



**ATTACHMENTS  
SPECIAL MACHINES  
SPARE PARTS  
SERVICE**

**HOW  
TO SELECT  
A PROPER  
BUCKET?**

## REGIONAL REPRESENTATIONS

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 **PROFESSIONAL**

## PROFESSIONAL LLC

Leader in the production of attachments for road construction and mining equipment\* in Russia.



Jaw for Caterpillar 6060/ Bucyrus RH 340 excavators (34 m<sup>3</sup>)



Bucket for HITACHI EX-850 (4.6 m<sup>3</sup>)

**Company profile** — design and manufacture of attachments. Every year the Company manufactures and sells more than 3,000 buckets for excavators and other special machines with a capacity from **0.01 to 40 m<sup>3</sup>**, as well as more than 2,500 rippers, metal scrap grippers, digging, loading and timber grabs, booms, dippers, ripper shanks, and bulldozer blades.

Currently Professional LLC has at its disposal manufacturing shops with an area of 35,000 m<sup>2</sup> fitted with advanced Hi-Tech equipment.

We use wear-resistant, high-strength and low alloyed steel for production of our attachments, while our own engineering developments and drawings make them unique.

Our own laboratory ensures 100% quality control of the incoming materials and manufactured products.

The Company covers a large sales territory. The Professional® buckets are operated in more than **40 countries of the world**, which fact proves the high quality of our products.

**Since 2006 the Company has gained a vast experience in production of attachments for special machines. Having a 80% share in the market, our Company is the leader among Russian and CIS bucket producers.**

**The bucket is the main working attachment** of an excavator, and its role in the construction process is very high. Therefore to make the excavator performance efficient, it is necessary to select attachments in compliance with the demands and operating conditions.

**Remember! A correct bucket selection may increase the excavator's efficiency by 40% and more.**

Expert from Professional LLC are ready to help their customers to select an ideal bucket variant. In this publication we would like to highlight the main aspects to be considered when selecting a bucket:

- 1. Capacity**
- 2. Design**
- 3. Quality**



Bucket storage area

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# 1. Bucket capacity

The main parameter of a bucket is its volume as it has a direct impact on the special machine efficiency. Today it is possible to increase the bucket capacity without increasing its weight and thus overloading the excavator.

For this purpose special steel grades shall be used. Thin, but very strong steel makes it possible to increase the bucket volume and at the same time to reduce its weight. It results in a reduced load on the excavator, an increased volume of shoveled soil during earthworks, and consequently a higher efficiency of the special machine.

So the steel grade from which the bucket is made is one of the main factors for selection of this attachment. Depending on the intended application of the bucket, different steel grades are used.

## Steel grades used for bucket production

### Low alloyed steels

(09G2S, S355). Such steel grades are used for manufacturing of standard, loading, trench, and land planning buckets, i.e. general purpose buckets. The field of application for these buckets is limited exclusively by light and medium-hard soils.



A standard bucket



A reinforced rock bucket

### Wear resistant and high-strength steels.

The largest international producers of such steel: Dillinger (Germany) — Dillidur steel, ThyssenKrupp (Germany) — Xar steel, SSAB (Sweden) — Hardox steel.

These steel grades are used for manufacturing of reinforced, rock, and open pit buckets. They are used for excavation of stiff, high-abrasive, and rocky soils. The basic elements of such buckets are made from different steel grades to ensure maximum strength and durability.

**Wear-resistant steel** has **higher hardness** (HB 400–500 units by Brinell method). Such steel is used for manufacturing of: bottom of rock buckets for excavators up to 60 tons, sides and side wear strips, and bottom wear strips.



Storage area for steel of different grades and thickness

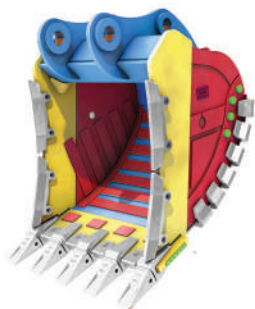
**High strength steel** with yield stress 690 MP exhibits high strength properties and is used for manufacture of: bottom of rock buckets for excavators more than 60 tons, bracket beams, and the rear wall of open pit buckets.

**Combined steel** (HT 360) combines the properties of wear-resistant and high-strength steel and has **a high impact resistance**. It is used for manufacturing of the lips and the wings of open pit buckets — the parts most subject to heavy impacts and wear. Addition protection of the bucket against wearing is provided by wear elements and chromium white cast iron (Brinell hardness up to 700 units).

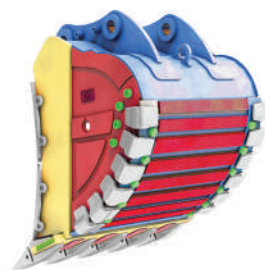
## 2. Bucket design

The bucket design shall ensure high efficiency in any operating conditions. The key role here is played by the **designer**. Apart from the excavator basic parameters and the field of application, it is necessary to consider such factors as: load on the item and its elements in the process of operation, approach angle, bucket mass, and component parts.

For competent development of engineering documentation we use **up-to-date programs for 3D modeling** and strength calculation. These programs enable us to identify critical load zones yet at the design stage and to take measures for their elimination. Designed with the use of 3D modeling, our buckets have optimal design with regard to strength, service life, and safety.

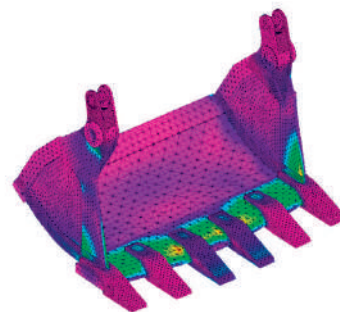
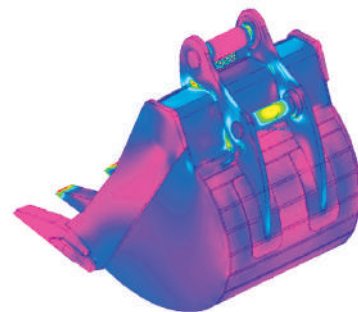


- wear resistant steel (sides, side plates, wear plates for the bottom and the lip)
- high-strength steel (bottom, beam, bracket)
- combined steel (lip, wing)
- chromium white cast iron (buttons, tiles)

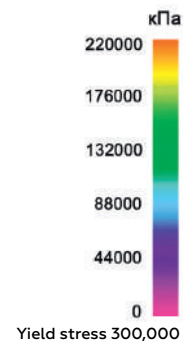


Bucket elements by steel grades

**Important! All bucket elements are subject to different loads in the process operation and therefore they are made from different steel grades.**



Design stress diagram





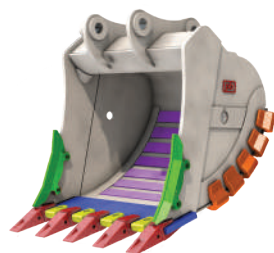
Engineering department

Performing individual orders, the engineering department specialists may visit the customer's premises to make measurements. Moreover, when developing drawings, we consider the machine brand and model, the climatic conditions and the soil, the customer's requests regarding the bucket capacity and mass, and select the components and the wear elements.

**The optimal bucket design facilitates better penetration into the soil, thus reducing the load on the work equipment and on the hydraulic system of the excavator. The optimal bucket mass facilitates minimization of fuel consumption by the excavator.**

## Bucket component parts

The bucket component parts may include the following elements, each having a direct influence on the bucket efficiency:



Bucket component parts

- cutting edge of
- the tooth
- side cutters and
- protectors, lip shroud
- wear elements
- heel shrouds

## Cutting edge

This is the most important element of the bucket. It is made from high-strength and wear-resistant steel. The cutting edge shape and shroud have a direct influence on future durability of the whole bucket.



Bucket cutting edge with shroud from MTG (Spain)

## Teeth

Frequent replacement of teeth results in equipment downtime, that is why their selection is also important for the bucket efficiency.

Depending on the type of soil to work with, the following types of teeth are distinguished: standard light (earth) soils, medium-hard soils (with higher abrasive effect, for example, wet sand), rocky soils (for excavation of rocky, hard or frozen soils).



Standard

Medium-hard

Rocky

Types of NBLF teeth (China)

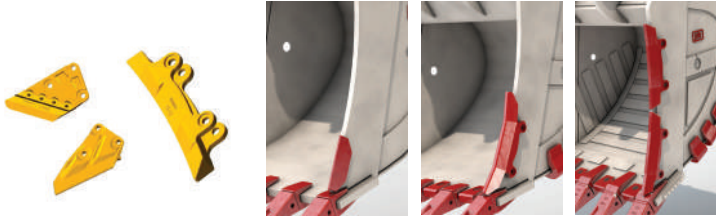
The following shall be considered for teeth selection:

- teeth wear resistance;
- the cost of teeth and their replacement;
- penetration capability.

Most popular in Russia are consumable materials from **NBLF** (for construction class buckets) – the largest Chinese manufacturer. They proved to be effective event in the most severe climate conditions of the Extreme North of Russia. Widely spread are also systems from **MTG (Spain), Hensley (USA), and ESCO (USA)** for mining class buckets.

### Side cutters and rotectors

The lower part of the bucket side (wing) is mostly subject to wear, so it is strengthened with protectors or side cutters. Protectors are selected individually depending on the bucket application field. They may cover 1/3, 2/3 or the entire wing. Side cutters are installed for better penetration of the bucket into the soil. There are different types of fixation: welded, bolted and mounted on the base.



Bucket wings protected with shrouds

### Lip shroud

The lip shroud is used to protect the bucket cutting edge. It may be either **welded or removable**. Selection depends on the distance between adapters, the cutting edge thickness, and the operating conditions on different soils.



**Weld-on shrouds** are made from steel with higher weldability, but the hardness of such steel is lower than that of removable shrouds. The service life may be shorter, but **the cost of weld-on**

**shrouds is lower.** They are cut to the size and may be used within different limits (for example, weld-on shrouds ML120UC from MTG are used for lips 90–120 mm).

**Removable shrouds** are made from **high strength steels having high hardness**. The weldability of such steels is low, and that is why bolt connections are used. Removable lip shrouds may get compacted due to hammer hardening during operation.



It should be noted, that removable shrouds can be used under any, even severe climatic conditions as well as in situations where service is not available to perform welding works. Moreover, removable shrouds proved to have higher efficiency and service life than welded shrouds, and the costs of that are always justified. An important advantage is also the fact that removable shrouds do not deform the cutting edge.

### Wear elements

For the purpose of maximum protection the bucket is reinforced with wear elements in order to increase the equipment wear resistance and service life. Standard or special wear elements may be used depending on the bucket operating conditions.

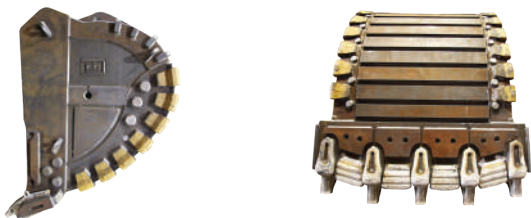
Standard wear elements in the form of steel strips with hardness more than HB 500 is welded both to the lower and to the upper part of the bottom.



**Corner elements or bucket heels** are also counted as standard wear elements. They protect the bucket edges against wear in the area of bottom and side connection.

**Special wear elements "buttons" and "tiles" made of chromium white cast iron** (hardness HB 700) withstand high abrasion loads and direct impacts, but are sensible to lateral impacts, because they are mounted on a base. As an alternative manufacturers offer replaceable blocks with mechanical fixation.

**Overlay plates** (HB 1000) withstand severe abrasion, but scale off under high impact loads.



A bucket reinforced with wear strips, bucket heels, "buttons", and "tiles"

## 3. Bucket quality

The bucket quality depends not only on the used materials and components, but also on correct bucket manufacture technology.

### Production process

The imported steels used for bucket manufacturing are very sensible to the welding process. The main constituents of a proper welding process are:

- **proper welding temperature control;**
- **relieving residual stresses in the metal;**
- **used welding materials and equipment.**

**Proper welding temperature control** is very important for retention of wear-resisting properties of steel. Otherwise the metal will become brittle, causing the bucket cracking and failure.

**The main reasons** leading to the loss of wear-resistant properties of the metal, cracks in the weld joints propagating to the welded material, and finally to the loss of the bucket:

**Important! Properly selected bucket component parts ensure good penetration into soil/rock, light weight, and wear protection of the bucket.**



Bucket for HITACHI EX-3600 (23.0 m<sup>3</sup>)



ESAB welding

- welding of cold, not pre-heated metal;
- welding in an unheated space;
- shock cooling of metal in the weld joint area;
- violation of welding procedures..

To avoid such situations **when welding wear-resistant steels**, it is necessary **to observe the following rules:**

- pre-heat welding elements to optimal work temperatures, taking into account the steel grade and the plate thickness (check the pre-heat temperature with a tempilstik or a pyrometer);
- maintain the recommended optimum temperature in the weld pool when welding different material integrated in the bucket;
- arrange enclosed warm zone in the welding space to avoid draughts and low ambient air temperatures causing shock cooling of metal in the weld joint area.

The steel welding process is very arduous, because it is very difficult to control the welding temperature. It is necessary to heat the steel, to control the process, and to check the result practically at the same time. All welders shall be qualified and have proper certificates permitting them to work with different steel grades.

**Attention! We DO NOT RECOMMEND to rework or to repair the bucket and to weld additional elements onto it! Wear-resistant and high-strength steel is very sensitive to the welding process, and you may easily damage your bucket! Consult our specialists!**

### Relieving residual stresses in the metal

The bucket is a complex welded structure made from materials having different thickness, different chemical composition, and physical properties. The more welding operations are performed, the more stressed is the finished product and the higher is the probability of cracking in the metal and in the weld joints.

#### Important:

- correct welding sequence, direction and termination of weld joints to minimize residual stresses;
- mandatory relieving of residual stresses in the weld joints and in the weld adjacent zones through heat treatment after welding, machining of the weld toe, peening with a pneumatic needle gun, and shot blasting.

Temperature control with a pyrometer



Temperature control with a tempilstik



Stress relieving in weld joints with a pneumatic gun



Deseaming





## Welding materials and equipment

The quality of weld joint depends largely on advanced equipment and used welding materials. The best known suppliers of welding equipment are: KEMPPPI (Finland), LINCOLN (USA), ESAB (Sweden). Professional welding equipment allows the user to program the required welding conditions and thus almost completely exclude the human factor. Welding shall be performed with a high quality wire (e.g. ESAB) in an atmosphere of shielding gas (argon 82% and carbon dioxide 18%).

Welding performed with such equipment and using properly selected welding materials and conditions will significantly improve the weld joint quality, namely:

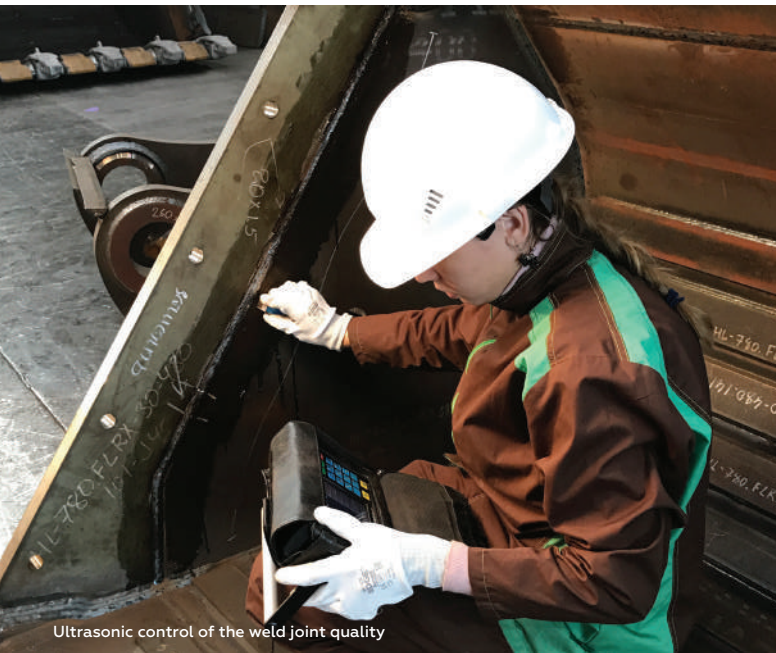
- better filling of the weld;
- lower porosity and non-metallic inclusions;
- provision of high surface tension and minimum stresses in the weld;

- higher stability of the welding process;
- no crater forming on completion of the weld;
- smaller heat-affected zone so that there is little workpiece deformation, if any at all.

**In 90% of cases the weld joint quality** is assessed through ultrasonic control. In other cases capillary method is also used to identify micro-fissures and defects in the weld joints.

Choosing a supplier of attachments, it is necessary to get acquainted with his **quality assurance policy**.

Starting from availability of a certificate of compliance with ISO 9001 series standard requirements, implementation of the quality assurance policy, and up to a possibility of leaving comments on the company's products and organization of a feedback with the customers.



Ultrasonic control of the weld joint quality



Visual inspection and dimensional control of welds

It proves that the company pays special attention to the quality of manufactured products. A **quality certificate and a warranty** shall be issued to each manufactured item.

A prime advantage is **availability of the manufacturer's own laboratory** to exercise strict quality control over the incoming raw materials and the manufactured products.

**Important! It is necessary to carefully follow the bucket production process. Special attention shall be paid to the welding process as the most complex and significant one. High quality of the products is assured by strict control at every stage!**

It should be noted that compliance with all above mentioned criteria will definitely lead to increase of the bucket cost, but it is clear that these expenses will always be justified. Everyone knows how expensive the equipment downtime may be, so it is very important to have the equipment in operation as long as possible.

At the same time, trying to increase the bucket capacity and to improve its quality, one should try to establish an affordable price for it. For this purpose it is necessary to trace the recent developments in the sphere of industrial equipment, materials, and component parts. An important aspect is the company's production output.

**The larger is the manufacturer, the lower is the purchase cost of materials and component parts required for bucket production. It provides an opportunity to offer the best price, maintaining the high quality of the products.**

**Please note that Professional LLC pays special attention to each of the 3 aspects, namely:**

- 1 In the process of bucket production we use European wear-resistant and high-strength steels subject to strict incoming control. Buckets made from such steel are light and robust, providing larger useful capacity and longer service life. When properly operated, the average service life of Professional® buckets is 5 years.



- 2 We have our own Engineering department — 30 employees with many years of experience in design of attachments and skilled in 3D modeling programs. Performing individual orders, our design engineers visit the site to make measurements, the accuracy of which is guaranteed by advanced equipment, including the use of a 3-D scanner. Our buckets are supplied complete with the best and carefully selected consumable materials.

**Professional LLC is an official dealer of leading European producers of teeth, adapters, and shrouds: MTG, ESCO, Hensley, NBLF.**





Bucket measurement with a 3-D scanner in the customer's premises



Specimen testing with a durometer



Company storage area



On-site welding seminar held by ESAB

**3** The works at all production process stages are performed with **advanced equipment operated by skilled and qualified specialists**. The equipment stock is regularly replenished and updated. More than 80 welding stations are equipped with welding machines: KEMPPPI, LINCOLN, ESAB. We use ESAB welding wire and comply with all necessary measures and recommendations developed by the equipment suppliers. The Company **undertakes large-scale efforts to assure the product quality** within the scope of

the applicable Quality Manual and proceeding from the Quality Assurance Policy, which fact is proved by the available ISO 9001 certificate.

**Our own test laboratory** exercises quality control of materials, component parts, welding process, and finished products. It enables us to prevent rejections and to improve the product quality.

All technical staff of Professional LLC engaged in the bucket production process undergoes qualification and certification. EASC certificates were issued for welding



technologies, the process engineer, foremen, and welders for manual and semi-automatic welding of commercial, high-strength, and wear-resistance steels with thickness up to 160 mm in different spatial positions. Specialists of suppliers/manufacturers (ESAB, ESCO, MTG) deliver quarterly trainings of the personnel in advanced methods of welding, product assembly, usage of materials, wear strips, etc. Guidance materials are issued and regular work is carried out to upgrade the employees' qualification.

**Professional LLC is one of the largest producers of attachments.**

Since 2006 Professional LLC has positioned itself as a leader in production of attachments. With its 80% share of the market, our Company is the leader among Russian and CIS bucket producers.



A workshop of Professional LLC

Using the latest innovations and developments, advanced equipment and materials, we manufacture products of superior quality.

**Our attachments will help you to earn more due to increased efficiency of your machines! As a large manufacturer, we are in position to offer a lower price than our competitors due large quantities of materials and component parts purchased at lowest prices.**

Specialists of Professional LLC company know everything about buckets and will be pleased to answer any questions you ask.

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Workshops of the company «Professional» (aerial photography)