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Section 45: Method of Evaluation of Cardiac Disability

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DISABILITY EVALUATION

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SECTION I: CLINICAL AND LABORATORY APPROACH TO CARDIAC DISABILITY EVALUATION

A. General

The clinical and laboratory approach to cardiac disability evaluation in workers' compensation is essentially no different from any other detailed exhaustive medical consultation. The physician shall start with a comprehensive history and physical as detailed below. This is the cornerstone of any good exhaustive evaluation. Beyond that, a judicious and minimal number of tests must be utilized to arrive at a disability rating. It is not uncommon at all after a comprehensive history and physical that there will be no further testing necessary. On the other hand, it is often thought that other testing are required and they will be discussed in detail below. However, by no means does this imply that all these testings need to be done. The listed testing are merely a number of clinical and laboratory testings that are useful in different clinical circumstances in evaluating a cardiac patient. It is anticipated that in most cases an evaluation considering all the medical records, what tests have been done previously, the history, the physical, the electrocardiogram, and some form of exercise testing will be more than adequate in determining a disability rating. The additional testing listed shall be done only in the special circumstances described. When these additional testing are utilized, full explanation to the justification of the testing must be included so that the reviewing agencies or the reviewing physician can determine its reasonableness in reimbursing medical-legal costs.

Testing of any kind is not to be repeated more than every six month unless there is evidence of a change in the clinical condition. If a physician decides to repeat the testing in less than six months' time, he or she must explain the necessity of such repeated testing. The physician shall inform the applicant of any significant medical finding(s) which could impact on his or her health even though these findings may not be directly related to the cardiac claims.

B. History and Physical

The cornerstone of a comprehensive medical evaluation is the history and physical. The history shall consist of a complete detailed history of the industrial injury, occupational history of the present occupation as well as past occupations; medical history of all prior hospitalizations, treatments, surgeries, and medical illnesses; family history; history of habits such as smoking, drinking and the use of drugs; history of the current illness, the sequence of events, the present complaints as well as a complete list of all present medications.

When determining whether an occupational event is related to cardiac disability, the applicant shall be asked specifically why he or she feels the cardiac problem is related to the work. Complete details of the current illness shall be reviewed, including circumstances of the industrial event or events relating to the cardiac condition, any previous or similar episodes of the same type of event which might have occurred away from the job, prior to the job, or during previous jobs. A complete list of all doctors who have treated the applicant for the illness shall be obtained in order to facilitate obtaining medical records that have not always been obtained before.

A complete listing of all the complaints at the time of the examination as to the duration, degree and nature shall be included. This is especially important when listing subjective complaints of permanent disability in the final report. Details of temporary disability shall be recorded, including whether the patient is working, and what effect going back to the work had on the illness, if any, or, if not working, whether the patient plans to return to work. These details bear on the patient's ability to do the same type of work, or whether the patient is a qualified injured worker and thereby a candidate for vocational rehabilitation.

All medical records shall, to the extent possible, be obtained prior the evaluation. The evaluator must be familiar with the medical record and its salient features in order to better direct the questions and evaluation and better outline the issues to be evaluated.

A comprehensive detailed physical examination shall be performed. If part of the examination such as detailed neurological examination is to be omitted, it must be so stated. Blood pressure shall be taken in supine and upright positions on both arms several times by the physician. Other physical findings especially germane to the cardiac examination such as fundoscopic examination, neck vein status, cardiac auscultation, and extremities' examination must be specifically mentioned and recorded.

C. Routine Laboratory Testing

Routine laboratory studies such as CBC, chemistry panel and urinalysis and thyroid functions, are generally useful in evaluating the general medical status of the patient. An electrocardiogram as well as a chest X-ray may be performed since they are relatively inexpensive and informative. Again as stated above, if any of this examination has been performed recently within six months, it must not be repeated unless indicated.

D. Stress Testing

Exercise stress testing is currently the most important and productive means of quantitating a worker's impairment. Protocols and guidelines for exercise testing on the treadmill utilizing the Bruce protocol and holding the front handrail and bicycle ergometer have been documented and quantitated. See Table 2 for comparison of exercise test standards.

Reports of stress testing to rate a worker's impairment shall include the following information:

1. Peak level of activity achieved, preferably expressed in METs (metabolic equivalents of oxygen consumption)
2. Any clinical signs or symptoms reported or observed
3. Record of ectopic (ventricular or supraventricular) activity
4. Specific EKG (ST segment and T wave) changes noted
5. Accurate description of, and timing of development of, such symptoms as dyspnea, angina, ischemic ST segment change or arrhythmia
6. Blood pressure response.

The end point of exercise testing shall be either to achieve maximum capability or to develop any of the following symptoms and signs noted below. If the examiner does submaximal testing, stopping at "90% of expected" for example, 10% shall be added to the METs level calculated from the Bruce or other testing protocol tables. The examiner must specify which symptom(s) or sign(s) caused testing to be stopped and shall fully explain why cardiac impairment (rather than some other condition) caused testing to be stopped. If the test subject stops voluntarily before reaching what his or her physician considers maximum capability, the examiner shall state an opinion as to what the true testing end point should be, giving reasons. Significant sections of the tracing, including scale as well as technical description of the equipment used, shall be enclosed with the report.

The signs and symptoms indicating the end point shall be the following:

1. Onset of atrial fibrillation
2. Onset of ectopic atrial tachycardia
3. Progressive drop in heart rate as exercise continues, or if systolic blood pressure falls 10 mm below prior measured level as exercise continues
4. Progressive ST segment elevation or depression
5. Progressive widening of the QRS complex or PR interval
6. PVCs with increasing frequency to the point of danger
7. Ventricular tachycardia (three or more consecutive beats)
8. Excessive blood pressure rise (230 mm Hg systolic or above)
9. Undue dyspnea: subjective evaluation by test subject that dyspnea is not acceptable (usually coupled with #10 below). The examiner must state whether the testing end point is or is not a valid measure of cardiac capability and give reason(s) for the opinion.
10. Undue fatigue: subjective evaluation by testing subject that fatigue is not tolerable (usually coupled with #9 above). The examiner must state whether the testing end point is or is not a valid measure of cardiac capability and give reason(s) for the opinion.
11. Feeling of faintness: subjective evaluation by test subject. The examiner shall state whether the testing end point is or is not a valid measure of cardiac capability and give reason(s) for the opinion.
12. Angina pain progressive to moderately severe: three or four on a scale of four. The examiner shall state whether the testing end point is or is not a valid measure of cardiac capability and give reason(s) for the opinion.
13. Musculoskeletal pain or discomfort that limits continuance of the test: the end point in this event is not valid for the evaluation of cardiac impairment.

If pulmonary function testing is needed to rule out pulmonary factors contributing to decreased exercise tolerance, the physician shall include an explanation of its necessity.

E. Newer modalities

In addition to stress testing, there are various newer modalities that can be very useful in the determination of disability. However, the physician performing and interpreting such testings shall have the appropriate training and experience. In addition, the physician shall be identified.

Stress testing done in conjunction with thallium-201 is a more sensitive tool in the diagnosis of coronary artery disease. Its sensitivity has been reported to range from 68% to 96% (average 84%), compared with a sensitivity of 60% to 70% for exercise EKG alone. The specificity of thallium scintigraphy has been reported to be between 65% and 100% (average 87%), which represents a modest improvement compared with the specificity of exercise EKG alone. Thallium scintigraphy is often done with SPECT (single photon emission computed tomography) which further increases the sensitivity. However, a stress test with thallium is costly and has the undesirable side effect of exposure to radiation. A total body radiation exposure associated with intravenous injection of 2mCi of thallium-201 is approximately 420 mrad; this amount is equivalent to that of approximately 30 chests X-rays. Thallium scintigraphy, however, is preferable to exercise EKG alone when the resting EKG shows a non-specific abnormality impairing interpretation of exercise EKG alone or when information on the probable reversibility (or nonreversibility) of apparently infarcted segment is needed to estimate the potential value of revascularization therapy. In the majority of cases of disability evaluation, thallium testing is not necessary in determining the disability status, above and beyond what information that can be derived from a standard exercise test.

Technetium 99m sestamibi study is another form of studying perfusion of the heart. This radioactive study is similar to that of thallium 201. With a combined approach using both thallium and sestamibi 99m, one can decrease the acquisition time by 50%. The information derived from these newer techniques allows for both evaluations of ischemia and data similar to a first pass MUGA study. This particular technique is more expensive than thallium imaging, but is of shorter time and is useful when information regarding wall motion abnormality and ejection fraction is important as well as the degree and area of ischemia. This obviates the need for ordering a MUGA scan.

Adenosine or Dipyridamole thallium studies are newer modalities that allow studying perfusion abnormalities to the myocardium when the patient cannot perform a regular treadmill or bike testing. The physician shall order one of these studies only if it is important to make an absolute diagnosis of coronary disease and the patient is unable to perform a treadmill test or a bike test. These studies do not allow for functional disability evaluation but only provide information regarding the presence or absence of myocardial ischemia.

Echocardiography with stress test, with Adenosine, with Dipyridamole, or with Dobutamine have all been described. The information is that of wall motion abnormality indicating ischemia. Ejection fraction can also be measured. These techniques are somewhat less expensive than radionuclear studies, but require an experienced technician to obtain a satisfactory study.

F. Echocardiogram

Echocardiogram is a useful tool in determining left ventricular function, chamber size, wall thickness, valvular anatomy and function, and flow pattern as determined by Doppler study. It is, therefore, useful in the determination of left ventricular hypertrophy and left ventricular mass, diastolic dysfunction as demonstrated by abnormal flow pattern, and valvular heart disease such as mitral valve prolapse and aortic stenosis. Ejection fraction can also be accurately determined by echocardiogram.

G. MUGA Scan

Multi-gated equilibrium radionuclide angiography (MUGA) is a very accurate method in measuring ejection fraction. Rest and exercise equilibrium radionuclide angiography has been used in conjunction with or as an alternative to thallium scintigraphy in the detection of coronary artery disease. Regional or global abnormal wall motion at rest or during exercise can be accurately delineated with this technique. It is also a powerful predictor of subsequent adverse cardiac event. It is also useful in managing patients with stenotic or regurgitant valvular lesions.

H. Holter Monitor

Holter monitoring is used in cases where arrhythmia is an issue. A 24-hour Holter monitor is valuable in determining whether the applicant has a significant enough arrhythmia to be considered in the process of disability rating. For instance, there may be a very complex arrhythmia which would prohibit certain types of activities. High fidelity Holter monitoring can also be done to determine whether patient has ischemia at various times of the day, which is not apparent on standardized exercise tests. It is especially useful in cases of coronary artery spasm. It is also useful in detecting silent ischemia.

I. Coronary Angiography

Coronary angiography is the gold standard for diagnosing coronary artery disease. It is also the gold standard for determining the best mode of therapy, be it angioplasty, bypass surgery, or medical treatment. It is generally not a testing which is done for disability evaluation. However, if the data is included in the medical record, it should be part of the material used in determining the coronary anatomy, the amount of myocardial damage, the amount of myocardium at risk, the amount of myocardium with akinesis or hypokinesis, or the ejection fraction. This shall be used as adjunctive material for disability evaluation. However, in general the coronary angiogram defines the anatomy of the coronary arteries, not the functional aspects of the patient which are better determined by exercise testing, with or without other adjunctive studies such as thallium scintigraphy.

SECTION II: OBJECTIVE AND SUBJECTIVE FACTORS UTILIZED IN CARDIAC DISABILITY EVALUATION

A. Work Level By Stress Testing

The acceptable exertional level of sustained (eight hours per day) work relative to VO₂ max is 45%. The VO₂ max is estimated by the METs achieved at the end point of stress testing. When stress testing has been performed and the end point in METs has been determined, the physician can predict a "safe" effort for a given applicant with the above information in mind. If the testing end point is related to poor state of physical fitness, the maximal short-term (less than 15 minutes once a day) work exertion allowed shall be 80% of the end point level. If the subject is post-medical intervention for cardiac ischemia and is asymptomatic off the treadmill, the maximum short-term (defined as less than 15 minutes once a day) work exertion allowed shall be 80% of the testing end points in METs. If the testing end point is related to signs or symptoms of cardiac distress, as listed above, the maximum short-term (defined as less than 15 minutes once a day) work exertion allowed shall be 70% of the end point level. The sustained level of work exertion for activities through most of the work day for all patients shall be set at 45% of the testing end point in METs.

B. Work Level By History and Previous Testing

Occasionally stress testing is not feasible. However, work level can still be assessed in the following manner:

- (1) Activity levels reported (consistent with clinical picture) translated into METs
- (2) Previous post-injury exercise testing
- (3) Documented level in post-injury exercise program in METs

C. Pre-Injury Work Level

It is extremely important to determine the work level before the industrial injury. The pre-injury METs level found from one of the four following tests shall be used, in this order:

("Pre-injury METs level" is defined as that subsequent to the time the last of any known previous cardiac injuries became "permanent and stationary" and within the past five years preceding the instant injury).

- (a) If available, use previous measurement by exercise testing.
- (b) If (a) is not available, use previous capability by activity level within the past five years translated into METs.
- (c) If (a) and (b) are not available, use previous capability level by non-work activities, translated into METs.
- (d) If (a), (b) and (c) are not available, use mean standard METs for age and sex from Table 3.

D. Ejection Fraction

Ejection fraction may be used to estimate cardiac impairment in the absence of exercise testing or used to modify or validate medical opinion based on exercise testing. However, one may have normal resting ejection fraction even though impairment may still be present with major coronary occlusion. Therefore, ejection fraction is a supplement rather than an alternative to stress testing.

Cardiac catheterization with direct measurement of cardiac output and cardiac index is an accurate method of measuring ejection fraction, but must not be routinely done for workers' compensation evaluation. If it happens to have been done for other reasons, the information provided is valuable if the test was done at a time reasonably close to the workers compensation evaluation. The physician shall explain why the data/information is considered relevant or not. Ejection fraction is best measured accurately by echocardiogram or MUGA scan.

The following guidelines must be followed with regard to ejection fraction:

- (a) More than 55% is in normal range, equivalent in cardiac performance to the normal for age and sex (see table 3).
- (b) 45 to 50% is slight impairment.
- (c) 30 to 45% is moderate impairment.
- (d) Less than 30% is not quite severe impairment.
- (e) Less than 20% is severe or total impairment.

E. Coronary Artery Spasm

Coronary artery spasm must be diagnosed by EKG or Holter monitor with S-T segment changes up or down more than one mm. The Holter monitor must be a high fidelity type and not a standard or event recorder. S-T segments are usually elevated with coronary spasm and depressed with ischemia, but this is not always the case. Significant sections of the tracing, including scale, as well as a technical description of the equipment used, shall be included with the report. There are several types of coronary artery spasm:

- (1) Coronary artery spasm with pain, however the coronary arteries are normal. The relationship of this type of coronary artery spasm to emotional stress is somewhat controversial. It is not related to physical stress.
- (2) Coronary artery spasm with pain, however there are coronary artery occlusions. This type of chest pain is related to physical and/or emotional stress.
- (3) Myocardial ischemia without pain (silent ischemia). This is usually associated with fixed-lesion coronary artery disease. It is also related to emotional and/or physical stress.

The impairment due to coronary artery spasm shall be evaluated after appropriate treatment, which shall be continued. The evaluator must describe the level of emotional and/or physical stress producing spasm and offer an opinion regarding the extent of the impairment, which shall be described in detail. The response to medication shall also be described. If the patient has nearly daily episodes not controlled with medication, it must be described as severe. If the

patient has an episode every week or two despite medication, the impairment is described as moderate. If the patient has an occasional episode despite medication, the impairment is described as slight. If there are side effects from the medications, they shall be described in detail.

F. Arrhythmia

Arrhythmia should be evaluated after appropriate treatment and documented by data from EKG, Holter Monitor, event recorder, or data from stress testing.

Any significant arrhythmia which terminates a stress test should automatically establish the impairment level. Occasional unifocal PVCs with an otherwise normal heart represents no impairment unless the PVCs are related to stress or because of the patient's marked preoccupation with symptoms. Ventricular arrhythmia in the presence of ventricular dysfunction or valvular abnormality is associated with an increased risk of sudden death. Supraventricular arrhythmia may result in impairment depending on the extent of subjective symptoms.

G. Hypertension

Hypertension is defined as a resting blood pressure over 140/90. The blood pressure must be taken multiple times in both arms, in both a supine and an upright position. It is extremely important to establish that hypertension does exist. At times this requires multiple visits or 24-hour blood pressure monitoring.

Hypertension is "controlled" when the blood pressure is lower than 140/90 with reasonable medication ("reasonable medication" means no untoward side effects). Any side effects shall be described and appropriate restrictions due to side effects must be stated. When there are no significant side effects, this shall also be stated.

Blood pressure is "incompletely controlled" if there is an intermittent elevation of blood pressure higher than 140/90 with reasonable medication.

Blood pressure is "uncontrolled" when the diastolic pressure is always higher than 90, with or without reasonable medication. If without medication, treatment is needed, the applicant may or may not be temporarily, partially, or totally disabled.

In most cases, with effective treatment, hypertension can generally be controlled. The medication and dosage, as well as increases needed, must be noted. There is usually a period of time need to adjust medication until the blood pressure is controlled and side effects are tolerable. This period of time is generally no longer than three months. During this period of time, the patient may be temporarily, partially or totally disabled. If the period of time exceeds three months, an explanation must be provided.

In terms of impairment factors, the side effects of the controlling medication may on their own warrant a finding of disability. The signs and/or symptoms must be described and quantified, and their relationship to the medication explained. In testing for "controlled" hypertension,

ambulatory blood pressure monitoring, or treadmill testing may show intermittent loss of control. The level of physical and emotional stress producing loss of control may be a basis for impairment rating. Such testing is ordered at the discretion of the physician. If there exists a "controlled" hypertension with end organ damage, the medical evaluator must describe and give the significance of the end organ damage. "Uncontrolled" hypertension may or may not be temporarily totally disabling.

H. Emotional stress

The following guidelines shall be used for prophylactic restrictions from stress. All conditions the physician feels justify a preclusion from emotional stress such as those listed below, or any others the physician feels are significant, shall be under appropriate and continuing treatment. The reasons listed for prophylactic restriction below are examples. If prophylactic restrictions are suggested for reasons other than those listed below, the restriction must be justified by comparison with the examples given. The physician shall give examples of emotional stressors to be avoided by the patient. The physician shall be as specific as possible.

(1) Prophylactic restriction against all emotional stress. Examples include:

- Recurrent complex cardiac arrhythmia persisting despite appropriate treatment.
- unstable angina or rest angina at a frequency of three or more times a week, documented by history.
- uncompensated heart failure.
- EKG demonstration of silent ischemia persisting despite appropriate treatment documented by Holter Monitor and diary.

(2) Prophylactic restriction from more than ordinary -- for the person being examined -- emotional stress. Examples include:

- occasional episodes of complex arrhythmia or arrhythmias associated with undue or more than ordinary emotional stress document by Holter Monitor and diary.
- angina with undue or more than ordinary stress.
- compensated heart failure.
- hypertension shown to become uncontrolled--with diastolic over 100 present 50% of the time or more -- under undue or more than ordinary emotional stress.
- EKG demonstration of silent ischemia under undue or more than ordinary emotional stress documented by Holter Monitor and diary.

(3) Prophylactic restriction against severe emotional stress. Examples include:

- arrhythmia precipitated by severe emotional stress documented by Holter.
- angina precipitated by severe emotional stress.

- documented decompensation or congestive heart failure precipitated by severe emotional stress.
- hypertension which becomes uncontrolled by severe emotional stress.
- EKG demonstration of silent ischemia with severe emotional stress documented by Holter monitor and diary.
- mitral valve prolapse: a mechanical abnormality which becomes symptomatic (chest pain and/or cardiac arrhythmias) under conditions of severe emotional stress. Mitral valve prolapse must be documented.
- psychophysiological cardiovascular reaction. This includes clinical pictures of chest pain with no cardiac pathology and cardiac irregularity (palpitation of simple arrhythmia) for which no other organic cause is found. These symptoms are often precipitated by severe emotional stress.

I. Previous Cardiac History Including Myocardial Infarction, Coronary Artery Bypass Surgery or Coronary Angioplasty

The previous history of myocardial infarction, coronary surgery, coronary angioplasty, atherectomy or coronary stent placement as a consequence of the incident injury shall be considered in a finding of disability and the resulting finding may or may not be absorbed in the (exercise capacity based) findings as the evidence directs.

SECTION III: DISABILITY EVALUTION SCHEDULE FOR THE HEART

The above clinical and laboratory approach to cardiac evaluation as described in Section I gives rise to the objective and subjective factors to be utilized in cardiac disability evaluation. The various factors were described above under Section II. The cornerstone of the disability evaluation is work level, before and after the industrial injury as established by stress testing (Section IIA, IIB, IIC). 45% of the testing end point is the accepted level for sustained work. Consideration shall also be given to a need for maximum short term effort (less than 15 minutes once a day) in certain occupations. The 80% level in METs of the person's testing end point shall meet or exceed this short-term METs requirement. In arriving at the findings of disability, the physician shall consider the current work level status (Section IIA, IIB) and the pre-injury work level status (Section IIC). Using those two levels as measured in METs, the physician shall calculate the percentage of impairment as a result of the industrial injury:

$$\% \text{ of impairment} = (1 - \text{current work level} / \text{pre-injury work level}) \times 100\%$$

For example, if a worker had a pre-injury work level of 12 METs, after his industrial injury his current work level has been determined to be 8 METs, his % of impairment is $(1 - 8/12) \times 100\% = 33 \frac{1}{3}\%$. The minimal METs required for mere surviving (generally less than 2.5 METs), that is without any capacity of any work, may be taken into consideration and may be used to modify the above formula.

When the determination of pre-injury work level is not feasible, Table 4 is offered as a guide to estimate *minimum* work preclusion on the basis of current work level.

Other objective and subjective factors as described in Section II shall be considered when they are appropriate in arriving at the final disability finding. If symptoms and signs of coronary artery spasm, arrhythmia, hypertension or emotional stress cause exercise testing to be stopped, disability for those clinical factors would be at least partially "absorbed" in the (exercise capacity based) disability findings. Otherwise (if there are no symptoms or signs resulting at the time) if coronary artery spasm, arrhythmia, hypertension or emotional stress given rise to non-scheduled disability findings, these findings may or may not be absorbed in the (exercise capacity based) disability findings as the evidence directs. If the physician feels comfortable with using the guideline for work capacity (Table I) directly without calculating the percentage of impairment, he may do so.

Table 1 - A
Guideline for work capacity
(For Dates of Injury Prior to 4/1/97)

(a) "Disability precluding very heavy lifting" contemplates the employee has lost approximately one-quarter of pre-injury lifting capacity. A statement such as "unable to lift 50 pounds" is not meaningful. The total lifting effort, including weight, distance, endurance, frequency, body position, and similar factors should be considered with reference to the particular individual.

(b) "Disability precluding very heavy work" contemplates the employee has lost approximately one-quarter of pre-injury lifting capacity for performing such activities as bending, stooping, lifting, pushing, pulling and climbing or other activities involving comparable physical effort.

(c) "Disability precluding heavy lifting" contemplates the employee has lost approximately half of pre-injury lifting capacity. (See statement regarding lifting in (a), above.)

(d) "Disability precluding heavy lifting, repeated bending, and stooping" contemplates the employee has lost approximately half of pre-injury capacity for lifting, bending, and stooping.

(e) "Disability precluding heavy work" contemplates the employee has lost approximately half of pre-injury capacity for performing such activities as bending, stooping, lifting, pushing, pulling and climbing or other activities involving comparable physical effort.

(f) "Disability resulting in limitation to light work" contemplates the employee can do work in a standing or walking position, with a minimum of demands for physical effort.

(g) "Disability resulting in limitation to semi-sedentary work" contemplates the employee can do work approximately one-half the time in a sitting position and approximately one-half the time in a standing or walking position with a minimum of demands for physical effort, whether standing, walking, or sitting.

(h) "Disability resulting in limitation to sedentary work" contemplates the employee can do work predominantly in a sitting position at a bench, desk, or table with a minimum of demands for physical effort and with some degree of walking and standing permitted.

Table 1 - B
Guideline for work capacity
(For Dates of Injury on or after 4/1/97)

- (a) "Disability precluding very heavy lifting" contemplates the individual has lost approximately one quarter of pre-injury capacity for lifting. (A statement "inability to lift 50 pounds" is not meaningful. The total lifting effort, including weight, distance, endurance, frequency, body position and similar factors should be considered with reference to the particular individual.)
- (b) "Disability precluding very heavy work" contemplates the individual has lost approximately one quarter of pre-injury capacity for performing such activities as bending, stooping, lifting, pushing, pulling and climbing or other activities involving comparable physical effort.
- (c) "Disability precluding repetitive motions of neck or back" contemplates the individual has lost approximately one half of pre-injury capacity for flexing, extending, bending, and rotating neck or back.
- (d) "Disability precluding heavy lifting" contemplates the individual has lost approximately one half of pre-injury capacity for lifting. (See statement regarding lifting under "disability precluding very heavy lifting" above.)
- (e) "Disability precluding heavy lifting and repeated bending and stooping" contemplates the individual has lost approximately one half of pre-injury capacity for lifting, bending and stooping.
- (f) "Disability precluding heavy work" contemplates the individual has lost approximately one half of pre-injury capacity for performing such activities as bending, stooping, lifting, pushing, pulling, and climbing or other activities involving comparable physical effort.
- (g) "Disability precluding substantial work" contemplates the individual has lost approximately three quarters of pre-injury capacity for performing such activities as bending, stooping, lifting, pushing, pulling, and climbing or other activities involving comparable physical effort.
- (h) "Disability resulting in limitation to light work" contemplates the individual can do work in a standing or walking position, with a minimum of demands for physical effort.
- (i) "Disability resulting in limitation to semi-sedentary work" contemplates the individual can do work approximately one half of the time in a sitting position, and approximately one half of the time in a standing or walking position, with minimum of demands for physical effort whether standing, walking or sitting.
- (j) "Disability resulting in limitation to sedentary work" contemplates the individual can do work predominately in a sitting position at a bench, desk or table with a minimum of demands for physical effort and with some degree of walking and standing being permitted.

Table 2
Oxygen Requirements For Various Step, Treadmill, and Bicycle Ergometer Tests:

METS	Treadmill Tests						Bicycle	Step	O2 Req ml/o2/kg/min	
	BRUCE		Kattus		Balke	Balke	Ergometer	Tests		
							For 70kg body weight (see Table 1 for METS level for wt and perfor.	Nagle		
								Balke		
								Naughtus		
16	3-min stages		3-min stages		% grade at 3.4mph	% grade at 3mph		2-min stages		
	mph %gr		mph % gr		26		kgm/min	30 steps/min (Step ht increased)	56.0	
15					24				52.5	
14	4.2	16	4	22			1500	4 cm q	49.0	
13										
					20			2 min	45.5	
								Ht (cm)		
12			4	18	18	22.5	1350	40	42.0	
11					16	20.0	1200	36	38.5	
10	3.4	14	4	14	14	17.5	1050	32	35.0	
9					12	15.0	900	28	31.5	
8			4	10	10	12.5	750	24	28.0	
7	2.5	12	3	10	8	10.0		20	24.5	
6					6	7.5	600	16	21.0	
5	1.7	10	2	10	4	5.0	450	12	17.5	
4					2	2.5	300	8	14.0	
3						0	150	4	10.5	
2										7.0
1										3.5

Figure 1. Oxygen requirements increase with work loads from bottom of chart to top in various exercise tests of the step, treadmill, and bicycle ergometer types.

Table 3
Maximum oxygen uptake in healthy "normal" volunteers*

MALE

Age	Mean	METS	METS	METS
	Mi/Kg/Min-1	10th %	Mean	90th %
20-29	39	9.0	11.0	13.5
30-39	37	8.6	10.5	13.2
40-49	35.7	7.8	10.0	12.8
50-59	33	7.0	9.4	12.4
60+	29	5.7	8.2	11.7

FEMALE

Age	Mean	METS	METS	METS
	Mi/Kg/Min-1	10th %	Mean	90th %
20-29	30.2	6.2	8.6	10.8
30-39	30.2	6.2	8.6	10.2
40-49	26.7	6.0	7.6	10.0
50-59	24.5	5.0	7.0	9.4
60+	21.8	4.5	6.2	8.6

Data from the Cooper Clinic Coronary Risk Factor Profile Charts, which are from data collected on patients being evaluated at the Cooper Clinic and standards being established at the Institute for Aerobics Research, Dallas, Texas, 1978. Reprinted with permission from Pollock, M.L., Wilmore, J.H., and Fox, S.M.: Health and Fitness Through Physical Activity, New York, copyright John Wiley and Sons, 1978.

* Maximum oxygen uptake was estimated from treadmill time.

Table 4

Peak METS	Preclusion Equivalent
>9	None to very heavy work
7 - 9	Heavy work
5 - 7	Light work
2.5 - 5	Sedentary work
<2.5	Total