The OCRA Method: Assessment of Exposure to Occupational Repetitive Actions of the Upper Limbs

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1 GENERAL ANALYTICAL MODEL AND DEFINITIONS

The description and assessment model of tasks that imply potential biomechanical overload for the upper limbs is aimed at identifying and quantifying the following four main risk factors: repetitiveness (frequency), force, awkward postures and movements, lack of recovery periods. These factors, when taken together, characterize work-related exposure as related to time pattern (*duration*) (Putz Anderson 1988; Colombini *et al*. 2001).

Additional risk factors that are to be considered as enhancers of the actual risk should be added to these. Each risk factor is to be properly described and classified (that is assessed, even if roughly). This means on the one hand to detail every single working action and on the other to consider all the factors contributing to the overall "exposure" in a general and integrated frame. The definitions regarding tasks cycles, and technical actions reported in Table 1 are important to this end.

Table 1 lists the main terms used in this section, together with the definitions that best fit the author's operational choices for exposure assessment and for the description of the main risk factors.

The suggested procedure for assessing the single risk factors and the overall exposure follows the general phases listed here:

- pinpointing the typical tasks of any job, and — among them — those which take place in repetitive and similar cycles for significant lengths of time
- finding the sequence of technical actions in the representative cycles of each task
- describing and quantifying the risk factors within each cycle (frequency, force, posture, additional factors)
- reassembling of the data concerning the cycles in each task during the whole work shifts, taking into consideration the duration and sequences of the different tasks and of the recovery periods
- brief and structured assessment of the risk factors for the job as a whole (exposure index)

1.1 Organizational Analysis

Organizational analysis should come before the analysis of the four main risk factors and of additional factors. It is essential to focus on the real *duration of repetitive tasks* and on the existence and distribution of *recovery periods*.

The first phase of the analysis is finding the distribution of work times and pauses within the work shifts.

If the task is characterized by cycles with mechanical actions it will be defined as a *repetitive task*. If it is characterized by control operations, and therefore without mechanical actions, it will be defined as a recovery for the upper limbs. The tasks with nonrepetitive mechanical actions remain and shall be defined as *nonrepetitive tasks*.

The number of foreseen cycles within a *repetitive task*, and the net duration of each cycle, must be counted at this point. The number of cycles often coincides with the number of pieces to be worked in each shift.

1.2 Frequency of Actions (Repetitiveness)

The characterization of repetitiveness can be used to discriminate in general the tasks that must be assessed. To this end, the presence of a repetitive task for the upper limbs can be defined as the consecutive activity, lasting at least one hour, in which the subject carries out work cycles similar to each other and of relatively brief duration.

Once repetitive tasks have been submitted to analysis, there is the more important problem of quantifying and assessing the level of repetitiveness.

To this end, a frequency measurement proposal that is applicable in the field is the analytical counting of *technical*

TABLE 1
Main Definitions of Recurring Terminology in Exposure Assessment

Organized Work (JOB)

The organized grouping of work activities that are carried out within a single working shift; it may be composed of one or more tasks

Task

Specific working activity whose objective is the attainment of a specific operational result. The following are identified:
Repetitive Tasks: characterized by repeated cycles with mechanical actions
Nonrepetitive Tasks: characterized by the presence of noncyclical mechanical actions

Cycle

A sequence of technical, mainly mechanical, actions of relatively short duration, that repeats itself over and over, always the same

Technical Action (Mechanical)

An action that implies a mechanical activity; not necessarily to be identified with the single joint movement, but rather with the complex movements of one or more body regions that enable the completion of an elementary operation

Main Risk Factors

Recovery

Period of time within the working shift or within a cycle, during which no repetitive mechanical actions are carried out. It consists of relatively long pauses after a period of mechanical actions, during which the metabolic and mechanical recovery of the muscle can take place. Lack of recovery is the relating risk factor

Repetitiveness

The presence of events (cycles, technical actions) that are repeated in time, always the same

Frequency

Number of technical (mechanical) actions per given time units (no. of actions per minute)

Force

The physical effort required by the worker for the execution of the technical actions

Posture

The ensemble of postures and movements used by each of the main joints of the upper limbs in order to execute the sequence of technical actions that characterize a cycle
Awkward posture: risky postures for the main joints of the upper limbs

Additional Risk Factors

The additional risk factors may be present in repetitive tasks but are not either necessarily or always present. Their type, intensity, and duration leads to an increased level of overall exposure

actions (mechanical) as defined in Table 2 also with reference to most known predetermined time systems like motion time measurement (MTM) methods (Barnes 1978).

After that, an analysis of postures and movements (see Section 1.4) will make it possible to estimate the duration and frequency of even single joint movements (the type of qualitative and quantitative joint involvement, the static or dynamic component of a movement).

A description of the technical actions requires often the filming of the job, which must then be reviewed in slow motion. Often, the company already has records available in which the task is described and numbered, and the elements constituting successive technical actions are timed.

From the technical action description it is possible to obtain: the number of actions per cycle, the action frequency in a given time unit (no. of actions per minute); the overall number of actions performed by the upper limbs (right; left) during the tasks, and consequently in the shift.

In this model, the contents of individual or grouped technical actions (by contents we mean the force and the postures associated with technical actions) are described qualitatively and quantitatively when the risk factors *force* and *posture and movements* are studied.

1.3 Force

Force more directly represents the biomechanical involvement necessary to carry out a given action — or sequence of actions. Force may be intended as being external — applied force — or internal — tension developed in the muscle, tendon, and joint tissues. The need to develop force during work-related actions may be related to the moving or the keeping still of tools and objects, or to keep a part of

TABLE 2
Criteria for the Definition and Counting of Technical Actions in Relation to Predetermined Time Systems (PTS) Elements

Reach move	Reach means shifting the hand towards a pre-fixed destination Move means transporting an object to a given destination by using the upper limb. Reaching an object should be considered as an action exclusively when the object is positioned beyond the reach of the length of the extended arm of the operator and is not reachable by walking. The operator must then move both the trunk and the shoulder to reach the objects. If that work-place is used by both men and women, or by women alone, the measurement of the length of the extended arm corresponds to 50 cm (5th percentile for females), and this length must be used as a reference point. Moving an object should be considered as an action exclusively when the object weighs more then 2 kg in grip (or 1 kg in pinch) and the upper limb has a wide shoulder movement covering an area >1 m
Grasp/take	Gripping an object with the hand or fingers, to carry out an activity or task, is a technical action *Synonyms*: take, hold, grip again, take again
Grasp with one hand, grasp again with other hand	The actions of gripping with the right hand and gripping again with the left must be counted as single actions and ascribed to the limb that actually carried them out
Position	Positioning an object or a tool in a pre-established point constitutes a technical action *Synonyms*: position, lean, put, arrange, put down; equally, to re-position, put back, etc.
Putting in, pulling out	The action of putting in or pulling out must be considered as a technical action, when the use of force is required *Synonyms*: extracting, inserting
Push/pull	These must be counted as actions because they stem from the need of applying force, although maybe only a little, aimed towards obtaining a specific result *Synonyms*: take apart, press
Release, let go	If, once an object is no longer necessary, it is simply "released" by opening the hand or the fingers, then the action must not be considered as a technical action (it is a passive return, or by dropping)
Start-up	This must be considered as an action when start-up of a tool requires the use of a push-button or lever by parts of the hand, or by one or more fingers. If start-up is done repeatedly without shifting the tool, then consider one action for every start-up *Synonyms*: press button, lower lever
Specific actions during a processing phase	In addition to those listed here, many technical actions exist, specifically describing the processing of a part/object, e.g.: Bend or fold Bend or curve, deflect Squeeze, rotate, turn Settle, to shape Lower, hit, beat Brush (count each brush passage on part to be painted) Grate (count each passage on part to be grated) Smooth or polish (count each passage on part to polish) Clean (count each passage on part to clean) Hammer (count each single hit on part) Throw, etc. Each one of these actions must be described and counted once for every repetition, e.g. Turn twice = 2 technical actions Lower 3 times = 3 technical actions Pass the brush 4 times = 4 technical actions
To walk, to do visual control	These must not be considered as technical actions because they do not imply any activity of the upper limbs
To transport	If an object weighing 3 or more kg is transported for at least 1 metre, the upper limb that supports the weight is the one that carries out the technical action "to transport." One metre means a true transport action (two steps)

Note: Identical actions must still be counted every time that they are repeated. It must be remembered that this risk analysis method counts the single technical actions, and not their duration time, because the aim is that of defining the frequency of action (no. of actions per minute).

the body in a given position. The use of force may be related to static actions (contractions) or to dynamic actions (contractions).

Force quantification in real implementation contexts is a problem. Some authors use a semi-quantitative estimation of external force via the weight of the objects being handled. In other cases, it has been suggested to use mechanical or electronic dynamometers. The quantification of internal force is suggested by means of surface electromyography techniques. All of these methods present implementation difficulties. In this proposal we suggest to use a specific Scale developed by Borg (10-Category Ratio Scale for the Rating of Perceived Exertion) (Borg 1982). It can describe muscular effort as subjectively perceived for any body region. The results of the implementation of CR-10 RPE Borg's Scale, when used for an adequate number of workers, have turned out to roughly be comparable to those obtained with surface electromyography.

The actions that require minimal muscle involvement could be identified as 0.5 value in Borg's Scale; then the involvement description procedure could only describe those actions, or groups of actions, that require more force than the minimal amount, always by using Borg's Scale. Once this procedure has been carried out, the average weighted score for the whole of the cycle can be calculated (range of values from 0 to 10).

1.4 Posture and Types of Movements

Upper limb postures and movements during repetitive tasks are of basic importance in contributing towards the risk of various musculoskeletal disorders. A definite agreement is found in literature as to the potential damage coming from extreme postures and movements of each joint, from postures maintained for a long time (even if not extreme), and from specific, highly repetitive movements of the various segments.

On the other hand, the description of postures and movements of each segment of upper limbs during technical actions of one cycle completes the description of repetitiveness risk factor.

The description/assessment of the postures must be done over a representative cycle for each one of the repetitive tasks examined. This must be via the description of frequency and duration of the postures and/or movements of the four main anatomical segments (both right and left):

(a) Posture and movements of the arm with respect to the shoulder (flexion, extension, abduction)
(b) Movements of the elbow (flexions–extensions, prono-supinations of the forearm)
(c) Postures and movements of the wrist (flexions–extensions, radio-ulnar deviations)
(d) Postures and movements of the hand (mainly the type of grip)

The description may be more or less analytical but has to be able to appreciate at least the following items:

(a) Technical actions requiring postures or movements of a single segment beyond a critical level of angular excursion (generally, beyond 50% of the specific movement angular excursion) for whichever of the movements of the joint and for almost 25% of the cycle time. The angular excursion critical level (for each joint) can be determined according to criteria available in the literature (Colombini *et al*. 2001). As far as the types of hand grip are concerned, some of them (pinch, palmar grip, hook grip) are considered as being less favorable with respect to the power grip, and are therefore classified as implying medium/high involvement.
(b) Technical actions involving static postures and/or movements which, also in acceptable angular excursion, are maintained or repeated in the same way for more than 50% of the (cycle, task) time.

Joint combination of such description factors (awkward posture/time) will provide the classification of posture effort for each segment considered (posture scores from 0 to 16).

1.5 Additional Factors

There are other factors which are considered important, apart from those which have already been discussed here. They always have their origin in work, and must be taken into consideration whenever assessing exposure. They have been described as additional here, not because they are of secondary importance, but because each of them can be either present or absent in the various occupational contexts which are examined and assessed.

The list of these factors — albeit not exhaustive — includes the following: (1) use of vibrating tools, even if only for some of the actions; (2) requirement for extreme precision (tolerance of about 1 mm in positioning an object, for instance); (3) localized compressions on anatomical structures of the hand or of the forearm, due to tools, objects, or fixtures on the workplace; (4) exposure to cold; (5) use of inadequate gloves for the task at hand; (6) objects with slippery surfaces; (7) rapid or sudden wrenching movements required; (8) gestures implying return shock (such as hammering hard surfaces); (9) pace determined by the machinery; (10) working on fast-moving objects.

The description of physical–mechanical additional factors can take place in parallel with that of postures, by using the same information supports (e.g. filming the tasks). For each of the factors, it is necessary to specify for how much time the factor is present (with respect to cycle/task time), or to describe the frequency of occurrence of actions where that factor is present (especially for sudden movements and movements with shock).

For organizational additional factors one has to describe if they are present; when present (one or more) they influence the whole task (3/3 of cycle time).

This model only considers factors of physical mechanical and organizational origin that acts on the whole collectivity of workers. It does not include psycho-social factors because they are often individual risk factors and are not easy to quantify.

Scores for additional factors range from 0 to 12.

1.6 Distribution and Duration of Recovery Periods

A recovery period is the period during which one or more of the muscle groups which are usually involved in the working tasks are basically inactive. The following may be considered as recovery periods:

(a) Pauses from work (both official and non-official), including the lunch break where it exists.
(b) Periods during which the working tasks carried out leave the muscles, previously employed in other tasks, at rest (e.g. visual control tasks, or tasks which are carried out, alternatively, with one of the two upper limbs).
(c) Periods *within the cycle* that leave muscle groups previously employed in tasks totally at rest. These rest periods (control/waiting), to be considered as significant, must be consecutively experienced for at least 10 seconds almost every few minutes.

Hence, the analysis of the recovery periods is first a check of their presence, duration, and distribution within the cycle, and foremost a macroscopic examination of their presence, duration, and frequency within the whole shift.

Apart from the partial exception as represented by recovery periods for actions implying protracted static contractions, the description and assessment of recovery periods should be based on the following:

- A description of the actual sequences of tasks implying an overload of the upper limbs, of "light" nonrepetitive tasks, and of the pauses
- Frequency of the recovery periods with reference to the actual number of working hours per day
- Ratio between the "total recovery time" and the "total repetitive working time"

No definite univocal criteria for the assessment of recovery periods in relation to repetitive dynamic actions of the upper limbs exist in the literature.

For practical purposes one can refer to different guidelines which suggest to have a break almost every 60 minutes of repetitive work. These and other documents also supply general criteria supporting the ratio of 5:1 between working time with repetitive movements and recovery periods. These two criteria seem wholly reasonable as far as current knowledge goes. Their *critical* use offers an interpretation of the descriptive data collected on sequence, duration, and frequency of recovery periods relating to cycles with a prevalence of dynamic actions.

For practical purposes, the description and classification of the risk factor "lack of recovery periods" requires the observation, one by one, of the single hours that make up a working shift: for each hour, a check must be made if there are repetitive tasks and if there are adequate recovery periods. For the hour preceding the lunch break (if it is present) and for the hour before the end of the shift, the recovery period is considered to be these two events.

On the basis of the presence or absence of adequate recovery periods within every hour of repetitive work analyzed, each hour is then considered as being "risk-free," or "at risk" (lack of recovery periods).

The overall risk for "lack of recovery periods" is determined by the overall number of hours at risk (generally, from 0 to 6).

1.7 Duration of Repetitive Task

Within a working shift, the overall duration of tasks with repetitive and/or forced upper limb movements is important to determine overall exposure. The present model (and the realated index) is based on scenarios where repetitive manual tasks continue for a good part (4 hours or more) of the shift. In some contexts, however, there may be deep differences with respect to the more "typical" scenario (e.g. regularly working over-time, part-time work, repetitive manual tasks for only part of a shift), and it is extremely important to consider these changes with respect to usual exposure conditions. The OCRA index calculation procedures (see Section 2.2) consider the necessary parameters for dealing with the duration factor (the overall duration of repetitive tasks is expressed in minutes and is the sum of the net time spent, during the shift, in repetitive tasks).

2 OCRA: A Concise Index for the Assessment of Exposure to Repetitive Actions of the Upper Limbs

2.1 Introduction

A procedure is here reported for calculating a concise index of exposure to the risks of musculoskeletal disorders associated with occupational repetitive actions (OCRA) of the upper limbs. The report is based on the quantification figures for the various risk factors proposed in the previous pages.

The "exposure index" (OCRA) is the ratio between the total number of technical actions (derived from tasks featuring repetitive movements) effectively performed during the shift (ATA) and the corripondent number of recommended technical actions (RTA).

In practice:

$$\text{OCRA} = \frac{\text{ATA (total number of technical actions actually performed during the shift)}}{\text{RTA (total number of recommended technical actions during the shift)}}$$

The overall number of technical actions effectively performed within the shift (ATA) is a known datum, which is calculated by organizational and frequency analysis (see Sections 1.1 and 1.2).

The following general formula is used to calculate the total number of recommended technical actions (RTA) to be performed during the shift:

$$\text{RTA} = \sum_{x=1}^{n} [\text{CF} \times (\text{Ff}_i \times \text{Fp}_i \times \text{Fa}_i) \times \text{D}_i] \times \text{Fr} \times \text{Fd}$$

where
1, n = task(s) featuring repetitive movements of the upper limbs performed during the shift
CF = reference frequency (constant) of technical actions per minute (set at 30 action per minute)
Ff_i Fp_i Fa_i = multiplier factors, with scores ranging between 0 and 1, selected according to the behavior of the "force" (Ff), "posture" (Fp) and "additional elements" (Fa) risk factors, in each (i) of the (n) tasks
D_i = duration of each (i) repetitive task in minutes
Fr = multiplier factor, with scores ranging between 0 and 1, selected according to the behavior of the "lack of recovery period" risk factor, during the entire shift
Fd = multiplier factor, with scores ranging between 0.5 and 2, selected according to the daily duration of tasks with repetitive upper limb movements

Since the values of all the variables included in the equation for calculating the index are still hypotheses awaiting validation, for practical purposes it is advisable to adopt a prudential classification system of the results of the exposure index, based on the three-zone rating system or "traffic light" approach (green/yellow/red).

In practice, given the current status of experiences in the use of the index and taking into account the results of parallel clinical surveys checking for UL-WMSDs in real contexts (Occhipinti and Colombini 2004), the following statements may be made:

I OCRA index scores, up to 2.2 indicate that the condition examined is almost acceptable (**green area**).

II OCRA index scores from 2.3 to 3.5 (**yellow area**) are borderline (uncertain). However, though exposure is not substantial, it may be significant and therefore careful monitoring for induced health effects should be introduced (health surveillance).

III OCRA index scores in excess of 3.5 (**red area**) are definitely significant, and the higher the value the higher the risk. Actions should be undertaken to improve working conditions (for which the analytical data will help determine priorities), as well as close monitoring for induced effects.

2.2 Procedures for Calculating the Total Number of Recommended Actions in the OCRA Index

The action frequency constant (CF) has been set at 30 actions per minute under optimal conditions (i.e. other risk factors not significant); this solution is based on a critical review of literature suggestions and on practical considerations. The elements for determining the multiplier factors for force, posture, additional factors, lack of recovery periods, daily duration of repetitive tasks are reported in Table 3. For the analysis of the different risk factors, reference is to be made to description and quantification procedures reported in the previous pages, and more in detail, in a specific handbook (Colombini *et al*. 2002).

Annex A reports a data sheet for calculating the OCRA Index.

2.3 Final Remarks

The OCRA index represents an endeavor to organize the data obtained from the descriptive analysis of the various mechanical risk factors as they are collected following indications contained in a specific *Consensus Document* produced by the Technical Group for Musculoskeletal Disorders of the International Ergonomics Association (IEA) (Colombini *et al*. 2001).

However, it must be emphasized that the proposal is still experimental. At this juncture, its value lies in its ability to: (a) classify or at least group together the various scenarios which might give rise to different degrees of exposure to the various significant risk factors, and thus steer priorities of preventive actions; (b) identify situations which do not constitute a problem, at least as far as is currently known; (c) forecast, within definite limits, the expected occurrence of persons affected by UL-WMSDs, given the actual level of exposure.

The OCRA index naturally requires further validation, particularly by means of parallel studies of induced effects in groups of exposed workers.

To this aim an updated study (Occhipinti and Colombini 2004) was performed in 23 different work contexts in which 5373 workers were exposed to different conditions of repetitive movements of upper limbs. This study

TABLE 3
Elements for Determining the Multiplier Factors for Force (Ff), Posture (Fp), Additional Factors (Fa), Recovery Periods (Fr) and Overall Duration of Repetitive Tasks (Fd)

Force score	*R.P.E. (CR-10 Borg scale)*	⩾0.5	1	1.5	2	2.5	3	3.5	4	4.5	5
	Mean effort (% of MCV)	⩾5	10	15	20	25	30	35	40	45	50
Multiplier Factor (Ff)		1	0.85	0.75	0.65	0.55	0.45	0.35	0.2	0.1	0.01

Postural involvement score	0–3	4–7	8–11	12–15	16
Multiplier Factor (Fp)	1	0.70	0.60	0.50	0.3

Additional Factors score	0	4	8	12
Multiplier Factor (Fa)	1	0.95	0.90	0.80

No. of hours without adequate recovery	0	1	2	3	4	5	6	7	8
Multiplier Factor (Fr)	1	0.90	0.80	0.70	0.60	0.45	0.25	0.10	0

Overall duration (in minutes) of repetitive tasks during shift	<120	120–239	240–480	>480
Multiplier Factor (Fd)	2	1.5	1	0.5

showed, among others, a good agreement (R^2 adj. = 0,92; $P < 0.001$) between the OCRA index and the prevalence of persons affected (PA) by one or more clinically diagnosed UL-WMSDs as they both resulted in different work contexts.

This association is best expressed by the linear regression equation:

$$PA = 2.39\ (\pm 0.14) \times OCRA$$

where PA= prevalence of persons affected by one or more clinically diagnosed UL-WMSDs; ±0.14 = Standard Error of factor b.

In the contexts examined the UL-WMSDs considered were all entrapment syndromes, tendonitis, peritendinitis of the upper limbs (shoulder included) confirmed by clinical examination and specific instrumental tests. If the above regression equation, with proper confidence limits, is being used as a forecast model, the OCRA index becomes a tool for forecasting the collective risk, for a given exposed population, to contract UL-WMSDs (in terms of PA).

The exhaustive description of the risk factors associated with a given repetitive task, the quantification of consequent exposure in a concise index and the need to perform further parallel studies on the clinical effects on exposed workers, all represent both an opportunity and a commitment to carry out further researches and investigations.

ANNEX A

Data Sheet for Calculating OCRA Index

Consider separately right and left upper limb.

The first part of the data sheet lists the main items characterising the repetitive tasks analyzed, followed by the second part which serves more specifically to calculate the OCRA index.

In particular, Part A of the data sheet identifies and quantifies the following:

- Production department or line and type of work performed by the exposed workers
- Items characterizing each repetitive task (up to a maximum of four repetitive tasks per shift) such as average cycle duration (in seconds); average action frequency (no. of actions per minute); total duration of each task (in minutes)
- Total number of actions performed in each repetitive task and during the entire shift (ATA)
- Breaks and nonrepetitive tasks that could be regarded as recovery periods
- Sequence of tasks and breaks as they occur during the shift
- Number of hours spent in the shift without recovery periods

PART A – Summary of data for calculating index of exposure to repetitive movements of the upper limbs.

Department or line.......................	*Station or task ....*	*Shift..........................*

Characterization of repetitive tasks performed during shift

	A	B	C	D
• duration of task in shift (min)				
• mean cycle duration (sec)				
• action frequency (no. of actions/min)				
• total actions in task				

• total actions in shift (sum of A, B, C, D) [ ] **ATA**

Characterization of non-repetitive tasks performed during shift

	X	Y	Z
• duration (min)			
• comparable to recovery			
• not comparable to recovery			

min

Total no. of minutes of non-repetitive task comparable to recovery [ ]

Characterization of breaks during shift

- duration of lunch break (min)
- other breaks
- total duration of other breaks (min)

Time-wise distribution of tasks and breaks in shift
(describe exact sequence of tasks and breaks, and their relative duration in minutes)

1 hour

No. of hours in shift with lack of recovery periods N.=_________________

PART B – Calculation of the OCRA index for the right (or left) upper limb.

	A	B	C	D	tasks
• Constant of action frequency (no. of actions/min.)	30	30	30	30	**CF**

×

• Force factor

BORG	0,5	1	1,5	2	2,5	3	3,5	4	4,5	5
% MVC	5	10	15	20	25	30	35	40	45	50
MULTIPLIER	1	0,85	0,75	0,65	0,55	0,45	0,35	0,2	0,1	0,01

				Ff

×

• Posture factor

SCORE	0-3	4-7	8-11	12-15	16
MULTIPLIER	1	0,70	0,60	0,50	0,33

SH [ ]	SH [ ]	SH [ ]	SH [ ]	(*)select
EL [ ]	EL [ ]	EL [ ]	EL [ ]	lowest factor
WR [ ]	W [ ]	WR [ ]	WR [ ]	among elbow,
HA [ ]	HA [ ]	HA [ ]	HA [ ]	wrist and hand
(*) [ ]	(*) [ ]	(*) [ ]	(*) [ ]	**Fp**

×

• Additional factor

SCORE	0	4	8	12
MULTIPLIER	1	0,95	0,90	0,80

				Fa

×

• Duration of repetitive task (min.) [| | |]

=

No. of recommended actions per task and totals (π)
(partial result without recovery/duration factors)

				π
α	β	γ	δ	α+β+γ+δ

• Factor for lack of recovery periods (No. of hours without adequate recovery)

N. HOURS	0	1	2	3	4	5	6	7	8
MULTIPLIER	1	0,90	0,80	0,70	0,60	0,45	0,25	0,10	0

[ ] **Fr**

• Factor for duration of repetitive task

OVERALL DURATION (MIN) OF REPETITIVE TASKS	< 120	120 – 239	240 - 480	> 480
MULTIPLIER	2	1.5	1	0.5

[ ] **Fd**

RTA = **π x Fr x Fd** **RTA**

OCRA INDEX = $\frac{\textbf{ATA}}{\textbf{RTA}}$ **OCRA INDEX**

Part B of the data sheet is used directly to calculate the desired index:

- For each task (and limb) analyzed the calculation starts from the frequency constant (CF) of 30 actions per minute.
- This constant is multiplied by the force factor (Ff), as obtained from the relevant conversion table, for each task.
- Now another multiplier is calculated, this time for the posture factor (Fp). Here too, the factor is chosen on the basis of a conversion table which matches descriptive values (scores) with multiplier factors. The scores obtained for the four segments of the upper limb (i.e. hand, wrist, elbow, shoulder) must be entered into the appropriate spaces. It is advisable to select the higher score (the worst condition) between elbow, wrist and hand (since the index is designed specifically for repetitive actions performed by these segments) and to find the corresponding multiplier factor that will be used for computation.
- The next multiplier to be calculated is for the additional items factor (Fa).
- The result of these three multipliers (not indicated in the data sheet) represents the frequency constant per minute weighted by the factors for force, posture, and additional elements. The result, multiplied by the duration (in minutes) of each task analyzed, is used for calculating the number of recommended actions for each individual task and, when added together, for the entire shift (π).
- At this stage, it is necessary to weight the total number of recommended actions (π) obtained in the partial result indicated above, using the factor relative to the presence and distribution of recovery periods (Fr) and to the daily net duration (in minutes) of repetitive tasks (Fd). This is achieved by obtaining those two factors from the corresponding conversion tables. These factors are then used as multipliers of the figure resulting from the previous equation (π).
- In this way, the total number of recommended actions for the shift (RTA) can be obtained.

This final result (RTA) is the denominator of a fraction in which the numerator is the total number of actions effectively performed during the shift (ATA) calculated in the first part of the data sheet. The ratio represents OCRA index.

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