JOB MOTIVATION AND SAFE OPERATIONS IN CYLINDER FILLING STATIONS

AIGA 007/04

Asia Industrial Gases Association

3 HarbourFront Place, #09-04 HarbourFront Tower 2, Singapore 099254
Tel : +65 62760160 Fax : +65 62749379
Internet : http://www.asiaiga.org

JOB MOTIVATION AND SAFE OPERATIONS IN CYLINDER FILLING STATIONS

KEYWORDS

- AUDIT
- BUNDLE
- CRYOGENIC
- CYLINDER
- FORKLIFT
- HAZARD
- HOSE
- INSPECTION
- PREVENTION
- SAFETY
- TRAINING
- VALVE
- WORK PERMIT

Disclaimer

ASIA INDUSTRIAL GASES ASSOCIATION
3 HarbourFront Place, #09-04 HarbourFront Tower 2, Singapore 099254
Tel: +65 62760160 Fax: +65 62749379
Internet: http://www.asiaiga.org

Acknowledgement

This document is adopted from the European Industrial Gases Association, IGC Doc 02/03/ E: Job Motivation and Safe Operations in Cylinder Filling Stations. Acknowledgement and thanks are hereby given to EIGA for permission granted for the use of their document.

Table of Contents

1 Introduction 1

2 Scope and purpose 1

2.1 Scope 1
2.2 Purpose 2

Appendix A: Summary of accidents reported by EIGA members over the period 1985 - 1989 3

PART 1 6

1 Motivation 6

1.1 Introduction 6
1.2 Theory 6
1.3 Motivation by recognition 7
1.3.1 Recognition 7
1.3.2 Status 7
1.3.3 Rewarding (Highlighting good performer) 8
1.4 Motivation by job enrichment 8
1.4.1 Job rotation 8
1.4.2 Increasing responsibility 9
1.5 Summary 10
1.6 Motivation aids 10
1.6.1 Safety committee 10
1.6.2 Safety representatives 10
1.6.3 Statistics/Reports/Analyses of incidents 10
1.6.4 Safety promotion 11
1.6.5 Safety posters 11
1.6.6 Safety literature (leaflets, pamphlets, brochures…) 11
1.6.7 Audio-visual safety materials (films, videos, photographs…) 11
1.6.8 Safety mentors 11
1.6.9 Sharing experience 12
1.6.10 Family targeting 12
1.6.11 Secondment 12
1.6.12 Medical support 13
1.7 Bibliography 13

Appendix B: Examples of pictures showing dangerous situations 14

PART 2 17

2 Safe operation in filling stations 17

2.1 Introduction 17
2.2 General safety recommendations 17
2.2.1 Recommendations for management 17
2.2.2 Recommendations for personnel 18
2.3 Loading/Unloading – Internal transport 18
2.3.1 General 18
2.3.2 Possible activities 19
2.3.3 Potential hazards 19
2.3.4 Personal consequences 19
2.3.5 Causes 19
2.3.6 Recommendations 20
2.4 Sorting of cylinders 20
2.4.1 General 20
2.4.2 Possible activities 21
2.4.3 Potential hazards 21
2.4.4 Personal consequences 21

2.4.5 Causes 21
2.4.6 Recommendations 21
2.5 Filling gaseous product 22
2.5.1 General 22
2.5.2 Possible activities 23
2.5.3 Potential hazards 23
2.5.4 Personal consequences 24
2.5.5 Causes 24
2.5.6 Recommendations 25
2.6 Cylinder maintenance and testing 25
2.6.1 General 25
2.6.2 Possible activities 25
2.6.3 Potential hazards 25
2.6.4 Personal consequences 26
2.6.5 Causes 26
2.6.6 Recommendations 26
2.7 Handling liquid cylinder 26
2.7.1 General 26
2.7.2 Possible activities 27
2.7.3 Potential hazards 27
2.7.4 Personal consequences 27
2.7.5 Causes 27
2.7.6 Recommendations 27

Appendix C: Examples of activities with connected hazards, possible consequences, causes and recommendations 28

1 Introduction

We live and work in a period of important changes to our society. High demands are placed on industry to achieve acceptable standards of safety, environmental protection and pollution control.

"Safety First" is the common philosophy among all the major gas producers. They all have well-established safety procedures which outline safe working arrangements. Protective clothing is provided to all employees who require it, to ensure they are safe at work. Safety guidelines are issued to increase safety awareness among the whole work force. Management and safety representatives are highly committed to the achievement of safe operational practices.

Generally, engineering and organizational improvements have led to a situation where accidents at work, due to technical failures, are greatly reduced. As a result of this achievement the number of accidents caused by human error appears even more evident. People at work have generally an optimistic view on the chances of suffering an accident. Despite all the accidents that occur, someone who has never had one believes - or hopes - that the possibility of it happening to him/her is very small.

This attitude of mind, matched with the nature of the work in cylinder filling stations, which is primarily routine, uninteresting and low skilled, creates barriers which are an obstacle to improved safety performance. According to IGC statistics, about 30 % of all reported lost time accidents take place in cylinder filling stations. The key to reducing the number of these accidents is by influencing human behaviour and discovering ways and means of getting people at work more interested in, and motivated towards, their work environment and tasks.

The difficulties of obtaining and maintaining commitment, motivation, interest and participation by employees at every level, to ensure continual safe working habits, for the well being of themselves and their colleagues is the longstanding and critical problem.

This document attempts to make a contribution towards its solution. In doing so, it not only provides information on technical and procedural matters within a cylinder filling station, but offers as well a practical guide to motivation.

2 Scope and purpose

2.1 Scope

This document is limited to work activities performed within a compressed gas filling station for air derivative gases. Technical aspects on the filling of special gases, carbon dioxide, acetylene, hydrogen, LPG and their mixtures are excluded. It is obvious that the general safety and motivation considerations apply also to these other gases. Also excluded is the movement of cylinders outside the plant for customer deliveries and work associated with liquid road tankers, i.e. the transfer of liquid product from tankers into storage vessels.

A summary of these accidents over a five-year period (1985-1989) reported by EIGA members (see Appendix A) highlights the following characteristics:

- The low skill and repetitive nature of the tasks performed,
- Little or no initiative required by the operator,
- Failure by the operator to comply with known working instructions,
- Low operator qualifications and inadequate job training,
- Minimal opportunity for job or skill development,
- Occasional difficult working conditions.

These characteristics describe work activities that are essentially routine, low skilled, specified and uninteresting, but demand critical attention to detailed work instructions and safety precautions, in order that serious incidents resulting in damage to people or equipment are avoided.

2.2 Purpose

The key task facing the managers/supervisors, to whom this document is mainly addressed, is how to motivate and interest the operators who perform these activities so as to ensure a safe and effective working environment. A combination of the managers' /supervisors' motivational skills matched with a re-emphasis of the operators' job knowledge should assist the aim of improving the sense of work fulfilment.

Consequently the document is divided into two parts, the first dealing with motivational aspects, and the second with technical and procedural aspects.

It is not intended to provide either a code of practice, technical guidelines or a summary for safe operation but to point out potential hazards and give recommendations. The systematic listing of facts based on the accident analyses should be a help to managers/ supervisors in improving the awareness of employees to potential hazards.

Managers/Supervisors may choose appropriate cases and adopt their own approach with the prime objective of reducing the number of accidents depending upon their own equipment, procedures and policies.

Appendix A: Summary of accidents reported by EIGA members over the period 1985 - 1989

Activity	What Happened	Number of accidents/incidents
Loading/Unloading		
Pallets	- Pallet fell from FLT[1]	2
	- Accident at works with the truck crane	6
	- Accident caused by the side board of the truck	3
	- Cylinder slipped from pallet	2
	- Pallet strapped to truck/other pallet	2
	- Pallet caught whilst being removed	16
Bundles	- Accident during bundle movement	1
	- Falling bundle	1
Cylinders	- Strained band/back etc	2
	- Injury of finger/band/foot	5
	- Cylinder fell due to bad floor condition	6
	- Loose protection cap	5
Miscellaneous	- Driver fell by climbing in/out truck	11
	- Driver hit the truck	3
	- Driver fell between truck and dock	1
	- FLT pulled over	3
	- Truck hit a worker	1
	- Trailer ran away	1
	Total	**71**
Internal transport	- FLT hit person	13
	- FLT collided with car	1
	- FLT hit cylinder/pallet	4
	- FLT hit building	1
	- FLT tipped over	2
	- Driver fell by getting in/out FLT	2
	- FLT hit objects left on floor	2
	- Operator hit himself/herself when handling with PFLT[2]	10
	- Cylinders fell when handling with PFLT	3
	- Incorrect operation with PFLT	1
	- Pallet fell from FLT due to uneven surface	5
	- Cylinder fell from pallet whilst being moved by FLT	3
	- Defect in hydraulics/mechanics	2
	Total	**55**

[1] FLT = Fork Lift Truck
[2] PFLT = Pedestrian Fork Lift truck

Activity	What Happened	Number of accidents/incidents
Sorting		
Handling pallets	- Cylinder tilted and injured finger/arm/leg etc	42
	- Bar/ramp fell	18
	- Wrong body position/strained hand/back/ankle	21
	- Cylinder slipped out of pallet	10
	- Strap broke	1
Miscellaneous	- Cylinder slipped away whilst rolling	17
	- Cylinder fell and hit person	19
	- Cylinder fell due to bad floor condition	5
	- Fingers caught between cylinders	7
	- Valve opened whilst removing cap/rolling	2
	- Strained back when lifting cylinders	2
	Total	**144**
Filling		
Cylinders	- Burns with O2	9
	- Burst pressure gauges	1
	- Accidents due to jammed caps	3
	- Broken hoses	10
	- Broken fittings	7
	- Broken valves	7
	- Accidents when connecting/disconnecting from rack/due to falling cylinders	6
	- Person fell during filling	7
	- Other cylinder handling	3
	- Wrong filling pressure	4
Bundles	Burns with O2	1
	Burst hoses/pipes	7
	Total	**65**
Maintenance/testing	- Worker hit his/her hand with the hammer	17
	- Cylinder fell	12
	- Cylinder tilted when opening the valve	4
	- Cylinder de-valved under pressure	3
	- Accident at works with the equipment of the repair/testing shop (turn-over device, clamping device, stamping gun)	10
	- Wrong body position	2
	- Cylinder burned during inspection	4
	- Cylinder burned	2
	- Valve burned during test	2
	- Accidents at works with hand tools	3
	- Wrench slipped	2
	- Accidents when repairing pallets	3
	- Miscellaneous	6
	Total	**70**

Activity	What Happened	Number of accidents/incidents
Miscellaneous	- Repair of filling pump	1
	- Repair of valve panel	1
	- Broken coupling nut	3
	- Open hole in ground	3
	- Bad floor condition	2
	- Person fell	2
	- Contamination	4
	- Poisoning	1
	- Hole/crack in cylinder	4
	Total	**21**
Total number of reported accidents		**426**

PART 1

1 Motivation

1.1 Introduction

This part of the document deals with the motivational aspects of safety within a compressed gas filling station. It summarises the various theories of motivation and suggests methods for practical implementation. It is important to point out however, that following the guidelines suggested in this section on their own is not the total solution, as they must be supported by management commitment at every level to promote a safe working environment.

The achievement of good safety standards requires leadership from the top executives of an organisation. Complete and unswerving support from senior management is essential and this can be one of the greatest motivators. Policy statements on their own are no substitute for effective action. Subordinates will not implement such statements unless they are confident that the action required has the full support of higher management. Even when senior management gives this type of policy statement their full support, problems can still occur when local management dilute the policy for the benefit of alternative gains.

Supervisors are the first level in the management of people at work and should therefore have a very important influence on the safety motivation of the work group they are responsible for. Their leadership will develop good attitudes on safe working practices, which can then be supported by other aids to ensure continued safety motivation by everyone.

1.2 Theory

The current working theory behind motivation is an amalgamation of various ideas put forward over the years by Maslow, Taylor, Mayo, McGregor, Herzberg, etc. (see 1.7). Perhaps the best known of these is attributed to Frederick Herzberg and his Motivation-Hygiene Theory, which identifies two separate sets of factors associated with the working environment.

A key distinction between the motivators and the hygiene factors is that motivators lead to positive job satisfaction, whereas the hygiene factors only serve to prevent job dissatisfaction. Motivators could be: achievement, recognition, the work itself, responsibility, advancement; the hygiene factors include company policy, administration, supervision, working conditions, salary, status etc.

Herzberg's theory has been criticised on the ground of representing a gross over simplification of the true situation, although its simplicity and ease of understanding has lead to its general adoption. However despite this, motivation by coercion (sometimes known as KIP or kick in the pants) is widespread and unfortunately regarded by some managers as the solution to motivation.

Many supervisors and managers still believe that motivation is achieved by providing outside stimulation either in the form of a penalty or incentive. This forces the employee to take action, but it does not provide the in-built generator to make a person want to do it. True motivation is when an individual wants to do something without outside stimulation.

A review of some key personnel practices that were developed to instil motivation along these lines highlights the weakness of this approach.

- Reducing the time spent at work - the fact is that most motivated people seek more hours at work not fewer.
- Spiralling wages - they seem only to provide a motivation for people to seek the next wage increase.
- Fringe benefits - no longer rewards, but seen as basic employee rights.

- Human relations training - 30 years of psychological approaches to handling people have led to the same end question "How do you motivate workers?".

The failure of these practices has lead to the conclusion that there are better ways available for supervisors to involve and motivate the employees for whom they are responsible. These can be separated into two main areas, motivation by recognition and motivation by job enrichment. These are comparable to Herzberg's list of motivating factors that lead to job satisfaction, i.e. achievement, advancement, work itself, recognition, responsibility and growth.

1.3 Motivation by recognition

Maslow stated in his motivation theory that man is motivated by his needs as he sees them; he classified these needs into five levels of importance, ranging from the base physiological need through to the self-fulfilment need. A summary of these five needs is given below:

- Physiological needs - requirement for food, rest, exercise and shelter.
- Safety needs - the need for protection against danger, threat and deprivation.
- Social needs - the need for belonging, for association, for acceptance.
- Ego needs - the need for self-confidence, for independence, for achievement, the need for status, for recognition.
- Self-fulfilment needs - the need to realize one's own potentialities, to experience continued self-development, to be creative.

The authors of this document believe that the majority of cylinders filling operators perceive that the base physiological, safety and social needs are satisfied during their normal work. Hence the higher Ego need plays a major role in their motivation. Therefore, it is important that attention is given to this Ego need. Ways of meeting this are detailed in the following sections under two main headings of recognition and status.

1.3.1 Recognition

For an employee, gaining recognition means among other things that superiors listen to his/her suggestions. Irrespective of the work entrusted to him/her, an employee is usually capable of highlighting potential hazards or suggesting improvements.

However, if no suitable worker relationship exists he/she may not express his/her ideas (as he/she may have been taught only to obey orders) or he/she may lack confidence if the manager has previously dismissed suggestions without suitable explanation. He/she may also be incapable of expressing them correctly due to a lack of education. Therefore, it is essential that management should develop and foster a suitable relationship by:

- Inviting suggestions
- Helping the employee to express his/her suggestions,
- Always providing the employee with feedback about his/her suggestions,
- Explaining why they cannot be implemented,
- Thanking the employee for his/her contribution,
- Acknowledging his/her presence.

This interaction will be more effective at the employee's workplace as he/she will be more at ease communicating in his/her own environment. Such behaviour from his/her superiors will induce in the employee's mind:

- The satisfaction of being listened to and appreciated,
- A desire for this experience to be repeated,
- A greater interest for his/her work.

1.3.2 Status

In this case, too, the manager plays a major role. This role consists of explaining to each and every employee during face to face informal conversations (at the workplace not in the office) that:

- The work done, even the least important one, plays a major role in the overall scheme of things.
- Even a small mistake or carelessness on his/her part can have serious consequences later.

It is essential that each employee understand the importance of the link he/she represents in the context of the whole chain.

The manager at the workplace of the employee should stress this point periodically. In general this is the only environment in which he/she feels at home, relaxed and capable of listening to his/her superiors and expressing his/her views to them.

1.3.3 Rewarding (Highlighting good performer)

Non-monetary aspects:

By rewarding a good worker or group or a whole plant, the management recognizes and acknowledges publicly that their contribution to the company's operation has been outstanding or exceptional. This recognition can be expressed in many ways:

- Awarding a certificate or plaque,
- Recognition by external awards e.g. AIGA Safety Award,
- Distribution of an internal letter,
- Speech by the manager,
- Invitation to a function (e.g. Dinner).

A key factor in this approach is to make the recipient feel proud, and be seen to be granted status in front of his/her peer group. A worker or group receiving such recognition before their colleagues will feel obliged to continue to work well and set an example to the others. This will also induce other to do likewise.

Monetary aspects:

Unlike those holding jobs with high responsibility, the majority of manual workers in the gas industry are characterised by:

- Performing jobs which are more or less identical,
- Being able to distinguish which of their colleagues are good or bad workers,
- Knowing each other’s salary.

If the most efficient employee is not rewarded in any way, to him/her, it means that his/her work and the way he/she does it is not important. He/she will then feel neglected and take little interest in his/her work, and this situation must be treated with care.

1.4 Motivation by job enrichment

Job enrichment should not be confused with job enlargement which just makes the job structurally bigger, e.g. employee challenged by increasing the amount of production required from 200 cylinders filled each shift to 300 each shift. Job enrichment not only strives for structural changes but also aims to provide the opportunity for employee's personal growth. The key points in providing job enrichment are explained in 1.4.1 and 1.4.2.

1.4.1 Job rotation

Much of the work within filling stations involves simple, repetitive and dull actions; introducing a rotation programme can help give job enrichment:

- Changing the employee's work regularly e.g. driving a FLT, filling
- Cylinders, maintenance,
- Giving appropriate training,
- Explaining the reasons behind job rotation.

Implementing job rotation may:

- Produce an initial hostile reaction (resistance to change) from the employees, especially the older workers,
- Require more vigilance during its introduction to maintain safety standards,
- Cause a lowering of productivity in the beginning,
- Place an increased demand upon training resources.

Depending upon local conditions or workers' capability job rotation is not always feasible.

These drawbacks vanish after a while as job rotation generally:

- Creates a greater interest in the employee for his/her job, he/she thus becomes more careful in his/her work,
- Revives the interest of the employee (a reaction caused by his/her new work). This new situation demands the full attention and concentration often dulled by a routine unchanged for years,
- Produces more flexible workers, i.e. those who display a greater capability for adaptation.

1.4.2 Increasing responsibility

This approach creates an interest in the employee for his/her job, which in itself is often dreary. Responsibilities may be given within the limits of existing procedures. By increasing responsibility the main role for the manager will consist of giving advice, general guidelines, controlling, etc. and not precise orders (so and so will fill x number of gas cylinders before this deadline).

Individually by giving an employee a fixed target (a certain amount of production in a set period), based on which he/she will be required to:

- Organise his/her tasks following his/her own priorities (MI a certain product line before another etc.),
- Carry out or arrange minor maintenance tasks that he/she thinks are necessary,
- Consult with his/her work colleagues (FLT, sorting etc.) to arrange a suitable schedule to carry out the required production.

Collectively by giving the whole work team (filling, sorting, FLT etc.) the responsibility of planning and executing a project following the objectives fixed by management. This will be a collective responsibility that involves deciding upon

- The sequence of operations,
- A work schedule,
- Work distribution (who does what),
- The safety measures to be adopted,
- The maintenance tasks, which need to be carried out.

This sharing of responsibilities by a group is the logical consequence of work enrichment. However, for it to work effectively it is necessary:

- To convince the employee; employees tend to avoid accepting an increase of responsibility (afraid of making a mistake, apprehensive that they will be penalized). This implies that they should not be penalized if they make an error associated with the learning process,
- That the management understands that, delegating responsibilities does not mean losing control,
- To introduce the notion of collective responsibility to supplement individual responsibility.

This situation will create in the employee a sense of belonging to a team in which:

- The others have confidence in him/her,
- He/she has an important role to play,
- He/she has some freedom and can take initiatives,
- A new type of relationship is created,

- His/her views are given due consideration,
- He/she wants to be a member.

This new situation will develop within the employee a positive attitude towards work. His/her behaviour should now display a greater awareness to the problems of safety resulting in a decrease in the number of accidents.

Job enrichment is not a one-time proposition but a continuous management function. It should be noted however, that not all jobs can or need to be enriched.

1.5 Summary

As a summary on motivation, the theory put forward by Dr. A. Maslow is used.

"Man is motivated by his own needs as he sees them".

Therefore, unless the individual can see clearly how his/her changed behaviour will result in satisfying a personal need, he/she is not likely to strive to change.

1.6 Motivation aids

This section describes various methods of increasing safety and motivation awareness at the workplace. These aids used correctly can provide valuable means of obtaining the benefit of motivation described earlier and promoting the safety message. It describes some of the possible training tools, including those which, based on the experience of the authors, are particularly good at increasing personal safety awareness and should be used in conjunction with the classical methods.

1.6.1 Safety committee

Based at plant level these committees, made up of management and employee representatives, make an important contribution to site attitudes, promoting a safe working environment and developing safety policies. They are most successful when individual members are fully committed to good safety philosophy, and as key members of their work team are able to influence group behaviour towards safe working habits.

The development of communication, presentation and influencing skills will need to be supported by suitable training and the provision of time for necessary work group consultation.

1.6.2 Safety representatives

Individuals may be elected or appointed to this representative role, which has the responsibility, alongside management, of ensuring that safety standards and procedures are adhered to.

Representatives can act as the spokesperson for work groups to ensure that safety issues are brought to the attention of local site management. They also make sure that procedures, instructions and policies are fully communicated and understood by every member of the work team they represent.

Experience has shown that careful use of knowledgeable safety representatives greatly helps the development of positive attitudes towards a safe working environment.

1.6.3 Statistics/Reports/Analyses of incidents

Example: Number of days without accidents, number of accidents, frequency rate, etc.

These methods are very efficient under certain conditions:

- Statistics (curves, ratios, etc.) must be easy to understand and explained to the personnel. Generally a single ratio will do it.
- Statistical results should be displayed in a prominent position to give maximum impact.

- Statistics must be kept up to date. Such signs lose all credibility if they don't reflect the current situation.
- They should be updated based on information supplied by the management.
- Displaying incident/accident reports is also useful. However:
  - The report must be simple (a few lines at most) if it is to be read. It must specify the influence of the accident on the statistics, which are, displayed elsewhere, the main causes, main consequences and recommendations to avoid repetition.
  - The name of the person involved should be used with caution to avoid unnecessary public criticism.

1.6.4 Safety promotion

This is essential, in order to raise awareness, and is a continuous process that should employ all the tools available to modern advertising, in order to convince the employee that all accidents are preventable. Objects like pens, markers, cups from coffee and soft-drink machines, notepads, etc. could be used.

1.6.5 Safety posters

The use of safety posters is an old, traditional method, but one which is generally considered to play an important role. However, if these posters are to have sufficient impact, it is necessary:

- To replace them frequently,
- To change their position regularly.

Experience shows that when posters are not renewed and moved around often, they are quickly taken for granted, and their message is not conveyed.

1.6.6 Safety literature (leaflets, pamphlets, brochures…)

These should be:

- Eye-catching,
- Brief and easy to understand,
- Distributed with some ceremony. Personnel will pay little attention to documents, which are distributed rapidly like advertising brochures.

However, personnel will be tempted to look through them if they are distributed by the management with a few words of comment, or even questions on the contents of previously distributed documents.

1.6.7 Audio-visual safety materials (films, videos, photographs…)

These can be used to show typical situations in which accidents can happen. These photographs will show one or more faults that the employees should discuss and comment in a group meeting run by the management.

Obviously, these scenes must be similar to those which employees see every day on the job.
Examples are given in Appendix B.

One particularly efficient version of this technique consists of photographing real situations observed on the job (Example: Use of a damaged ladder, untidy and therefore dangerous work zone, etc.) When the group examines these photos, employees will find situations that they hadn't even noticed in real life as dangerous. Furthermore, the fact that they recognize either themselves or their colleagues, and always-in familiar surroundings, has considerable impact. Photographs showing persons in unsafe situations should only be used with the agreement of the persons involved.

1.6.8 Safety mentors

This technique consists of matching each new employee with a senior employee who is already well acquainted with the safety problem, and who must:

- Help the newcomer become integrated in the team,
- Draw his/her attention to potential risks,
- Teach him/her to limit the risks,
- Keep him/her from making the most common errors,
- Make him/her aware of the importance given to safety in the company.

This instruction period is undeniably effective and usually lasts for a few months.

1.6.9 Sharing experience

It can be rewarding and enriching for an employee who is the victim of an accident (or near-accident) to share the causes or errors which led to the situation with his/her colleagues. However, this technique must be used prudently. The idea is not to ask each accident victim to make a public confession but to make a contribution to the common goal of reducing accidents by sharing his/her experiences.

Management should emphasize the positive aspects of the talk.

At an advanced phase, this sharing of experience should take place spontaneously among the personnel with no management initiative.

1.6.10 Family targeting

Involving the family and getting the children interested can be an important initiative. This technique makes it possible to increase individual awareness of safety problems outside the workplace. Furthermore, the fact that persons other than management or colleagues mention the safety aspect of the job has considerable impact.

Several supports may be used:

- Soft toys
- Posters
- Colouring/Puzzle books
- Games
- Place mats, etc.

A recurring theme or character can also be created and used on all items. It can be used to raise all aspects of safety in a fun way. The smaller items can be given away and the most expensive articles will be used as prizes. These prizes will be given for various competitions, which are open to all employees' children, such as painting contests etc.

Another possibility is to invite the whole family to attend a meeting or a group weekend outing to celebrate reaching some exceptional safety goal: A year with no accidents for a team, 15 years with no accidents for an individual etc.

1.6.11 Secondment

A technique, which can be used by companies, which have several branches with, a similar activity (e.g. filling stations) is to second employees from locations with a bad safety performance to locations with an outstanding safety record. These employees, moved to a different site where they carry out the same activities, will be able to see how behaviour, relationships etc. make it possible to do the same job more safely.

Such an operation must obviously be well-prepared. Seconded personnel must be volunteers, and they must be welcomed and guided in their new job. Upon their return to their original branch, they will be asked to discuss with their colleagues what they saw and learned elsewhere. The persons seconded must be recognized by their colleagues as competent and credible and have the confidence of the management.

Experience has shown that the results of this technique are worth the time and money it takes.

1.6.12 Medical support

The expert view of a doctor, his/her objective stance regarding the company and his/her wide experience of other companies, always make his/her ideas and suggestions a useful influence on employees' opinions. He/she could host a meeting of employees and explain to them, using drawings and photographs, the immediate or long-term consequences coming from exposures to unsafe practices (absence of hearing and eye protection etc.). The doctor could also describe the most serious possible effects of even the most minor accidents or incidents.

1.7 Bibliography

- MASLOW, A.H. A theory of human motivation, Psychological review, Vol 50, No 4, 1943
- MASLOW, A.H. Motivation & personality, Harper & Row, 2nd ed., 1970
- HERZBERG, F. Work & The nature of man, Staples press, New York, 1966
- HERZBERG, F. One more time: How do you motivate employees? Harvard Business Review, Vol 46, No 1 pp53-62, 1962
- TAYLOR, F. W. Principles & Methods of scientific management, Harper, New York, 1941
- TAYLOR, F.W. Scientific management, Reprinted Harper & Bros, New York, 1947
- MCGREGOR, D. The human side of enterprise, McGraw-Hill, 1960
- MCGREGOR, D. The professional manager, McGraw-Hill, 1967
- MAYO, G. E. The social problems of an industrial civilization, Harvard Business School, 1945
- MAYO, G.E. The human problems of an industrial civilization, 1933
- EIGA: IGC-Document 23/00 Safety training of employees
  (AIGA 009/04: Safety training of employees)
- EIGA: IGC-Document 32/87 Safety: Motivation and Training (Symposium)

Appendix B: Examples of pictures showing dangerous situations

	Hazard of hand injury

	Driver jumps out of truck cabin

	FLT hits free standing cylinders

	FLT hits a person

	Operator knocks over free standing cylinder

PART 2

2 Safe operation in filling stations

2.1 Introduction

This part of the document covers in brief the possible activities in a filling station highlighting hazards and their causes and also gives safety recommendations.

The following types of activities have been considered

- Loading/Unloading - Internal transport
- Sorting of cylinders
- Filling gaseous product
- Cylinder maintenance and testing
- Handling liquid cylinders

All these sections are set up in the same way:

- General
- Main components used in daily operation
- Possible activities
- Potential hazards
- Personal consequences
- Causes
- Recommendations

Only the main components are listed and explanations given, when their use is not obvious.

The filling of road tankers/cryogenic vessels is not dealt with in this document.

The reader has to extract from every section the appropriate items corresponding to his/her equipment (e.g. falling ramps and bars are irrelevant for plants using pallets not equipped with these parts). It is self-evident that activities, hazards and possible consequences are interdependent. Examples of such cross-references are given in the Appendix C.

The aim of this part of the document is to give the reader key-words to assist the implementation of measures to improve safety in his/her working area. Due to the general availability of extensive technical guidelines, it is not intended to include in the document procedures for safe operation.

2.2 General safety recommendations

2.2.1 Recommendations for management

- Written work and emergency procedures shall be available and enforced.
- These procedures shall be updated regularly and safe systems of work developed.
- Responsibilities of persons/departments should be clearly stated.
- All personnel shall be instructed and trained for their job; information on possible hazards shall be given.
- Instruction and training should be periodically repeated.
- An emergency plan shall be initiated, updated regularly and practised.
- Special instruction and training should be devoted to the emergency plan.
- A Work Permit System shall be introduced.
- Regular safety checks and audits of equipment and location should be undertaken and recorded .

- Accidents/incidents/near-misses should be recorded, investigated and measures taken to prevent recurrence.

2.2.2 Recommendations for personnel

- It is the responsibility of every employee to know and adhere to the safety rules and regulations; everybody is responsible for each other's safety. Their colleagues should reprove operators not complying with safety rules.
- All injuries shall be reported to the supervisor as soon as practical; even minor wounds shall be given first aid to avoid risk of infection.
- Unsafe conditions, faulty equipment and near misses shall be reported to the supervisor at once.
- The protective clothing and equipment required shall be worn (e.g. safety shoes, gloves, goggles, hearing protection etc.).
- Installations/tools shall only be used for the purpose they are intended.
- Only authorized personnel shall operate machinery or equipment.
- Installations/tools shall be kept in good condition.
- Worn or damaged tools should not be used. They should be given to the supervisor who will have them repaired or scrapped.
- Only authorised personnel are allowed to repair installations/tools.
- Unauthorised modifications to plant or equipment shall not be carried out. The appropriate level of management shall approve any changes.
- Guards, safety valves and other protective devices are provided for protection. They shall not be removed or tampered with.
- Good housekeeping should be a general practice.
- Walkways, aisles, exits and working areas shall be kept free.
- Unauthorised persons shall not remove tags used to identify equipment in a dangerous condition.
- The location and use of emergency equipment shall be learnt.
- All fire and safety equipment shall be kept clear of obstructions. The equipment should not be removed or used except in an actual emergency or an authorised practice.
- Employees shall learn how to react in emergency.

2.3 Loading/Unloading – Internal transport

2.3.1 General

This section covers the unloading and loading of pallets, bundles and single cylinders/liquid cylinders to/from transport vehicles and their transport to different areas - sorting, filling, storage, maintenance within the filling plant.

Main components used in daily operation:

- Fork lift truck with on-board driver (FLT), most commonly used with specially designed pallets or bundles,
- Pedestrian fork lift truck (PFLT), generally with electrical drive; operator walks with the truck and guides direction with a tiller,
- Hand pallet truck,
- Crane
- The crane could be overhead, mobile, gantry or mounted on the transport vehicle,
- Manual movement involves the movement of single cylinders by hand; in support of this activity a trolley is sometimes used to move one or two cylinders over a short distance,
- Elevating platform,
- Conveyor,
- Automatic guided vehicle (AGV).

Conveyors and AGVs are intended for an automatic transport within the plant. Currently the use of this type of equipment is rare, and therefore it has been omitted from the document.

2.3.2 Possible activities

Fork Lift Truck

- Pick-up or set-down the load - pallet, bundle or liquid cylinder
- Manoeuvre/drive loaded/unloaded FLT,
- Raise and lower forks,
- Enter and exit from cab.

Pedestrian Fork Lift Truck/hand pallet truck

- Similar activities as FLT except for exit and entry to cab.

Crane

- Pick-up and set-down load,
- Manoeuvring loaded/unloaded crane.

Manual

- Lift and set-down single cylinder,
- Roll cylinder,
- Load/unload trolley,
- Manoeuvre trolley.

2.3.3 Potential hazards

- FLT/PFLT strikes object (e.g. building, truck, cylinder) or person,
- FLT/PFLT rolls over,
- FLT driver falls from cab or moves awkwardly during entry or exit,
- PFLT driver strikes himself/herself with vehicle,
- Pallets, bundles fall from forks, vehicles,
- Release of cylinder from pallet,
- Falling cylinders,
- Overloading of FLT/PFLT,
- The load falls from crane hook,
- Hanging load strikes object/person,
- Truck moves whilst FLT is unloading/loading pallet.

2.3.4 Personal consequences

- Broken/crushed hand, arm, foot, leg,
- Head injuries,
- Internal injuries,
- Cuts, abrasions, lacerations.

2.3.5 Causes

- Bad driving technique,
- Over speeding,
- Incorrect positioning of pallet/bundle on fork,
- Pallet in poor condition,
- Poor condition of lifting equipment e.g. deformed forks,
- Lack of visibility due to FLT design,
- Poor housekeeping,
- Uneven ground,
- Lack of space,
- Lack of route marking/separation of pedestrian routes from traffic routes,
- Poor maintenance,
- Lack of training,

- Misuse of equipment,
- Incorrect manual handling techniques,
- Uneven cylinder base,
- People standing to close to lifting/transport equipment.

2.3.6 Recommendations

- Good FLT operator visibility shall be ensured e.g. by using FLTs with higher seats and lower masts.
- For good visibility the operator of a loaded PFLT should steer by pulling instead of pushing.
- Rubber sideguards should be fitted to PFLT.
- FLT/PFLT drivers shall be fully trained and regularly assessed; authorised drivers shall only drive the trucks.
- Proper and regular maintenance of FLT/PFLT, lifting equipment, pallets, cylinders shall be carried out, faulty equipment should be reported immediately.
- Traffic and pedestrian routes should be separated.
- Hoist shall not be used on uneven ground.
- FLTs should be driven at low speed.
- Forks should be fully engaged and load stabilised before moving.
- The load shall not be raised or lowered while moving.
- Particular attention should be paid when approaching corners, intersections and doorways.
- FLT forks should not be longer than required for the load to be lifted.
- Sufficient space for FLT/PFLT manoeuvring should be provided.
- Floors should be kept in good condition, also ice-free.
- Operators should be trained on manual single cylinder lifting and moving techniques.
- Safe system of work shall be developed and complied with.
- FLTs should be equipped with audible or visual devices to warn of approach.

2.4 Sorting of cylinders

2.4.1 General

The sorting of cylinders normally takes place once the cylinders have been unloaded from the cylinder vehicles in the case of palletised distribution or during the unloading/loading for non-palletised operations. Incoming cylinders are generally sorted into gas type, size, filling pressure, cylinders for maintenance etc. whereas outgoing cylinders are sorted to meet customer requirements or vehicle routing.

The sorting activity is normally carried out manually by an operator handling each cylinder individually. It is during this sorting process that the pre-filling inspection takes place, and it is essential that the personnel have the necessary training and information to carry out this function. It should be noted, however, that part of the inspection may take place at the filling area, e.g. valve examination on cylinders with valve caps can only take place once the caps are removed.

Inspection involves a visual examination of every cylinder being sorted and, although the list will depend upon individual company procedures, it will as a minimum involve checks for:

- Cylinder damage,
- Date of retest,
- Valve condition/contamination,
- Identification of contents,
- External corrosion/damage.

For aspects connected with the use of transport devices within the sorting area - see 2.3 Loading/Unloading -Internal transport.

Main components used in daily operation:

- Pallets,

- Sorting platform (the ground may be used as the working area),
- Manual /mechanical transport equipment e.g. trolleys, FLTs, pedestrian FLTs, conveyors - see also 2.3 Loading/Unloading – Internal transport.

2.4.2 Possible activities

Pallets

- Release of retaining device (strap, bar, both),
- Taking cylinders out of pallet,
- Cylinder identification,
- Outer inspection,
- Manual moving (to storage area, into pallet),
- Securing in pallet (with strap, bar, both).

Single cylinders

- Identification,
- Outer inspection,
- Manual move (to storage, filling, pallet),

2.4.3 Potential hazards

- Falling cylinders,
- Cylinders striking (other cylinders, pallets, other objects/persons),
- Falling parts of pallets (bars, ramps),
- Sudden release of retaining devices (bars, straps),
- Persons hit by moving objects e.g. truck, FLT,
- Pressure release (open valve by rolling, broken valve by falling),
- Slips, trips and falls of persons.

2.4.4 Personal consequences

- Broken/crushed hand/arm/foot/leg,
- Head contusion,
- Strained back.

2.4.5 Causes

- Instability of standing cylinders,
- Damaged cylinder base,
- Uneven pallet base,
- Foreign objects in pallets,
- Damaged retaining devices (bolts, clamps, bars),
- Damaged pallet parts (ramp).
- Uneven floor,
- Cylinders hit by moving objects/persons,
- Incorrect handling techniques,
- Lack of visibility,
- Lack of space,
- Lack of route marking,
- Incorrect footwear,
- Slippery floor (ice, water, oil),
- Poor housekeeping.

Also see 2.3 Loading/Unloading - Internal transport.

2.4.6 Recommendations

- Good housekeeping (floor) should be ensured.

- The number of free standing unsecured cylinders should be minimised.
- Cylinder bases shall be checked and rejects taken to maintenance.
- Pallets shall be checked for obvious defects, retaining devices, tilted cylinders, ramps, bases.
- Operators should not try to stop falling cylinders.
- In case of defects precautionary measures shall be taken (information of supervisor).
- Defective pallets shall be taken to maintenance.
- Cylinders shall be handled carefully (special care should be taken of cylinders with concave base).
- Protection gloves/shoes shall be used.
- Large cylinders shall be rolled using correct technique and safe hand position with respect to cylinder and cap/guard design.
- When taking out cylinders it should be ensured that remaining cylinders are stable.
- If possible, cylinders should be placed directly into filling pallets/storage areas.
- Cylinders shall be checked for:
  - damage
  - paint/surface condition
  - test date
  - pressure rating
  - identification (consistent marking/stamping/colour/label/valve)

- Unknown/suspect cylinders shall be separated and special advice sought.
- For good visibility, route marking, collision avoidance - see 2.3.

2.5 Filling gaseous product

2.5.1 General

This section covers the filling of high-pressure cylinders. Compressing the products into cylinders is normally the prime operation achieved, in the majority of cases, by pumping cryogenic liquid products through vaporisers, although certain products/ operations utilise gas compressors.

The main item of equipment, used at the interface with the cylinder, is the charging rack. The product is filled into the cylinder, generally via flexible hoses, using two basic approaches:

- Pallet charging racks
  The filling hoses are grouped together so that cylinders can be connected and filled whilst remaining in their pallets. There are three main designs of this type of charging system:

  - Individual hose pull down. Each hose is capable of being pulled down independently and when not in use retracts upwards.
  - Multi hose pull down. All the hoses on a particular rack are raised and lowered together.
  - Individual hose hook up. The hoses cannot be raised or lowered, and when not in use the hoses are hooked out of the way.

- Charging manifolds
  Designed to fill single cylinders. They are normally constructed to accept a row of cylinders and vary in capacity. The position of the hoses on these manifolds is fixed and, when not in use, they are allowed to hang from the manifold.

  A variation of the above is used to fill bundles that are either filled on a dedicated manifold, designed to accept bundles, or on a conventional charging rack/manifold. On conventional rack/manifold either a couple of hoses are utilised, the rest being isolated, or a special hose is used.

Main components used in daily operation

- Hose isolation valves,
- Flexible hoses,
- Filling connectors,

- Pressure gauges.
- Scales: used instead of pressure/temperature measurement to calculate when cylinders are full.
- Walkways,
- Main process valves,
- Vacuum pumps.
- Pneumatic tools: used to open/close cylinder valve or caps.
- Hose securing system:
- Anti-whip wire on individual hoses,
- Safety guard.
- Cylinder securing device,
- Control panel: start/stop buttons for electrical ancillaries, e. g. cryogenic pumps, vaporisers, vacuum pumps etc.,
- Control instrumentation for pressure, temperature and weight indication
- Quality control equipment.

2.5.2 Possible activities

- Final positioning of cylinder, pallet or bundle,
- Securing of cylinders at manifold,
- Removal of valve protection cap,
- Final pre-fill inspection of cylinders and valves,
- Positioning and connecting of hoses,
- Opening cylinder valves,
- Positioning guards.

- Starting of filling
  This sequence will vary depending upon product filled and company procedures, but may include.
  - Venting/evacuating,
  - Hammer testing of cylinders;
  - Checking for contaminants,
  - Checking for cylinders not filling correctly e.g. uniform temperature rise,
  - Leak testing cylinder valves,
  - Determining when full by pressure and temperature or weight measurement,
  - Labelling.

- Carrying out quality control checks
  This will vary depending upon product filled and company procedure and may take place away from the filling activity.
- Removal of guards,
- Closing cylinder valves,
- Venting of high pressure lines,
- Disconnecting hose,
- Replacing cap,
- Identification marking of full cylinder,
- Removal of cylinder securing device.

2.5.3 Potential hazards

- Falling cylinder,
- Sudden release of valve protector cap,
- Sudden release of hose connector from stowed position.

- Hose failure
  - Gas release,
  - Pressure hazard,
  - Flaying hose.

- Defective/bursting cylinder
  - Gas release,
  - Pressure hazard,

  - Metal fragments/splinters.

- Valve/fitting failure
  - Gas release,
  - Pressure hazards,
  - Metal fragments/splinters.

- Cylinder overpressure

- Adiabatic compression O2 service
  - Hose fire,
  - Valve seat fire,
  - Toxic fumes from hose material e.g. PTFE.

- Contamination
  - Valve and equipment (e.g. oil, grease, particles),
  - Cylinder content (e.g. moisture, air, chemicals/wrong product by back- flow at customers).

- Incorrect connection
  - incorrect product line,
  - incorrect pressure/mix of various pressures,
  - connection of full cylinders.

- Incorrect mixtures,
- Excessive heat of compression,
- Hose disconnection whilst still pressurised,
- Removal of cylinders whilst still connected to hose,
- Falling guards,
- Material incompatibility, e.g. lubricant, elastomers.

2.5.4 Personal consequences

- Broken/crushed band, arm, foot, leg, ribs,
- Head injuries,
- Asphyxiation/intoxication,
- Cuts/abrasions/laceration,
- Cold and hot burns,
- Splinter wound,
- Eye injuries,
- Loss of hearing,
- Internal injuries

2.5.5 Causes

- Damaged hose,
- Worn fittings,

- Operator error
  - Manual systems left unattended at critical period,
  - Incorrect filling procedure,
  - Safety guards not used,
  - Personal safety equipment not worn.

- Process equipment failures, e.g. valve, pressure switch, relief valve
- Incorrect process material e.g. on oxygen system.

- Cylinders defective
  - Excessive internal corrosion,
  - Extensive external damage

2.5.6 Recommendations

- Hoses, valves and fittings etc. should be regularly inspected.
- Periodic change or hydraulic testing of hoses should be carried out.
- Pressure switches and gauges on filling systems should be regularly calibrated.
- Cylinder valves shall be visually inspected prior to connection (particular attention shall be paid to possible presence of oil or grease at oxygen cylinders).
- To minimise adiabatic compression
  - Valves shall be opened slowly,
  - Heat sinks on non metal hoses should be used,
  - Approved material, shall only be used,
  - Sufficient volume according to pump capacity shall be connected.

- Cylinders on filling manifolds shall be secured.
- Anti-whip device should be fitted to hoses.

2.6 Cylinder maintenance and testing

2.6.1 General

This section covers activities performed in maintenance shops of filling plants. The scope of work within these areas varies from company to company and even between filling plants of the same organization. Typical activities might comprise the periodic hydraulic testing of cylinders and/or small maintenance operations, e.g. renewing valves, painting etc.

Main components used in daily operation:

- Cylinder clamping/lifting device,
- Devalving/revalving device,
- Hydraulic testing machine with turn-over device,
- Drying manifold/cabin,
- Shot blasting cabinet,
- Brushing device,
- Painting cabin,
- Machine tools e.g. saw, turning lathe.

2.6.2 Possible activities

- Handling and transporting cylinders
- See 2.3 Loading/Unloading - Internal transport.
- Clamping cylinders,
- Blowing out residual gas,
- Checking possible defective valves,
- Devalving/revalving cylinders,
- Connecting/disconnecting hoses,
- Cleaning cylinders externally/internally,
- Inspection of cylinders,
- Stamping cylinders,
- Brushing cylinders,
- Painting cylinders,
- Sandblasting cylinders,
- Disassembling/mounting neck-ring/foot-ring,
- Scrapping cylinders,
- Using machine tools.

2.6.3 Potential hazards

- Falling cylinders (additionally with "domino" effect),
- Incorrect securing,

- Hose failure,
- Removing valve with cylinder under pressure,
- Cylinder contaminated with toxic/flammable gases,
- Hazards connected with portable hand tools (hammer, stamp) and the unguarded moving parts of machines, e.g. clamping device,
- Health hazards when painting/shot blasting/brushing,
- Bursting or leaking cylinder under pressure.

2.6.4 Personal consequences

- Broken/crushed hand, arm, foot, leg,
- Head injuries,
- Asphyxiation/intoxication,
- Cuts/abrasions,
- Internal injuries.

2.6.5 Causes

- Defective cylinder,
- Uneven floor,
- Poor housekeeping,
- Incorrect handling,
- Missing or inadequate safety guards,
- Equipment failure,
- Operator error,
- Defective tools
- Insufficient ventilation,
- Wrong procedure,
- Obstructed valves,
- Back-flow from customers' equipment

2.6.6 Recommendations

- Good housekeeping should be ensured.
- Number of freestanding cylinders should be minimized
- Standing cylinders should be secured against falling.
- Hoses, valves etc. should be regularly inspected.
- Anti-whip device should be fitted to hoses.
- Protective equipment shall be used.
- Suspect valves shall be checked for obstructions.
- Only the correct type of valve/sealing material shall be fitted to any, cylinder.
- The recommended torque shall not be exceeded when valving
- Machine tools should be regularly inspected and serviced.

2.7 Handling liquid cylinder

2.7.1 General

This section deals with the handling of cryogenic gases in liquid cylinders. The filling of these cylinders can be achieved either by using a pump or utilising the pressure of -the cryogenic storage tank. The correct volume is determined using weight scales or the liquid level trycock.

Main components used in daily operation

- Liquid cylinder comprised of an inner vessel encased within an outer vessel; the insulation system may consist of multiple layer insulation and vacuum. A pressure-built-up-system could be integrated.
- Trolley used for the manual movement of the cylinder,
- Scale used to weigh cylinders within the filling process,

- Flexible hoses to connect the cylinder to the filling system,
- Control panel for the control of the filling process; could be manual or automatic.

2.7.2 Possible activities

- Cylinder transport to filling area/scale,
- Product identification, pre-fill inspection (condition of vessel, valves, gauges, state - warm/cold -, weight),
- Positioning and connecting of hose,
- Filling /leak testing,
- Disconnecting,
- Final check.

2.7.3 Potential hazards

- Wrong identification,
- Boiling/flashing liquid,
- Hose failure,
- Defective/bursting cylinder,
- Failure of valve/gauges,
- Overfilling,
- Falling cylinder,
- Contamination,
- Oxygen enrichment/deficiency,
- Incorrect venting, - Incorrect connection, - Material incompatibility (temperature, O2)

2.7.4 Personal consequences

- Broken/crushed hand, arm, foot, leg, ribs,
- Head/eye injuries,
- Asphyxiation,
- Internal injuries,
- Cuts, abrasions, lacerations,
- Cold burns.

2.7.5 Causes

- Damaged hoses,
- Worn fittings,
- Operator error,
- Insufficient ventilation,
- Incorrect filling procedure,
- Safety equipment not worn,
- Not recognizing cylinder in warm condition,
- Process equipment failure,
- Incorrect process material,
- Defective cylinders.

2.7.6 Recommendations

- Hoses, valves, fittings etc. should be regularly inspected.
- Anti-whip devices should be fitted to hoses.
- Appropriate trolleys should be used.
- Liquid cylinders shall be stored and operated in vertical position.
- Check for gas leaks shall be carried out.
- Appropriate venting and ventilation shall be ensured.
- Only approved material shall be used.
- Protective equipment shall be worn.
- Frozen valves shall not be operated; they should be defrosted first e.g. with warm air.

Direct flame or electrical heating devices shall not be used to raise the pressure.

Appendix C: Examples of activities with connected hazards, possible consequences, causes and recommendations

Activity	Hazards	Possible Consequences	Causes	Recommendations
Driving FLT	Collision with person/objects	- Severe injuries - Material damage	- Lack of visibility - Lack of space - Inadequate training - Lack of route marking	- Use improved FLT with higher seats - Good housekeeping - Maintain drive training - Provide route marking - Separate FLT and pedestrian routes
Driving pedestrian FLT (PFLT)	Driving over own feet	- Severe injuries	- Wrong setting of bar - Missing foot protection - Inattentiveness	- Use of improved PFLT Provide training
Loading/unloading pallets on/from trucks	Falling pallets/ cylinders	- Severe injuries	- Forks not fully engaged - Inadequate training	Provide training
Getting in/out FLT/Truck	Slips, trips, falls	- Hand/foot injuries	- Incorrect procedure e.g. jumping - Poor ground conditions	- Training - Good housekeeping
Handling single cylinders	Falling cylinders	- Squeezed/broken hands/fingers/feet - Internal injuries	- Damaged cylinder base - Cylinder hit by moving objects/persons - Poor floor condition - Faulty handling technique	- Check cylinder base - Minimize free standing unsecured cylinders - Good housekeeping - Training
Taking cylinders out of pallets	Falling cylinders	- Squeezed/broken hands/fingers/feet - Internal injuries	- Damaged cylinder base - Faulty handling technique - Uneven pallet base - Damaged retaining device	- Check pallets - When taking cylinders out ensure that remaining cylinders are stable
Cylinder and contents identification	Faulty identification	Could be disastrous!	- Lack of knowledge - Inattentiveness	- Separate unknown cylinders and ask for special advice
Opening/closing valves	Burning of O2 valves/fittings	- Burns - Material damage	- Adiabatic compression - Contamination - Wrong materials	- Slowly open valves - Visual inspection - Quality control
Filling	Hose failure Broken coupling nuts	- Injuries - Burns - Material damage	- Faulty construction - Wrong materials	- Anti whip wire/guards - Quality control - Regular inspection