GUIDANCE FOR MANUAL HANDLING ACTIVITIES OF CYLINDERS

Doc 229/24

Revision of Doc 229/22

EUROPEAN INDUSTRIAL GASES ASSOCIATION AISBL

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Amendments to 229/22

Section	Change
8	New reference added
Appendix 3	New hazard item added

NOTE Technical changes from the previous edition are marked on the left

1 Introduction

Manual handling is an important issue for the industrial gases sector (including all areas such as medical, food etc.). Many activities of the industrial gases industry involve manual effort which have the potential to cause harm if not properly managed. Manual handling related injuries are a major cause of lost workdays.

National or local regulations shall be considered separately. If such regulations exist, they shall be followed as a minimum.

2 Scope and purpose

2.1 Scope

This publication covers the ergonomics and occupational health of manual handling activities_of cylinders in the industrial, medical and homecare sectors. Included specifically are ergonomic principles that can be adopted to reduce likelihood of musculoskeletal issues.

Appendix 1 of this publication provides guidance and good practices for tasks when manual handling cylinders during:

- rolling cylinders (moving cylinders by turning in an almost vertical position);
- carrying small cylinders;
- loading and unloading cylinders on pallets;
- moving cylinders with trolleys;
- strapping, ratcheting cylinders; and
- handling the pallet ramp.

Appendix 2 provides guidance and good practices for tasks when filling cylinders, including:

- removing and replacing cylinder caps;
- aligning cylinders in pallet, as needed;
- connecting and disconnecting filling hoses / adaptors on pallet racks / manifolds and opening / closing valves while standing on elevated platforms; and
- connecting and disconnecting filling hoses / adaptors on linear racks / manifolds and opening / closing valves while standing on ground level.

Appendix 3 provides guidance and good practices for deliveries to customers, including:

- use of tail lifts;
- use of vehicle mounted cranes;
- use of vehicle mounted forklifts;
- environment/weather/lighting factors;
- moving over uneven ground;

- doorways / thresholds / ramps
- using steps;
- using lifts / elevators;
- carrying small cylinders;
- moving over long distances;
- risks of low ceilings;
- risks of basements;
- securing loads to vehicles;
- restricted spaces/corridors/cupboards; and
- handling of items in and out of vans/small commercial vehicles.

The following activities / situations are not covered by this publication:

- accidental falling of free-standing cylinders (including those in pallets);
- cryogenic containers [1][1];
- specific tasks in retest centres and during cylinder maintenance;
- manual moving of palletised cylinders / packs / bundles;
- delivering cylinders with highly abnormal conditions, construction sites, service lifts, multiple flights of stairs, extreme distances, confined spaces); and
- distribution activities such as [1]:
    - handling hoses;
    - operating tanks / tankers during delivery and filling;
    - use of tools (hammers / spanners etc); and
    - trip hazards.

The working environment (such as lighting, humidity, cylinder stability, flooring, temperature etc.) is not specifically addressed in this publication however they can impact manual handling activities and should be considered in manual handling risk assessment.

Although customer activity and premises are not within the scope of this publication, guidance in this publication can be applicable from to end users.

2.2 Purpose

The publication is intended to provide guidance and good practices when manually handling industrial and medical gas cylinders and comply with minimum requirements of EU directives.

[1] References are shown by bracketed numbers and are listed in order of appearance in the reference section.

Sections 1-7 provide information on ergonomic principles, the health effects from manual handling activities and manual handling risk assessment methodology including the hierarchy of control. Appendix 1 provides guidance and good practices for tasks when manually handling cylinders. Appendix 2 provides guidance and good practices for tasks when filling cylinders. Appendix 3 provides guidance and good practices for tasks when delivering to customers.

This publication is not intended to replace the requirement for conducting a task specific risk assessment.

This publication does not replace or supersede any regulatory requirements for cylinder handling.

This publication also provides information that is useful for training of operators.

3 Definitions

For the purpose of this publication the following definitions apply.

3.1 Publications terminology

3.1.1 Shall

Indicates that the procedure is mandatory. It is used wherever the criterion for conformance to specific recommendations allows no deviation.

3.1.2 Should

Indicates that a procedure is recommended.

3.1.3 May

Indicate that the procedure is optional.

3.1.4 Will

Is used only to indicate the future, not a degree of requirement.

3.1.5 Can

Indicates a possibility or ability.

3.2 Technical definitions

3.2.1 Competent person

Competence is the demonstrated ability to undertake responsibilities and to perform activities to a recognised standard. Competence is a combination of practical and thinking skills, experience and knowledge, see EIGA Info HF 02, *Individual – "Training and Competence"* [2].

3.2.2 Manual handling and ergonomics

Application of bodily force to manually move or support a load, including the lifting, putting down, pushing, pulling, carrying, or turning by hand, which, by reason of its characteristics (weight, size, shape), unfavourable ergonomic conditions or the physical capability of the individual person, has the potential to cause an injury.

NOTE This definition while based on international standards is aimed specifically at the European industrial and medical gases sector and may not be applicable or relevant to other industries. It does not attempt or claim to be suitable as a generic definition for manual handling.

Further information on manual handling can be found in ISO 11228, *Ergonomics – Manual Handling (parts 1-3)* [3].

3.2.3 Musculoskeletal disorders

Disorder of the muscles, nerves, tendons, ligaments, joints, cartilage, blood vessels, or spinal discs such as muscle strains and tears, ligament sprains, joint and tendon inflammation, pinched nerves, and spinal disc degeneration. Musculoskeletal disorders (MSD) affect body parts including the neck shoulder, elbow, forearm, wrist, hand, abdomen (hernia only), back, knee, ankle, and foot.

MSDs do not include injuries resulting from slips, trips, falls, vehicle accidents and similar accidents.

3.2.4 Risk assessment

Structured and systematic identification and analysis of workplace hazards to assess their potential risks to health and determine appropriate control measures to protect the health and wellbeing of workers.

3.2.5 Rolling

Manual movement of a cylinder in the vertical position which involves the operator leaning the cylinder over with one hand and then rotating the cylinder by pushing it with the other hand. Rolling is also known as cylinder churning or trundling. Foot may be used to assist rolling.

3.2.6 Work related upper limb disorder

Disorder of the hand, fingers, upper arm, shoulder, or neck. An upper limb disorder (ULD) may be any pain, tension, or other injury to any part of the upper limb. When this condition is caused by, or exacerbated by, workplace conditions or job tasks, it is a work-related upper limb disorder (WRULD).

4 Ergonomic principles

There are important ergonomic principles that shall be understood to help individuals achieve correct posture and reduce the likelihood of injury when carrying out manual tasks. Biomechanics is the application of mechanical principles to how humans move. The principles aim to place joints and spine in optimal position ensuring that the muscles are balanced and reduce the forces that are placed on the body.

The basic ergonomic principles are given below which will form the basis of the guidance given in Appendix 1:

- keep the load close to the body;
- joints in optimal position (neutral);
- use a wide stance (feet shoulder width apart) when possible;
- avoid bending forwards;
- avoid twisting the spine;
- alternate postures and movements;
- avoid sudden movements; and
- prevent muscle fatigue.

5 Health effects

Manual handling of cylinders can cause disorders due to acute and cumulative deterioration of musculoskeletal system through the related continuous activities (for example rolling, carrying, lifting, pushing) and can result in fatigue and lead to injury.

Typical injuries can include:

- Injuries due to sudden exertion whilst handling cylinders, considering that the cumulative effects of repetitive actions prior to the event can increase occurrence and/or gravity of the pain or injury (for example muscle strain, cuts, fracture, crushed fingers and broken bones).

- Musculoskeletal disorders are damages to the musculoskeletal system, that can occur as a consequence of gradual and cumulative wear and tear as well as from awkward postures, affecting mainly:

    - upper limb disorders (WRULD): tennis elbow, shoulder rotator cuff pain, shoulder arm strain, wrist pain, etc; or

    - lower back pain and back injuries.

6 Risk assessment

The purpose of this section is to provide an objective approach in identifying, assessing and controlling (see Section 7) ergonomic risk factors associated with manual handling activities in the workplace. Due to the diversity of the tasks, a case-by-case approach is recommended.

A competent person should be involved in the risk assessment process.

A manual handling risk assessment should consider the following (see Annex 1 EC Directive 90/269/EEC *on Minimum Health and Safety Requirement for Manual Handling*) [4]:

- Task – requirements of the activity: For example, cylinder churning, lifting of small cylinders or boxes, repetitive actions such opening/closing cylinder valves or attaching hoses.

- Individual – physical effort required: The capability of the person carrying out the task, physical and psychological, training and competence.

- Characteristics of the working environment: The work area, floor surface, temperature, humidity, cleanliness and housekeeping, cramped or confined areas.

- Characteristics of the load: The weight, size, shape and stability of the load. For example, smooth wet cylinders, sharp edged boxes or containers where the contents can move around.

To help characterise the load specifically in relation to cylinders, Table 1 and Figure 1 can be used as guidance [5].

Table 1 Guidance on cylinder weight

Type of cylinder	Product	Approximate weight full (kg)
Small (10 Litre)	Oxygen	20
	Carbon Dioxide	23
	Acetylene	19
	LPG (approx. 7 kg)	17
Medium (30 Litre)	Oxygen	58
	Carbon Dioxide	60
	Acetylene	59
	LPG (approx. 19 kg)	45
Large (50 Litre)	Oxygen	80
	Carbon Dioxide	99
	Acetylene	93
	LPG (approx. 47 kg)	95
< 10 Litre		< 10

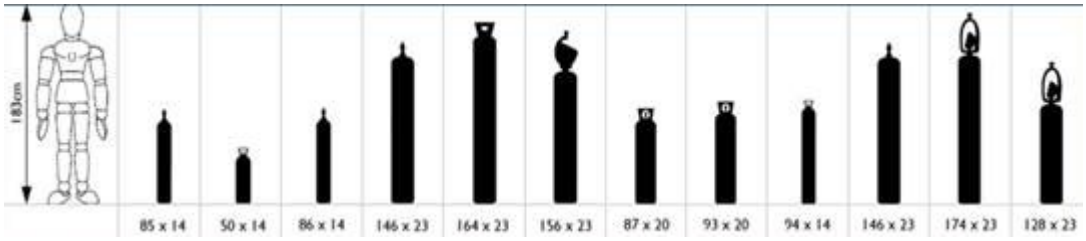


Figure 1 Guidance on cylinder size (dimensions in cm)

The tools in Table 2 can be used to help in assessing general manual handling tasks.

Table 2 Example Tools for assessing manual handling tasks

Methodology	*Weblink*
AFNOR NFX35-109 Oct 2011 "ergonomics – manual load handling for lifting, moving and pushing / pulling – Analysis methodology and threshold values – Ergonomy'	*https://www.afnor.org/en/*
Leitmerkmalmethode (Key Indicator Method)	*https://www.baua.de/DE/Themen/Arbeitsgestaltung-im-Betrieb/Physische-Belastung/Leitmerkmalmethode/Leitmerkmalmethode_node.html*
MAC	*http://www.hse.gov.uk/msd/mac/index.htm*

PAPP "push-pull risk assessment tool"	*http://www.hse.gov.uk/pubns/indg478.htm*
REBA "rapid entire body assessment"	*https://www.ergo-plus.com*
RULA "rapid upper limb assessment"	*https://www.ergo-plus.com*
Snook and Ciriello method	*http://calculadores.insht.es*
KIM Lichaamsbeweging	http://www.ergonomiesite.be/
NOTE The tools listed above are not exhaustive and are provided for guidance, other local tools / resources / references may be available that are not listed here.	

7 Hierarchy of controls

Controlling and improving exposures to occupational hazards is the fundamental method of protecting workers. Traditionally, a hierarchy of controls has been used as a means of determining how to implement feasible and effective control solutions.

One representation of this hierarchy is shown in Figure 2 [6]:

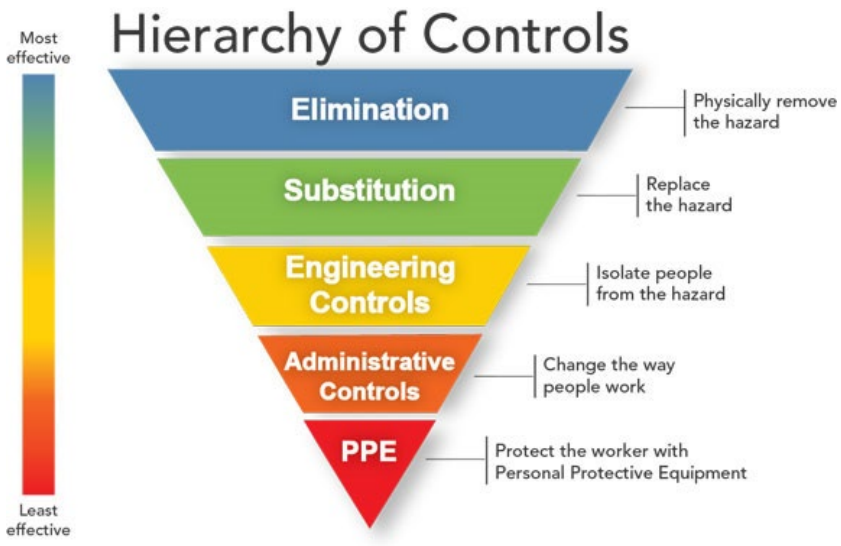


Figure 2 Hierarchy of controls

7.1 Elimination and substitution

To eliminate or substitute manual handling activities the following examples can be considered:

- automation or mechanisation, for example automated filling plants or automate loading on / off pallets;

- redesign the task to avoid moving the cylinders by hand, for example using palletised process, where cylinders remain in the pallet, or introducing the use of cylinder bundles;
- mechanisation, for example introduction of a lift truck, hoist, trolley, pallet inverters, vacuum pull type systems. All handling aids should be compatible with the rest of the work system, be effective, appropriately designed and easily operated;
- using fixed cylinder caps to avoid removal and replacing of caps for filling;
- using quick connectors for filling to avoid repetitive movement for manual connections; and
- delivery of product, for example bulk tank, mini-tank rather than cylinder.

7.2 Engineering controls

Examples of engineering controls include:

- mechanical assistance – hoist;
- use of technical aids – such as handheld straps, slide mats, hooks, suction pads, rolling tools; and
- use of cylinder trolleys.

7.3 Administrative controls

Examples of administrative controls include performing risk assessments, writing policies and procedures, reducing exposure time to the job for example job rotation.

7.4 Personal protective equipment

Typical cylinder handling Personal Protective Equipment (PPE) includes foot protection (safety boots / shoes with metatarsal protection is recommended), hand protection and eye protection. For further guidance see EIGA Doc 136, *Selection of Personal Protective Equipment* [7].

7.5 Information, instruction and training

Manual handling information and training should include:

- how the body functions, possible injuries, illnesses;
- biomechanical principles, good lifting and handling techniques;
- guidance on tools/equipment to improve manual handling (trolleys, hand tools, pallets, quick connectors, automation, valve opening tools, vacuum lifts) and reduce physical force; and
- PPE.

Manual handling should not be considered a one-off training. It should be refreshed at regular intervals.

8 References

Unless otherwise stated the latest edition shall apply.

[1] EIGA Doc 248, *Guidance for Manual Handling in Distribution Activities*, www.eiga.eu.

[2] EIGA Info HF 02, *Safety Information – Human Factors: Individual – "Training and Competence"*, www.eiga.eu.

[3] ISO 11228-1, *Ergonomics – Manual Handling – Part 1: Lifting and Carrying.* www.iso.org.

ISO 11228-2, *Ergonomics – Manual handling – Part 2: Pushing and pulling*, www.iso.org.

ISO 11228-3, *Ergonomics – Manual handling – Part 3: Handling of low loads at high frequency*, www.iso.org.

[4] EC Directive 90/269/EEC *on Minimum Health and Safety Requirement for Manual Handling*. www.europa.eu.

[5] BCGA Guidance Note 3, *Safe cylinder handling and the application of the manual handling operations regulations to gas cylinders*. www.bcga.co.uk.

[6] Hierarchy of Controls, U.S. National Institute for Occupational Safety and Health https://www.cdc.gov/niosh/topics/hierarchy/default.html.

[7] EIGA Doc 136, *Selection of Personal Protective Equipment*, www.eiga.eu.

9 Additional references

HSE Manual Handling, *Manual Handling Operations Regulations*, UK Health and Safety Executive, www.hse.gov.uk.

HSE INDG398, *Making the best use of lifting and handling aids*, UK Health and Safety Executive, www.hse.gov.uk.

Appendix 1: Guidance and good practices for tasks when manually handling cylinders

Title: Lifting, lowering and carrying a small standing cylinder

Hazards: Cylinder size and weight, operator capability

How to (in words):

- Keep load close to your body
- Lower centre of gravity by bending at the knees, keeping a wide base of support with your feet
- Grip the valve guard if it has been designed for this purpose (ensure valve guard is secure), use two hands to hold the cylinder (at guard, or alternatively one hand at guard and one underneath the cylinder)
- Use large muscle groups (thighs) to create force, keep back straight (does not mean it has to be vertical)
- Lift decisively with a smooth non-jerking motion. This is done initially by straightening the legs

Pictures

Guard:

Dome Cap:

Title: Lifting a cylinder from horizontal (fallen/laying on a pallet)

Hazards: Cylinder size and weight, operator capability, work environment

How to (in words):

- Position body facing the top of cylinder (valve guard end)
- Bend at the knees to lower your centre of gravity
- Grip valve guard if it has been designed for this purpose (ensure valve guard is secure), or grip the cylinder neck, grip firmly with two hands to distribute the load
- Lift decisively with a smooth non-jerking motion. This is done initially by straightening the legs then following through with the arms at the same time walking forward until the cylinder is upright
- Adjust hand grip of the cylinder as you lift it
- Slowly walk the cylinder upwards as you move with it

Pictures

Large cylinders with Guard:

Large cylinders with dome cap:

Small Cylinders

Title: Strapping pallets

Hazards: Strap, operator capability

How to (in words):

- Lower your centre of gravity by bending knees
- Back spine in neutral posture
- Try to ensure you are working at waist level (bend knees to achieve this)
- Maintain a wide stance
- Place front foot in-line with ratchet
- Secure the strap in a smooth non-jerking motion
- Do not lean back using body weight to tighten ratchet

Pictures

Good practise

Large cylinders


Small cylinders:


Poor practice

Leaning body weight to tighten ratchet (high load on lower back)

Title: Pushing a cylinder with trolleys

Hazards:

Cylinder size and weight, work environment, operator capability, design and condition of trolley

How to (in words):

- When loading a cylinder onto a trolley maintain good body posture (standing upright, straight back, bending slightly at the knees if required, avoid twisting)
- To help pivot single handle trolleys and to minimise the force through wrists and arms, one hand should grip the top of the cylinder guard cap and pull towards the body
- For two-wheel trolleys, lean back a little, back straight, while simultaneously, creating a lever effect to tilt the trolley back so it balances comfortably on the wheels and position handle height between the shoulder and waist (minimise weight load)
- For three or four-wheel trolleys, lean back a little, back straight, while simultaneously, creating a lever effect to tilt the trolley back until it rests on the supporting wheels
- Use foot to help pivot the trolley
- Keep back straight while pushing trolley
- Pushing a two-wheel trolley, whilst more manoeuvrable, requires more effort to maintain balance by the individual in comparison to a three or four-wheel trolley

NOTE Before moving the trolley, ensure cylinders are secured (for example with chain)

Pictures

Two-wheeled – 1 hand trolley

2 wheel 2 handle

3 and 4 wheel trolleys

Title: Cylinder Rolling

Hazards: Cylinder size and weight, operator capability, falling cylinder, work environment

How to (in words):

- Roll one cylinder at a time for short distances only, do not roll 2 cylinders at once
- If the cylinder starts to fall while under your control, let it fall, do not try to catch it
- Face the cylinder, keep back straight, one hand supports and guides the cylinder valve cap or guard whilst the other hand turns and pushes the cylinder to roll it. Shoulder, elbow and wrist should be positioned to minimise forces/effort
- Keep cylinder close to the body

Pictures





Title: Handling cylinders on pallet ramps

Hazards: Cylinder size and weight, operator capability, falling cylinder/ramp, work environment, trap/pinch hands/feet, ramp design/weight

How to (in words):

A horizontal/level working surface of the ramp reduces manual handling and other safety issues. The angle of ramps should be minimised as far as reasonably practicable.

Lift and lower pallet ramp:

- Keep back straight
- Bend at the knees to lower centre of gravity
- Grip the ramp firmly and lift/lower in a smooth motion to/from the floor using large muscle groups

Handling a cylinder on ramp or slope:

- Handle one cylinder at a time
- Cylinders should be handled facing the pallet, not from the side or from within the pallet, avoid twisting
- Keep back straight, use a wide stance to help balance cylinder and maintain control as it moves on the ramp
- Rolling cylinders on a ramp will require additional effort/force to maintain control. Use cylinder momentum to move cylinders in a smooth motion up the ramp avoiding stopping on the ramp.

Pictures

Lowering/lifting the ramp

Unloading cylinders on the ramp

Loading cylinders on the ramp

Title: Loading and unloading wine racks

Hazards: Cylinder size and weight, design of the wine rack, operator capability

How to (in words):

- Load small cylinders in the top rows and, if possible, avoid using the bottom two rows
- Only one cylinder should be handled at a time
- Handle cylinders facing the wine rack to avoid twisting
- For the lower rows, bend at the knees with feet slightly apart ("split stance") to lower your centre of gravity. To stand upright use large muscle groups and keep back straight
- Avoid placing a knee on the ground
- Grip the valve guard if it has been designed for this purpose (ensure valve guard is secure), or grip the cylinder neck, pull with one hand and support the body of the cylinder with the other hand
- Pull or push cylinder with a smooth non-jerking motion

Pictures

Good practice

Top rows:

Middle rows:

Bottom/lower rows:

Poor practice

Top rows:

Middle rows:

Bottom/lower rows:

Appendix 2: Guidance and good practices when filling cylinders

Title: Removing and replacing cylinder caps

Hazards: Cylinder size and weight, operator capability, cap type, cap condition (for example rust or damage), cap not replaced securely, damage or opening of valve when using tools
(not applicable to fixed caps)

How to (in words):

Large cylinders:

- Try not to complete this from ground level due to working above shoulder height
- Move around the pallet for example when on filling manifold
- Avoid stretching where possible

Small cylinders:

- This can be done from ground level
- Move around the pallet to avoid stretching / reaching

Use of hand tools:

- Some pneumatic / battery operated tools with bespoke attachments can be used to remove caps Note – check for accidental valve opening, remove suspect cylinders for further investigation)

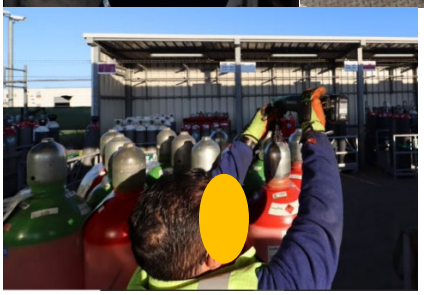
Body Posture:

- Position yourself in front of each cylinder
- Keep as close to the cylinder as possible to avoid stretching/reaching from shoulder or bending at the waist
- Keep wrists in neutral alignment where possible
- Use two hands to unscrew cap where possible
- Do not strain, use tools to loosen if necessary

Pictures

Good practice

Poor practice



Title: Aligning cylinders in pallet for filling (when needed to fit filling adaptors)

Hazards: Cylinder size and weight, operator capability, work environment, strap, accidental loosening of cylinder valve, tools

How to (in words):

Cylinders should be approximately aligned to correct orientation when loading pallet

- Loosen strap (a little) as per guidance in Appendix 1
- With caps removed from cylinders, stand close to cylinder with wide stance
- Move around the pallet to avoid stretching/reaching for each cylinder
- Either:
  - Manually rotate cylinder with small movements on the cylinder shoulder
  - Use a tool (for example lever or wrench) to turn cylinder clockwise with a smooth, non-jerking movement
- For large cylinders, work should not be completed from ground level due to working above shoulder height, normally work from an elevated platform

Pictures

Using tools

Title: Pallet rack / manifold – Connecting and disconnecting filling hoses / adaptors and opening / closing valves (standing on elevated platform)

Hazards: Operator capability, pressure, repetitive movements, hand arm vibration (when using tools)

How to (in words):

Basic principles:

- Adapt posture to ensure work at waist height where possible when handling different height cylinders
- Keep cylinder close to the body – move around the pallet avoid overreaching/stretching
- Relaxed neutral wrist, shoulder, spinal posture
- Keep shoulders relaxed
- Keep body upright – avoid leaning and twisting
- Where possible, ensure connection is side on when you are connecting / disconnecting filling adapter
- When manually connecting and disconnecting/opening closing valves keep shoulders relaxed, keep wrists neutral as far as possible

Tools:

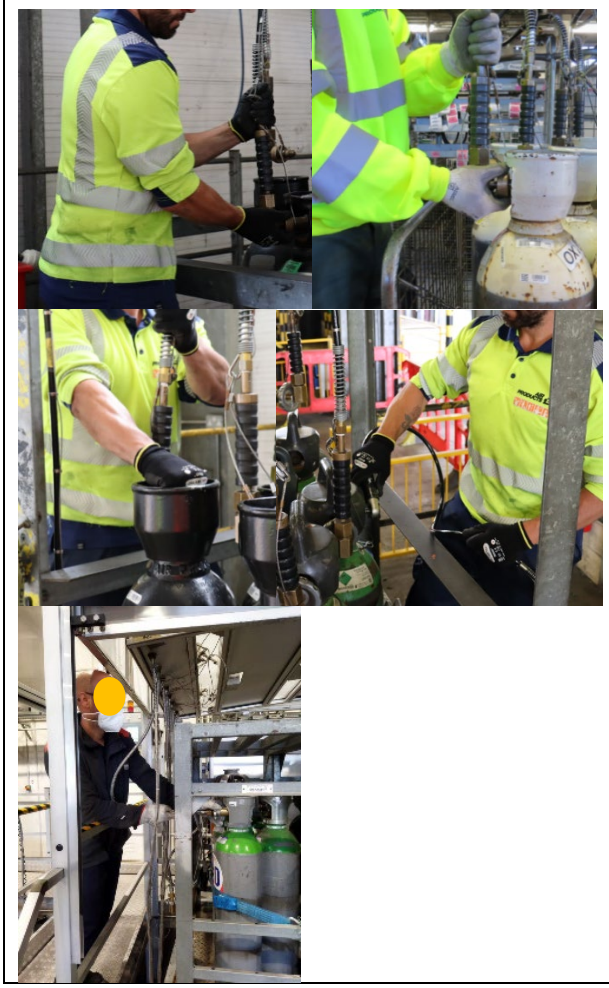
- Hand tools may be used to reduce repetitive movements – neutral wrist posture
  NOTE Use of tools should consider torque settings and potential damage to o-rings and adaptor threads

Avoid:

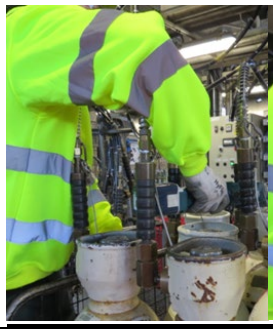
- Avoid over tightening / jarring
- Avoid rotating from shoulder

Pictures

Good practice



Poor practice

	 
Using tools  	 

Title: Linear rack / manifold – Connecting and disconnecting filling hoses / adaptors and opening / closing valves (standing on ground level)

Hazards: Cylinder size and weight, operator capability, pressure, repetitive movements, hand arm vibration (when using tools), falling cylinder, work environment

How to (in words):

- Rolling/Handling of cylinders as in Appendix 1

Basic principles:

- Adapt posture to ensure work at waist height where possible when handling different height cylinders
- Keep cylinder close to the body – move along the rack / manifold to avoid overreaching / stretching
- Relaxed neutral wrist, shoulder, spinal posture
- Keep shoulders relaxed
- Keep body upright – avoid leaning and twisting
- Ensure connection is in the appropriate direction for the filling system when connecting adapter NOTE Connection method shall be assessed and operators trained
- When manually connecting and disconnecting/opening closing valves keep shoulders relaxed, keep wrists neutral as far as possible

Tools:

- Hand tools may be used to reduce repetitive movements – neutral wrist posture
  NOTE Use of tools should consider torque settings and potential damage to O-rings and adaptor threads

Large cylinders:

- Work may be above shoulder height for some operators, additional attention is required to keep shoulder and wrist in neutral relaxed positions
- Avoid rotating from shoulder
- Avoid overreaching
- Avoid over tightening / jarring

Small cylinders:

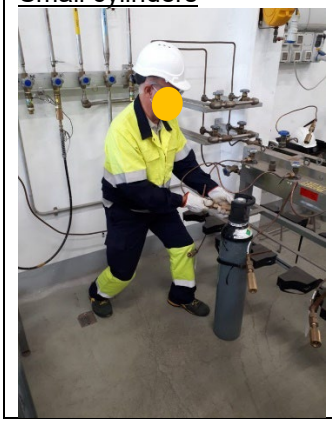
- Work may be below waist height, additional attention is required to keep back straight, bend legs to lower centre of gravity
- Avoid rotating from shoulder
- Avoid bending from waist and twisting
- Avoid over tightening / jarring

Pictures

Good practice

Large cylinders

Poor practice

Small cylinders 	

Appendix 3: Guidance and good practices for cylinder deliveries to customers

The table below provides guidance for ergonomic considerations for these hazards. A site specific risk assessment should be completed for these tasks. When completing cylinder deliveries to customer locations, ergonomic considerations shall be reviewed.

<table>
<tr><th>Hazard</th><th>Ergonomic considerations</th><th>Possible control measures</th><th>Additional considerations</th></tr>
<tr><td rowspan="2">Tail lifts</td><td>Manual tail lift:
Awkward positions
Weight
Resistance to move

Cylinder handling:
Restricted space
Surface conditions</td><td>Use automated / powered platforms
Maintenance of platform
Use ergonomic principles and training

Use of forklift
Use of trolleys
Use ergonomic principles and training.</td><td>Cylinder falling
Working at height

Slips, trips, falls</td></tr>
<tr><td colspan="3">Visual reference
  </td></tr>
<tr><td rowspan="2">Vehicle mounted crane</td><td>Connecting crane
Awkward working position/reaching</td><td>Use step to assist reach
Use ergonomic principles and training</td><td>Falling / striking objects</td></tr>
<tr><td colspan="3">Visual reference
  </td></tr>
</table>

<table>
<tr><th>Hazard</th><th>Ergonomic considerations</th><th>Possible control measures</th><th>Additional considerations</th></tr>
<tr><td rowspan="2">Vehicle mounted forklift</td><td>Loading on vehicle
Reaching/stretching

Operating
Position while driving (no seat adjustment, limited space)</td><td>Positioning of controls at acceptable/comfortable height

Limited exposure
Frequently adjust posture

Demounting forklift remotely</td><td></td></tr>
<tr><td colspan="3">Visual reference
  </td></tr>
<tr><td rowspan="2">Environment
Weather (rain, snow, ice)

Dark/night delivery</td><td>Slippery surface

Visibility
Hidden harm
Cold
Personal injury (not warmed up)
Hot (exhaustion)
Lighting</td><td>Appropriate footwear/gloves
Use of trolley
Assess best route
Use ergonomic principles and training.

Warm up and stretches</td><td>Slips, trips, falls
Use of other physical controls like salt / grit</td></tr>
<tr><td colspan="3">Visual reference
  </td></tr>
</table>

<table>
<tr><th>Hazard</th><th>Ergonomic considerations</th><th>Possible control measures</th><th>Additional considerations</th></tr>
<tr><td rowspan="2">Uneven ground</td><td>Cylinder rolling

Trolley</td><td>Dynamic risk assessment
Route choice
Trolley considerations
2 vs 3 wheel
Tyre choice (solid/pneumatic)
Tyre size
How many cylinders
Cylinder securing
Pushing vs pulling
Use ergonomic principles and training</td><td>Slips, trips, falls</td></tr>
<tr><td colspan="3">Visual reference
  </td></tr>
<tr><td rowspan="2">Doorways / thresholds / ramps</td><td>Exertion/effort/force

Lifting
Jerking/sudden movement
Twisting, turning, stretching</td><td>Use ergonomic principles and training
Use of second person
Pre-walk route
Prop open doors
Use of trolley
Pushing vs pulling
Dynamic risk assessment</td><td>Slips, trips, falls
Falling cylinders</td></tr>
<tr><td colspan="3">Visual reference
  </td></tr>
</table>

Hazard	Ergonomic considerations	Possible control measures	Additional considerations
Steps	Additional length of time and more intense in comparison to doorways / thresholds / ramps	Avoid if possible (for example use lift) Stair trolley (manual / powered) Carry One at a time Small cylinders Handrails Use ergonomic principles and training	Slips, trips, falls Communication with customers / commercials teams to avoid Falling cylinders
	Visual reference 		
Lifts / elevators	Rushing, lack of attention	Second lift operator	Safe system of work for confined spaces Unattended cylinder Public exposure
	Visual reference 		
Carrying small cylinders	Multiple cylinders Multiple trips Length of exposure Grip	Use a trolley One at a time Use ergonomic principles and training (see Appendix 1)	See Appendix 1
Long distances	Effort, exertion Length of exposure	Park closer Use trolley Dynamic risk assessment Take breaks and preventative stretches Use ergonomic principles and training	
Low ceilings	Awkward posture	Alternative storage / route Use ergonomic principles and training	Confined space Slips, trips, falls

Hazard	Ergonomic considerations	Possible control measures	Additional considerations
Basements	Chutes Ramps Drop holes Effort/exertion	Site specific survey and risk assessment Evaluate alternative location for cylinders Dynamic risk assessment Cylinder size	Confined space Slips, trips, falls Visibility
Securing load to vehicle	Throwing straps, sudden movement Stretching, reaching, awkward posture	Alternative securing method (pintle / clamp etc) Internal strap mounting Pole to assist Warm up / stretch Use ergonomic principles and training	Hitting people / objects
	Visual reference 		
Restricted spaces, corridors, cupboards etc	Stretching, reaching, awkward posture	Dynamic risk assessment Moving obstacles / preparing route Use ergonomic principles and training	Confined space
Handling of items in/out of Vans, Small Commercial Vehicles e.g cylinders, concentrators, cryogenic containers	Stretching, reaching, lifting, lowering awkward posture Pushing/pulling/rolling Limited space Weight of the load Height differences in loading area	Dynamic risk assessment Moving obstacles / preparing route Use ergonomic principles and training Use mechanical aids where available e.g lifting platforms, tail lifts Use vehicle's flat bed edge as support and pivot for handling larger cylinders if appropriate	External environmental factors, e.g public, traffic