

# Hoist Classification **EN 14492** **ISO 4301**

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# New cycle based hoist classification

EN 14492 and ISO 4301

## What is the difference and how does it work?

→ Instead of stating the **lifetime and the lifting speed**, the number of foreseen **lifting cycles** and the average **hook path** are given:

**Number of full load cycles** the hoist is designed and tested for: shown by A-classes, which are connected to cycle classes U ( $1.6 \times 10^4$  –  $8.0 \times 10^6$ ).

**Average load displacement** in each cycle (hook path up+down): shown by Dh classes which are connected to the hookpath in (0,63 m – 320 m).

→ The system is also applicable for trolley movements, then instead of the Dh classes the Dt class (traversing displacement) is used.

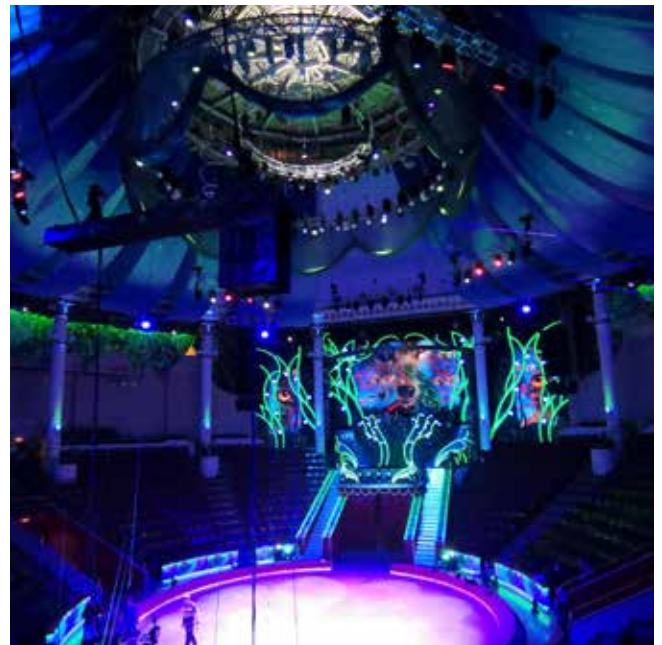
# Application range examples



- Very short hookpath.
- Very high cycle number.



- Normal hookpath.
- Medium cycle number.



- Extreme hookpath.
- Very low cycle number.

# Cycle based hoist classification

Example of two technical similar hoists, classified according to old Iso/FEM and new cycle based standards.



## Time based example

- M5 / 2m hoist.
- Lifetime 1.600 hours.
- Lifting speed 4/1 m/min (ED 40/20%, average speed over lifetime: 3 m/min).
- Lifting path during lifetime:  
 $1.600 \text{ h} \times 3 \text{ m/min} \times 60 \text{ min/h} = \mathbf{288 \text{ km}}$ .



## Cycle based example 1

- A5 hoist, Dh 2.
- 125,000 cycles.
- Hookpath per cycle 2.5 m (1.25 + 1.25).
- Lifting speed: not relevant here.
- Lifting path during lifetime:  
 $125,000 \text{ cycles} \times 2.5 \text{ m} = \mathbf{312.5 \text{ km}}$ .



## Cycle based example 2

- A4 hoist, Dh 3.
- 63,000 cycles.
- Hookpath per cycle 5 m (2.5 + 2.5).
- Lifting speed: not relevant here.
- Lifting path during lifetime:  
 $63,000 \text{ cycles} \times 5 \text{ m} = \mathbf{315 \text{ km}}$ .



The complete load displacement is similar in this case, but the cycle numbers can vary significantly.

# Changed standards: EN + ISO

**DIN EN 14492-2:2019-09**  
**EN 14492-2:2019 (E)**

→ Note: also ISO rules changed to the cycle based classification.

## Annex B (normative)

### General hoist class

A hoist represents a special case where the stress variations in load carrying members depend upon the hoist load variations, without load effect variations e.g. due to dead weights of moving parts. The number of stress cycles is directly proportional to the number of load cycles and the stress ranges are directly proportional to the hoist load variations. Therefore the Q- and U-classes of EN 13001-1 can be combined into a single class describing the fatigue effect of hoisted loads on the hoist; see table B.1. However, the S-class of detailed components of hoist can be derived directly from the hoist class only for stationary parts of the hoist.

**Table B.1 - Specification of A-classes for hoists**

Classes Q and load spectrum factor, EN 13001-1		Classes U and design number of work cycles, EN 13001-1									
Class Q	Design value of load	U <sub>0</sub>	U <sub>1</sub>	U <sub>2</sub>	U <sub>3</sub>	U <sub>4</sub>	U <sub>5</sub>	U <sub>6</sub>	U <sub>7</sub>	U <sub>8</sub>	U <sub>9</sub>
	Spectrum factor k <sub>Q</sub>	1.6 x 10 <sup>4</sup>	3.15 x 10 <sup>4</sup>	6.3 x 10 <sup>4</sup>	1.25 x 10 <sup>5</sup>	2.5 x 10 <sup>5</sup>	5.0 x 10 <sup>5</sup>	1.0 x 10 <sup>6</sup>	2.0 x 10 <sup>6</sup>	4.0 x 10 <sup>6</sup>	8.0 x 10 <sup>6</sup>
Q0	0.031 3	A03	A02	A01	A0	A1	A2	A3	A4	A5	A6
Q1	0.062 5	A02	A01	A0	A1	A2	A3	A4	A5	A6	A7
Q2	0.125 0	A01	A0	A1	A2	A3	A4	A5	A6	A7	A8
Q3	0.250 0	A0	A1	A2	A3	A4	A5	A6	A7	A8	A9
Q4	0.500 0	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10
Q5	1.000 0	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11

**ISO 4301-1:2016 (E)**

**Table 4 - Classes A for group classification**

Classes Q <sub>p</sub> and load spectrum factor K <sub>p</sub>		Classes U and total number of work cycles									
Class Q <sub>p</sub>	Design value of load	U <sub>0</sub>	U <sub>1</sub>	U <sub>2</sub>	U <sub>3</sub>	U <sub>4</sub>	U <sub>5</sub>	U <sub>6</sub>	U <sub>7</sub>	U <sub>8</sub>	U <sub>9</sub>
	Spectrum factor K <sub>p</sub>	1.6 x 10 <sup>4</sup>	3.15 x 10 <sup>4</sup>	6.3 x 10 <sup>4</sup>	1.25 x 10 <sup>5</sup>	2.5 x 10 <sup>5</sup>	5.0 x 10 <sup>5</sup>	1.0 x 10 <sup>6</sup>	2.0 x 10 <sup>6</sup>	4.0 x 10 <sup>6</sup>	8.0 x 10 <sup>6</sup>
Q <sub>p</sub> 0	0.031 3	A03	A02	A01	A0	A1	A2	A3	A4	A5	A6
Q <sub>p</sub> 1	0.062 5	A02	A01	A0	A1	A2	A3	A4	A5	A6	A7
Q <sub>p</sub> 2	0.125 0	A01	A0	A1	A2	A3	A4	A5	A6	A7	A8
Q <sub>p</sub> 3	0.250 0	A0	A1	A2	A3	A4	A5	A6	A7	A8	A9
Q <sub>p</sub> 4	0.500 0	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10
Q <sub>p</sub> 5	1.000 0	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11

# Hook path classes

**DIN EN 14492-2:2019-09  
EN 14492-2:2019 (E)**

→ Note: also ISO rules changed to the cycle based classification.

**Table B.4 - Symbols for classes of average hoisting displacements and design values**

Désignation of class	Range of average hoisting displacement $h_a$ [m]	Design value of average hoisting displacement [m]
Dh 0	$h_a \leq 0.63$	0.63
Dh 1	$0.63 < h_a \leq 1.25$	1.25
Dh 2	$1.25 < h_a \leq 2.5$	2.5
Dh 3	$2.5 < h_a \leq 5$	5
Dh 4	$5 < h_a \leq 10$	10
Dh 5	$10 < h_a \leq 20$	20
Dh 6	$20 < h_a \leq 40$	40
Dh 7	$40 < h_a \leq 80$	80
Dh 8	$80 < h_a \leq 160$	160
Dh 9	$160 < h_a \leq 320$	320

→ E.G. DH3: 5 m displacement in 1 cycle : 2.5 m up + 2.5 m down.

# Why cycle based hoist classification?

## Disadvantages of time based classification

### → Utilization

- Time based hoist classification is fitting only to “normal / standard” usage conditions.
- Time based hoist classification can lead to unsuitable hoist selections.
- Time based hoist classification can lead to fatigue failures, even if there is still enough remaining gearbox lifetime.

### → Product design

- Time based classification is mostly considering the gearbox lifetime, but not the fatigue lifetime that is affected by the cycle numbers.
- Some fatigue related parts are considered in relation to the M class (hooks, ropes, sheaves, chains), but there is no clear connection to the cycle numbers.
- The time based test procedure according to the old standard, can be done with quite large hook pathes, that leads to a low number of cycles during the test.
- A High lifting speed in combination with a lower M classes can lead to a long usage time (many cycles), while the fatigue related parts are selected quite light.

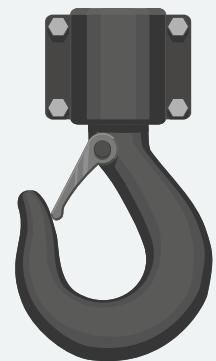
# Comparison cycle numbers slow and fast hoist

Time based classification

→ **Assumption :** two hoists that are used with 5 m hook path in each lift, same capacity, different speeds.

- V4, M5 (1,600 h).

- **76,800 cycles**  
during hoist life.



- V12, M4 (800 h).

- **115,200 cycles**  
during hoist life.



Hook and chain/rope selection according to the M-class.

→ **Result:** the hoist with the higher cycle number does get the smaller components. **This does not make any sense!**

# Hook selection table time based

## DIN 15400

### Lifting capacity

Table 3 specifies the drive group as a function of hook strength class, and the lifting capacity as a function of hook number. It does not make specifications for hooks whose lifting capacity is under 100 kg or over 500,000 kg. Where such hooks are to be used in exceptional cases, the lifting capacity shall be selected in accordance with the R10 series of preferred numbers specified in DIN 323 Part 1.

Table 3 - Lifting capacity

Strength class	Drive group									Strength class	
<b>M</b>	Hooks used in a drive group lower than 1B <sub>m</sub> are not included here			1B <sub>m</sub>	1A <sub>m</sub>	2 <sub>m</sub>	3 <sub>m</sub>	4 <sub>m</sub>	5 <sub>m</sub>	<b>M</b>	
<b>P</b>				1B <sub>m</sub>	1A <sub>m</sub>	2 <sub>m</sub>	3 <sub>m</sub>	4 <sub>m</sub>	5 <sub>m</sub>	–	<b>P</b>
<b>S</b>				1B <sub>m</sub>	1A <sub>m</sub>	2 <sub>m</sub>	3 <sub>m</sub>	4 <sub>m</sub>	5 <sub>m</sub>	–	<b>S</b>
<b>T</b>				1B <sub>m</sub>	1A <sub>m</sub>	2 <sub>m</sub>	3 <sub>m</sub>	4 <sub>m</sub>	–	–	<b>T</b>
<b>V</b>				1B <sub>m</sub>	1A <sub>m</sub>	2 <sub>m</sub>	3 <sub>m</sub>	4 <sub>m</sub>	–	–	<b>V</b>

Hook number	Lifting capacity in kg										Hook number
<b>006</b>	320	250	200	160	125	100	–	–	–	–	<b>006</b>
<b>010</b>	500	400	320	250	200	160	125	100	–	–	<b>010</b>
<b>012</b>	630	500	400	320	250	200	160	125	100	–	<b>012</b>
<b>020</b>	1,000	800	630	500	400	320	250	200	160	125	<b>020</b>
<b>025</b>	1,250	1,000	800	630	500	400	320	250	200	160	<b>025</b>
<b>04</b>	2,000	1,600	1,250	1,000	800	630	500	400	320	250	<b>04</b>
<b>05</b>	2,500	2,000	1,600	1,250	1,000	800	630	500	400	320	<b>05</b>
<b>08</b>	4,000	3,200	2,500	2,000	1,600	1,250	1,000	800	630	500	<b>08</b>
<b>1</b>	5,000	4,000	3,200	2,500	2,000	1,600	1,250	1,000	800	630	<b>1</b>
<b>1.6</b>	8,000	6,300	5,000	4,000	3,200	2,500	2,000	1,600	1,250	1,000	<b>1.6</b>
<b>2.5</b>	12,500	10,000	8,000	6,300	5,000	4,000	3,200	2,500	2,000	1,600	<b>2.5</b>

- High time classification: larger Hook but no connection to the cycle numbers that can occur.
- High cycle numbers can lead to fatigue failures.
- Same principle was used for ropes, chains and the rest of the hoist structure.

# Test procedure according to **old EN14492/old FEM**

## Time based classification

- Example chain hoist: lifetime 1600 h, (288 km lifting path),  
lifting speed 4/1 m/min, reeving 1/1.  
Max allowed hookpath in the lifetime test according to the  
time based hoist testing procedure: 4 m.



### Required cycle number in lifetime test

- $288,000 \text{ m} / (2 \times 4 \text{ m}) = 36,000$  cycles.
- The load must be lifted from the ground with every **4<sup>th</sup> cycle**: the load is lifted from the ground only **9,000 times** during the whole lifecycle test.

Max. load path during lifetime test per start on EN14492 (annex G 3.3.3)

1/1	2/1	Chain 1/1	Rope 1/1	Chain 2/1	Rope 2/1
$V \leq 12.5$	$V \leq 6.25$	4	6	2	3
$V > 12.5$	$V > 6.25$	6	10	3	5

# Test procedure according to **EN14492**

## Cycle based classification

→ Example chain hoist: classification A5 (125,000 cycles)  
Dh2 (2.5m), 312.5 km lifting path), lifting speed 4/1 m/min,  
reeving 1/1.  
Max allowed hookpath in the lifetime test according to the  
classification 1.25m.



**Required cycle  
number in lifetime  
test: 125,000**

- The load lifted from the ground with **every cycle**: the load is lifted from the ground **125.000 times** during the whole lifecycle test.

# Improvements of cycle based testing **and consequences for the design**

- The cycle based classification test, does typically lead to a significantly higher number of motor and brake switchings during the test.

→ This means it must be considered in the design

- It makes sure, that the testing of the hoist is really done with the number of fatigue cycles that can occur in real usage and according to the classification.

→ The fatigue cycles need to be considered in the design accordingly

# Comparison examples from EN 14492

## DIN EN 14492-2:2019-09 EN 14492-2:2019 (E)

Table C.3 - Hoist classification in examples. Comparison of classification for different applications

FEM/ISO classification			
FEM	2m		
ISO	M5		
Hoisting speed [m/min]	12		
Lifetime full load [h]	1,600		
Hoisting displacement during lifetime [m]	1,152,000		
A-Class classification			
Application example	Assembly process with high frequency and very short hook path	Workshop hoist with medium frequency and medium hook patch	Maintenance hoist e.g. for wind turbine with extreme hook path
Selected Dh-class	1	4	7
Average hoisting displacement according to Dh-class [m]	0.53 - 1.25	5-10	80-160
Average hoisting displacement in example [m]	1.25	10	160
Max. number of cycles of 2m/M5 hoist for this Dh-class	921,600	115,200	7,200
Suggested A-Class with similar number of cycles	A8	A5	A1
Cycles of A-class	1,000,000	125,000	8,000
Max. hoisting displacement during life time [m]	1,250,000	1,250,000	1,280,000

→ For a given FEM/ISO classification the possible number of lifting cycles during the life time depends on the hoisting speed. Different from this the A-classification, based on EN 13001-1 classification shows directly the lifting cycles independant from the hoisting speed.

Table C.4 - Hoist classification in examples. Comparison of classification for different hoisting speeds

A-Class classification			
A-Class	A5		
Cycles of A-Class	125,000		
Selected Dh-Class	3		
Average hoisting displacement according to Dh-class [m]	5		
Hoisting displacement during lifetime [m]	625,000		
FEM/ISO classification			
Example for FEM/ISO	1Am/M4	2m/M5	3m/M6
Lifetime full load [h]	800	1,600	3,200
Hoisting speed [m/min]	12	6	3
Hoisting displacement during lifetime [m]	576,000	576,000	576,000

# Extreme comparison example

→ New technical aspects

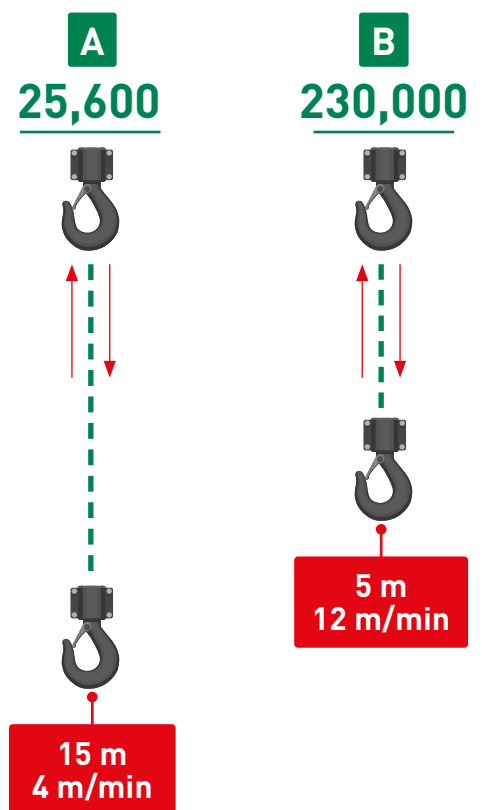
→ New CEN hook standard

## Hook sizing in DIN15400 vs hook fatigue in reality

- Hook is selected by the mechanism class, e.g. M5.
- This class determines the operating time, e.g.  $T = 3,200$  h.
- Case A and B have the same operating time of hoist motion: the same M-class, the same hook size.
- Hook fatigue is - however - related to number of lifts :  
A = 25,600 versus B = 230,000!?

Work cycle for both cases:  
M5:  $T = 3,200$  hours

Numbers of lifts:



Classification of mechanism: FEM, DIN, ISO

Total duration of use T (hours)	Classification of mechanism: FEM, DIN, ISO										
	T ≤ 200	200 < T ≤ 400	400 < T ≤ 800	800 < T ≤ 1,600	1,600 < T ≤ 3,200	3,200 < T ≤ 6,300	6,300 < T ≤ 12,500	12,500 < T ≤ 25,000	25,000 < T ≤ 50,000	50,000 < T	
<b>L1</b>	M1	M1	M1	M2	M3	M4	M5	M6	M7	M8	
<b>L2</b>	M1	M1	M2	M3	M4	M5	M6	M7	M8	M8	
<b>L3</b>	M1	M2	M3	M4	M5	M6	M7	M8	M8	M8	
<b>L4</b>	M2	M3	M4	M5	M6	M7	M8	M8	M8	M8	

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