

Guideline for the compilation of a
Risk Assessment
on the
Jackpot Headboard

This guideline has been prepared by New Concept Mining (Pty) Ltd to assist the Mine in compilation of their own Risk Assessment as required by the Mine Health and Safety Act.

The assessment has been reviewed and edited by Snowden Mining Industry Consultants

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1 Summary

1.1 Introduction

This guideline has been prepared by New Concept Mining (Pty) Ltd to assist any mine using the Jackpot Headboard in compilation of its own Risk Assessment as required by section 11 of the Mine Health and Safety Act. The assessment has been undertaken by the supplier in terms of the requirement of section 21 of the Act.

This Risk Assessment has been undertaken by staff of New Concept Mining who have been involved in the design, manufacturing and marketing to establish what the risks are associated with the use of the product. The assessment has been reviewed and updated by the Sigma Risk Division of Snowden Mining Industry Consultants (Pty) Ltd.

1.2 Key Risk Issues

Arising from the assessment and analysis were the following main key risk issues.

- The underground environment and particularly the risk associated with falls of ground due to poor hangingwall conditions which may exist during the installation process.
- The inadequate installation of the headboard and prop which may lead to removal of the support by the blasting process with potential impacts of falls of ground. These installation conditions are characterized by the installation on loose material on the footwall, insufficient preload pressure or skew installations which are not perpendicular to the reef plane.
- Support which is deployed incorrectly, usually with spacing that is greater than the required distance.
- The weight of the bundled packs of headboards, and stacking techniques which may lead to toppling, falling, sliding incidents resulting in injury to persons.

1.3 Recommendations

The following recommendations have been made:

1. The mine develop, implement and maintain appropriate procedures, training programmes and ongoing systems to monitor the quality of installation of the headboard units by its operating personnel.
2. The mine's rock engineering department is aware of and approves the use of the units as compatible with existing support strategy.
3. Appropriate Personal Protective Equipment is provide to all operatives installing the headboard/prop units (e.g. gloves, eye protection)
4. Appropriate pressurising equipment is provided and authorised for use in the pre-stressing of the headboard during the installation.

2 Objectives

To identify the hazards, prioritise the associated risks and highlight the controls required to eliminate or minimise the risks related to the **Jackpot Headboard** and its operation, as well as any risk of failure, primarily from the point of view of the health and safety of the workforce, but also production delay and asset damage or a combination of the three.

This process ensures that all reasonable precautions are taken to either eliminate or minimise the risk of injury to the workforce during the installation or operating phases.

The outcome is a formal Risk Assessment Report with prioritised actions where applicable.

3 Risk Analysis Method

The risk analysis follows a standard method of work process analysis. All risk assessments follow a general scheme, which can be described as follows:

1. Description of the system under analysis (including equipment, personnel, procedures, work environment, management and supervisory systems) etc.
2. Identification of loss scenarios (i.e. sequences of events leading up to potential or actual losses such as incidents or accidents) in the form of hazards, potential productivity interruptions, asset damage events, environmental contamination issues etc. and evaluation of the risks of each loss scenario by determination of the relative likelihood of each event, and the relative consequence of each event.
3. Evaluation of the currently planned controls, barriers and safeguards, including a post control risk rating.
4. Identification of additional controls, barriers and safeguards.

In the current exercise, a select team followed a risk analysis framework as follows to accomplish these steps.

3.1 Defining the operational system

The exercise was scoped to review risks related to the work process during the storage, transport and installation of the headboard. An operational flow chart highlighting these activities was derived during the risk assessment.

The performance of the unit was also examined by way of a Failure Mode and Effect Analysis (FMEA) on the component parts of the system.

3.2 Identification of the possible system hazards

This step postulated the maximum reasonable consequence of loss scenarios (i.e. of circumstances leading up to or resulting in hazards). The consequences were classified as losses to people (health & safety), production delays, equipment and environmental damage, or combinations of these losses.

In the current exercise, the mandate was to focus on health & safety issues.

3.3 Determination of the level of risks

Risks associated with each step in the operational flow chart were considered. This was achieved by considering the event frequency (probability) and the event severity (consequence).

In South Africa, Sigma Risk utilises a standard ranking system that has been used on many previous analyses, and has been acknowledged by international authorities as an acceptable means of prioritising and ranking risk-based information during team exercises.

The ranking system used is described below.

Risk is defined as the product of probability and consequence.

3.3.1 Probability categories

Probability categories (A - E) were defined as follows.

Category	Probability
A	Common
B	Likely to happen
C	Could happen
D	Unlikely
E	Extremely unlikely (Practically impossible)

Table 1- Probability Categories

3.3.2 Consequence categories

Consequence categories (1 - 5) were defined for various loss categories as follows.

Category	Health & Safety consequence
1	Fatality / fatalities
2	Major Injury
3	Average Lost Time Injury
4	Minor Injury
5	Medical treatment only, or less

Table 2 - Consequence Categories

3.3.3 Risk categories

Risk categories were defined by combining the probability and consequence categories above according to a matrix of prioritised risk ranking as follows. For each hazard, an assessment of probability and consequence was carried out. The risk rating was then derived using the following risk matrix.

		Probability Category					Risk Categories
		A	B	C	D	E	
Consequence Category	1	1	2	4	7	11	<div style="display: flex; flex-direction: column; gap: 5px;"> <div style="background-color: #FFC0CB; width: 20px; height: 10px; display: inline-block;"></div> High (1-6)</div> <div style="background-color: #FFFF00; width: 20px; height: 10px; display: inline-block;"></div> Medium (7-15)

Figure 1 - Risk Matrix

A risk score of 1 denotes the highest (most significant) risk. A risk score of 25 denotes the lowest (least significant) risk.

Each risk rating was then grouped into high, medium or low categories, according to the grouping above. High risks are those ranked 1 - 6 on the matrix, and medium risks are those which ranked 7 - 15. Low risk hazards may be analysed at a later date, but are considered to be of an acceptable level.

3.4 Definition and description of the system controls and barriers

This step identified existing controls and barriers, and also considered planned and possible additional controls and barriers, which could be used to manage the operational risks. Controls and barriers include engineering devices, operational methods and practices, management actions and principles, and environmental and system amendments that the team agrees appropriate to consider.

Controls were assessed for all the hazards identified in the Work Process Analysis (WPA), and for high and medium risk hazards in the FMEA.

3.5 Assessment of the acceptability of the controls

The acceptability of the nominated controls in terms of design devices, management and operational practices and system amendments was reviewed by the team to ensure that additional scope for risk reduction has not been overlooked within the time available. An assessment of the residual risk rating after the implementation of existing controls was made. Hazards still found to carry an unacceptably high risk rating were the subject of further assessment and additional measures were recommended where appropriate.

3.6 Documentation of the study process and results

The report is presented so that the mine can review the planned and proposed controls and barriers and can devise an implementation plan to incorporate any additional approved controls established through the risk analysis.

4 Workshop details

The initial risk analysis was conducted over one day on the 16th March 1999 at **New Concept Mining (Pty) Ltd** offices with a selected risk review team participating in the exercise. The participants in this assessment are listed below:

Participants	Position
Paul McKelvey B.Sc. MSc (Mech. Eng.)	Technical Director
Nick Marvin B.Sc.(Min.Eng.)	Manager
Owen McMahon	National Sales Manager
Simon Mangena	Technical Support and Safety
Errol Wilson	Area Sales Manager
Greg La Vita	Manufacture
Dave Tyrer B.Sc. (Mech. Eng)	Design Engineer

Table 3 - Risk Analysis Participants

The review of this assessment was conducted by Alistair Forbes, BSc (Mining), MBL., Consultant Mining Engineer - Risk Management and Benchmarking, of Snowden Mining Industry Consultants during February 2002.

5 Results

The risk analysis exercise generated a structured set of results presented in this section.

5.1 Format for results

The analysis team developed a format for results based on the flow chart of work activities and the component parts of the equipment.

Results are presented in the following sequence.

- System description
- Flow chart
- Component list
- Risk analysis tables

5.2 System description

The Jackpot Headboard is supplied to users of elongate support in order to increase the bearing area and thus reduce the bearing pressure on the hangingwall above the support.

The headboard is supplied in two types, one of which is supplied with a pre-stressing device. Both utilise the same timber mat as described in the table of components for each type in Table 4.

The headboard dimensions are 70mm by 350mm by 450mm.

The assessment considers the associated risks involved with the transport, storage and installation of the headboards as shown in the flowchart in Figure 2.

5.3 The flowchart of work activities

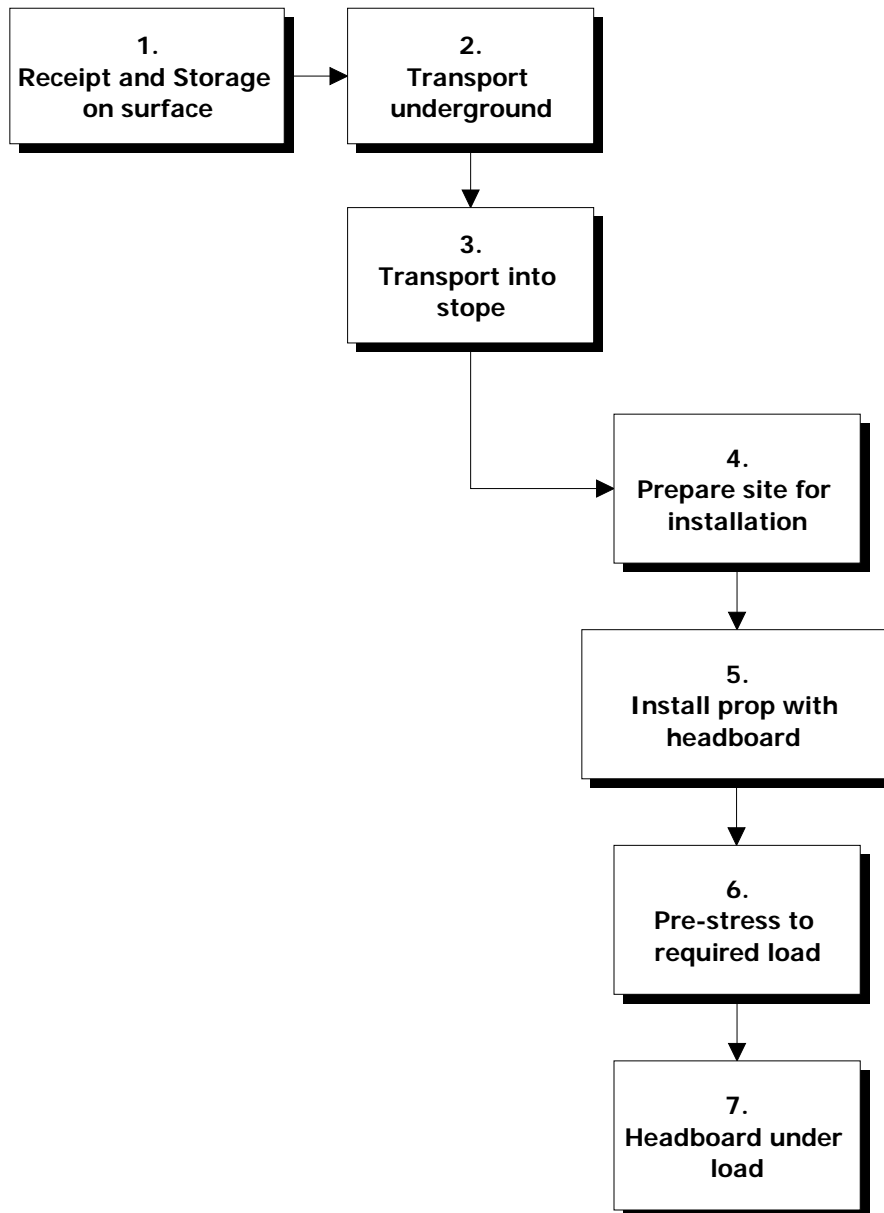


Figure 2 - Activities falling within the scope of this assessment

5.4 Component List

Two variations of headboard are considered in this assessment.

Type 1 - Consists of a timber mat attached to a universal steel plate. It has no pre-stressing unit attached.

Type 2 - Consists of a timber mat attached to an assembly which is made up of a jackpot pre-stressing unit welded to two angle iron brackets. The brackets are attached to the timber mat.

The accompanying table lists the various components.

Component		Type 1 Headboard	Type 2 Headboard (with Jackpot)
1	Timber mats, 70mm by 350mm by 450mm (made up of five pieces of 70mm by 70mm by 450mm timber.) See figure 1 below.	4	4
2	Connecting wire threaded through holes in the timber to form the "mat".	4	4
3	Universal steel headboard	4	
4	One set of springs (used for gripping the prop to prevent the headboard from falling off during the installation process)	4	
5	Jackpot welded to angle iron brackets		4

Table 4 - Components List of the Headboards



Figure 3 - Wire-Spun Mats

(Timber of 70mm by 70mm connected by a wire)

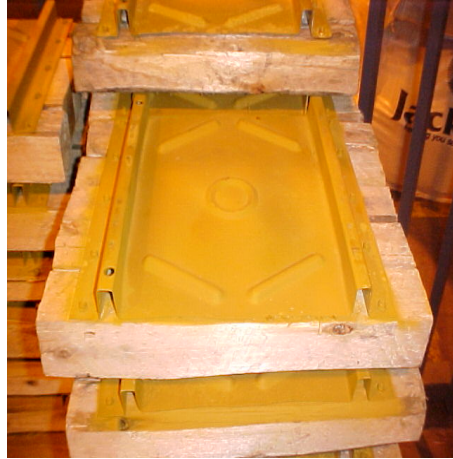


Figure 4 - Universal Headboard
(A single piece of shaped steel bolted to the timber)



Figure 5 - Jackpots Welded to Angle Frames



Figure 6 - Completed Headboard with attached Jackpot

A failure mode and effects analysis was carried out on the various components as identified and results are tabulated in the table in Appendix B.

5.5 Hazards

Based on the table of results of the assessment the following principal hazards have been identified in the handling, storage and installation of the headboard. These constitute the higher risk areas as rated using the risk matrix in 3.3.3 above.

5.5.1 *Use in the underground environment*

The headboard is an optional item for use where friable or weak hangingwall conditions require larger bearing areas than the existing prop offers. It is, in itself, a control for props or elongates to reduce the risk of dislodging loose rock which may fall and injure nearby workers.

However, the environment in which the headboard is deployed is inherently hazardous and therefore the use of the headboard has to take into consideration these conditions.

5.5.2 *Physical characteristics*

The headboard is easy to carry and relatively light for one man to manhandle. However when strapped in bundles of 6 and 30 they constitute a weight hazard which may be stacked too high, or which may be difficult to manhandle in the underground environment. However the ease of handling in bundles by mechanical means makes it less time consuming to transport.

The headboard operates with a pressurised pre-stressing cell to pre-load the support at the time of installation. The pressure device requires pumping up to set pressures in the underground workplaces with water pumps and hoses. This pressure can give rise to hazardous conditions which have the potential to harm workers if not properly controlled. The need for the proper pressurising equipment, maintained in good condition and operated by trained, competent people is important.

5.5.3 *Deployment of support*

The safe use of the headboards is dependant on the correct deployment of the support system. Headboard/prop combinations which are installed contrary to the mine standards constitute hazardous situations which should be recognised and corrected.

5.5.4 *Installation issues*

A number of installation hazards are highlighted in the installation process. These focus on the potential for incorrect installation of the prop/headboard combination and will normally result in inadequate load setting and early blast out of the prop. This can be caused by locating the prop on loose material, insufficient pre-loading of the prop, or not installing the prop perpendicular to the plane of the reef.

Locating the headboard on sharp or uneven hangingwall constitutes a further hazard, where failure of the headboard as the prop takes load may result. However, the headboard has undergone successful testing under these conditions up to 200kN loading.

5.6 Controls

5.6.1 *Design and manufacturing process*

In the manufacture of the headboards certain controls have been identified as having a positive effect on the control of the potential hazards. These include the correct QA procedures for steel procurement, quality control checks in the manufacturing process, quality acceptance testing on all materials and components, air pressure testing of all completed Jackpots and high pressure testing of 1 percent of completed units.

5.6.2 *Procedures*

The use of the headboards is directed through training programmes offered by the supplier and assistance with the setting up of standard procedures for the transport and installation of the units in the workplace.

The mine will be responsible for setting up its own procedures in the use of the headboard in accordance with both the current safety procedures for the installation of support and the rock engineering requirements regarding the deployment of the support units.

5.6.3 *Training*

Training of the mine trainers by the supplier is offered to ensure that the units are properly installed by the safest possible means. The supplier also offers on-site training to assist in the accumulation of the proper skills by mine staff. It is recommended by the supplier that all stope operatives required to install the support unit are appropriately trained and issued with the necessary personal protective equipment.

5.6.4 *PPE*

In the area of PPE, it is important that proper protective equipment is issued to those either transporting or installing the headboard and props. This should include safety boots and eye protection.

Appendix A - Table of Risk Assessment Results

	AREA/ ACTIVITY/	HAZARD	CONSEQUENCE / EFFECT	PRE- CONTROLS RISK INDEX			EXISTING SAFEGUARDS / CONTROLS	POST- CONTROLS RISK INDEX			RECOMMENDED CONTROLS
				P	C	R		P	C	R	
1	Receipt and storage on surface	a. Headboards are stacked too high and topple	▪ Injury to persons in vicinity	C	2	8	▪ Units are bundled in packs of 5 and then into greater bundles of 30 for ease of handling	D	2	12	▪ Procedures for stacking and storage ▪ Training of stores staff to handle the bundles
		b. Stored in adverse conditions	▪ Wood rots, steel corrodes and unit becomes unusable	D	4	21	▪ Recommended stock turnover on FIFO basis ▪ Appropriate storage conditions recommended by supplier	E	5	25	▪
2	Transport underground		▪				▪				▪
3	Transport into stope	a. Worker drops unit whilst carrying it	▪ Injury	B	4	14	▪	B	4	14	▪ Use mono rope where possible, ▪ PPE to be supplied by mine ▪ Procedure should include a requirement to carry, not throw the unit
		b. Loosely stacked headboards slide down dip into worker	▪ Injury	B	3	9	▪	B	3	9	▪ Stack correctly in stope storage areas ▪ Training and Supervision
		c. Unit falls off mono rope or is dropped	▪ Injury	C	2	8	▪ Fastening twine is supplied attached to the units	D	2	12	▪ Gate stulls. ▪ Mine standards for steep areas apply.
		d. Slip and fall whilst carrying headboard	▪ Injury	C	4	18	▪	C	4	18	▪ Area >35-degree steep area, safety belts needed. ▪ Good house keeping. ▪ Gate stulls. ▪ Mine procedure to prevent rolling rocks etc.

	AREA/ ACTIVITY/	HAZARD	CONSEQUENCE / EFFECT	PRE- CONTROLS RISK INDEX			EXISTING SAFEGUARDS / CONTROLS	POST- CONTROLS RISK INDEX			RECOMMENDED CONTROLS
				P	C	R		P	C	R	
4	Preparation site for installation	a. Loose hanging wall falls whilst preparing site for support	▪ Injury from fall of ground (FOG)	B	2	5	▪	B	2	5	▪ Mine Standard procedures for making safe
		b. Support installed at incorrect spacing	▪ Inadequate support resistance and possible F.O.G	C	1	4	▪	C	1	4	▪ Mark off positions of props on hanging wall to mine support standard
		c. Prop installed on loose rock	▪ Prop can blast out resulting in FOG and wastage of material	B	1	2	▪ Supplier recommended procedure ▪ Supplier training	D	1	7	▪ Clean footwall to solid rock ▪ Standard installation procedures
		d. Prop installed with insufficient pre-load	▪ Prop can blast out because it - F.O.G and wastage of material	C	1	4	▪ Supplier training ▪ Supplier recommended procedure ▪ Use of gauge and setting tool	D	1	7	▪ Appropriate pre-stressing equipment (pump, hoses and water pressure) is provided for use ▪ Check water hose and pump (and air supply where applicable). ▪ Check pressure relief valve setting on pump
		e. Timber cut too short	▪ Production delay	C	5	22	▪ Supplier training ▪ Supplier recommended procedure	D	5	24	▪ Procedures to include "Measure correctly to ensure tight fit of headboard against hanging wall"
		f. Prop sawn excessively skew so that Head Board cannot accommodate misalignment	▪ Prop blasts out	B	1	2	▪ Supplier training ▪ Supplier recommended procedure	D	1	7	▪ Training ▪ Inspections
5	Installing the prop with headboard	a. Knocking the hanging wall with hammer	▪ FOG or rock fragments leading to eye injury	C	1	4	▪ Supplier training ▪ Supplier recommended procedure ▪ PPE recommended	D	1	7	▪ Mine standard procedure
		b. Prop not at 90 degrees to reef plane	▪ Blasts out causing FOG	B	1	2	▪ Supplier training ▪ Supplier recommended procedure	D	1	7	▪ Install at 90° to strike and dip
		c. Prop or rocks fall during installation or handling	▪ Injury	D	3	17	▪	D	3	17	▪ No workers to work below installation ▪ Use gate stulls
		d. Hanging wall structure is either jagged or smooth	▪ Headboard and Prop fall out when blasted	C	5	22	▪ Supplier training ▪ Supplier recommended procedure	D	5	24	▪ Install normal to dip.

	AREA/ ACTIVITY/	HAZARD	CONSEQUENCE / EFFECT	PRE- CONTROLS RISK INDEX			EXISTING SAFEGUARDS / CONTROLS	POST- CONTROLS RISK INDEX			RECOMMENDED CONTROLS
				P	C	R		P	C	R	
6	Pre-stress to required load	a. Prop falls during pre-loading	▪ Injury.	D	3	17	▪ Supplier training ▪ Supplier recommended procedure ▪ Remote pre-stressing advised	D	5	24	▪ Accurately measure and saw timber pole. ▪ Knock in with hammer. ▪ Remotely pre-stress with pump. ▪ PPE (Eye protection) supplied by mine
		b. Bursting of Jackpot	▪ High pressure water in eyes.	D	2	12	▪ Correct QA procedures by Supplier	E	2	16	▪ Attach hoses securely. ▪ Training
		c. Struck by hose	▪ Injury from loose hose	C	4	8	▪ Recommend regular inspections of equipment	D	4	21	▪ Unit pressure tested prior to departure
		d. Valve fails after pre-stressing	▪ Loss of load	E	5	25	▪ QA by supplier	E	5	25	▪ Internal valve unaffected by fly rock.
		e. Valve damaged by flying rock.	▪ Loss of load	C	5	22		D	5	24	
7	Headboard under load	a. Timber cracks and breaks before design level of load is achieved	▪ Support loses load	D	1	7	▪ Design strength is excessive	E	1	11	
		b. Headboard Timber fails due to seating on sharp or uneven level	▪ Support loses load	C	1	4	▪ Design strength is excessive ▪ Extensive tests performed on headboard by CSIR	E	1	11	

Appendix B - Failure Mode and Effect Analysis

	COMPONENT	FAILURE MODE	CONSEQUENCE / EFFECT	SAFEGUARDS / CONTROLS	RECOMMENDED CONTROLS
1	Timber mats, 70mm by 350mm by 450mm (made up of five pieces of 70mm by 70mm by 450mm timber.)	Timber rots, swells, warps	Headboard potentially unusable	<ul style="list-style-type: none"> ▪ Selection of suitable timber during the manufacturing process 	<ul style="list-style-type: none"> ▪
2	Connecting wire threaded through holes in the timber to form the "mat".	Wire breaks	Some timber pieces may fall out before installation. Mat is attached to the steel headboard assemblies by bolts	<ul style="list-style-type: none"> ▪ Replace defective headboard assemblies 	<ul style="list-style-type: none"> ▪
3	Universal steel headboard.	Steel failure - prop punches up through the steel plate	Bearing surface is reduced	<ul style="list-style-type: none"> ▪ QA by supplier ▪ Steel specially selected: 	<ul style="list-style-type: none"> ▪
		Steel corrodes	Reduced strength - prop punches up through the steel plate	<ul style="list-style-type: none"> ▪ Steel plates are painted to resist corrosion 	<ul style="list-style-type: none"> ▪
4	One set of springs (used for gripping the prop to prevent the headboard from falling off during the installation process)	Springs come loose	Headboard fails to grip the prop	<ul style="list-style-type: none"> ▪ QA by supplier - springs assist the installer to erect the prop without the headboard sliding off ▪ Installation can continue without springs, but headboard must be held in place manually during the installation process 	<ul style="list-style-type: none"> ▪
		Springs break	Headboard fails to grip the prop	<ul style="list-style-type: none"> ▪ see above 	<ul style="list-style-type: none"> ▪
5	Jackpot welded to angle iron brackets	Failure of weld between jackpot and bracket	Second bracket will maintain integrity of headboard during installation	<ul style="list-style-type: none"> ▪ Check material batch chemical analysis certificates ▪ Quality Acceptance testing on all material and components ▪ Air pressure testing of all completed units ▪ High Pressure test of 1% of completed units 	<ul style="list-style-type: none"> ▪
		Failure of valve on jackpot	Loss of load	<ul style="list-style-type: none"> ▪ Procedures for pre use inspection of valve 	<ul style="list-style-type: none"> ▪