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Optimum breaking capacity for your success

The application areas of a Kleemann impact crusher range from conventional natural stone processing through the recycling of construction waste on to mining applications. The focus is thereby primarily on two objectives: increasing the blow bar service life and reducing the operating costs. The economical operation is not only ensured by the blow bar purchase price but mainly by choosing the right blow bar for a particular application. Only this way can the impact crusher deliver optimum results.
The wear during the crushing process depends on numerous factors with interactions that are often difficult to analyse. These include:

■ Selection of the crushing parameters
■ Material the blow bar is made of (strength)
■ Shape

The way the crusher is loaded and the amount of material in the crusher also influence the blow bar service life.

Kleemann offers blow bars of suitable material for each application. Because the quality of the wear-resistant casting makes a primary contribution to the service life, Kleemann only works together with renowned foundries that adhere to Kleemann’s strict manufacturing standards, such as testing the quality of castings and controlling the dimensional accuracy. The foundries ensure compliance with the requisite tolerances through state-of-the-art manufacturing processes.

Selecting the right blow bar for the material being broken up, foreign objects and the task size ensures that the impact crusher provides the required service performance and cost-efficient breakage.

This brochure will inform you about the different blow bars and give you guidance on maintenance and timely replacement. Use the guidelines to find the right blow bar for your application.
Altogether, in addition to its shape, the blow bar benefits from the respective components.

- The impact edge, pointed in the rotor’s rotational direction, is chamfered to maintain the impact edge longer, thus providing for better crushing over a lengthy period.
- The holes on the side ensure easy and quick handling when turning or exchanging a blow bar.
- The lug mounted on the back provides for the ideal transfer of the centrifugal forces to the rotor (only with C-shape).
- The clamping wedges affix the blow bars and thus ensure the proper position on the contact areas of the rotor. The modified clamping surface provides exact fit along the entire length, with a reduced danger of breakage.
Kleemann impact crushers are equipped with different rotors depending on the size of the crusher and the application. The number of built-in blow bars primarily depends on the crushing chamber geometry and its associated intake behaviour.

For smaller crushing chamber geometries (inlet width of under 1,100 mm with rotor diameter under 1,100 mm), rotors with two or three blow bars are used. Larger crushing chamber geometries (over 1,200 mm with larger rotor diameter over 1,200 mm) are equipped with rotors featuring four blow bars to increase the operational spectrum. In the majority of applications, these rotors are operated with two high blow bars and two low blow bars.
Depending on the model series of the machines, different blow bar shapes are used. Kleemann offers three different shapes: X-shape, S-shape and C-shape.

The **X-shape** blow bars are fitted in the MR 100, MR 122 and MR 150. They are pushed into the rotor from the side and affixed horizontally by this. In contrast to the other systems, the blow bars rest loosely in the rotor. The use of highly wear-resistant blow bars, e.g. chrome or chrome with ceramic, is not recommended for these mounting variants due to the increased risk of breakage.

With the **S-shape** blow bars, which are installed in the MR 130 V3, a newly developed clamping system is utilised. The blow bars are connected to the rotor with clamping wedges without any play, which reduces the risk of breakage for wear-resistant blow bars, e.g. chrome or chrome with ceramic. In contrast to the X-shaped blow bars, the blow bars can be mounted and dismantled from above.
The shape was further developed for the EVO generation and is known as the **C-shape**.

The blow bar affixing to the rotor is handled here by means of the lug of the blow bar. These are made thicker at this place, so that the clamp cross-section is strengthened in the highly-stressed area. Moreover, due to the rigid mounting, the impact energy is optimally conveyed to the rotor, which further substantially reduces the risk of breakage with highly wear-resistant chrome blow bars.

**Summary:** The material from which the blow bars are cast could be identical for all shapes, but this is not always recommended practice, however. Based on the different shapes and attachment systems, different areas of application arise.
In practise, different materials for manufacturing blow bars have established themselves. These include manganese steels, steels with martensitic structure (referred to in the following as “martensitic steels”), chrome steels and the Metal Matrix Composites (MMC, e.g. ceramic), in which the various steels are combined with a special type of ceramic.
A combination of the composite materials

An increase in the steel’s wear resistance (hardness) is usually accompanied by a reduction in toughness (impact resistance) of the material.

1 Manganese steel
2 Martensitic steel
3 Chrome steel
4 Martensitic steel with ceramic
Manganese steel
The wear resistance of manganese steel with austenitic structure is attributable to the phenomenon of work hardening. The impact and pressure load results in a hardening of the austenitic structure on the surface.
The initial hardness of manganese steel is approx. 200 HV (20 HRC, hardness test according to Rockwell). The impact strength is approx. 250 J/cm².

After the work hardening, the initial hardness can thereby increase to an operational hardness of up to approx. 500 HV (50 HRC). The deeper-set, not yet hardened layers thereby provide for the great toughness of this steel. The depth and hardness of the work-hardened surfaces depend on the application and type of manganese steel. The hardened layer penetrates down to a depth of approx. 10 mm.

Manganese steel has a long history. Today, this steel is used mostly for crusher jaws, crushing cones and crushing shells. In the impact crusher, it is only recommended to use manganese blow bars when crushing less abrasive and very large feed material (e.g. limestone).

Martensitic steel
Martensite is a completely carbon-saturated type of iron that is made by quick cooling-off. It is only in the subsequent heat treatment that carbon is removed from the martensite, which improves the strength and wear properties. The hardness of this steel ranges between 44 to 57 HRC and the impact strength between 100 and 300 J/cm².
Thus, with regard to hardness and toughness, martensitic steels lie between manganese and chrome steel. They are used if the impact load is too little to harden the manganese steel, and/or good wear resistance is required along with good impact stress resistance.

**Chrome steel**

With chrome steel, the carbon is chemically bonded in the form of chromium carbide. The wear resistance of chrome steel is based on these hard carbides of the hard matrix, whereby the movement is hindered by offsets, which provides for a high degree of strength but at the same time less toughness. To prevent the material from becoming brittle, the blow bars must be heat-treated. It must thereby be observed that the temperature and annealing time parameters are exactly adhered to. Chrome steel typically has a hardness of 60 to 64 HRC and a very low impact strength of 10 J/cm². To prevent breakage of chrome steel blow bars, there may not be any unbreakable elements in the feed material.
METALLURGY OF THE BLOW BARS
METAL MATRIX COMPOSITES

1 Ceramic particles
2 Basic material (martensite or chrome steel)

Porous ceramics
Preform

Infiltration with metal

Metal Matrix Composites (MMC)
Metal Matrix Composites, ergo MMC, combine the high resistance of the metal matrix with extremely hard ceramics. Porous preforms made of ceramic particles are produced in the process. The metallic molten mass penetrates into the porous ceramic network. The experience and knowledge are particular to the casting process in which two different materials – steel with a thickness of 7.85 g/cm³ and ceramic with a thickness of 1-3 g/cm³ – are combined and there is a thorough infiltration.

This combination makes the blow bars especially wear-resistant but at the same time very impact-resistant. With blow bars made of composites from the field of ceramics, a service life that is three to five times as long as that of martensitic steel can be achieved.

The advantages of blow bars made of ceramic
- Very wear-resistant
- High impact resistance (depending on the base material)
- A higher service life than that of conventional steel, hence lower costs per tonne
WEAR OF BLOW BARS

The crusher tools are subject to more or less wear, depending on various influencing factors.

Dirt, incorrect installation or elements from different manufacturers that are not identical will degrade not only the productivity and/or crusher performance of the machine, but can also damage the rotor’s attachment systems. In extreme cases breakage can also occur, resulting in massive damage to the impact crusher.

The most common reasons for an unusually short service life of blow bars include the following:

- Caking of crushed material around the impact area of the blow bar
- Selecting the wrong blow bar for the material to be crushed (see usage recommendations, page 38 - 39)
- Machine parameter settings that are inappropriate for the application (e.g. rotor speed or crushing ratio)

What is wear?

Wear is produced by two elements pressing against each other with relative movement (e.g. between the blow bar and the crushing material). During this process small particles become detached from the surfaces of both elements.

The primary agent of wear in the crushing process is abrasion. There is also material fatigue, as the crusher tools are subjected to numerous pressure and impact stresses.
Stresses and deformations occur due to mechanical contact forces, which worsen the ensuing abrasion if the opposing object is substantially harder and rougher than the basic material or if individual hard particles (bound or unbound) are pressed into the opposing object.

**Increasing service life means**
- cleaning thoroughly each day,
- regularly inspecting the blow bars in order to act promptly, to counteract any wear or damage,
- performing regular checks and maintenance of the entire crusher housing,
- selecting the right blow bars for an application,
- adjusting all machine parameters to match the application (rotor speed, gap etc.).

**Correct installation of the blow bar**
- Inspect the degree of soiling and remove possible loosely clinging dirt on the rotor, blow bars and tensioning devices.
- Usage of appropriate tools and suitable lifting gear for the hoist, e.g. block and tackle.
- Only turn the rotor with the rotor turning device (where available). Do not remove the rotor safeguard.
WEAR OF BLOW BARS AND INFLUENCING FACTORS

When assessing the service life of a blow bar, further influencing factors must be taken into account in addition to the blow bar material. The figure shows examples of the main influencing factors and the respective blow bar wear.

Generally, the various influencing factors – which are mutually interactive – can be divided up into various categories.
Material-related factors
- Abrasiveness
- Breakability
- Grain size
- Grain shape
- Fine-particle proportion
- Moisture content
- Proportion of unbreakable elements

Machine-/process-related factors
- Crushing ratio
- Ratio of the upper to the lower impact toggle
- Rotor speed
- Type of loading
- Screening mesh of the prescreen
- Contamination in the crushing chamber

Application-/operation-related factors
- Continuity of feed
- Correct adjustment of machine parameters
- Replacement of wear parts in due time
- Selection of the right blow bars
WEAR OF BLOW BARS
FEED MATERIAL FACTOR

Clay
Coal
Iron ore
Basalt
Gabbro
Quartzite
Andesite
Gneiss
Porphyry
Diabase
Granite
Sandstone
Slate
Dolomite
Limestone
Natural rock
Recycling

Slag
Broken-up asphalt
Reinforced concrete
Non-reinforced concrete
Slate
Ceramic
Brick
Building rubble

ADVANTAGES | FACTS | APPLICATION
Feed material factor
The most important factor with regard to the blow bar wear is the composition of the material. The boundary between the economic and non-economic work areas fluctuates. Natural stone is subject to natural fluctuations and can also exhibit severe differences depending on the origin.

Summary: To prevent high costs due to wear, the material to be crushed must be sufficiently analysed.

The diagram serves as a guideline. The area shown in green marks the cost-effective, optimum use spectrum for impact crushers. The materials shown in yellow should be more exactly analysed by Kleemann. The materials in the red area generally cannot be cost-effectively processed with an impact crusher.
WEAR OF BLOW BARS
ROTOR SPEED FACTOR
Rotor speed factor
Tips on setting the rotational speed of the rotor:

- Start with the medium speeds
  (only for the EVO series)
- Monitor the material flow
- Monitor the grain size and fine-particle proportion in the final product
- Change the rotor speed in consideration of the material flow and final product quality

Increasing the rotor speed results in:

- generally, more wear of blow bars, impact toggles and abrasion plates,
- a tendency, to a higher fine-particle proportion,
- in some cases, to greater output.

<table>
<thead>
<tr>
<th>Rotor speed</th>
<th>Wear</th>
<th>Fines</th>
<th>Rate oversized gain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>↓</td>
<td>↓</td>
<td>↑</td>
</tr>
<tr>
<td>High</td>
<td>↑</td>
<td>↑</td>
<td>↓</td>
</tr>
</tbody>
</table>

↑ Tendency to high values
↓ Tendency to low values
Crushing ratio factor
The maximum crushing ratio as the ratio of the size of the feed particles (1) to the size of the discharged particles (2) essentially depends on the physical properties of the feed material. This results in the reference values seen here:

<table>
<thead>
<tr>
<th>Feed material</th>
<th>Theoretical crushing ratio, considering the maximum feed size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limestone, non-reinforced building rubble, asphalt</td>
<td>approx. 15 : 1</td>
</tr>
<tr>
<td>Steel reinforced concrete (depending on the quality of the concrete and iron content)</td>
<td>approx. 10 : 1 - 15 : 1</td>
</tr>
<tr>
<td>Medium-hard natural stone</td>
<td>approx. 18 : 1</td>
</tr>
</tbody>
</table>
**Crusher configuration factor**

Rotors with two or three blow bars are always equipped with high blow bars and are universal in use, particularly where materials are changed frequently. Rotors with four blow bars are usually operated with two high blow bars and two low blow bars so that the maximum feed size can be processed with the maximum crushing ratio. In cases where the feed size is under 250 mm, the rotor can be equipped for targeted crushing, e.g. down to an end product of up to 10 mm, with four high blow bars. If the rotor speed is also increased here, the crushing effect is enhanced even further.

Note that the wear on blow bars, the crusher abrasion lining and impact toggles increases considerably here. If the selected blow bars and rotor speed are not optimised for the feed material, excessive wear and reduced feed capacity will result due to the hampered intake of material.

<table>
<thead>
<tr>
<th>Blow bar configuration</th>
<th>4 x high</th>
<th>2 x high 2 x low</th>
<th>3x high (D' with 1100 mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feed size</td>
<td>less than 0 - 400 mm</td>
<td>larger than 0 - 400 mm</td>
<td>0 - 600 mm</td>
</tr>
</tbody>
</table>
**Wear of Blow Bars**  
**Splitting Ratio and Pre-screening Factors**

**Splitting ratio factor**  
In order to ensure the material flow and uniform filling of the crushing chamber, the ratio between the upper and lower crusher gap must be correctly selected. An incorrectly adjusted ratio will result in increased wear on the blow bars and the crusher tools:

- **Lower crusher gap:** 100% of the desired final grain size.
- **Upper crusher gap:** approx. 30% of the maximum feed size.

**Calculation example – determination of the splitting ratio**

*Values: specified grain size = 0 - 45 mm, feed size = 0 - 600 mm*

1) Crushing ratio test \((600 : 45 = 13.33)\)
2) Setting of the lower crusher gap = 45 mm
3) Upper crusher gap 30% of 600 = 180 mm
4) Fine-tuning of the gap to achieve the desired final particle size
5) Monitoring the oversize grain content: If it comprises more than 10 - 15% of the feed material, the crushing gaps should be reduced accordingly.

*Upper (1) and lower (2) crusher gap*
Factor of pre-screening – fine-particle proportion in the crusher

Depending on the properties of the feed material, active primary screening should be used to reduce the load on the crusher and to reduce wear. Because of the screening of the feed material, less sticky fine material and less soiled or cohesive material ends up in the crusher; this reduces wear.
EXAMPLES OF BLOW BAR WEAR

Condition:
Systematic wear on the side of the blow bar

Possible cause:
- Higher fine-particle proportion in the feed material
- Non-homogeneous feed material
- Contaminated crushing chamber: Due to the caking of material on the sides, the friction wear increases there.

Solution:
- Daily checking of the crushing chamber and cleaning if necessary
Condition:
Wear in the centre of the blow bar

Possible cause:
- Insufficient filling of the crushing chamber with an increased proportion of coarse, large feed material
- Non-homogeneous feed material

Solution:
- Continuous loading of the crusher
- Change the setting parameters on the feed chute
- Check excavator and the wheel loader
Condition:
Severe wear on one side of the blow bar

Possible cause:
- Increasing oversize particle return due to incorrectly set c.s.s. (closed gap width)
- Machine not positioned horizontally
- Material supply through the feed chute to low

Solution:
- Levelling of the system
- Continuous loading
- Set the appropriate c.s.s. to reduce the oversize grain content
Condition:  
Blow bar breakage

Possible cause:
- The blow bar is inappropriate for the application
- Unbreakable elements in the feed material
- Feed size too large
- Use of dimensionally non-compliant blow bars

Solution:
- Select blow bars appropriate for the application
- Use original Kleemann products
- Reduce feed size
The main source of wear experienced by the impact edge (1) is impact contact with the crushed material. The ceramic insert reduces the edge and friction wear on the top of the blow bar (2).

The honeycomb structure of the ceramic, which occurs automatically in the blow bar as a result of the casting process, is only visible after a number of operating hours.
If the ceramic insert is completely worn down, the wear is characteristically the same as for a blow bar without ceramic.

**Reference value**

Whether or not the ceramic blow bar provides the desired effect can only be judged if there are ceramic deposits on the carrier material as shown in the picture. If a difference is visible here, then the ceramic advantage is tangible.
MAINTENANCE AND REPLACEMENT OF THE BLOW BARS

1 Blow bar with heavy wear
2 Wear limit is 15 - 20 millimetres
The correct assessment of the blow bar wear is a prerequisite for the cost-effective operation of an impact crusher. Replacing blow bars at the right time ensures successful operation and reduces operating costs significantly.

It is common that blow bars do not wear evenly along the entire width. The wear limit is reached if on one part of the blow bar the specified minimum dimension has been attained (see picture 2).

The blow bars are symmetrically shaped and can therefore be turned around after the wear limit has been reached:

- Open the impact crusher as per the instruction manual.
- Switch off the system components and diesel generator.
- Secure the rotor.
- Visually inspect the wear limits on all blow bars.
- Visually check the blow bars for cracks and protrusions.
- Turn around or replace the blow bars as necessary.

Please note: Changing the blow bars too late will result in increased wear on the rotor and the blow bar mounting. This results in expensive subsequent damage and prolonged machine downtimes. In addition to the necessary renewal of the rotor cladding (hard facing), the clamping wedges for blow bar mounting are also often damaged.
MAINTENANCE AND REPLACEMENT OF THE BLOW BARS

Please note: A detailed description of how to replace blow bars can be found in the instruction manual for the respective machine.

1 Wear due to replacing the blow bars too late

2 Border area wear on the rotor resulting from wear of the blow bar on exterior side
General notes on replacing the blow bars

- For rough cleaning of the crushing chamber it is recommended to fill the crusher for several minutes with clean, coarse material.
- At least two people should always take part in installing and removing blow bars.
- Always use suitable lifting gear and tackle.
- Completely extend the crusher gap before blow bar replacement in order to prevent a collision between the blow bars and toggle after new blow bars have been installed.
- Improper replacement of the blow bars can lead to crusher damage.
- Only operate the rotor if the blow bars have been correctly installed.
- Always replace blow bars in sequence.
- Replace all blow bars even if only one of them is broken.
- Before making the final settings, briefly operate the machine at the highest rotational speed (for the EVO 1800 rpm), then check the wedge clamps; tighten the screws if necessary.
- Always use conical spring washers with the clamping bolts of the tensioning devices. Retighten the clamping bolts after approx. two operating hours.
- Caution: A non-secured rotor can lead to severe injuries. Therefore: Always observe safety instructions!
The following table will provide you with an overview of the different blow bars which are used in the Kleemann machines:

<table>
<thead>
<tr>
<th>Blow bar</th>
<th>Recommended for</th>
</tr>
</thead>
</table>
| Manganese steel                 | - Very low abrasiveness, e.g. limestone  
- When there is a very high proportion of unbreakable objects in the feed material (e.g. iron), or if other blow bars are not cost-effective  
- In case of very large feed size |
| Martensitic steel               | - Building rubble and concrete  
- Blasted limestone  
- In case the impact loads are too low to harden the manganese steel |
| Chrome steel                    | - Secondary crushing level for abrasive applications in natural stone  
- In case of smaller feed sizes, e.g. gravel |
| Martensitic steel with ceramic (MMC) | - Recycling of building rubble with little to medium iron content  
- Asphalt  
- Natural stone |
| Chrome steel with ceramic (MMC) | - Secondary crushing level with natural stone or river gravel  
- Asphalt in case of smaller feed size (milled material) and without any iron content |
<table>
<thead>
<tr>
<th>Not cost-effective</th>
<th>Risk of breakage</th>
</tr>
</thead>
<tbody>
<tr>
<td>With abrasiveness of &gt; 100 gr/to</td>
<td></td>
</tr>
<tr>
<td>In case of abrasive material</td>
<td>In case of a large proportion of unbreakable objects in the feed material</td>
</tr>
<tr>
<td></td>
<td>In case of very large feed material (depends on the crusher inlet geometry)</td>
</tr>
<tr>
<td>In case of low-abrasive material</td>
<td>Unbreakable objects in the crushed material</td>
</tr>
<tr>
<td></td>
<td>In case of a too large feed size</td>
</tr>
<tr>
<td>In case of a low-abrasive application</td>
<td>Large feed size</td>
</tr>
<tr>
<td></td>
<td>In case of very low abrasiveness, material fatigue can result after a too long service life</td>
</tr>
<tr>
<td>In case of low-abrasive material</td>
<td>Large feed size (primary crusher)</td>
</tr>
<tr>
<td></td>
<td>Iron content in the crushed material (high risk of breakage)</td>
</tr>
</tbody>
</table>
The cost-effective use of the blow bars is influenced by many factors (e.g. feed material, rotor speed, moisture content, feed size, crushing ratio). In the guidance table you will find the most important influencing factors for selecting the blow bars. Follow the questions and determine the most cost-effective blow bar grade for the application case based on the material conditions that you know of. If this leads you to choose between various blow bars, start with the most cost-effective crusher tool for your application (represented as a dark section in the middle, on pages 42 - 43).

01 Questions on selecting a blow bar appropriate to the application (see on the right for details)
   a) Which material will be crushed?  
          (Broken-up concrete, for example)
   b) How can the feed size be classified?  
          (E.g. largest grain size 600 mm)
   c) Is the material cubic or plate-like?  
       d) In which area is the abrasiveness?

02 Determining the possible blow bars  
   (see pages 42 - 45)

03 Verification of the determined blow bar with regard to the availability of the crusher type  
   (see pages 46 - 47)

<table>
<thead>
<tr>
<th>Material version</th>
<th>Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manganese steel</td>
<td>Manganese</td>
</tr>
<tr>
<td>Martensitic steel</td>
<td>Martensitic</td>
</tr>
<tr>
<td>Martensitic steel with ceramic</td>
<td>Martcomp</td>
</tr>
<tr>
<td></td>
<td>Martxpert</td>
</tr>
<tr>
<td></td>
<td>Martxtra</td>
</tr>
<tr>
<td></td>
<td>Martpro</td>
</tr>
<tr>
<td>Chrome steel</td>
<td>Chrome</td>
</tr>
<tr>
<td>Chrome steel with ceramic</td>
<td>Chromcomp</td>
</tr>
<tr>
<td></td>
<td>Chromxpert</td>
</tr>
</tbody>
</table>
Re d) Classification of the abrasiveness

- Non-abrasive (0 - 100 g/t)
- Low abrasive (100 - 600 g/t)
- Medium abrasive (600 - 1200 g/t)
- Abrasive (1200 - 1700 g/t)
- Very abrasive (< 1700 g/t)
Examples of the classification of the feed material when selecting blow bars:

<table>
<thead>
<tr>
<th>Nr.</th>
<th>Feed material</th>
<th>Max. feed size in mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Natural stone (soft limestone)</td>
<td>0 - 800</td>
</tr>
<tr>
<td>B</td>
<td>Natural stone (medium-abrasive limestone)</td>
<td>0 - 600</td>
</tr>
<tr>
<td>C</td>
<td>Concrete (medium-abrasive)</td>
<td>0 - 700</td>
</tr>
<tr>
<td>D</td>
<td>Asphalt</td>
<td>0 - 700</td>
</tr>
<tr>
<td>E</td>
<td>River gravel</td>
<td>0 - 200</td>
</tr>
</tbody>
</table>
Usage must be checked by Kleemann by means of a material sample.

Additional materials are decisive (e.g., granite, quartzite, basalt).

Classification of material

- Cubic
- Cubic
- Plate-like
- Plate-like
- Cubic

¹ Usage must be checked by Kleemann by means of a material sample.
² Additional materials are decisive (e.g., granite, quartzite, basalt).
SELECTION OF BLOW BARS

¹ Usage must be checked by Kleemann by means of a material sample.
² Additional materials are decisive (e.g. granite, quarzite, basalt).
Please note: If you are unable to determine a suitable blow bar when assisted by the selection aid, then please contact our sales and service company directly, or Kleemann GmbH, to have your application usage checked and an appropriate solution found.
# PRODUCT RANGE OF BLOW BARS

<table>
<thead>
<tr>
<th>Machine type</th>
<th>Model</th>
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