

TABLE 4 (a) Normal Time Values for MTM-1 Motion Element: Reach (R)

Distance		Time in TMU						Case and Description
						Hand in Motion		
cm	inches	A	B	C or D	E	A	B	
< 2.0	< 0.75	2.0	2.0	2.0	2.0	1.6	1.6	A Reach to object in fixed location, or to object in other hand or on which other hand rests.
2.5	1	2.5	2.5	3.6	2.4	2.3	2.3	
5.1	2	4.0	4.0	5.9	3.8	3.5	2.7	
7.6	3	5.3	5.3	7.3	5.3	4.5	3.6	B Reach to single object in location that may vary slightly from cycle to cycle.
10.1	4	6.1	6.4	8.4	6.8	4.9	4.3	
12.5	5	6.5	7.8	9.4	7.4	5.3	5.0	
15.2	6	7.0	8.6	10.1	8.0	5.7	5.7	C Reach to object jumbled with other objects in a group so that search and select occur.
17.8	7	7.4	9.3	10.8	8.7	6.1	6.5	
20.3	8	7.9	10.1	11.5	9.3	6.5	7.2	
22.9	9	8.3	10.8	12.2	9.9	6.9	7.9	D Reach to a very small object or where accurate grasp is required.
25.4	10	8.7	11.5	12.9	10.5	7.3	8.6	
30.5	12	9.6	12.9	14.2	11.8	8.1	10.1	
35.6	14	10.5	14.4	15.6	13.0	8.9	11.5	E Reach to indefinite location to get hand in position for body balance or next motion or out the way.
40.6	16	11.4	15.8	17.0	14.2	9.7	12.9	
45.7	18	12.3	17.2	18.4	15.5	10.5	14.4	
50.8	20	13.1	18.6	19.8	16.7	11.3	15.8	
55.9	22	14.0	20.1	21.2	18.0	12.1	17.3	
61.0	24	14.9	21.5	22.5	19.2	12.9	18.8	
66.0	26	15.8	22.9	23.9	20.4	13.7	20.2	
71.1	28	16.7	24.4	25.3	21.7	14.5	21.7	
76.2	30	17.5	25.8	26.7	22.9	15.3	23.2	
Additional		0.4	0.7	0.7	0.6	TMU per 2.54 cm > 76 cm (per 1.0 in > 30 in.)		

TABLE 4 (b) Normal Time Values for MTM-1 Motion Element: **Grasp (G)**

Type of Grasp	Case	Time, TMU	Description and Object Dimensions	
Pickup	1A	2.0	Any size object, by itself	
	1B	3.5	Object very small or lying close against a flat surface	
	1C1	7.3	Interference with grasp on bottom and one side of cylindrical object	Diameter > 1.3 cm (0.5 in.)
	1C2	8.7		Diameter 0.6 to 1.3 cm (0.25 to 0.5 in.)
	1C3	10.8		Diameter < 0.6 cm (0.25 in.)
Regrasp	2	5.6	Change grasp without relinquishing control	
Transfer	3	5.6	Control transferred from one hand to other	
Select	4A	7.3	Object jumbled with other objects so that search and select occur	Size larger than 2.5 × 2.5 × 2.5 cm (1 × 1 × 1 in.)
	4B	9.1		0.6 × .6 × .3 cm (.25 × .25 × .12 in.) to 2.5 × 2.5 × 2.5 cm (1 × 1 × 1 in.)
	4C	12.9		Size smaller than .6 × .6 × .3 cm (.25 × .25 × .12 in.)
Contact	5	0	Contact, sliding, or hook grasp	

TABLE 4 (c) Normal Time Values for MTM-1 Motion Element: Move (M)

Distance		Time in TMU				Hand in motion	Weight up to	Formula Parameters		Case and Description
		A	B	C	B			Constant	Factor	
cm	inches					kg (lb)				
< 2.0	< 0.75	2.0	2.0	2.0	1.7				A Move object to other hand or against stop.	
2.5	1	2.5	2.9	3.4	2.3	1.1 (2.5)	0	1.00		
5.1	2	3.6	4.6	5.2	2.9					
7.6	3	4.9	5.7	6.7	3.6	3.4 (7.5)	2.2	1.06	B Move object to approximate or indefinite location.	
10.1	4	6.1	6.9	8.0	4.3					
12.5	5	7.3	8.0	9.2	5.0	5.7 (12.5)	3.9	1.11		
15.2	6	8.1	8.9	10.3	5.7					
17.8	7	8.9	9.7	11.1	6.5	7.9 (17.5)	5.6	1.17		
20.3	8	9.7	10.6	11.8	7.2				C Move object to exact location.	
22.9	9	10.5	11.5	12.7	7.9	10.2 (22.5)	7.4	1.22		
25.4	10	11.3	12.2	13.5	8.6					
30.5	12	12.9	13.4	15.2	10.0	12.5 (27.5)	9.1	1.28		
35.6	14	14.4	14.6	16.9	11.4					
40.6	16	16.0	15.8	18.7	12.8	14.7 (32.5)	10.8	1.33		
45.7	18	17.6	17.0	20.4	14.2					
50.8	20	19.2	18.2	22.1	15.6	17.0 (37.5)	12.5	1.39		
55.9	22	20.8	19.4	23.8	17.0					
61.0	24	22.4	20.6	25.5	18.4	19.3 (42.5)	14.3	1.44		
66.0	26	24.0	21.8	27.3	19.8					
71.1	28	25.5	23.1	29.0	21.2	21.5 (47.5)	16.0	1.50		
76.2	30	27.1	24.3	30.7	22.7					
Additional		0.8	0.6	0.85	TMU per 2.54 cm > 76 cm (per 1.0 in. > 30 in.)					

TABLE 4 (d) Normal Time Values for MTM-1 Motion Element: **Position (P)**

			Time in TMU	
Class	Description of Fit	Symmetry	Easy to Handle	Difficult to Handle
1	Loose (no pressure required)	S	5.6	11.2
		SS	9.1	14.7
		NS	10.4	16.0
2	Close (light pressure required)	S	16.2	21.8
		SS	19.7	25.3
		NS	21.0	26.6
3	Exact (heavy pressure required)	S	43.0	48.6
		SS	46.5	52.1
		NS	47.8	53.4

Key: S = symmetrical, SS = semi-symmetrical, NS = nonsymmetrical.

TABLE 4 (e) Normal Time Values for MTM-1 Motion Element: **Release** (RL)

Case	Time in TMU	Description
1	2.0	Normal release performed by opening fingers as an independent motion
2	0	Contact release with no finger motion

TABLE 4 (f) Normal Time Values for MTM-1 Motion Element: **Disengage** (D)

Class	Description of Fit	Height of Recoil	Time in TMU	
			Easy to Handle	Difficult to Handle
1	Loose (very slight effort, blends with subsequent move)	Up to 2.5 cm (1 in)	4.0	5.7
2	Close (normal effort, slight recoil) (1 to 5 in)	2.5 to 12.7 cm	7.5	11.8
3	Tight (considerable effort, hand recoils markedly)	12.7 to 30 cm (5 to 12 in)	22.9	34.7

TABLE 4 (g) Normal Time Values for MTM-1 Motion Element: **Turn** (T)

Weight, kg (lb)	Time in TMU for Degrees Turned										
	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°	180°
Small, up to 0.9 (2)	2.8	3.5	4.1	4.8	5.4	6.1	6.8	7.4	8.1	8.7	9.4
Medium, 1 to 4.5 (2 to 10)	4.4	5.5	6.5	7.5	8.5	9.6	10.6	11.6	12.7	13.7	14.8
Large, 4.5 to 16 (10 to 35)	8.4	10.5	12.3	14.4	16.2	18.3	20.4	22.2	24.3	26.1	28.2

TABLE 4 (h) Normal Time Values for MTM-1 Motion Element: **Apply Pressure (AP)**

Symbol	Time in TMU	Description
APA	10.6	Apply pressure alone
APB	16.2	Apply pressure preceded by regrasp

TABLE 4 (i) Normal Time Values for MTM-1 Motion Element: **Eye Travel (ET)** and **Eye Focus (EF)**

Eye motion	Symbol	Time in TMU	Key to Symbols
Eye travel	ET	$\frac{15.2L}{D}$	L = distance between points from and to which eye travels, D = perpendicular distance from the eye to the line of travel. Maximum time allowed = 20 TMU
Eye focus Reading	EF (none)	7.3 5.05 N	N = number of words read (330 words/min)

TABLE 4 (j) Normal Time Values for MTM-1 Motion Element: **Body, leg, and foot motions** (various symbols given in table)

Motion	Symbol	Time in TMU	Description and Conditions
Sit	SIT	34.7	From standing position
Stand	STD	43.4	From seated position
Turn body	TBC1	18.6	Turn body 45° to 90°, Case 1 – Lagging foot not aligned with leading foot
Turn body	TBC2	37.2	Turn body 45° to 90°, Case 2 – Lagging foot aligned with leading foot
Bend	B	29.0	Bend body forward so hands can reach knees
Stoop	S	29.0	Stoop body forward so hands can reach floor
Arise	AB	31.9	Arise from bent position
Arise	AS	31.9	Arise from stooped position
Kneel	KOK	29.0	Kneel on one knee
Kneel	KBK	69.4	Kneel on both knees
Arise	AKOK	31.9	Arise from kneeling position on one knee
Arise	AKBK	76.7	Arise from kneeling position on both knees
Walk	WXFT	5.3 per ft	Walking in ft of distance, X = distance in ft
Walk	WNP	15.0/pace	Walking in number of paces, N = number of paces
Walk	WNPO	17.0/pace	Walking in number of paces with weight or obstruction, N = number of paces
Leg motion	LM6	7.1	Move leg up to 6 in. any direction
Leg motion	LMX	$7.1 + 1.2(X-6)$	Move leg more than 6 in. any direction, where X = distance of movement
Foot motion	FM	8.5	Foot moves up to 4 in. hinged at ankle
Foot motion	FMP	19.1	Foot moves up to 4 in. hinged at ankle, apply heavy pressure with leg muscles

TABLE 4 (k) MTM-1 Simultaneous Hand and Arm Motion Elements

Motion of One Hand		Reach			Grasp			Move			Position			Disengage	
Motion of other hand	Case or Class	A E	B	C D	1A 2 5	1B 1C	4	A Bm ^a	B	C	1S	1SS 2S	1NS 2SS 2NS	1E 1D	2
Reach	A, E	1	1	1	1	1	1	1	1	2	1	1	2	1	1
	B	1	1	1	1	1	2	1	1	2	2	2	3	1	1
	C, D	1	1	1	1	2	3	2	2	3	3	3	3	2	3
Grasp	1A, 2, 5	1	1	1	1	1	1	1	1	1	1	1	3	1	3
	1B, 1C	1	1	2	1	3	2	1	1	2	3	3	3	3	3
	4	1	2	3	1	2	3	1	2	3	3	3	3	3	3
Move	A	1	1	2	1	1	1	1	1	1	1	1	2	1	1
	B	1	1	2	1	1	2	1	1	1	2	2	3	1	1
	C	2	2	3	1	2	3	1	1	2	3	3	3	2	3
Position	1S	1	2	3	1	3	3	1	2	3	2	3	3	3	3
	1SS, 2S	1	2	3	1	3	3	1	2	3	3	3	3	3	3
	1NS, 2SS, 2NS	2	3	3	3	3	3	2	3	3	3	3	3	3	3
Disengage	1E, 1D	1	1	2	1	3	3	1	1	2	3	3	3	1	1
	2	1	1	3	3	3	3	1	1	3	3	3	3	1	1

^aBm is Case B with hand in motion.

(continued)

TABLE 4 (k) (continued)

Key: The cell numbers indicate the degree of difficulty when motions are performed simultaneously.

1 = Easy to perform simultaneously. Use the longest motion element time.

2 = Can be performed simultaneously with practice. Use the longest motion element time.

3 = Difficult to perform simultaneously. Add the times of the two simultaneous motion elements.

Assumptions: All Reach, Grasp, and Move motions are performed within the area of normal vision. In the Position and Disengage motion elements, objects are assumed easy to handle. In general, the degree of difficulty increases if these assumptions are violated.

Motions not included in the table:

Turn: normally degree of difficulty = 1 except when Turn is controlled or with Disengage.

Position Class 3: degree of difficulty = 3.

Disengage Class 3: normally degree of difficulty = 3.

Release: degree of difficulty = 1.