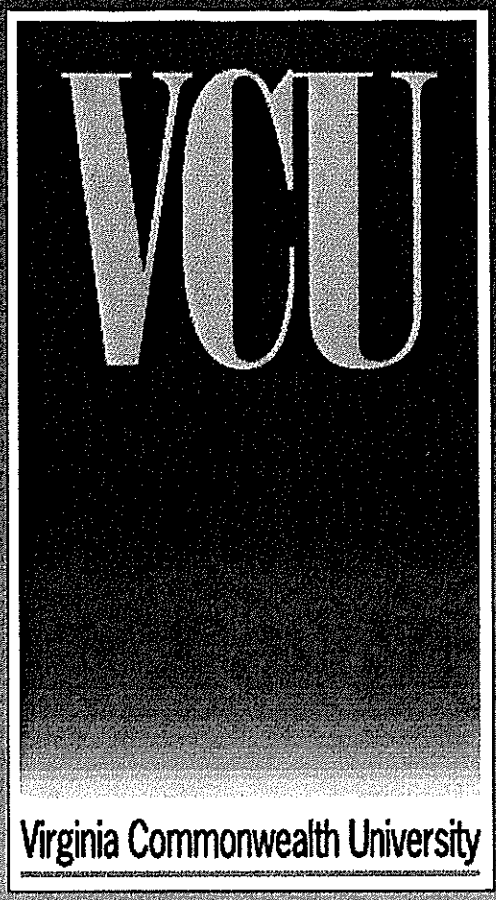


Functional Capacity Evaluation Course

Williamsburg, Virginia
September 14, 2000

ARCON
VerNova FCE

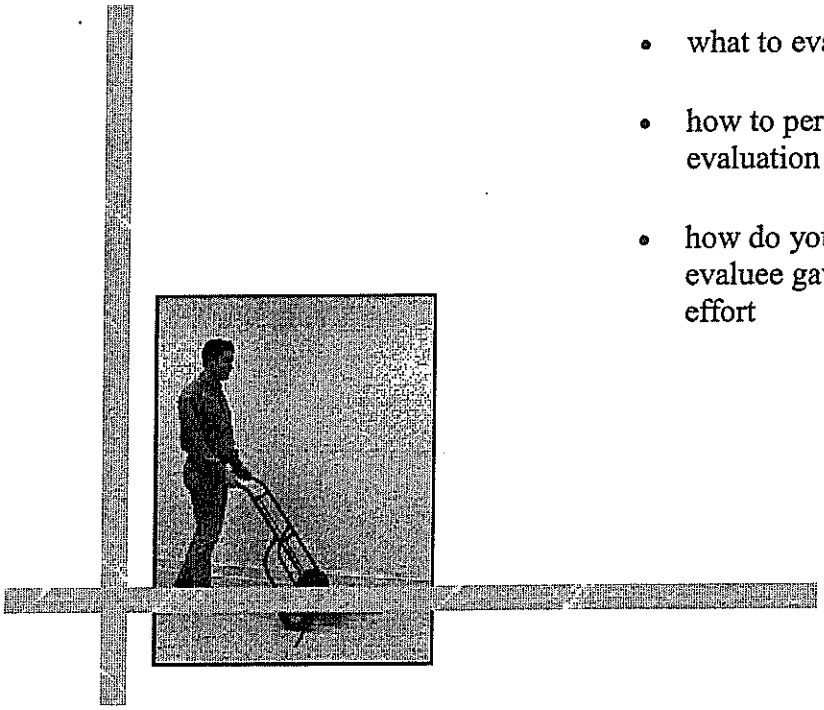
Part 4
Physical Abilities Testing (MTM)

physical abilities

I. Physical Abilities Testing
II. Introduction to MTM
III. Issues in Evaluation and Interpretation

WHAT YOU NEED TO KNOW

- what to evaluate
- how to perform the evaluation
- how do you know if the evaluee gave reasonable effort



PHYSICAL DEMAND CONDITIONS

The DOT and the CCDO Physical Demand Conditions (PDC) have been established as the physical abilities classification model commonly used in industry, insurance claims management, vocational rehabilitation and occupational medicine.

walk	carry	push/pull	stoop	bend	crouch
crawl	kneel	reach	handle	finger	feel

Unfortunately, these PDC classifications do not have evaluation guides, unlike the DOT/CCDO aptitude classifications, which are assessed by established aptitude test batteries. Hence an established methodology is not dictated, and has typically been left to evaluator clinical judgment.

RELIABILITY AND VALIDITY:

Clinical judgment of PDC functional tasks has poor inter-rater reliability and only limited content validity. Therefore, a criterion-reference measurement system would be highly desirable to increase the validity of this section of the Functional Capacity Evaluation. The criterion measurement would need to be adaptable to a variety of occupational demands within a discrete PDC classification. A walking test should equally represent a warehouseman's or an office worker's occupational tasks.

A concern is the ability to predict the evaluee's ability to sustain a full day's work from a brief period of testing. Scientific measurement principles are the solution to this dilemma. It is not economical to perform an evaluation throughout multiple 8 hour days, and through all conditions the evaluee might encounter. Hence the criterion-reference measurement system has to be based on an 8 hour day, and have generalizability to varied environmental, postural and frequency conditions.

Dexterity tasks have the benefit of psychomotor tests that have been developed with published norms. The concern with these tests is that the norm-reference validity is limited to the relevance of the norm group to the evaluee.

EFFORT:

The evaluation of PDC categories has to be sensitive to the effort (or lack thereof) the evaluee might render in the evaluation. PDC functional tasks do not have maximal levels of task performance that could be discounted for sustainability over an 8 hour day. The effort falls within the psychophysical model of testing. The disadvantage of psychophysical testing is the degree of control the evaluee has over effort, and susceptibility to poor effort. A method of evaluating effort is desirable in this testing.

Methods-Time Measurement is a criterion measurement system that facilitates these methodological concerns. The following sections will outline how it has been adapted for physical abilities testing.

DEFINITIONS:

Methods-Time Measurement is a system for measuring and analyzing the components of motion (work methods) in performing work tasks. The purpose is to improve the economy of motion, increase worker efficiency, reduce fatigue, and consequently improve performance.

Constant is defined in the DOT as an activity or condition that exists 2/3 or more of the time.

Frequent is defined in the DOT as an activity or condition that exists 1/3 to 2/3 or more of the time.

Occasionally is defined in the DOT as an activity or condition that exists up to 1/3 or more of the time.

MOTION TIME STANDARD

Methods-Time Measurement (MTM), the most widely developed and validated motion-time system in the world, was developed in the 1940's. MTM-1 motion standards were first published in the United States in 1948, based on expert rater analysis and standardization of films of industrial tasks performed by qualified operators at many work places (Maynard, Stegemerton, and Schwab, 1948). Since that time the MTM system has continued to be validated in many work sites and production systems (Karger and Bayha, 1987). The MTM Association coordinates world wide development, training and standardization practices (MTM Assoc., 1972, 1990). Studies at Cornell University and Western Michigan University supported the original research (Karger and Bayha, 1987).

THE MTM INDUSTRIAL STANDARD

MTM is a criterion reference system, rather than a population based (normative) system. The concept of *normal* work is the basic premise of the MTM Industrial Standard. ***The Industrial Standard (IS) is the time it takes the average worker with average skill to perform a task throughout an average 8 hour day, with appropriate rest allowances and without undue stress or fatigue*** (MTM Assoc., 1972, 1990).

VALIDITY

The Industrial Standard is an achievable time for the majority of workers aged 18-65 in good health to perform the task (Karger and Hancock, 1982). At least 95% of all workers can achieve the Industrial Standard (Karger and Hancock, 1982). The statistical mean of workers is 120% of the Industrial Standard, with a range of 84-156% (Karger and Hancock, 1982). The lower 5% of the population that can not achieve Industrial Standard time represent workers who are not competitively employable in the workplace (Karger and Hancock, 1982). Therefore the population is not a normal distribution, as it is skewed curve from 92% to 156% due to the absence of the bottom 5% of people aged 18-65 who are not competitively employable (Karger and Hancock 1982).

UNIVERSAL CHARACTERISTICS

MTM motions are 'universal' characteristics demanded by all jobs. Universal characteristics have the greatest predictiveness compared to 'occupationals' (the characteristics required by a specific job), or 'relationals' (the characteristics of a job relative to the environment).

RELIABILITY

The MTM system has demonstrated high internal consistency with an 8% standard error of measurement at 95% confidence level. (i.e., if an individual scores at 100% of the IS then the rater can assume the individual would score from 92-108% of the IS 95% of the time (Karger and Bayha, 1987). The original research found only 8% variance between high and low range (Karger and Bayha, 1987). Interobserver agreement studies were published demonstrating a high level of consistency and agreement (Karger and Bayha, 1987). Evaluators using MTM data following a standardized methodology have proven inter-rater reliability. The data can assist in determination of client consistency.

REST ALLOWANCES

The MTM time standards represent work under ideal conditions (Karger and Bayha, 1987; Karger and Hancock, 1982). Realistic performance requires some adjustment and/or allowance (Karger and Bayha, 1987; Karger and Hancock, 1982). The usual allowances are for personal time, fatigue and minor unavoidable delay (Karger and Bayha, 1987; Karger and Hancock, 1982). The usual allowance for these variables is 10-15% (Karger and Bayha, 1987; Karger and Hancock, 1982).

The International Labor Organization (ILO) has published Relaxation Allowances for MTM data. Physiological validation studies have been performed on these allowances with general agreement found with the ILO allowances (Frievalds and Goldberg,1969).

Fundamental motions are aggregated to synthesize work activity. Lifting a box weighing 20 pounds from the floor, carrying it 12 feet and placing it on a table involves a MOVE with two hand motion with a 20 lb. static lift factor to account for the inertia, an ARISE FROM STOOP motion with a 20 lb dynamic lift factor, WALK 25 feet, and RELEASE when placing on the table. The MTM time (industrial standard) for this task is 6.5 seconds.

MTM 'LEVELING' SYSTEM

MTM has accounted for effort since the original research in the 1940's (Lowry, Maynard, Stegemerten, Barnes).

MTM has 6 effort categories that allow an increase or decrease to the observed time:

- ☑ Poor (+15%),
- ☑ Poor to Fair (+10%),
- ☑ Fair (+5%) Average (+0%),
- ☑ Good (-5%),
- ☑ Excellent (-10%) or
- ☑ Excessive (-15%)

LEARNING CURVES

The rate or progress of an individual acquiring skill at a new task can be demonstrated on a learning curve (Woeber). MTM learning curves vary from 88-92% and 90% is commonly used. Two concepts of learning are used, "threshold" and "reinforcement" learning (Woeber). MTM Industrial Standards presume the individual has average skill to perform the task. Disability evaluation should therefore use tasks that are easily mastered, can be demonstrated and *practiced* before the timed assessment, effectively eliminating the learning curve for the simple evaluation tasks by attaining "threshold" learning. If an evaluee demonstrates ability to perform the task correctly they have achieved MTM threshold learning. A learning curve analysis of the disability evaluation should be performed for more complicated tasks or work samples.

MTM AND PERSONNEL SELECTION

The MTM Association developed a series of personnel selection tests (Poocke, Foulke). A study found little difference between work performance predicted by the selections tests and actual work performance (Anderson and Edstrom). The European MTM Associations collaborated on a Manual Abilities Scanning Test (MAST) that has been used in disabled and non-disabled populations (Wilcock, 1980). MTM data can be used to design work methods and standards or to match workers' abilities to work requirements

MTM based evaluations have been used with disability populations for more than 30 years. Birdsong and Chyatte (1970) used an MTM based dexterity test to evaluate treatment effects on hemiplegic patients, to test the effect of L-Dopa on Parkinson's patients, and the effects of a muscle relaxant on patients with central nervous system disorders. Todd, Chyatte and Decker (1979) compared MTM based evaluations of Cerebral Palsy patients with AMA impairment ratings. They conclude that the AMA impairment rating had little or no bearing on specific task function while the MTM based evaluation deals in specific task performance. The authors compared MTM based assessment times to norm based classifications of a work sample and found that the work sample overestimated work performance.

Birdsong (1972) reviewed the successful use of MTM based evaluations as a monitoring and investigative technique at the Emory University School of Medicine. MTM has been used in evaluation of the mentally handicapped and design of their sheltered workshop tasks. The relevance of the MTM data, its appropriateness for matching a worker to a job task and designing job accommodation and modification are discussed by various authors *(Brickey; McQuaid and Winkler; Grant, Moores and Whelan; Wilcock, and Mink).*

AssessAbility, an MTM based automated FCE system developed by Michael Coupland, C.Psych, has been recognized as a valid and reliable method of assessing functional Capacity (Rucker, Wehman and Kregel).

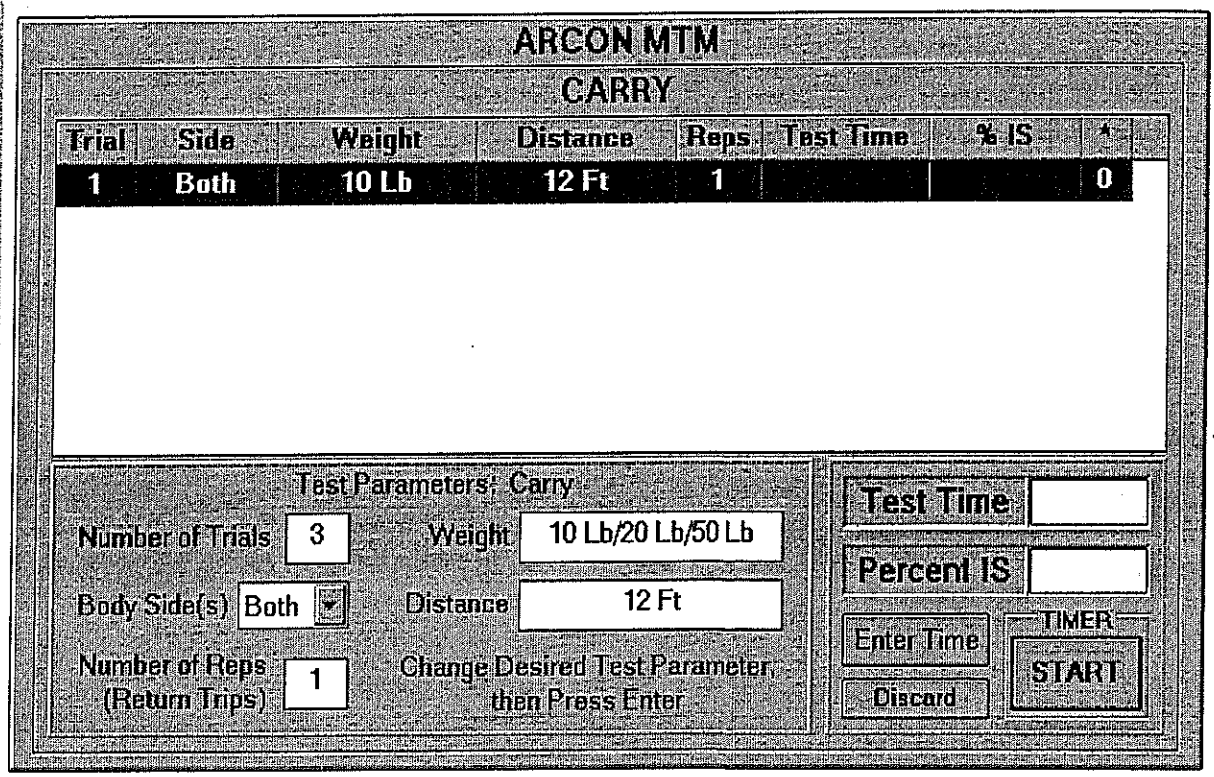
STANDARDIZATION

Standardization of measurement forms the foundation of the MTM testing protocols. It is critical that the evaluator follow the testing and timing protocol precisely to ensure a reliable comparison to the MTM Industrial Standard. Multi-media *HELP* files, graphics and computer automated timing devices assist to ensure reliability.

The MTM test protocols evaluate *discrete* tasks (e.g. Reach) instead of simultaneously assessing multiple functions as in Work Sample testing. MTM allows the evaluator to customize the testing protocols to simulate job requirements and ergonomic solutions. Outcome measurement to document therapeutic interventions is available via repeat testing .

GENERAL INSTRUCTIONS

- ☑ The Evaluator should demonstrate one cycle then have the evaluee practice one cycle.
- ☑ Indicate to the evaluee that you want him/her to work as fast as they would if they were employed in a job requiring this task.
- ☑ Repeat the cycles according to the number in the prescribed protocol (minimum of 3 to allow Coefficient of Variance).



FREQUENCY RATING

A significant issue in the evaluation of physical abilities is based in the vague definitions of Constant, Frequent and Occasional work demands. Evaluee performance at or above the MTM Industrial Standard suggests that the evaluee is able to meet the Constant occupational requirements throughout an 8 hour day.

When the evaluee scores between 70 and 100% of the Industrial Standard they could be considered able to meet Frequent occupational demands. The definition of Frequent is 1/3 to 2/3 of the day. Consequently, this statement is true if the Frequent occupational requirement allows the worker to self pace, or the job is not production or safety sensitive to slower than average pace during task performance.

However, if the task is required at a Industrial Standard pace for safety or production reasons then this statement is not true. The same reasoning exists for the evaluee score falling below 70% of the Industrial Standard being considered able to meet Occasional occupational demands.

A supervisor has to climb a stair occasionally to check a boiler. It is not critical that the task be performed at 100% Industrial Standard, as the task does not impact on productivity or safety. The task demands can be met at the MTM Occasional rate (less than 70% IS).

A first aid officer has to relieve an assembly line worker occasionally. It is critical that the worker perform at 100% of Industrial Standard, as the task does impact on productivity. Therefore the MTM Occasional rate (less than 70% IS) would not be valid for this job.

EVALUEE STABILITY

An issue in evaluation of functional abilities exists with a medically unstable evaluee, such as one presenting with a diagnosis of chronic fatigue syndrome. Measurement science considers that human performance is expected to be consistent within the validated MTM normal fatigue allowances. If the evaluee is not within those normal fatigue and performance limits then greater validity is gained if repeated measures are used. The evaluator should design a test protocol that can measure the variance.

PREDICTING 8 HOUR DAY

The prediction of performance over an 8 hour day based on a short test is based on measurement science. With a very valid and reliable MTM dataset the evaluator can answer questions in the most scientifically sound method by applying the wealth of measurement science methodology and by realizing the strengths and limitations of measurement. MTM is a measurement, and as with any testing situation, interpretation must consider any *threats* that may exist to content and testing reliability.

Threats to reliability and validity:

- *** Medical stability of the evaluee**
- *** Reliability of the testing protocols**
- *** Evaluator training**
- *** Number of repeated tests**
- *** Evaluee Effort**

If threats to reliability and validity have been accounted for then the evaluator can proceed with great confidence. If there are threats to reliability or validity then the evaluator should remark on those concerns in the report and qualify their opinions:

- ☑ with reader caution
- ☑ suggested range of scores
- ☑ qualification words such as 'likely', 'probably', 'possible'.

The evaluator always interprets scores with an established standard error of measurement and confidence interval. With MTM scores the evaluator can conclude that if an evaluee scores 100% IS on a given testing event, and there is no clinical or motivational threat to his/her performance, then it is valid to represent that that evaluee would score between 92 and 108% of IS, 95% of the time.

DETECTING SUBMAXIMAL EFFORT

MTM based testing has a number of methods of considering evaluee consistency and effort. Foremost is the coefficient of variance (CoVar). A study found that poor effort on MTM based tests had a higher variance in scores than evaluees who performed with average effort (Applewhite, Paulhe, and Thompson). MTM Standard Error of Measurement (SEM) is 8%. Although it may be expected that an evaluee will be within 8% CoVar it is suggested that 10% be the minimal cutoff point of concern. Even so, this must be considered within the framework of any reasonable indicator of effort:

- ☑ the evaluation must be on an unimpaired body part to consider a high CoVar as an indicator of poor effort
- ☑ no change in effort was volitionally given (i.e., the evaluator asked for more effort).

Effort rating is available through the MTM leveling system. This requires subjective analysis by the evaluator, and should be used within this regard. It is suggested that the MTM leveled score be presented as a range of scores (from performance score to leveled score) within which the evaluee could likely perform.

Naturalistic testing is based on timed observation of the evaluee while he/she are not in overt testing, i.e. they are on a 'break and walking to the break area, stooping to retrieve drinks from a bottom shelf, reaching etc. The ethics of this testing are established by the evaluator informing the evaluee at the beginning of testing that they are being evaluated during their *entire* time at the evaluation facility.

Alternate forms testing is to perform the same functional test with varying parameters that the program offers. Since the data is always presented as a ratio of the Industrial Standard, the results are comparable.

The evaluator's ability to motivate the evaluee to perform as if they were in an actual work performance situation is critical.

MTM testing does not require significant exertion.
An unimpaired function should be able to demonstrate 100% IS.
Motivate the evaluee to perform better if they do not achieve 100% IS and are not constrained by symptoms or biomechanics.

If evaluator propmting has led to increased effort, COV may exceed the expected range of 10%

INTERPRETATION

Discrete motion analysis allows interpretation of function as it may relate to diagnosis, job accommodation and modification. (Evaluee performs better sitting than standing).

Fingering: (tested 10/18/99)

Trial	Body Side	Position	Plane	Reps	Time (sec)	% IS	CV (%)	PE	Time Set Completed
1	Dom.	Standing	Immediate	10	19.9	79.9			
2	Dom.	Standing	Immediate	10	18.9	84.2			
3	Dom.	Standing	Immediate	10	18.5	86.0			
Avg: S1	**Dom.**	**Standing**	**Immediate**	**10**	**19.1**	**›83.3‹**	**3.1**	**4**	**10:42**
1	Dom.	Sitting	Immediate	10	14.4	110.5			
2	Dom.	Sitting	Immediate	10	13.9	114.4			
3	Dom.	Sitting	Immediate	10	13.3	119.6			
Avg: S2	**Dom.**	**Sitting**	**Immediate**	**10**	**13.9**	**›114.7‹**	**3.2**	**1**	**10:44**

Evaluee consistency can be interpreted from the coefficient of variance.
Evaluee effort rating can allow a range of score to be considered. (CoVar was high and poor effort was noted and, therefore MTM leveling was applied).

Climb Stairs: (tested 10/18/99)

Trial	Body Side	Weight	Distance	Reps	Time (sec)	% IS	CV (%)	PE	Time Set Completed
1	None	None	8 stairs	1	5.2	105.9			
2	None	None	8 stairs	1	6.8	81.0			
3	None	None	8 stairs	1	7.1	77.6			
Avg: S1	**None**	**None**	**8 stairs**	**1**	**6.4-15%**	**›101.8‹**	**13.1**	**4**	**10:37**

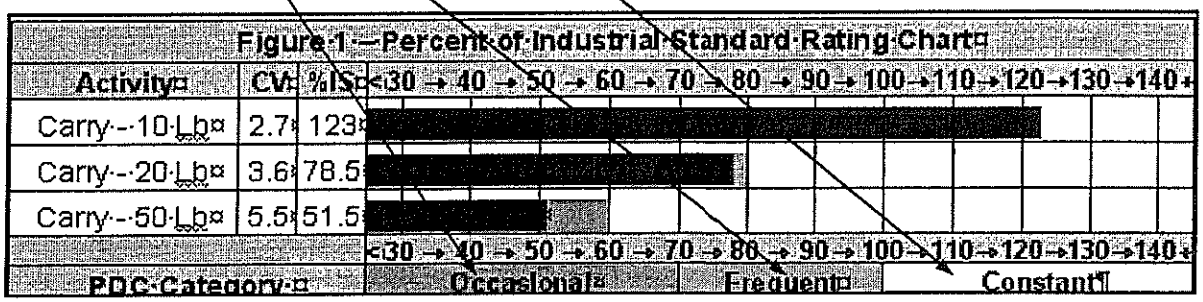
Comments for Climb Stairs by Set (e.g. S1)
S1: Inappropriate Body Mechanics Symptom Complaints or Behaviors Observed Effort was Poor, -15% Leveling Factor applied. complained that they did not want to be in assessment, showed poor motivation to step consistently, had no biomechanical or fitness conditioning impairments, reported perceived exertion inconsistent with demonstrated ability and heart rate (89 bpm)

Short cycle tests can be repeated throughout an evaluation to allow trend analysis. (Ability declined with time).

Fingering: (tested 10/18/99)

Trial	Body Side	Weight	Distance	Reps	Time (sec)	% IS	CV (%)	PE	Time Set Completed
1	None	None	12 Ft	3	22.6	113.3			
2	None	None	12 Ft	3	23.3	109.9			
3	None	None	12 Ft	3	21.1	121.3			
Avg: S1	**None**	**None**	**12 Ft**	**3**	**22.3**	**›114.6‹**	**4.1**	**1**	**8:31**
1	None	None	12 Ft	3	26.6	96.2			
2	None	None	12 Ft	3	27.9	91.7			
3	None	None	12 Ft	3	28.5	89.8			
Avg: S2	**None**	**None**	**12 Ft**	**3**	**27.7**	**›92.5‹**	**2.9**	**2**	**10:32**
1	None	None	12 Ft	3	39.3	65.1			
2	None	None	12 Ft	3	41.1	62.3			
3	None	None	12 Ft	3	40.4	63.4			
Avg: S3	**None**	**None**	**12 Ft**	**3**	**40.3**	**›63.6‹**	**1.8**	**4**	**2:17**

Evaluee ratio to the MTM Industrial Standard allows interpretation into DOT/CCDO categories of Occasional, Frequent or Constant work.



Outcome measurement is available via analysis of pre and post treatment scores.

Stoop: (tested 10/19/99)

Trial	Body Side	Weight	Distance	Reps	Time (sec)	% IS	CV (%)	PE	Time Set Completed
1	Dom.	<2 Lb	None	6	17.9	73.5			
2	Dom.	<2 Lb	None	6	16.8	78.3			
3	Dom.	<2 Lb	None	6	17.2	76.5			
Avg: S1	**Dom.**	**<2 Lb**	**None**	**6**	**17.3**	**76.0**	**2.6**	**5**	**09:43**

Stoop: (tested 11/1/99)

Trial	Body Side	Weight	Distance	Reps	Time (sec)	% IS	CV (%)	PE	Time Set Completed
1	Dom.	<2 Lb	None	6	12.4	106.1			
2	Dom.	<2 Lb	None	6	13.1	100.4			
3	Dom.	<2 Lb	None	6	12.7	103.6			
Avg: S1	**Dom.**	**<2 Lb**	**None**	**6**	**12.7**	**103.3**	**2.3**	**2**	**08:54**

SUMMARY

The learning objective of this section was to:

- ✓ Introduce the physical ability testing
- ✓ Acquaint the evaluator with Methods-Time Measurement
- ✓ Outline the major issues in physical abilities evaluation

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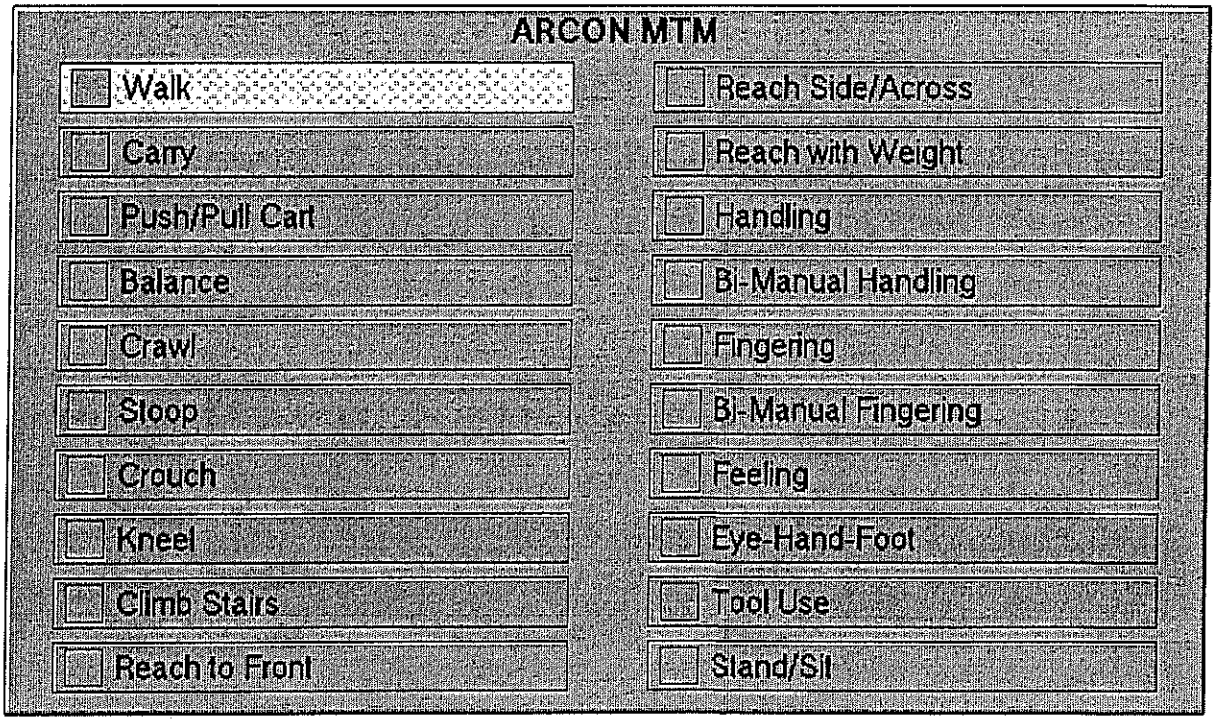
LEARNING EXERCISE:

THE ARCON MTM based functional capacity tests will be demonstrated.



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