CIC Rigging Data Tables

(These tables are for use with CIC Advanced and Qualified Rigger and Lift Director written exams.)

JRRC-1

Journeyman Rigger's Reference Card

Sling Capacities

MECHANICAL SPLICE IN POUNDS — DESIGN FACTOR 5:1 (1)

Wire Rope EIPS IWRC	Size in inches	1.00 VERTICAL	.75 CHOKER	2 - Legs or Basket 90° 2.00	60° 1.73	45° 1.41	30° 1.00	3 - Legs Only if 1/3 each leg 60° 2.60	Size in mm	Wire Rope EIPS IWRC
	1/4	1,300	960	2,600	2,200	1,820	1,300	3,300	6.4	
	5/16	2,000	1,480	4,000	3,400	2,800	2,000	5,100	8.0	
	3/8	2,800	2,200	5,600	5,000	4,000	2,800	7,400	9.6	
	7/16	3,800	2,800	7,600	6,800	5,400	3,800	10,000	11.0	
	1/2	5,000	3,800	10,000	8,800	7,200	5,000	13,200	13.0	
	9/16	6,400	4,800	12,800	11,000	9,000	6,400	16,500	14.0	
	5/8	7,800	5,800	15,600	13,600	11,000	7,800	20,000	16.0	
	3/4	11,200	8,200	22,400	19,400	15,800	11,200	29,100	19.0	
	7/8	15,200	11,200	30,400	26,000	22,000	15,200	39,000	22.0	
	1	19,600	14,400	39,200	34,000	28,000	19,600	51,000	25.4	
	1-1/8	24,000	18,000	48,000	42,000	34,000	24,000	62,000	28.5	
	1-1/4	30,000	22,500	60,000	52,000	42,000	30,000	76,000	32.0	
			MULTIPLIER →		1.00	.75	.60	← MULTIPLIER		

Formula to find sling length Total distance between pick points x Multiplier = Sling Length

JRRC-2

Load Factors & Weight Distribution

(2)

5,000 # 5,000 # (s) (h) 10,000 #

Tension in s = $\frac{\text{length s}}{\text{length h}}$ x share of load wt. $\frac{s}{h}$ = Load Factor

Tension in A = $\frac{6}{3}$ x 4,000

Tension in A = 8,000 #

6' 3' 6' A B 8,000 #

Known Runs

A R_1 R_2 B

Share of Load Wt. @ A	Share of Load Wt. @ B	Legend
$R_1 + R_2 = TS$	$R_1 + R_2 = TS$	R_1 = Run, Side 1
$\frac{R_2}{TS} = P$	$\frac{R_1}{TS} = P$	R_2 = Run, Side 2
P x W = Share of Load Wt @ A	P x W = Share of Load Wt @ B	TS = Total Span
		P = Percentage
		W = Weight of Load

Known Weights

A W_1 B W_2 Span

CG In Feet From A	CG In Feet From B	Legend
$W_1 + W_2 = TW$	$W_1 + W_2 = TW$	W_1 = Weight at A
$\frac{W_2}{TW} = P$	$\frac{W_1}{TW} = P$	W_2 = Weight at B
		TW = Total Weight
		P = Percentage
P x S = CG in ft. from A	P x S = CG in ft. from B	S = Span

JRRC-3

Sling Capacities

DESIGN FACTORS - CHAIN 4:1 WEB 5:1 ROUND 5:1 (3)

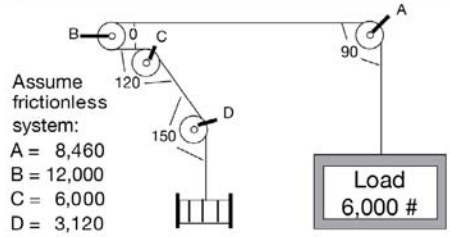
	Size or Code	1.00 VERTICAL	.80 CHOKER	2 - Legs or Basket 90° 2.00	60° 1.73	45° 1.41	30° 1.00	60° 3 - Legs Only if 1/3 each leg 2.60	Diameter or Width	
Chain G-8	9/32	3,500	2,800	7,000	6,100	4,900	3,500	9,150	7 mm	Chain G-8
	3/8	7,100	5,680	14,200	12,300	10,000	7,100	18,450	10 mm	
	1/2	12,000	9,600	24,000	20,800	17,000	12,000	31,200	13 mm	
	5/8	18,100	14,480	36,200	31,300	25,600	18,100	46,950	16 mm	
Web Eye/Eye	1-9-1	1,600	1,280	3,200	2,770	2,260	1,600	4,150	1"	Web Eye/Eye
	1-9-2	3,200	2,560	6,400	5,540	4,452	3,200	8,310	2"	
	1-9-3	4,800	3,840	9,600	8,320	6,780	4,800	12,480	3"	
	1-9-4	6,400	5,120	12,800	11,090	9,040	6,400	16,630	4"	
	2-9-3	8,880	7,100	17,760	15,390	12,540	8,880	23,080	3"	
	2-9-4	11,520	9,210	23,040	19,960	16,270	11,520	29,940	4"	
Polyester Round	EN30	2,600	2,100	5,200	4,500	3,600	2,600	6,750	1"	Polyester Round
	EN60	5,300	4,200	10,600	9,100	7,500	5,300	13,650	1"	
	EN90	8,400	6,700	16,800	14,500	11,800	8,400	21,750	1.5"	
	EN120	10,600	8,500	21,200	18,300	14,900	10,600	27,450	1.5"	
	EN150	13,200	10,600	26,400	22,800	18,600	13,200	34,200	2"	
	EN180	16,800	13,400	33,600	29,100	23,700	16,800	43,650	2"	

JRRC-4

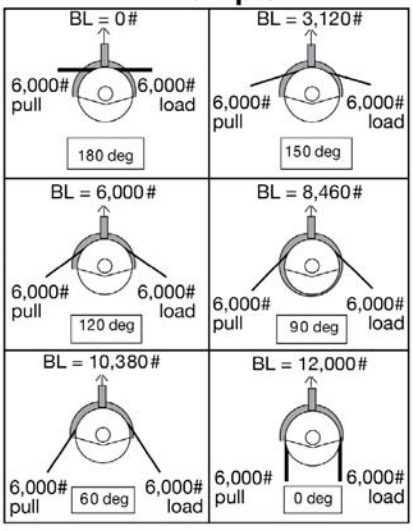
Block & Fairlead Loading

Angle full included	Block Factor	Line Pull in lbs.	Block Load in lbs.
180	0.00	6,000	0
150	0.52	6,000	3,120
120	1.00	6,000	6,000
90	1.41	6,000	8,460
60	1.73	6,000	10,380
0	2.00	6,000	12,000

Formula: Block Factor x Line Pull = Block Load



Example (4)



JRRC-5

Rigging Hardware Capacities

FORGED STEEL

(5)

Size in inches	Shldr Eye Bolt 5:1 Vertical	Shldr Eye Bolt 5:1 45 deg.	Turnbuckle 5:1 Eye or Jaw	Master Link 5:1	Shackle 6:1 SPAnchor	Wire Rope Clip Min.# clips	Wire Rope Clip Turnback in inches	Wire Rope Clip Torque in ft. lbs.
1/4	500	125	500	------	1,000	2	4.75	15
5/16	800	200	800	------	1,500	2	5.25	30
3/8	1,200	300	1,200	------	2,000	2	6.50	45
7/16	------	------	------	------	3,000	2	7.00	65
1/2	2,200	550	2,200	4,920	4,000	3	11.50	65
9/16	------	------	-------	------	-------	3	12.00	95
5/8	3,500	875	3,500	6,600	6,500	3	12.00	95
3/4	5,200	1,300	5,200	10,320	9,500	4	18.00	130
7/8	7,200	1,800	7,200	------	13,000	4	19.00	225
1	10,000	2,500	10,000	24,360	17,000	5	26.00	225
1-1/8	------	------	-------	------	19,000	6	34.00	225
1-1/4	15,200	3,800	15,200	35,160	24,000	7	44.00	360

Flat Shackle 5:1	Web Eye Width Inches
6,500	1-2
9,000	3
12,500	4
17,000	5

Swivel Hoist Rings

Size	5:1 WLL
3/8	1,000
1/2	2,500
5/8	4,000
3/4	5,000
7/8	8,000
1	10,000

Coefficients of Friction

Concrete on concrete	.65	Continuous lubricated surface	.15
Metal on concrete	.60		
Wood on concrete	.45	Steel on steel	.10
Wood on metal	.30	Load on wheels	.05

D/d Ratios

30:1 = .94	8:1 = .83
20:1 = .92	5:1 = .77
15:1 = .89	2:1 = .65
10:1 = .86	1:1 = .50

JRRC-6

Load Weights - Calculating

(6)

Materials and Liquids - Pounds / cu. ft.			
Aluminum	165	Iron Casting	450
Asbestos	153	Lead	708
Asphalt	81	Lumber - Fir	32
Brass	524	Lumber - Oak	62
Brick	120	Lumber - RR Ties	50
Bronze	534	Oil, Motor	58
Coal	56	Paper	58
Concrete, Reinf.	150	Portland Cement	94
Crushed Rock	95	River Sand	120
Diesel	52	Rubber	94
Dry Earth, Loose	75	Steel	480
Gasoline	45	Water	63
Glass	162	Zinc	437

Pounds / sq. ft.	
Steel plate	
• 1/8"	5
• 1/4"	10
• 1/2"	20
• 1"	40
Aluminum plate	
• 1/8"	1.75
• 1/4"	3.50
Lumber	
• 3/4" Fir	2
• 3/4" Oak	4

Pounds / gal.	
Gas	6.0
Diesel	7.0
Water	8.3

- 7.5 gallons of liquid to a cubic foot
- 27 cubic feet to a cubic yard
- 2,000 lbs = 1 U.S. ton

Formulas and Information

- H = Height • W = Width • L = Length • d = diameter • r = 1/2 diameter • π = 3.2 (approx.)
- Area of square or rectangle = LW • Vol. of cube = HWL • Area of circle = πr^2 • Circumference = π d
- The area of a circle is approx. 80% of its diameter squared (diameter x diameter)
- Load Weight (to estimate) ⟶ Volume in cu. ft. x 500 lbs. x density factor .02, .05, .10, .20, .30 etc.

MRRC-1

Master Rigger's Reference Card

Angles / Ratios / Factors / Formulas / Data

1 & 2

Angle from horizontal	Sling length to height ratio (L, H, R) Length : Height : Run	% of grade (H, R) (H/R x 100)	Sling Load Factor [r*] (L/H)	Full Included Angle**	Block Load Factor [FIA**]	Angle from Ceiling
90	1.000 : 1 : 0.000	∞	1.00	0	2.00	90
85	1.004 : 1 : 0.090	1111.1	1.10	10	1.99	85
80	1.015 : 1 : 0.174	574.7	1.10	20	1.97	80
75	1.035 : 1 : 0.269	371.7	1.10	30	1.93	75
70	1.064 : 1 : 0.363	275.5	1.10	40	1.87	70
65	1.104 : 1 : 0.467	214.1	1.20	50	1.81	65
60	1.155 : 1 : 0.578	173.0	1.20	60	1.73	60
55	1.221 : 1 : 0.701	142.7	1.30	70	1.64	55
50	1.305 : 1 : 0.838	119.1	1.40	80	1.53	50
45	1.414 : 1 : 1.000	100.0	1.50	90	1.41	45
40	1.555 : 1 : 1.191	83.9	1.60	100	1.29	40
35	1.742 : 1 : 1.426	70.1	1.80	110	1.15	35
30	2.000 : 1 : 1.732	57.7	2.00	120	1.00	30
25	2.364 : 1 : 2.142	46.7	3.00	130	.84	25
20	2.924 : 1 : 2.748	36.4	3.00	140	.68	20
15	3.861 : 1 : 3.729	26.8	4.00	150	.52	15
10	5.747 : 1 : 5.659	17.1	6.00	160	.35	10
5	11.490 : 1 :11.446	8.7	12.00	170	.17	5
0	∞ : 0 : ∞	0.0	∞	180	0	0

MRRC-2A

MRRC 2A

Pythagorean Theorem

$A^2 + B^2 = C^2$
$C^2 - A^2 = B^2$
$C^2 - B^2 = A^2$

MRRC 2B

Formulas

d = diameter • r = radius • L = length • H = height • W = width
∞ = infinity • **TT** or Pi = 3.1416 (3.2r*) • Circumference = **TT**d
r* = rounded • Area of a circle = **TT**r^2 or (d^2x .8) • Volume = LWH
Area of a square = LW • Area of triangle = LW/2 • Area of circle, when diameter is doubled it will quadruple the area • Farhenheit to Centigrade $^{\circ}C = 5/9(^{\circ}F-32)$, Centigrade to Farhenheit $^{\circ}F = 9/5(^{\circ}C+32)$
• Wt. est. = Vol. in cu.ft. x 500 x density factor .02, .05, .10, .20, .30, etc.

MRRC 2C

Conversions

1 mile = 5,280 ft.,1,760 yds, 1.61 km / 1 kilometer = .62 mile, 3,281 ft
1 yard = 3 ft, 36 inches, .91 meter / 1 meter = 1.09 yds, 3.28 ft, 39.37 in.
1 ton (short) = .891 long ton, .91 metric ton, 2,000 pounds, 907 kgs
1 ton (metric) = 1.1 short ton, .98 long ton, 2204 lbs, 1000 kgs
1 pound = 16 ounces, .45 kg, / 1 kg = 1000 grams, 35 ozs, 2.2 lbs
1 gallon(US liq) = 4 qts, 3.8 liters / 1 liter = .264 gallon (US), 1.06 qts

MRRC 2D

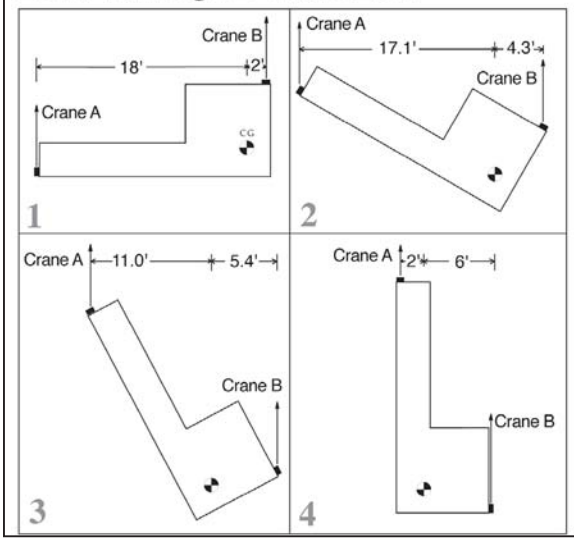
D/d Ratios

D/d Ratio Strength Efficiencies
30:1 = .94
20:1 = .92
10:1 = .86
5:1 = .77
2:1 = .65
1:1 = .50

MRRC-6

Load Turning / 2-Crane Lifts

③



Example
(Load wt. = 10,000 lbs.)

Position 1
Load to A = 10% or 1,000 lbs.
Load to B = 90% or 9,000 lbs.

Position 2
Load to A = 20% or 2,000 lbs.
Load to B = 80% or 8,000 lbs.

Position 3
Load to A = 33% or 3,300 lbs.
Load to B = 67% or 6,700 lbs.

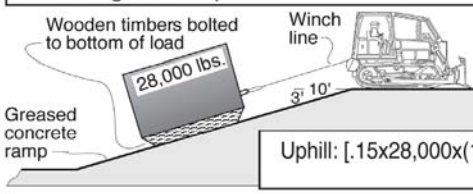
Position 4
Load to A = 75% or 7,500 lbs.
Load to B = 25% or 2,500 lbs.

MRRC-7

Level & Incline Planes

[For Estimation Only] ⑥

Legend	Formulas
W = **W**eight of load	Level: CFxW=F
CF = **C**oefficient of **F**riction	Uphill: [CFxWx(R/L)]+[(H/L)xW] = F
F = **F**orce required to move load	Downhill: [CFxWx(R/L)]-[(H/L)xW] = F
H = **H**eight in feet	
R = **R**un, horizontal distance in feet	
L = **L**ength of ramp in ft.	



Example

Uphill: [.15x28,000x(10/10.44)] +[(3/10.44)x 28,000]=F
4,032+8,120=F
12,152 lbs.=F

Coefficients of Friction

Concrete on concrete	.65	Wood on metal	.30	Steel on steel	.10
Metal on concrete	.60	Cast iron on steel	.25	Load on wheels	.05
Wood on wood	.50	Continuous lubricated		Load on ice	.01
Wood on concrete	.45	surface	.15	Load on air	.002

MRRC-7

Discover CG by Test Lift

7

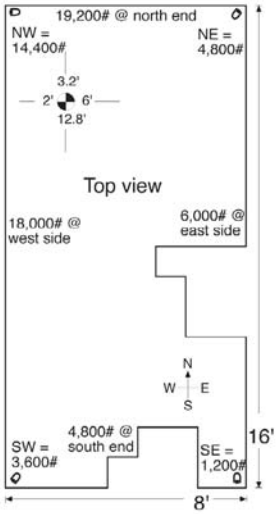
Example

Step 2
Convert lbs. to %, inverse to get CG location.
19,200/24,000=.80 (inv=.20)
.20x16'=3.2' from north end
18,000/24,000=.75 (inv.=.25)
.25x8'=2' from west side

Step 1
By lifting each end & side one at a time we discover the following weight in pounds (lbs.):

North end	=	19,200
South end	=	4,800
West side	=	18,000
East side	=	6,000

Step 3
Multiply end weight by side % to get corner load.
NW corner =
19,200x.75 = 14,400 lbs.
NE corner =
19,200x.25 = 4,800 lbs.
SW corner =
4,800x.75 = 3,600 lbs.
SE corner =
4,800x.25 = 1,200 lbs.



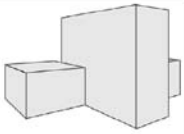
MRRC-9

Multiple CGs

9

Example

Part A + Part B = Total A & B; 4,000+12,000=16,000
4,000/16,000=.25 & 12,000/16,000=.75
.25x8'=2' and .75x8'=6'
(Combined CG of A & B is 2' from B's CG on 8' line.)



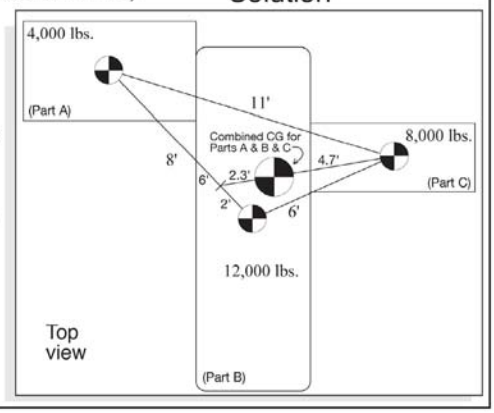
Part (A & B) + Part C = Total load
16,000+8,000=24,000
16,000/24,000=.67
8,000/24,000=.33

By scale measurement, the line from C's CG to 2' & 6' intersect is 7'.
.67x7'=4.7' and .33x7'=2.3'

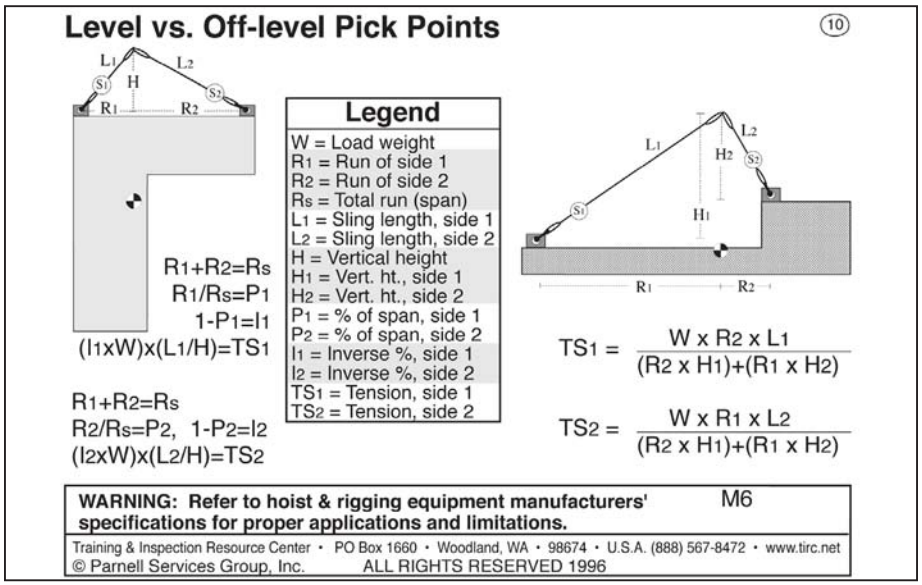
The 2' & 6' intersection on the 8' line between Parts A & B, represents 16,000 lbs. The CG mark on Part C represents 8,000 lbs.

The CG for the entire load is on a line between the 2' & 6' intersection and Part C's, CG mark; at a point 33% or 2.3' from line AB, and 4.7' from Part C's, CG mark.

Solution



MRRC-10


Level vs. Off-level Pick Points
10
L1
L2
H
S1
S2
R1
R2
Legend
W = Load weight
R1 = Run of side 1
R2 = Run of side 2
Rs = Total run (span)
L1 = Sling length, side 1
L2 = Sling length, side 2
H = Vertical height
H1 = Vert. ht., side 1
H2 = Vert. ht., side 2
P1 = % of span, side 1
P2 = % of span, side 2
I1 = Inverse %, side 1
I2 = Inverse %, side 2
TS1 = Tension, side 1
TS2 = Tension, side 2
R1+R2=Rs
R1/Rs=P1
1-P1=I1
(I1xW)x(L1/H)=TS1
R1+R2=Rs
R2/Rs=P2, 1-P2=I2
(I2xW)x(L2/H)=TS2
TS1 = W x R2 x L1 / (R2 x H1)+(R1 x H2)
TS2 = W x R1 x L2 / (R2 x H1)+(R1 x H2)
WARNING: Refer to hoist & rigging equipment manufacturers' specifications for proper applications and limitations.
M6
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