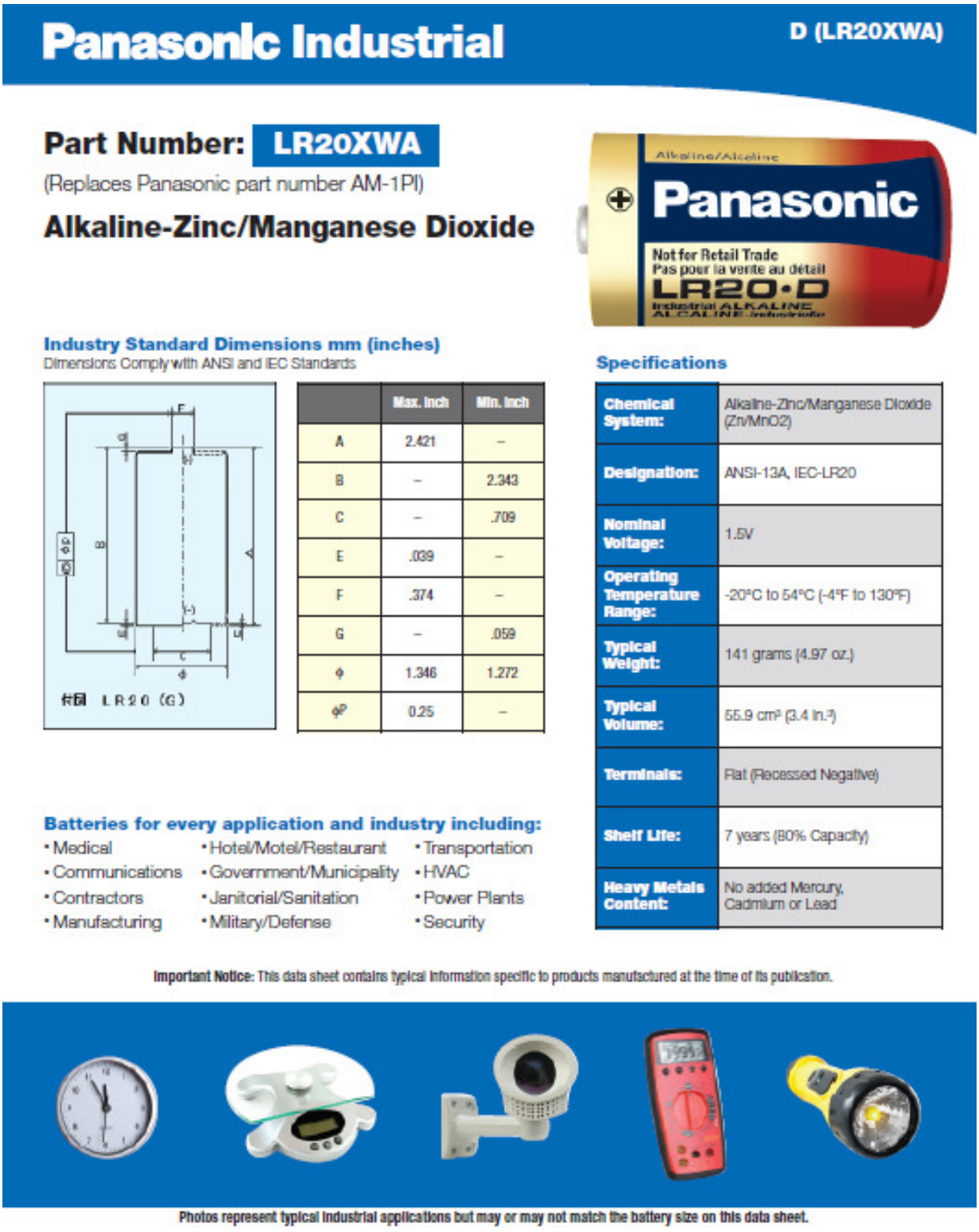
2.14. LITHIUM BATTERY FIRST AID MEASURES

If there is exposure to lithium batteries follow the instructions below.

- EYES: Immediately flush eyes with water for 15 minutes, lifting the upper and lower lids occasionally. See a physician immediately.
- SKIN: Immediately wash with plenty of water. Remove contaminated clothing. If irritation occurs or persists, obtain medical attention.
- INHALATION: Remove to fresh air. Support respiration with oxygen, if necessary. If breathing discomfort occurs and persists, obtain medical attention.
- INGESTION Rinse mouth with water. Drink two glasses of water or milk. Do not induce vomiting. Do not give anything by mouth to an unconscious person. See a physician immediately.

2.15. ALKALINE BATTERY

The datasheet for alkaline battery cells used in the alkaline battery pack is illustrated in the figure below



Panasonic Industrial

D (LR20XWA)

Part Number: LR20XWA

(Replaces Panasonic part number AM-1PI)

Alkaline-Zinc/Manganese Dioxide

Industry Standard Dimensions mm (inches)

Dimensions Comply with ANSI and IEC Standards

	Max. Inch	Min. Inch
A	2.421	–
B	–	2.343
C	–	.709
E	.039	–
F	.374	–
G	–	.059
ϕ	1.346	1.272
ϕP	0.25	–

Specifications

Chemical System:	Alkaline-Zinc/Manganese Dioxide (Zn/MnO2)
Designation:	ANSI-13A, IEC-LR20
Nominal Voltage:	1.5V
Operating Temperature Range:	-20°C to 54°C (-4°F to 130°F)
Typical Weight:	141 grams (4.97 oz.)
Typical Volume:	55.9 cm³ (3.4 in.³)
Terminals:	Flat (Recessed Negative)
Shelf Life:	7 years (80% Capacity)
Heavy Metals Content:	No added Mercury, Cadmium or Lead

Batteries for every application and industry including:

- Medical
- Communications
- Contractors
- Manufacturing
- Hotel/Motel/Restaurant
- Government/Municipality
- Janitorial/Sanitation
- Military/Defense
- Transportation
- HVAC
- Power Plants
- Security

Important Notice: This data sheet contains typical information specific to products manufactured at the time of its publication.

Photos represent typical industrial applications but may or may not match the battery size on this data sheet.

Figure 26 alkaline battery data sheet

2.16. BATTERY DO'S AND DON'TS

BATTERY DO'S

- Do use only in specified equipment.
- Do disconnect and remove battery from tool if it is not in use.
- Do store batteries according to local regulations. Temporary storage should be restricted, and adequately ventilated.
- Do contact Extreme Engineering the battery if it is damaged.
- Do inform management of any observed problem regarding lithium battery operations or storage.
- Do review the MSDS for the Lithium /Thionyl Chloride Cell and the Alkaline Battery cell.

BATTERY DON'TS

- Don't short-circuit a battery. A short-circuit may cause the battery to rupture and vent toxic vapors.
- Don't drop, hit, or otherwise abuse the battery, as this may result in the exposure of the cell contents, which are corrosive.
- Don't expose the battery to moisture or rain. Keep the battery away from fire or other sources of extreme heat.
- Don't incinerate. Exposing battery to extreme heat may result in an explosion.

2.17. XEM TOOL HANDLING

1. Use special field tools and hand tools correctly to avoid damage to tool components; make sure hand tools are regularly maintained.
2. Ensure that assembled backup tools are stored in a location that will prevent them from being damaged: offshore, be wary of crane loads, etc.; on land, protect from forklifts, trucks, etc. If a battery section is crushed sufficiently, the lithium cells may rupture.
3. Perform routine inspections of the lifting equipment used for raising the tool into the derrick. Check all fasteners and cable condition. Replace any damaged equipment that may cause the tool to be dropped.
4. Prior to lifting, ensure the pickup plate is certified and correctly attached to the Pickup Sling.
5. Use particular care when lifting the tool into the derrick. Do not allow the tool to drag without being guided to prevent unnecessary bending or flexing.

6. When being lifted off the catwalk, the tool string has the potential to break at the ROTC Upper body. The high deflection and bending moment in the middle of the tool string causes this problem. Therefore, lifting the tool string in the field, ensure that there is one person positioned to support the tool string in the middle.
7. **When lifting the tool, the ROTC connector can break when it is laid down. While laying down the tool from the catwalk, exercise caution so that the ROTC does not break.**
8. Dust cap/end caps should be used to cover all connections of the down hole tool when the components are not in use. This will keep excess moisture and debris out of the connections, and prevent damage to O-rings and threads.

2.18. COLLARS

- Ensure that only certified and appropriate slings and shackles are used to move Schlumberger and Extreme collars.
- Slings must always be double-wrapped around collars and secured with bolts.
- “Tail” all collars during lifts (attach at least one guide rope to the lifting sling).
- Remember, thread protectors are for protecting threads, not for lifting collars.
- Never use hooks on the collar box or pin with the intention of lifting the collar. The connections will be damaged, as they are not designed for lifting.
- Never expose collar threads unless making up the BHA or inspecting collars. Protect threaded connections at all times when the tool is not in use.
- Do not permit crane or forklift operators to drop collars. This may result in damage to the collar.
- Torque values should be clearly marked on all Schlumberger and Extreme collars and subs. These values should not be exceeded under any circumstances.
- Stagnant mud left on the collar bore, and trapped in crevices formed between the down hole tool and collar ID, may attack and corrode the collar bore while racked back in the derrick or on the rig deck. Rinse collars before breaking them apart on the rig floor.

3. XEM TOOL STUCK IN HOLE

- In the event that the Extreme tool gets stuck in the hole, do not rotate if the pumps are off. This will overheat the tools and destroy the electronics.
- The following information should be provided to the Driller, Directional Driller and Company Representative from the specifications chapter.
    - Verify the maximum jarring load and tensile strength for the tool.
    - Ensure that someone is in the unit at all times monitoring the time log and rig activity. Watch for rotation with no flow and other actions that could damage the tool.
    - Identify the acid content for the tool.

4. TRANSPORTATION SAFETY

This section will address specific issues during transportation and storage to protect equipment, personnel, and environment.

4.1. PERSONAL SAFETY

All Extreme Engineering personnel are required to comply with the company driving policy and QHSE standard S001for Journey Management and Driving.

The following points highlight key concepts to ensure safety while driving to the job site:

- Understand and enforce the active journey management program, which addresses local driving conditions and identified risks;
- Maintain defensive driving certification and current commentary drives;
- Always perform accurate pre-job checks before proceeding to the work site;
- Make sure that everyone is wearing a seat-belt while traveling in the company vehicle;
- Avoid substance abuse.

4.2. LITHIUM BATTERY TRANSPORTATION SAFETY

Lithium Batteries are classified as Hazardous Materials (or Dangerous Goods: IATA) during transportation, and as such are subject to special shipping requirements worldwide. Each field location must comply with different regulatory agencies depending on the specific carrier mode (e.g., air, rail, sea, and land).

The truck or pickup carrying the batteries MUST have the MSDS sheet in section 2.9.

The Lithium batteries are typically transported to the well site in housings certified for 15,000psi. The battery probe dust cap protectors are also rated for 15,000psi and have the Logo with a class 9 and UN certification UN3091 (Lithium batteries contained in equipment).

Figure 23 Class-9 Logo UN3091 on Battery dust Cap

If for any reason the batteries are removed from the probe and need to be transported accompanying paper work such be provided. If not transported in the Housing the UN ID will change to 3090 (Lithium batteries). Paper work such as the one in the following figure should be provided. This should not normally occur at the well site.

Alkaline batteries do not require any paperwork for transportation.

4.3. COLLAR TRANSPORTATION SAFETY

Extreme Engineering collars must be protected from damage during transportation. If the collar is being shipped, follow the guidelines below:

- Install thread protectors on all connections prior to loading outgoing tools;
- Ship collars in collar baskets when sending them offshore;
- Ensure the address is labeled on all lifts;
- Ensure that a copy of all accompanying paperwork is secured to the collar in a watertight package;
- Upon arrival to the job site location, consider the following when preparing to move the collars around the Rig Site:
- Properly rated slings must be double-wrapped around the collar when lifting;
- Do not lift a collar by hooking into the thread protectors;
- Understand local practices concerning transportation requirements.

5. REFERENCES

1. Electrochem Lithium Thionyl chloride cells and batteries MSDS
2. Panasonic LR20XWA alkaline – Zinc /Manganese dioxide
3. Extreme engineering: 07-OPDC-0004 Battery event Kit Inventory
4. Extreme engineering 07-OPDC-005 battery event Kit procedures
5. Schlumberger QHSE Policy
6. Schlumberger SLB-QHSE-S020 Hazard assessment and risk control
7. Schlumberger Injury prevention posters courtesy Dave Duffy
8. Schlumberger QHSE-S013 Mechanical lifting standard