

Wire rope inspection sheet: CSA Z248:17

One rope per sheet. How to fill it in: page 4. Mark ✓ nothing found, X found (write where and what), N/A does not apply. **Free analysis:** send us a photo of the completed sheet for a same-day response (page 2).

Date	Inspection type (codes: page 4)	Crane total hours (6.2.3 c)	Inspector (print)	Trolley distance (m) or boom angle (°)	Hook height (m) and hook load
Customer / owner	Site / location	Crane make	Crane model	Serial number	Unit number
Winch number	Winch duty (main hoist, aux, boom hoist, trolley)	Rope length (m / ft)	Nominal diameter d (mm)	Construction (e.g. 6x36 WS)	Core (IWRC, WSC)
Lay (ordinary / regular or Lang, direction)	Grade / finish	OEM specified breaking force (crane manual, not the mill cert)	Minimum breaking force (mill cert)	Date installed	Certificate number
Rope manufacturer / supplier	Drum: single or multi-layer	Sheaves: steel or synthetic	Rotation-resistant category (ASTM A1023 Cat 1, 2 or 3)		

Your limits for this rope (how to work them out: page 6; tables: page 9)

Broken wires: sections of rope working in steel sheaves and/or spooling on a single-layer drum	Broken-wire limit (reached or exceeded: removal): over 6d _____ over 30d _____	Tables 1 / 2
Broken wires: sections of rope spooling on a multiple-layer drum (crossover zones and wrap interference)	Broken-wire limit (reached or exceeded: removal): over 6d _____ over 30d _____ (N/A if single-layer)	Tables 1 / 2 note c
Your minimum diameter = actual diameter x 0.95 (6.5.2.2 e)); rotation-resistant rope: actual diameter as the base, CRS practice)	_____ mm	6.5.2.2 e), f)
Waviness gap limit	d/10 = _____ mm (rope that runs over sheaves or onto the drum) d/3 = _____ mm (straight rope that never runs through a sheave or onto the drum)	Figure 1
Sheave grooves	Rope nominal Ø (d): _____ mm Manufacturer's groove limit: _____ mm (6.5.4.2 a)) Pitch Ø at least 18 d load block / 15 d boom hoist (4.12 d))	

Actual diameter (measured on an unused part of the rope, for example the wraps that stay on the drum): _____ mm, measured at _____ m from the _____ end on (date) _____. D1 _____ mm, D2 _____ mm, averaged (CRS practice).

1. Diameter: D1 and D2 at right angles, average (D1 + D2) / 2 (averaging: CRS practice)

#	Measured at	D1 (mm)	D2 (mm)	Average (mm)
1.1	_____ m from the _____ end			
1.2	_____ m from the _____ end			
1.3	_____ m from the _____ end			
1.4	_____ m from the _____ end			
1.5	_____ m from the _____ end			
1.6	_____ m from the _____ end			

3. Other measurements

	Check	Reading	Where (m from which end)
3.1	Wear of outside individual wires		
3.2	Largest waviness gap g (mm)		
3.3	Lay length (mm), same place each time (CRS practice)		

Notes



2. Broken wires: one line for every broken wire or group you find

	Where (m from which end)	Zone SH or ML	Ø at this spot D1 / D2 (mm)	Broken wires in 6d	Broken wires in 30d	Breaks at an end fitting	Outer wires broken at the core	Notes
2.1	___ m from the ___ end		/					
2.2	___ m from the ___ end		/					
2.3	___ m from the ___ end		/					
2.4	___ m from the ___ end		/					
2.5	___ m from the ___ end		/					
2.6	___ m from the ___ end		/					
2.7	___ m from the ___ end		/					

Zone SH: rope working in steel sheaves and/or spooling on a single-layer drum (wire breaks randomly distributed). Zone ML: multiple-layer drum, for deterioration at the cross-over zones and interference between wraps due to fleet angle defects, not sections of rope which only work in sheaves (Tables 1 and 2 note c). Outer wires broken at the core: outer wires broken where they touch the core, seen as a wire or loop sticking out (6.5.2.2 c)). Ø at this spot: D1 and D2 measured where the breaks are, so the diameter and the breaks at the same spot are judged together (CRS practice). Broken-wire limits: page 1.

Check	✓ / X / N/A	If X: where and what	Check	✓ / X / N/A	If X: where and what
4. Rope condition					
4.1	Grouped breaks in one or two neighbouring strands (sections that do not spool on and off the drum)		5.2	End fittings severely corroded, cracked, bent or worn	
4.2	Strand or wire extrusion		5.3	Wedge sockets installed as the manufacturer specifies, using one of the Figure 2 methods	
4.3	Kinks or tightened loops		5.4	Wedge socket dead end (Figure 2 method a): tail; rope at the dead-end exit	
4.4	Crushing		5.5	Hand-spliced end termination	
4.5	Birdcaging		5.6	Wire rope clips	
4.6	Bends or other distortion (unstranding, strand displacement, core protrusion)		5.7	Eye splices mechanical with a thimble; swaged fittings as the maker recommends	
4.7	Local increase in diameter		5.8	Swivel	
4.8	Broken or cut strands		5.9	Complete wraps left on the drum (hook at lowest working position; boom hoist at minimum boom angle)	
4.9	Heat damage or electric arcing		5.10	Drum flanges above the top layer	
4.10	Contact with high-voltage lines, including through rigging and loads		5.11	Drum end of the rope attached as the crane maker specifies	
4.11	Internal or external corrosion		5.12	Rope spools evenly	
4.12	Exposure to ambient temperatures above 82 °C (180 °F) or below -40 °C (-40 °F)		5.13	Flange, crossover and repetitive pickup points	
4.13	Lubrication condition, including sections over sheaves		5.14	Load block, hook, rings, shackles, chains and slings	
4.14	Rope test done (non-destructive or other): date, by whom, crane hours, result				
5. Rope ends and drum and block					
5.1	Severely corroded or broken wires at end connections				

6. Sheaves: one line per sheave (groove gauges: page 10; groove limits: page 1)

	Sheave (which one)	Groove Ø (mm) or gauge OK / not OK (6.5.4.2 a)	Groove wear: general or uneven wear, grooving, flat spots (6.5.4.1); negative impressions (CRS practice): ✓ / X	Flange: chips or damage (6.5.4.2 b)); broken, deformed or cracked (6.5.4.4); rope kept in the groove (4.12 b)): ✓ / X	Bearing: free-wheeling, no excessive play (6.5.4.2 c)): ✓ / X	If X: where and what
6.1						
6.2						
6.3						
6.4						
6.5						

Decision: out now / end of shift; repairs (6.5.2.1)	Next periodic (at least monthly) and next annual due	Competent person: name and signature	Date
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Wire rope inspection: CSA Z248:17

A free inspection sheet and guide from Crane Rope Solutions. It shows what CSA Z248:17 asks you to check and record, and how to record it. One rope per inspection sheet.

How to use this guide

1. Work out your limits for this rope once (page 6) and write them at the top of page 1.
2. Inspect the rope and fill in the inspection sheet, pages 1 and 2. How to fill it in: page 4. A filled-in example is on pages 11 and 12.
3. Send us a photo of the completed sheet for a free analysis (below).

WHO

All inspections shall be carried out by a designated person (6.5.1.1); periodic rope inspections by a competent person (6.5.1.3.2), who also examines any rope deficiency and determines whether it is cause for immediate rope removal (6.5.1.1).

WHEN

Daily by a designated person (may be the operator): all load hoist, boom hoist and trolley rope expected in use that day, especially attachment points (6.5.1.2.1). Weekly: sheaves, pins, guy ropes, pendants, clips, thimbles, ferrules, attachments (6.4.5). At least monthly: periodic rope inspection, frequency set by the rope maker or a competent person (6.5.1.3.1). Annual: after 12 months in service (6.4.7). Also at erection (6.4.2, 6.4.3), special inspections (6.4.8), and rope idle over a month, after an incident or reassembly (6.5.1.3.5).

HOW MUCH ROPE

Periodic: the length of rope at the current height of the crane (6.5.1.3.2). Annual: all fixed and running ropes (6.4.7 c), d)).

Have on hand

- The wire rope report for each rope (6.5.2.4): diameter, length, wire tensile strength and finish, construction, lay, outer strands, core, minimum breaking force, working load limit, end fittings and proof-test loads, swivel permitted, manufacturer, and who issued the report.
- The rope installation date and who installed it, from the crane logs (6.2.2 e), 6.2.3 e)).
- Your broken-wire numbers from Table 1 or Table 2 on page 9.

Look closely at these areas (6.5.1.3.3)

- Sections in contact with saddles, equalizer sheaves or other sheaves where rope travel is limited
- At or near end fittings where corroded or broken wires can protrude
- Sections subject to reverse bends
- Sections normally hidden, such as parts passing over sheaves



Send it to us: free analysis, same-day response

When you finish the sheet, take a clear photo of both pages and text it to **604-813-WIRE (9473)** (scan the code), or email it to **dean@craneropesolutions.com**. Add photos of anything you marked X, with a tape or ruler in the frame. We send back our analysis the same day.

A photo review is advice only. It does not replace the inspection the standard requires; the decision stays with the competent person.

CSA Z248:17, Code for tower cranes. Clause numbers in brackets point to the standard. Text marked Crane Rope Solutions (CRS) practice is our method, not the standard.



How to fill in the inspection sheet

1 Top of page 1: the inspection, crane and rope

- Date, inspection type (codes below), hours, your name, and the crane set-up at the time: Tower cranes with a trolley: write the trolley distance; luffing jib cranes: write the boom (jib) angle. Hook height and hook load (none, block only, or tonnes). Set the crane up the same way each time if you can, so the same part of the rope sits at your points (CRS practice).
- Rope details from the mill certificate (size, construction, core, lay, grade, minimum breaking force) and the crane manual (OEM specified breaking force).

2 Your limits (page 1)

- Work them out once for this rope with page 6 and copy them onto each new sheet.

3 Section 1: diameter

- Take two readings at right angles and average them, using calipers with jaws wide enough to span at least two strands (CRS practice).
- Measure across the tops of the strands, not into the gaps (CRS practice).
- Choose points you can find again (areas to look at: page 3), including the place with the smallest diameter you can find.
- For each point, write how far along the rope it is from the drum end or from the dead end (picture on page 5). Measure the distance with a tape measure, or read it from a rope counter, and mark the spot on the rope with a paint pen so the next inspection measures the same place (CRS practice).
- Actual diameter: Z248 says the inspection is performed best by comparing an unused portion of the rope (for example on the drum) with a used portion (6.5.2.2 e)).

4 Section 2: broken wires

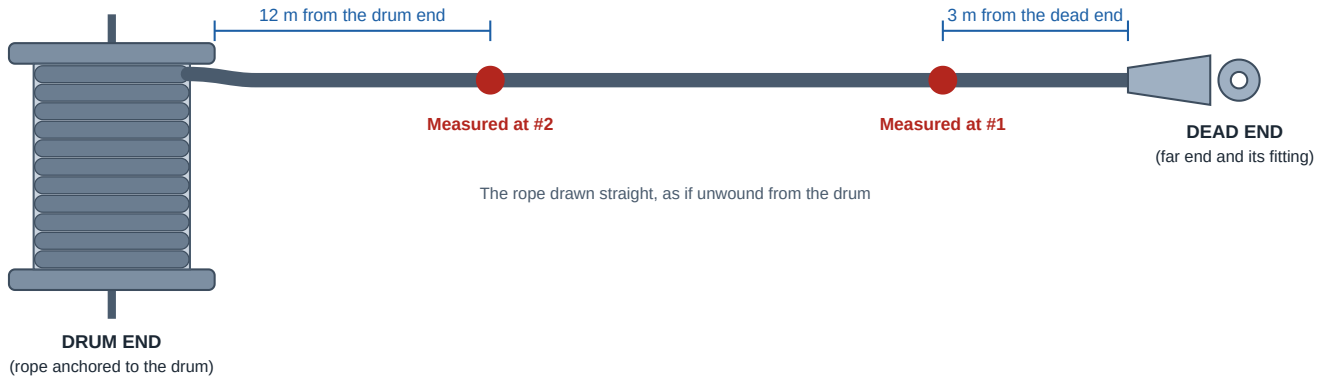
- Look along the rope this inspection covers (page 3). Write one line for every broken wire, or group of broken wires, that you find, and mark each spot on the rope with a paint pen (CRS practice).
- For each line, write how far along the rope it is from the drum end or the dead end. In each count column, write the most broken wires in any 6d length, and in any 30d length, that includes this spot. 6d and 30d mean 6 or 30 times the nominal diameter d: for a 28 mm rope, 168 mm and 840 mm.
- Zone SH: rope working in steel sheaves and/or spooling on a single-layer drum (wire breaks randomly distributed). Zone ML: multiple-layer drum, for deterioration at the cross-over zones and interference between wraps due to fleet angle defects, not sections of rope which only work in sheaves (Tables 1 and 2 note c). Outer wires broken at the core: outer wires broken where they touch the core, seen as a wire or loop sticking out (6.5.2.2 c)).
- On every line, also measure D1 and D2 at that spot, the same way as section 1, and write them in the Ø column, so the diameter and the breaks at the same spot are judged together (CRS practice).
- Write ML only for breaks at a crossover zone or where wraps interfere; otherwise write SH. Breaks grouped in one or two neighbouring strands: also mark row 4.1.

Inspection type codes

D daily (6.5.1.2) W weekly (6.4.5) M monthly / periodic (6.4.6, 6.5.1.3) A annual (6.4.7) E erection (6.4.2, 6.4.3) S special (6.4.8) O idle over a month, incident, reassembly (6.5.1.3.5)



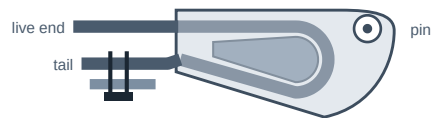
Finding your points again



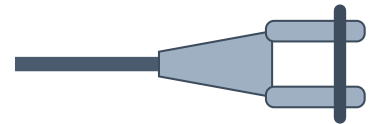
Common dead-end fittings (Crane Rope Solutions illustration)



Button (swaged or poured)



Wedge socket



Open spelter socket (pin through the jaws)

5 Sections 3 to 6: everything else

- Measurements: write the reading and where. Checks: mark ✓ nothing found, X found, N/A does not apply. For every X, write where it is (m from which end, or which part) and what you found in the same row.
- Corrosion (row 4.11): write internal or external, where it is and what you see, for example light surface rust, pitted wires, or rust coming from between the strands (CRS practice). The competent person evaluates it (6.5.2).
- Sheaves (section 6): one line per sheave, named so you can find it again (for example "Boom tip 2"). Groove: write the groove diameter in mm, or OK / not OK from a go / no-go gauge (page 10). Then mark ✓ or X for groove wear, flange and bearing as the column headings say, and for every X write what and where in the last column. Negative impressions: the pattern of the rope's strands pressed or worn into the groove.

6 Sign and send

- Sign or initial, write the next inspection due, and send us a photo of both pages for a free analysis and a same-day response.



Your limits from CSA Z248:17

Work these out once for each rope and write them on page 1. Then the rules below tell you what each finding means. **FAIL** the standard says (shall) the rope or that part comes out of service, or the item must be put right. **SHOULD** the standard recommends (should) it; the competent person decides (Crane Rope Solutions practice). **EVALUATE** no fixed limit; the competent person judges it (Crane Rope Solutions practice). Rows not listed are for the record only.

A. Broken-wire limits

- Regular ropes use Table 1; rotation-resistant ropes use Table 2 (page 9). Both tables apply only to rope on steel sheaves and drums (6.5.2.2).
- Find your construction in the "Example constructions" column, or count n: the load-bearing wires in the outer strands, leaving out filler wires.
- Table 1: pick regular or Lang lay. Write the broken-wire limits over 6d and over 30d for rope working in steel sheaves and/or spooling on a single-layer drum. Multiple-layer drum: also write the broken-wire limits from the multiple-layer drum columns. Those apply only at the crossover zones and where wraps interfere due to fleet angle defects (Tables 1 and 2 note c).
- Example: 6x36, regular lay, single-layer drum (row 161 to 180): 7 broken wires over 6d and 14 over 30d.

B. Minimum diameter

- Measure the actual diameter on a part of the rope that is not used, for example the wraps that stay on the drum.
- Minimum diameter = that diameter x 0.95 (a 5% decrease).
- Example: unused section 20.6 mm. $20.6 \times 0.95 = 19.57$ mm. A reading of 19.57 mm or less fails (19.5 fails, 19.6 passes).
- Rotation-resistant rope: a 5% reduction indicates core failure and is cause for immediate rope removal (6.5.2.2 f)). It can deteriorate from the inside out (6.5.1.2.3 Note).

C. Other limits

- Waviness: lay a straightedge along the rope and measure the gap under the wave. Limit $d/10$ where the rope runs over sheaves or onto the drum (20 mm rope: 2 mm), $d/3$ on straight rope that never does.
- Outside wires worn by one-third of their original diameter fail (6.5.2.2 e)).
- Tables 1 and 2 apply to rope on steel sheaves and drums. Other sheave materials: the user shall get the broken-wire limits from a competent person and the sheave, drum or crane manufacturer (6.5.2.2).

D. Rules for the sheet rows

Row	Check	Rule	Clause
1.1 to 1.6	Each average diameter	FAIL At or below your minimum diameter (page 1): a 5% or more decrease due to wear (6.5.2.2 e)). From another cause (core support, corrosion): EVALUATE per 6.5.2 (6.5.1.3.4 b), 6.5.1.3.6)	6.5.2.2 e)
1	Rotation-resistant rope: any loss of diameter	EVALUATE A competent person shall inspect the section at once	6.5.1.3.4 c)
1	Rotation-resistant rope: 5% reduction in diameter	FAIL Indicates core failure and is cause for immediate rope removal	6.5.2.2 f)
2	Most broken wires in any 6d. Sections of rope working in steel sheaves and/or spooling on a single-layer drum (wire breaks randomly distributed)	FAIL Reaches or exceeds the broken-wire limit over 6d (page 1)	Tables 1, 2
2	Most broken wires in any 30d. Sections of rope working in steel sheaves and/or spooling on a single-layer drum (wire breaks randomly distributed)	FAIL Reaches or exceeds the broken-wire limit over 30d (page 1)	Tables 1, 2
2	Most broken wires in any 6d. Sections of rope spooling on a multiple-layer drum (at the crossover zones and where wraps interfere due to fleet angle defects)	FAIL Reaches or exceeds the multi-layer drum broken-wire limit over 6d (page 1)	Tables 1, 2 note c
2	Most broken wires in any 30d. Sections of rope spooling on a multiple-layer drum (at the crossover zones and where wraps interfere due to fleet angle defects)	FAIL Reaches or exceeds the multi-layer drum broken-wire limit over 30d (page 1)	Tables 1, 2 note c
2	Broken wires at an end termination fitting	FAIL 2 or more	6.5.2.2 d)
2	Outer wires broken at the core contact point (protruding wire or loop)	FAIL 2	6.5.2.2 c)
3.1	Wear of outside individual wires	FAIL Worn by one-third of the original wire diameter	6.5.2.2 e)
3.2	Largest waviness gap g (mm)	FAIL $d/10$ or greater (rope that runs through a sheave or onto the drum); $d/3$ or greater (straight rope that never does) (page 1)	Figure 1
4.1	Grouped breaks in one or two neighbouring strands (sections that do not spool on and off the drum)	EVALUATE Might need discard even below the 6d broken-wire limit	6.5.2.2 b)
4.2	Strand or wire extrusion	FAIL Any	6.5.2.2 g)
4.3	Kinks or tightened loops	FAIL Any	6.5.2.2 g)
4.4	Crushing	FAIL Any	6.5.2.2 g)



Row	Check	Rule	Clause
4.5	Birdcaging	FAIL Any	6.5.2.2 g)
4.6	Bends or other distortion (unstranding, strand displacement, core protrusion)	FAIL Any damage that distorts the rope structure	6.5.2.2 g), 6.5.1.2.2
4.7	Local increase in diameter	EVALUATE Competent person decides (distortion of the rope structure = FAIL, g))	6.5.1.2.2
4.8	Broken or cut strands	EVALUATE Competent person decides (distortion of the rope structure = FAIL, g))	6.5.1.2.2
4.9	Heat damage or electric arcing	FAIL Any evidence, from any cause	6.5.2.2 h), 6.5.1.2.2 g)
4.10	Contact with high-voltage lines, including through rigging and loads	FAIL Any contact that might pass current through the rope	6.5.2.2 i)
4.11	Internal or external corrosion	EVALUATE Competent person evaluates per 6.5.2; remove if a replacement criterion is met	6.5.1.2.2 c), 6.5.1.3.4 b)
4.12	Exposure to ambient temperatures above 82 °C (180 °F) or below -40 °C (-40 °F)	EVALUATE The rope manufacturer shall be consulted before use	4.11.1 h)
4.13	Lubrication condition, including sections over sheaves	SHOULD Rope should be maintained in a well-lubricated condition (6.5.3.5). Where the manufacturer specifies lubrication, the rope shall be regularly lubricated as the manufacturer recommends (7.5). Lubricant shall not hinder visual inspection (6.5.3.5)	6.5.3.5, 7.5
5.1	Severely corroded or broken wires at end connections	EVALUATE Broken wires: use section 2. Severe corrosion: evaluate per 6.5.2 and remove if a replacement criterion is met (6.5.1.3.6)	6.5.1.3.4 d)
5.2	End fittings severely corroded, cracked, bent or worn	EVALUATE Competent person decides (6.5.2)	6.5.1.3.4 e)
5.3	Wedge sockets installed as the manufacturer specifies, using one of the Figure 2 methods	FAIL Improperly installed: evaluate per 6.5.2 (6.5.1.3.4 e)); a hazardous condition is corrected before operation resumes (7.4 a))	4.11.2 e)
5.4	Wedge socket dead end (Figure 2 method a)): tail; rope at the dead-end exit	FAIL Tail at least 6 x d, not less than 150 mm (shall, via 4.11.2 e)); clip distance about 3 x d or 75 mm, whichever is less (should). Regularly inspect the rope where it exits on the dead-end side	4.11.2 e), Figure 2
5.5	Hand-spliced end termination	FAIL Not allowed	4.11.2 d)
5.6	Wire rope clips	FAIL Clips as the only termination, or on a wedge socket anywhere but the unloaded dead end: not allowed	4.11.2 h)
5.7	Eye splices mechanical with a thimble; swaged fittings as the maker recommends	FAIL Otherwise: put right before use	4.11.2 b), c), f)
5.8	Swivel	FAIL On Category 2 or 3 rotation-resistant rope or regular rope without the approval of the crane manufacturer, rope manufacturer or a competent person: not allowed	4.11.2 i)
5.9	Complete wraps left on the drum (hook at lowest working position; boom hoist at minimum boom angle)	FAIL Fewer than the minimum: in no case less than 3, or as the drum manufacturer specifies	4.13.1
5.10	Drum flanges above the top layer	FAIL Grooved drum: less than 1 x d or 25 mm (whichever is greater). Ungrooved: less than 2 x d or 65 mm (whichever is greater)	4.13.3, 4.13.4
5.11	Drum end of the rope attached as the crane maker specifies	FAIL Otherwise: put right before use	4.13.2
5.12	Rope spools evenly	EVALUATE Crane Rope Solutions practice: a competent person decides	4.13.5
5.13	Flange, crossover and repetitive pickup points	EVALUATE Evaluate against 6.5.2	6.5.1.2.3
5.14	Load block, hook, rings, shackles, chains and slings	EVALUATE Inspected in the annual; Crane Rope Solutions practice: a competent person decides	6.4.7 b)

E. Sheaves (section 6)

FAIL Broken or deformed flange, or a crack anywhere in the sheave: remove the sheave. A replacement matches the old sheave's hardness, or at least Rockwell C35 if unknown (6.5.4.4).

FAIL No means to keep the running rope in the groove under all conditions: put right (4.12 b)).

EVALUATE Groove outside the manufacturer's limits (6.5.4.2 a)): restore only if the sheave manufacturer approves (6.5.4.3). Wear, uneven wear, grooving, flat spots (6.5.4.1); flange chips or damage (6.5.4.2 b)); bearings free-wheeling, no excessive play (6.5.4.2 c)).

SHOULD New sheaves only: Z248 says the groove radius should exceed the nominal rope diameter by at least 6% and not more than 10% (4.12 a)).

When: Inspect sheaves before a new rope goes on, and whenever there is premature wear and damaged or broken wires (6.5.4.1); sheaves weekly and monthly (6.4.5, 6.4.6).



F. After the inspection

Limit reached: A replacement criterion is reached (6.5.2.2): a competent person decides whether the rope is removed now or allowed to run to the end of the work shift (6.5.2.1). The rope is removed when the criteria are met (6.5.1.3.6). Rotation-resistant rope, 5% loss of diameter: immediate removal (6.5.2.2 f)).

Corrective actions: Any hazardous condition found by inspection is corrected before operation resumes (7.4 a), shall). Damage and the repairs that follow are recorded in detail, with the date, who did it and the crane's total hours (6.2.3 c), d), shall). A worn section may be cut off only if the diameter there is adequate and as the maker recommends (6.5.3.6).

Records: A dated report of rope condition referring to the 6.5.1.3.4 damage, kept on file (6.5.1.3.7). Daily and periodic results in the operator's crane log (6.5.1.2.5, 6.5.1.3.1), with the date, who did it and the crane's total hours of service (6.2.3 c)); incidents, damage and repairs in detail (6.2.3 d)). The wire rope report for each rope stays with the crane log (6.5.2.4); the owner's crane log goes with the crane to a new owner (6.2.2 b)). A long-term inspection program should include records of examination of ropes removed from service (6.5.2.1).



How many broken wires reach the limit?

1) Find your construction in the example column, or count n: the load-bearing wires in the outer strands, leaving out filler wires. 2) Read the broken-wire limit for your lay and the length counted over (6d or 30d). Multi-layer columns are only for crossover zones and where wraps interfere due to fleet angle defects. Reaching or exceeding that limit is a rope replacement criterion (6.5.2.2 a)); a competent person then decides whether the rope is removed now or at the end of the work shift (6.5.2.1). d = nominal rope diameter. A broken wire has two ends and counts once.

Table 1: round strand ropes working in steel sheaves

Load-bearing outer wires (n)	Example constructions	Steel sheaves and/or single-layer drum				Multi-layer drum	
		Regular lay		Lang lay		Regular and Lang	
		6d	30d	6d	30d	6d	30d
Under 50	6x7, 7x7	2	4	1	2	4	8
51 to 75	6x19 Seale	3	6	2	3	6	12
76 to 100		4	8	2	4	8	16
101 to 120	6x26, 6x25, 8x19 Seale	5	10	2	5	10	19
121 to 140		6	11	3	6	11	22
141 to 160	8x19 Filler	6	13	3	6	13	26
161 to 180	6x36	7	14	4	7	14	29
181 to 200		8	16	4	8	16	32
201 to 220	6x41	9	18	4	9	18	38
221 to 240		10	19	5	10	19	38
241 to 260	8x36	10	21	5	10	21	42
261 to 280		11	22	6	11	22	45
281 to 300		12	24	6	12	24	48
300 and over		0.04n	0.08n	0.02n	0.04n	0.08n	0.16n

Table 2: rotation-resistant and non-rotating rope (Category I and II, ASTM A1023) in steel sheaves

Load-bearing outer wires (n)	Example constructions	Steel sheaves and/or single-layer drum		Multi-layer drum (all classes)	
		6d	30d	6d	30d
4 strands ≤ 100	4x29F	2	4	2	4
3 or 4 strands ≥ 100	4x26WS, K3x40	2	4	4	8
11+ outer strands: 71 to 100	19x7	2	4	4	8
101 to 120	35x7	3	5	5	10
121 to 140	39x7	3	5	6	11
141 to 160		3	6	6	13
161 to 180		4	7	7	14
181 to 200	19x19S	4	8	8	16
201 to 220	6x41	4	9	9	18
221 to 240	35x17S	5	10	10	19
241 to 260		5	10	10	21
261 to 280		6	11	11	22
281 to 300		6	12	12	24
300 and over	35x31WS, 35x25F, 35x19W	6	12	12	24

Seale outer strands with 19 wires or fewer per strand (e.g. 6x19 Seale): use the row two rows above where n would place it. Multi-layer columns apply to deterioration at crossover zones and interference between wraps due to fleet angle defects, not to sections of rope which only work in sheaves and do not spool onto the drum. Twice the number of broken wires listed may be applied to ropes on mechanisms whose ISO classification is known to be M5 to M8. These counts apply to rope on steel sheaves and drums (6.5.2.2). Also see the grouping, end-connection and core-break criteria in 6.5.2.2. Summarized from CSA Z248:17 Table 1 and Table 2 for field reference.

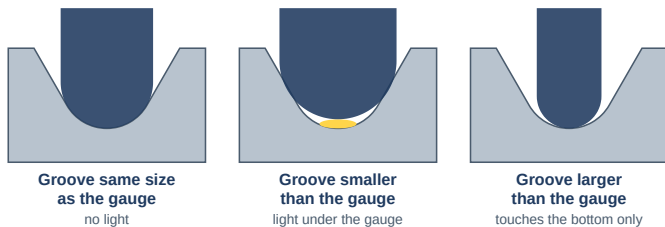


Checking sheave grooves with groove gauges

There are two types of groove gauge: **go / no-go gauges** and **actual size gauges**. How to use them, and what to do about a groove outside the limits, is Crane Rope Solutions practice unless a clause is given. The groove sizes come from CSA Z248:17 (box at the bottom).

1. Go / no-go gauges

1. Clean the groove so the gauge sits on bare metal, not grease or dirt.
2. A go / no-go gauge is made to a groove size, not to the rope size: check the size marked on it. For a 28 mm rope use a **minimum gauge of 29.68 mm** (Z248 4.12 a) new sheave figure, $d \times 1.06$ and a **maximum gauge of 30.80 mm** (Z248 4.12 a) new sheave figure, $d \times 1.10$). CSA Z248 4.12 a) is for new sheaves; in service, grooves shall be within the manufacturer's limits (6.5.4.2 a)).
3. Place it into the groove, square to the sheave. **Plastic gauges: do not push down hard.** They flex, and pressing down can easily give a wrong reading, so plastic gauges are not the best choice. Crane-specific steel groove gauges are available at craneropesolutions.com.
4. Shine a flashlight behind the gauge.
5. **Minimum gauge, any light under it** (middle picture): the groove is outside the limit: restore it only with the sheave manufacturer's approval (6.5.4.3), or replace the sheave (Crane Rope Solutions practice).
6. **Maximum gauge touches only the bottom, with gaps at both sides** (right picture): the groove is more than 10% larger than the rope: oversized for a new sheave (4.12 a)). Check it against the manufacturer's limit (6.5.4.2 a)); if it is outside that limit, replace the sheave (Crane Rope Solutions practice).
7. Check several places around each sheave and write the result in section 6 of the sheet.



2. Actual size gauges

Crane Rope Solutions offers actual size gauges in 0.25 mm steps. Try gauges until you find the one that best fills the groove without letting light underneath it. That gauge is your true groove size. Write the size in section 6 of the sheet.

Check it against the minimum. CSA Z248 4.12 a), new sheaves (should): at least 6% larger than the nominal rope diameter. In service, use the manufacturer's limit. For a 28 mm rope: $28 \times 1.06 = 29.68$ mm, so the closest 0.25 mm step at or above it is the **29.75 mm** gauge.

Check it is not oversized. CSA Z248 4.12 a), new sheaves: not more than 10%. For a 28 mm rope: $28 \times 1.10 = 30.80$ mm; a groove reading more than this is oversized for a new sheave.

Why we prefer actual size gauges

A go / no-go gauge only tells you pass or fail. An actual size gauge shows how much wear is left, so your maintenance plan can move from pass, pass, pass, fail to 100% life remaining, 75%, 50%, 25%, replace.

100% 30.75 mm	75% 30.50 mm	50% 30.25 mm	25% 30.00 mm	Plan to replace 29.75 mm
------------------	-----------------	-----------------	-----------------	-----------------------------

Example, 28 mm rope: new groove 30.75 mm, minimum gauge 29.75 mm. Life remaining = $(\text{gauge now} - \text{minimum}) / (\text{new} - \text{minimum})$. Crane Rope Solutions planning practice: "Plan to replace" is the last 0.25 mm step at or above the minimum, so plan the work before the groove goes below it. Example figures; use your manufacturer's limit where it has one.

What CSA Z248:17 says. CSA Z248 6.5.4.2 a): grooves shall be within the limits specified by the manufacturer. New sheaves: the groove radius should exceed the nominal rope diameter by a minimum of 6%, but should not exceed 10% (4.12 a)). Z248 words this as groove radius; reading it as groove diameter is Crane Rope Solutions practice. A worn or damaged groove may be restored only if approved by the sheave manufacturer (6.5.4.3).



Don't have gauges? Scan to see our groove gauges.

Want a free gauge? Give us a shot at quoting your wire ropes and we will send you a free groove gauge, just to say thank you.

604-813-WIRE (9473) | dean@craneropesolutions.com



EXAMPLE, made-up readings. A 28 mm rope filled in to show how the sheet works. Your blank sheet is pages 1 and 2.

Wire rope inspection sheet: CSA Z248:17

One rope per sheet. How to fill it in: page 4. Mark ✓ nothing found, X found (write where and what), N/A does not apply. **Free analysis:** send us a photo of the completed sheet for a same-day response (page 2).

Date 2026-04-03	Inspection type (codes: page 4) A	Crane total hours (6.2.3 c) 4,318	Inspector (print) J. Smith	Trolley distance (m) or boom angle (°) 25 m	Hook height (m) and hook load 40 m, block
Customer / owner Example Crane Co.	Site / location Vancouver yard	Crane make ABC Cranes	Crane model Example TC-8	Serial number EX-12345	Unit number 12
Winch number W1	Winch duty (main hoist, aux, boom hoist, trolley) Main hoist (tower)	Rope length (m / ft) 210 m	Nominal diameter d (mm) 28	Construction (e.g. 6x36 WS) 8x26 WS	Core (IWRC, WSC) IWRC
Lay (ordinary / regular or Lang, direction) Right regular lay	Grade / finish 1960 / bright	OEM specified breaking force (crane manual, not the mill cert) Per crane manual	Minimum breaking force (mill cert) Per mill cert	Date installed 2025-12-15	Certificate number EX-0001
Rope manufacturer / supplier Crane Rope Solutions	Drum: single or multi-layer Multi-layer	Sheaves: steel or synthetic Steel	Rotation-resistant category (ASTM A1023 Cat 1, 2 or 3) N/A (not RR)		

Your limits for this rope (how to work them out: page 6; tables: page 9)

Broken wires: sections of rope working in steel sheaves and/or spooling on a single-layer drum	Broken-wire limit (reached or exceeded: removal): over 6d 9 over 30d 18	Tables 1 / 2
Broken wires: sections of rope spooling on a multiple-layer drum (crossover zones and wrap interference)	Broken-wire limit (reached or exceeded: removal): over 6d 18 over 30d 38 (N/A if single-layer)	Tables 1 / 2 note c
Your minimum diameter = actual diameter x 0.95 (6.5.2.2 e); rotation-resistant rope: actual diameter as the base, CRS practice)	27.39 mm	6.5.2.2 e), f)
Waviness gap limit	d/10 = 2.80 mm (rope that runs over sheaves or onto the drum) d/3 = 9.34 mm (straight rope that never runs through a sheave or onto the drum)	Figure 1
Sheave grooves	Rope nominal Ø (d): 28 mm Manufacturer's groove limit: 29.75 mm (6.5.4.2 a)) Pitch Ø at least 18 d load block / 15 d boom hoist (4.12 d))	

Actual diameter (measured on an unused part of the rope, for example the wraps that stay on the drum): **28.84** mm, measured at **2** m from the **drum** end on (date) **2025-12-15**. D1 **28.88** mm, D2 **28.80** mm, averaged (CRS practice).

1. Diameter: D1 and D2 at right angles, average (D1 + D2) / 2 (averaging: CRS practice)

#	Measured at	D1 (mm)	D2 (mm)	Average (mm)
1.1	3 m from the dead end	28.62	28.54	28.58
1.2	120 m from the drum end	28.50	28.42	28.46
1.3	150 m from the drum end	28.76	28.72	28.74
1.4	180 m from the drum end	28.80	28.74	28.77
1.5	___ m from the ___ end			
1.6	___ m from the ___ end			

3. Other measurements

	Check	Reading	Where (m from which end)
3.1	Wear of outside individual wires	under 1/3 of wire Ø	120 m from the drum end
3.2	Largest waviness gap g (mm)	none	
3.3	Lay length (mm), same place each time (CRS practice)	190	3 m from the dead end

Reading this example: n = 8 strands x 26 wires = 208, so Table 1 row "201 to 220": regular lay 9 over 6d and 18 over 30d; multi-layer 18 over 6d and 38 over 30d. The actual diameter of an unused part (dead wraps on the drum) is 28.84 mm, 28.84 x 0.95 = 27.398 mm. Readings are to 0.01 mm, so write 27.39: a reading of 27.39 or less is a 5% or more decrease (FAIL); 27.40 is 4.99% (pass). Waviness: 2.80 mm and 28 / 3 = 9.333 mm, written 9.34 (a gap of 9.34 mm or more meets the d/3 rule).

Reading this example: The lowest average at this inspection is 28.46 mm at point 1.2 (120 m from the drum end). The minimum diameter at the top of this sheet is 27.39 mm, so every reading passes.



EXAMPLE, made-up readings. Page 2 of the example sheet.**2. Broken wires: one line for every broken wire or group you find**

	Where (m from which end)	Zone SH or ML	Ø at this spot D1 / D2 (mm)	Broken wires in 6d	Broken wires in 30d	Breaks at an end fitting	Outer wires broken at the core	Notes
2.1	120 m from the drum end	SH	28.50 / 28.42	3	6	0	0	6 within 840 mm
2.2	35 m from the drum end	ML	28.80 / 28.74	1	2	0	0	Crossover zone
2.3	___ m from the ___ end		/					
2.4	___ m from the ___ end		/					

Zone SH: rope working in steel sheaves and/or spooling on a single-layer drum (wire breaks randomly distributed). Zone ML: multiple-layer drum, for deterioration at the cross-over zones and interference between wraps due to fleet angle defects, not sections of rope which only work in sheaves (Tables 1 and 2 note c). Outer wires broken at the core: outer wires broken where they touch the core, seen as a wire or loop sticking out (6.5.2.2 c)). Ø at this spot: D1 and D2 measured where the breaks are, so the diameter and the breaks at the same spot are judged together (CRS practice). Broken-wire limits: page 1.

	Check	✓ / X / N/A	If X: where and what		Check	✓ / X / N/A	If X: where and what
4. Rope condition				5.2	End fittings severely corroded, cracked, bent or worn	✓	
4.1	Grouped breaks in one or two neighbouring strands (sections that do not spool on and off the drum)	✓		5.3	Wedge sockets installed as the manufacturer specifies, using one of the Figure 2 methods	✓	
4.2	Strand or wire extrusion	✓		5.4	Wedge socket dead end (Figure 2 method a)): tail; rope at the dead-end exit	✓	
4.3	Kinks or tightened loops	✓		5.5	Hand-spliced end termination	N/A	
4.4	Crushing	✓		5.6	Wire rope clips	N/A	
4.5	Birdcaging	✓		5.7	Eye splices mechanical with a thimble; swaged fittings as the maker recommends	N/A	
4.6	Bends or other distortion (unstranding, strand displacement, core protrusion)	✓		5.8	Swivel	N/A	
4.7	Local increase in diameter	✓		5.9	Complete wraps left on the drum (hook at lowest working position; boom hoist at minimum boom angle)	✓	
4.8	Broken or cut strands	✓		5.10	Drum flanges above the top layer	✓	
4.9	Heat damage or electric arcing	✓		5.11	Drum end of the rope attached as the crane maker specifies	✓	
4.10	Contact with high-voltage lines, including through rigging and loads	✓		5.12	Rope spools evenly	✓	
4.11	Internal or external corrosion	✓		5.13	Flange, crossover and repetitive pickup points	✓	
4.12	Exposure to ambient temperatures above 82 °C (180 °F) or below -40 °C (-40 °F)	✓		5.14	Load block, hook, rings, shackles, chains and slings	✓	
4.13	Lubrication condition, including sections over sheaves	X	30-40 m from drum end: dry; lubricated				
4.14	Rope test done (non-destructive or other): date, by whom, crane hours, result	N/A					
5. Rope ends and drum and block							
5.1	Severely corroded or broken wires at end connections	✓					

6. Sheaves: one line per sheave (groove gauges: page 10; groove limits: page 1)

	Sheave (which one)	Groove Ø (mm) or gauge OK / not OK (6.5.4.2 a))	Groove wear: general or uneven wear, grooving, flat spots (6.5.4.1); negative impressions (CRS practice): ✓ / X	Flange: chips or damage (6.5.4.2 b)); broken, deformed or cracked (6.5.4.4); rope kept in the groove (4.12 b)): ✓ / X	Bearing: free-wheeling, no excessive play (6.5.4.2 c)): ✓ / X	If X: where and what
6.1	Jib head	30.25	✓	✓	✓	
6.2	Trolley 1	29.75	✓	✓	✓	At limit: plan to replace (CRS)
6.3	Trolley 2	30.50	✓	✓	✓	
6.4	Block 1	30.00	✓	✓	✓	
6.5	Block 2	30.25	✓	✓	✓	

Decision: out now / end of shift; repairs (6.5.2.1)
Stays in service; dry section lubricated

Next periodic (at least monthly) and next annual due
2026-05-03 / annual 2027-04-03

Competent person: name and signature
J. Smith

Date
2026-04-03

Reading this example: Worst spot 120 m from the drum end: 3 breaks in 6d (limit 9) and 6 in 30d (limit 18), so the rope passes the broken-wire limits. Tower crane: the trolley distance and hook height are written at every inspection instead of a boom angle. This was the annual inspection (type A).

Reading this example: The manufacturer's groove limit in this example is 29.75 mm (made up: use the figure from your manual, 6.5.4.2 a)). Trolley 1 reads 29.75 mm: at the limit, so it still passes. A worn groove may be restored only if the sheave manufacturer approves (6.5.4.3); otherwise plan to replace it (Crane Rope Solutions practice).



Words used on these forms

From CSA Z248:17

Term	Clause	What it means
Competent person	3	Knowledgeable and qualified, from training and/or significant practical experience, in the area of tower crane they are responsible for; familiar with the standards and safety regulations, and able to detect errors, dangers and hazards.
Designated person	3	A person selected or assigned by the employer, or the employer's representative, as competent to do specific duties.
Rope	3	Wire rope, unless otherwise specified.
Rotation-resistant rope	3	Wire rope with an inner layer of strands laid one way, covered by a layer laid the opposite way, which counteracts torque and reduces the tendency to rotate.
Guy rope	3	A fixed-length supporting rope that keeps a set distance between two attachment points. Also called stay rope, standing rope or pendant.
Sheave	3	A wheel or pulley with a groove designed for a particular size of wire rope, used to change the direction of a running rope.
Pitch diameter	3	The diameter of a sheave or rope drum measured at the centreline of the rope.
Drum	3	The cylinder that rope is wound around to lift or lower a load.
Crossover point	3	Where one layer of rope on a drum crosses over the previous layer.
Flange point	3	Where the rope touches the drum flange as it changes layers.
d	Table 1, footnote e	Nominal rope diameter.
Load-bearing wires	Tables 1 and 2, footnote a	Filler wires are not load-bearing wires and are not counted in the total wires in the outer strands.
Broken wire	Tables 1 and 2, footnote b	A broken wire has two ends; count it as one wire break.
Owner's / operator's crane log	6.2.1	The owner's log holds the machine's history up to, not including, erection at this site; the operator's log holds its history at this site.

All inspections shall be carried out by a designated person. A competent person shall examine any identified rope deficiencies and determine whether they are cause for immediate rope removal (6.5.1.1).

Words this form uses (Crane Rope Solutions)

D1 and D2	Two diameter readings at the same point, at right angles to each other. The form uses their average.
Negative impressions	The pattern of the rope's strands pressed or worn into the groove surface of a sheave or drum.
Measured at	A point you can find again, written as the distance from the drum end or the dead end.
Winch number	The number or name of the winch this rope is on.
Winch duty	What the winch does: main hoist, auxiliary hoist, boom hoist, trolley.
OEM specified breaking force	The breaking force the crane manual asks for. Not the figure on the mill certificate.
Minimum breaking force (mill cert)	The figure on the rope's mill certificate.
Drum end / dead end	The drum end is where the rope is fixed to the drum. On this form the dead end means the other end of the rope and its end fitting (button, wedge socket, spelter socket).

