DACC

DRILLING AND COMPLETION COMMITTEE

IRP 8:

Pumping of Flammable Fluids

An Industry Recommended Practice (IRP)
for the Canadian Oil and Gas Industry

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This IRP is a set of best practices and guidelines compiled by knowledgeable and experienced industry and government personnel. It is intended to provide the operator with advice regarding the specific topic. It was developed under the auspices of the Drilling and Completions Committee (DACC).

The recommendations set out in this IRP are meant to allow flexibility and must be used in conjunction with competent technical judgment. It remains the responsibility of the user of this IRP to judge its suitability for a particular application.

If there is any inconsistency or conflict between any of the recommended practices contained in this IRP and the applicable legislative requirement, the legislative requirement shall prevail.

Every effort has been made to ensure the accuracy and reliability of the data and recommendations contained in this IRP. However, DACC, its subcommittees, and individual contributors make no representation, warranty, or guarantee in connection with the publication of the contents of any IRP recommendation, and hereby disclaim liability or responsibility for loss or damage resulting from the use of this IRP, or for any violation of any legislative requirements.

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8.0 Preface

8.0.1 Purpose

IRP8 Pumping of Flammable Fluids was developed to provide guidelines for the safe handling and pumping of flammable fluids for the well service industry. The purpose of this IRP is to enhance operating consistency within industry through the establishment of minimum standards and procedures. This IRP is intended to clarify and document good practices and procedures. The purpose of this document is to recommend specific standards and operating procedures that should be considered the minimum acceptable for a given application. The IRP stresses the importance of standards and safe operating procedures to protect workers and the public and to minimize environmental risk. They are intended to complement existing documentation and regulation.

8.0.2 Audience

The intended audience for IRP 8 is as follows:

- Operating company personnel
- Service company field personnel
- Service company engineering representatives
- Site representatives
- Regulators
- Other concerned parties looking to understand how the Oil and Gas Industry manages the pumping of flammable fluids

8.0.3 Scope and Limitations

The practices described herein describe the requirements for a well servicing operation with flammable fluid storage tanks, multiple personnel and equipment. Judgement should be used when applying these practices to smaller well service jobs with low volumes of flammable fluid and minimal manpower. However, there is still a need to meet the intent of IRP 8. Pre-job planning, written hazard assessments, operating procedures, quality assurance of pressurized equipment, control of ignition sources etc. should be completed for all well servicing jobs. For the majority of well servicing work such as hot oiling, these can be developed ahead of time for a specific well or group of wells and used repeatedly. When well service work involves more than one person, appropriate safety meetings should be held to review the pre-job plan such as the hazards, hazard control methods and emergency response procedures etc. The safety meetings described in this document can be used as a guide but the frequency and content will vary depending on the type of work being performed. The need for mobile safety showers and/or mobile firefighting equipment for small servicing jobs should be defined as part of the pre-job planning hazard assessment.

This IRP is intended to supplement existing standards and regulations and does not replace current regulations

8.0.4 Revision Process

IRPs are developed by the Canadian Association of Petroleum Producers' (CAPP) Drilling and Completions Committee (DACC) with the involvement of both the upstream petroleum industry and relevant regulators. Enform acts as administrator and publisher.

The DACC will formally review the need to revise IRP 8 every two years considering changes in scope, purpose, technology, practices, etc. Enform will track review dates and bring them to DACC's attention when required.

Technical issues brought forward to the DACC, as well as scheduled review dates, can trigger a re-evaluation and review of this IRP in whole or in part. For details on the IRP creation and revisions process, visit the Enform website at www.enform.ca.

Revision history for IRP8 can be found in Appendix A.

8.0.5 Sanction

The following organizations have sanctioned this document:

Canadian Association of Oilwell Drilling Contractors (CAODC)

Canadian Association of Petroleum Producers (CAPP)

Petroleum Services Association of Canada (PSAC)

Explorers & Producers Association of Canada (EPAC)

8.0.6 Acknowledgements

The following individuals helped develop this edition of IRP 8 through a subcommittee of DACC.

Table 1. Development Committee

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8.0.7 Range of Obligations

Throughout this document the terms ‘must’, ‘shall’, ‘should’, ‘may’, and ‘can’ are used as indicated below:

Table 2. Range of Obligation

Term	Usage
Must	A specific or general regulatory and/or legal requirement that must be followed.
Shall	An accepted industry practice or provision that the reader is obliged to satisfy to comply with this IRP
Should	A recommendation or action that is advised
May	An option or action that is permissible within the limits of the IRP
Can	Possibility or capability

8.0.8 Background

IRP8 was initially published in July of 2002 after PSAC formed the committee to develop recommended practices for equipment, procedures and personnel to safely handle the fluids associated with the pumping of flammable fluids.

8.1 Overview

Handling or pumping flammable fluids introduces additional unique risks to the well site. The mitigation of these risks for the safety of all workers is the highest priority during all stages of a job. The operator, pumping service company and firefighting service provider are responsible for detailed planning and the establishment of effective safety procedures that adhere to jurisdictional and OH&S regulations.

The most critical parameter in planning the pumping job is the classification of the fluids to be used. The higher the hazard the fluid presents, based on MSDS/SDS data, flash point and vapor pressure, the greater the risk to personnel. It is imperative to use proper procedures for classifying the fluids and assessing the potential hazards so that the appropriate equipment and procedures are in place during the job.

One of the greatest challenges facing the firefighting service providers is inadequate space on site for firefighting and safety equipment. Mobile shower requirements, water storage, firefighting equipment and first aid requirements all need to be considered. Including the safety service provider in the job planning will help ensure their spacing needs are met.

Other key considerations for planning include identification of the hot zone, fire protection requirements, equipment bonding and grounding, secondary containment requirements, flammable fluid storage requirements, flammable fluid tank loading, blending activities, well intervention requirements and pumping procedures.

The final consideration for a safe job is properly trained personnel. First aid, fire extinguisher and firefighter training could all be required depending on the hazards associated with the job.

This IRP and the other IRPs and standards referenced in this IRP provide a framework for planning and executing a safe flammable fluid pumping job. Following the recommendations will help reduce the risk to personnel and, if an incident does occur, help get them safely out of the hot zone and out of danger.

8.2 Pre-Job Planning

This section describes the planning phase of wellbore service work performed in well servicing operations involving the use of any hazardous or special fluid.

Explicit definition of responsibilities is necessary for effective planning. Refer to the Enform Crossing Borders Report for more detailed definitions and responsibilities for lease owner/operator and prime contractor.

IRP The lease owner/operator shall designate an individual to be responsible for concurrent activities at the well site.

IRP The lease owner/operator or designated representative (prime contractor) and the service provider shall enter into an agreement regarding the scope of work for a job.

The lease owner/operator is responsible for ensuring that the service company has an acceptable Safety Management Program and shall use suitable procedures and equipment and materials to perform the task or service contracted with the lease owner/operator. The work will be conducted in a safe manner and in accordance with Provincial/Territorial Regulatory requirements.

IRP Prior to the commencement of any work under the agreement, representatives of the lease owner/operator and the service company shall develop a job plan and site layout (see 8.4 Pre-Spotting Activities). The service company shall communicate all details relating to proper procedures and equipment to all personnel on site.

IRP All work must be completed by competent workers or under the supervision of a competent worker.

The lease owner/operator and the service company are responsible for ensuring worker competency.

8.2.1 Hazard Assessment

IRP A hazard assessment of all well site fluids (e.g., work-over fluids, fracturing oils, solvents, inhibitor fluids, etc.) shall be prepared by the service company for the review and approval of the lease owner/operator.

IRP The necessary equipment and competent workers should be available to handle well site fluids in a safe manner.

Refer to the applicable legislation and regulations of the jurisdiction in which the work is to be performed for more details regarding hazard assessments.

IRP The hazard assessment shall identify all personnel safety hazards and suitable control measures.

The hazard assessment should, at minimum, identify the following:

- Whether special Personal Protective Equipment (PPE), in addition to that specified in 8.9.2 Minimum PPE Requirements for Personnel Working Within the Hot Zone, is to be worn by personnel in the hot zone.
- Whether air breathing apparatus (SABA/SCBA) will be required.
- Whether dikes and/or secondary containment are required around tanks.
- Whether an ambulance and shower units are required on site.
- The fire protection requirements (see 8.9.3 Determining Fire Protection Requirements).
- Where and how equipment needs to be bonded and grounded.

8.2.2 Fluid Classification

IRP The three classifications defined in Table 3 shall be used to determine the level of fire hazard associated with flammable fluids.

Table 3. Classification of Flammable Fluids

Classification	Open Cup Flash Point Minus Fluid Temperature		Open Cup Flashpoint		RVP
Reduced Hazard Fluids	Greater than 10 °C	**and**	Greater than 0 °C	**and**	Less than 14 kPa
High Hazard Flammable Fluids	0.1 °C to 10 °C	**and**	Greater than 0 °C	**and**	Less than 14 kPa
Special Hazard Fluids	Equal to or less than 0 °C	**or**	Equal to or less than 0 °C	**or**	Equal to or greater than 14 kPa

IRP The prime contractor shall ensure the hazard classification of all materials added to the well-service fluids, as well as reconstituted well service fluids as a whole, is determined using the applicable MSDS/SDS, flash point and Reid Vapor Pressure (RVP) data.

IRP The prime contractor shall make the hazard classification information available to all workers handling the fluids.

IRP The potential fire hazards associated with flammable fluids should be determined by the Open Cup Flash Point method (see Appendix B: Guidelines for Classifying Flammable Fluids) and the RVP.

IRP The MSDS/SDS must be available on site for all hazardous materials that are used on site.

The operating conditions that the fluid is subject to and its Open Cup Flash Point will determine the precautions required to meet the minimum regulatory requirements (e.g., WHMIS).

When using High Hazard or Special Hazard well servicing fluids, the following additional precautions should be considered:

- Closed system gelling
- Inert gas blankets on open blending systems
- Fire suits (bunker gear) for the blender crew and any additional exposed workers

8.2.2.1 Methanol and Methanol Water Blends

Methanol can be supplied by weight or volume percent. The values provided in these examples are based on percent by volume.

IRP The MSDS/SDS must reflect whether the methanol concentration is by weight or by volume.

Methanol is easily ignited but its flash point may not reflect the fire hazard it presents under various situations. Flammability tests have shown that methanol/water mixtures (30% methanol or less by volume) can be considered Reduced Hazard Fluids provided they are not used within 10 °C of the Open Cup Flash Point.

Mixtures with higher than 30% volume/volume (v/v) methanol should be considered High Hazard Flammable Fluids. Methanol is a polar solvent (i.e., miscible with water). Specialized extinguishing media are required to extinguish these polar solvents (as per NFPA 11).

The use of methanol/water mixtures at temperatures approaching or exceeding their flashpoint may change their classification. For example, 40% methanol water by volume used at a temperature of 34 °C would be a Special Hazard Fluid (40% methanol – flash point = 32 °C).

IRP For any methanol/water mixture, the fire protection requirements for non-fracturing type operations should be determined through a Hazard Assessment (see 8.9.3 Determining Fire Protection Requirements).

8.2.2.2 Oils

Crude oils, and any liquid hydrocarbons produced/returned from well operations, are classified in the same manner as well servicing fluids per flammability limits determined. The vapour pressure of the fluid may impact well servicing applications and should be evaluated if they are to be used for pumping operations.

Note: RVP testing is standardized at 38º C (100º F). The actual operating conditions may be significantly different from the test results. The RVP value will change as the crude weathers (i.e., some of the light ends dissipate). The RVP test is typically performed in a lab. The time between taking the sample and performing the test can, in some instances, be several hours, making the sample unrepresentative. It is recommended that the open cup flash point test also be used to determine an accurate indication of flammability for crude oils.

See Appendix B: Guidelines for Classifying Flammable Fluids for information about fluid classification and Alberta regulations regarding High Vapour Pressure Hydrocarbons.

8.2.3 Mobile Safety Shower Requirements

IRP The number of personnel inside the hot zone shall be limited to the number of shower heads that have sufficient water supply to meet the Provincial/Territorial Regulations and ANSI Z358.1 design requirements.

Refer to 8.10 Mobile Safety Shower Requirements for more information.

8.2.4 Fire Protection

IRP The authority to take charge in case of a fire emergency shall be assigned to an on-site person. Establishing a command structure is recommended.

Refer to 8.9 Fire Protection Requirements for more information.

IRP The hazard classification information for materials to be used on site shall be made available to the company contracted to or individuals assigned to provide fire protection.

The fire protection personnel use this information as follows:

- To ensure the proper equipment is available on site including the requirement for safety showers (see 8.10 Mobile Safety Shower Requirements).
- To understand the type and volume of storage for flammable fluids and chemicals.

- To understand the contents of the chemical van, whether it will be equipped with its own fire protection system and where it will be located for operations (i.e. outside the hot zone or offsite). See 8.5.7 Chemical Vans for more information.

8.2.5 Pressure Rating of Wellhead and Components

The design and pressure rating of the wellhead and components is critically important to the safe and successful execution of the service.

The pressure rating of the wellhead and all of its components can be verified and recorded on a Wellhead and Components Pressure Rating Data Sheet similar to the sample shown in Appendix D: Sample Pressure Rating Data Sheet.

Note: The sample may not address all components involved in the service. The data sheet used should include/consider all components being pumped through.

There are several rig-in procedures related to pressure that are critical to operations where flammable fluids are pumped.

IRP The lease owner/operator must ensure a master valve suitable for the services is attached to the wellhead before making any of the other connections to the wellhead.

IRP The following rig-in procedures shall be followed:

- Prior to rigging up, check the pressure rating of the wellhead valves and fittings to ensure their rated working pressure won't be exceeded during pumping.
- Notify the lease owner if valves or fittings are unsatisfactory and ensure they are changed.
- Direct gas bled from the rig or other equipment on location to the flare.
- Ensure there are no open ignition sources during bleed down.

IRP The following rig-in procedures should be followed:

- Bleed off of well head pressure prior to the commencement of rig-up.
- Pressure test treating lines against the well master valve only after successfully pressure testing the lines against the service company main valve.
- Use the master valve test procedure supplied by the manufacturer. Verify test procedures during the pre-job planning phase.

Note: Some valves are directional (i.e., they are built to withstand pressure from below) so it is important to determine what kind of wellhead master valve is to be used.

Note: Count the number of turns to close master valve.

- Verify all pressure rating data (see Appendix D: Sample Pressure Rating Data Sheet).
- Use an integral flange when connecting treating iron to a tree or the wellhead BOP stack. Wells without a wellhead may be treated through casing or tubing within the pressure ratings specified by the manufacturer.

Note: Use caution when treating through line pipe connections often found as annulus connections. The line pipe thread is very easily cracked by vibration. Always consult the manufacturer's specifications for treating pressure limits of proprietary or "premium threads".

Refer to Appendix E: Pressure Rating of Wellhead Valves for specific information about pressure rating of wellhead valves.

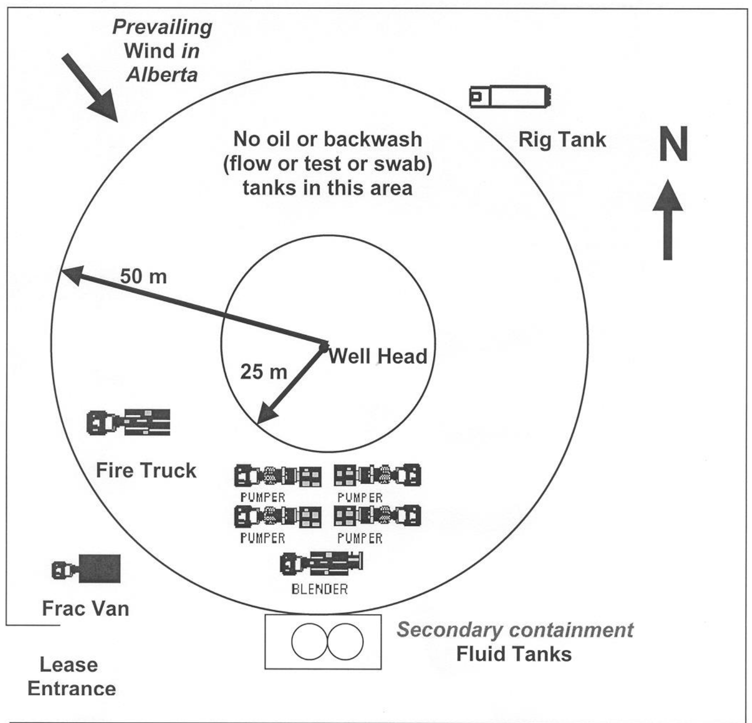
For additional well testing and fluid handling information refer to IRP 4: Well Testing and Fluid Handling.

8.2.6 Placement of Equipment and Fluid Storage Tanks

IRP Equipment shall be laid out so that any release from the wellhead or rig tanks will not impact the fracturing van or the fire truck.

Figure 1 illustrates an equipment placement example.

Figure 1. Equipment Placement Example



See also AER Directive 37: Service Rig Inspection Manual Schedule 11: Equipment Spacing for Well Servicing Conventional Wells.

8.2.7 Requirements for Secondary Containment

IRP Secondary containment requirements must be based on jurisdictional regulations.

IRP If secondary containment is necessary, an earthen berm other than the lease berm (or equivalent containment) shall be constructed around the tanks.

Dike area is generally dependent on the number of tanks. For example:

- When the diked area contains one tank the dike should be sized to be at least 110% of the capacity of the tank.
- When the diked area contains more than one tank the dike should be sized to contain 100% of the volume of the largest tank plus 10% aggregate capacity of all the other tanks.

8.2.8 Annular Blowout Preventer and Ram Type Blowout Preventer Rubber Seal Requirements

Some fluids used for fracture treatments can cause the rubber elements on Blowout Preventer (BOP) systems to swell and stop functioning properly.

IRP Compatibility between the fluid and the rubber seals and gaskets of the BOP system shall be confirmed.

This may require that the rubber elements be tested with the specific fluids to be used to determine the aniline point (refer to IRP14 Non-Water Based Drilling Fluids section 14.5.1.2 for information about how to determine the aniline point).

8.2.9 Site Inspection

IRP A site inspection shall be conducted at the job site prior to spotting equipment to

- identify existing or potential hazards,
- review and approve the pre-job plan,
- review and approve the hazard assessment (see 8.2.1 Hazard Assessment) and
- verify the location of fluid tanks, berm construction and egress access from the site.

8.3 Bulk Storage of Flammable Fluids

This section covers the storage of flammable fluids for well servicing operations where flammable fluids will be pumped.

8.3.1 Locating Bulk Storage Tanks On Site

IRP Bulk storage tanks should be located as follows:

- Positioned as per Provincial/Territorial regulations for distance from the wellhead.
- Positioned so prevailing winds will carry any flammable vapours away from the well head and equipment.
- Positioned within secondary containment when needed (see 8.2.7 Requirements for Secondary Containment) or on a surface grade that will, in the event of a tank rupture, allow fluids to flow away from where the well servicing equipment is located.

8.3.2 Pre-Loading Tank Preparation

IRP The following shall be completed before tanks are filled with flammable fluid:

- Tanks shall be grounded (see 8.5.5 Static Electricity and Appendix I: Static Electricity).
- Tanks shall be inspected to ensure that the tank valves are in good working order. Once inspected a blank cap shall be installed on all tank valves.
- Tanks shall be examined to ensure there is adequate capacity for the amount of fluid and additives that will make up the final fluid mixture volume.
- Tanks shall be examined to ensure remote volume indicating devices are in working order.

8.3.3 Tank Loading

8.3.3.1 Tank Loading Safety Precautions

Care should be taken to avoid spark promoters (i.e., un-bonded conducting objects) within a tank compartment.

IRP Tanks should be inspected and any un-bonded object removed prior to loading with flammable fluids.

A tank gauging rod projecting into the cargo space of a tank truck could provide a gap between itself and the rising liquid and allow static sparking. Trucks having a gauge rod projection should have the rod extended directly to the bottom of the tank or connected by wire or chain to the bottom of the tank. Alternatively, a nonconductive rod may be used. In top loading where a grounded conductive fill pipe is placed in close proximity to the gauging rod, the voltage gradient on the liquid surface in the vicinity of the rod will be lowered and reduce the risk of a static discharge.

IRP Where flammable mixtures can be expected in the vapour space, metal or conductive objects (e.g., gauge tapes, sample containers and thermometers) should not be lowered into or suspended in a compartment while the compartment is being filled or immediately after completion of filling.

After completion of loading, a waiting period of approximately three hours allows for a substantial dissipation of the electrostatic charge which will reduce the potential for sparking.

8.3.3.2 Splash Loading

IRP Splash loading of flammable fluids shall not be performed.

Splash loading of flammable fluid into any tank or container causes a large amount of vapour to be released into the atmosphere above the fluid in the tank and to the tank's surrounding area. This results in a potential ignition hazard. Splash loading also causes a large amount of static electricity to develop in the liquid providing a potential ignition source (see 8.5.5 Static Electricity and Appendix I: Static Electricity).

IRP Loading flammable fluids should only be performed using tanks that have the capability for bottom loading either through bottom tank connections or through a filling pipe that rises up the side of the tank and is continuous on the inside to the tank bottom.

8.3.3.3 Bottom Loading

Bottom loading of tank trucks and lease storage tanks tends to reduce the possibility of electrostatic hazards that may result from failure to bond properly and improper positioning of the fill pipe. In the initial stages of bottom loading, upward spraying of the product could increase charge generation and should be prevented (e.g., by reducing filling velocity, using spray deflectors, etc.). If bottom loading inlets in tanks are not designed to prevent spraying, low-vapour-pressure products may form an ignitable mist.

Bottom loading may result in higher liquid surface voltages than fill pipe loading because the fill pipe acts as a conductive path to help relax a charge. It is especially important with bottom loading that spark promoters (e.g., gauging rods or other metallic conductors) are extended to the tank bottom unless the cargo tank can be kept filled during highway transportation.

8.3.3.4 Fill Pipe Loading

During open-dome top loading of intermediate vapour-pressure products or low vapour-pressure products, the fill pipe

- should reach as near as possible to the bottom of the tank being loaded and
- should, preferably, be in contact with the bottom to avoid undue turbulence.

Avoid resting on the bottom by using a T-deflector or 45 degree bevel on the end of the fill pipe. If a deflector is used, it should be designed to resist lifting of the fill pipe off the tank bottom when the flow starts. If the fill pipe does not reach the tank bottom the velocity should be limited to about one metre per second (three ft./sec) until the outlet is submerged. In some cases the control of loading velocities can be accomplished through the use of two flow loading valves, one of which automatically limits the initial velocity to about one metre per second (three ft./sec).

8.3.4 Pre-Job Fluids Handling

The pre-job handling and heating of flammable fluids is to be performed in accordance with the procedures set out in the following sections:

- 8.9 Fire Protection Requirements
- 8.5.2 Fluid Transfer Systems
- 8.5.5 Static Electricity and Appendix I: Static Electricity

8.3.5 Tank Gauging

IRP Tank contents should be gauged by external gauges during tank filling and pumping operations.

This can be accomplished either by using either an external mechanical gauge mounted on the tank or an external gauge that will determine the amount of fluid in the tank by the hydrostatic head the fluid exerts.

Gauging tanks from the top hatch exposes personnel to hazardous vapours and leaves them without a means to escape in the event of an incident.

IRP Personnel should not manually gauge tanks from the top hatch.

If manual gauging is the only option the following should be considered:

- Tanks should be equipped with guardrails or fall arrest systems.
- Someone on location should be trained in rescue from elevated structures.
- SCBA/SABA should be used.

- Non-sparking gauges should be used.
- A written procedure and/or a Job Safety Analysis should be conducted.
- A hazard analysis should be conducted.
- Procedures for the gauging should be documented and discussed in a safety meeting prior to gauging.
- All documentation about the gauging should be archived in the well file.

8.4 Pre-Spotting Activities

The most common problem encountered by firefighting teams during well-servicing procedures is the lack of space available on location. Care should be taken to ensure that the spacing of well-servicing equipment allows easy egress for personnel involved in the well-servicing procedures, and adequate access for firefighting teams.

8.4.1 Planning

The job plan shall consider how equipment is to be spotted and deployed prior to the equipment arriving on site. In particular, the fire protection equipment and mobile shower units need to be positioned where they are readily accessible in an emergency (see 8.9.7 Positioning of Firefighting Equipment and 8.10 Mobile Safety Shower Requirements).

IRP All fire protection equipment shall be on location ready for service with access to flammable fluid storage area prior to spotting of well servicing equipment.

IRP The fire protection equipment shall remain on location until storage tanks are secured with caps in place, wellhead is isolated from pumping equipment and there is no further need to handle flammable fluids.

IRP The hot zone shall be identified. The responsibility for identification of the hot zone shall be shared between the well operator and the service company.

IRP Identification of the hot zone should consider the following:

- The number of personnel required to operate the equipment.
- Contingency personnel for operational upsets.
- Minimizing the number of people working in the hot zone.
- Other potential danger zones such as silica, pressure, radiation, etc. will overlap the high fire hazard area.

IRP The fire truck shall not be located in the hot zone.

IRP Job planning should include the following:

- Identification of a smoking area and placement of appropriate signage.
- Identification of the hot zone and placement of appropriate signage and/or barriers.

- Identification of grounding and bonding for equipment (see 8.5.5 Static Electricity and Appendix I: Static Electricity).
- Ensuring that the high pressure treating iron is suitable for the job (see Appendix G: High Pressure Manifold Inspection and Maintenance).
- Ensuring that pressure relief systems will be installed where required and properly directed (see Appendix H: Annular Pressure Relief Systems).
- Ensuring that all diesel engines in the hot zone that will be running during mixing and pumping will be equipped with fully functional air shut-offs (refer to Provincial/Territorial Safety Regulations).
- Identification of the location and readiness of emergency services if required (refer to Provincial/Territorial Safety Regulations).
- Confirmation that the pressure ratings of the connections to the wellhead are suitable for the maximum anticipated pressures (see 8.5.2 Fluid Transfer Systems, Appendix D: Sample Pressure Rating Data Sheet and Appendix G: High Pressure Manifold Inspection and Maintenance).
- Confirmation that an emergency response plan is in place for the mixing of the flammable fluids.
- Ensure sufficient spill response and containment will be in place.
- Ensure appropriate lighting will be in place as per Enform Lease Lighting Guideline.
- Ensure communication equipment is available for all pertinent personnel.

If conditions on the worksite change, the job plan may need to be revisited and adjusted to ensure new or changed hazards are addressed.

8.4.2 Pre-Spot Safety Meeting

IRP The service company representative shall conduct a pre-spot safety meeting immediately prior to the spotting of equipment on location. The meeting shall be attended by all personnel on location and should discuss the following:

- The pre-job plan and safety hazards, particularly chemicals and/or flammable fluids that will be used.
- The use of and instruction for Personal Protective Equipment (see Appendix F: Personal Protective Equipment Requirements).
- The position of firefighting equipment.
- Escape route(s) and muster stations.
- The instructions for rigging-in high pressure lines and equipment.
- The location of the smoking area.
- The location of the hot zone .

- The personnel authorized to be in the hot zone.
- The location of grounding and bonding for equipment.
- The location of mobile shower units.
- The location of first aid equipment and identification of the first aid person on site.
- The location of emergency services, including when and how to summon them.
- The location of the safe briefing area in an emergency.
- The emergency response plan, including the use of flammable fluids, and the duties of all staff in an emergency.
- The on-site person assigned the responsibility to take charge in case of a fire emergency.
- The list of the names of all personnel on site and the individual responsible for custody of the list.
- The list of emergency contact phone numbers and the individual assigned as the designated caller and custodian of the list.
- The procedures for notifying offsite emergency and post-incident contacts (e.g., operator, regulators, etc.).
- The plan for the movement of equipment and the land guide’s responsibilities (see the Enform Worker’s Guide to Hand Signals for Directing Vehicles).
- Confirmation that the high pressure treating iron is suitable for the job (see Appendix G: High Pressure Manifold Inspection and Maintenance).
- Confirmation that pressure relief systems will be installed where required and properly directed (see Appendix H: Annular Pressure Relief Systems).
- Function testing of diesel engine air shut-offs and confirm or placement as per regulations (e.g. AER Directive 37: Service Rig Inspection Manual Schedule 11Equipment Spacing for Well Servicing Conventional Wells).
- Inspection and function testing of firefighting equipment.
- Confirmation that proper connections to the wellhead will be used (see 8.5.2 Fluid Transfer Systems).

8.5 Pre-Blending and Blending

This section provides guidance on the high risk activity of blending. Procedures and checklists are to be followed in order to mitigate the hazards of this activity.

8.5.1 Pre-Blending Safety Meeting

IRP A safety meeting shall be held prior to the blending of any flammable fluid or additives. All personnel involved in the handling of flammable fluids shall attend.

IRP The following should be addressed at the pre-blending safety meeting:

- Perform roll call.
- Identify and introduce on-site personnel responsible for conducting the roll call in the event of an incident.
- Review emergency shut-down, shut-in and evacuation procedures and muster points.
- Identify personnel responsible for activating shut-in procedures.
- Identify personnel responsible for rescue procedures and identify back-up personnel.
- Review the properties and hazards of all well-servicing fluids to be used.
- Review procedures for notifying the firefighting personnel of any developing problems (e.g. leaks, overheating equipment, etc.).

8.5.2 Fluid Transfer Systems

IRP Rubber hoses used for pumping flammable fluids shall be suitable for the operating conditions and the fluid being handled.

IRP All pressurized hoses shall be pressure tested in accordance with Appendix C: Hydrostatic (Shop) Testing Requirements for Pressurized Hose prior to delivery to the work site. Testing documentation shall contain the following information:

- Hose manufacture date
- Date on which hose first placed in service
- Hose pressure ratings (lesser of hose and coupling)
- Details of any repairs carried out to the hose

- Test pressures and dates of testing

See 8.5.2.2 Pressurized Hose Strength Requirements.

IRP Hose condition shall be confirmed during rig-in. Hoses shall not be used if past their expiry date.

8.5.2.1 Hose Couplings and Clamps

IRP The following should be considered for hose couplings:

- Hammer union thread connectors are preferred for all hose couplings, including hoses located on trucks.
- Self-locking cam and groove fittings may be used within their design limits.
- Hose couplings should be secured with connectors capable of withstanding pumping pressures and movement due to pump jacking.

IRP Standard cam and groove fittings and cross-overs incorporating standard cam and groove fittings shall not be used for fluid transfer systems.

IRP Connectors shall be installed in accordance with the manufacturer's guidelines.

Clamping systems from hose to king nipples should be appropriate for the conditions of use.

IRP Suitable pressurized hose restraints should be installed to restrain the hose from whipping if it becomes disconnected.

8.5.2.2 Pressurized Hose Strength Requirements

IRP Pressurized hoses shall be designed to meet the following requirements:

- When using a centrifugal pump, the pressure ratings of hoses shall be 100% greater than the design head pressure of the pump and be rated to withstand the maximum shut-off head.
- Hoses used for the transfer of flammable fluids shall be pressure tested to 150% of the maximum allowable working pressure before they are put into service. All hoses shall be tagged with an identification number and the last test date of the hose. These hoses shall be retested as per the service company guidelines but shall not exceed two years of service. Proof of the completion of the pressure test in the form of a chart or a certification sheet shall be available for review on location.
- Positive displacement pumps used in conjunction with rubber hoses shall have a full opening pressure and flow bypass. The bypass is to flow back to the tank or suction side of the pump and be set at 50% or less than the rated working pressure of the hose.

8.5.2.3 Pressurized Hose Covers

IRP Covers shall be in place on all discharge hoses.

IRP Covers shall be clamped on both ends and allow fluids to flow from the hose through the cover to indicate leaks.

8.5.2.4 Operator Inspection Checks for Pressurized Hoses

IRP Hoses shall be inspected prior to each use. The inspection includes the following:

- Ensure hose covers are in place and in good condition. Any cuts, deformities or stains may signal hose failure.
- Ensure fittings are in good condition. Slippage, cracks, deformities, excessive corrosion or evidence of movement may be cause for removing the hose from service.
- Ensure the hose area around fittings does not have any excessive wear.
- Ensure any certification dates are current
- Perform any other inspection requirements as per manufacturer or employer

IRP Service providers should consider a formal hose inspection program at regular intervals and have a detailed inspection covering, at minimum, the following:

- The external surface of the hose for signs of damage to, or exposure of, the hose reinforcement caused by cuts, abrasions, cracks, cover bubbles, severe kinks, etc.
- The couplings for slippage, cracks, deformities, excessive corrosion and evidence of movement.
- The clamping for proper fitting and connection.

IRP The hose shall be removed from service if there is any doubt as to the condition of the hose, clamps or couplings.

IRP Service providers should consider a formal hose inspection program.

8.5.3 High Pressure Hoses

IRP High pressure hoses must be used in accordance with the manufacturer specifications, must be compatible with the fluid system to be pumped and must be bonded and grounded.

8.5.4 Wellhead Connections

IRP Wellhead connections must meet Provincial/Territorial Regulatory requirements.

IRP Service providers shall have a formal wellhead connector certification program.

IRP Certification of any component to be pumped through shall be made available to all service providers who will be pumping through the wellhead or flow equipment.

IRP Wellhead connections shall meet the following minimum standards:

- The maximum allowable working pressure for properly installed threaded installations are as follows:
  - Line Pipe Threading (LPT) up to and including 13.8 MPa (2,000 psi) as per IRP5: Minimum Wellhead Requirements
  - Premium Thread to 34.5 MPa (5,000 psi)
- Flanged connections shall be used at or above the pressures below:
  - Flanged fitting above 34.5 MPa (5,000 psi)
  - Flanged fitting if well service fluid is gas assisted

8.5.5 Static Electricity

Static electricity is produced when like or unlike materials are in motion and in contact with each other. The materials may be in the solid, liquid or gaseous state. Flammable fluids that become statically charged can provide a potential for ignition in the presence of oxygen.

Many problems associated with static electricity can be removed or at least reduced by draining off the static charge as fast as it is produced. One method for preventing a build-up of static electricity during the blending and pumping process is to bond and ground all equipment in the area where there is a potential for flammable fluid vapours to exist (e.g., the hot zone).

Bonding and grounding will not eliminate electrostatic charging. It will ensure that all parts of the system are at the same electrical potential or ground potential. This will eliminate voltage differences and the risk of ignition caused by sparking or arcing discharges.

Note: Bonding and grounding are two different procedures and are not always interchangeable when removing static charges. Refer to the definitions of bonding and grounding in the glossary for more information.

Refer to Appendix I: Static Electricity for more information about accumulation and measurement of static electricity.

8.5.5.1 Equipment Requiring Bonding and Grounding

The following are some examples of equipment requiring bonding and grounding:

- All metal storage tanks
- Hot Oilers
- Service rig pumps
- Pressure trucks
- Transport trucks (chemical vans etc.)
- Acidizing equipment
- Fracturing equipment
- Sand hauling equipment
- Coiled tubing equipment
- Chemical batch equipment
- Pumping and flow lines

8.5.5.2 Bonding

An electrical bond attached to both conducting bodies can prevent sparking. This bond will prevent a difference in potential across the gap by providing a conductive path through which the static charges can recombine. This prevents the charge from accumulating so that no spark can occur.

IRP All equipment to be used in the blending and pumping process shall be bonded with a proper ground wire prior to the start of blending or pumping operations.

IRP The connector attachment sites shall be non-painted, clean, rust-free surfaces.

The following steps should be taken when bonding equipment:

- Bond all tanks, pumps, sand hauling equipment and chemical vans. Connect the bonding circuit to the well head or other suitable grounded object to form a grounded circuit.
- Hook up an appropriate multi-meter to monitor for static build up.
- Ensure that two grounds are in place and correctly installed.
- Bond or ground fluid tanks and transport trucks before the heating or transfer of flammable fluids commences.

If connections to trucks not previously in the bonding circuit are made during operations, the connections shall be made with cables of sufficient length to perform the connections at a distance of at least three metres away from the hot zone.

8.5.5.3 Grounding

Grounding of a container or tank cannot prevent the accumulation of charges in the liquid.

IRP Two sources of grounding should be used on all flammable fluid sites.

A primary source for grounding is the well head as long as proper connections are made. Supplemental or alternative grounding methods are as follows:

- A 16 mm diameter stake driven into the ground to a depth of 2.5 – 3.0 m minimum. This should be done at the same time that the drilling rig anchors are installed on location, or when the service rig anchors are installed.
- A 650 mm by 650 mm plate buried to a depth of 1.3 m shall also be adequate.

These two methods should be considered semi-permanent installations.

8.5.5.4 Location of Ground Stakes

The preferred location for (semi-permanent) secondary ground stakes is on the west and north edge of the well site. If temporary ground stakes are installed they should be in an area near the tanks taking into account the lease access road and the location of the drilling sump. Using two stakes will allow for dealing with lease surface problems that might not be foreseen at the time of installation. If the completion fluid tanks are expected to be placed in an obvious well drained and dry location, one stake should be placed to the edge of this area.

The lease owner/operator is responsible for the proper installation of the ground stakes.

8.5.5.5 Selection of Bond or Ground Connection Point

IRP The bonding cables should be connected between the wellhead and the tanks and trucks throughout the entire blending and pumping operation.

High pressure treating lines attached to the well head will be sufficient to ground the pumpers to the well head. The following will help ensure the ground does not become saturated during operations:

- Bond one fluid pumper to the blender.
- Bond the sand equipment to the blender.
- Bond the chemical truck to the blender.

- Bond the blender to the fluid storage tank farm grouping.
- Bond all fluid storage tanks together.
- Run a ground line to a ground stake as a supplemental ground.

The secondary ground will provide a conductive path in the event the bonding lines between the equipment in the circuit become loose during the operation.

8.5.5.6 Monitoring Bonding

The well logging industry has successfully used a potential monitor to evaluate the conductivity of bonding for a number of years. The potential monitor has two grounding clamps on the ends of 33 m flexible conductor cables.

IRP The bonding and grounding should be monitored during operations at all times. If a build-up of static potential occurs the following steps should be taken:

- Stop the blending or pumping of the flammable fluids.
- Check all bonding sites to ensure a good connection on a bare surface.
- Check all bonding cables (with monitor) to ensure cables are not broken.
- Install another temporary ground source as a precautionary measure in case the grounding points are saturated.

IRP Blending or pumping operations shall not restart until the static has been completely dissipated.

8.5.5.7 Apparel

Under the right conditions many fabrics can generate static electricity.

IRP Clothing should not be removed in a flammable atmosphere.

Note: Synthetic fabrics are not to be worn under the fire retardant protective work wear or as a base layer under fire retardant protective garments.

Refer to Appendix I: Static Electricity for more information about static electricity and clothing.

8.5.6 Equipment and Personnel

IRP The number of blender operators and other personnel within the hot zone should be kept to a minimum and all personnel in the hot zone should wear the appropriate personal protective equipment (see 8.9.2 Minimum PPE Requirements for Personnel Working Within the Hot Zone).

IRP Fluids being moved on surface should be kept as cool as possible to minimize the amount of vapours.

IRP High pressure pump fluid-end burst disks should have containment plates that cover the fluid end to direct spray from leaks or ruptures downward.

IRP Annulus pop-off valves that have flammable fluids behind them shall be rigged into a containment tank with a staked steel line. The line should be of sufficient size and strength to relieve the potential flow.

8.5.7 Chemical Vans

IRP All equipment inside a chemical van (i.e., lights, pumps and rheology measurement systems, etc.) must meet all applicable fire, electrical and transportation code requirements.

Enclosed chemical vans can have their own automatic fire protection system that may be sufficient to handle all the chemicals carried in the van.

IRP If the chemical van does not have its own automatic fire protection system then the fire protection services should be made aware of the chemicals and chemical transfer systems being used.

IRP Chemicals with conflicting fire protection requirements should be housed in separate compartments during transportation and operations.

8.6 Pumping Procedures

This section describes practices and procedures for the high pressure pumping of flammable fluids in conjunction with a hydraulic well-servicing treatment.

8.6.1 Pre-Pumping Safety Meeting

The time between blending and pumping varies from job to job based on the nature of operations. Changing operations and conditions (i.e. wind direction, personnel on site) can impact the safety procedures.

IRP A pre-pumping safety meeting shall be held to ensure any changes from the pre-blending safety meeting are addressed.

IRP The pre-pumping safety meeting should revisit all items covered in the pre-blending safety meeting (see 8.5.1 Pre-Blending Safety Meeting), address any changes in operations or conditions and address safety concerns specific to the pumping operation.

8.6.2 High Pressure Manifolds

IRP All high pressure manifolds must be pressure tested in accordance with applicable local regulatory requirements.

IRP Swivel joints shall be sufficient in number and placed in positions that shall ensure independent movement of the treating lines between the wellhead and the high pressure pumps.

IRP The unions used in the high pressure treating manifolds must be appropriate for the operating conditions (see 8.5.2 Fluid Transfer Systems), meet manufacturers specifications and meet the requirements of the Provincial/Territorial Regulations.

Note: High pressure treating iron is to be non-pressure seal (NPST) or integral union type.

8.7 Fire Protection for Rig Out

IRP Fire Protection shall be at a state of readiness during rig out.

IRP The following procedures should be followed during rig out:

- Shut down all equipment not required during vacuum truck operations.
- Vent the hose from the vacuum truck downwind and away from any possible ignition source (e.g. hot manifolds).
- Remove product from all hoses prior to rig out.
- Clean up all spills prior to demobilization.

8.8 Handling Well Intervention and Flow Back Fluids

Well intervention and flow back fluids can pose a hazard. When the fluids are recycled or reused, in whole or in part, the physical and chemical properties can change so the fluid properties need to be re-evaluated and the appropriate steps taken to ensure the safety of site workers.

IRP The properties shall be determined for all fluids pumped into and/or produced from the formation, including fluids that are recycled or reused in whole or in part. The MSDS/SDS shall be revised to reflect any changes and reviewed with personnel handling the flow back fluid. Refer to 8.2.2 Fluid Classification.

If applicable, revert to the appropriate crude oil or condensate MSDS/SDS.

8.8.1 Flow Back Fluids

IRP The properties of any produced gases, liquids or solids should be evaluated for potential hazards. The following should be identified:

- PPE required to meet identified health hazards.
- Appropriate fluid handling procedures.
- Criteria for shutdown when using an open tank system.
- Fluid disposal method.
- Acute and chronic toxic effects (H_2S and carcinogens) of the fluids.
- Environmental impact of escaped fluids.
- Corrosive effect of the fluids.
- Possible degradation of elastomers.
- Naturally Occurring Radioactive Material (NORM).

Follow safe handling procedures as per the MSDS/SDS.

Oils, whether native or previously injected, should also be evaluated for flammability (i.e. ignition of oil and oil vapours).

Note: There is a general relationship between flammability and the lighter hydrocarbon content (i.e., hexanes and heptanes) of a hydrocarbon fluid. Flammability and RVP increases with increasingly lighter hydrocarbons. Refer to 8.2.2 Fluid Classification and Appendix B: Guidelines for Classifying Flammable Fluids for additional detail.

Gases, whether native or previously injected, should also be evaluated for hydrate potential and the ignition potential of contained and escaped vapours.

Water, whether native or previously injected, should also be evaluated for possible gas entrainment and ignition potential.

8.8.2 Kill fluids, Fracturing Fluids, Acids and Solvents

IRP Well intervention fluids contaminated from chemical addition and/or reservoir exposure should be evaluated for the following hazards:

- Flammability, or ability to retard flammability
- Toxic effects
- Possible degradation of elastomeric materials
- Radioactive tracer in sand
- Reactive effects
- Erosive potential (e.g., fracturing sand)

Properties to be considered include the following:

- Explosive limits
- Flash point
- Chemical composition
- Toxicity information
- RVP (see Appendix B: Guidelines for Classifying Flammable Fluids section B.2 Alberta Regulation for information about limits)
- pH levels (as applicable)

Note: MSDS/SDS and Transportation of Dangerous Goods (TDG) information may be useful in assessing the potential toxicological or flammability hazards related to uncontaminated intervention fluids but any fluids produced from the reservoir should be considered separately.

8.9 Fire Protection Requirements

The critical factors involved in determining the fire and explosion hazards associated with oilfield operations involving the use of flammable fluids are as follows:

- The presence of flammable vapours caused by:
  - the mixing procedures or
  - the nature of a specific flammable fluid in relation to the temperature and flashpoint of the fluid.
- The potential failure of high pressure containment systems and the release of flammable fluids in an atomized state.
- The potential ignition sources present regardless of the precautions undertaken to minimize these ignition sources.

8.9.1 Firefighter Training

IRP Firefighters shall be trained to a minimum of NFPA Standard 1081 Full for Industrial Fire Brigade Members or an equivalent documented training program that meets this NFPA standard.

The minimum components of this training include the following:

- Conducting search and rescue operations
- Qualifications to wear SCBA and bunker gear
- Fire pump operations
- Fire hose operations
- Ability to extinguish an ignitable liquid in a rescue situation

Note: NFPA 1001 and 1002 meet this standard.

Note: Additional training and/or firefighting procedures may be required for jobs involving Liquid Propane Gas (LPG) or Liquid Natural Gas (LNG).

IRP Firefighters shall be trained in firefighting procedures and in the use of the applicable equipment.

8.9.2 Minimum PPE Requirements for Personnel Working Within the Hot Zone

IRP All service companies should have a written policy on the use of protective clothing.

IRP All on-site personnel shall wear PPE appropriate for the potential risks or hazards for the tasks to be performed.

See Appendix F: Personal Protective Equipment Requirements for general information about PPE use and care.

IRP All personnel working within the hot zone during fluid blending, the pumping operation or clean-up operations (i.e., using a vacuum truck) must wear Canadian Standards Association (CSA) or Canadian General Standards Board (CGSB) fire retardant or equivalent approved safety apparel.

IRP Firefighters shall wear personal protective equipment that conforms to NFPA standard 1971.

8.9.3 Determining Fire Protection Requirements

The minimum fire protection requirements are based on the fluid classification (see 8.2.2 Fluid Classification), the anticipated volume of fluid and the anticipated number of people in the hot zone. Personnel considerations (i.e., egress) take precedence over equipment.

IRP Tables 4, 5 and 6 should be used as a guide for minimum fire protection requirements.

> **Note:** For larger operations the overall footprint of the equipment involved in the operation should be considered when determining fire protection requirements (e.g., maximum hose lay, ensuring that firefighters are not required to cross the hot zone to provide fire suppression).
>
> **Note:** Consideration should be given to using 63 m^3 (400 Bbl tanks) for water supply.

IRP Minimum water volumes, as specified for firefighting, need to be maintained for firefighting purposes only.

G	1 Twin Agent Unit or 1 Continuous Foam Unit with onboard water supply
Y	1 Continuous Foam Unit with a minimum 15.8 m^3 (100 Bbl) water supply
R	2 Continuous Foam Units, each with a minimum 31.6 m^3 (200 Bbl) water supply
C	2 Continuous Foam Units, each with a minimum 63 m^3 (400 Bbl) water supply

Table 4. Reduced Hazard Flammable Fluids

	Number of People in the Hot Zone		
Tanks of Flammable Fluid	**0 to 3**	**4 to 8**	**9 or More**
Over 756 m^3 (over 12 tanks)	Y	R	R
442 m^3 - 756 m^3 (8 to 12 tanks)	G	Y	R
> 63 m^3 – 441m^3 (2 to 7 tanks)	G	G	Y
Less than 63 m^3 (1 tank)	G [1]	G	G

Table 5. High Hazard Flammable Fluids

	Number of People in the Hot Zone		
Tanks of Flammable Fluid	**0 to 3**	**4 to 8**	**9 or More**
Over 630 m^3 (over 12 tanks)	C	C	C
442 m^3 - 756 m^3 (8 to 12 tanks)	R	R	C
> 63 m^3 – 441 m^3 (2 to 7 tanks)	Y	Y	R
Less than 63 m^3 (1 tank)	G	G	Y

Note: Each flammable fluid tank is 63 m^3 (400 Bbl)

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[1] For low volume non-fracturing operations the fire protection requirements should be determined through a site specific hazard management plan (refer to NFPA Standard 10 Portable Fire Extinguishers and Appendix K: Sample Hazard Assessment Fire Protection Plan for Small Fluid Volumes).

B	1 Continuous Foam Unit with a minimum 31.6 m^3 (200 Bbl) water supply
P	1 Continuous Foam Units with a minimum 63 m^3 (400 Bbl) water supply
O	2 Continuous Foam Units, each with a minimum 63 m^3 (400 Bbl) water supply

Table 6. Special Hazard Fluids or Pumping Energized Flammable Fluids

Tanks of Flammable Fluid	Fire Protection Requirements
Over 441 m^3 (over 8 tanks)	O
> 63 m^3 – 441 m^3 (2 to 7 tanks)	P
Less than 63 m^3 (1tank)	B

Note: Each flammable fluid tank is 63 m^3 (400 Bbl)

IRP The type of operation should be considered when determining minimum fire protection requirements. Some applications may require more than the minimums specified above.

Additional fire suppression resources may be required to provide for safety, reduce environmental impact and protect equipment.

IRP When two or more firefighting units are on site a fire safety plan should be developed to ensure effective communication of roles and responsibilities (see 8.9.8 Fire Safety Plan).

IRP For pumping special hazard fluids or pumping of energized flammable fluids, a fire safety plan should be developed (see 8.9.8 Fire Safety Plan).

8.9.4 Firefighting Equipment Capabilities and Requirements

IRP NFPA Standards 11 (Low-, Medium-, and High Expansion Foam) and 18 (Wetting Agents) should be considered when calculating the requirements for firefighting equipment and personnel.

There is a variety of oilfield firefighting equipment available on the market. This equipment falls into two basic categories:

1. The Twin Agent system
2. Continuous Foam System

Either of these systems will provide suitable fire suppression capability to facilitate personnel protection and/or rescue from the hot zone. See the definition for Firefighting Equipment in the Glossary for more information about these fire suppression systems.

The minimum requirements for each type of system are outlined in the table below.

Table 7. Minimum Requirements of Firefighting Equipment Types

Twin Agent System	Continuous Foam System
• 1,136 litres (300 US gallons) pre-mixed AR-AFFF solution at 6 % • 680 kg (1,500 lb.) Purple "K" Dry Chemical System • 30 m discharge hose with Twin-Agent application system • Two competent fire-fighting personnel • Minimum of two SCBA	• 475 litres (125 US gallons) chemical concentrate (suitable for on-site fluids) • 1,900 litres per minute (500 US gallons per minute) centrifugal certified fire pump • 227 kg (500 lb.) Purple "K" Dry Chemical System • Two competent fire-fighting personnel • When on-board water supply is used minimum is 3,028 litres (800 US gallons) • Minimum of two SCBA • Minimum of 90 m of 38 mm hose (300 feet of 1.5 inch hose) • Minimum of 60 m of 65 mm hose (200 feet of 2.5 inch hose) • At least one 350 gpm (minimum) ground monitor

Note: When supplemental water supply is used it requires a minimum of four inch suction.

Although dry chemical has quick knock-down capabilities, and is required in many cases to extinguish energized liquid and/or gas fires, it does not have the capability to secure fuel vapours or cool equipment after suppression is achieved. For this reason, the ability to generate large amounts of fire suppressant agents at the required rate is vital.

8.9.5 Rescue Personnel

IRP A competent, properly equipped rescue team shall be available on site whenever flammable fluids are to be pumped (as outlined in 8.9.1 Firefighter Training).

IRP The firefighting personnel shall assist in a fire exposed rescue attempt by controlling the fire. However, the two person firefighting team shall not provide firefighting and rescue duties simultaneously.

IRP For a fire rescue there shall be a minimum of two firefighters dedicated to firefighting duties and one dedicated rescue person (the rescue team).

IRP The rescue person shall be prepared to initiate a fire rescue whenever personnel are working in the hot zone. Suitable bunker gear shall be worn by firefighters during pumping operations and a positive pressure SCBA face mask shall be in a ready-to-use state or position.

IRP The rescue team shall have an Emergency Rescue Plan that is reviewed and communicated before the job. The plan shall contain the steps needed to respond to and recover a casualty.

Rescue personnel may be contracted by the firefighting service company or a third party

8.9.6 Fire Training for Well Service Personnel

IRP Well service personnel expected to use a fire extinguisher should receive basic fire extinguisher training at minimum as outlined in Appendix J: Fire Training Requirements for Well Service Personnel.

8.9.7 Positioning Firefighting Equipment

IRP The proper positioning of firefighting equipment should be consistent with the pre-planned locations with considerations for local hazards and conditions.

IRP The following criteria should be considered when positioning firefighting apparatus:

- The prevailing wind direction in relation to the hot zone and wellhead.
- Equipment should be a minimum distance of 25 m from any fuel source.
- Equipment should be positioned to avoid spilling well-service fluid on the fire truck in the event of a rupture.
- Equipment should not be located directly in line of any plugs, valves or other components of the pressurized system.

IRP Foam and dry chemical application hoses should be able to reach all well-servicing and associated equipment on location. If this is not possible the hoses should be movable to positions that can reach this equipment.

The amount of hose required for foam application will depend on the total area of coverage required.

IRP All firefighting equipment should be positioned prior to transferring, heating or blending activities and be ready for service.

8.9.8 Fire Safety Plan

IRP The fire safety plan should be based on a hazard assessment considering, at minimum, the following:

- Number of people on site
- Amount and location of equipment
- Volume and properties of flammable substances
- Flammable substance storage systems
- Firefighting water supply
- Communication systems and processes
- Additional resources (e.g., Purple K, gas detection, controlled access to equipment, thermal cameras, etc.)
- Emergency preparedness

IRP The fire safety plan shall be created in conjunction with the fire protection service provider prior to mobilization.

8.10 Mobile Safety Shower Requirements

Shower units are intended to provide standby safety services for workers whenever hazardous fluids are being pumped or handled. There are several different designs of shower units available on the market. In this IRP the Mobile Shower Unit includes showers, eye wash units and drench hoses. See the definition of Mobile Shower Unit in the Glossary for ANSI requirements.

8.10.1 Capability and Capacity of Mobile Shower Units

IRP Capability and capacity of mobile showers units shall be as per applicable jurisdictional regulatory bodies. Consult OH&S and ANSI standards. See Mobile Shower Unit definition in the Glossary.

On-board water supplies are typically 1.9 m^3 – 2.3 m^3 (500 – 600 US gallons).

IRP Each shower head shall have 1.15 m^3 (300 US gallons) of potable water available for safety shower use.

Seasonal weight restrictions (i.e., road bans) may limit the amount of water allowed on board the mobile shower units. This will have to be taken into account when determining the need for a supplemental potable water supply.

Refer to the definition of Mobile Shower Unit for ANSI standards. The following minimum standards should also be observed:

- The showering area shall be fully enclosed and heated and large enough to comfortably accommodate one adult per shower head.
- The showering area shall be provided with forced air ventilation.
- The recovery area shall not be used for transportation of the victim and may only be used for first aid purposes until medical aid arrives at the scene. The shower stalls must not be used as a recovery area
- A First Aid Kit in accordance with Provincial/Territorial First Aid Regulations shall be readily available.
- Two self-contained breathing apparatus (SCBA) shall be readily available.
- The shower unit must be fully mobile in order to change position on location to effectively compensate for changes in wind direction or movement of other equipment on location.

- The shower unit shall be separated from any potential hazard, shall not be located within the hot zone and be within a 10 second walking distance of the hot zone.
- Shower units located on tank trucks delivering acid or other fluids to the location are to be used by the tank truck operator only and shall not be factored in when determining the number of shower heads required to provide adequate protection for personnel working in the hot zone.

IRP Typical showers installed in travel trailers do not meet the ANSI standard and shall not be included in the calculation of shower heads required to provide adequate protection for personnel working in the hot zone.

8.10.2 Training and Responsibilities of Safety Shower Operators

IRP Shower unit operators shall be competent to operate the specific shower units assigned to them.

IRP Shower unit operators shall have current training certificates in the following:

- Standard First Aid/CPR
- H_2S Alive®
- WHMIS

IRP The shower unit operator's duties and responsibilities shall be limited to the following:

- Aiding in decontamination of on-site personnel exposed to chemical or corrosive substances.
- Ensuring the safe operation of the shower unit, eyewash unit and drench hose.
- Reviewing hazard awareness with all personnel.
- Instructing personnel who may be exposed to hazardous materials in the location and proper use of the emergency shower units.

8.10.3 Personal Protective Equipment Requirements for Safety Shower Operators

IRP Shower unit operators shall be equipped with a complete acid/chemical resistant wet suit including gloves, rubber boots, goggles, fire retardant clothing and a hardhat.

IRP Fire retardant clothing must meet CSA or CGSB Standards.

8.10.4 Determining Factors for the Number of Safety Shower Units Required

IRP Job planning shall include a review of the hazards, exposed personnel and job parameters to determine the number of safety shower units required.

> **Note:** Some acid job hot zones are on the rig floor when the treating iron is suspended therefore the rig crew in this instance need to be counted as exposed personnel.

The following should be considered:

- The number of pump units involved in the service.
- The volume of acid involved in the well treatment and on site.
- The type and number of corrosive fluid transfers.

IRP The mobile shower unit should be on location when the acid is being transferred, mixed or under pressure on the surface. This shall include the time when back pressure is being used to circulate the acid to the bottom.

IRP The shower unit shall remain on site until the pumping equipment is rigged out or all corrosive materials have been flushed from the equipment.

Appendix A: Revision History

Table 8. Revision History

Edition	Sanction Date	Remarks/Changes
1	July 2002	Initial publication
2	March 2009	Section 8 Handling Well Intervention and Flow Back Fluids opened for review and modifications
2.1	March 2009	Reference to GSR was updated
3	October 2015	• Document converted to new (2014) DACC Style Guide • Editorial Review (spelling, grammar, punctuation, active voice, parallel structure etc.). Note: as a result of review many sections were renumbered. Sections listed below are the original sections prior to the review and update to new style. Changed attachments to appendices and intentionally forced appendix sub-headings to the table of contents. Some attachments were removed as noted below. Moved IRP statements out of appendices into main body of the document where relevant to the pumping of flammable fluids. Updated section 8.1 Overview with an executive summary for the document. • Review and update 8.2.4 Fluid Classification and Attachment 1: Guidelines for Classifying Flammable Fluids (now 8.2.2 and Appendix B). Rearranged some information between the section and appendix. Removed duplication of Alberta regulation and created hyperlink instead. Converted definition of hazardous fluid types to a table and included RVP in the classification. • Moved information from Attachment 4 Well Servicing – Well Head Rig-In Procedures and Pressure Rating of Well Head Valves to section 8.2.5 Pressure Rating of Wellhead and Components so that IRP statements weren't buried in the appendix. • Review and update 8.4 Pre-spotting activities. Reworked entire section to separate between planning function and activities to review at the pre-spot safety meeting. • Moved some items from the pre-blending safety meeting to (8.5) to the pre-spotting safety meeting (8.4) as appropriate to current industry practices. • Add Hot Zone planning and placarding responsibilities to section 8.4 Pre-Spotting Activities and removed Attachment 7 (Hot Zone Placard) and Attachment 8 (Hot Zone Placard Placement – Wellsite). Note that group felt the placard itself was not used. IRP now references 'appropriate identification and signage'. • Reorganize information between section 8.5.5 Static Electricity and Attachment 11 Static Electricity so that relevant and IRP statements are in section 8.5.5 and only background/reference material is in the appendix. • Changed section 8.7 to Fire Protection for Rig Out and clarified information.

		• Reorganized and cleaned up section 8.8 Handling Well Intervention and Flow Back Fluids • Reworked section 8.9 Fire Protection Requirements including moving some information to definitions and merging some sections together. Added a new section for firefighter training requirements are removed Attachment 13 Fire Training Requirements for Industrial Oilfield Firefighters. Created a matrix for determining fire protection requirements including fire protection for small volumes (reference Appendix K). Updated section of fire suppression equipment and positioning fire-fighting equipment. Added section for firefighter training for well service personnel and referenced information in Appendix J (Attachment 12). Note that this attachment was not previously referenced in the document. • Remove image from Attachment 3 (Sample Wellhead and Components Pressure Rating Data Sheet) because it was out of date and create a sample to replace it (Appendix D). • Removed Attachment 5 and put all information into main body of the document (section 8.2.6). • Add Appendix K Sample Hazard Assessment Fire Protection Plan for Small Fluid Volumes. • Delete Attachment 13: Fire Training Requirements for Industrial/Oilfield Firefighters.

Appendix B: Guidelines for Classifying Flammable Fluids

B.1 Background

Several methods can be used to determine the hazards associated with the use of flammable fluids. This Appendix deals with the measurement of fire hazard.

The American Society for Testing of Materials (ASTM) has two methods for determining the fire potential of a flammable fluid. They are the “open cup” method and the “closed cup” method. The results obtained by the open cup method are subject to evaporation of light-ends and may be difficult to compare with results from the closed cup method.

The Committee that developed this IRP decided to use the open cup method as it was deemed as the more appropriate method for measuring the potential fire hazard of flammable fluids used in well servicing operations. The test methodology should be clearly stated in any associated documentation.

The flash point of a flammable fluid is the temperature at which there are sufficient flammable vapours in the atmosphere to cause a flash fire when those vapours come into contact with an ignition source. At the flash point temperature, there is insufficient vapour to support continuous combustion and the fire quickly extinguishes itself. The ignition temperature is the point where there is sufficient vapour generated to support continuous combustion. Generally, the ignition temperature is only a couple of degrees above the flash point temperature. Because these two temperatures are so close together, the flash point temperature is generally used to indicate the potential for continuous combustion. Testing methods and purity of the liquid tested may vary, and as a result, flash points are intended to be used as a guide only, not as fine lines between safe and unsafe. The Committee recognized the need for a buffer between what could be considered a “reduced” fire hazard, and what could be considered a “high” fire hazard. That buffer was determined by the Committee to be 10 °C below the open cup flash point temperature.

The fire hazard of flammable fluids used in well servicing can vary, depending on how the flammable fluid is being used, the ambient temperature, and flammable fluid heating etc.

> **Note:** IRP 4 Well Testing Fluid Handling notes API Standards for determining the specific gravity of a fluid. The specific Gravity of the fluid is then used to determine the hazard of the fluid being handled.

As WHMIS legislation requires the flash point of the fluid to be determined, IRP 8 only recommends this method for determining the hazard of the fluid being handled.

B.2 Alberta Regulation

In the Alberta Oil and Gas Conservation Act, Regulation AR 151/71 defines High Vapour Pressure Hydrocarbons and places limitations on their use. Refer to the regulation sections 8.110(1), 8.110(2) and 8.110(3) for detail.

Appendix C: Hydrostatic (Shop) Testing Requirements for Pressurized Hose

C.1 General

Hydrostatic testing of hoses, including hoses located on tank trucks, should be conducted at least once every twelve months and whenever the integrity of hoses is in doubt.

All hoses shall be tagged with an identification number and the last test date of the hose as follows:

- The tag should be clearly visible and capable of withstanding conditions of use.
- Precautions should be taken to protect personnel performing the testing and to ensure that personnel not involved in the testing do not enter the area where the testing is being performed.

C.2 Pressurized Hose Testing Procedures

The procedures for pressurized hose testing are as follows:

- Bind one end of the hose with a fitting that incorporates a valve with a pressure rating of at least 110% (2-1 safety factor is recommended) of the maximum test pressure being used.
- Attach a fitting for connection of a pressure pump to the other end of the hose.
- To reduce danger in the case of failure, tie down both ends of the hose in the test area.
- Fill the hose with water and ensure that there is no air left in the hose.
- Slowly pressure the hose up to 50% test pressure then shut the hose in and inspect for leaks and other indications of hose weakness such as cover bubbles, end coupler slippage, grooves and other defects.
- Slowly increase the pressure to 150% of the maximum rated working pressure of the hose (or to manufacturers testing specification) then shut the hose in and inspect hose as per above.
- Monitor and record pressure for at least five minutes.

- If hose pressure remains constant (±2%) after five minutes and hose does not show evidence of weakness, bleed off and re-stamp the hose with test date.
- If the hose fails at any time it should be removed from service for more detailed inspection, testing and repair.

Appendix D: Sample Pressure Rating Data Sheet

Wellhead and Components Pressure Rating Data Sheet

Well Owner: ______________________________

Well Name and Location: ______________________________

Service Provider: ______________________________

	Casing Assembly[2]	Tubing Head Assembly[1]	Master Valve Assembly[1]
Make and Model			
Serial # (Major Component)			
Date of Initial Installation			
Manufacturer's Working Pressure[3]	MPa	MPa	MPa
Date Last Reconditioned			
Derated Maximum Working Press (if applicable)	MPa	MPa	MPa
Maximum Allowable Safe Working Pressure[4]	**MPa**	**MPa**	**MPa**

Wellhead Schematic Attached? Yes No

Additional Pertinent Information: ______________________________

____

____

Well Owner Representative: ______________________________

Signature: ______________________________

Title: ______________________________

Date: ______________________________

Service Company Representative: ______________________________

Signature: ______________________________

Title: ______________________________

Date: ______________________________

[2] Assembly includes all nipples, valves, flanges and any other attached accessories.

[3] Pressures stated are for the lowest rated individual component in each assembly.

[4] IRPs and jurisdictional regulations should be consulted for details regarding pressure testing. IRPs are available at www.enform.ca.

Appendix E: Pressure Rating of Wellhead Valves

Valve sizes are identified by the nominal size which is not an accurate reflection of their inside diameter (ID) or bore size. If a valve has a restricted or oversize bore it will be marked accordingly.

If a valve is flanged the letter “R” or the letters “BX” and the number indicating the ring size will be marked near the valve flange. If the valve is threaded the thread size and symbol will be marked near the valve outlet thread.

If only one pressure rating is stamped on a valve then it is not an API valve and it must be assumed that the rating refers to the valve’s working pressure.

Refer to API Spec 6A Sections 4 and 5 for detail about specifications for flanged and threaded valves.

Appendix F: Personal Protective Equipment Requirements

The following are the basic requirements for the use and care of PPE for all workers on location:

- Wear fire CSGB retardant coveralls, CSA safety footwear, safety glasses (or safety prescription glasses), hearing protection and a hardhat while in the work area.
- Wear hand protection suitable for the hazard.
- Wear safety goggles when chemicals are handled or where there is a danger of splashing or dusting of chemicals.
- Wear clothing that fits properly and is in good repair.
- Remove and replace any clothing contaminated with hazardous materials.
- Properly clean and store all specialized outer garments used during the handling of hazardous materials.
- Choose undergarments made of natural fibres rather than synthetic.

Table 9. PPE Minimum Standards

Equipment	Standard
Hardhats	• CSA Z94.1 • Saskatchewan: CSA Z94.1 or ANSI
Footwear	CSA Z195 Grade 1
Eyewear	CSA Z94.3
Goggles	CSA Z94.3
Hearing Protection	• CSA Z94.2 • Jurisdictional Regulations
Fire Retardant Outerwear	CGSB

Provincial/Territorial Regulatory requirements may require additional protective clothing.

CSA standards are available from the CSA website at www.csa.ca.

Additional requirements for those working within the hot zone are defined in 8.9.2 Minimum PPE Requirements for Personnel Working Within the Hot Zone.

Appendix G: High Pressure Manifold Inspection and Maintenance

The failure of the High Pressure Discharge Manifold (HPDM) during the pumping of flammable fluids can result in a potentially hazardous situation. HPDM failure is usually caused by one of the following conditions:

- The equipment is unable to withstand the required pressure.
- The equipment is subjected to pressures above its rated capacity.
- The equipment is poorly maintained and/or installed incorrectly.

Equipment failure at pressures below the pressure rating for the equipment may be the result of a defect in manufacturing but is more typically the result of improper inspection and maintenance.

Inspection and maintenance of high pressure manifolds needs to conform to local jurisdictional regulations.

G.1 Identification

The design pressure limitations need to be clearly marked on all HPDMs.

If this information is not stamped on the HPDM by the manufacturer it can be attached using an identification band. The band can either be a pre-fabricated punch lock band or may be fabricated by cutting pieces from 3 mm by 25 mm flat iron and stamping the piece with the proper markings. The piece can then be bent around the piece of iron to be banded and the ends spot welded together. Do not weld the band directly onto the HPDM as it will affect the integrity of the steel. The owner of the HPDM is responsible for ensuring that this information is fixed to the equipment or HPDM.

The following is a sample of the information to be stamped onto the band:

Mpa XX YY ## mm ZZZZ dd/mm/yy

Where:

- **### MPa** is the maximum working pressure of the component
- **XX** is the location where permanent records are retained (e.g., GP for Grande Prairie)
- **YY** is the component code (e.g., LJ for Long Joint; PJ for Pup Joint; CV for Check Valve, etc.)
- **## mm** is the ID size of manifold in millimetres (e.g., 25 mm, 50 mm, etc.)
- **ZZZZ** is the serial Number for that specific element (for record keeping)
- **dd/mm/yy** is the date (day, month and year) of the last test

G.2 Non-Destructive Testing

There are two types of non-destructive testing:

1. On site pressure testing
2. Maintenance testing

The on-site pressure test should include a visual inspection and a hydrostatic pressure test. The visual examination should include an inspection of the union threads, seal pockets, male sub ends, weld areas, hammer nuts, retainer segments and visual material loss. This visual inspection will help determine if the components have suffered damage as a result of mishandling, cracks, erosion or corrosion.

Do not use field hydrostatic testing (leak test) to determine whether or not a particular component will fail at a particular pressure. This type of testing should only be performed to detect leaks and should never exceed the rated working pressure of the component. Leak testing should be performed using water. It is preferred that compressed gas, acid or flammable fluids not be used.

Fill the entire component structure with water, positioning it to avoid entrapment of air. If possible, dry all exterior surfaces to enable detection of leaks. The components should then be slowly pressured up to 110% of the maximum expected pressure or to the maximum working pressure of the weakest component in the assembly. Inspect the assembly for leaks after the 10 minute pressure test and de-pressurization.

A pressurized line should not be visually inspected. Never attempt to tighten a component connection while it is pressurized.

Maintenance testing should be conducted at least once a year, or more often depending upon the exposure of the manifold components to H_2S, abrasive or corrosive fluids. A testing record should be kept on the unit containing the HPDM with a copy at the base. Maintenance testing should, at minimum, include the following:

- Hydrostatic testing.
- Ultrasonic wall thickness measurements. Wall thickness should be measured and recorded for each component at pre-determined points on the element.

Refer to the manufacturer recommended maintenance programs for specific HPDM maintenance testing recommendations.

Additional testing procedures could include the following:

- Radiography (x-ray) to determine internal structure of welds and castings.
- Magnetic particle to detect surface or near surface cracks.
- Liquid penetrant to detect surface cracks.
- Eddy current testing to check for defects such as erosion, corrosion pits, cracks, vibration damage, etc.

G.3 Sample High Pressure Manifold Inspection and Maintenance Record Sheet

The following is a sample of a High Pressure Manifold Inspection and Maintenance Record Sheet.

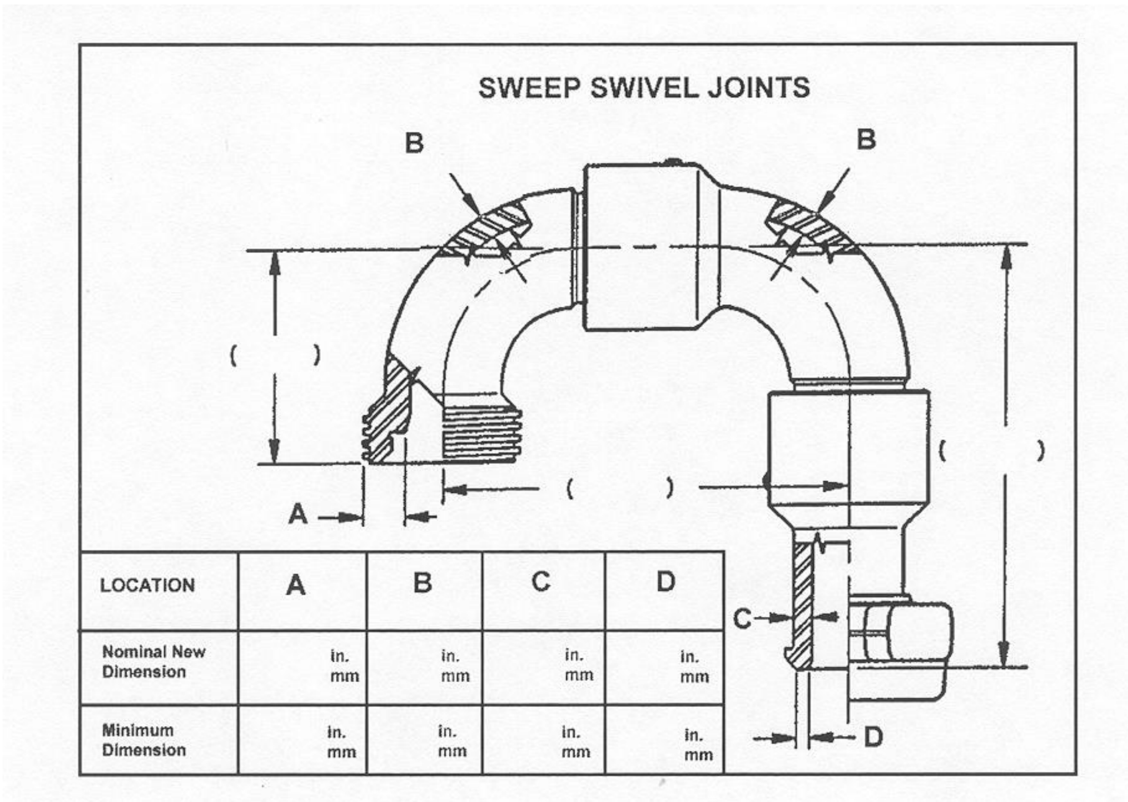
Table 10. Sample High Pressure Manifold Inspection and Maintenance Record Sheet

High Pressure Manifold Inspection and Maintenance Record Sheet								
Location Code	**Component Code**	**Size**	**Serial Number**	**Previous Serial Number (If applicable)**	**Unit Number**	**Minimum Wall Thickness Observed (mm)**	**Maximum Pressure**	**Comments**

G.4 Additional Inspection/Maintenance Records

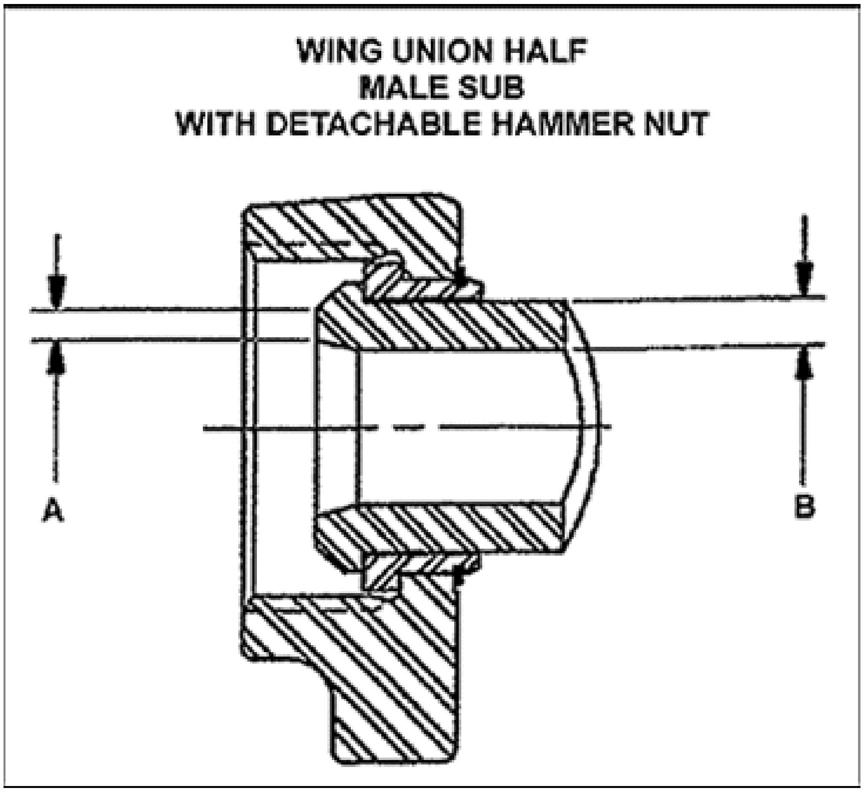
The following figures show additional examples of inspection/maintenance records for specific equipment.

Figure 2. Sweep Swivel Joints



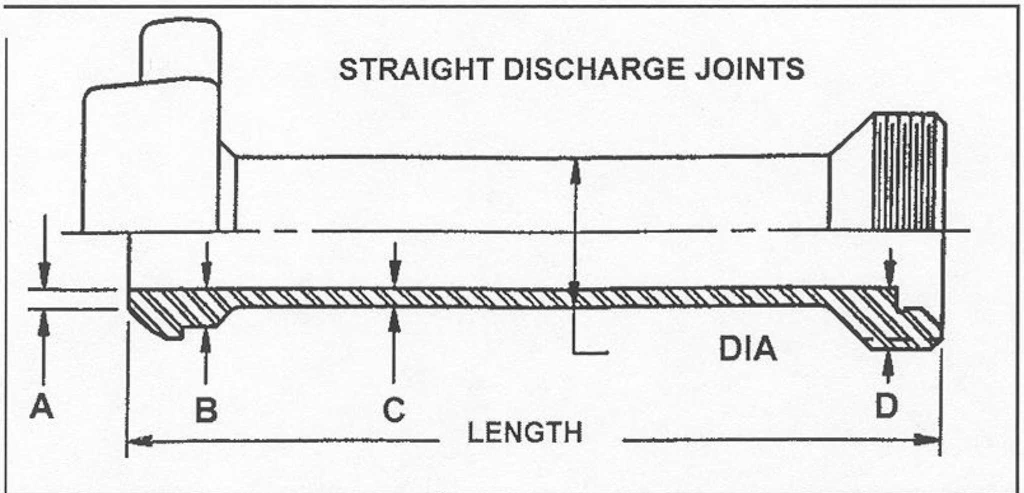
LOCATION	A	B	C	D
Nominal New Dimension	in. mm	in. mm	in. mm	in. mm
Minimum Dimension	in. mm	in. mm	in. mm	in. mm

Figure 3. Wing Union Half Male Sub with Detachable Hammer Nut



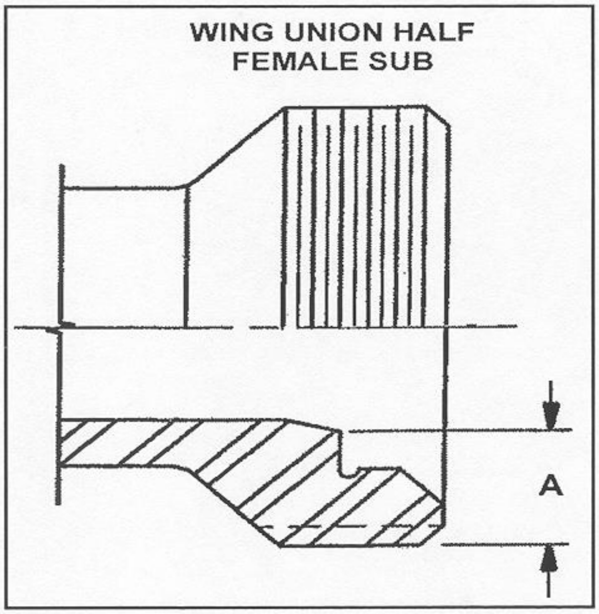
SIZE	FIGURE NUMBER	WORKING PRESSURE	SERVICE	LOCATION			
				A		B	
				NEW NOM. DIMENSION	NEW NOM. DIMENSION	NEW NOM. DIMENSION	NEW NOM. DIMENSION
				in. mm	in. mm	in. mm	in. mm
				in. mm	in. mm	in. mm	in. mm
				in. mm	in. mm	in. mm	in. mm

Figure 4. Straight Discharge Joints



LOCATION	A	B	C	D
NOMINAL NEW DIMENSION	in. mm	in. mm	in. mm	in. mm
MINIMUM DIMENSION	in. mm	in. mm	in. mm	in. mm

Figure 5. Wing Union Half Female Sub



SIZE	FIGURE NUMBER	WORKING PRESSURE	SERVICE	LOCATION	
				A	
				NEW NOM. DIMENSION	MINIMUM DIMENSION
				in. mm	in. mm
				in. mm	in. mm
				in. mm	in. mm

Appendix H: Annular Pressure Relief System

H.1 Annular Relief Valve

The annular relief valve (or pop valve) is usually installed on the annulus side of the wellhead to relieve pressure when a predetermined set pressure is exceeded during fluid pumping. There are two types of relief valves:

1. Resetting: Automatically opens when set pressure is exceeded and then automatically closes when pressure falls below the set pressure.
2. Full-flow trip: Automatically opens when set pressure is exceeded but must be manually closed once pressure falls below the set pressure.

Annular relief valves should be installed with the outlet pointed away from equipment and personnel and secured to withstand the back thrust of the discharging fluid without changing the direction of discharge.

H.2 Main Line Relief Valve

Relief valves should not be positioned on the main treating line – particularly for well service jobs.

If a relief valve has to be positioned on the main treating line the following steps should be taken:

- Ensure the relief valve is rated for 100% of the maximum flow rate being performed on the well.
- Do not place the relief valve directly on the main treating line. Place a tee in the main line and a 50 mm x 50 mm (i.e., Hamer valve) immediately downstream, perpendicular to the main treating line. Place a joint of discharge manifold iron, then the relief valve, downstream of plug valve.
- Place a 50mm x 50mm plug type valve (i.e. Hamer valve) before each relief valve. For safety reasons, this valve should be air actuated. It is important to note that relief valves may bleed if they are operating near their set point. They may continue to leak after being closed.
- Function test the relief valve before use to confirm that it will open at the required pressure.
- Ensure that the pressure relief valve is protected from freezing while in use (where relevant).
- Lay a staked line from the valve to a safe location to allow for safe discharge.

- Place relief valves upstream (pump side) of the main line check valve.
- Use the relief valve only to provide overpressure protection and not to control well flow.
- Do not flow sand through the relief valve as it will quickly cut off the valve body.
- Do not place any equipment or personnel in the area around the relief valve.

The installation of relief valves on gas energized systems for treating lines on CO_2 or N_2 jobs is not recommended.

Appendix I: Static Electricity

Static electricity consists of opposite charges separated by electrical insulators. It is caused when electrons are transferred between materials and generally discharges by sparking of the accumulated charge. Static electricity is different from “power” electricity and requires special measuring instruments and techniques.

Even though the flow of electricity during generation and accumulations is small – in the range of millionths of an ampere – potential differences amounting to thousands of volts may be produced.

A static charge can build up on either conducting or non-conducting surfaces. The ability of a substance to hold a static charge depends on its conductivity and its proximity to a charge release point. One unit of conductivity is the picosiemens per metre (pS/m). The lower the conductivity the longer the substance can hold a static charge.

One method of measuring static accumulation is the half-value time. Half-value time is the time required, in seconds, for the original charge in a substance to drop to one-half of the original value.

The following table describes the conductivity and relaxation time of some typical liquids:

Table 11. Conductivity and Relaxation Times for Typical Liquids

Substance	Conductivity (pS/m)	Half-Value Time (Seconds)
Highly Refined Flammable Fluids	0.01	1500
Light Distillates	0.01 to 10	1500 – 1.5
Black Oils	1,000 to 100,000	0.015 – 0.00015
Distilled Water	1,000,000	4×10^6

Static accumulation is typically considered to be insignificant when the conductivity of the substance exceeds 50 pS/m.

The time required for a static charge to decrease to an acceptable level in purified flammable fluids is very long because purified flammable fluids have 100,000,000 times greater ability to retain a static charge than distilled water.

Many fabrics can generate static electricity when they contact other materials then separate or when rubbed on other surfaces. Most synthetic fabrics (e.g., nylon, orlon, dacron and rayon) are more active generators of static electricity than natural fabrics (e.g., cotton or linen). Rubber and leather-soled shoes can generate static when the wearer walks on dry carpeting or other non-conductive surfaces during periods of low humidity. While static electricity from synthetic fabrics has not been shown to pose a significant hazard it is still important to consider and mitigate the ignition potential.

Appendix J: Fire Training Requirements for Well Service Personnel

The following basic fire extinguisher training should be given to all personnel that are expected to use an extinguisher:

- Fire Fighting Theory
    - The Chemistry of Fire
    - Fire Prevention
    - Classification of Fire
    - Fire Extinguishing Agents
    - Fire Extinguisher Ratings and Classifications
    - Fire Extinguishers
- Fire Extinguishment
    - Attacking the Fire
    - Use of Dry Chemical Fire Extinguishers
- Burns and Burn Treatment
- Personal Protective Equipment
- Personal Fire Survival

Appendix K: Sample Hazard Assessment Fire Protection Plan for Small Fluid Volumes

Job Description:		**Date:**	***draft***
Task:	**JHA Developed By:**		**Supervisor:**
	Customer:	**Location:**	**Safe Work Permit #:**

Step #	Task Steps	Potential Hazards	Risk Controls	Risk
1	Location preparation for product delivery	Other activities on site (e.g., other service providers, maintenance crews, etc.)	Communicate with other personnel on site	
2	Truck access to location	• Equipment, cables, hoses, etc. in travel path of supply units • Vehicles striking object or ground guide	• Plan ahead to provide access for supply units • Clear area as needed • Communicate vehicle movement requirements with drivers • Ground guides to wear traffic vest	
3	Equipment rig in	Inadequate preparation for service: • Static electricity	• Use closed loop fluid system • Check all connections for gaskets and condition before connecting hoses • Use drip pans to catch any small leaks • Bond tank truck and pumping unit • Ensure all units have functional positive air shut off	

Step #	Task Steps	Potential Hazards	Risk Controls	Risk
4	Fire protection	Fire Ignition hazard controls: • Flammable Vapours	• Ensure fire extinguishers are minimum 20 pound BC • Ensure fire extinguishers are in good condition • Remove fire extinguishers from all units involved in service and place on the ground in a readily accessible location • Smoking allowed in designated smoking area only • Personal gas monitors able to detect LELs	
5	Fluid Pumping	Fluid leaks	• Clean up spills • Stop fluid transfers if any concerns arise and notify supervisor	
		Vapours from tanks or transfer	• Use closed loop fluid delivery • Keep hatches closed on tanks	
6	Emergency preparedness and response	• Spill • Major leak • Fire • Spray • Worker splashed • Hose failure	• Establish safe meeting area • Communicate safe area • Have fire extinguisher available for emergency escape • Eye wash available in case of splash • Pump operator transport drive to stop transfer, alert others, close tank emergency valve, shut off engine and go to safe area	
7	Other hazards and controls identified on site			

Safety Equipment Required for Task							
☐	JHA Review	☐	Ventilation	☐	Safety Signs	☐	Lock Out/Tag Out
☐	Safe Work Permit	☐	Rubber Gloves/Apron	☐	Goggles/Face Shield	☐	Approved Hardhat
☐	SCBA/SABA	☐	Fall Protection	☐	Respirator	☐	Approved Safety Glasses
☐	Hearing Protection	☐	FR High Visibility Coveralls	☐	Back-up Alarm	☐	Approved Steel Toed Boots
☐	Personal Gas Monitors	☐	Fire Extinguishers	☐	No Smoking Signs	☐	Eye Wash
☐	Safe Area Sign	☐		☐		☐	
☐		☐		☐		☐	
☐		☐		☐		☐	
☐		☐		☐		☐	
☐		☐		☐		☐	
☐		☐		☐		☐	

Print Name	Initials	Print Name	Initials	Print Name	Initials

Acronyms and Abbreviations

ANSI American National Standards Institute

API American Petroleum Institute

AR-AFFF Alcohol-Resistant Aqueous Film-Forming Foam

ASTM American Society for Testing and Materials

CGSB Canadian General Standards Board

CSA Canadian Standards Association

FR Fire Retardant

FRC Fire Retardant Clothing

GHS Globally Harmonized System of Classification and Labelling of Chemicals

HPDM High Pressure Discharge Manifold

ID Inside Diameter

JHA Job Hazard Analysis

IRP Industry Recommended Practice

LFL Lower Flammable Limit

LNG Liquid Natural Gas

LPG Liquid Propane Gas

LPT Line Pipe Threading

MSDS Material Safety Data Sheets

NFPA National Fire Protection Association

NORM Naturally Occurring Radioactive Material

PPE Personal Protective Equipment

RVP Reid Vapor Pressure

SABA Supplied Air Breathing Apparatus

SCBA Self Contained Breathing Apparatus

SDS Safety Data Sheet

TDG Transportation of Dangerous Goods

UFL Upper Flammable Limit

WHMIS Workplace Hazardous Material Information System

Glossary

Thef ollowing terms have been defined from an IRP 8 context.

Aniline Point As per IRP14 Non-Water Based Drilling Fluids, the aniline point is defined as the lowest temperature at which aniline (an aromatic amine/benzene derivative) remains miscible in a specified quantity of an oil product as determined by test method ASTM D611.

Bonding The act of forming an electrically conductive circuit between all vessels containing flammable fluids and pieces of well servicing equipment. Bonding ensures that the electrical potential caused by electrostatic build-up or stray currents is the same on all equipment in the circuit. It does not necessarily result in a "Ground Potential" of zero. Bonding is suitable for the transfer of fluids from tank to tank. However, it is preferred that the service equipment be connected together and grounded to the well head.

Bottom Loading The act of unloading flammable fluid into a tank or container through inlet valves situated relatively low on the side of the tank. With the valves located near the bottom of the tank, the fluid that is being unloaded into the tank soon covers the inlet valves and becomes submerged under the fluid that has already been unloaded.

Cleveland Open-Cup (ASTM Test D-92-12b) Used for materials with flash points between 79 and 400 °C respectively.

Closed Blending System A mixing system in which there is no contact between flammable fluid vapours and surrounding air, and one in which air is not introduced via an added component (e.g., sand).

Competent In relation to a worker, means adequately qualified, suitably trained and with sufficient experience, to safely perform the work without or with only a minimal degree of supervision.

Energized Flammable Fluids Flammable fluids that are pumped with one or more expansive fluids (e.g., nitrogen, liquid CO_2, LPG) or flammable fluids which are not a liquid at atmospheric pressure under normal conditions (e.g., liquid propane gas (LPG), etc.).

Foamed flammable fluids are considered energized flammable fluids for IRP 8.

Fill Pipe Loading The act of transferring flammable liquid into a tank or container through a pipe that rises up the outside of the tank and is continuous on the inside of the tank to the bottom. The end of the fill pipe should be one foot off the bottom of the tank or container. A slow filling rate of 1 m/sec (3 ft./sec) should be maintained until the end of the fill pipe is completely submerged so as to eliminate initial splash loading hazards.

Firefighting Equipment There is a variety of oilfield firefighting equipment available on the market. This equipment falls into two basic categories:

1. Twin Agent Systems
2. Continuous Foam Systems

The Twin Agent System is a fire suppression system consisting of both dry chemical (“Purple K”) and pre-mixed foam. Nitrogen is used to propel the fire suppressants out through separate discharge hoses.

The Continuous Foam System consists of a centrifugal fire pump and a fire suppressant chemical. When combined with supplemental or on-board water, these two suppressant agents produce a solution that is then pumped through a discharge hose. The delivery rate of the fire suppressant and fire equipment is pre-determined by the NFPA standards, or the manufacturer’s specifications.

The advantages of each type of system are outlined in the table below.

Table 12. Advantages of Firefighting Equipment Types

Twin Agent System	Continuous Foam System
• Can be activated quickly for fire suppression and rescue purposes. • Can be used independently or in combination with a continuous foam system.	• Can be discharged a longer distance, supply more efficient coverage and effectively secure the liquid spill to control re-ignition. • Fire fighters have more mobility thus ensuring a greater safety factor

Flammable (or Explosive) Limits Flammable (or explosive) limits are the minimum and maximum concentrations (expressed as volume fraction or %) of a flammable vapour (or aerosol/mist) in air that are capable of supporting combustion. These limits are usually abbreviated to LFL (Lower Flammable Limit) and UFL (Upper Flammable Limit) or LFL/UFL. Flammable limits in the literature are normally given at atmospheric conditions. An increase in oxygen content will widen the flammable range (i.e. the LFL will be lower and the UFL will be higher). A decrease in oxygen (adding inert gas) will narrow the flammability range to the point where combustion cannot occur. An increase in pressure or temperature will also widen the flammable range (or reduce the amount of oxygen required to support combustion).

Flash Point The flash point is the lowest temperature at which a liquid exposed to air gives off sufficient vapour to form a flammable mixture near the surface of the liquid, or within the test apparatus used, which can be ignited by a suitable flame. Flash Points are derived by the Open Cup or Closed Cup methods. In this publication, references to flash point refer to both the Open and Closed Cup method. As required by WHMIS, an SDS provides information on the material's fire/explosion hazard by describing the material's flash point as derived by the Closed Cup test method.

Fracturing A specific type of well service procedure involving the pumping of a specialized fluid or gas into a formation at a sufficient rate and pressure to create certain formation “cracks” through which the fluid or gas is pumped. The fluids or gases used in a fracturing treatment typically carry a natural or man-made, refined and sized set of particles that will be left in the created fracture to prop the crack open.

Grounding Grounding is similar to bonding except that the equipment circuit is not only connected to each other but also to an adequately grounded object (i.e. the well head, ground anchor etc.). This ensures that the equipment can be at ground (zero) potential.

Ground Monitor For purposes of this IRP, a ground monitor is a portable, unmanned, firefighting appliance to direct the flow of water. Some models can be remote controlled.

Definitions from NFPA Glossary of Terms:

A monitor is a fixed master stream device, manually or remotely controlled (or both) capable of discharging large volumes of water or foam.

A master stream device is a portable or fixed firefighting appliance supplied by either hose lines or fixed piping and that has the capability of flowing in excess of 1140 litres/minute (300 g/m) or water or water-based extinguishing agent.

Figure 6. Ground Monitor

Ground Wire A proper ground wire is a minimum 6 gauge wire with CSA approved connectors (see Alberta Electrical Regulations STANDATA 10 Revision 8 and CSA Standard C22.2 No. 41 (Grounding and Bonding Equipment)).

Half-Value Time The time taken for an accumulated electrostatic charge in a liquid (within an enclosed conductive container), to decrease to one half of its' original value.

High Hazard Flammable Fluids Flammable fluids handled at a temperature within 10 °C (18 °F) of the open cup flash point. For example, a liquid with a flash point of 15 °C (59 °F) operating at a temperature above 5 °C (41 °F) should be treated as a high hazard flammable fluid. Refer to section 8.2.2 Fluid Classification for a chart comparing the different fluid classifications.

High Pressure Discharge Manifold (HPDM) Steel reinforced hose or steel piping used to carry well servicing fluids from tanks through pumps to piping connected to the wellhead and wellbore tubulars.

Hot Zone The area having the highest risk potential to personnel involved in the well servicing process, including the following components:

- Flammable Fluid Tank(s)
- Blender
- Sand Equipment

Other equipment that may be applicable to the hot zone may include the following:

- Chemical Van
- Hydration Unit
- Coiled Tubing Unit
- Fluid Pumping Unit(s)

In most cases the blender is the area with the highest exposure to flammable fluid vapours.

The hot zone can change depending on events at the wellsite (e.g., hose leak, line leak, etc.).

Mobile Shower Unit For purposes of this IRP, the mobile shower unit encompasses the showers, eye wash units and drench hoses.

Standards and regulations applicable to mobile shower units include the following:

- OH&S Code Section 23
- First Aid Regulation Part 11
- Provincial/Territorial Regulations
- ANSI Z358.1 - 2014

ANSI Standard Z358.1 sections 4, 5 and 8, set out the following minimum standards for shower units, eyewash units and drench hoses:

- Each shower head shall be capable of delivering a minimum of 76 litres per minute (20 US gallons per minute) of flushing solution for a minimum of 15 minutes. This requires a minimum of 1.15 m^3 (300 US gallons) for each person exposed to hazardous fluids.
- Each eyewash unit shall be capable of delivering flushing fluid to the eyes at a rate of not less than 1.5 litres per minute (0.4 US gallons per minute) for 15 minutes.
- Each drench hose shall be capable of delivering a minimum of 11.4 litres per minute (3 US gallons per minute) of flushing fluid for a minimum of 15 minutes.
- The delivered flushing fluid temperature shall be “tepid”. Tepid is defined in the ANSI Standard as “moderately warm; lukewarm”.
- If the number of persons required to be in the hot zone exceeds the onboard water supply of a mobile shower unit, supplemental (tepid) potable water shall be required.

Refer to ANSI Standard Z358.1 for more information on the performance requirements, inspections and maintenance of safety shower equipment.

MSDS The Material Safety Data Sheet defines the health, safety and fire risks associated with a specific product. MSDS transitioned to Safety Data Sheet (SDS) in 2015.

Non-Destructive Testing A method of determining the integrity of pressurized equipment without incurring damage to the equipment.

Open Blending System A mixing system where flammable fluids are exposed to the surrounding air.

Open Cup Flash Point See definition for Flash Point.

Owner/Operator (Lease) A person, partnership, company or group of persons who, under contract and agreement of ownership, direct the activities of one or more employers involved at a work site. See the Enform Crossing Borders Report for more detailed definitions and responsibilities.

Personal Protective Equipment (PPE) The equipment or clothing worn by a worker to reduce the consequences of exposure to various hazards associated with working conditions or a work site. Personal protective equipment includes goggles, chemical goggles, chemical suits and aprons, cold weather clothing, dust masks, face shields, fire-retardant clothing, gloves, hardhats, hearing protection, high visibility safety vests, hoods, safety goggles, safety helmets and safety-toed footwear.

Polar Solvents For the purpose of this document, polar solvents are generally referenced as those organic compounds that are soluble in water or organic compounds that are mixed into water for oilfield well servicing, (e.g. methanol, alcohol, glycol's, ethers).

Prime Contractor In this document the Prime Contractor is the lease owner/operator or their designated representative. See the Enform Crossing Borders Report for more detailed definitions and responsibilities.

Reduced Hazard Fluids Flammable fluids handled at temperatures at least 10 °C (18 °F) below the open cup flash point. For example, a liquid with a flash point of 15 °C (59 °F) operating at a temperature of 5 °C (41 °F) or less should be treated as a reduced hazard fluid. Refer to section 8.2.2 Fluid Classification for a chart comparing the different fluid classifications.

> **Note:** A Reduced Hazard Fluid may be pumped into a well but because of the temperature increase of the fluid down-hole, the fluid may return to surface in a High Hazard condition.

Safety Data Sheet (SDS) Safety Data Sheet is a 16 section communication sheet which replaces MSDS in the Globally Harmonized System of Classification and Labelling of Chemicals (GHS).

Self-Contained Breathing Apparatus (SCBA) An air cylinder and mask intended to be carried on the back of the worker and has ± 30 minutes of breathing air contained in the cylinder. This device is used for short work periods where a worker is in an H_2S or other hazardous breathing environment. Also used for emergency situations to aid in the rescue of injured personnel.

Service Company A person, corporation or association who is contracted to supply, sell, offer or expose for sale, lease, distribute or install a product or service to another company, usually the owner of the worksite

Shower unit A mobile, truck mounted personnel shower facility which provides the personnel on a work location the facility to "shower off" chemical and or toxic substances should they come in contact with the skin of personnel working on a location.

Spark Promoters Are un-bonded conducting objects within a tank or compartment. Metal or conductive objects such as gauge tapes, sample containers and thermometers should not be lowered into a tank or compartment during loading or immediately after cessation of loading.

Special Hazard Fluids Flammable fluids with an open cup flash point of 0 °C (32 °F) or less. Refer to section 8.2.2 Fluid Classification for a chart comparing the different fluid classifications.

Splash Loading The act of unloading of flammable fluid into a tank or container, such that the flammable fluid free-falls from the inlet pipe to the surface of the stored flammable fluid. This causes the flammable fluid to splash down in an uncontrolled fashion and increases the risk of an electrostatic ignition. See 8.3.3.2 Splash Loading for more information about Splash Loading.

Supplied Air Breathing Apparatus (SABA) A small air cylinder (less than 5 minutes of breathing air) and air mask intended to be carried on the hip of a worker with the ability to connect, by hose, to numerous larger air cylinders. This type of configuration is used for extended work periods where a worker is exposed to an H_2S or other hazardous breathing environment.

Tag Open-Cup (ASTM Test D-1310-14) Used for materials with flash points between 0 and 325 °C.

Well Service Fluids Fluids used in conjunction with a well service procedure.

Well Service Operations Work done on a wellbore that is connected to a potential flammable fluid bearing formation, for the purpose of production of petroleum products, whether gases or liquids. Wellbores can also be used for injection of liquids or gases, to enhance the production of petroleum products in other wellbores connected to the same formations.

Wellbores may also be used to dispose of liquids or gases that were produced from other wellbores, and are not wanted by the operator. Stimulation of the wellbores for increased production or injection, or the working over of a well to maintain or regain production, and/or injection, is also considered a well service operation.

Workplace Hazardous Material Information System (WHMIS) an information system that, along with other requirements, includes safe handling precautions of controlled products on labels and material safety data sheets.

References

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Alberta Electrical Regulations STANDATA 10 Revision 8

Alberta Oil and Gas Conservation Act Regulation AR151/71

ANSI Z358.1 – 2014 American National Standard for Emergency Eyewash and Shower Equipment

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Enform Crossing Borders Report

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Enform Worker's Guide to Hand Signals for Directing Vehicles

IRP4: Well Testing and Fluid Handling

IRP5: Minimum Wellhead Requirements

IRP14: Non-Water Based Drilling Fluids

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