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Handling Tyres

What follows are a series of examples of manual handling 'problems' within the tyre industry which are specific to tyre distribution and storage. Where possible, actual or potential improvement options are shown. Companies operating in the new tyre and retread sectors, and participating in the RUBIAC working group for manual handling have provided them.

Each example is presented in the form of an outline of the handling operation and then the quantified manual handling risk factors, followed by a comparison with the detailed risk assessment criteria presented in HSE guidance and other relevant sources (L23 Guidance on the Manual Handling Operations Regulations 1992, Manual Handling Assessment Charts - MAC). Where the task characteristics go beyond the scope of general guidance, specific references sources are used to form a judgement on the likely risk of injury.

1. Depot / Factory loading & unloading

The manual loading and unloading of casings and tyres of all varieties is a typical activity. This operation applies to loads of similar casings being brought in for retreading, and to loads of retreaded tyres being sent out to customers as a whole load. At many companies there are no loading bay facilities, and this creates particular handling difficulties.

Unloading…

During unloading, casings are typically handled from stacks or a laced stack within the vehicle to a cradle trolley or gondola. They are usually laced into the cradle trolley also.

It is common for two workers to perform this operation, one in the vehicle, pulling casings down and passing them to the second worker at ground level outside the vehicle.

Loading…

During loading of (retreaded) tyres, the change in level between outside and inside the vehicle creates more of a problem since the load has to be raised. The tyres are handled between the cradle trolley, and the vehicle, where they will usually be laced. Larger tyres may simply be stacked.

In the picture the workers are close together, when the workers are further apart, there is the added element of propelling the tyres/casings the distance between the rear of the load and the tailgate of the trailer. Typically the casings will be bowled along.

Manual handling risk factors:

- Load - around 10-15kg
- Force – there can be some force applied in removing the casings from a laced stack. Force is also exerted when bowling the casings/tyres between the two workers.
- Frequency - 10-20/min handling operations per minute. Frequency is likely to vary according to the position in the trailer, with faster rates being when the workers are closest together.
- Postures - stooping, twisting, reaching, above shoulder level (2.3m)
- Duration - typically at least 50% of the shift. Typically, other handling operations will be performed in the remainder of the time, such as stacking within the building for drying the tyres out before processing.
- Environmental conditions – hot in summer, cold in winter. There are adverse conditions to contend with, as well the potential for cuts from damaged casings, they are typically dirty, wet and difficult to grip. They can contain water and even ice, which also makes them significantly heavier. Depot yards can have tyre debris on the ground and have uneven surfaces. As well as increasing the risks of slips and trips, these conditions make the movement of trolleys more difficult.

The handling of retreaded or new tyres in this way presents less load-related hazards, since they should not be sharp, wet etc….

Comparison with guidance…

The detailed assessment guidelines filter in HSE's guidance on the Manual Handling Operations Regulations (L23) suggests that in the postures adopted by the workers performing this task, the load weight values may need to be reduced by 80% for handling at a rate of more than about 12 items per minute.

For handling above shoulder level and below knee level, the reduced load figure exceeds the filter figures by around 5 times for males and females.

Assessment

The overall risk of manual handling injury arising from this activity is therefore considered to be high, due to the combination of the weight of the casings, handling above shoulder/below knee level and the relatively high rate of handling.

Risk reduction measures

- An Alternative to lacing? An alternative to lacing casings could allow conventional handling aids/equipment to be used, such as powered lifting devices.

- Avoid/reduce reaching and stooping – any means of reducing the extent to which either of the workers have to handle the tyres/casings above shoulder level or below knuckle level.
    - A conveyor can be used to present the tyres or casing to the workers at a suitable level. Powered or gravity conveyors will be suitable. Extending conveyors will best suited to the changing distance that tyres need to be transported within the vehicle.
    - Can the worker in the rear of the vehicle use a platform of any kind to stack or lace the tyres high into the trailer?

- Remove change in level
    - There are a variety of mobile loading bays available which would enable the cradle and vehicle to be at the same level. This would remove the need for the worker unloading the cradle to raise the tyres to vehicle height, and lift above shoulder level.
- Provide a platform?
    - A low stable platform to use in the rear of the vehicle may reduce the amount of handling above shoulder level when stacking and unstacking.
- Conveyor?
    - A conveyor extending into the rear of the vehicle could be an option to avoid some of the repeated handling associated with filling and emptying the cradle trolley. A powered extending and height adjustable conveyor could assist in both unloading and loading. Even without a loading bay conveyors can be used, and mobile models are available. These can avoid carrying or bowling casings the length of the vehicle, avoid repeated handling associated with filling and emptying the cradle trolley, eliminate the need to lift or lower casings from ground level to the level of the vehicle deck.

- Conveyor with platform?
    - This represents the most advanced solution to the problem, a powered height adjustable (and slewing) conveyor can be fitted with a platform on which the worker stands. This enables the worker to handle tyres or casings only in the optimum region between knuckle and shoulder level.

- As with all wheeled devices, it is important to ensure that the wheels are suitable for the terrain over which the trolleys are to be taken, that the floor is kept clear of debris, there are no potholes or changes of level which increase the force required to move the trolley, and that there is a maintenance regime to ensure that wheels are kept in good condition.

2. Depot / Factory delivery vehicle loading

Loading multi-drop delivery trucks with no loading bay

The manual handling related risks associated with the loads of small tyres and the common practice of lacing are described above. The problem here is in the loading of different sizes of tyre. It is typical for a lift truck to load larger tyres into the rear of the vehicle, and for the tyres to then be positioned manually. It is normal for larger tyres to be stowed in a vertical orientation as can be seen here on the left, and this presents a relatively low risk, as relatively small forces are involved, and the postures are usually fairly good.

However things are different if the operation goes wrong. It is typical for two large tyres to be lifted into the vehicle at once, and it can be difficult for the worker to control two larger tyres. If one or both tyres fall over and end up flat on the floor, they need to be raised to vertical again, and this is done manually. Since the worker's hands need to be placed under the tyre, or at least within the rim, this means that the worker will stoop or squat. The tyres can weigh 80kg or more and the worker will be applying a force at least as great as half of the tyre weight.

In addition there are likely to be large forces exerted and in awkward postures if the worker tries to prevent the tyre from falling. The size of any forces is difficult to establish however.

Considering the case where the tyre has been allowed to fall flat on the floor and the worker is returning it to the upright position.

Manual handling risk factors:

- Load - 70-80kg or more, so minimum of 35-40kg applied force at floor level
- Force - Pushing and pulling forces to manoeuvre the tyres and in preventing them toppling
- Posture - Raised from flat on the floor means full stoop or squat
- Frequency & Duration - Relatively infrequent, and usually short duration

Comparison with guidance…

When considering the operation of raising a large commercial or agricultural tyre from flat on the vehicle floor to upright when it has been allowed to fall over, the force exerted by the worker, and applied at close to floor level is estimated to be at least half of the weight of the tyre, which can easily be as much as 40kg.

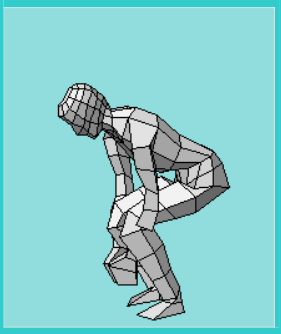
Comparing this load figure with those in the L23 risk filter, the values exceed the filter by a factor of 4 (for infrequent lifts).

MAC

Using the recently developed Manual Handling assessment Charts (MAC), a 40kg load lies within the Medium (Amber) and High (Red) risk zones depending upon the frequency of lifting.

NB: The top of the MAC Low Risk band (green) corresponds to the capability of an average female (i.e. protects half of females and most males), the top of the Medium Risk band (amber) corresponds to an average male (protects half of males and a few females), the top of the High Risk band (red) corresponds to 90 percentile male capability (protects only 10% of males and no females).

In addition, the scientific research upon which the MAC load/frequency chart is based suggests that a load of 38kg lifted once a day from floor level will be considered unacceptable by (i.e. likely to be beyond the capability of) at least 25% of the male working population.



Biomechanical analysis

Lifting at tyre edge close to floor level. Tyre weight 75kg - 18.75 kg force per hand.

L5/S1 Disc Compression Force = 4564 Newton

This far exceeds the NIOSH biomechanical criterion of 3400N

NB: The model is unable to account for the splayed leg and knee posture shown.

Assessment

The MAC and Biomechanical Modelling results are a further indicator of the degree of risk presented by the operation. This kind of lifting operation is therefore considered to present a very high risk of injury to a large proportion of the working population.

Possible risk reduction measures

- Only load one large tyre at a time - This will mean that the worker is better able to control the single large tyre, rather than trying to control one with each hand.
- Keep tyres upright and roll them - Keep all larger tyres upright as far as possible. This will reduce the risks associated with stooping or squatting to lift from floor level.
- Use a tail lift – Even a small delivery vehicle such as the one shown here would benefit from a tail lift – it is likely to be especially useful at the delivery end of the journey where there may not be a lift truck to assist. A fold up support to lean tyres against may be useful.
- Load/unload as a stack? - Can larger tyres be loaded on a pallet and manoeuvred within the vehicle with a hand pallet truck?
- Mechanical aids? - Pallet trucks, sack trolleys, or even powered lifting devices within the vehicle are possible alternatives to a completely manual approach

- clamp truck? – Clamp trucks can be used to pick up stacks of tyres or a group of tyres stood vertically, and then rotated to form a stack
- hoist? Vehicle mounted powered lifting devices are becoming available.

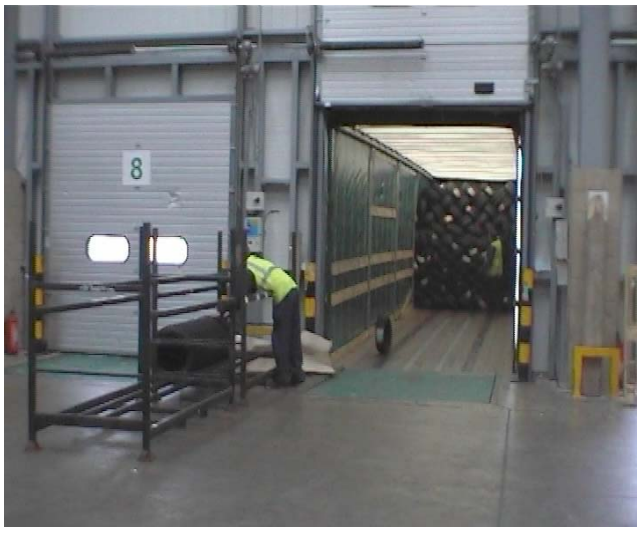
Vehicle based lifting devices

- Capable of lifting stacks of truck tyres of different sizes
- Capable of picking individual tyres or part stacks

NB: These devises are still being developed and refined, but they appear to offer a potential alternative to manually handling large tyres.

They do not necessarily fit well with the principle of keeping the tyres upright and rolling as much as possible. However, they may integrate well if manual handling is avoided throughout the rest of the process, for example through palletization.

3. Distribution (a)



At distribution centres or where large quantities of similar tyres are being unloaded or despatched for single drop delivery there is typically intensive manual handling

associated with stacking and un-stacking (laced or otherwise), or transferring tyres from stillages to stacks.

There are two main activities:

1. in the trailer - working with a stack (loading or unloading) handling tyres between the stack and bay.
2. on the bay - working with a stillage, handling tyres between the stillage and the trailer.

The picture above shows a typical arrangement, very similar for loading or unloading, where one worker is removing tyres from the stillage or placing them into it, and the other is either adding to, or removing tyres from a laced stack. The tyres are moved between the two workers by being bowled along the floor. The workers will generally develop quite a high level of skill in the bowling action, so that tyres are directed accurately, and with the minimum of effort.

The task is also monotonous, with the workers rarely having the opportunity to perform another task. They will invariably both loading and unloading operations.

Manual handling risk factors:

1. Working in the trailer

- Load - ranging from smaller car tyres to the heavier high performance and 4x4 tyres, weight up to 10~15kg plus the force involved in propelling tyres the length of the trailer
- Frequency - up to 13 operations per minute (varies through trailer)
- Postures - handling from knee level to 2.3m high in the trailer, stooping and reaching
- Duration - for the length of shift (1.5 hours/load), no job rotation

2. Working on the bay

- Load - as above
- Frequency - variable up to 13 operations per minute, as above
- Postures - handling from knee level to up to shoulder lever and reaching across to the opposite side of stillage (as shown in the picture)

Comparison with guidance…

Comparison of the task details with the L23 risk filter indicates that for the stacking/unstacking tyres below knee height and above shoulder/head height, the filter load weight values are exceeded when the frequency of handling and working postures are considered. Tyres are handled across the width of the stillage with some stooping and reaching postures.

Assessment

The overall operation (both tasks) is therefore considered to present a high risk of manual handling related injury.

Possible risk reduction measures

- Improve handling postures for both workers?
    - Improve stillage design to reduce reach
    - Use ramps to reduce bending
    - Use platform/step for worker in trailer
    - Rotate the stillages to reduce reaching
    - Use a conveyor to reduce bending
- Reduce forces?
    - Use ramps to propel tyres
    - Use a conveyor
- Manage exposure
    - Rotate workers to other operations

4. Distribution (b)

In this operation the workers are performing basically the same function but through the use of an extending powered conveyor and the tyres are stored on pallets instead of stillages.

There are again two handling operations:

1. in the trailer - handling tyres between the stack (in this case NOT laced) in the trailer and the conveyor.
2. on the bay - handling of the tyres between the conveyor and the pallets.

Manual handling risk factors:

- Load - up to 10~15kg
- Frequency -
    1. In the trailer – up to 30 tyres per minute
    2. On the bay – up to around 15 tyres per minute
- Postures -
    1. In vehicle – handling tyres from floor level and above shoulder level up to the trailer roof at around 2.3m.
    2. On the bay - handling tyres to empty pallet height to 1.4m stacks reaching and some trunk twisting.
- Duration = shift (1 hour/load)

Comparison with guidance…

This operation can involve very high frequency handling rates for the worker within the trailer, especially on unloading operations. Frequencies are somewhat lower when building the stacks.

For the worker(s) on the bay, the handling rate is less, but can still be relatively high

(The increased handling rate resulting from the use of the conveyor means that the risk filter load values should be reduced by up to 80%)

Comparing the task risk factors with the L23 risk filter, the task, although some aspects of the overall operation are improved through the use of the conveyor, there are still elements that exceed the filter. This is primarily the high handling rate and the awkward postures when handling tyres low and high in the trailer, and when stooping and/or reaching at the pallets.

High Frequency Handling
Scientific research into the effects of high frequency manual handling has shown that 50% of workers are likely to have considerable difficulty (i.e. find it unacceptable) in handling loads greater than 10kg in weight at rates above 16 operations per minute (from Mital et al 1997).

Furthermore, studies of endurance times when handling loads of up to 15kg at 12 lifts per minute above shoulder level (and below knuckle height) suggest that these aspects that are critical to endurance, and that a sensible time limit to protect the majority (90%) of workers from fatigue would be around 2 hours. (from Asfour et al 1991, presented in Mital et al 1997).

Mital *et al* (1997) suggest that the workers performing handling at rates of 20 operations per minute are likely to be under considerable cardiovascular and metabolic energy demands as well as being at risk of musculoskeletal injury.

Assessment

Overall this operation is considered to present a moderate to high risk to the two workers on the bay, and a high risk to the worker in the trailer.

Possible risk reduction measures

- Improve handling postures of workers
- Height adjusting conveyor
- Platform in trailer
- Pallet levellers
- Control or manage the handling rate
- Manage exposure

Control measures 2

If the loads can be stacked, and at this site they were stacked rather than laced it opens up the possibility of handling groups of tyres mechanically. At a different loading bay, this was being trialed with an FLT fitted with a clamp attachment. The truck was used to load and unload trailers with stacks of tyres. The rotating head of the clamp attachment enabled tyres to be lifted from and placed into stillages.

5. Storage and retrieval

In this operation an order-picker truck is used for storing new stock and retrieving tyres for orders in high racking (not palletised). The business supplies orders of small numbers of tyres from a very wide range of stock. As such a pallet or stillage based racking system is not thought to be very workable.
New stock is stored shortly after it arrives, and stacks of tyres are left in the racking aisles at the appropriate place to be stored. The piles are put there using sack trolleys. The orderpicker then moves along the aisles and puts the tyres up into the racking, and takes out tyres for orders as required.

The design of the order picker operator's platform is such that there is a continuous safety rail around it with an interlocked gate. This means that any tyres to be taken up to the racking need to be lifted from the stack on the floor, over the rail, to form another stack within the platform. Once at height, the tyres are again lifted from the stack and placed into the rack.

Similarly, when retrieving stock, the tyres are removed from the rack, stacked within the platform, returned to ground level and then unstacked over the rail and stacked again to be moved by sack trolley.

All this adds to the already numerous occasions that each tyre is lifted manually. It is estimated that each tyre can be manually handled up to seven times between delivery and despatch.

Manual handling risk factors:

- Load - up to an over 10kg
- Frequency – handling is in short bursts of approximately 1 minute periods, handling around 10 tyres per minute
- Postures – Stooping to stack and lift at floor level, some reaching into racking
- Duration - for the length of the shift, but intermittent and interspersed with other activities which also involve handling tyres

Comparison with guidance…

The tyres are handled below knee level and above shoulder level by both workers when loading the platform. The handling operation is not continuous, but handling is done at a relatively high rate for a significant proportion of the shift. For handling at this rate the L23 risk filter load weight values can be reduced by up to 50%. The filter can therefore be exceeded for a proportion of the task.

Assessment

This operation is classified as presenting a moderate overall risk of handling injury because it is performed intermittently. However, it is an avoidable repeated handling operation. Avoiding the need to load the platform manually would cut out 2 handling operations.

Risk reduction measures

- Avoid repeated handling - Enable stacks to be placed directly into the platform by sack truck - i.e. modify the platform safety to rail relocate the gate at the front, stacks could then be wheeled in directly
- Improve handling postures - Can the tyres be provided in the correct orientation to go into the racks? At least if the tyres were handled into the platform and onto a raised rack that supports the tyres in a vertical orientation, the order picker operator would not need to stoop to handle them into or out of the racking.

NB: This problem highlights the need to think about how manual handling can be avoided throughout the transport, storage and delivery process. This is not easy target to achieve, and many companies share similar problems. For many companies and operations it would require radical change to avoid the majority of the manual handling in one go, and changes will occur over time. However, there are small and practical steps that can be taken in many instances that can achieve worthwhile reductions in the overall risk of worker becoming injured through manual handling at work.

If manual handling cannot be avoided, then the handling operation should be improved as far as possible in terms of the load, the postures, the rate of handling, and the duration, etc.

General Principles

- Make it normal practice to keep larger tyres upright and rollable

- Stop the common practice of stacking tyres in piles, unless you have the mechanical handling equipment to stack and unstack them without resorting to manual handling. This will have a significant impact on the amount of and severity of manual handling throughout the tyre lifecycle

- Avoid lacing tyres wherever possible. Lacing is probably the single largest barrier to avoiding many manual handling operations within the tyre industry. It is still the exception, but it is becoming increasingly common for tyres to be handles in packages, either palletised or on stillages. For example some car manufacturers request that their original equipment tyres are supplied on stillages (which are subsequently returned to the supplier). The new tyres are then transported to point of use mechanically.

Manual Handling Training

There is no prescriptive specification of what constitutes 'good' training in manual handling, but typically a course should:

- Be suitable for the individuals, and relevant to the handling jobs and the work environment, and use suitable example jobs. This means that it should at least be industry specific. While is might be suitable to demonstrate the basic principles using a cardboard box in a spacious training room, it is poor practice to continue to focus on such examples where they bear little relation to the actual jobs. As well as being of limited utility to workers, this will detract from the credibility of the training;
- Last approximately ½ day or more, depending upon the job; anything less than 1 hour is not likely to cover all the relevant information.

The content should include:

- Some basic information about the anatomy of the spine and muscular system, and how injuries occur;
- The key risk factors for manual handling injuries relating to the load, the task, the environment and individual capability and how those factors present in the particular industry and workplace;
- How to avoid manual handling and reduce the risks;

- Basic principles of safe moving and handling and then how those can be applied in that particular industry and workplace taking into account the local tasks and workplace and wearing of PPE, etc;
- However, the training should enable delegates to deal with unfamiliar operations through basic understanding of the principles of avoidance and safe lifting techniques;
- Demonstration and practice of lifting and handling techniques such as planning the lift, feet position for stability/balance, posture, keeping load close to the body, moving the feet instead of twisting the trunk, etc;
- Demonstration and practice in safe use of lifting equipment if applicable;
- Practical work to allow the trainer to identify and remedy any unsafe practice demonstrated by trainees;
- What the company procedure for reporting injuries is and what action will be taken if a member of staff is injured.

Records

- There should be a planned programme of training to ensure all staff are trained with a system to ensure that they actually did attend, and records kept of who has been trained, when, and what was covered in the course.

Other things to consider when selecting an outside trainer:

- Whether the trainer asks for information about the company and specific identified risks before starting the training. If a trainer has not asked these questions it is likely that the course will not have been tailored to that company and whilst covering the basics it is less likely to be effective, and credible to the workers.