Annex A

Clearance Height Calculations

The following calculation theory applies to all fall arrest lanyards, however the expected deployment data tables shown below refer to the SpanSet SP140 range ONLY. Throughout this guide the following formula will be used to calculate the required clearance below the anchor.

$$C_A = (F_F - H_{DA}^{(1)}) + T_X + U + C_M$$

CLEARANCE REQUIRED BELOW THE ANCHOR (C_A)
FREE-FALL DISTANCE (F_F)
HEIGHT OF D-RING ABOVE ANCHOR(H_{DA}[1])
TEAR WEB EXTENSION (T_X)
USER BODY LENGTH (U)
CLEARANCE MARGIN (C_M)

(1) USE NEGATIVE VALUES WHEN D-RING BELOW THE ANCHOR. REMEMBER A DOUBLE NEGATIVE IS A POSITIVE!

FREE-FALL DISTANCE

In a fall arrest event, free-fall is the distance a User can fall before the lanyard comes under tension and begins to arrests the fall. The distance a User can free fall is determined by the length of the fall arrest lanyard and the positioning of the anchor it is connected to. To calculate a free fall value use the following formula:

$$F_F = L_L + H_{DA}$$

FREE-FALL DISTANCE (F_F)
LANYARD EFFECTIVE LENGTH (L_L)
HEIGHT OF D-RING ABOVE ANCHOR(H_{DA})

It is important to remember, when calculating free fall distances, that using anchor points above the User's D-ring reduce the free fall distance, whereas anchor points below the D-ring will increase free fall.

EXAMPLES

1. A User has a **2m lanyard** connected to an anchor point **1m below** their harness D-ring. Their potential free fall is:

FF= 2m + 1m = 3m

NOTE: WHEN THE ANCHOR POINT IS BELOW THE HARNESS D-RING THE VALUES ARE ADDED

2. A user has a **2m lanyard** connected to an anchor point **1m above** their harness D-ring. The potential free fall is:

FF= 2m + – 1m = 1m

NOTE: WHEN THE ANCHOR POINT IS ABOVE THE HARNESS D-RING THE VALUES ARE SUBTRACTED

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TEAR WEB EXTENSION (T_X)

The following tables give information on the expected extension of the tear webbing (T_X) in the SP140 energy absorber for different falling distances and User body mass.

Free Fall Distance (m)	User Body Mass (kg)				
	60	80	100	120	140
0.0-0.5	0.07	0.10	0.14	0.17	0.22
0.5-1.0	0.15	0.21	0.27	0.35	0.43
1.0-1.5	0.22	0.31	0.41	0.52	0.65
1.5-2.0	0.30	0.42	0.55	0.70	0.86
2.0-2.5	0.37	0.52	0.69	0.87	1.08
2.5-3.0	0.45	0.63	0.82	1.05	1.30
3.0-3.5	0.52	0.73	0.96	1.22	1.51
3.5-4.0	0.59	0.83	1.10	1.40	1.73

NOTE: VALUES SHOWN REFLECT AN AVERAGE ARRESTING FORCE OF 4.5kN

ANCHOR TO D-RING (H_{DA})

The relative position of the harness D-ring connection to the anchor point is critical to performing accurate calculations of clearance. Selection of anchor points above the D-ring will have a beneficial effect on free fall distances, and are therefore a negative number (reducing free fall). Anchor points below the harness D-ring will have a detrimental effect, and are therefore positive (increasing free fall).
SpanSet strongly recommends using the worst possible scenario for the work at height activity to use as a basis for the calculation. It is also important to consider the usual working position of the work at height User i.e. kneeling down, stood on a platform etc.

CONSTANT VALUES (C_M, U)

For any calculation, SpanSet recommends the following constant values be used:
Clearance Margin (C_M): 1.0m
User Body Length (U): 1.5m

THE CLEARANCE MARGIN IS SPECIFIED IN EN355 AS 1.0m AND SHOULD NEVER BE DECREASED FOR ANY CALCULATION. THE USER BODY LENGTH VALUE OF 1.5m IS THE RELATIVE POSITION OF THE D-RING TO THE GROUND WHEN THE USER IS WEARING A FULL BODY HARNESS. THIS VALUE SHOULD NEVER BE DECREASED BUT, WHERE NECESSARY, MAY BE INCREASED.

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TYPICAL CALCULATION EXAMPLES

EXAMPLE 1
A 100kg User has a 1.5m lanyard connected to an anchor point 1m BELOW the harness D-ring.
In this example the D-ring is above the anchor, so remains a positive value.
L_L = +1.5m
H_{DA} = +1.0m

Free Fall = $F_F = L_L + H_{DA}$
Free Fall = 1.5m + 1.0m = 2.5m

From Table 1, the tear out value of the energy absorber will be:
T_X= 0.69m

Required clearance below the anchor:
$C_A = (F_F - H_{DA}) + T_X + U + C_M$
C_A = (2.5m -(+1.0m)) + 0.69m + 1.5m + 1.0m = 4.69m

EXAMPLE 2
A 140kg User has a 2.0m lanyard connected to an anchor point 1m ABOVE the harness D-ring.
In this example the D-ring is below the anchor, and is therefore a negative value.
L_L = +2.0m
H_{DA} = -1.0m

Free Fall = $F_F = L_L + H_{DA}$
Free Fall = 2.0m + -1.0m = 1.0m

From Table 1, the tear out value of the energy absorber will be:
T_X= 0.43m

Required clearance below the anchor:
$C_A = (F_F - H_{DA}) + T_X + U + C_M$
C_A = (1.0m -(-1.0m)) + 0.43m + 1.5m + 1.0m = 4.93m