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HEALTH & SAFETY LABORATORY

Development of an inspection tool for manual handling risk assessment

HSL/2002/30

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OBJECTIVES

The Ergonomics Section of HSL was commissioned in April 2000 by the Human Factors Unit of HSE's Health Directorate to examine the feasibility of providing HSE inspectors with an existing manual handling risk assessment tool or producing a new tool. The tool needed to conform to the following criteria:

- It must be very quick and easy to use.
- It must link in with other published information on manual handling, particularly that published by HSE.
- It should intuitively indicate good manual handling practice.
- It must be able to identify high risk manual handling tasks.

This report outlines the work on the new tool from the initial development, through its conceptualisation, and up to its formal release to HSE inspectors in November 2002.

MAIN FINDINGS

The potential for use of an existing tool in the inspection setting was restricted through failure of any one tool to possess all the criteria specified by the project team.

A draft set of tools was produced for assessing lifting, carrying and team handling operations. Each chart used a flowchart format with a "traffic-light" risk indication system. Risk factors, such as load weight, frequency and hand distance from the low back, were selected for inclusion on the basis of the ergonomics literature and on the ergonomist's approach to assessing manual handling in the field.

Discussion groups were set up with HSE inspectors to seek the comments of the target group of end-users on the design criteria of the charts and so produce a revised draft for further evaluation. In addition, technical aspects of the charts were examined in a peer-review exercise undertaken by another ergonomist.

CONCLUSIONS

The charts were found to conform to the design criteria.

- Inspectors found them useful, quick and easy to use.
- The commonalities with HSE published guidance improved user understanding of the charts.
- The peer-review exercise found the charts to be an appropriate method to rapidly assess manual handling activities, and the factors selected were justified.

The chart format of the tools and the use of factor risk grades focussed the inspectors' minds on possible improvements and what compliance would look like.

Improvements were made as a result of suggestions by the participants and the peer-review exercise. For example:

- Inspectors found the instructions too cumbersome and suggested a short one page aide-memoire as a useful alternative. The scoring system was focussed on individual risk factors rather than an aggregate action level.

- A smaller notebook sized version of the charts was produced in May 2002.

The suggestions from users and the recommendations from the evaluation work were reviewed in August 2002, as described in other related reports. Appropriate updates were discussed by the project team and included in the edition of the charts finally issued to all HSE inspectors in November 2002.

1 INTRODUCTION

1.1 BACKGROUND

The prevention and control of work-related musculoskeletal disorders (WRMSD) is now a major Health and Safety Commission (HSC) priority and one of the keys to improving occupational health. Success in this area is vital if the targets (a 20% reduction in the incidence of work-related ill health and a 30% reduction in the number of work days lost due to work-related ill health by 2010) established by the national occupational health strategy, *Securing Health Together* (HSC, 2000), are to be achieved. The HSC is now planning wide ranging measures to tackle this issue, most of which will require sustained action by HSE in partnership with other stakeholders.

Health and Safety Executive (HSE) and Local Authority (LA) inspectors will play an important part in preventing WRMSD. As well as enforcing health and safety law, they provide advice on risk factors and control measures on a wide range of health and safety issues and therefore need to be able to quickly identify high risk activities. However, it can be particularly difficult to establish the degree of risk in relation to WRMSD because of the lack of quantitative exposure-response relationships, the wide range of risk factors, and the interactions between them.

1.2 SPECIFICATION OF AN INSPECTION TOOL FOR MANUAL HANDLING

The Ergonomics Section of HSL was commissioned in April 2000 by the Human Factors Unit of HSE's Health Directorate to examine the feasibility of providing HSE inspectors with an existing manual handling risk assessment tool or of producing a new tool.

This report outlines the work on the new tool (the Manual handling Assessment Charts, or MAC) from the initial development, through conceptualisation, and up to the formal release to HSE inspectors in November 2002 (HSE, 2002b). Other aspects of the tool development are considered in separate reports (usability testing (Care *et al.*, 2002), reliability testing (Tapley, 2002) and benchmarking of the charts against other tools (Pinder, 2002)).

1.3 CRITERIA FOR THE INSPECTION TOOL

Criteria for the tool were specified at the outset in order to ensure maximal suitability for the target users:

- The tool should to be very quick and easy to use (e.g., few pages and intuitive design).
- It must link to traceable scientific studies and guidance on manual handling, particularly that published by HSE (e.g., L23, the Guidance on the 1992 Manual Handling Operations Regulations (MHOR) (HSE, 1998)).
- It should intuitively indicate good manual handling practice.
- It must be able to identify high risk manual handling tasks.

2 EXISTING ASSESSMENT TOOLS

A range of existing assessment tools was reviewed to examine their feasibility for use by HSE inspectors and their potential for meeting the criteria for a suitable tool. The principal tools and assessment methods examined were:

- Quick Exposure Checklist (QEC) (Li and Buckle, 1999)
- NIOSH Lifting Equations (Waters *et al.*, 1994; NIOSH, 1981)
- Psychophysical lifting and carrying tables produced by Liberty Mutual (Snook and Ciriello, 1991)
- Job Severity Index (JSI) (Liles *et al.*, 1984)
- Ovako Working posture Analysis System (OWAS) (Vedder, 1998)

A previous review (Dickinson *et al.*, 1998) of these (except the QEC) and other commonly used tools was the basis for the critical evaluation. Table 1 shows the merits of the tools in relation to the first three tool selection criteria and comments on their suitability for use as an inspection tool. The overall suitability of the methods was assessed by the project team, based on their experience as ergonomists of using the tools and their previous experience working as, and alongside, inspectors during investigations of manual handling practices in workplaces.

Based on the examination of the available tools, it was concluded that the potential for use of the tools in the inspection setting was restricted through failure of every tool to possess all four of the criteria specified by the project team. Another consideration was that none of the tools reviewed had been validated as predictors of injury risks. It was decided a new manual handling tool targeted specifically at HSE inspectors should be developed with the specified criteria in mind.

Table 1 Suitability of existing tools to become a manual handling risk assessment tool used by HSE inspectors.

	Description	*Comments*	*Development criteria*			*Overall potential suitability and problems*
			Quick and easy	*Linked to L23*	*Guides good practice*	
QEC	Posture and load exposure tool for MSD risks.	Matrix for exposures is useful. Developed specifically for practitioners.	Quick and easy after some familiarisation. Scoring observations live can be awkward. May not be quick enough where varied manual handling occurs.	Emphasis on overall MSD risk, not manual handling. Less applicable to load related factors	Useful but not intuitive to a duty holder.	**Reasonable**, but limited by reduced manual handling emphasis, involved observation required and need for employees to rate every operation.
NIOSH lifting equations	Numerical equation based method.	Two-handed lifting only. Accuracy of assessment depends on other conditions and assumptions being met.	Numerical basis not suited to inspection approach. Can be time-consuming to collect the information required.	Reasonable compatibility; factors in the equation link with L23.	Possible but awkward. Demonstrating good practice to duty holders impractical.	**Poor**
Snook / Liberty Mutual Psychophysical tables	A database of capability information	Applicable to lifting, lowering, carrying and pushing and pulling.	Large fairly complex tables can be awkward to read. Can be quick and easy if task is similar enough to those in the table.	Implicitly related to issues in L23 (load size, lifting range and posture).	Useful in terms of matching load weight and frequency of lift with a target population.	**Reasonable**, but much background information needed for easy use. Very useful if part of a broader assessment method.
JSI	Numerical equation based method.	JSI output highly dependant on capability data used. Sagittal plane lifting and lowering only.	Numerical basis not suited to inspection approach. More awkward if large number of distinct jobs undertaken by single operative.	Capability data could be used that linked to L23 guidance. The link is not explicit in many cases.	Possible but awkward. Demonstrating good practice to duty holders impractical.	**Poor**
OWAS	Posture analysis tool	Requires observation at intervals across a shift.	Perhaps over simple. Speed of use is a problem given postures over a period are needed to be meaningful	Postures do link with L23. Factors related to the load and environment are sparse.	Posture good practice is quite clear with the method.	**Poor**

3 CONCEPTUALISATION OF THE NEW TOOL

3.1 DEVELOPING A FORMAT FOR THE TOOL

The idea from the outset of the project had been to develop a flowchart type format for the tool that would fit on one side of A4 paper and which the user would progress through in a simple logical way while noting categories of risk within each flowchart section. A traffic-light system was also selected to grade relative risks within each factor. Therefore, Green would represent good practice and low risk, while Red would represent high risk and poor practice.

A tool for assessing lifting was the starting point for the development, with the aim that separate charts in a similar vein would also be developed to assess team handling and carrying operations.

A draft chart was constructed and circulated to the project team for comment. At that stage, the factors within the chart had not been fully considered. The project team considered the broad approach to be worthy of further development, so it was agreed that lifting, carrying and team handling charts should be developed.

3.2 SELECTION OF RISK FACTORS FOR INCLUSION IN THE TOOL

In line with the second criterion, the tool needed to be linked in with current guidance on manual handling, in particular information published by HSE. Therefore, efforts were made to ensure the risk factors used in the charts were at least implicitly related to those described in the HSE guidance on the 1992 Manual Handling Operations Regulations (HSE, 1998).

The initial process was to consider the ergonomist's approach to examining manual handling in the field and try to harness that approach for use in the tool. This was done by considering the risk factors in Schedule 1 of the 1992 MHOR (HSE, 1998) and listing the aspects normally identified when observing manual handling operations in workplaces. The listed factors were then ranked in order of observation/importance (Table 2). The factors needed to be those that would be consistently assessed in almost all situations. Load-related issues, such as bulk or sharp edges, are not found on all occasions and can be dealt with implicitly during an inspection by examination of other factors. Thus, a bulky load could impact on the low back moment of force, while sharp edges would relate to hand coupling.

Table 2 Ergonomist's approach to manual handling observation and assessment in the field

Load weight	Observed first
Frequency of lifting	
Low back moment of force	
Back and trunk posture	
Constraints on posture	
Hand to load coupling	
Other work environmental issues (flooring, lighting and temperature)	Final observations

The ranking exercise used prominent reviews (Bernard, 1997; Op De Beeck and Hermans, 2000) summarising health based epidemiological research on work-related back disorders, and original reports from the manual handling literature. Importantly, a consensus exists that physical risk factors associated with an increase risk of back disorders are: heavy physical work; lifting and handling of loads; and awkward postures (e.g., bending and twisting).

The identified factors were then examined closely to develop categories into which the levels observed for each factor could be separated. Boundaries that would be easy to identify during field observations were defined on the basis of the scientific literature on individual factors. It was clear that, while most factors would be common across the three charts, there would be additional factors, such as co-ordination and communication (for team handling), or obstacles en-route (for carrying), which should be added as appropriate.

The final factors used for the tool are described below, though it should be noted that the design and piloting of the tool was an iterative process giving rise to several revisions of components in the tool. Some of the revisions are described in later sections of the report.

3.3 LOAD WEIGHT AND FREQUENCY

3.3.1 Lifting flowchart

It was clear that simple weight limits for each risk grade would be inappropriate, and therefore the aim was to develop a graphical approach to allow an assessment to be made using the weight handled and the repetition rate. Data from Snook and Ciriello (1991) were selected to provide information on what can be considered to be the upper end of individual capability. Therefore, other factors in their tables that reduce lifting capacity are not taken into account at this stage,

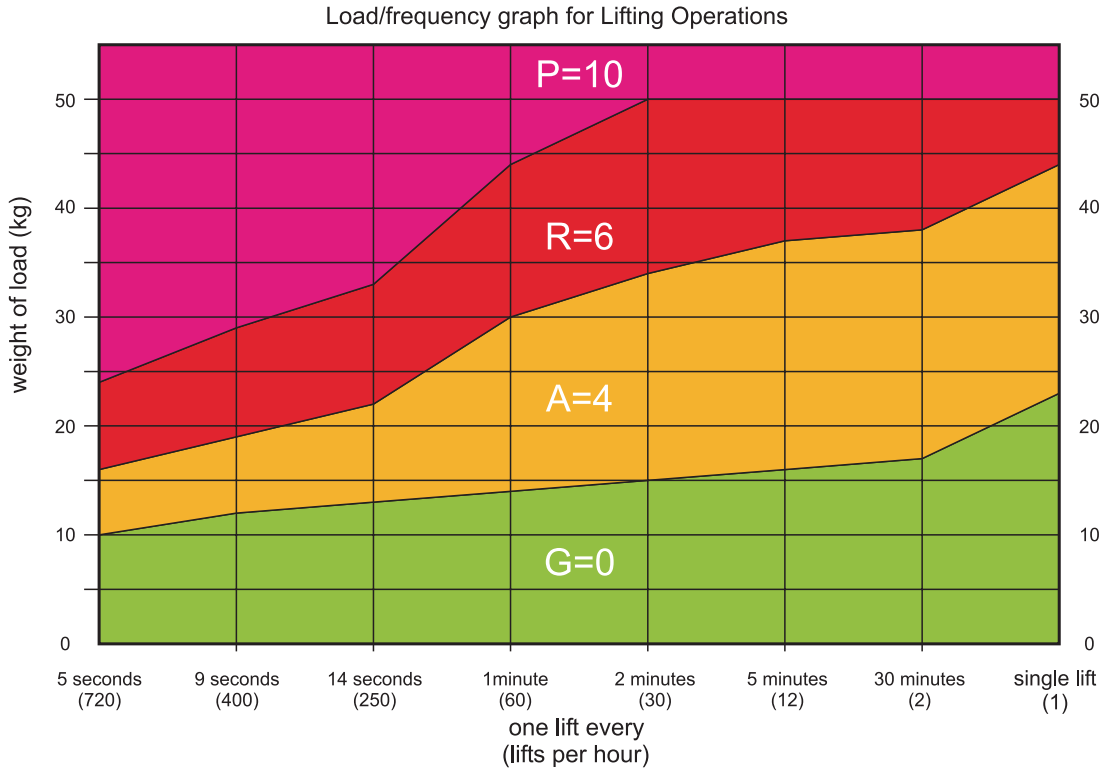

Figure 1 Frequency / load graph developed for the lifting flowchart

but are accounted for by later factors in the flowchart. This approach assumes that the effects of the different factors do not interact, that they are independent of each other. The data used were maximum acceptable weights of lift in the floor to knuckle region, with a compact load being lifted over a 760 mm range close to the body.

Initially, consideration was given to providing separate graphs for males and females but, for simplicity, it was decided to have one graph (Figure 1) applicable to both males and females. The boundary between the Green and Amber zones in the graph is based on data that Snook and Ciriello (1991) found acceptable to 50th percentile (i.e., average) females. The boundary between the Amber and Red zones is defined by load/frequency combinations acceptable to 50th percentile males. The boundary between the Red and Purple zones is acceptable to 90th percentile males (strong males), until it reaches 50 kg. The 50 kg maximum for the upper limit of the Red zone was selected in line with information in the HSE risk filter (twice the 25 kg upper load level for males) in Appendix 1 of HSE (1998) and as a package / sack size that HSE had succeeded in encouraging the construction industry to abandon. The project team considered it important to define the Purple zone as indicating load/frequency combinations that would indicate a very high level of risk of injury due to it being acceptable to very few industrial workers.

3.3.2 Carrying flowchart

The same source (Snook and Ciriello, 1991) was used for the data used to create a load / frequency graph for carrying operations (Figure 2). The same population values as for the lifting graph were used as boundaries between the risk grades. Again, in order to represent the upper end of capability, without influence from other factors, the data from a 2.1 m carry distance with a hand height of 1.1 m were selected.

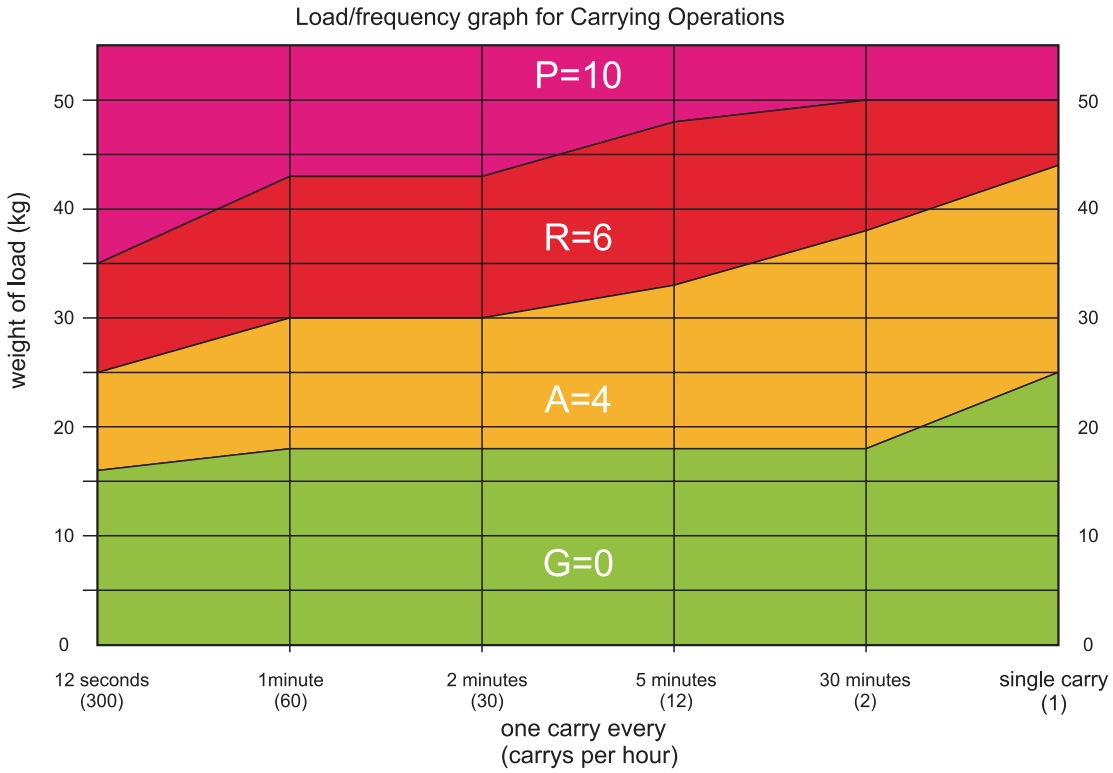

Figure 2 Frequency / load graph developed for the carrying flowchart

3.3.3 Team handling flowchart

In the team handling flowchart ranges of capability are specified on the basis of the team size, but independent of the lifting frequency. Although repetition rates are very important in determining safe lifting capacity, it was felt that team handling operations are typically less repetitive than single person handling and that they are probably less appropriate if loads are handled at rates greater than approximately 1 lift per minute.

Laboratory research examining team handling has used different approaches to determine team handling capabilities in terms of the individual capabilities of the team members. The approaches used have differed: some have used free inertial strength measures to determine capability (Sharp *et al.*, 1997); some have used isometric and isokinetic measures (Karwowski and Mital, 1986; Karwowski and Pongpatanasuegsa, 1988); and others have used psychophysical methods (Johnson and Lewis, 1989; Pinder *et al.*, 1997). There is conflicting evidence as to whether there is a reduction in efficiency based on team handling compared to the sum of individual capabilities (Pinder *et al.*, 1997). Where reductions have been found, it is likely they arose from alterations in the mechanics of the operations (compared to individual tasks), co-ordination effects and/or the limitations imposed by the weaker member of the team.

The HSE Guidance on the Manual Handling Operations Regulations 1992 (HSE, 1998, paragraph 75) takes a conservative approach to the effect of team size. Based on work reported by Karwowski and Mital (1986) and Karwowski and Pongpatanasuegsa (1988), it states:

> *"As an approximate guide the capability of a two person team is two thirds the sum of their individual capabilities; and for a three person team the capability is half the sum of their individual capabilities."*

A European Standard (CEN, 2003) on the safety of machinery where manual handling is required of its operation has used a factor for team handling of 85 % of the sum of individual capabilities.

No Green zone was defined for teams of more than three workers. The increased difficulties of co-ordination and control as the team size increases are themselves risk factors. No zones were defined for teams of more than four workers due, partly, to a lack of evidence and to the infrequency with which such tasks occur. The boundary between the Green and Amber zones was based on the maximum value of 25 kg in the risk filter in Appendix 1 of HSE (1998). For teams of two and three people this was multiplied by the team size and the reducing factors from HSE (1998) and rounded up to the nearest 5 kg.

- 2 person team $25 \times 2 \times 0.666 = 33.3$ kg, rounded to 35 kg
- 3 person team $25 \times 3 \times 0.5 = 37.5$ kg, rounded to 40 kg

The boundary between the Amber and Red zones used the Amber/Red boundary value of 30 kg at one lift per minute for one person lifting. This was multiplied by the team size and the 85% factor suggested by CEN (1999) and then rounded down to the nearest 5 kg.

- 2 person team $30 \times 2 \times 0.85 = 51$ kg, rounded to 50 kg
- 3 person team $30 \times 3 \times 0.85 = 76.5$ kg, rounded to 75 kg
- 4 person team $30 \times 4 \times 0.85 = 102$ kg, rounded to 100 kg

The boundary between the Red and Purple zones also used the 85% decrement suggested by CEN due to the effect of team size. The base figure selected was the maximum value of 50 kg for the Red/Purple boundary in the lifting chart. After multiplying by team size, and the decrement the figures obtained were rounded down to the nearest 5 kg.

- 2 person team $50 \times 2 \times 0.85$ = 85 kg, rounded to 85 kg
- 3 person team $50 \times 3 \times 0.85$ = 127.5 kg, rounded to 125 kg
- 4 person team $50 \times 4 \times 0.85$ = 170 kg, rounded to 170 kg

Table 3 Risk zones for team handling

	Green	*Amber*	*Red*	*Purple*
2 person	< 35 kg	35 - 50 kg	50 - 85 kg	> 85 kg
3 person	< 40 kg	40 - 75 kg	75 - 125 kg	> 125 kg
4 person		40 - 100 kg	100 - 170 kg	> 170 kg

3.4 HAND DISTANCE FROM THE LOWER BACK

The moment about the lumbar spine required to counterbalance the combined effect of upper body posture and the load at the hands is a well-established indicator of low back stress and risk (e.g., Marras *et al.*, 1995). HSE (1998) illustrates the issue in detail (Figure 6, p13, paragraph 54-55). Consequently, the factor has been included in the lifting, carrying and team handling charts. The greater the load, and the further the hands supporting the load are away from the low back, the greater is the compressive load on the intervertebral discs, and the greater the torque about the lumbar spine being counteracted by the muscles and ligaments of the low back.

The necessary hand distance forward of the trunk in the sagittal plane is often determined by the size of the load and has a strong influence on the postures adopted. Studies have shown that combinations of high compressive and shear stresses can be damaging to the intervertebral discs (Adams and Hutton, 1982; Adams and Hutton, 1985). Other studies have shown that lifting capability decreases with increases in horizontal distance, specifically in relation to the spinal stresses experienced (Mital and Kromodihardjo, 1986), acceptable weights selected (Snook and Ciriello, 1991) and the physiological stress imposed (Mital, 1986a).

Video footage of industrial manual handling activities was reviewed with the aim of picking out common features and postural indicators that could be usefully used as definitions for the categories. The load being close to the body represents a simple starting point. It was considered that a useful indicator of hand distance was accessible by observing the posture of the back and shoulders/arms of the operative, rather than trying to estimate or measure the actual distances of the hands from the low back area.

Table 4 Risk gradings for hand distance from the lower back

Good	*Reasonable*	*Poor*
Upper arm vertical with the trunk upright	Upper arm angled or trunk bent forward	Upper arm angled and trunk bent forward

3.5 VERTICAL LIFT REGION (LIFTING AND TEAM HANDLING)

The vertical positions of the start and finish of the lift help determine the postures that are adopted during the lift. They therefore influence the biomechanical stresses imposed on the low back and also relate to the low back moment, especially when the trunk is bent forward. Therefore, this factor was developed to identify high risk aspects of an operation related specifically to forward bending of the trunk and reaching vertically with the arms.

The definitions of the risk grades were chosen to enable the user to relate easily the position of the hands holding the load with anatomical landmarks on the operative undertaking the operation. This lead to the adoption of floor level, knee height, elbow height and head height as easily discernible landmarks separating the risk grades.

Table 5 Risk gradings for vertical lift region

Good	*Reasonable*	*Poor*
Between knee height and elbow height	From below knee height or above elbow height	From floor level or below, or from head height or above

The Green zone is similar to the zone in the risk filter in Appendix 1 of HSE (1998) with the highest filter value. The Amber zones covers vertical positions from the Green zone to the vertical limits of the risk filter. The Red zone relates to extreme vertical positions (above head height and floor level or below) that require the adoption of particularly awkward postures and are outside the risk filter diagram.

3.6 TRUNK ASYMMETRY

3.6.1 Trunk twisting and sideways bending (lifting and team handling)

An association between asymmetric trunk postures and low back disorders was documented by Bernard (1997) and Op De Beeck and Hermans (2000) and is reflected by the guidance in HSE (1998). Trunk twisting and sideways bending involve the contraction of large muscle groups in patterns which, under certain conditions, may be less easily co-ordinated than a simple sagittal plane lift. Biomechanical modelling has indicated that asymmetrical lifting activities give rise to greater low back stress (both spinal compression and shear) than symmetrical lifting (Mital and Kromodihardjo, 1986). This has also been found for team lifting (Marras *et al.*, 1999). Therefore, a factor concerned with trunk asymmetry and sideways bending was developed.

The aim was to identify asymmetrical postures and movements. It was considered that the best approach was to break the asymmetry into twisting and sideways bending (forward bending being dealt with in the load moment and vertical position factors). It was considered necessary to keep the assessment of what can be a complex situation of trunk movement and posture as simple as possible to ensure consistent scoring.

Table 6 Risk gradings for asymmetrical lifting and team handling

Good	*Reasonable*	*Poor*
No twisting or sideways bending of the trunk	Either twisting or sideways bending is present	Both twisting and sideways bending of the trunk seen in the same operation.

3.6.2 Asymmetrical carrying and carrying of asymmetrical loads

For carrying, the nature of the load can have a marked effect on the trunk postures adopted, so the presence of asymmetrical trunk postures or loads was used as an indicator of risk. Carrying capability is affected by load distribution and stability (Mital, 1987). For example, a load held at the individual's side places an imbalanced loading on the muscles of the back which does not occur with an object held symmetrically in front of the trunk.

Table 7 Risk gradings for asymmetrical carrying

Good	*Reasonable*	*Poor*
A two handed carry with the load positioned to the front of the operative	A two handed carry with the load positioned at an offset position (this may then involve trunk twist or bending)	A one handed carry at the individual's side (probably involving marked bending or twisting at the trunk)

3.7 POSTURAL CONSTRAINTS

The working environment can sometimes give rise to postural constraints that reduce the flexibility of operatives to vary their posture or impose added stresses on the musculoskeletal system. For example, handling in confined spaces requires operatives to work in less favourable postures irrespective of the handling operation taking place, while lifting loads onto a high level conveyor places additional stress on the operative due to excessive reaching and stretching and reduces overall control and stability. Ridd (1985) demonstrated a reduction in lifting capability with a reduction in headroom. Mital (1986b) found carrying in narrow passages gave rise to reduced carrying capacity.

Table 8 Risk gradings for postural constraints

Good	*Reasonable*	*Poor*
Movements unhindered	Restricted postures	Severely restricted postures

3.8 GRIP ON LOAD

The quality of the grip on a load during manual handling is important. Studies of lifting have shown that when a good grip (i.e., handles) is provided, 4% to 30% more load can be handled than in less favourable grip situations (Garg and Saxena, 1980; Snook and Ciriello, 1991). A study of horizontal pulling forces has shown that handle design can reduce strength by 65% (Fothergill *et al.*, 1992). A more suitable grip affords less opportunity for fatigue of the forearm muscles and therefore a reduced risk of the load being dropped during the operation.

The risk categories used (Table 4) are based on those adopted in the 1991 NIOSH lifting equation (Waters *et al.*, 1994).

Table 9 Grip on the load criteria

Good	*Reasonable*	*Poor*
Containers with well designed handles or handholds, fit for purpose.	Containers with poorer handles or handholds.	Containers of poor design. Loose parts, irregular objects, bulky or difficult to handle.
Loose parts enabling comfortable grip.	Fingers to be clamped at 90 degrees under the container.	Non-rigid sacks or animate objects (animals and people)

3.9 FLOOR SURFACE

Since a loss of grip at the feet can cause a slip or loss of balance during manual handling, the quality of the floor surface and hence the grip afforded at the feet has clear implications for how force is applied and thus the assurance of grip (Grieve, 1983). Therefore, factors important in the risk of slipping or tripping (e.g., contamination or loose materials on the floor) were included.

Table 10 Floor surface criteria

Good	*Reasonable*	*Poor*
Dry and clean floor in good condition	Dry floor, but in poorer condition, worn or uneven	Contaminated/wet or steep sloping floor or unstable footing

3.10 OTHER ENVIRONMENTAL FACTORS

To help provide a balanced assessment, the environmental factors of temperature, draughts, and lighting were also considered. If any of extremes of temperature, strong air movements and inadequate lighting conditions are identified then an Amber score is recorded.

3.11 ADDITIONAL FACTORS IN THE CARRYING CHART

3.11.1 Carry distance

Carrying capability decreases as carry distance increases (Snook and Ciriello, 1991; Mital *et al.*, 1997). Operations involving a lift and a carry of less than two metres or one to two paces should be considered using the lifting flowchart as the carry distance is negligible.

The risk grading criteria selected define the Green zone so that it represents carry distances that can be considered short. The Amber zone was defined to indicate a reduction in maximum acceptable weight of carry due to an increase in carrying time, local muscle fatigue and metabolic costs. The 10 m boundary between the Amber and Red zones was selected as a distance above which carrying capacity reduces significantly (Mital *et al.*, 1997).

3.11.2 Obstacles en route

The metabolic stress of carrying a load increases when obstacles such as inclines or stairs are negotiated en-route and load carrying capability decreases (Mital *et al.*, 1997). In addition, obstacles can greatly increase the complexity of a carry and introduce the potential for traumatic

incidents such as a trip or fall. The risk grades were selected on the basis that a slope was considered to be a lesser risk than a ladder or flight of stairs.

3.12 COMMUNICATION AND CO-ORDINATION IN TEAM HANDLING

Mannion *et al.* (2000) suggested that loading on the lumbar spine can increase by 30% to 70% under conditions of an unexpected incident compared to the same loads being held statically in the same posture. Team handling is a situation in which one team member could unexpectedly release the load with the result that remaining team members would suddenly be handling a disproportionate amount of the load. Therefore, team handling exertions need to be co-ordinated to ensure that control is maintained over the load through out the operation. Effective communication between team members to bring about this co-ordination is therefore necessary.

Therefore, it was considered essential that at least a subjective consideration was made of these issues as part of the assessment. The risks were graded good (Green), reasonable (Amber) and poor (Red). Factors such as whether the team members can see each or hear all other team members other should be taken into account as communication cues could be either visual or auditory.

4 INITIAL CONFORMITY TO DESIGN CRITERIA

4.1 INTRODUCTION

Following the drafting of the charts it was considered essential that, at the earliest opportunity, constructive comments and opinion be sought from the target users of the charts. At this initial stage the aim was to examine the draft charts from the point of view of the design criteria. In addition, technical aspects of the charts were examined in a peer-review exercise undertaken by another ergonomist.

4.1.1 Discussion groups

Two discussion groups, each lasting three hours, and involving five operational inspectors had the purpose of familiarising them with the manual handling charts. The basic principles of the charts were described and instruction was provided in their use. The inspectors then used the charts to evaluate seven manual operations (three lifting, two carrying and two team handling) shown on video. Each inspector filled out the appropriate chart for each operation and the scores were discussed and compared. Any discrepancies were identified and causes sought in problems of ease of use. This process enabled improvements to be made to the drafts without recourse, at that stage, to formal testing of reliability and consistency of scoring. Issues pertaining to the use of the tools, such as training provision, and the information and systems of support needed to help inspectors effectively use the tools in the field were also discussed.

4.1.2 Peer-review

The peer-review scrutinised the selected risk factors, the proposed scoring system and the general layout of the charts. This involved examining the on technical validity of the risk factors and how the initially suggested system of action levels functioned, particularly in relation to the risk filter in Appendix 1 of HSE (1998).

4.2 RESULTS

4.2.1 General

The basic idea of the tool and the layout using the flowchart type approach were very well received. The flowchart format limited to two pages per chart was found to be very easy to follow and apply. There was a general consensus that the charts would help to improve the competence of inspectors and their consistency of approach when inspecting premises where manual handling operations occur. Inspectors found that the way that the charts drew on the terminology in the Manual Handling Operations Regulations and the HSE guidance (HSE, 1998) on them was helpful.

Several inspectors considered the instructions to be too large and inappropriate for use during site visits. One suggested that a simple one page ‘aide-memoire’ of the factors and how to make an assessment would facilitate on-site use.

The peer-review found the charts to be a valid approach for the assessment of manual handling. The risk factors selected for inclusion were found to be justified. The traffic-light approach was

considered attractive and linked well with the low, medium and high risk classifications used in the example assessment checklist in Appendix 2 of HSE (1998).

4.2.2 Training and accompanying information

Inspectors emphasised that they are very busy and that any training demands need to take account of this. Clearly, a system that required minimal training would be most beneficial. They acknowledged the advantages of structured training provided by a facilitator, particularly with regard to ensuring consistency of scoring and assessment.

Opinions on the format of suitable training were diverse. Suggestions were made that a half-day session organised for participating inspectors would be beneficial. One inspector thought a video-based package would be useful, mainly because the tools are so simple to use. He suggested that training using the video could be carried out at group meetings, perhaps by Principal Inspectors, so long as the video was kept to 30 to 60 minutes in length. Others felt that a video-based system would be ineffective for several reasons: the hassle of getting hold of a video and TV at work; the lack of support in explaining the use of the tools; and concern that, as a result, inconsistencies could arise. Another inspector suggested that a video-based training system would need specialist support that they could go to with queries/for help. Alternatively, nominated individuals trained in a more structured manner could be made available to help matters. It was considered more tricky to identify the risk factors from the video than if the inspector was on-site as camera angle and picture framing could restrict what could be seen. Given the absence of a consensus, it was considered prudent to include investigations of the impact of training on use and reliability of scoring during the evaluation of the tool.

The inspectors found the discussion of possible options to reduce and control the risks posed by the example tasks very useful.

The inspectors agreed that how the use of the tool was to be arranged and supported was crucial. Some were attracted to the idea of an information pack that would help give inspectors the confidence and competence to use the tool properly. The pack could include:

- A basic introduction outlining why manual handling is a problem, with some useful statistics on costs and incidences, etc.
- How tackling manual handling can benefit a company.
- How to use the charts to carry out the assessment (aide-memoire).
- How to proceed once the assessment is done (enforcement routes, control measures/solutions).

The Revitalising Health and Safety inspection pack for WRMSD (HSE, 2002a) has subsequently been released to all HSE inspectors and fills many of these gaps.

4.2.3 Score system and action levels

The scoring system and action levels were found to be poorly received both by the inspectors and the peer-review. There were several reasons for the inspectors responding this way, mostly to do with the opportunity for unscrupulous use of the tools. For instance, duty holders could use the criteria in the tools to contrive scores just below critical levels instead of reducing risks as low as reasonably practicable (ALARP). It was felt that the scores could come under legal

scrutiny and weaken a prosecution/appeal. Due to possible variation in scoring and use of the tools it was suggested that consistency of approach could still be criticised. In addition, industry often uses risk scoring, and inspectors have in the past tried very hard to get them to look beyond this since scores can often miss the point of controlling and reducing risks. If HSE started relying wholly on a scoring system, this might make it difficult to persuade industry against using scores to assess risk.

Much of the debate on the score and action levels centred on the absence of validation of the scoring system. In respect of this it was thought that expert/specialist advice and assistance must be available to fill the void (at least until it can be properly validated). There was concern that lack of such support to inspectors using the tools could be a barrier to their use.

It was suggested that if the action levels were dropped (at least until the scoring could be validated) then an approach by which highlighted risks from the assessment could be targeted. This approach was thought by the inspectors to be more solutions / improvements based (linking in with legal requirements for solutions to be 'reasonably practicable'). It was considered to give less scope for manipulating the scores and a greater chance of consistency, particularly with the right information regarding solutions/control measures.

The peer-review exercise added technical weight to the perceptions of the discussion groups, mainly due to the complex nature of risk interaction and the difficulty of designing a scoring system which was compatible with the risk filter in HSE (1998). It was suggested that it was more appropriate to focus on the presence of risk factors than on an action level. Leading on from this, the review highlighted the need for longer term study of the validity of the charts in relation to injuries incurred.

As a result, the action levels idea was put on hold, with less emphasis being placed on the scores. The scores were considered useful as a method to prioritise tasks and to assess improvement. The weighting of scores in the factors was seen as a good way of indicating to users which factors were of greater importance. However, the key approach would be examination of the risk grades for the separate factors. Long term validation of the scores in relation to health risk may be a very useful approach.

4.2.4 Specific problems/improvements identified

Suggestions were made that the charts should be reformatted into a smaller 'pocket' size matching the notebooks inspectors use which would enable it to be carried around and referred to on a regular basis. The concern was that A4 sized charts would be less usable and more cumbersome to deal with (even A4 laminated in a book). This possibility was subsequently examined in detail following the design of a notebook size booklet (Care *et al.*, 2002).

The peer-review described some useful improvements to help clarify the scoring system (all Green scores should attract a zero score), as well as other minor changes to some risk categories. Useful technical suggestions were made to improve the ease of use of the charts and the load/frequency graphs. Horizontal and vertical grids were added to the graphs to aid inspectors in identifying precise grades of risk.

A separate score sheet was suggested for recording information and could be held on file without the need to write on the chart itself. A draft of the score sheet was examined in detail as part of the evaluation project. On the basis of a suggestion that proactive inspection of every manual handling operation at a location would be very time consuming, prompts to aid selection of operations requiring assessment were added onto the score sheet:

- Task is identified as high risk in company risk assessments.
- Task has a history of manual handling incidents (e.g., company accident book, RIDDOR reports).
- Task has a reputation of being physically demanding or high risk.
- Employees performing the task present signs that they are finding the task arduous (e.g., breathing heavily, red faced, sweating profusely).

The description of the Vertical lift region in the lifting tool was clarified by changing its label from "Vertical lift distance" and by producing the aide-memoire to illustrate the different zones with diagrams.

It was identified that more work was needed on the Obstacles factor of the carrying tool- a steep slope had been denoted Green, suggesting that this was acceptable. A clearer distinction between steps and stairs was found to be necessary since steps conveyed an impression of two or three steps rather than a flight of stairs. As a result, obstacles were denoted as either Amber or Red. In addition, a total score could be allocated in cases where more than one type of obstacle was observed for a carrying operation.

The updated version included sloping or uneven flooring in the floor surface factor, in addition to wet and slippery conditions.

4.3 OUTCOMES

Updated charts were produced based on the findings of the discussion groups. This gave rise to a pack of information made ready for release to FOD inspectors for piloting and evaluation. The pack consisted of:

- An A4 set of colour charts
- An aide-memoire for each chart
- A score sheet
- A set of instructions
- An HSE Operational Minute describing the release of the charts and their purpose. It also gave contact details for the project team so users could make comments on the charts or report problems arising.

During the trial period, 'word' of the MAC was disseminated throughout HSE and LA inspectors. Prior to the delivery of the finalised version of the MAC, requests were made to the development team for copies both from duty holders and other ergonomists.

A smaller notebook sized set of charts was developed for further user testing (Care *et al.*, 2002).

5 CONCLUSIONS

1. The charts were found to conform to the design criteria.

   - Importantly, the inspectors found them useful, quick and easy to use.
   - The commonalities with HSE published guidance improved user understanding of the charts.
   - The peer-review exercise found the charts to be an appropriate method to rapidly assess manual handling activities, and the factors selected justified.
   - The format and focus on factor risk grades focussed the inspectors' minds on possible improvements and what compliance would look like.

2. Useful comments and improvements were made as a result of suggestions by the participants and the peer-review exercise.

3. Inspectors found the instructions too cumbersome and suggested a short one page aide-memoire as a useful alternative. This was designed and issued as part of the charts for evaluation.

4. Questions were generated about the format and provision of training that require further work.

5. Further work was undertaken to develop a smaller notebook sized booklet with the view of specifically comparing usability of the booklet with the A4 version during the evaluation.

6. The project team responded to comments from users of the charts and collated them for review alongside the other information arising from the evaluation. The suggestions from users and the recommendations from the evaluation work were reviewed by Care *et al.* (2002). Appropriate updates were discussed by the project team and included in the version of the charts issued to Inspectors in November 2002 (HSE, 2002b).

6 SELECTED PREVIOUS DRAFTS OF THE CHART

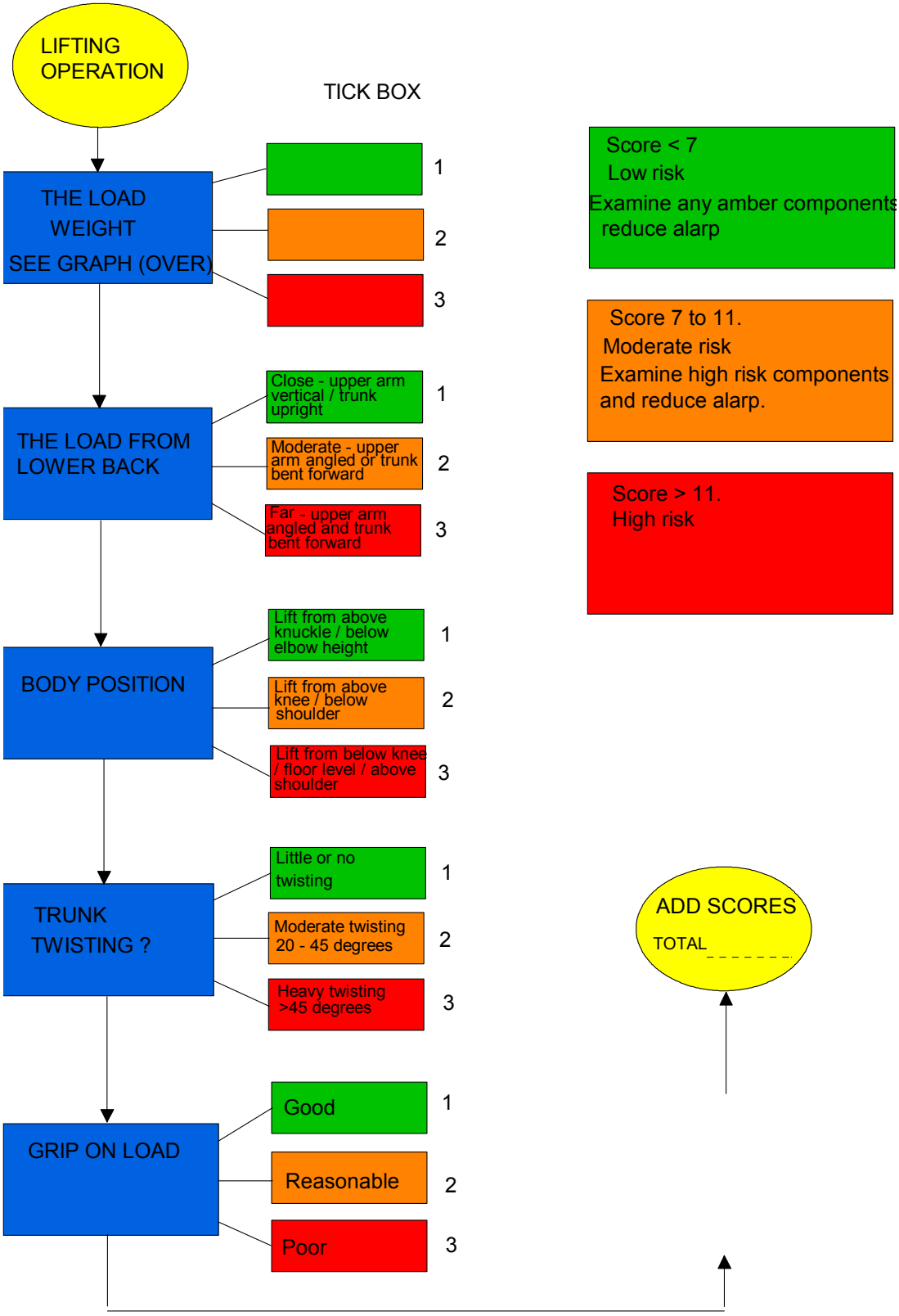

Figure 3 The initial draft of the lifting chart

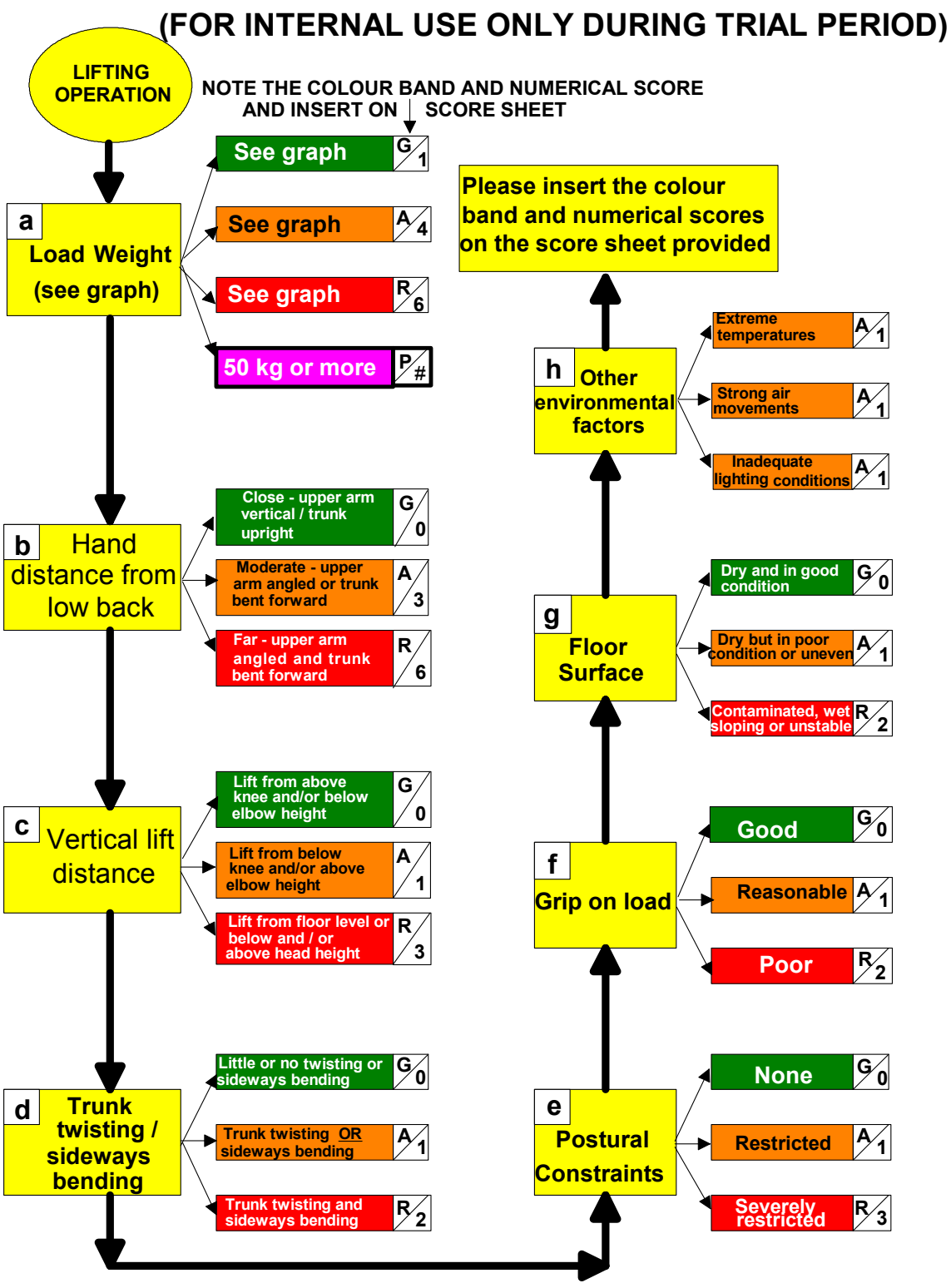

Figure 4 The draft version of the lifting chart released for the evaluation period

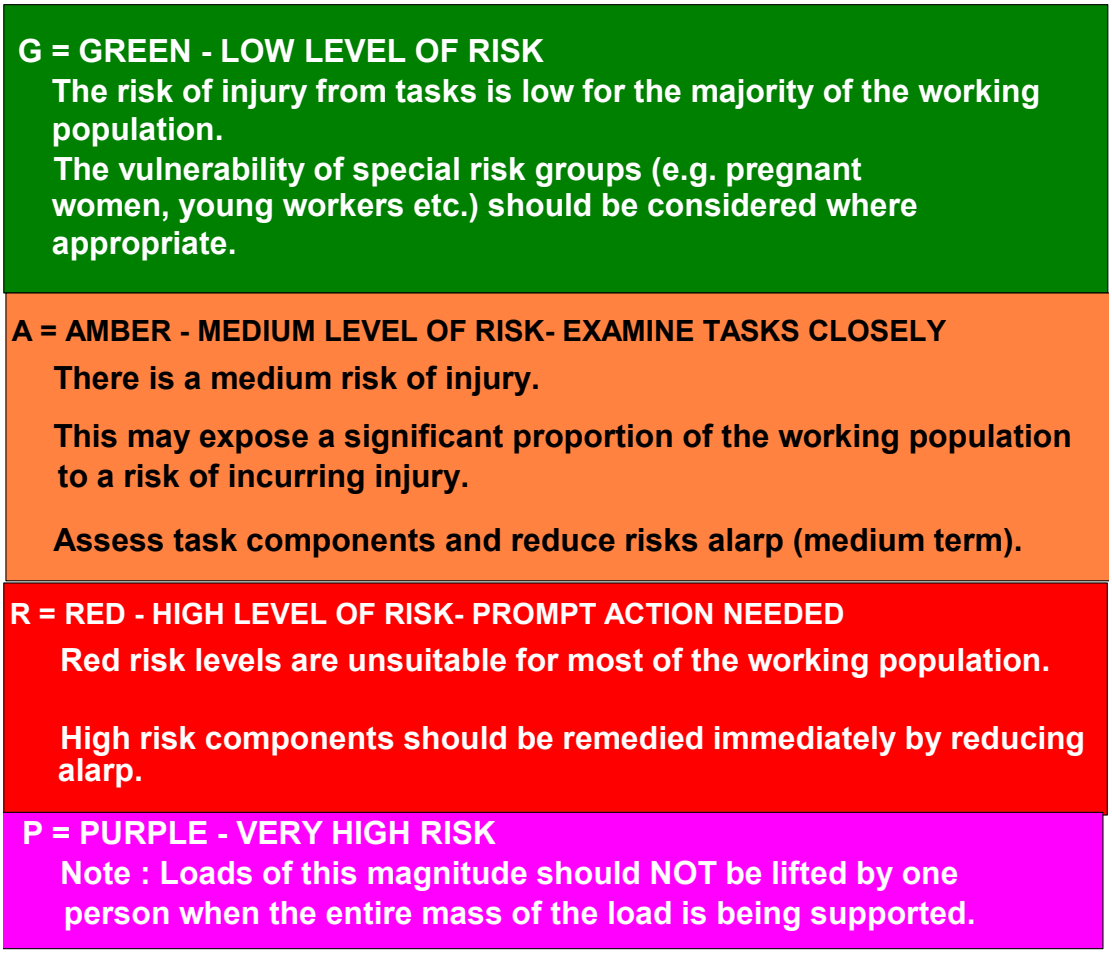

Figure 5 The 'Colour Coding - Classification of Risk' definitions released for the evaluation period

Manual Handling Assessment Tool - Score Sheet

Company Name :

_____

Client / Location:

_____

Task Description:

Are there indications that the task is high risk? (tick the appropriate boxes)
☐ Task is identified as high risk in company risk assessments.
☐ Task has a history of manual handling incidents (e.g. company accident book, RIDDOR reports).
☐ Task has a reputation of being physically demanding or high risk.
☐ Employees performing the task present signs that they are finding the task arduous (e.g. breathing heavily, red faced, sweating profusely).
☐ Other indications, If so what? _____

Inspector's Name : _____
Date : _____

Signature : _____

Insert the colour band and numerical score of each of the risk factors in the appropriate boxes below, with reference to your assessment using the tool.

Risk Factors	Colour Band (G, A, R or P)	Numerical Score
The load weight and lift / carry frequency		
The hand distance from the lower back		
Vertical lift distance		
Trunk twisting / sideways bending		
Postural constraints		
Grip on the load		
Other environmental factors		
Floor surface		
Carrying distance		
Obstacles en route (carrying only)		
Communication and co-ordination (team handling only)		
TOTAL SCORE		

Other risk factors (e.g. in L23) that are not covered by the tool? Specify

Figure 6 The score sheet released for the evaluation period

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