Guidance on
The Use of Chain Lever Hoists in the Offshore Subsea Environment

International Marine Contractors Association

www.imca-int.com

IMCA LR 005, D 028 – Rev. 2
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IMCA promotes improvements in quality, health, safety, environmental and technical standards through the publication of information notes, codes of practice and by other appropriate means.

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- Contracts & Insurance
- Health, Safety, Security & Environment
- Lifting & Rigging
- Marine Policy & Regulatory Affairs

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There are also five regions which facilitate work on issues affecting members in their local geographic area – Asia-Pacific, Europe & Africa, Middle East & India, North America and South America.

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This guidance was produced for IMCA under the direction of its Diving Division Management Committee.

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Date	Reason	Revision
June 2002	Initial publication	
February 2008	To reflect experience gained by industry in using the guidance and to incorporate lessons learnt during investigations into lever hoist incidents over the past five years. In particular it contains a new section 7 on the use of chain lever hoists underwater.	Rev. 1
June 2017	Minor editorial changes throughout. Changes to section 4.1, 4.6, 7.3 *Length of time the lever hoist is in service should be limited*, and section 7.4.	Rev. 2

Guidance on The Use of Chain Lever Hoists in the Offshore Subsea Environment

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1 Introduction

Chain lever hoists are used extensively in underwater construction activities. Their design characteristics allow for ease of transportation to site and require minimum set up. Unlike the chain hoist, which can only be used upright and vertical, the chain lever hoist can be used in almost any orientation. This makes the chain lever hoist potentially a very useful tool for diver use during subsea construction activities.

However, there has been a history of failures in the use of this equipment, both underwater and topside. The offshore environment can be particularly harsh, with its combination of extreme temperature, airborne dust or grit, atmospheric salinity, silt, washing out of lubricants and general corrosion from seawater. This has prompted critical examination into the cause of these failures, with a view to establishing industry guidance on the safe application for use of chain lever hoists.

A number of existing standards and specifications for chain lever hoists exist and each country will have its own legislation regarding the conducting of lifting operations. The intention of this guidance is not to replace any existing standards or legislation but to supplement them by providing IMCA members with specific guidance for the safe use of chain lever hoists in the offshore subsea environment.

2 Background

In the late 1990s, following concern being expressed regarding their safe operation, IMCA set up a workgroup to consider the development of guidance on the use of chain lever hoists. This group commenced its work by consulting with IMCA members, clients and the major equipment test houses.

A separate working group, comprising the UK regulatory authority (the Health & Safety Executive), the Lifting Equipment Engineers Association (LEEA) and representatives from equipment test houses and manufacturers was also set up to develop guidance on the use of chain hoists and chain lever hoists. The guidance document *Hand chain blocks & lever hoists in the offshore environment*, published in 2003, is available from LEEA.

IMCA recognised the benefits in achieving alignment with the results of that work in formulating its document. IMCA gained representation on the working group where the development of its document was monitored, and provided specialist input regarding the equipment's use subsea, ensuring ultimate alignment between the two sets of guidance created. This work resulted in the publication on IMCA D 028 in June 2002.

This revision (IMCA LR 005, D 028 – Rev. 2) supersedes IMCA D 028. The changes in the document reflect the experience gained by the industry in using the original guidance and incorporate lessons learnt during investigations into lever hoist incidents over the past five years.

3 General Principles for Lifting Equipment

The lever hoist is a compact and versatile tool and is used extensively in the offshore and subsea environments. It is important, however, to remember that a chain lever hoist is not a hand tool but is an item of lifting equipment and should be treated as such.

The following general principles for lifting equipment should be taken into account when planning or conducting any lifting operation either subsea or on the surface and apply fully to operations utilising chain lever hoists.

For lifting operations to be conducted safely, the following principles are normally considered appropriate:

- The equipment should be used within its working load limit (WLL) when all load factors have been taken into consideration;
- The equipment should suitable for its intended purpose;
- Information on the use of the equipment should be provided by the manufacturer and/or supplier;
- An adequate risk assessment should be undertaken prior to any lifting operation;
- The lifting operation should be adequately planned, supervised and executed in a safe manner;
- The personnel using the equipment should be suitably trained;
- The equipment should be maintained in a safe condition;

- Records of conformity, test and examination, etc. should be kept.

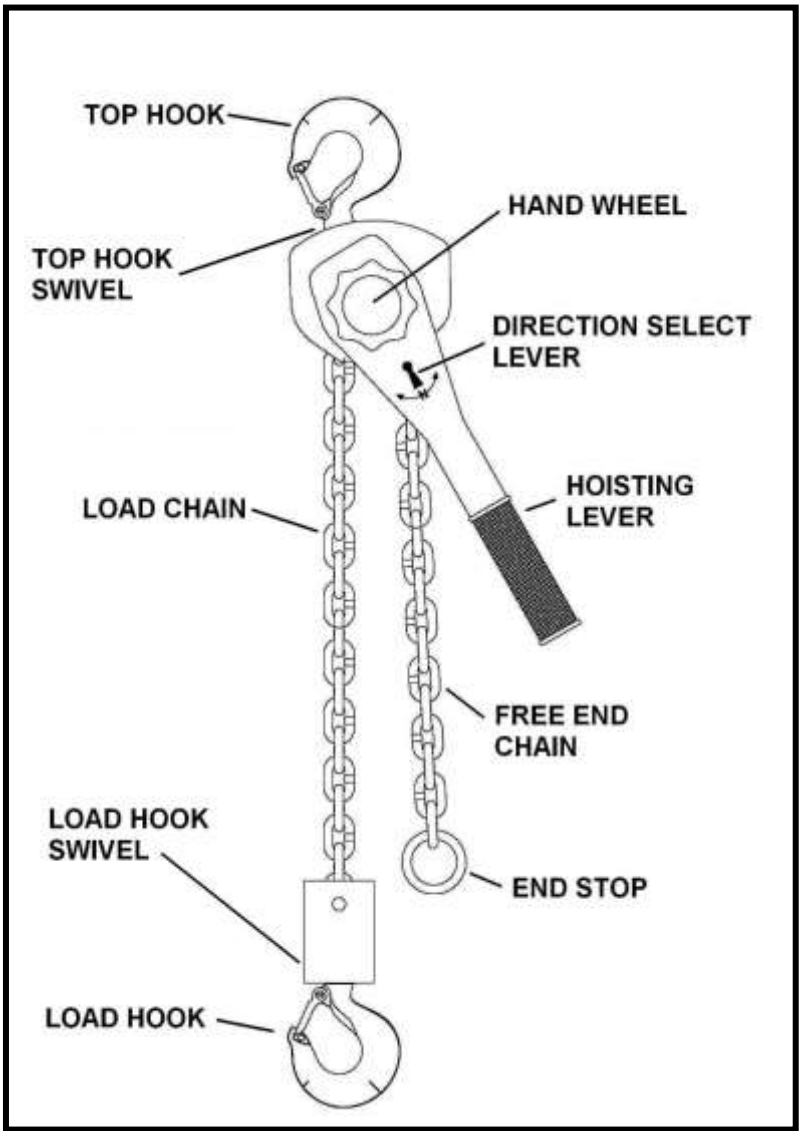

Figure 1 – Typical chain lever hoist with parts identified

4 Selection of Equipment

4.1 Types of Lever Hoists

There are many makes and models of chain lever hoist on the market, with some manufacturers producing more than one type. Some models are more suitable for use in a subsea environment than others, which are only suitable for use on board the deck of a vessel. The suitability for subsea use of particular hoist models will require demonstration by the manufacturers or their agents. Such hoists should be proven to perform well in subsea conditions through extensive testing and trials.

Note: All makes and models of chain lever hoist, including those considered more suitable for use in a subsea environment than others, should still be subject to the single immersion policy recommended in this guidance (see sections 4.6 and 7.4).

The following information, although of a general nature, gives guidance on some features that should be considered when selecting a chain lever hoist for use in the offshore subsea environment.

It is important that lever hoists used underwater are suitable for the temperatures and the environment in which they will be used. In the absence of chain lever hoists certified for use subsea, companies buying or hiring chain lever hoists for use in that environment should satisfy themselves, through risk

assessment, enhanced procedural and maintenance requirements, that any unit proposed is suitable for subsea use.

4.2 Type of Chain

Chain lever hoists are designed to use one of two types of chain – fine tolerance (calibrated) round steel link chain or roller chain. A roller chain is not considered suitable for the offshore environment, due to the potential for corrosion.

4.3 Brake Mechanism

The hoist should be fitted with an automatic brake capable of arresting and holding the load. It should function at all loads from the design working load limit (WLL) down to a minimum of 5% of the WLL.

4.4 Chain Retention

The load chain should be fitted with a stop at the free end. This should be large enough to prevent it passing over the load wheel or be fitted with some other equally effective way of preventing the chain from running out. The stop should be capable of withstanding a load of at least 2.5 times the maximum tension in the load chain at the full design working load limit and tested and certified accordance with the manufacturer's recommendations.

4.5 Load Hook

Hooks (top hooks and load hooks) should be fitted with a suitable safety catch to prevent the load or lever hoist becoming detached.

4.6 Selection for Specific Underwater Lifting Application

The harsh conditions experienced at subsea worksites undoubtedly will have an adverse effect on any lever hoist used in that environment. The salt water conditions may accelerate the corrosion within the unit, the immersion in water may wash grease from internal parts and particles suspended in the water can affect the ability of the brake to hold the load.

There are some manufacturers that claim to have developed chain lever hoists that are suitable for multiple immersions in offshore subsea applications. However, after subsea trials by IMCA contractors it was found that sealing arrangements and coatings on such equipment can fail due to the pressures experienced at operational water depths with the subsequent ingress of sand and/or silt which causes accelerated wear. In view of this IMCA does not accept that any design of chain lever hoist currently available, or in use, is suitable for multiple immersions within subsea industry applications (see section 7.4).

Because of the extreme operating conditions the following additional points should be considered when selecting a chain lever hoist specifically for subsea use:

- Specific designs or type(s) of chain lever hoist for use subsea. This could, for example, be a hoist model confirmed as suitable for subsea use by the manufacturer, a hoist modified (by the manufacturer or his agent) to enhance its performance in subsea conditions or a hoist proven to perform well in subsea conditions though extensive use, testing and risk assessment;
- Introduction of a system of marking chain lever hoists that have been specified and procured for use subsea, clearly identifying them and differentiating them from other chain lever hoists that may be present at the worksite;
- A proof load test to over the working load limit by a person deemed competent to do so, conducted prior to delivery to site and each time the chain lever hoist is reassembled after inspection, servicing or repair. The test limit should be agreed with the manufacturer;
- A recorded light load test to prove that the chain lever hoist will hold a load of 5% of the working load limit, undertaken by a person deemed competent to do so and conducted each time the chain lever hoist is reassembled after inspection, servicing or repair;

- In conjunction with the manufacturer or his agent, consideration of the benefits of additional greasing of the internal components of the chain lever hoist or the use of an alternative type of grease considered more suitable for subsea conditions;
- In-date load test certificate provided with new equipment.

5 Information and Data Requirements

5.1 Equipment Specification

As chain lever hoists are used for a variety of lifting purposes, precise dimensions and weight of the load to be moved are not always available. In these circumstances, only a general specification can be given and this should include the following information:

- Intended application, e.g. lifting, tensioning, pulling;
- Working load limit;
- Maximum extended dimension – height of lift (HOL);
- Minimum extended dimension (fully drawn-up length) if the headroom is important;
- Range of the lift;
- Conditions of service and, in particular, any conditions which the user suspects might be hazardous, i.e. it is important that the supplier is made aware if the intention is to use the chain lever hoist in an underwater application.

5.2 Information Which Should be Provided with the Chain Lever Hoist

While this guidance does not address the design and manufacturing standard, generally the responsibility is on the manufacturer and/or supplier of equipment to ensure that its product is fit for the intended purpose.

The following information should be provided to the end user:

- A copy of the thorough examination report (a suggested checklist for the thorough examination is given in Appendix 1);
- Instructions for use, which should include:
  i) general-purpose instructions for the safe use of the equipment
  ii) working load limit
  iii) any limitations on use in hazardous conditions
  iv) a statement regarding the potential for light load failure
  v) a declaration of conformity, where applicable;
- Additional instructions issued specifically to address the use of chain lever hoists in offshore subsea conditions.

6 Transportation, Storage and Control

6.1 Preparation of Equipment Prior to Dispatch Offshore

The following steps should normally be taken to prepare the equipment prior to dispatch offshore:

- All hoists should be thoroughly examined, irrespective of whether the equipment has previously been used. The thorough examination should include a light load test at a maximum of 5% of the working load limit;
- Criteria for this test should be as advised by the company competent person;
- A report of the thorough examination should be prepared;

- Care should be taken in preparation for shipping to ensure units are not exposed to harsh environmental conditions or potential damage during shipment;
- The equipment should be accompanied by the following documentation:
  i) a thorough examination report including load test certificate
  ii) instructions for use, including relevant extracts from this guidance.

6.2 Transportation and Storage Conditions Offshore

During transport to the offshore worksite and whilst in store at the worksite, the equipment should be protected from exposure to any conditions which may affect its ability to operate safely. In particular, it should be protected from exposure to:

- water/seawater;
- temperatures higher than can be comfortably tolerated by the hand;
- temperatures below freezing point;
- solvents;
- corrosive chemicals or fumes;
- grit, sand and wind-blown dust.

The equipment should ideally be stored in a purpose-designed facility where it can be kept secure from unauthorised use. Storage would normally be on suitable racks in a manner that prevents accidental mechanical damage.

6.3 Inspection Prior to Use

All chain lever hoists in the designated storage location should have been inspected and found fit for service and clearly identified as such.

At the time of issue the nominated person should check the certification supplied with the chain lever hoist is in order and that there has been no apparent deterioration during storage.

6.3.1 Pre-Lift Checks

Conducting thorough and consistent checks on a chain lever hoist immediately prior to use subsea will help identify problems due to accidental damage, internal corrosion, brake contamination or inappropriate storage.

Recommended checks should include:

- inspection of the hooks, latches and swivels;
- inspection of the chain and end stop;
- inspection of the casing and fittings;
- operation of the free chaining mechanism, ensuring it is free running in neutral and locks when the chain is loaded or pulled sharply;
- operation of the hoist in the up and down directions with a light load on the hook;
- the ability of the hoist to hold the light load without slippage as the direction select lever is moved between neutral, up and down.

It is recommended that these pre-use checks are carried out with the chain lever hoist hanging from the top hook with a maximum load of 5% of the working load limit suspended on the load hook, confirming the light load performance of the chain lever hoist prior to deployment subsea.

7 Use of Chain Lever Hoists Underwater

Analysis of chain lever hoist incidents in the subsea and offshore construction industry over a number of years has identified a number of common causes for chain lever hoist slippage or failure.

Incidents have occurred due to:

- slippage/failure due to the use of a lever hoist beyond its stated working load limit, e.g. using a 3te WLL lever hoist to lift 3.5te;
- slippage/failure to hold the load due to the use of a lever hoist below the recommended minimum load, e.g. using a 3te WLL lever hoist to lift 100kg;
- slippage/failure to hold the load due to use of a lever hoist in a dynamic lifting arrangement where the load on the brake varies, e.g. as the load goes through the splash zone;
- slippage/failure to hold the load possibly due to contamination of the braking mechanism or corrosion of the internal components, e.g. due to extended or cyclic immersion in salt water.

The guidance outlined in the remainder of this section has been introduced to prevent, as far as possible, the types of failure detailed above.

7.1 Lift Planning

Lift planning should recognise initially that there are alternatives to the chain lever hoist and should ensure that, following assessment, the lever hoist is the most appropriate item of lifting equipment for the task.

Once it is determined that a chain lever hoist will be used it should be confirmed that the hoist will be used in a range that is between the working load limit and 10% of the working load limit and that the hoist will only be used in applications where it is free to articulate with its attachment point and aligned such that it is in a straight pull.

Issues identified in this guidance document, and particularly in this section (section 7), should be considered when completing the lift planning and risk assessment prior to use of a chain lever hoist in an offshore subsea environment.

7.2 Use of Static Rigging or Multiple Rigging Points to Avoid Single Point Failure

Where a lever hoist introduces a single point failure into a lifting arrangement, the user should consider the use of static rigging or some other means to eliminate the potential single point failure. This is particularly important if a load is to be suspended on a lever hoist for an extended period. The need for additional backup rigging should be identified as part of the lift plan and risk assessment.

As an alternative to static rigging, consideration should be given to the use of a suitably rated mechanical stopper fitted in place of the end stop that is capable of being moved up and down and attached to the free end chain such that it can be positioned close to the body of the lever hoist – like a movable end stop. Any modification, e.g. brake friction material or chain end stop, should be discussed with the manufacturer. If the brake mechanism fails the chain could only run through the hoist until the mechanical stopper contacts the hoist body, significantly limiting the distance the load could drop.

7.3 Practical Considerations During Subsea Lifting Operations

At no time during lifting operations should the working load limit of a lever hoist be exceeded.

As with any item of lifting equipment, the lever hoist will be specified for a maximum working load limit. This should not be exceeded during any lifting operation. It is important, therefore, when planning an underwater lifting operation that the load to be lifted on the hoist is known or has been accurately estimated with an adequate allowance for safety. The possible effects of additional loading, such as friction, seabed suction and buoyancy, should be included when the lever hoist is being selected for the lift.

A lever hoist should not be used to lift a load that is less than 10% of the working load limit.

The design of chain lever hoists is such that a brake mechanism is used to suspend the load. This brake mechanism gives the lever hoist its versatility but also introduces limitations on its use. The functionality of the brake mechanism relies on the application of a load for its operation. Under very light load conditions, lever hoists have been known to pay out chain due to the lack of load on the brake. This has been a problem when, or immediately following, changing the hoisting direction. When planning a lifting operation using a lever hoist or selecting a lever hoist for a lift, the light load limitation of the braking mechanism should be recognised and the hoist should not be used to lift a load that is less than 10% of the stated working load limit for that hoist.

A lever hoist should only be used for static lifts.

The lever hoist is intended for straight line static lifting. If used in a dynamic lifting arrangement, such as an adjustable leg in an overboarding rigging bridle, the changing loading may cause the hoist to fail or slip. As the load goes through the splash zone the weight could come off the brake mechanism and the chain could pay out. Chain lever hoists are not suitable for use in overboarding rigging and should not be used in a dynamic lifting application.

A lever hoist should not be used in the fully inverted orientation.

The chain lever hoist is much more versatile than a chain block, as it can be used in almost any orientation. It is important, however, that the free end chain runs smoothly through the block without 'hanging up'. When the lever hoist is used in an inverted orientation it is possible for the free end chain to bunch up, jam temporarily then release unexpectedly if not fed through cleanly. Consequently, it is not recommended that chain lever hoists be used fully inverted and that attention is paid to how the chain runs through the block when partly inverted.

A chain lever hoist should be loaded and unloaded using the hoisting lever.

When a load is removed from a chain lever hoist other than by the use of the hoisting lever (e.g. by transfer of a load to a surface crane) the brake mechanism will remain locked together. Subsequent loading of the hoist (for example, by the transferring of a load on to the hoist from a surface crane) will result in the load being applied to a locked brake mechanism – something manufacturers regard as bad practice, potentially resulting in unexpected slippage as the hoist is then operated. If a chain lever hoist has the load transferred off it (a common practice during subsea use) the hoist should be operated to unlock the brake and confirm the hoist is fully functional before a load is transferred back on to it. Alternatively the load could be landed (or suspended on static rigging) by using the hoisting lever before the transfer to the other lifting device.

Use of multiple lever hoists to share the load.

When using multiple chain lever hoists, each individual hoist unit should be rated to a capacity of at least 100% of the load. Any operation involving the transfer of the load from one hoist to another should use clearly defined procedures, and drawings or sketches would support the procedures. If two or more lever hoists are used to share the load during lifting operations, careful consideration of the operation is necessary as there is the potential to overload one of the hoists (beyond the working load limit) or under load one of the hoists (below 10% of the working load limit).

Length of time the lever hoist is in service should be limited.

If the application requires the load to be supported for a length of time beyond two weeks between the lifting and lowering operations, consideration should be given to using other equipment to sustain the load, as the hoist may corrode during the supporting period and be unsafe for the subsequent lifting or lowering part of the operation. Alternatively, consideration should be given to using other equipment to hold the load before releasing the equipment that has been supporting it (see section 7.4).

Brake contamination should be prevented.

Contamination of the brake lining can also cause the lever hoist to fail. This can be due to inappropriate cleaning practices, e.g. using a pressure washer or immersion in diesel, or because of in water contamination (particulate or chemical). During use, care should be taken to avoid unnecessarily

contaminating the chain lever hoist brake mechanism, such as by dragging it along the seabed. Chain lever hoists should not be used in locations where there are excessive suspended particles in the water, such as in the vicinity of grit blasting operations.

The effects of corrosion on the internal components should be limited.

Corrosion of internal components has been identified as an important factor in a number of incidents where lever hoists have failed. Extended periods in salt water and cyclic periods of immersion may accelerate the corrosion of the internal components in the lever hoist. The storage, issue and control of the use of the lever hoist are important in any system introduced for the safe use of lever hoists. Practices such as hanging lever hoists on the work basket and continually subjecting them to salt water and then air will accelerate corrosion and will affect the ability of the hoist to hold a load in a short period of time.

The prevention of accelerated corrosion leading to slippage/failure to hold the load can best be addressed by the introduction of a single immersion policy where lever hoists are only used subsea once before being inspected, serviced and retested (see section 7.4).

7.4 Immersion Policy

To avoid deterioration of the lever hoist during use subsea, a single immersion policy should be implemented. Each lever hoist should only be submerged once and this immersion should have a maximum time limit specified by the company competent person. A chain lever hoist should not normally be submerged a second time until it has been inspected, serviced and tested by a suitably qualified person (see section 4.6).

Pre-planning of the work should be done with the single immersion policy in mind and the need to reuse a lever hoist that has been subsea without first servicing and testing it should be eliminated.

8 Management of Equipment Issue and Return to the Store

Each company should have a system in place for issuing of equipment. Local legislative requirements, where appropriate, should be followed.

In general, a record of the equipment stored should be kept containing the following information:

- equipment identification;
- make;
- model;
- working load limit;
- height of lift;
- report number of relevant thorough examination.

A suitable system should be in place for the chain lever hoist equipment issue from store, its use and its return to store, that includes:

- record of issue;
- identification of work to be undertaken;
- equipment not to be left unsecured or used for any other purpose than its intended use;
- monitoring and record of the equipment returned to store;
- availability and serviceability status of all chain lever hoist equipment in store.

8.1 Cleaning of Equipment

Equipment that has been used subsea or which has been exposed to seawater splash/spray should be washed in unpressurised fresh water. Pressure washing should not be applied.

After washing, the equipment should be dried without the application of direct heat.

Equipment should not be immersed into lubricant, diesel, etc. in an attempt to displace water, as this could allow lubricant into the brake components.

The equipment should not be dismantled for cleaning or maintenance, except by an authorised competent person.

8.2 Maintenance of Equipment

Suitable competent trained personnel should be identified to undertake maintenance of equipment prior to its reuse. This may be carried out by the manufacturer or equipment supplier at their premises onshore or by trained and competent personnel at the worksite.

Prior to the reuse of a chain lever hoist that has completed its planned immersion the following will be required:

- cleaning;
- dismantling of the equipment;
- inspection;
- re-assembly and load test;
- thorough examination.
- quarantine of equipment

Any equipment found not fit for service during use should be labelled as unfit for service and quarantined in a controlled area. Equipment which is found to be faulty should be dealt with as part of a company's in-house process for defective equipment.

9 Maintenance

The level of maintenance and 'strip down' regime should be determined by the company competent authority.

9.1 Maintenance/Thorough Examination

It is likely that companies will have in place a method by which they appoint suitable competent persons to manage their maintenance both whilst offshore and the more intrusive works required during a thorough examination. Companies should create planned maintenance schedules based on the likely usage and potential exposure to harsh environmental conditions.

All lifting equipment should be thoroughly examined by a competent person throughout its life. Local legislation should be checked regarding the frequency of these thorough examinations.

10 End User Competence

Companies should ensure that all end users (e.g. divers, riggers, etc.) are suitably trained and competent in the use of the equipment and for the planned operation. This could take the form of an in-house training course, an external training course or an on-site pre-job briefing.

Suggested Checklist for the Thorough Examination of a Chain Lever Hoist

The following generic maintenance checklist has been produced by the Lifting Equipment Engineers Association (LEEA). It could be used as a basis for individual maintenance regimes, in association with a company's competent authority.

Prior to examination, the equipment should be stripped down to its component parts, the components cleaned and any corrosion, paint, etc. removed;

PRE-USE INSPECTION CHECKLIST FOR LEVER HOISTS			
Lever Assembly		**OK**	**DEFECT**
1	Examine lever and hand wheel for cracks, distortion and broken parts		
2	Check correct operation of pawl changing mechanism		
3	Examine fit of pawl to stud		
4	Examine pawl springs for corrosion and fractures		
Brake Assembly			
5	Examine splines, threads and ratchet teeth for wear and damage		
6	Examine brake component surfaces and ensure they are smooth and flat		
7	Check fit of ratchet ring bush and screwed sleeve		
8	Check condition of pawls and pawl springs and ensure pawls operate freely		
9	Discard brake discs and replace with new		
Load Chain Dead End Ring or Stopper			
10	Examine anchor ring or stopper for strength, security, distortion and wear (note that this should be at least equal in strength to 2.5 times the tension in the load chain at working load limit)		

PRE-USE INSPECTION CHECKLIST FOR LEVER HOISTS			
Bottom Hook			
11	Examine load pin for distortion and wear		
12	Check that the hook swivels freely and there is no excessive wear on the shank		
13	Check hook for stretch, distortion and wear		
14	Check that safety latch is present and operates correctly		
Gear Cover			
15	Examine for cracks, distortion and broken parts		
Spur Gears, Drive Pinion and Shaft			
16	Examine all gears for wear, fracture and alignment		
17	Examine drive pinion for damage and distortion		
18	Check shaft for straightness		
Load Chain			
19	Clean load chain in rumbler		
20	Examine and measure load chain, checking for bent, notched, stretched, worn or corroded links		
Internal Frame Side Plates			
21	Examine body plates for alignment and ensure they are free from wear and distortion		
22	Examine load pin holes for signs of wear and stretch		
23	Where applicable, check top hook yoke and cross bar for wear and distortion		
Top Hook			
24	Examine load pin for distortion and wear		
25	Check that the hook swivels freely and there is no excessive wear on shank		
26	Check hook for stretch, distortion and wear		
27	Check that safety latch is present and operates correctly		

PRE-USE INSPECTION CHECKLIST FOR LEVER HOISTS			
Chain Rollers, Chain Guide and Chain Stripper			
28	Examine chain roller and pin for wear and damage		
29	Examine chain guide for wear and damage		
30	Examine chain stripper for wear and damage		
Load Chain Pocket Wheel			
31	Check load chain pockets for wear and damage, ensuring satisfactory seating of load chain in pockets		
Bearings			
32	Examine all bearings/bushes for wear		
33	Check smoothness of operation		
Multi-Fall Hoists			
34	Check all load chain reeving sprockets for wear and ensure they rotate freely		
35	Check all associated bearings and pins		
36	Check all sprocket frames for wear, damage and distortion		
General			
37	Check that all components are suitable for their purpose and have not been replaced by inadequate substitutes		