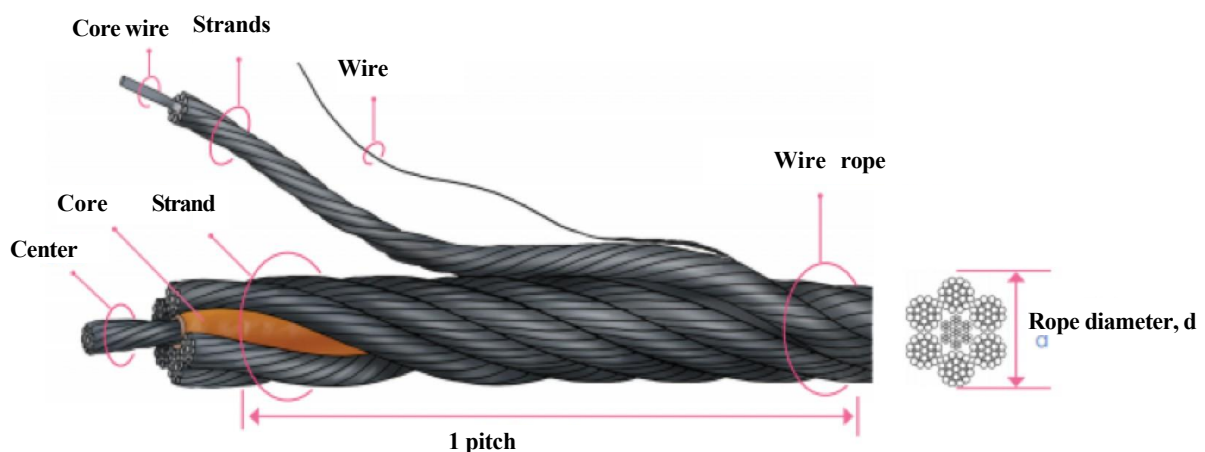


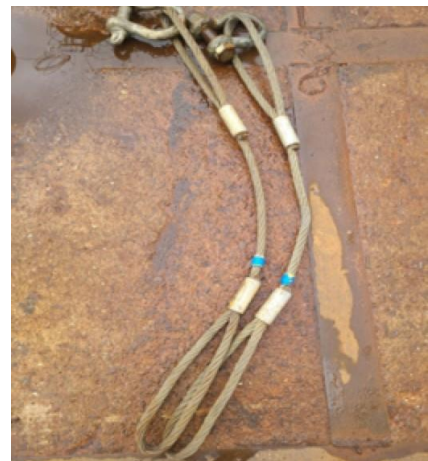


What is the use and determination to dispose of wire rope?

When multiple damages occur on one wire rope, it is not simple to determine whether to discard it by judging its strength decline. This is because there are cases where each item of the disposal standard is not met, but when considered as a whole, it must be discarded. When determining continued use or disposal based on general practice or experience, caution must be exercised as severe consequences such as amputation during use may result.



● How to use wire rope



Standards for Disposing of Wire Rope

● Occupational Safety and Health Act (Article 166 of the Rules on Occupational Safety and Health Standards)

- ✓ Seamed wire rope
- ✓ The number of broken wires in one strand of wire rope is more than 10% (for non-rotating rope, the number of broken wires is 4 or more within 6 times the nominal diameter of the wire rope or 8 or more within 30 times the nominal diameter).
- ✓ Reduction in diameter exceeds 7 percent of the nominal diameter.
- ✓ Twisted wire rope
- ✓ Severely deformed or corroded
- ✓ Damaged by heat or electric shock

● International standard

(ISO 8792-1986(E) Wire rope slings-Safety criteria and inspection procedures for use)

- ✓ Randomly broken in excess of 5% of the number of rope wires within a range of 6 times the rope diameter
- ✓ The number of locally broken wires is three or more.
- ✓ The diameter is less than 90 percent of the nominal diameter.
- ✓ Significant deformation such as kinks, dents, central collapse, or knots
- ✓ Damaged with cracks, severe compression, or distortion to the terminal, mold, or splice
- ✓ The splice or mold has come off.
- ✓ The wire is broken near or at the mold or splice.
- ✓ Wires are broken on the outer surface of the eye.



Standards for Disposing of Wire Rope

Guide to the Use and
Determination to
Dispose of Wire Rope



● KOSHA Guide (G-133-2020 Technical Guidelines for the Use and Inspection of Wire-rope Slings, etc.)

- Rope**
- ✓ Over 10% of the wires in the outermost strand were broken during one twist, or over 20% of the ropes were broken during five twists.
 - ✓ Due to wear, the current diameter has decreased by more than 7% of the nominal diameter.
 - ✓ Due to corrosion, pitting occurs on the surface of the wire, giving it a pockmark shape or the wire is loose due to internal corrosion.
 - ✓ Defects such as twisting, significant flattening, bending, and blocky shapes occurred due to distortion.
 - ✓ Tamper color or melt damage is recognized.
 - ✓ Cracks, deformations, rope misalignment, or significant grooves are identified.

- Attached metal fittings**
- ✓ Deformations such as bending, twisting, and crushing were recognized.
 - ✓ Significant butt-welding blemishes, notches, or cracks are recognized
 - ✓ Worn beyond 10% of original dimensions
 - ✓ Corrosion is recognized as a whole, or significant corrosion developed locally.



Review of the Standards for Disposing of Wire Rope (Example)

If 6×24 , $\Phi 20$ mm, 8 pieces of wire are cut within 1 pitch, and the diameter of the worn part is 19mm, consider discarding it.

Solution Applied with the Occupational Safety and Health Act

- 1) Review whether the number of broken wires in a strand is more than 10%

Wire with cuts within 1 pitch: 8 pieces

$24 \text{ pieces} \times 10\% = 2.4 \text{ pieces} \Rightarrow$ Discard when cutting more than 2.4 pieces

$\therefore$ The wire rope must be disposed of as 8 pieces, more than 2.4 pieces, have been cut (A).

- 2) Review whether the current diameter has decreased by more than 7 percent of the nominal diameter.

Diameter of worn areas: : 19mm

Nominal diameter: 20mm $\Rightarrow$ Reduction in the diameter
 $= 20\text{mm} - 19\text{mm} = 1\text{mm}$

$20\text{mm} \times 7\% = 1.4\text{mm} \Rightarrow$ Discard when the diameter decreases
by more than 1.4 mm

$\therefore$ The reduction in diameter of the wire rope (1 mm) is less than 1.4 mm, so it does not need to be discarded (B)

- 3) Conclusion:

The wire rope must be discarded because either (A) or (B) meets the disposal standard.

Major Hazards

✓ Risk of suspended cargo falling when the rope breaks

Suspended cargo may fall if:

- The rope breaks due to dynamic load, impact load, etc., when carrying cargo while ignoring the safety factor;
- The rope breaks while carrying a load heavier than the standard due to incorrect application of the safety factor;
- The rope breaks when the cargo is hung on the rope to be disposed of and transported without pre-work inspection;
- The rope breaks when it needs to be disposed of, but it is still used due to a lack of knowledge and experience regarding the use and disposal of ropes;

Safety measures

✓ Prevent the rope from breaking.

- Check the safety factor and damage of the rope and use it only if appropriate.
- Check the breaking load and the safety factor. Find the rope's maximum bearable load, then apply it only to cargo below the maximum value.
 - $\text{Maximum load} \leq \text{Breaking load} \div \text{Safety factor}$
 - * Safety factor: 10 or more for vehicles with workers on board, 5 or more for directly supporting cargo, and 4 or more for other cases.
- Designate a manager responsible for using and disposing of ropes and develop his/her capabilities through training.
- Establish and implement disposal standards for simultaneous and multiple damages.

✓ Replace the rope.

- Replace wire ropes if damaged or worn according to the disposal standards.
- Observe the safe use standards.

Risk assessment table (checklist method applied)

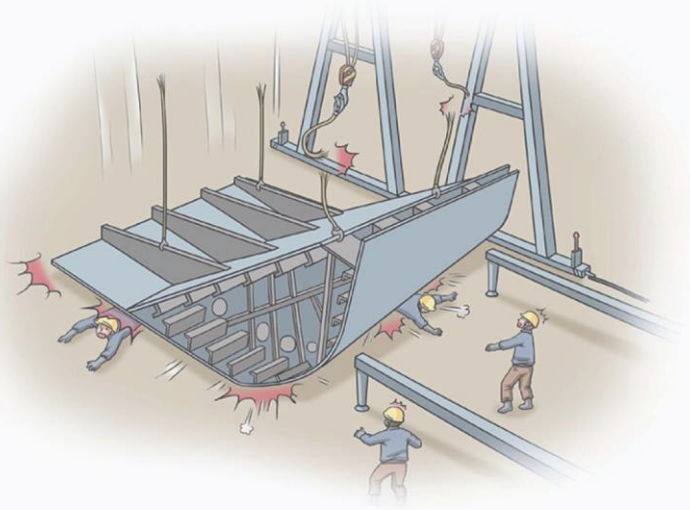
Rigging with wire rope (examples)

Identify harms/hazards (checklist)	Results			Improvement measures	Relevant codes
	Appropriate	Action required	N/A		
Is there any external strength reduction in the wire rope, such as corrosion, kink, or wire breakage?				Inspect before work and determine whether to use or dispose of damaged rope according to the disposal standards.	Article 166 of the Rules on Occupational Safety and Health Standards (Article 63-1 (1))
Has it been confirmed that the oil on the wire rope's outer surface and inner core has not dried?					
Considering any visible damage, has it been determined to use or dispose of the rope?					
Is the maximum bearable load of the rope determined and observed according to the safety factor and breaking load?				Apply the rope only to cargo below its maximum load, for which the safety factor for each work situation is considered.	Article 163 of the Rules on Occupational Safety and Health Standards
When carrying heavy objects, is there any risk of impact load due to collision with surrounding obstacles?				Determine the transport route for heavy objects to avoid colliding with obstacles.	Articles 38-1 (11), 39, 40 of the Rules on Occupational Safety and Health Standards
Is any excessive dynamic load added to the rope by abruptly lifting heavy objects?				When lifting heavy objects, work slowly to avoid shaking.	
Will the rope be damaged by coming into contact with cargo or structures?				Prevent heavy objects from coming into direct contact with cargo or structures.	
Is the wire rope severely bent when it touches the edge of the load?				Install protectors at the corners to prevent the wire rope from directly contacting the corners.	
Is there any unbalanced load because the center of gravity of heavy objects is not considered?				When rigging, consider the center of gravity of heavy objects and avoid unbalanced loads.	
Is rigging carried out by designated personnel only?				The designated work leader shall direct the work procedure according to the work plan for handling heavy objects.	
Are any workers working or accessing hazardous areas, such as under or close to the heavy objects being lifted?				The designated work leader shall direct the work procedure according to the work plan for handling heavy objects.	Article 20 of the Rules on Occupational Safety and Health Standards

* Article 35-2 (Pre-work Inspection by Management Supervisors), Article 38-1 (11) (Work Plan for Handling Heavy Objects), and Article 37 (Work Leader) of the Rules on Occupational Safety and Health Standards apply to all hazards.

Outline

While a block (weighing approximately 106 tons) was being lifted and fixed to a trestle within a block manufacturing company, the crane's auxiliary wire rope broke, causing the block to fall, killing two workers who were checking the joint position.



Cause of the accident

■ Use of wire rope with insufficient strength

- A wire rope with a safety factor of 5 or more must be used when lifting heavy objects such as ship blocks. However, in this case, a wire rope with insufficient strength, with a safety factor of approximately 1.5, was used and consequently broke.

■ Failure to prepare work plans for handling heavy objects

Preventive measures

■ Use wire rope with sufficient strength.

- When directly supporting heavy objects during rigging, a safety factor of 5 or more must be applied; use wire rope with a breaking load at least 5 times the weight of the heavy objects.

■ Prepare and comply with a work plan for handling heavy objects.

- When handling heavy objects, prepare a work plan regarding safety measures to prevent risks such as falling and tipping and ensure relevant workers understand the work plan. The work plan should include the type and shape of heavy objects, handling methods and procedures, and the dimensions and structural conditions of the work area.