



# THE DROPPED OBJECT SOLUTION

**Investigation into shackle related  
dropped object incidents offshore  
for Santos and Diamond Offshore**



# PROJECT AIMS

- ∞ **Review of Ocean Epoch 4-piece shackle related dropped object incidents.**
- ∞ **Review wider industry experiences of similar incidents and investigation of alternative shackle designs available.**
- ∞ **Production of shackle inspection and selection guidance along with relevant remedial training requirements.**

# PROJECT DELIVERABLES

## SHACKLE

### SELECTION

- ∩ Manufacturers
- ∩ Suppliers
- ∩ Product designs available
- ∩ Onboard applications
- ∩ DROPS recommended

## SHACKLE

### INSPECTION

- ∩ Manufacturers
- ∩ Inspection Vendors
- ∩ Australian Standards
- ∩ DROPS Practices



SHACKLE

SELECTION

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# AUSTRALIAN STANDARDS

## AS 2741-2002: Shackles

- ∩ *Materials and Proof Test - Manufacture.*
- ∩ Shackle Selection.
- ∩ Markings and Inspection.
- ∩ Shackle Assembly.
- ∩ Test and Certification.

# SELECTION CRITERIA

AS 2741-2002 Appendix B Paragraph B2 & B4

## ∞ Working Load Limit - WLL

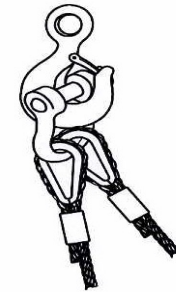
- Maximum load that can be supported by a shackle in general use (direct vertical load).
- Definitions vary due to environment and rigging design (Ref AS 1418.1 Crane Mechs).

## ∞ Temperature

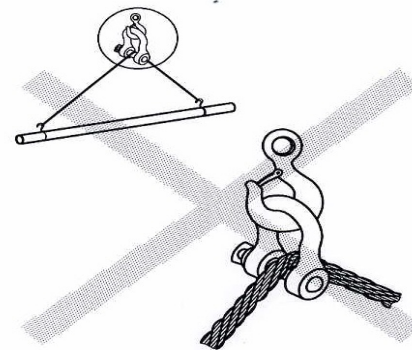
- Do not use outside -10°C to 200°C window without manufacturer consultation.

# SELECTION CRITERIA

❧ Avoid load configurations where rope or load can roll and 'unscrew' pin/nut.



NOTE: Using two ropes with eyes.  
(a) Correct method

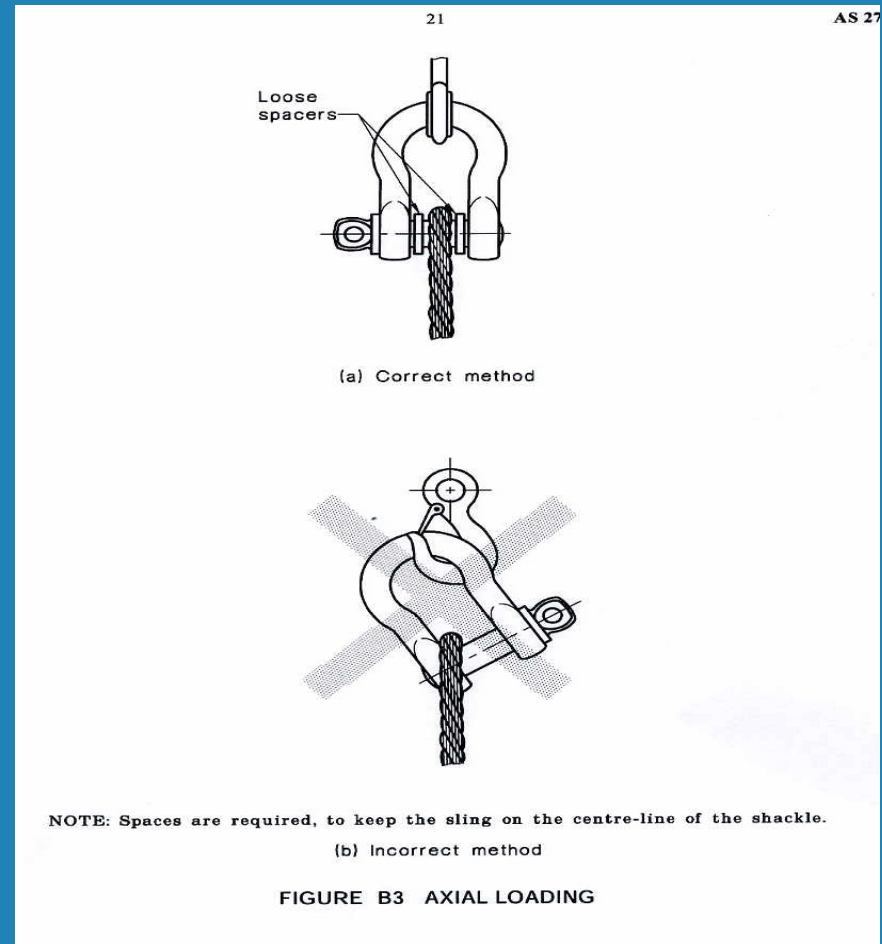


NOTE: If the load shifts, the sling could unscrew the shackle pin.  
(b) Incorrect method

FIGURE B2 AVOIDING UNSCREWING THE PIN BY USING TWO SINGLE-LEG SLINGS WITH EYES

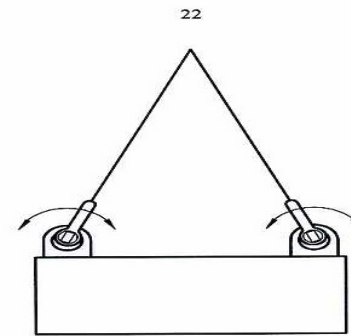
# SELECTION CRITERIA

⌚ Avoid eccentric loading - use of 'spacers' - not to be welded.

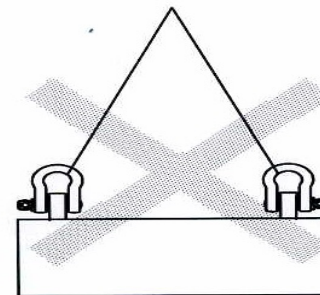


# SELECTION CRITERIA

∞ Side loading of a shackle is to be avoided. Select a shackle design and configuration to facilitate loading along the axis of the centre line of the shackle.



(a) Correct method



NOTE: Shackles are being twisted sideways

(b) Incorrect method

FIGURE B4 TYPICAL USE OF SHACKLES TO SLING A LOAD

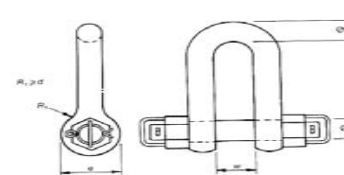
# A. Noble & Sons Ltd



- ⌚ RUD VIP-Shackle 'Foolproof' design.
- ⌚ Van Beest 'Safety' Shackles.
- ⌚ Crosby '4-piece' shackles.

## SHACKLES — DEE — ALLOY — GRADE 'T'

(non preferred Refer Manufacturers Specification)



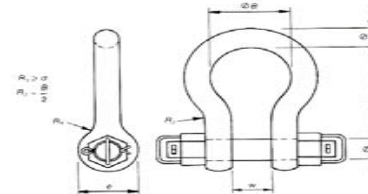
Nominal size mm	Dimension, mm					WLL t	Pin type
	d	D	w	L	e		
13	13	16	21	41	33	3.0	Fig. 12
16	16	19	27	50	40	4.0	
19	19	22	32	60	48	6.0	
22	22	25	36	71	54	8.0	
25	25	28	43	80	60	10	
28	28	32	46	90	67	12	
32	32	35	52	100	76	15	
35	35	38	57	112	84	20	
38	38	41	60	125	92	30	
45	45	50	73	150	110	40	
50	50	55	85	200	127	50	Fig. 13
65	65	70	110	250	152	80	
80	80	82	130	300	180	120	
90	90	95	150	350	205	150	
105	105	110	185	400	250	175	
110	110	120	175	450	250	200	
120	120	130	200	500	260	250	
130	130	145	210	550	290	300	
145	145	155	225	600	310	400	
155	155	170	240	640	340	500	
205	205	215	340	700	415	750	
245	245	255	395	850	500	1000	

Shown with Fig. 13 type pin.

Permitted types of pins are shown in the following Figures:  
 (a) For shackle size less than 50 mm, Fig. 12.  
 (b) For shackles size at least 50 mm, Fig. 13.

## SHACKLES — BOW — ALLOY — GRADE 'T'

(non preferred Refer Manufacturers Specification)



Nominal size mm	Dimension, mm						WLL t	Pin type
	d	D	w	B	L	e		
13	13	16	21	33	48	33	3.0	Fig. 12
16	16	19	27	43	61	40	4.0	
19	19	22	32	50	72	48	6.0	
22	22	25	36	58	84	54	8.0	
25	25	28	43	68	95	60	10	
28	28	32	46	74	110	67	12	
32	32	35	52	82	120	76	15	
35	35	38	57	92	135	84	20	
38	38	41	60	98	150	92	30	
45	45	50	73	127	180	110	40	
50	50	55	85	160	250	127	50	Fig. 13
65	65	70	110	200	320	152	80	
80	80	82	130	250	390	180	120	
90	90	95	150	280	435	205	150	
105	105	110	185	300	460	250	175	
110	110	120	175	330	520	250	200	
120	120	130	200	360	575	260	250	
130	130	145	210	400	650	290	300	
145	145	155	225	450	780	310	400	
155	155	170	240	490	775	340	500	
205	205	215	340	585	830	415	750	
245	245	255	395	740	990	500	1000	

Shown with Fig. 13 type pin.

Permitted types of pins are shown in the following Figures:  
 (a) For shackle size less than 50 mm, Fig. 12.  
 (b) For shackle size at least 50 mm, Fig. 13.

# Bullivants Lifting & Safety

**Bullivants**<sup>®</sup>  
LIFTING & SAFETY SPECIALISTS

∞ Van Beest 'Safety' Shackles: 4-piece shackle design

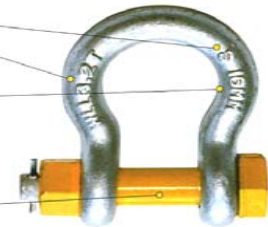
∞ Boss 'Grade S' Alloy safety shackles

## Shackles

BOSS

### Shackles Alloy Grade "S"

- Full Traceability
- Grade 'S' identification
- Individually stamped with working load limit (WLL tonnes)
- Subject to Bullivants internal batch test programme
- Body Diameter (mm)
- On request standard test certification
- NATA test certification available at extra cost
- Complies to AS2741
- Hot dipped galvanised body & pin
- Boss yellow pin for lifting safety



WORKING LOAD LIMIT	Bow Shackle with screw collar pin		Bow Shackle with screw collar pin		Safety Bow Shackle bolt type		Safety Dee Shackle bolt type		TEST FORCE, kN	
	DIA BOW	DIA PIN	INSIDE WIDTH	INSIDE LENGTH	DEE TYPE	BOW TYPE	WIDTH OF BOW	DESTRUCTIVE TEST	PROOF TEST	
TONNES	mm	mm	mm	mm	C	C	2r			
0.33	5	6	10	N/A	22	15	19.5	6.5		
0.50	6	8	12	22	29	20	29.5	9.9		
0.75	8	10	13	25	31	21	44.2	14.8		
1.00	10	11	17	32	37	26	58.9	19.7		
1.50	11	13	18	37	43	29	88.3	29.5		
2.00	13	16	21	41	48	33	118	39.3		
3.20	16	19	27	51	61	43	199	62.8		
4.70	19	22	32	60	72	51	277	92.3		
6.50	22	25	37	71	84	58	383	128		
8.50	25	29	43	81	95	68	501	167		
9.50	29	32	46	90	108	74	840	187		
12.00	32	35	52	100	119	83	707	236		
13.50	35	38	57	113	133	90	795	265		
17.00	38	41	60	124	146	98	1010	334		
25.00	48	51	73	146	178	127	1480	491		
35.00	51	57	83	171	197	146	2070	687		
42.50	57	63	95	181	222	160	2510	834		
55.00	63	70	105	203	267	184	3040	1080		
85.00	76	83	127	229	339	200	5010	1330		
120.00	89	95	146	267	381	241	7070	1670		
150.00	102	108	165	318	432	279	8830	1970		

Tolerances on Dimensions: +8% -5% as per AS2741

# UniRig Pty Ltd



Ω Van Beest 'Safety' Shackles: 4-piece shackle design.

Ω Rouen 'Safety' shackle design - Chinese Manufactured.

Ω Yoke 'forged bolt pin' shackle - DNV/ABS

**Forged Chain Shackle, with Bolt Pin, Dachromated. Code " AVB ".**


- Shackles are Type Approved by DNV & ABS.
- Shackles are forged carbon steel with alloy pin.
- Size and Working Load Limit permanently shown on each shackle.
- All shackles with Batch Code which links to Test Certificate and quality traceability.
- 100% magnafux crack detection during manufacturing.
- Fatigue rated.

Item No.	Nominal Size		Working Load Limit	Dimensions (mm)						N.W.
	inch	mm		B	D	W	A	G	H	
8-835-08	5/16	8	0.75	8	9.5	13	31	19	52	0.08
8-835-10	3/8	10	1	10	11	16	36	23	63	0.1
8-835-11	7/16	11	1.5	11	13	19	43	27	74	0.2
8-835-13	1/2	13	2	13	16	20	47	30	83	0.4
8-835-16	5/8	16	3.25	16	19	27	60	38	106	0.7
8-835-19	3/4	19	4.75	19	22	33	71	46	126	1.1
8-835-22	7/8	22	6.5	22	26	38	84	53	148	1.7
8-835-26	1	26	8.5	26	28	44	95	60	166	2.4
8-835-28	1-1/8	28	9.5	28	32	46	108	68	190	3.4
8-835-32	1-1/4	32	12	32	36	52	119	76	210	4.9
8-835-36	1-3/8	36	13.5	36	38	57	133	84	232	6.5

YOKE 8-835 Bolt Type Anchor Shackles meet the performance requirements of Federal Specification RR-C-271D, Type 4B, Grade A, Class 3.

**Type Approval and Certification with**

★ Minimum Ultimate Load is 6 times the Working Load Limit.  
Maximum Proof Load is 2.0 times the Working Load Limit.



# SHACKLE INSPECTION

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# AUSTRALIAN STANDARDS

## AS 2741-2002: Shackles

### Ω Inspection

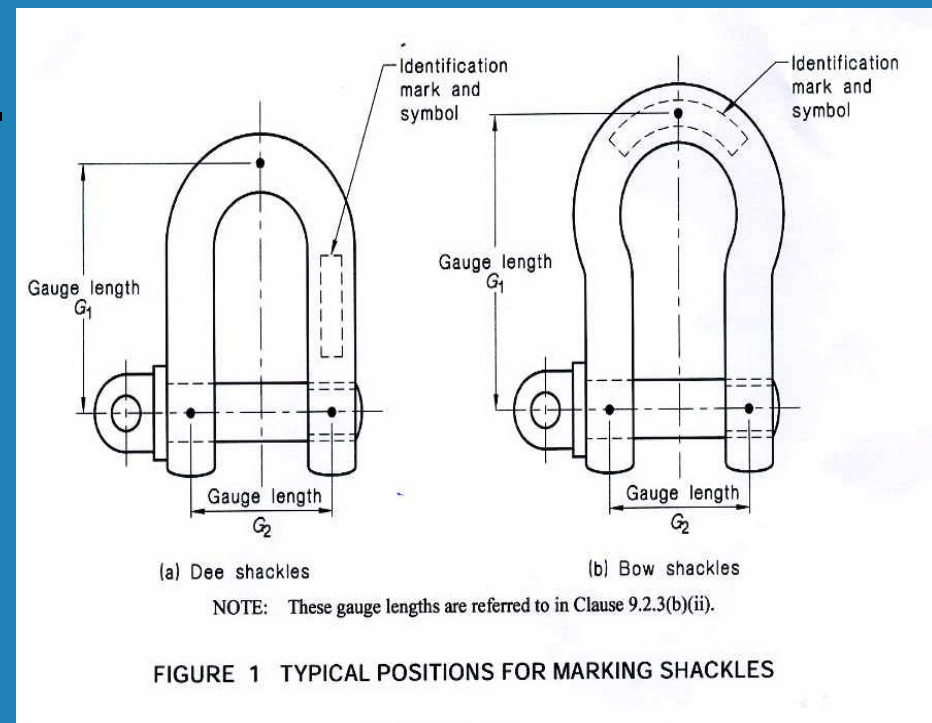
- Markings
- Certification
- Shackle Assembly
- Worn material inspection

# SHACKLE MARKINGS

Information to be raised or indented - must be legible to be legal!

To include:

- Manufacturers ID
- Quality Grade of Material (i.e M or S)
- WLL
- Test Certificate ID



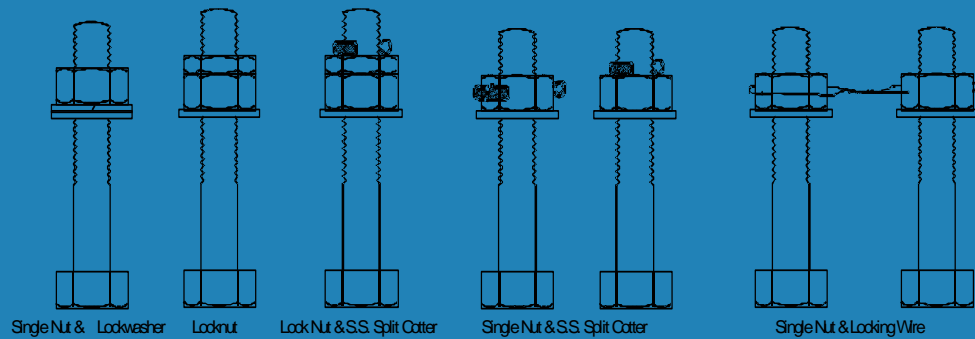
# CERTIFICATION

∞ The certificate should state:

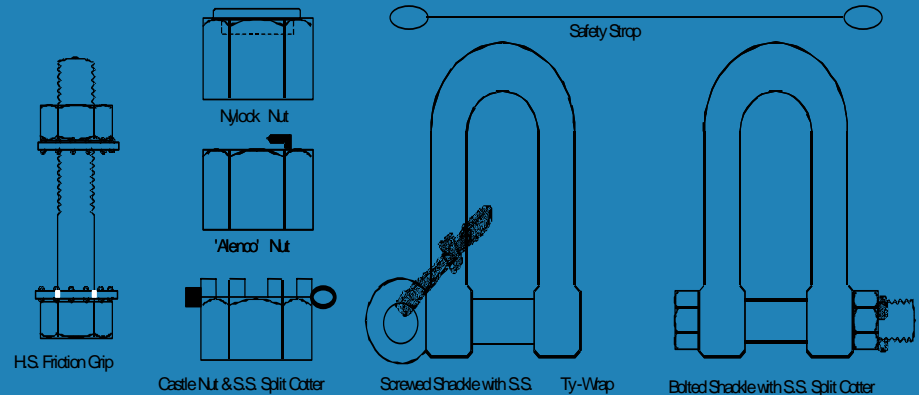
- Type (dee, bow, body and pin design)
- Material Quality Grade
- Nominal size
- Surface finish
- WLL
- Proof force
- Date of proof test
- Quantity in batch
- Number tested
- Batch identification
- Declaration of compliance to AS 2741
- Name of manufacturer
- Name of testing house
- Signature of Inspector

# SHACKLE ASSEMBLY

⌚ Ensure the pin is not bent (visually) and seats correctly.



⌚ Ensure pin is not loose within shackle body.



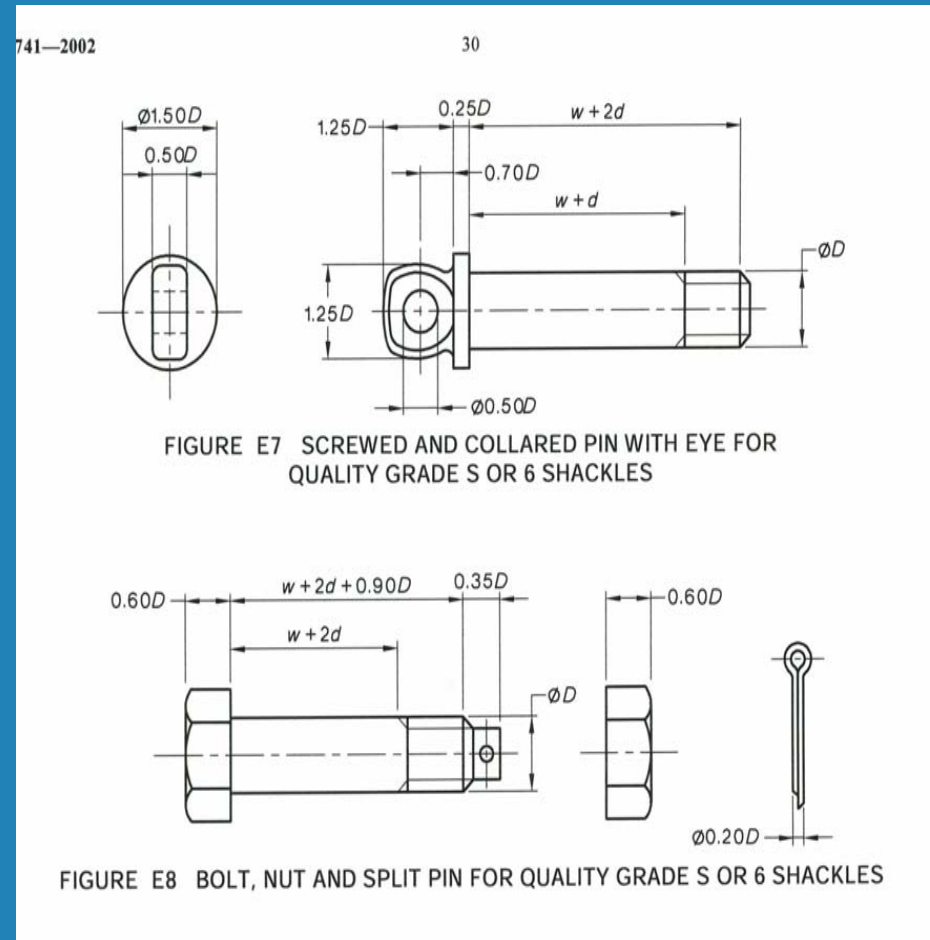
⌚ Ensure body and crown of the shackle are not deformed/bent.

# SHACKLE ASSEMBLY

⌚ Never replace pin with a different material grade. (>150t WLL, new pin requires retest of shackle by vendor - Van Beest).

⌚ Ensure 'split' pin is correctly installed:

- Prongs bent back fully
- Stainless Steel
- Only use once



# WORN MATERIAL

∞ Essentially, if its visual, its not good!

- >8% loss in diameter is a fail
- Gouges and sharp burs are a fail



# WORN MATERIAL





# BROADENING TRAINING

- ∞ **Provided by Bullivants**
- ∞ **Predominantly aimed a slinging ops for non-dogmen and non-riggers**
- ∞ **Contact: Jim Purcell (Bullivants)**
- ∞ **NOT A CERTIFICATED COURSE!**
- ∞ **WILL NOT COVER DROPS ISSUES SPECIFICALLY**
- ∞ **....and WILL BE COMPANY SPECIFIC TO A DEGREE**



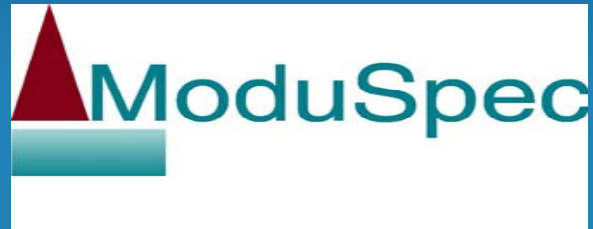
# SUMMARY

## ∞ Shackle Selection

- Guidance from AS 2741-2002
- Product available from 3 local suppliers
- Global Manufacturers

## ∞ Shackle Inspection

- Comprehensive Guidance from AS 2741-2002
- DROPS Guidance
- Broadening training available - Bullivants



# THE DROPPED OBJECT SOLUTION

**Investigation into shackle related  
dropped object incidents offshore  
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