

ISO/TR 22676:2006-10 (E)

Prosthetics - Testing of ankle-foot devices and foot units - Guidance on the application of the test loading conditions of ISO 22675 and on the design of appropriate test equipment

Contents

Page

Foreword	vi
Introduction	vii
1 Scope	1
2 Guidance on the specification of the test loading conditions of ISO 22675	1
2.1 General	1
2.2 Directions of static and maximum cyclic heel and forefoot reference loading	1
2.2.1 Basic relationships and conditions	1
2.2.2 Lines of action of the resultant reference forces FR1 and FR2	2
2.2.3 Position of the top load application point PT	3
2.3 Magnitudes of static and maximum cyclic heel and forefoot reference loading	6
2.4 Reference test loading conditions of static and cyclic tests	7
2.4.1 Static tests	7
2.4.2 Cyclic test	8
3 Guidance on the design of appropriate test equipment for the application of ISO 22675 ...	20
3.1 Background statement	20
3.2 Basic design for test equipment	20
3.3 Design variants for load application	24
3.3.1 General	24
3.3.2 Design variant A	24
3.3.3 Design variant B	24
3.3.4 Main differences between design variants A and B	25
3.4 Examples of crank gear designs	25
3.4.1 General	25
3.4.2 Asymmetrical (60:40) crank gear	25
3.4.3 Symmetrical (50:50) crank gear	26
3.5 Effect of deviations of the tilting angle (t) from the specified profile (curve), addressed in 3.4, on the test loading conditions of ISO 22675	30
3.6 Effect of the position of the tilting axis TA of the foot platform on the elevation E and the A-P displacement f of the test sample at the foot	35
3.6.1 General	35
3.6.2 Position of the tilting axis TA of the foot platform	36
3.6.3 Values of elevation E	36
3.6.4 Values of A-P displacement f	37
3.6.5 Conclusions	39
3.7 Effect of the elevation E and A-P displacement f of the test sample, caused by the tilting of the foot platform, on the test loading conditions of ISO 22675	43
3.8 Transposition of the top load application point PT for compensation of the dependence of the position of the tilting axis TA of the foot platform on the foot length L	49
3.8.1 General	49
3.8.2 Possibilities of transposing the top load application point PT	49
3.8.3 Practicality	50
3.9 Effect of the position of the tilting axis TA of the foot platform on the tilting moment and the driving torque	53
3.10 Alternative design of foot platform	58

Annex A (informative) Information on ISO 22675	61
Bibliography	62
Figure 1 -- Illustration of different components of loading	10
Figure 2 -- Profiles (curves) of force components and tilting angle for test loading level P5, based on gait analysis data representative of normal level walking	11
Figure 3 -- Profiles (curves) of force components and angles for test loading level P5, establishing the basis from which to specify the test loading conditions of ISO 22675	12
Figure 4 -- Illustration of different test loading conditions for test loading level P5	13
Figure 5 -- Illustration of different test loading conditions for test loading levels P5, P4 and P3	15
Figure 6 -- Illustration of the dependence of the position of the top load application point PT on the foot length L (see 2.2.3)	17
Figure 7 -- Illustration of the progression of the line of action of the resultant force FR from heel contact to toe-off in 30 ms time increments for related values of angle shown in Figure 3	19
Figure 8 -- Diagrammatic view of test equipment with test sample	22
Figure 9 -- Parameters of a crank gear capable of driving the foot platform of the test equipment to generate the profile (curve) (t)	23
Figure 10 -- Asymmetrical (60:40) crank gear according to 3.4.2 -- Tilting range - 20° (heel contact) to + 40° (toe-off)	27
Figure 11 -- Symmetrical (50:50) crank gear according to 3.4.3 -- Tilting range -- 20° (heel contact) via + 40° (toe-off) to + 50°	28
Figure 12 -- Tilting characteristics of asymmetrical (60:40) crank gear according to 3.4.2 and Figure 10 and symmetrical (50:50) crank gear according to 3.4.3 and Figure 11	29
Figure 13 -- Profiles (curves) of angles , and as specified and as produced by crank gear 60:40	31
Figure 14 -- Illustration of angular deviations produced by crank gear 60:40	32
Figure 15 -- Profiles (curves) of force components FP and FT, as specified and as produced by crank gear 60:40	33
Figure 16 -- Illustration of force deviations produced by crank gear 60:40	34
Figure 17 -- Illustration of distortion of time base of test force F produced by crank gear 60:40	35
Figure 18 -- Effect of f-position of tilting axis TA of foot platform on the elevation E of the foot at the instants of heel contact and toe-off	40
Figure 19 -- Effect of u-position of tilting axis TA of foot platform on the A/P displacement f of the foot at the instant of toe-off	41
Figure 20 -- Values of elevation E and A-P displacement f at specific positions of tilting axis TA	42
Figure 21 -- Illustration of the effect of A-P displacement f on the angular movement of the test sample about the "internal" top load application point PT in an arrangement according to 3.3.2	46

Figure 22 -- Illustration of the effect of A-P displacement f on the angular movement of the test sample about the "external" top load application point PTE in an arrangement according to 3.3.3	47
Figure 23 -- Illustration of possibilities of transposing the top load application point PT for compensating the dependence of the position of the tilting axis TA of the foot platform on the foot length L	51
Figure 24 -- Illustration of the effect of a fixed compromise offset u_{TA} , C of the tilting axis TA of the foot platform on the A-P displacement f at the foot for different foot lengths L [see 3.8.2 c) 2)]	52
Figure 25 -- Illustration of effective lever arms	55
Figure 26 -- Force transmission by asymmetrical (60:40) crank gear drive according to 3.4.2 and Figure 10	56
Figure 27 -- Force transmission by symmetrical (50:50) crank gear drive according to 3.4.3 and Figure 11	57
Figure 28 -- Tilting characteristic of foot platform of polycentric (four-bar-linkage) design	59
Figure 29 -- Horizontal displacement of instantaneous centre IC of foot platform of polycentric (four-bar-linkage) design	60
Table 1 -- Magnitudes of resultant reference forces FR1x and FR2x	7
Table 2 -- Coordinates f_{TA} and u_{TA} of the tilting axis TA of the foot platform and related values of elevation E and A-P displacement f for foot length L = 30 cm	43
Table 3 -- Specific values demonstrating the effect of A-P displacement f on the angular movement of the test sample about the top load application point PT for foot length L = 30 cm	48
Table 4 -- Possibilities of transposing the top load application point PT for compensating the dependence of the position of the tilting axis TA of the foot platform on the foot length L	53
Table 5 -- Moments at tilting axis TA and crankshaft CS, generated by test force F(t) at test loading level P5, applied to test sample of foot length L = 30 cm	58
Table A.1 -- Excerpt from contents of Annexes A and E of ISO 22675:2006 and list of corresponding clause/s of this Technical Report, in which selected items are dealt with ..	61