LIFTING SAFETY ON HONG KONG CONSTRUCTION WITH FOCUS ON LIFTING GEARS

建造業吊運安全 – 聚焦吊運工具之意見

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吊運安全

目錄

- 為何要重視安全
- 安全文化
- 影響安全的因素
- 吊具 / 起重裝置
- 測試
- 案例討論
- 解決方案

為何要重視安全

- 生命價值
- 家庭責任
- 社會責任

安全文化

- 安全感性理解
- 安全理性技術
- 安全意識教育
- 安全科技應用
- 安全認知推廣
- 安全制度及法例
- 安全執行條件

影響安全的因素
-人・機・物・法・環

人	機	物	法	環
執行者	吊重機械/起重裝置	負重物	使用方法	環境因素

吊具 / 起重裝置 - 鋼絲繩索具

- 結構 – Ung 6x36(WS)+IWRC
- 強度 – T/S 1770N/mm2 & T/S 1960/mm2
- 標準 – EN-12385-4 / JIS G3525
- 測試 – SWL / MBL / PL / SF

鋼絲繩索具
-末端加工 01

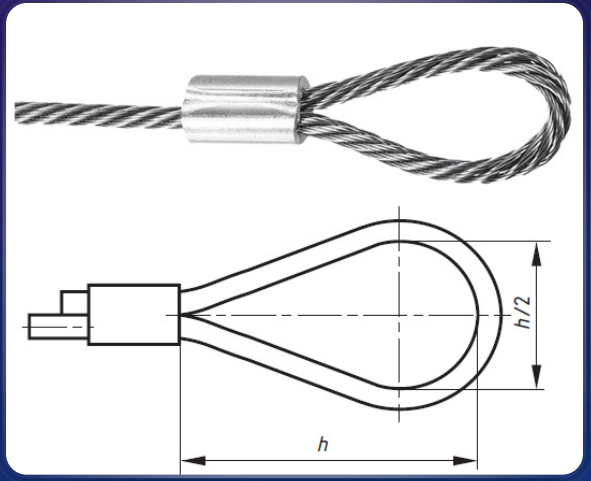
- 叉接

鋼絲繩索具
-末端加工 02

- 壓接
- 標準: EN13411

鋁合金壓套

Aluminum Ferrule



鋼絲繩索具
-末端加工 02 附件

- 鋁合金壓套尺寸

壓制前標準尺寸

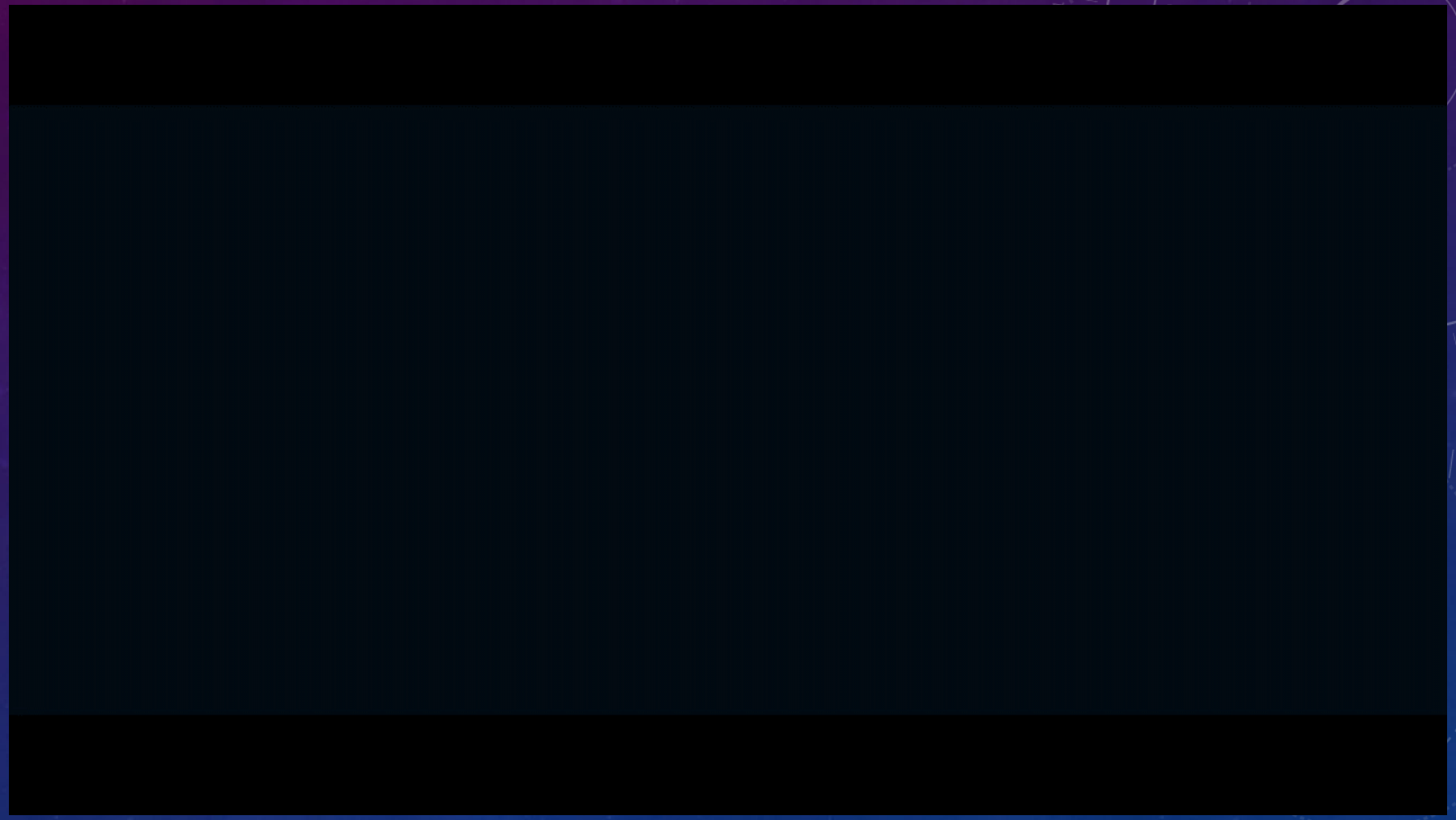
Rope diameter			Ferrule size number (see A.6)			
			Case 1	Case 2	Case 3	Case 4
			single layer round strand ropes with FC and cable laid ropes	single layer round strand ropes with IWRC and rotation-resistant round strand ropes	single layer round strand ropes with IWRC, rotation-resistant ropes and parallel-closed ropes	spiral strands
Nominal	Measured					
d	from	to				2 ferrules
mm	mm	mm	$C \geq 0{,}283$	$C \leq 0{,}487$	$0{,}487 < C \leq 0{,}613$	AC $C \leq 0{,}613$ AC
18	16.9	17.9	18	20	20	22
	18	18.9			22	
20	19	19.9	20	22	22	24
	20	21			24	
22	21.1	21.9	22	24	24	26
	22	23.1			26	
24	23.2	23.9	24	26	26	28
	24	25.2			28	
26	25.3	25.9	26	28	28	30
	26	27.3			30	
28	27.4	27.9	28	30	30	32
	28	29.4			32	

壓制後標準尺寸

Ferrule size number	External pressed size d_1 nominal	tolerance	d_2 min	Parallel length l_1 [1)]	l_2 [1)]	r [1)]
	mm	mm	mm	mm	mm	mm
18	36		32	81	27	18
20	40	+ 0,9	36	90	30	20
22	44	0	39	99	33	22
24	48		43	108	36	24
26	52	+ 1,1	46	117	39	26
28	56	0	50	126	42	28

鋼絲繩索具-末端加工 02

- 鋁合金壓接過程



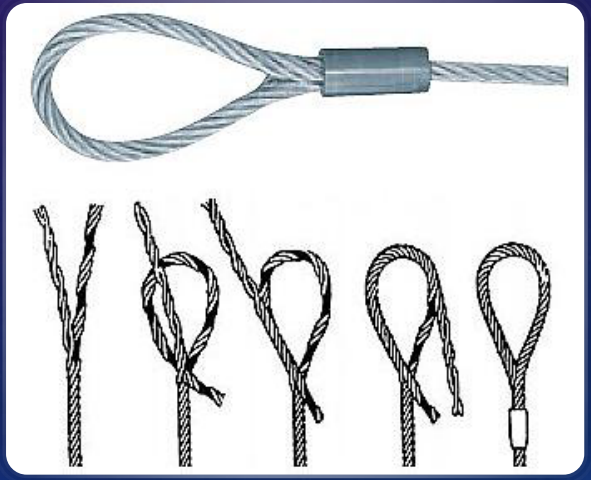
鋼絲繩索具
-末端加工 02

- 壓接
- 標準: EN13411

鋼壓套

Flemish Eye

Steel Ferrule



鋼絲繩索具
-末端加工 02

鋼壓套

Flemish Eye

Steel Ferrule

Rigging Applications

Sling Capacities

End Attachment and Splicing Efficiency

- Swaged sleeve fitting up through 1”… 95%
- over 1” through 2”…92.5%
- over 2” through 3.5”…90%

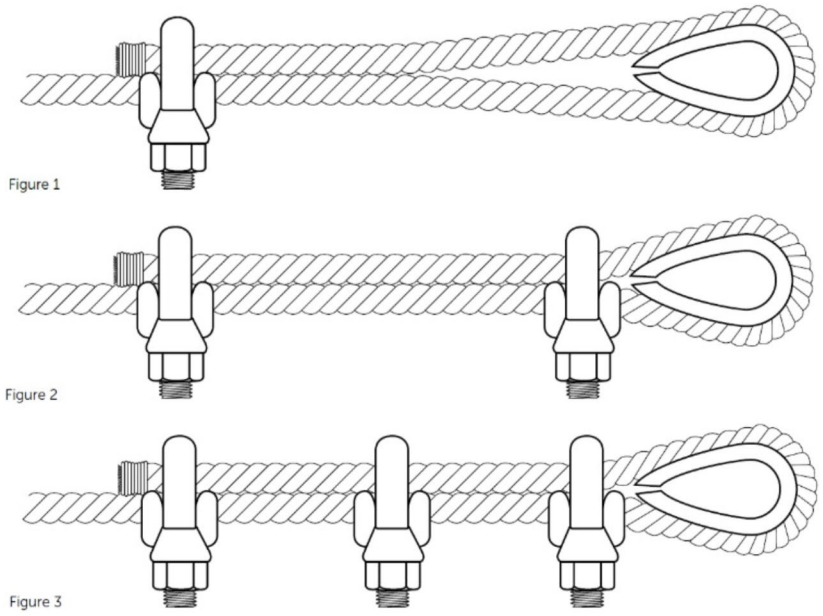
鋼絲繩索具
-末端加工 02

- 鋼壓套壓接過程

鋼絲繩索具
-末端加工 03

威也夾
(Wire Clip)

安裝示範



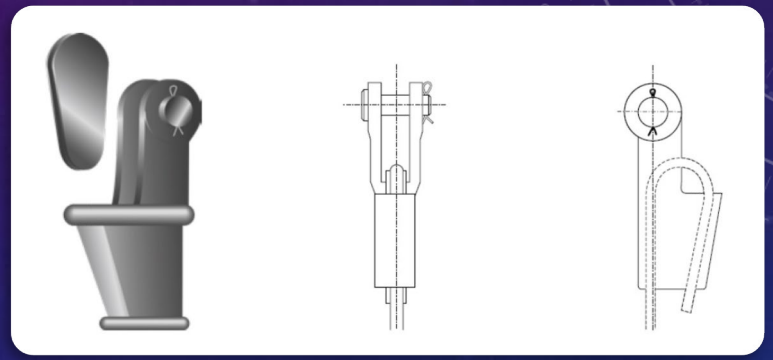
呎吋標準

diameter wire rope	diameter wire rope	min. no of clips required	length of rope to turn back	torque value	torque value
inch	mm		mm	Nm	Ft.Lbs
1/8	3 - 4	2	85	6.1	4.5
3/16	5	2	95	10.2	7.5
1/4	6 - 7	2	120	20.3	15
5/16	8	3	133	40.7	30
3/8	9 - 10	3	165	61	45
7/16	11	3	178	88	65
1/2	12 - 13	3	292	88	65
9/16	14 - 15	3	305	129	95
5/8	16	3	305	129	95
3/4	18 - 20	4	460	176	130
7/8	22	4	480	305	225
1	24 - 26	5	660	305	225
1 1/8	28 - 30	6	860	305	225
1 1/4	32 - 34	7	1120	488	360
1 3/8	36	7	1120	488	360
1 1/2	38 - 40	8	1370	488	360
1 5/8	41 - 42	8	1470	583	430
1 3/4	44 - 46	8	1550	800	590
2	48 - 52	8	1800	1017	750
2 1/4	56 - 58	8	1850	1017	750
2 1/2	62 - 65	9	2130	1017	750
2 3/4	68 - 72	10	2540	1017	750
3	75 - 78	10	2690	1627	1200

鋼絲繩索具
-末端加工 03

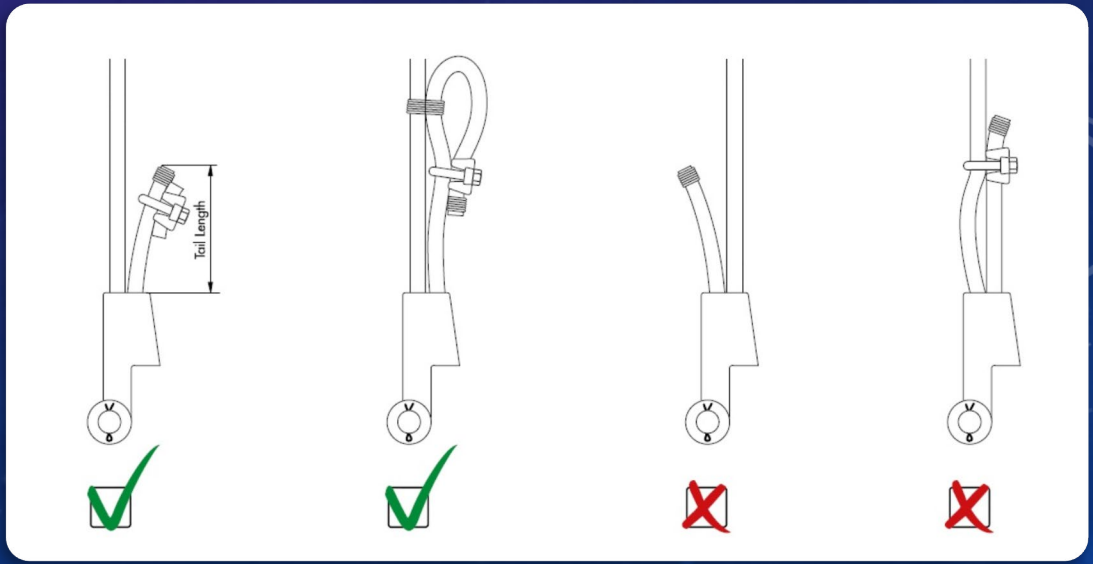
槍袋梳結
(Wedge Socket)

安裝示範



呎吋標準

number	minimum breaking load	diameter wire rope	length	length to center pin	width	width inside	diameter pin	thickness side plates	diameter eye	weight each
	t	mm	a mm	b mm	c mm	d mm	e mm	f mm	g mm	kg
0.25	8	7 - 8	128	110	51	18	16	9	36	0.8
0.5	12	9 - 10	165	142	62	20.5	21	11	46	1.5
1	20	11 - 13	175	146	66	25	25	12	57	2.4
2	25	14 - 16	211	176	82	31	30	15	70	4
3	40	18 - 19	252	212	95	38	35	16	80	7.4
4	55	20 - 22	288	240	110	44	41	19	95	11
5	75	24 - 26	329	274	130	51	51	22	110	16
6	90	27 - 29	375	310	144	57	57	25	130	22
7	110	30 - 32	423	350	155	63	64	28	146	31
8	125	34 - 36	474	400	163	69	64	28	148	39
9	150	37 - 39	527	450	178	76	70	30	153	48
10	170	40 - 42	580	500	187	76	76	33	160	64
11	225	43 - 48	650	550	226	89	89	39	186	96
12	280	49 - 52	745	640	240	101	95	46	194	130
13	360	54 - 58	785	660	275	114	108	54	230	180
14	425	60 - 68	970	835	300	127	121	60	250	275
15	460	72 - 76	1150	1000	355	146	133	76	270	440
16	625	81 - 86	1252	1100	375	159	140	79	300	510



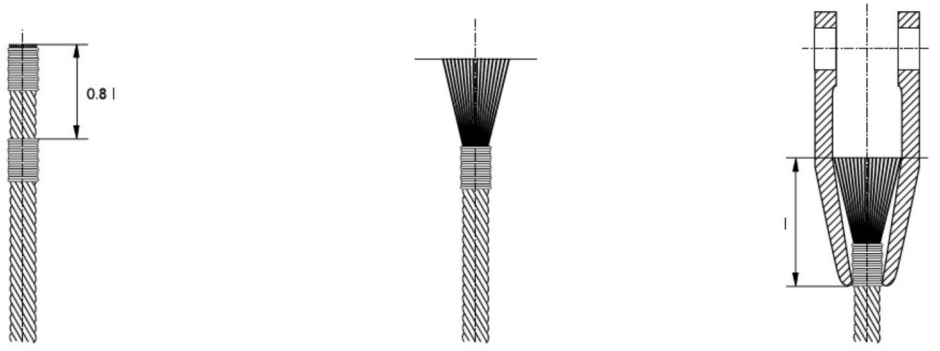
鋼絲繩索具
-末端加工 03

開口梳結
(Spelter Socket)

呎吋標準

number	minimum breaking load	diameter wire rope	length	width	width inside	diameter pin	length inside	opening	weight each
	t	mm	a mm	b mm	c mm	d mm	e mm	f mm	kg
196	8	6 - 7	109	51	19	16	33	9	0.4
197	12	8 - 10	124	62	21	21	34	12	0.7
198	20	11 - 13	143	66	26	25	37	15	1
199	25	14 - 16	172	82	33	30	49	18	1.8
100	40	18 - 19	205	95	38	35	58	21	3
104	55	20 - 22	235	110	44	41	68	24	4.6
108	75	23 - 26	275	130	51	51	75	28	8
111	90	27 - 30	306	144	57	57	85	32	11
115	125	31 - 36	338	155	63	64	95	38	16
118	150	37 - 39	394	178	76	70	127	41	22
120	170	40 - 42	418	187	76	76	127	44	27
125	225	43 - 48	468	213	89	89	134	51	41
128	280	49 - 54	552	240	101	95	181	57	64
130	360	55 - 60	598	270	113	108	196	63	88
132	425	61 - 68	654	303	127	121	213	73	125
135	460	69 - 75	696	349	133	127	216	79	155
138	560	76 - 80	737	371	146	133	220	86	187
140	625	81 - 86	788	391	159	140	228	92	230
142	720	87 - 93	852	411	171	152	242	99	265
144	875	94 - 102	914	447	191	178	254	108	400
146	1200	108 - 115	1160	489	206	193	369	125	660

安裝示範



吊具 / 起重裝置 - 鏈條索具

強度 – Grade 80 / 100

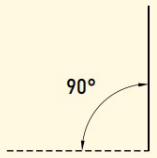
標準 – EN 1677-4

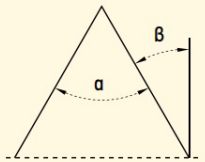
鏈條索具

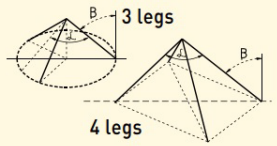
鏈條索具
-工作負荷極限表

Grade 80 Chain Sling Components

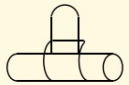
WORKING LOAD LIMITS IN TONNES acc. to EN1677







Choke endless sling



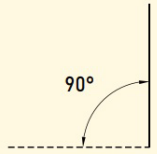
For Chain Size mm	tonnef	β 0 - 45° α 0 - 90°	45° - 60° 90° - 120°	β 0 - 45° α 0 - 90°	45° - 60° 90° - 120°	
6	1.12	1.6	1.12	2.36	1.7	1.8
7	1.5	2.12	1.5	3.15	2.24	2.5
8	2.0	2.8	2.0	4.25	3.0	3.15
10	3.15	4.25	3.15	6.7	4.75	5.0
13	5.3	7.5	5.3	11.2	8.0	8.5
16	8.0	11.2	8.0	17.0	11.5	12.5
19	11.2	16.0	11.2	23.6	17.0	18.0
20	12.5	17.0	12.5	26.5	19.0	20.0
22	15.0	21.2	15.0	31.5	22.4	23.6
26	21.2	30.0	21.2	45.0	31.5	33.5
32	31.5	45.0	31.5	67.0	47.5	50.0

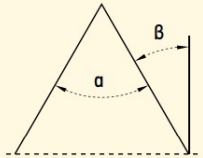
**Safety factor 4:1 above limits are valid for standard use and equally loaded slings. Properly use and maintaince of your YOKE chain slings will give long life and enable you to carry out your lifting operations efficiently and safely.

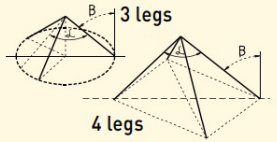
Warning: Never exceed a vertical sling angle of 60°

Grade 100 Chain Sling Components

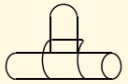
WORKING LOAD LIMITS IN TONNES acc. to PAS 1061







Choke endless sling



Load Factor	1	1.4	1	2.1	1.5	1.6
For Chain Size mm	tonnef	β 0 - 45° α 0 - 90°	45° - 60° 90° - 120°	β 0 - 45° α 0 - 90°	45° - 60° 90° - 120°	
6	1.4	2.0	1.4	2.9	2.1	2.2
7	1.9	2.7	1.9	4.0	2.9	3.0
8	2.5	3.5	2.5	5.3	3.8	4.0
10	4.0	5.6	4.0	8.4	6.0	6.4
13	6.7	9.4	6.7	14.1	10.1	10.7
16	10.0	14.0	10.0	21.0	15.0	16.0
20	16.0	22.4	16.0	33.6	24.0	25.6
22	19.0	26.5	19.0	39.9	28.5	30.4
26	26.5	37.1	26.5	55.7	39.8	42.4
32	40.0	56.0	40.0	84.0	60.0	64.0

**Safety factor 4:1 above limits are valid for standard use and equally loaded slings. Properly use and maintaince of your YOKE chain slings will give long life and enable you to carry out your lifting operations efficiently and safely.

Warning: Never exceed a vertical sling angle of 60°

吊具 / 起重裝置
-吊帶

A類: 形式

- 扁吊帶 Webbing Sling
- 圓吊帶 Round Sling

C類: 標準

- EN 1492

B類: 物料

- 滌綸 Polyester
- 尼龍 Polyamide (Nylon)
- 高聚合聚乙烯 HMPE

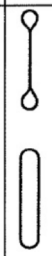
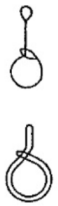
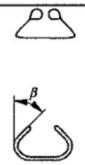
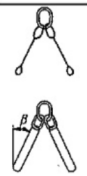
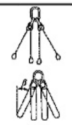
D類: Slingmax

- 安全設計吊帶 Desigin for Safety

吊帶
-扁吊帶

吊重標準

Table 3 — Working load limits and colour codes

WLL of sewn webbing component	Colour of sewn webbing component	Working load limits in tonnes								
		Straight lift	Choked lift	Basket hitch			Two leg sling		Three and four leg slings	
										
				Parallel	β = 0 to 45°	β = 45°to 60°	β = 0 to 45°	β = 45° to 60°	β = 0 to 45°	β = 45° to 60°
		M = 1	M = 0,8	M = 2	M = 1,4	M = 1	M = 1,4	M = 1	M = 2,1	M = 1,5
1,0	Violet	1,0	0,8	2,0	1,4	1,0	1,4	1,0	2,1	1,5
2,0	Green	2,0	1,6	4,0	2,8	2,0	2,8	2,0	4,2	3,0
3,0	Yellow	3,0	2,4	6,0	4,2	3,0	4,2	3,0	6,3	4,5
4,0	Grey	4,0	3,2	8,0	5,6	4,0	5,6	4,0	8,4	6,0
5,0	Red	5,0	4,0	10,0	7,0	5,0	7,0	5,0	10,5	7,5
6,0	Brown	6,0	4,8	12,0	8,4	6,0	8,4	6,0	12,6	9,0
8,0	Blue	8,0	6,4	16,0	11,2	8,0	11,2	8,0	16,8	12,0
10,0	Orange	10,0	8,0	20,0	14,0	10,0	14,0	10,0	21	15,0
Over 10,0	Orange									

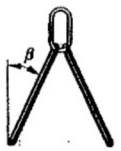
M = Mode factor for symmetrical loading. Handling tolerance for slings or parts of slings indicated as vertical = 6°

顏色分級

吊帶
-圓吊帶

吊重標準

Table 2 — Working load limits and colour codes

WLL of roundsling in straight lift	Colour of roundsling cover	Working load limits in tonnes								
		Straight lift	Choked lift	Basket hitch			Two leg sling		Three and four leg slings	
										
				Parallel	ß = 0 to 45°	ß = 45° to 60°	ß = 0 to 45°	ß = 45° to 60°	ß = 0 to 45°	ß = 45° to 60°
		M = 1	M = 0,8	M = 2	M = 1,4	M = 1	M = 1,4	M = 1	M = 2,1	M = 1,5
1,0	Violet	1,0	0,8	2,0	1,4	1,0	1,4	1,0	2,1	1,5
2,0	Green	2,0	1,6	4,0	2,8	2,0	2,8	2,0	4,2	3,0
3,0	Yellow	3,0	2,4	6,0	4,2	3,0	4,2	3,0	6,3	4,5
4,0	Grey	4,0	3,2	8,0	5,6	4,0	5,6	4,0	8,4	6,0
5,0	Red	5,0	4,0	10,0	7,0	5,0	7,0	5,0	10,5	7,5
6,0	Brown	6,0	4,8	12,0	8,4	6,0	8,4	6,0	12,6	9,0
8,0	Blue	8,0	6,4	16,0	11,2	8,0	11,2	8,0	16,8	12,0
10,0	Orange	10,0	8,0	20,0	14,0	10,0	14,0	10,0	21	15,0
Over 10,0	Orange									

M = Mode factor for symmetrical loading. Handling tolerance for slings or parts of slings indicated as vertical = 6°

吊帶
-SLINGMAX

CITF建造業創科基金預先批核項目

吊具 / 起重裝置
-吊重配件 Lifting Accessories

- 塞古 Shackle
- 吊勾 HOOK
- 吊環 Master Link

吊重配件
-塞古 SHACKLE

吊重配件
-吊勾 HOOK

吊重配件
-吊環 MASTER LINK

吊重配件
-吊環製造

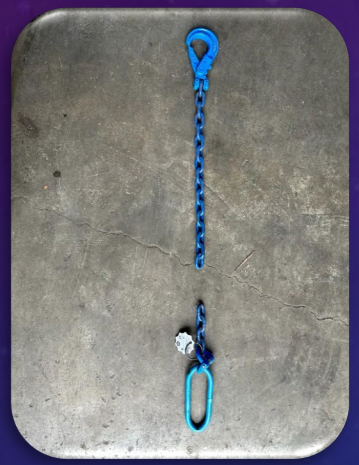
測試
-拉力測試

- 最少破斷拉力 M.B.L.
- 安全載荷 Safe Working Load (M.B.L. 5:1)
- 認可測試 Proof Load (S.W.L. x 2)
- 安全使用荷重 Working Load Limit
- 安全系數 Safety Factor

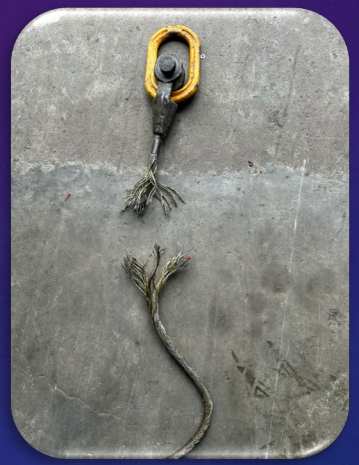
測試
-測試例子

吊勾

鏈條索具

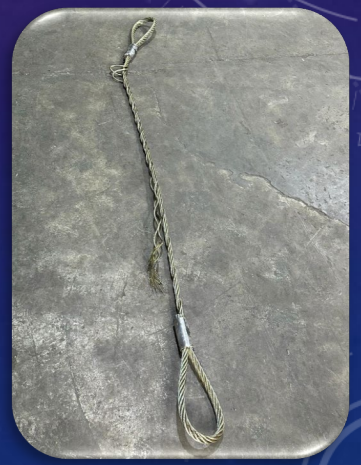


梳結



塞古

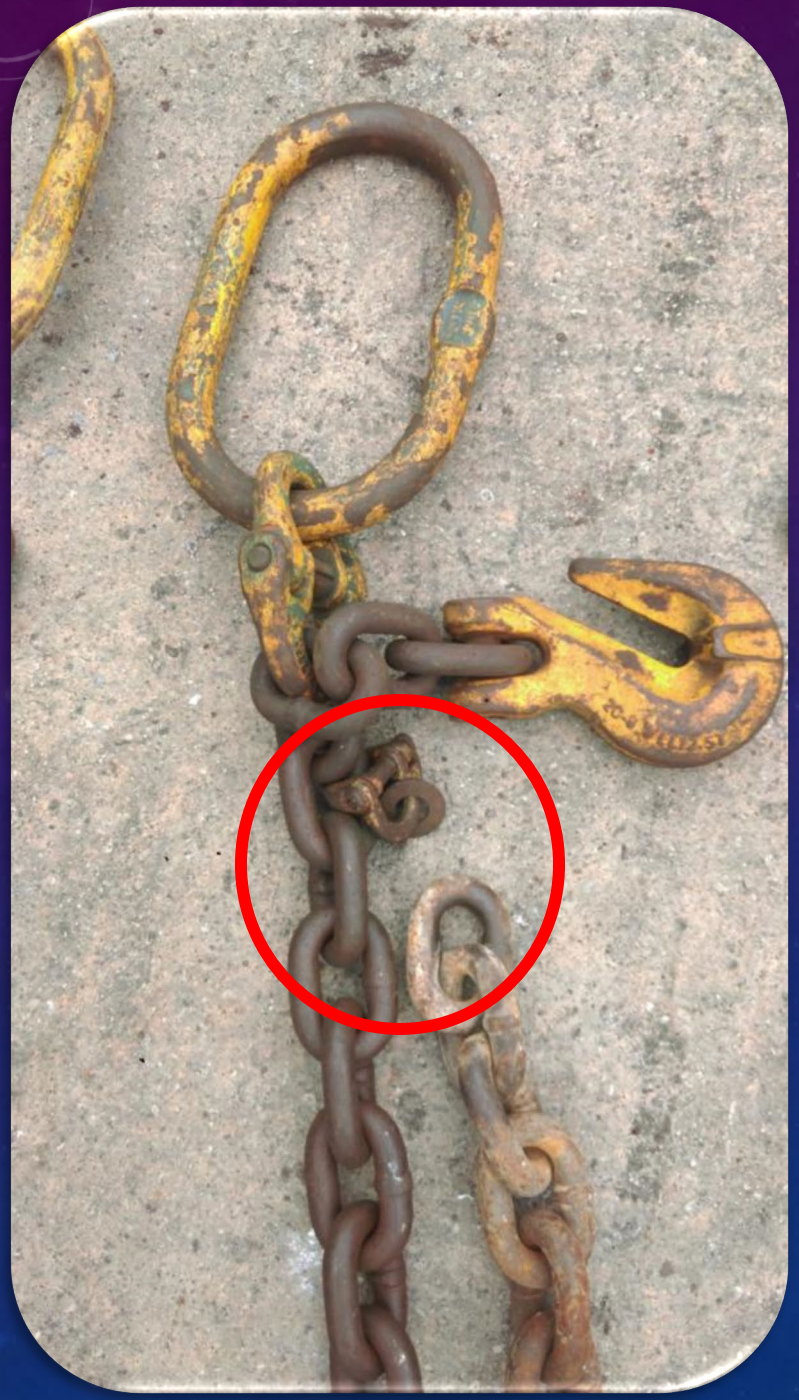
鋼絲繩索具



測試
-破斷拉力實測

測試
-案例

測試
-案例

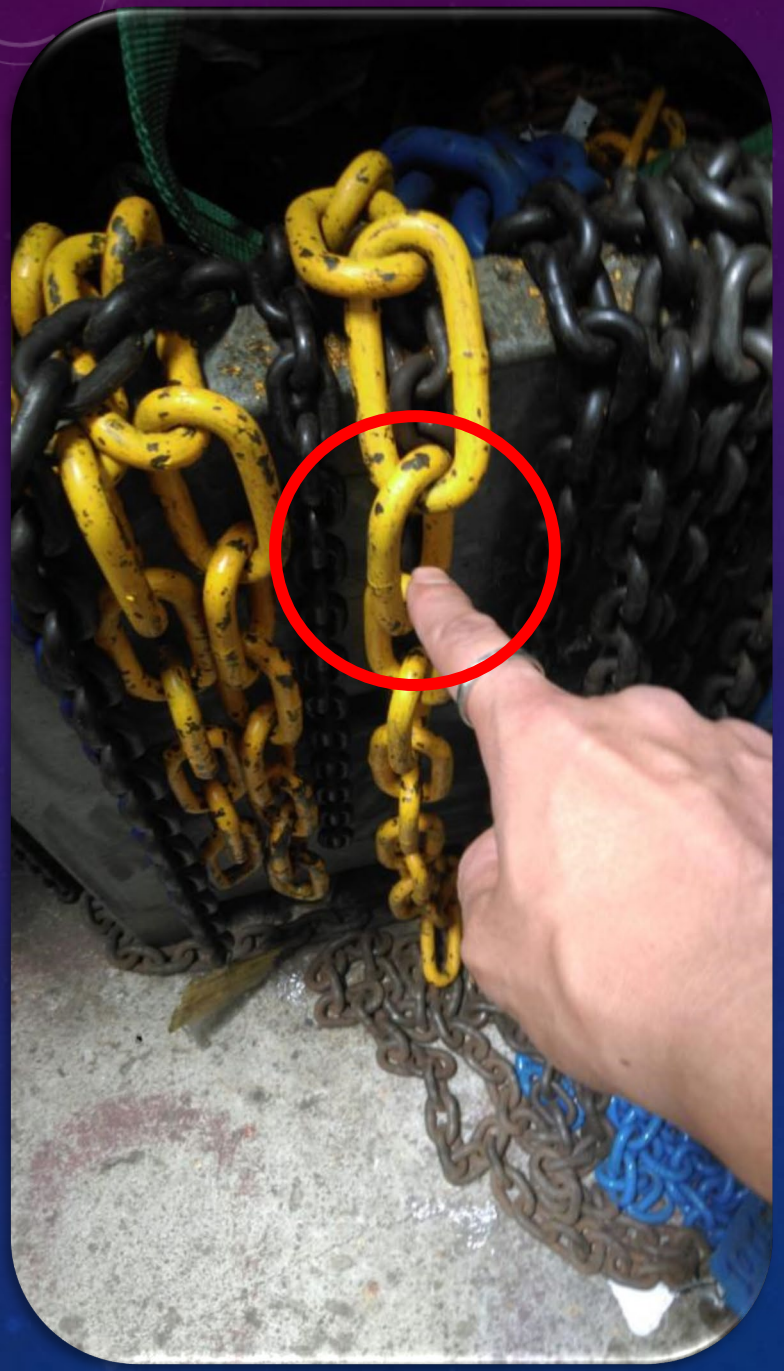


測試
-案例

測試
-案例

測試
-案例

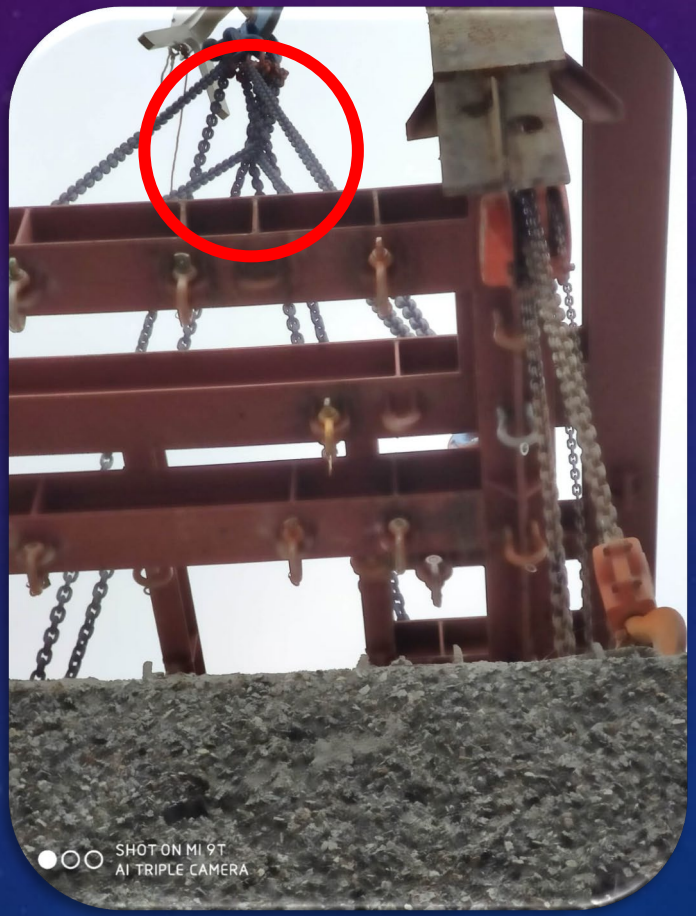
測試
-案例



測試
-案例

測試
-案例

SHOT ON MI 9T
AI TRIPLE CAMERA


SHOT ON MI 9T
AI TRIPLE CAMERA

上午10:02

測試
-案例

SHOT ON MI 9T
AI TRIPLE CAMERA

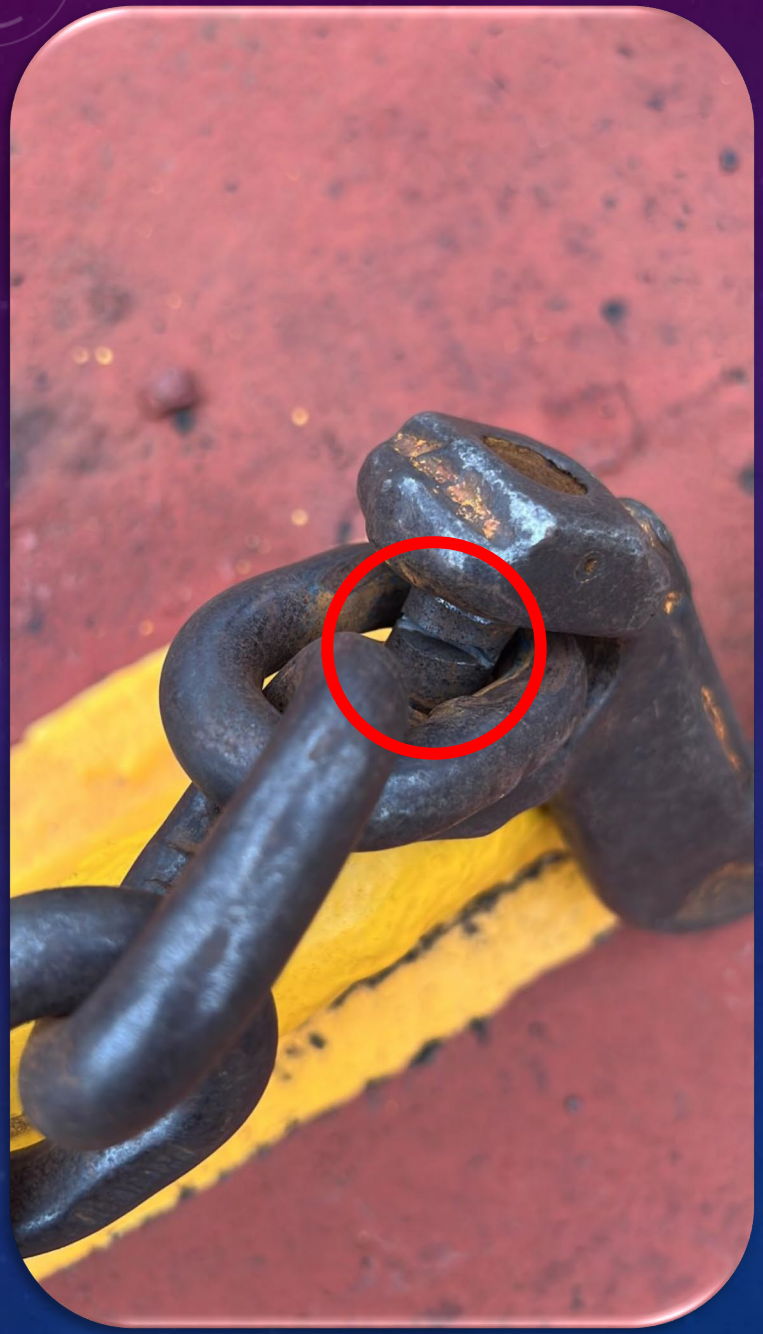
SHOT ON MI 9T
AI TRIPLE CAMERA

SHOT ON MI 9T
AI TRIPLE CAMERA

測試
-案例

測試
-案例

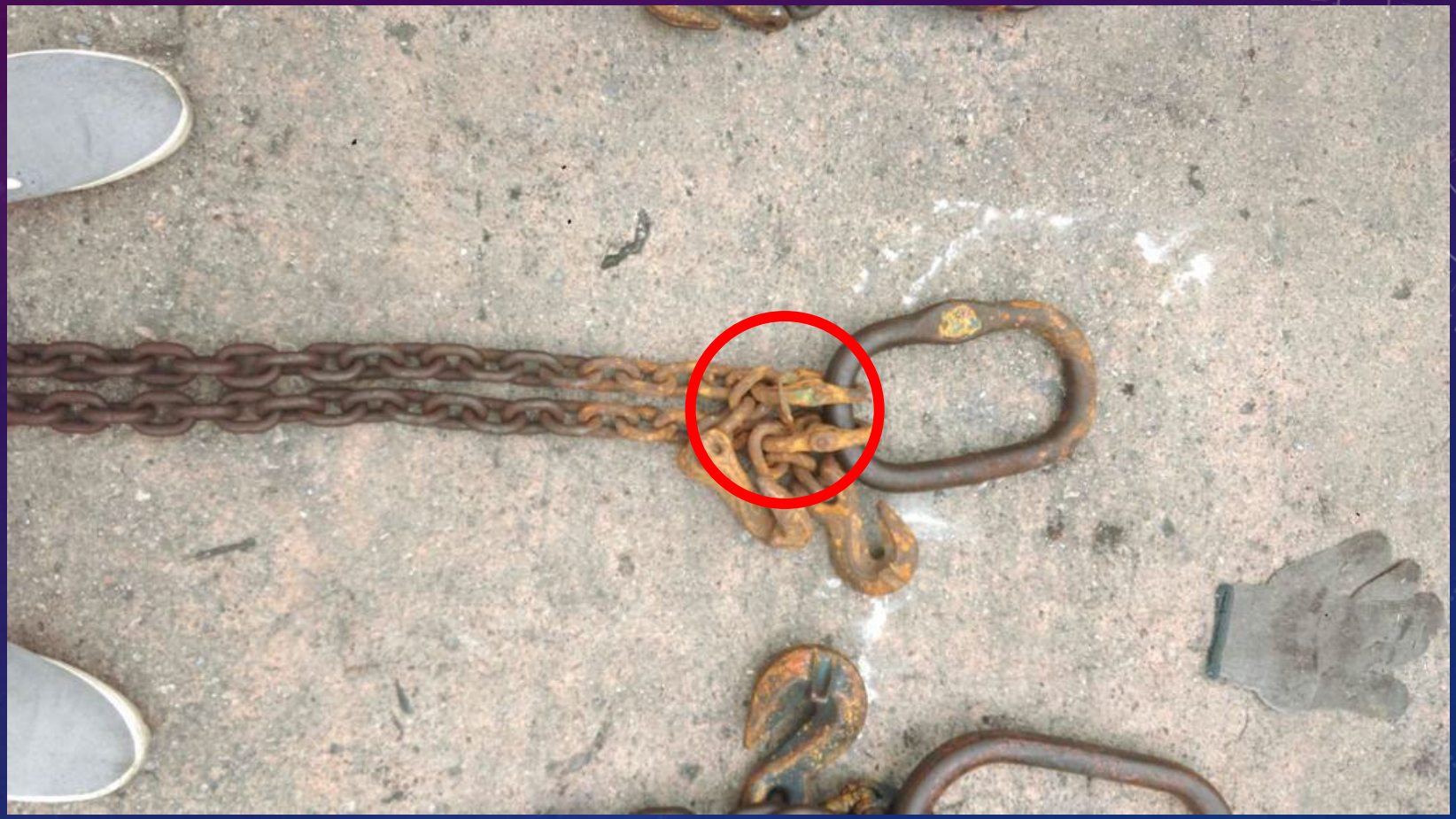
測試
-案例



測試
-案例

測試
-案例

測試
-案例



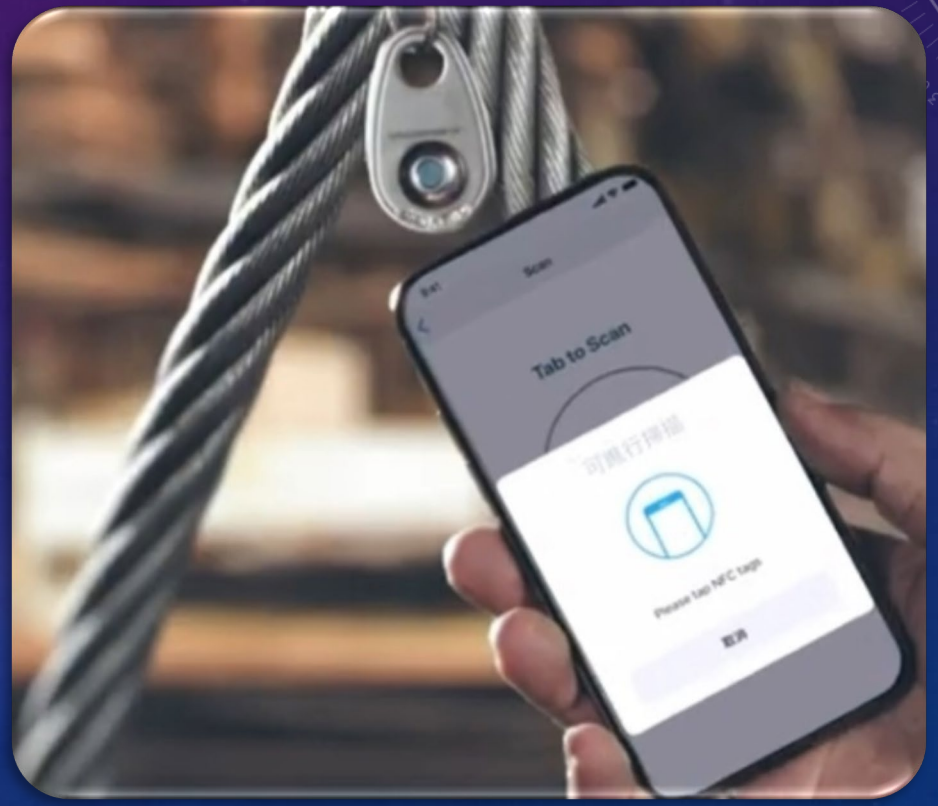
測試
-案例

建議解決方案

- 數碼管理跟蹤
- 安全設計
- 自動化
- 執行測試/保養/檢查

建議解決方案
-數碼管理跟蹤 01

建議解決方案
-數碼管理跟蹤 02



建議解決方案
-數碼管理跟蹤 03

設備狀態管理

Asset

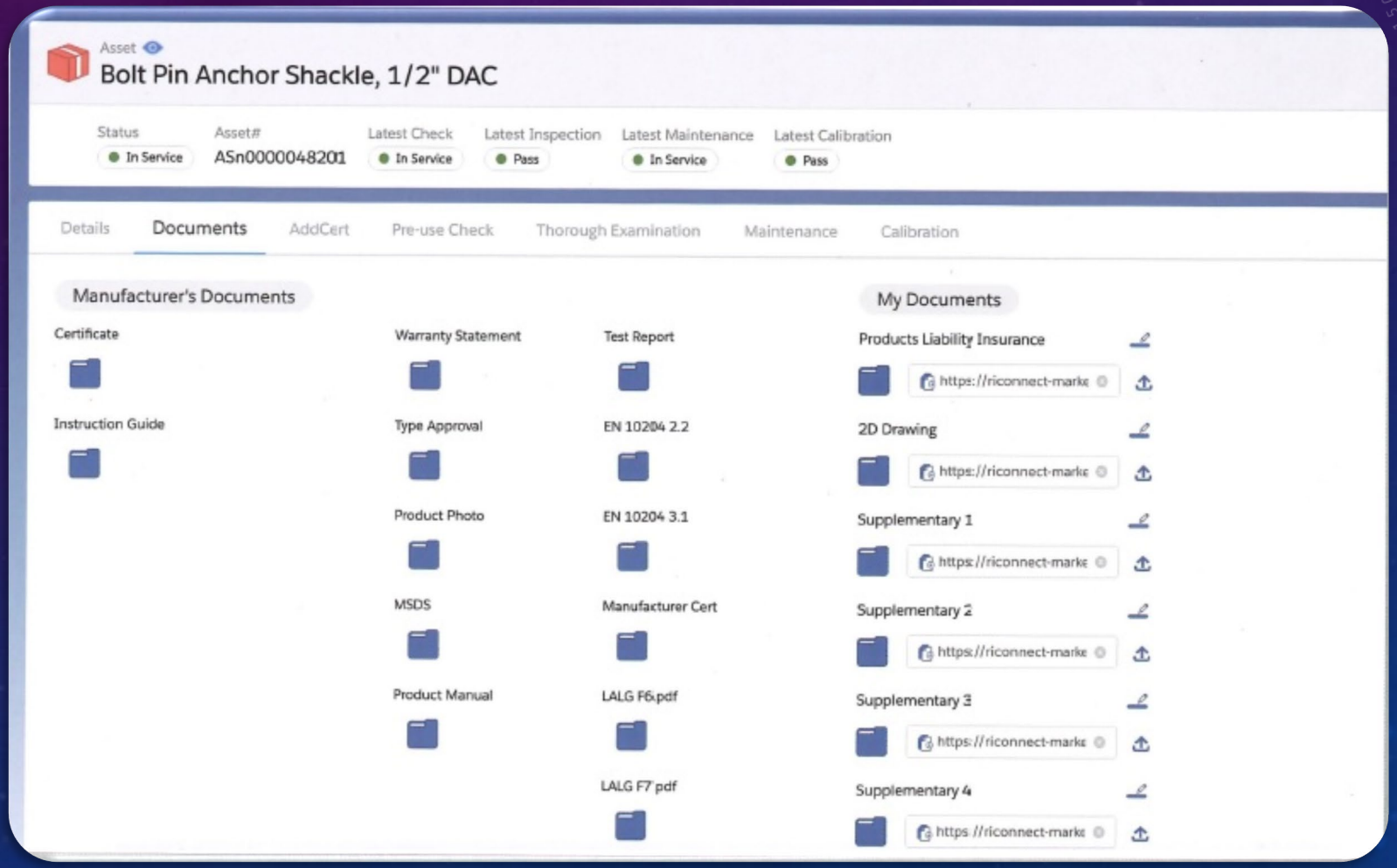
New

All | Asset | Rentable

	Status	Asset#	Serial#	Description	Site	Exam Before	Certificate
1	Alert	ASn0000051041	GSS0001506	GMK7450 All-Terrain ...	Geneva	2023-08-30	DCA0676170
2	Alert	E0022300F8FE2481	E0022300F8FE2481	Wire Rope 3/8"	Geneva	2023-08-18	DCA0547053
3	In Service	ASn0000048201	E0022300CCA8D06B	Bolt Pin Anchor Shac...	Geneva	2023-08-23	DCA0061676
4	In Service	EQn0000021031	E0022300D259D48A	Digital Bolt Pin Anch...	Geneva	2023-09-08	DCA0999433
5	In Service	E00223008FAD060B	E00223008FAD060B	Bolt Pin Anchor Shac...	Geneva	2023-08-26	DCA0223381
6	In Service	ASn0000029231	E0022300130D0473	Heavy Duty Bow Shac...	Geneva	2023-08-25	DCA0685092
7	In Service	ASn0000040522	E0022300CC23F74E	Wire Rope 1/2"	Geneva	2023-08-27	DCA0241497
8	In Service	ASn0000016375	E00223000077F710	Bolt Pin Anchor Shac...	Geneva	2023-08-30	DCA0783818
9	In Service	E00223006935C740	E00223006935C740	Heavy Duty Bow Shac...	Geneva	2023-08-19	DCA0048819
10	In Service	ASn0000034381	E00223006A16200A	Heavy Duty Bow Shac...	Geneva	2023-08-19	DCA0782084
11	In Service	E0022300913EAB02	E0022300913EAB02	GMK7450 All-Terrain ...	Geneva	2023-09-03	DCA0336225
12	In Service	E0022300A30301D7	MAO0001109	RT890E Rough Terrai...	Geneva	2023-09-06	DCA0787480
13	In Service	EQn0000054129	GSS0001043	Wire Rope 1/2"	Geneva	2023-08-31	DCA0169120
14	In Service	E002230035D24478	E002230035D24478	Wire Rope 3/8"	Geneva	2023-09-07	DCA0269023
15	In Service	ASn0000032117	E00223008CF73718	Bolt Pin Anchor Shac...	Geneva	2023-08-21	DCA0201548

建議解決方案
-數碼管理跟蹤 04

設備文件追溯



建議解決方案
-數碼管理跟蹤 05

建議解決方案
-安全設計

建議解決方案
-自動化 01

建議解決方案
-自動化 02

建議解決方案
-執行測試/保養/檢查

無損鋼絲繩檢測

拉力測試

The End