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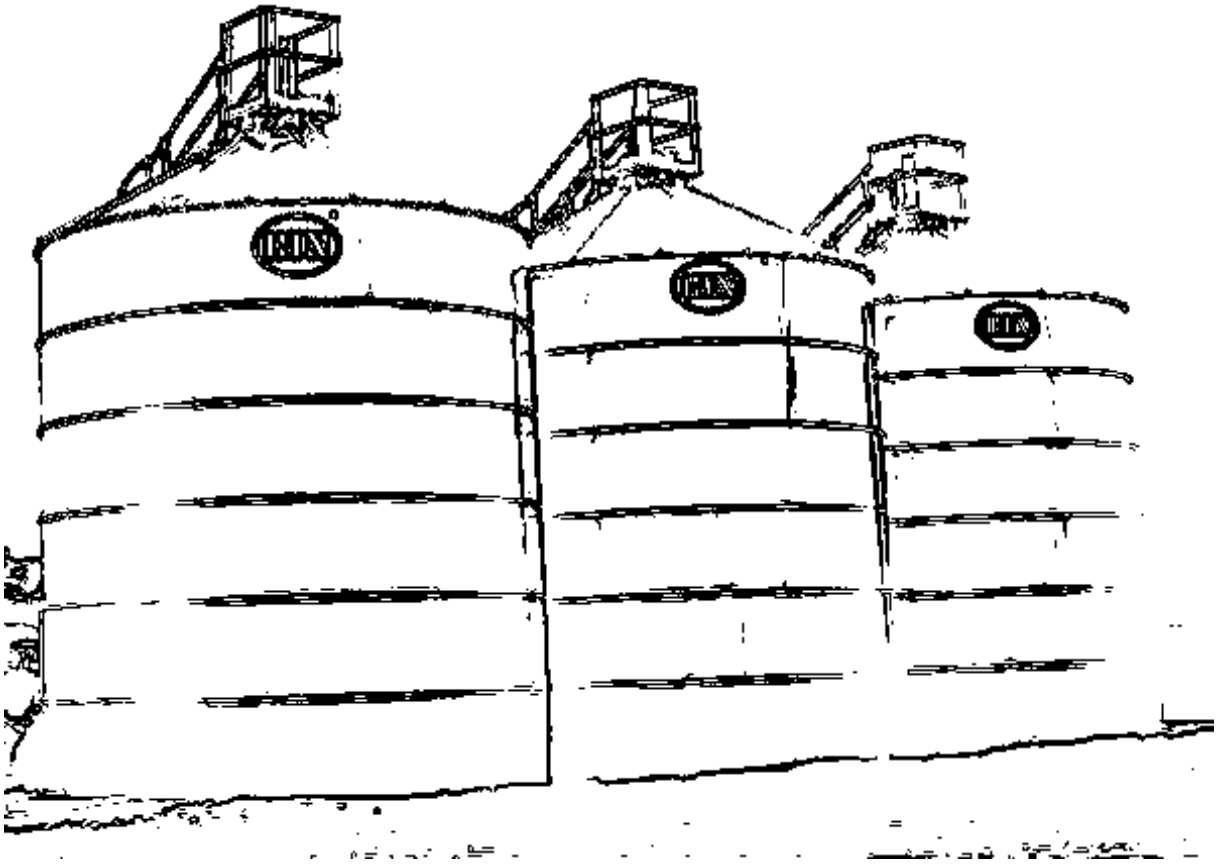
FLAT BOTTOM BIN SILOS

FOR STORAGE OF CEREAL GRAIN, MAIZE AND OILSEEDS DRIED BY ACTIVE VENTILATION SYSTEMS

TYPE: BIN10, BIN20, BIN40, BIN60, BIN100, BIN200, BIN500, BIN1000, BIN1500

OPERATING MANUAL (IO:SIL)



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INTRODUCTION

Thank you for purchasing a BIN silo. The product is provided with safety devices to protect operators and the silo during its normal use in process. However, these devices cannot ensure safety in all circumstances, and, therefore, before operators start to use it, they must thoroughly read this Operating Manual and understand it. This way errors during the machine installation, and during operation itself can be avoided. Please, do not attempt to use the product before you get acquainted with all sections of this manual, and not understand each of its functions and all procedures.

The Operating Manual aims at acquainting the user with a correct operation of the purchased product. It contains practical guidelines that must be known to a user during silo operation.

If any content of this OPERATING MANUAL is not understood by or unclear for the user, please, contact the producer or its representative.

This operating manual forms an integral part of the product, and should be kept for further use.

Before starting to operate the silo, read this operating manual, and, in particular, the chapter concerning safety at work.

Each use of the silo for purposes other than those specified in the operating manual will be treated as the misuse. The manufacturer of the product shall not be held responsible for any resultant damages. The user bears the sole risk related to the misuse. All and any unauthorised changes to the product design exclude the manufacturer's responsibility regarding any resultant damages.

The warning sign in the operating manual indicates that the special caution must be exercised because of the danger to people and possibility of product damage.

It is strictly forbidden to make additional openings and holes in the silo bottom or shell (walls) for unloading or installation of additional unloading equipment.
It is forbidden to make non-central unloading openings in the silo floor. Making such openings and holes in the silo shell or floor may result in deformation or even bursting of the silo shell during unloading.

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1. Safety

1.1. Basic safety rules

1. People operating, performing maintenance or overhauls of silos are obliged to adhere to general occupational safety regulations.
2. The user is obliged to read and understand operating manuals for the silo and for all other auxiliary equipment, and to strictly adhere to them.
3. The silo can only be operated by able-bodied adults. These persons need to be fully aware of undertaken activities.
4. In particular, the following is forbidden:
   - operation by any “third” persons, who are not familiar with the Operating Manual;
   - operation by any persons that are ill or under an influence of alcohol or narcotic drugs, or by minors.
5. The silo should be secured against access of children.
6. A silo owner is obliged to provide the silo with detailed occupational health and safety instructions.
7. It is recommended to equip people employed to operate and use silos with anti-static tools (spades, brooms, hammers, spanners, etc.), clothes and footwear.
8. Each entry into the silo must be preceded by a command issued by an employer or a person authorised by them.
9. The silo and its surroundings should always be kept tidy and clean.
10. It is forbidden to leave any tools, items, etc., on the silo or its structure due to a risk of an operator or any third persons being hit by objects falling from height.
11. It is strictly forbidden to climb onto a layer of grain in the silo, except when only a small amount of grain remained in the silo, and the inlet opening to the unloading device is not covered and clearly visible. Then it is necessary to enter to shovel grain into that opening or to start the shovelling device.
12. Overhaul works inside the silo can be performed after emptying the silo and removing grain remains, locking and disconnecting from power source feeding and unloading equipment, and after placing an information board “Attention: do not start, overhaul”.
13. A worker working in the silo should be assisted by another person and provided with relevant personal protection equipment.
14. A person entering the silo through a roof hatch should be assisted by two people and provided with equipment protecting against falling from heights, including an automatic fall arrest system.
15. It is strictly forbidden to disconnect a lifeline protecting against a fall from height while working in the silo.
16. While workers are present in the silo, the roof (top) manhole and, whenever possible, a bottom manhole should be kept open, with a shutter of the underfloor conveyor closed.
17. When there are hazards related to noise, causing problems in communication, then special equipment for smooth communication between workers is required.
18. It is forbidden for people to stay near the silo while any works at height are in progress, and the area around the silo should be secured against any access of third parties.
19. Ban on use of naked flame, smoking, and conducting welding works or similar in the silo and within 10 m radius of the silo or the unloading outlet should be strictly adhered to.
20. Before entering the silo, disconnect the power supply to all electrical devices working with the silo and secure them against accidental switching on by any third persons.
21. It is strictly forbidden for people to be present in the silo during its loading or unloading, or when grain is aerated.
22. Before loading or unloading equipment, or a grain ventilation fan is started, make sure there are no people in the silo.
23. When BIN loading or unloading equipment is installed in the silo, provided with limit switches on an external ladder and near the bottom manhole, then it is forbidden to:
   - remove the limit switches;
   - block the switches;
   - attempt to bypass them.
24. When loading or unloading equipment from other manufacturers is installed in the silo, then the silo owner is obliged to construct the electrical wiring of these devices in such way that any attempt to access the silo through the bottom manhole or the ladder automatically stops their work immediately.
25. When loading or unloading equipment manufactured by companies other than BIN is installed in the silo, then the silo owner is obliged to equip these devices with a main switch with a padlock, so power supply to those devices can be effectively disconnected before entering the silo.
26. Manual shovelling of grain into the silo unloading sleeve or to the discharge opening in the floor requires all silo auxiliary equipment to be stopped first.
27. It is strictly forbidden to put hands into inlets of conveyors installed in the silo.
28. It is strictly forbidden to enter the space under the silo floor.
29. Temperature measurements with a manual probe should be made while standing on the internal ladder.
30. All guards and security devices representing the factory equipment of the silo must be installed.

31. When all works in the silo are completed, close and padlock the guard of the external ladder. Before attaching the padlock, make sure there are no people in the silo.
32. Lock the bottom manhole of the silo.
33. The keys for access to the silo (the key to the ladder with the guard and the key to the bottom manhole) must be kept by an authorised person.
34. When any operations are conducted in the silo, use safe voltage portable lightning. While operating, components of the portable lighting cannot heat up to a temperature that may cause grain dust fire or explosion.
35. Do not store in the silo any grain that is contaminated or of excessive moisture content *(Table 7).*
36. The user is responsible for construction and operational condition of the lightning system and the protective grounding of the silo.
37. The user is responsible for correct connection of power delivery points and their correct operation.
38. In case of any outage in power supply, switch all devices working with the silo off.
39. The silo and its direct surroundings must be used and maintained in a way preventing fire, and it should be provided with handheld fire extinguishing equipment, including a dry powder or carbon-dioxide extinguisher.
40. In the event of the fire:
    - evacuate people from the danger zone;
    - call the fire brigade;
    - disconnect devices from the power supply;
    - start extinguishing the fire.
41. It is forbidden to extinguishing fires of electric systems with water or a foam extinguisher.
42. When any situation hazardous to human life or health is discovered, the equipment must be stopped immediately and power supply to the equipment must be disconnected with the main switch.
43. When any defects or damages to the silo are found, which may affect human safety or safety of materials stored in the silo, the investor is obliged to immediately notify them in writing to the silo manufacturer.
44. The repair and maintenance operations can only be conducted by able-bodied adults holding relevant qualifications.
45. Do not attempt any works in adverse weather conditions (rain, heavy frost, ice, strong wind, lightnings, poor visibility).
46. Fumigation, pest control, and similar operations in the silo or on the stored grain should be ordered at specialist companies. After these activities, relevant OHS regulations concerning use of chemicals in confined spaces should be strictly adhered to.
47. People working in the silo, manually shovelling the grain or cleaning the silo, must be equipped with protective goggles and respiratory protection.
48. Observe rules for complete control over auxiliary equipment connected to the grid.
49. In the event of the unloading equipment failure, when it cannot be repaired due to large quantities of grain stored in the silo, unload the grain through a sack-filling device or through an emergency duct in the silo, at the speed not exceeding 20 tonnes per hour. Higher rates may cause permanent deformation of the silo.
50. It is forbidden to make any changes in design or to change the intended use of the equipment without the producer’s consent in writing.
51. Any design changes in the finished product require the new technical acceptance by the manufacturer or its authorised representative.
52. It is strictly forbidden to make unauthorised additional openings and holes in the silo bottom or shell (walls) for unloading or installation of additional unloading equipment. It is forbidden to make non-central unloading openings in the silo floor. Making such openings and holes in the silo shell or floor may result in deformation or even bursting of the silo shell during unloading.
53. All equipment and systems connected to the silo (e.g., feeding pipes of bucket elevators or vertical conveyors) must be constructed in such way that they do not damage the silo equipment.
54. During the silo loading the speed of 60 tonnes per hour for silos of the BIN10 to BIN200 type and 150 tonnes for silos of the BIN500 type and larger should not be exceeded; higher speeds may result in the permanent deformation of the silo.
55. Do not start a fan in the silo without grain.
56. When the silo is equipped in any BIN device or sets of devices (loading, unloading, active ventilation, and similar equipment), then necessary information on their operation, including control, switching on/off, lubrication, operation of electrical equipment, and other, can be found in relevant operating manuals for that equipment. The manufacturer accepts a possibility of equipping the silo with devices or sets of devices from other manufacturers, provided they are "CE" marked and have the "EU declaration of conformity". This forms a basis for use of relevant operating manuals of this equipment as a part of their correct operation.
57. Each silo with a roof manhole must be provided with an external access to it.
    The external access to the roof manhole is understood as a possibility to enter through an external ladder or an external spiral staircase, and/or indirectly through roof stairs from a service catwalk.

58. Each silo loaded through an inlet in a silo collar must be provided with an external access to it. The access to a collar is understood as a possibility to access it using appropriate lifting equipment, through roof stairs with a collar platform and/or through a service catwalk.
59. When the silo owner does not purchase and install (manufactured by BIN) equipment ensuring access to the roof manhole and the collar with the loading inlet, it is obliged to construct itself (in accordance with relevant current legislation) equipment for using and operating the above units. If those conditions are not met, then the Declaration of Conformity EC attached by BIN to this Operating Manual becomes invalid.
60. The silos are labelled with safety marks. Each user is obliged to become acquainted with their meaning.
61. In no device included in this Operating Manual the equivalent acoustic pressure level does not exceed 70dB(A), as measured in accordance with PN-EN ISO 11201:1999 and PN-N-01307:1994.

1.2. Information and warning signs

Warning signs

DO ENTER AND DO NOT REACH INTO THE CRUSH ZONE WHEN PARTS CAN ROTATE

Other warning signs

READ OPERATING MANUAL

ATTENTION! DANGER

RISK OF FALL FROM HEIGHT

NO ENTRY – NO TRAMPLING OVER

NO ENTRY FOR UNAUTHORISED PERSONS

USE PROTECTIVE GLOVES

USE PROTECTIVE FOOTWEAR

NO USE OF NAKED FLAME OR SMOKING

USE LIFELINE WHEN ENTERING THE SILO

USE RESPIRATORY PROTECTION WHEN ENTERING THE SILO

All warning and safety signs are installed on the silo shell, at the height of ca. 1.6m, near the silo ladder or bottom manhole.

Additional warning signs: "do not enter or reach into the crushing zone when the parts can move", "use of a lifeline is obligatory when entering the silo", "no entry - no trampling over" and "no entry to unauthorised persons" signs are installed on the cover of the silo top manhole.

The nominal plate is installed on the silo shell, at the height of ca. 1.6m from the foundation surface.

Model: NBIN XXX
Year of production: 20XX
Serial number: XXXX-XXX
Weight: XXXX kg
Usable properties declaration No.: SZJ/029/XXXXX
Harmonised standard: PN-EN 1090-1
ZKP certificate No.: XXXX-CRP-XXXX
ZKP certifying body No.: XXXX
Further information: Operating Manual and declaration
Year of the first-time product labelling: XX
Construction class: XXXX

Note! Warning signs, nominal plates and other information provided on the equipment must be kept legible and clean. When the signs or marks mentioned above are damaged or destroyed, or a part containing them is replaced, new plates should be purchased from BIN Company and installed on the product.

2. General product description

2.1. Intended use of the product

- for storage of corn and maize grain, and oilseeds
- cooling of grain or seed mass;
- additional drying by active ventilation.

Stored grain and seeds must have appropriate moisture content *(Table 7)* and be free of contamination. Material of such optimum parameters can be stored in high layers for a long time without deterioration in its quality. When grain deviates from the parameters provided above, it should be dried by active ventilation. This drying method can be used in NBIN10 to NBIN200W silos. For larger silos, it is recommended to store material only of optimal parameters. The silos are not designed for preservation of grain and seeds that are strongly contaminated, or of moisture content that cannot be reduced by active ventilation. It is forbidden to store in the silo materials other than listed, and in particular, materials of density exceeding 800 kg/m^3. When the silo is used contrary to its intended use, the manufacturer shall not be held responsible for any resultant damage.

Note! A special sealing kit should be used for storage of small seeds, smaller than cereal grain (e.g., for rapeseed). **Information that silo will be used for storage of small grain or seeds should be provided when ordering the silo.**

2.2. Basic silo technical data

Table 1. Technical specification of BIN silos

Silo type	*Silo model*	*Usable volume[1)] m^3*	*Loading capacity for wheat[2)] t*	*Diameter m*	*Total height m*	*Wall height m*	*Number of anchors, pieces*	*Weight kg[5)]*	
								Silo components	*Concrete blocks*
BIN 10	NBIN10	15.6	10.5	2.29	5.10	3.85	4	581	260
	NBIN10W	19.5	13.5		6.05	4.80		739	
BIN 20	NBIN20N	26.3	19.7	3.18	4.60	3.35	4(+4) [3)]	837	698
	NBIN20	29.9	22.4		5.10	3.85		879	
	NBIN20R							912	
	NBIN20W	37.4	28.1		6.05	4.80		1006	
	NBIN20WR							1039	
	NBIN20WW	45	33.8		7.00	5.75		1191	
BIN40	NBIN40NS	45	33.8	3.82	4.98	3.85	6	1116	1116
	NBIN40S	56	42.0		5.93	4.80		1267	
	NBIN40WS	67	50.3		6.88	5.75	12	1482	
	NBIN40WWS	78	58.5		7.83	6.70		1650	
BIN 60	NBIN60	76.9	57.7	4.46	6.12	4.80	8(+8) [3)]	1503	1339
	NBIN60R							1546	
	NBIN60W	91.7	68.8		7.07	5.75		1734	
	NBIN60WR							1776	
	NBIN60WW	121.3	91.0		8.97	7.65	5	2185	
BIN 100	NBIN100U	133	99.8	5.35	8.18	5.75	12	2472	1860
	NBIN101U							2607	
	NBIN100RU							2498	
	NBIN100WU	176	132		10.08	7.65	18(+6) [4)]	2966	
	NBIN101WU							3134	
	NBIN100WRU							2991	
BIN 200	NBIN200NU	247	185	6.69	9.65	6.70	7	4023	3720
	NBIN200U	281	211		10.60	7.65		4339	
	NBIN200WU	348	261		12.50	9.55		4978	
BIN 500	NBIN500	695	521	8.59	15.33	11.45	18	9363	7440
	NBIN501							10338	
	NBIN501W	805	604		17.23	13.35		11775	
BIN 1000	NBIN1001	1264	948	11.46	16.18	11.45	24	14990	14880
	NBIN1001W	1460	1095		18.08	13.35		16805	
BIN 1500	NBIN1500_N	1560	1170	14.32	14.15	8.60	30	18114	16740
	NBIN1500_P	1713	1285		15.10	9.55		18950	
	NBIN1500	2019	1514		17.00	11.45		20931	20460
	NBIN1500_W	2325	1744		18.90	13.35		23494	

1) - total volume of the silo inner space (above the floor);
- an actual volume of grain stored in the silo depends on the following factors: loading method, equipment installed in the silo, grain pour parameters, etc.

2) - in relation to the usable capacity, for wheat of bulk density of 750 kg/m3

3) - additional anchors required when the silo is installed in the 2nd wind zone, and 1 and 3 wind load zone for the height of 300 ≤ A ≤ 600 m amsl according to PN-EN1991-1-4:2005 (not included in the standard silo equipment – please include in the silo order, as necessary)

4) - additional anchors required for assembling of the silo with the POM100 service catwalk (standard catwalk equipment)

5) - net weight of silo components (without packaging, etc.), silo weight and blocks rounded up to 1 kg.

2.3. Recommended methods for silo loading and unloading

Table 2. Recommended methods for BIN silo loading and unloading

Silo	*Loading/Unloading*	*Recommended equipment system*
NBIN10 NBIN10W	Loading	grain blower PPZ-7.5-WNT
		inclined screw conveyor
		vertical screw conveyor PS220-PN
	Unloading	underfloor PS screw conveyor
		sack-filling device
NBIN20N NBIN20 NBIN20R NBIN20W NBIN20WR NBIN20WW	Loading	grain blower PPZ-7.5-WNT
		vertical screw conveyor PS220-PN
	Unloading	sack-filling device
		underfloor PS screw conveyor
		universal screw conveyor through an unloading sleeve
NBIN40NS NBIN40S NBIN40WS NBIN40WWS	Loading	grain blower PPZ-7.5-WNT
		universal inclined screw conveyor
		vertical screw conveyor PS220-PN
	Unloading	sack-filling device
		underfloor screw conveyor PS160
		universal screw conveyor through an unloading sleeve
NBIN60 NBIN60R NBIN60W NBIN60WR	Loading	grain blower PPZ-7.5-WNT
		vertical screw conveyor PS220-PN
	Unloading	sack-filling device
		universal screw conveyor through an unloading sleeve
		BIN PS/PSW conveyors system
NBIN60WW	Loading	grain blower PPZ-7.5-WNT
		bucket (scoop) elevator
		vertical screw conveyor PS220-PN
	Unloading	sack-filling device
		BIN PS/PSW conveyors system
NBIN100 NBIN101U NBIN100RU NBIN100WU NBIN101WU NBIN100WRU	Loading	grain blower PPZ-7.5-WNT
		bucket (scoop) elevator
		vertical screw conveyor PS220-PN
	Unloading	sack-filling device
		universal screw conveyor through an unloading sleeve
		BIN PS/PSW conveyors system
NBIN200NU NBIN200U	Loading	bucket (scoop) elevator
		grain blower PPZ-7.5-WNT
		vertical screw conveyor PS220-PN
	Unloading	BIN PS/PSW conveyors system
NBIN200WU NBIN500 NBIN501 NBIN501W NBIN1001 NBIN1001W BIN1500_N NBIN1500_P NBIN1500 NBIN1500_W	Loading	bucket (scoop) elevator
	Unloading	BIN PS/PSW conveyors system

2.4. Design description

Figure 1 shows a silo in form of a cylindrical tank with a flat perforated bottom, a shell made of flat galvanised metal, and a self-supported roof with a manhole. Multi-row screw joints of the shell are sealed with self-adhesive seals of polyurethane foam. Rings strengthening the shell structure are installed in all silos, except for BIN10 and BIN20. The perforated floor is assembled of trays supported on concrete supports installed on the foundation slab.

During installation the whole structure is bound with the foundation slab with anchors and steel rawlplugs. A brief characteristics of the most important units and devices installed in BIN silos is presented below. Views and basic silo dimensions are presented in Figures *from Figure 15 to Figure 29.*

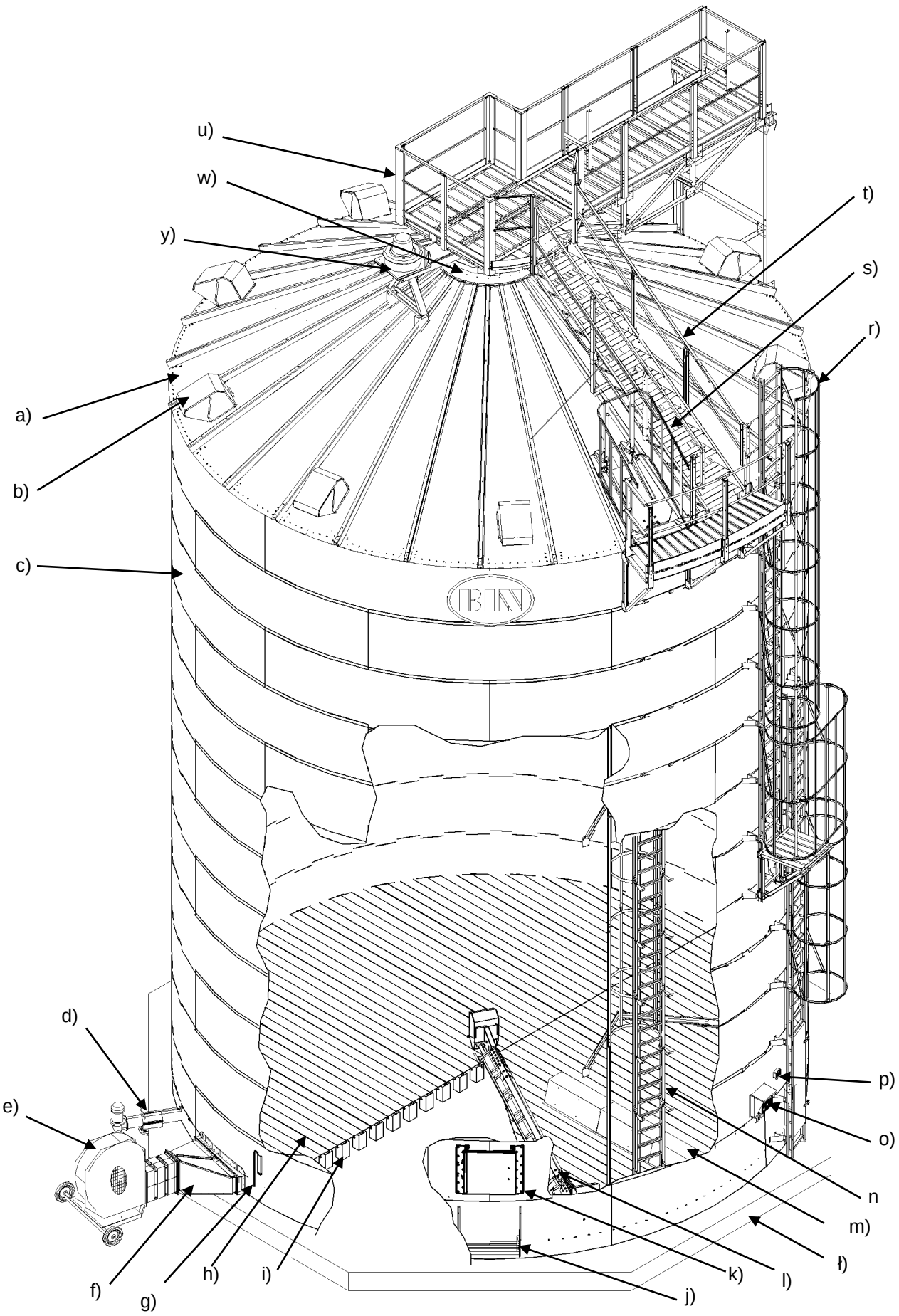


Figure 1. BIN silo design - diagram

a) SILO ROOF

Roofs in all BIN silos are conical, of hot-dip galvanised steel. Individual roof components (sections) are joined with steel screws with anti-corrosion coating. At the joints, roof sections are appropriately shaped, additionally strengthening the roof structure and ensuring its tightness. A special internal strengthening system has been implemented in silos of larger diameter, of the BIN500, BIN1000, and BIN1500 type. All prefabricated roof components (exhauster openings, roof hatch, and similar) are provided with special external embossing preventing precipitation (rain, snow, etc.) penetration into the silo.

b) VENT (EXHAUSTER)

A roof vent (exhauster) is a device installed on the silo roof. It is constructed of hot-dip galvanised metal sheets and ensures an appropriate level of grain ventilation. The vent (exhauster) design prevents penetration of precipitation or strong wind into the silo. Additional sealing is installed at a connection between the vent (exhauster) and the roof. Vents (exhausters) are installed in silos of the BIN60, BIN40, BIN100, BIN200, BIN500, BIN1000 and BIN1500 type.

c) SILO SHELL

The silo shell means its side cylindrical side walls, of hot-dip galvanised steel. The shell consists of components (sheets) joined with steel screws with anti-corrosion coating. The shell sheets are joined with an overlap, and additional seals are installed on joints, to ensure the highest possible tightness of the structure. A special internal strengthening system of components called stringers has been implemented in silos of larger diameter, of the BIN500, BIN1000, and BIN1500 type. Special strengthening rings of triangular cross-section are installed outside, maintaining the cylindrical shape of the shell (except for silos of the BIN10 and BIN20 type), The shell is connected to the silo roof with a roof connector in its upper part. In its bottom part it is supported on the foundation slab, to which it is connected with special connectors and expansion or chemical anchors. On the foundation slab side the silo shell must be sealed, usually with concrete overlay additionally secured with bitumen mass along the complete circumference of the silo shell base. More information is provided in this Operating Manual, section 3.4.5. Shell sealing at the base edge.

d) SILO UNLOADING

BIN silos are provided with components and equipment for their unloading. Furthermore, installation of various unloading machines, such as screw, scrapping, or belt conveyors, and similar.

UNLOADING SLEEVE

A rectangular duct installed in the silo. Its one end rests on the silo floor, while the other is connected to the silo shell. With the unloading sleeve, a conveyor, usually a screw conveyor, can be introduced into the silo to unload the silo through the sleeve outlet. The unloading sleeve is made of hot-dip galvanised steel, and it can only be installed in smaller silos, such as BIN20, BIN40, BIN60 and BIN100.

UNLOADING SACK-FILLING DEVICE AND AN ANTI-DYNAMIC PIPE OF A SACK-FILLING DEVICE

The sack-filling device is a discharge trough installed in the lower part of the silo shell. It is equipped with a shutter for adjustment of an outlet gap, which can be padlocked. With the sack-filling device the silo can be unloaded through an opening in its shell. It can be installed in silos of the BIN10, BIN20, BIN40, BIN60 and BIN100 type. In NBIN40WS, NBIN40WWS, NBIN60W, NBIN60WW andBIN100 silos an anti-dynamic pipe must be installed together with the sack-filling device. The anti-dynamic pipe is a device installed in the silo. It prevents too fast outpour of the stored material (grain) from the silo, because otherwise the silo could be damaged. Both the sack-filling device and the anti-dynamic pipe are made of hot-dip galvanised steel.

UNLOADING CONVEYORS

Various underfloor unloading conveyors can be installed in the silos. BIN manufactures two types of universal screw conveyors that can be used for underfloor unloading of the silos. The screw conveyors of the nominal diameter of 160 mm and the screw conveyors of the nominal diameter of 220 mm. They are provided with a special central inlet with a control shutter for connection to the silo floor. The conveyors transport the unloaded material (grain) outside the silo, and they can also be connected with other transport equipment, including bucket elevator and scrapping, or belt conveyors, using special connectors. Detailed information on BIN conveyors and possibilities to use them in silos is provided in the operating manual "SCREW CONVEYORS".

e) ACTIVE VENTILATION EQUIPMENT - FANS/HEATERS

The air passes through perforated floor and then through the material (grain) in the silo, and this way the material is ventilated. Issues related to correct ventilation and correct storage of material kept in the silo and selection of an appropriate fan suitable for the silo are described in further sections of this Operating Manual. When the material for storage has too high moisture content, temperature, or other parameters, then it must be dried additionally by active ventilation. This drying method can be used in silos of the BIN10 to BIN200 type. For larger silos, it is recommended to store material only of optimal parameters.

To increase intensity of the active ventilation process, an electrical heater is used, heating air supplied by the fan. The heater is a flow-through electrical device installed between the fan and the air inlet into the silo.

The following heaters are manufactured:

- NG-310-4.5 heater, of 310mm in diameter and 4.5kW power,
- NG-310-9.0 heater, of 310mm in diameter and 9kW power.

Detailed information on BIN heaters and possibilities to use them in silos is provided in the operating manual "ELECTRICAL AIR HEATER".

f) AIR INLET

Air inlets enable connecting an appropriate fan to the silo. BIN manufactures and equips its silos with the following air inlets:

-an air inlet of 310 mm in diameter for silos of the BIN10, BIN20, BIN40S, BIN60 and BIN100 type,
-an air inlet of 400 mm in diameter for silos of the BIN200, BIN500, BIN1000 and BIN1500 type,
- a universal air inlet for silos of the BIN200, BIN500, BIN1000,and BIN1500 type

The fan can be connected to the air inlet through a special connection (a confusor). All air inlets are made of hot-dip galvanised metal sheet.

Furthermore, in silos equipped with a universal air inlet, one fan can be installed for two adjoining silos, when a special air splitter is used.

g) MANOMETER

The water manometer is a simple device for determining pressure of air flowing through a layer of material (grain) stored in the silo. Its use is described in further chapters of this Operating Manual, using a special diagram. The manometer is always installed near the air inlet.

h) SILO FLOOR

The floor is a structural component of the silo, on which the material (grain) is stored). In all BIN silos the floor is installed at a certain height above the foundations, to facilitate active ventilation. it is made of hot-dip galvanised steel and its whole surface is perforated (with openings for air flow). BIN manufactures a special system for additional sealing of the floor for oilseeds (rapeseed) and other fine materials, to ensure the best ventilation results and safe storage.

i) PERFORATED FLOOR SUPPORTS

Installation of silos of the BIN10 to BIN1500 type requires concrete floor supports (concrete blocks) in quantities specified below *(Table 3)*. They have a form of:

- cuboids of 14cm x 12cm x 25cm.

Supports must be made of at least C16/20 concrete.

Concrete floor supports should be purchased from BIN.

It is forbidden to use supports other than concrete, including lime and sand ones.
It is forbidden to use supports of other dimensions.

Table 3. Concrete blocks - technological quantity (quantity of blocks in the construction design, required for the silo assembling). Commercial quantity includes an additional reserve.

Silo type	*Silo model*	*Technological quantity of concrete blocks [pcs]*	*Commercial quantity of concrete blocks [pcs]*
BIN 10	NBIN10, NBIN10W	26	28
BIN 20	NBIN20N, NBIN20, NBIN20R, NBIN20W, NBIN20WR, NBIN20WW	71	75
BIN40	NBIN40NS, NBIN40S, NBIN40WS, NBIN40WWS	112	120
BIN 60	NBIN60, NBIN60R, NBIN60W, NBIN60WR, NBIN60WW	134	144
BIN 100	NBIN100U, NBIN100RU, NBIN100WU, NBIN100WRU, NBIN101U, NBIN101WU	176	200
BIN 200	NBIN200U, NBIN200WU	378	400
BIN 500	NBIN500, NBIN501, NBIN500W, NBIN501W	752	800
BIN 1000	NBIN1001, NBIN1001W	1536	1600
BIN 1500	NBIN1500_N, NBIN1500_P	1617	1800
	NBIN1500, NBIN1500_W	2144	2200

j) BOTTOM PLATFORM

The bottom platform is a component facilitating access to the silo through the bottom manhole. It is made of hot-dip galvanised steel sheets, with an anti-slip surface to ensure safety of its use. It is screwed to the silo shell with M8 screws, below the bottom manhole and is a standard equipment for all silos with the bottom manhole.

k) BOTTOM MANHOLE

The double-door bottom manhole provides access into the silo and equipment installed inside. The inner door with a lock opens into the silo. The outer door acts as a cover and opens to the outside of the silo. The manhole is made of hot-dip galvanised steel and installed at ca. 95 cm above the foundations surface. In the body, a special connection is made for installation of the limit switch stopping the equipment in the event the manhole is opened accidentally. BIN Sp. z o.o. designed installation of the bottom manhole in silos of the BIN20 to BIN1500 type.

l) INTERNAL SCREW CONVEYOR

The internal screw conveyor, PSW, is a device installed in the silo that supports unloading. It allows unloading of that part of grain (*Table 10*) that did not get gravitationally into the unloading underfloor conveyor. Cooperating underfloor and internal conveyors allow to unload the silo practically completely. The internal screw conveyor (PSW) transports the grain along the silo radius to the centrally located inlet, at the same time travelling around the silo axis clockwise (when looking down towards the silo floor). The grain is gradually unloaded, until nearly full circle is made.

The internal screw conveyor cannot be installed alone in the silo - it always works together with the unloading underfloor screw-conveyor.

The following PSW conveyors are manufactured:

-PSW60 for silos of the BIN60 type;
-PSW220-BIN100 for silos of the BIN100 type;
-PSW220-BIN200 for silos of the BIN200 type;
-PSW500 for silos of the BIN500 type;
-PSW1000 for silos of the BIN1000 type;
-PSW1500 for silos of the BIN1500 type.

Detailed information on BIN conveyors and possibilities to use them in silos is provided in the operating manual "SCREW CONVEYORS".

ł) FOUNDATION SLAB

A correctly designed and constructed foundation slabs is one of preconditions for correct installation, and safe and failure-free operation of a silo.

- guidelines for designing foundation slabs

- geotechnical conditions - when designing foundation slabs for BIN silos, local geotechnical conditions should be considered;
- minimum thickness and shape of the slab:
  for BIN10 silos – a 200 mm-thick, rectangular slab
  for BIN20 ÷ BIN1000 silo range – a 300 mm (350 mm for BIN200) thick, octagonal slab;
  for BIN1500 silos – a 300 mm-thick, circular or octagonal slab
- foundation load (grain in the silo plus the silo with the standard equipment):
  for the BIN10–BIN100 silo range – up to 65 kPa;
  for the BIN200–BIN1500 silo range – up to 135 kPa;
- minimum concrete class:
  for the BIN10–BIN100 silo range – C16/20 (B20);
  for the BIN200–BIN1500 silo range – C20/25 (B25);
- reinforcement:

  Reinforcement is a necessary component of the foundation slab and must be constructed in accordance with the guidelines provided in the construction design for a relevant silo.

  The investor is responsible for development of the construction design. The construction design, considering the geotechnical conditions and geometrical guidelines from the BIN company (
  *Figure **2** Figure 3*
  *Figure **4***), must be developed by a designer holding relevant licences;

- Conditions for foundation slab construction and acceptance

- a topsoil layer and non-load bearing layers under the foundation slab must be removed;
- backfill the dug pit with sand laid in layers of ca. 30 cm and compacted to Id=0.6 – 0.7;
- construct sand and cement bedding, class 7.5–10 MPa (substrate of B7.5–B10 lean concrete), 150 mm thick;
- draining holes must be drilled in the foundation slab, to drain water that may accumulated under the silo floor;
- for silos installed in a row or in a cluster, foundations of individual silos must be separated with expansion joints;
- when pouring concrete for foundation slabs, it is important to maintain the slab dimensions and to correctly (horizontally) trowel the upper slab surface (a difference between the lowest and the highest point on the foundation slab cannot exceed 10mm), it is obligatory to vibrate the concrete;
- acceptance of the foundation slabs in a presence of the installing team manager and an investor representative is a prerequisite for starting silo installation;
- when the foundation slab is not constructed correctly, installation of the silo may be cancelled;
- foundation slabs must be constructed in such way that a difference between the slab surface and the surrounding ground does not exceed 10cm. When the difference between the slab surface and the surrounding ground exceeds 10 cm, the investor is obliged to ensure an appropriate access level for the side manhole, an external ladder, or stairs and other equipment installed on the silo. An appropriate access level must be constructed in accordance with current legislation.
- when a difference between the slab surface and the surface of the ground surrounding the slab exceeds 40cm, the investor must ensure a temporary installation platform on the whole slab circumference;
- the platform must be constructed in accordance with current legislation and be at least 60 cm wide;
- when this platform is not provided, installation of the silo is not possible for safety reasons and technical conditions;
- BIN Sp. z o.o. shall not be held responsible for any silo damage and other damage resulting from incorrect design and construction of the foundation slab.

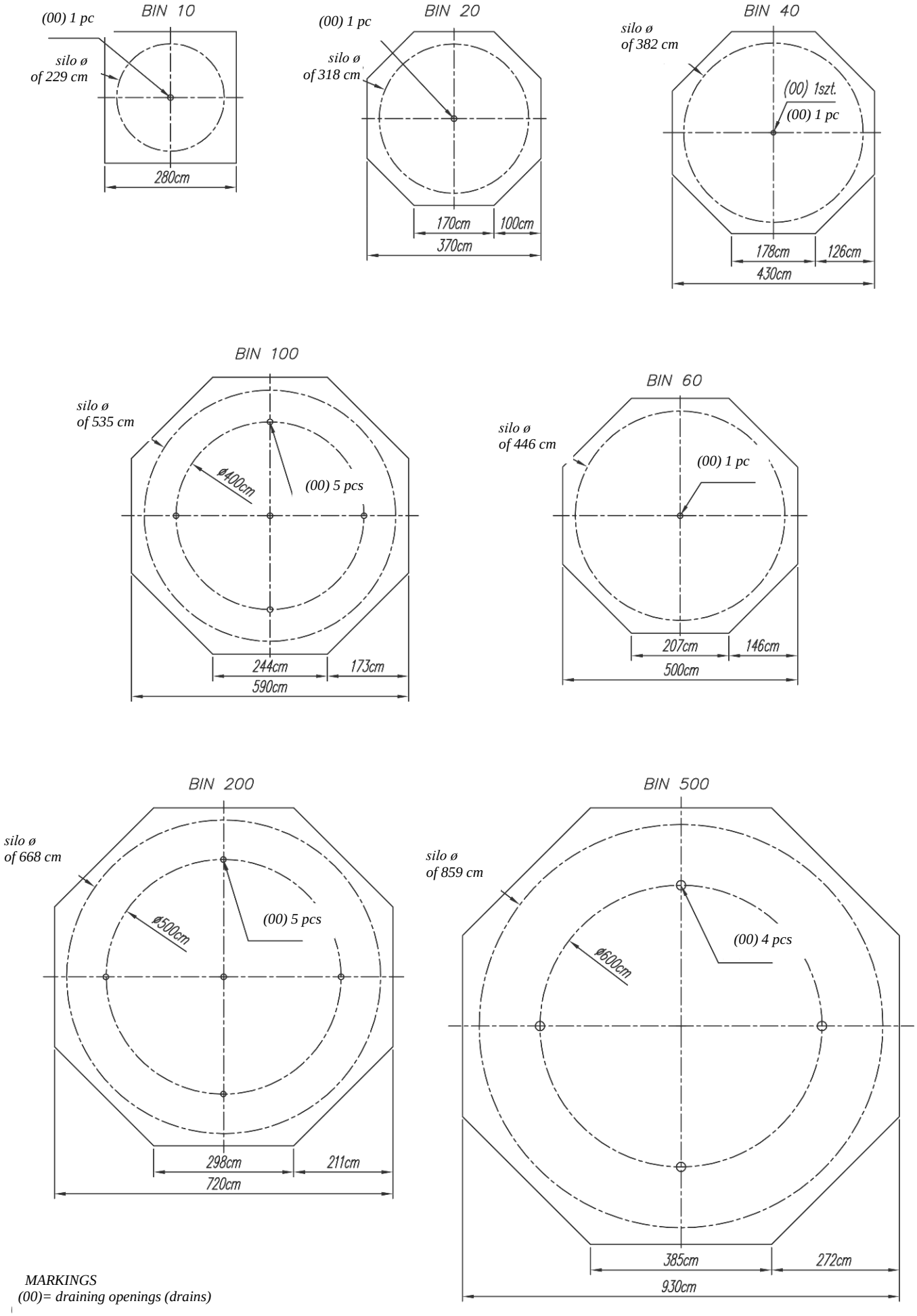
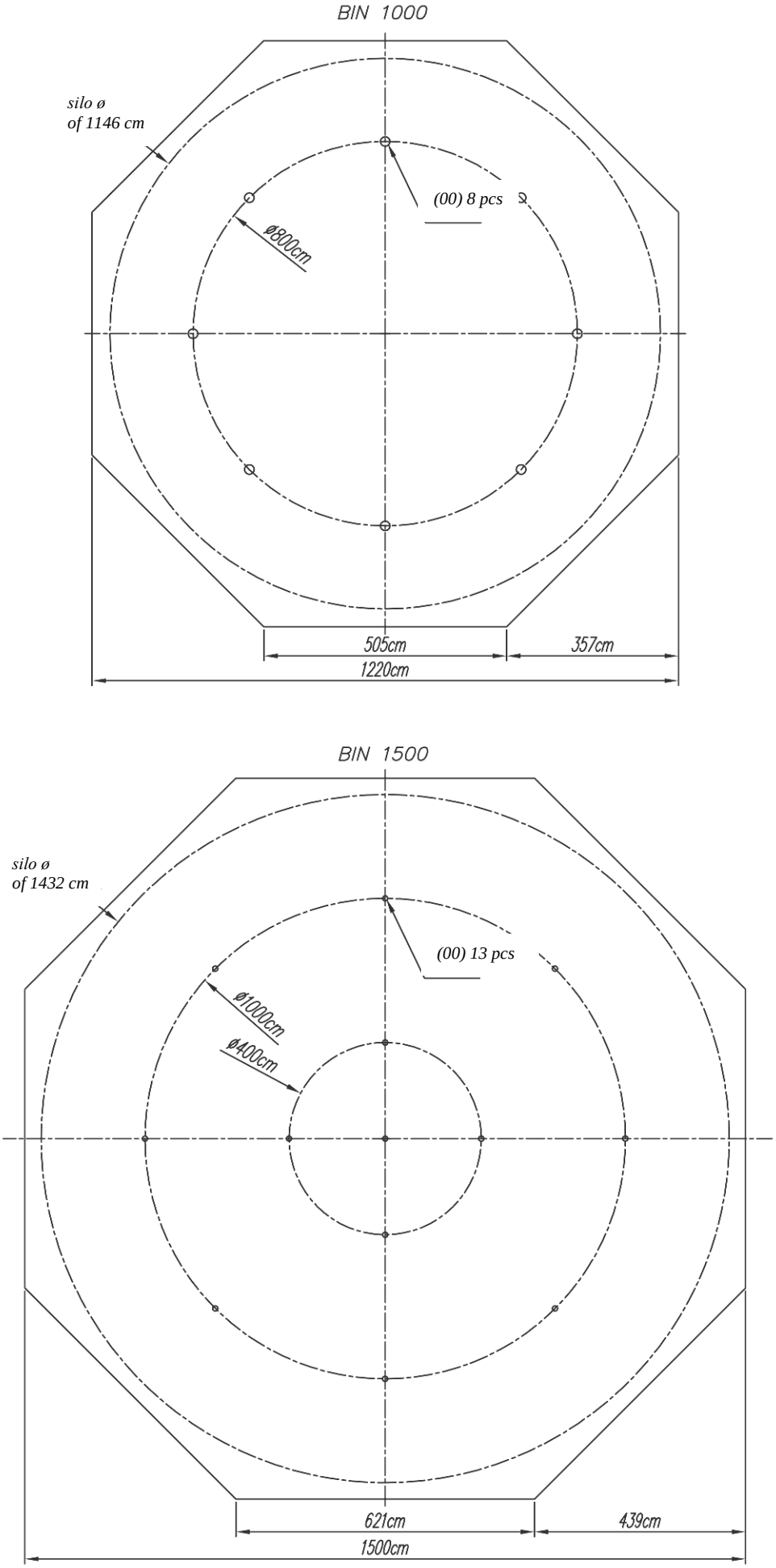


Figure 2. Foundation slab characteristics for silos of the BIN10 to BIN500 type.



MARKINGS
(01)= draining openings (drains)

Figure 3. Foundation slab characteristics for silos of the BIN1000 and BIN1500 type.

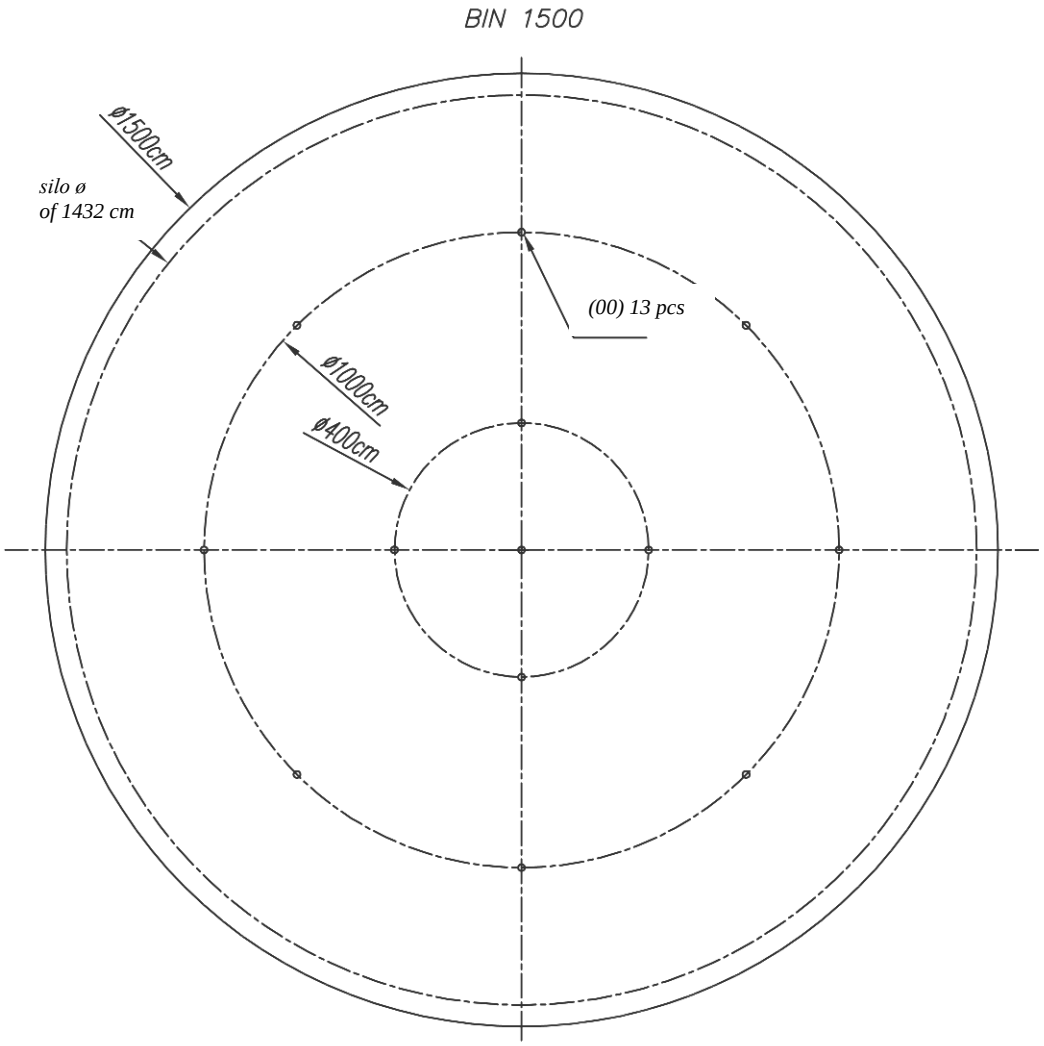


Figure 4. Foundation slab characteristics for silos of the BIN1500 type (circular slab)

m) EMERGENCY DUCT

In silos of the BIN40 to BIN1500 type, an option for the emergency unloading is foreseen, through a special emergency unloading duct. It is necessary when the inlet into the underfloor unloading device is blocked or in the event of the failure of that device, when it is not possible to repair it in the loaded silo. The duct can be used for inserting into the silo a conveyor to transport the material outside the silo. It should be installed on the silo floor, near the internal ladder. All emergency ducts are made of hot-dip galvanised steel. The emergency duct is not designed for normal unloading of the silo.

n) INTERNAL LADDER

The internal silo ladder is a vertical ladder with a fixed safety cage. It is fixed to the silo shell with special supports. All silos equipped with the internal vertical ladder must also have a roof hatch. The internal ladder provides access to the material (grain) in the silo through the roof hatch. Access is possible using a special harness protecting from a fall from height, and when special precautions are observed.

o) SILO CONTROL MODULE MKS-100/2

The Silo Control Module is a device designated for BIN silos, and having a control and protective function. MKS-100/2 may control and inform a user about a maximum acceptable filling of the silo with stored material and whether access manholes to the silo are closed. The silo control module can be used to connect machines, unloading/loading equipment or active ventilation, with a function for their control and switch off to:

- secure against access to the silo interior during loading, unloading or active ventilation;
- prevent silo overfilling by switching the loading devices off at an appropriate time. Stopping of the loading equipment after loading the silo does not prevent starting the silo unloading equipment.

p) MEASUREMENTS OF GRAIN TEMPERATURE IN THE SILO

The temperature of grain in the silo is one of the most important parameters informing about the grain condition. The increase in the grain temperature indicates a significant intensity of biological processes, usually caused by too high moisture content in the grain. The temperature should be measured with an electronic thermometer STW-100 (*Figure 5*) with a multi-point probe for temperature measurements of grain stored in the silo (in its whole volume).

The STW-100 thermometer consists of two basic units: a temperature reader and a measuring probe. Regardless of a number and types of measuring probes, one reader is sufficient to operate all of them in all cases. A reader is a device with a display, on which the user reads out the temperature on individual sensors of the measuring probe. The measuring probe consists of temperature sensors spaced every 1 m along its length. All sensors are connected with an electrical cable routed outside the silo and ending with a connecting plug for connection of the temperature reader.

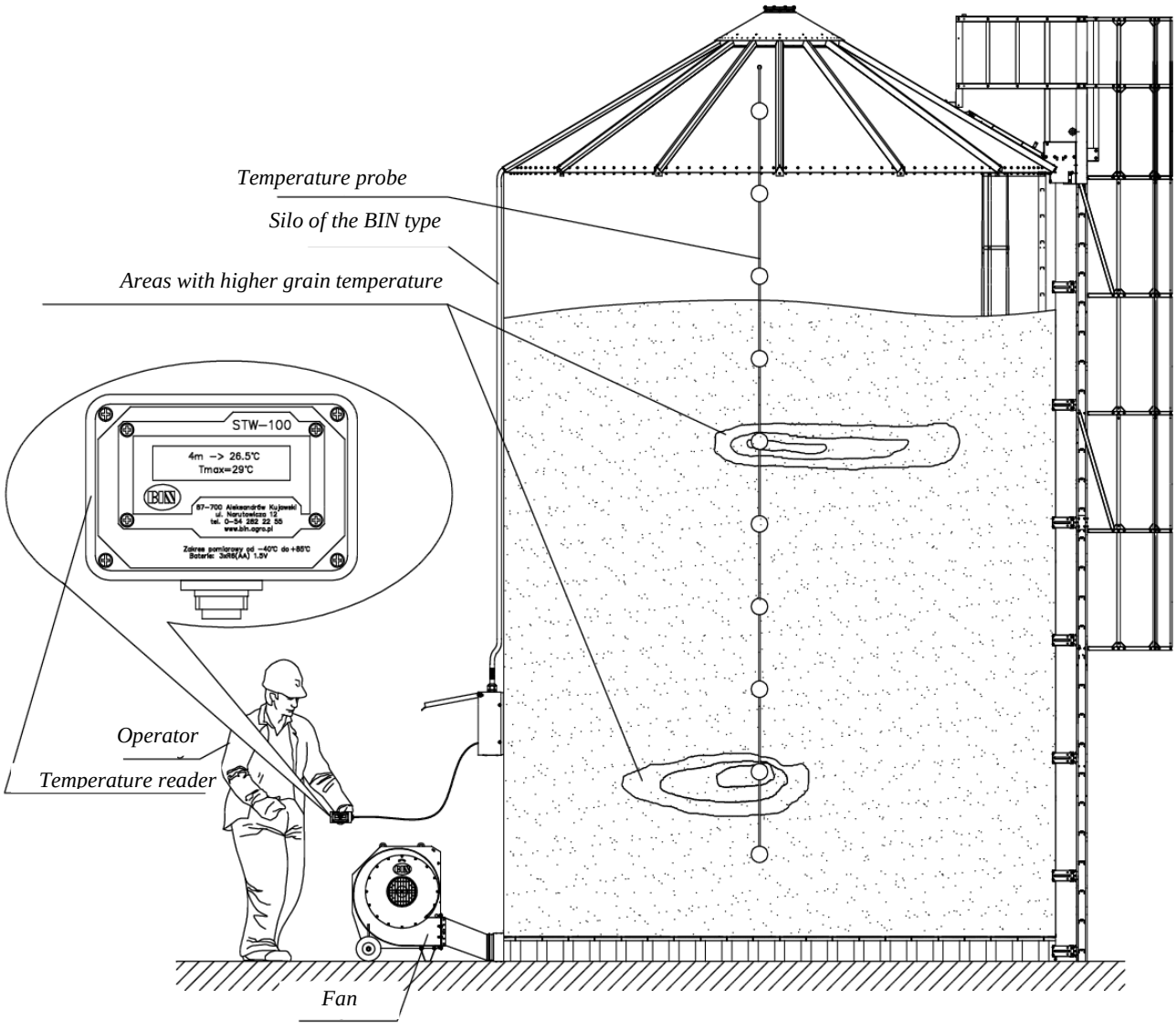


Figure 5. Design and a principle of operation for the STW-100 temperature sensor.

Regardless of the measuring method, when the temperature is found to be too high, immediately start airing grain to reduce its temperature.

During temperature measurements stay on the internal ladder of the silo.
It is forbidden to climb onto the grain pile in the silo.

r) EXTERNAL LADDER/SPIRAL STAIRS

Access to places of use and operation in upper parts of BIN silos is provided by installation of an external ladder or a spiral staircase. The external ladder is a vertical ladder with a fixed safety cage, and provided with a door preventing an accidental access to the ladder by unauthorised persons. The door securing the ladder is adapted to installation of the limit switch stopping the equipment in the event the door is opened accidentally. Higher silos are equipped with ladders with a landing. All ladder components are hot-dip galvanised.

The spiral staircase is a solution alternative to the external ladder, ensuring access to places of use and operation in upper parts of the silo. This is a ladder-type staircase, with two security railing, available for silos of the BIN200, BIN500, BIN1000, and BIN1500 type. The staircase is provided with a security door, having an identical function as in a case of ladders.

s) ROOF MANHOLE

The roof manhole with a platform and a security cover provides access to the upper part of the silo. The manhole is a standard silo equipment. It is not allowed to install a roof manhole without an internal ladder. When a roof manhole is installed in the silo, it must be provided with an external access. This access can be ensure through an external ladder, a spiral staircase or indirectly through a service catwalk and roof stairs. All silos manufactured by BIN are provided with an access to the inside in their upper part. All components of the roof hatch and the silo cover are hot-dip galvanised.

t) ROOF STAIRS

Roof stairs are used to provide access from outside to devices and units in the top part of the silo roof. When access to these places is ensured in other way, e.g., through a service catwalk or a relevant lifting equipment, then installation of roof stairs is not required. Roof stairs can be installed on BIN silos, except for silos of the BIN10, BIN20, BIN40 and BIN60 type. Silos of the BIN1500 type are equipped with roof stairs with a landing. All stair components are made of hot-dip galvanised steel.

u) SERVICE CATWALK/COLLAR PLATFORM

Service catwalks enable correct use and maintenance of silos, particularly when several silos are arranged in a row. They belong to additional silo accessories. They ensure safe and easy installation and operation of various equipment for grain transport. The catwalk structure is based on a system of profiles made of hot-dip galvanised metal sheets. Service catwalks are intended to be installed on silos of the BIN60, BIN100, BIN200, BIN500, BIN1000, and BIN1500 type.

When installation of the service catwalk is not necessary then the collar platform can be used as a unit ensuring access to equipment located in the top part of the roof. Collar platforms are intended to be installed on silos of the BIN100, BIN200, BIN500, BIN1000, and BIN1500 type. Detailed information on BIN service catwalks and possibilities to use them in silos is provided in the operating manual "BIN SERVICE CATWALKS".

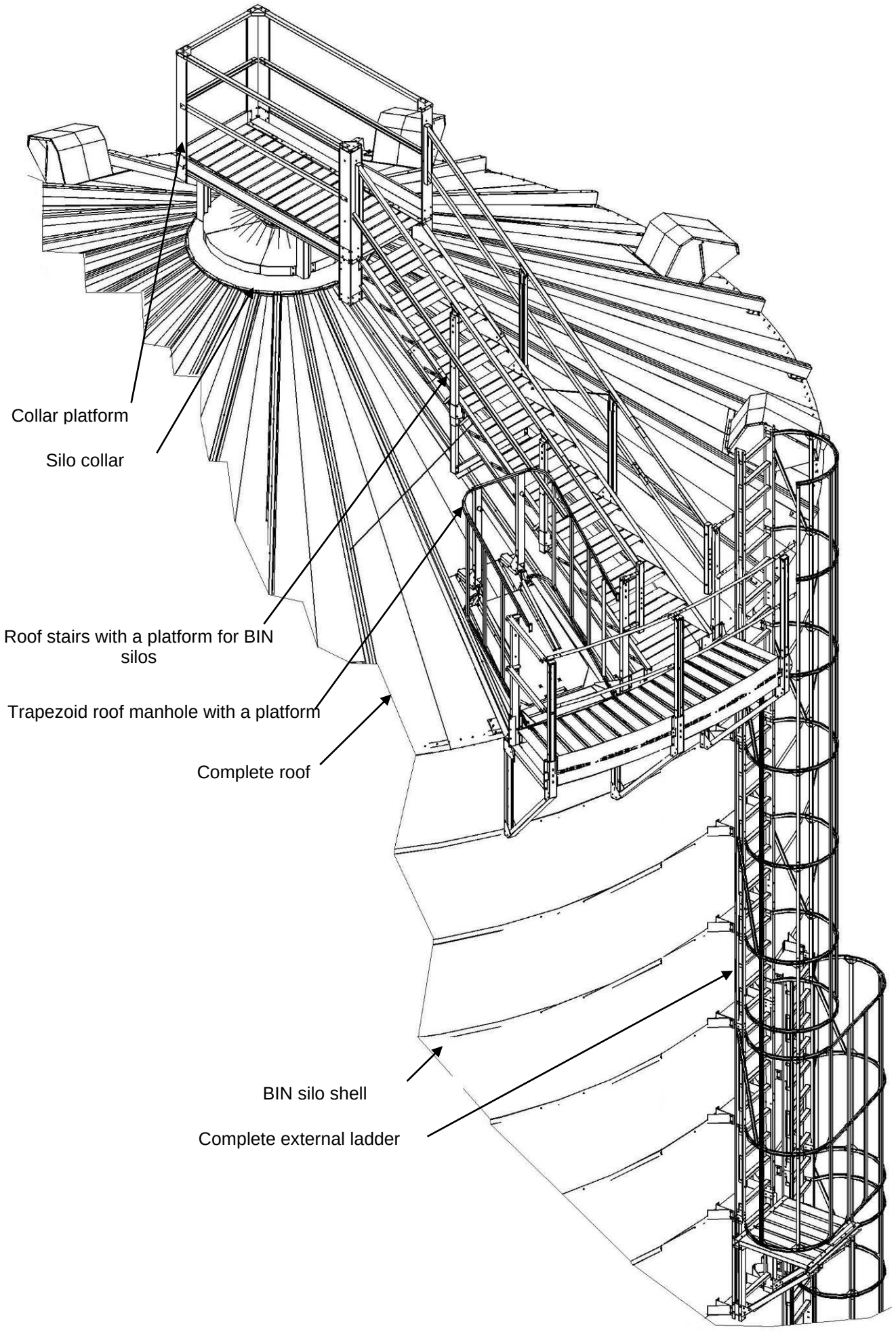


Figure 6. A diagram showing a silo of the BIN type with a collar platform.

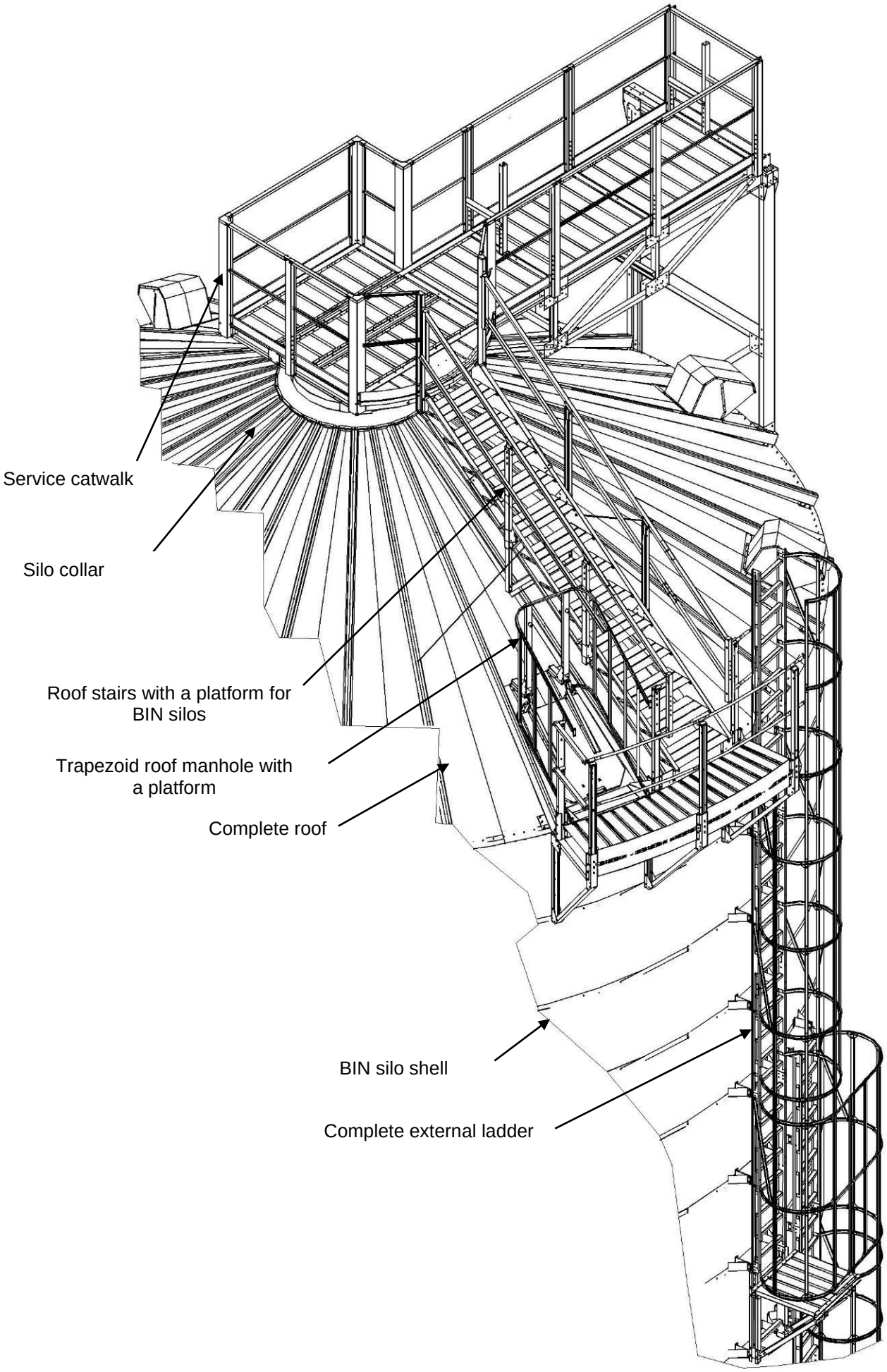


Figure 7. A diagram showing a silo of the BIN type with a service catwalk.

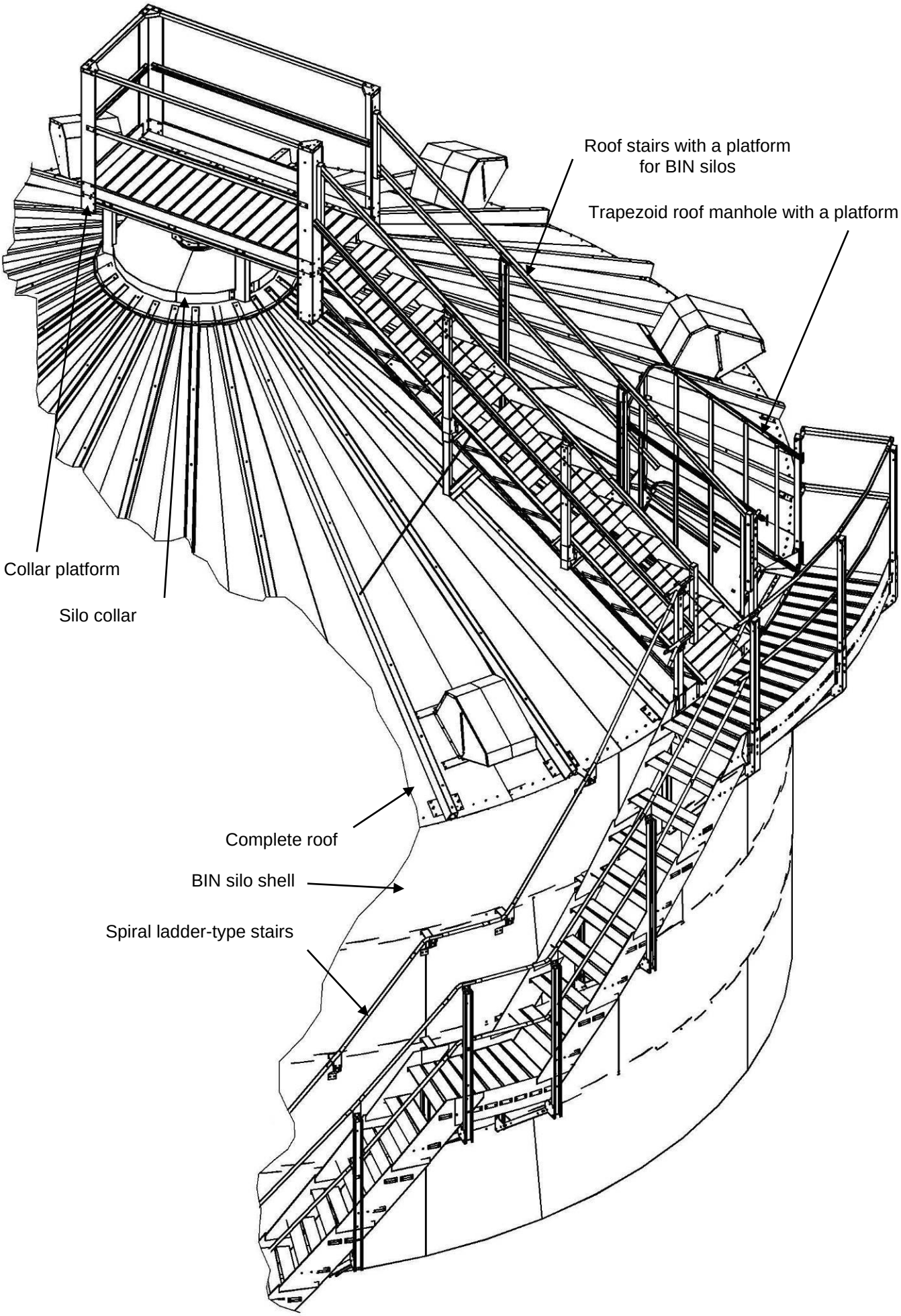


Figure 8. A diagram showing a silo of the BIN type with spiral ladder-type stairs.

w) LOADING INLET

All BIN silos are adapted to loading through special loading inlets. In larger silos of the BIN1500, BIN1000, BIN500 and NBIN200W type, loading can be done only through a central loading inlet (of ca. 200 mm in diameter in NBIN200WU silos and of 300 mm in other silos mentioned above) installed in the silo collar. In smaller silos, of the BIN10, BIN20, BIN40, BIN60, BIN100, NBIN200NU, and NBIN200U type, pneumatic loading through a side loading inlet installed in the silo shell is acceptable. In silos of the BIN10, BIN20, BIN40, BIN60, BIN100, NBIN200NU, and NBIN200U type, the central loading inlet (of ca. 200 mm in diameter) installed in the silo collar or a side loading inlet installed in the silo shell can be used. Furthermore, the loading inlet of 200 mm in diameter can be equipped with a hopper with a flap, where the inlet can be closed and opened from the ground level using the control line. This solution is particularly useful when portable loading equipment, temporarily connected to the silo, is used. It does not require providing means of access to connect the conveyor to the silo. When the central loading inlet is used, the silo can be filled with stored material to its maximum loading capacity.

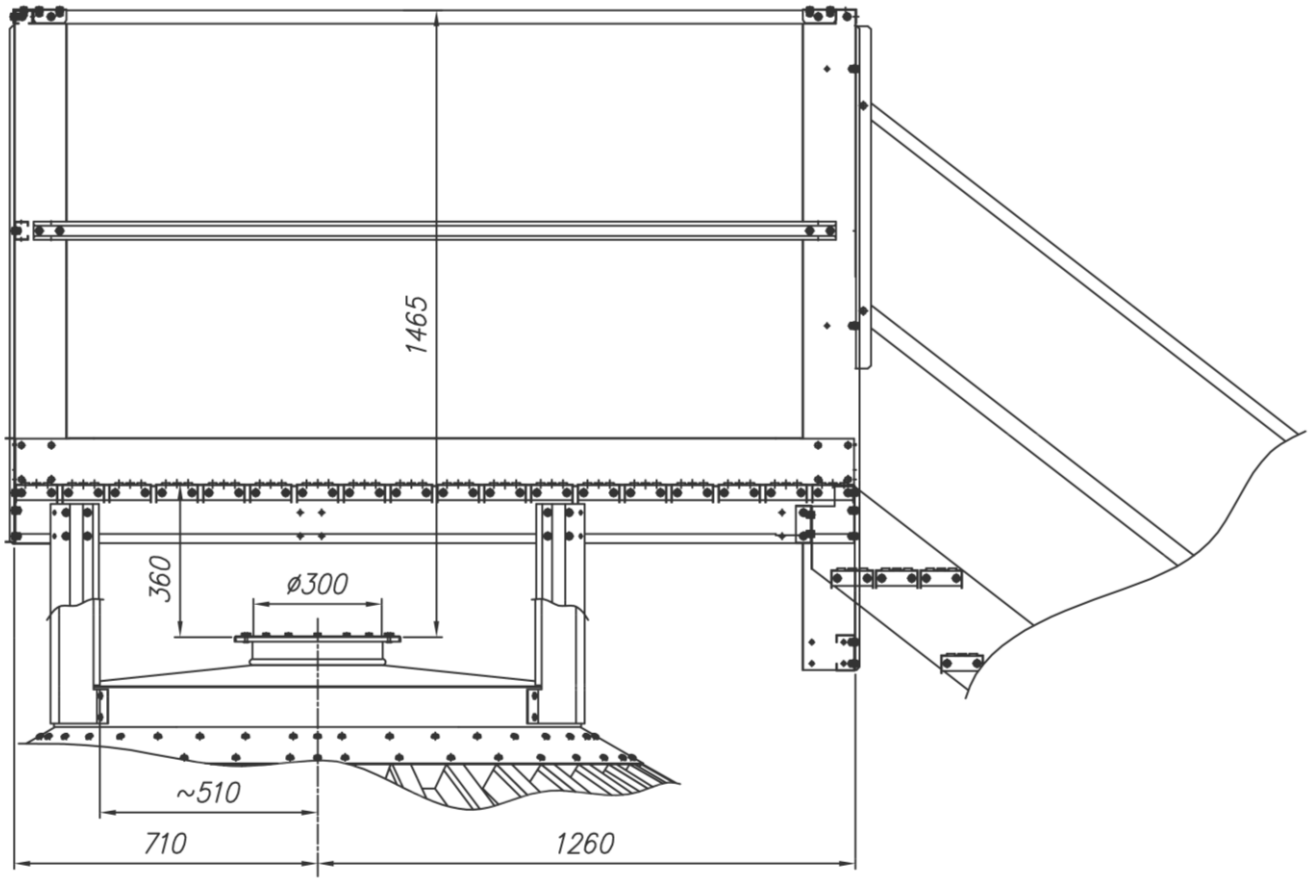


Figure 9. A diagram showing a central loading inlet together with conditions and options for connecting loading equipment to the collar in silos of the BIN500, BIN1000 and BIN1500 type with the collar platform installed.

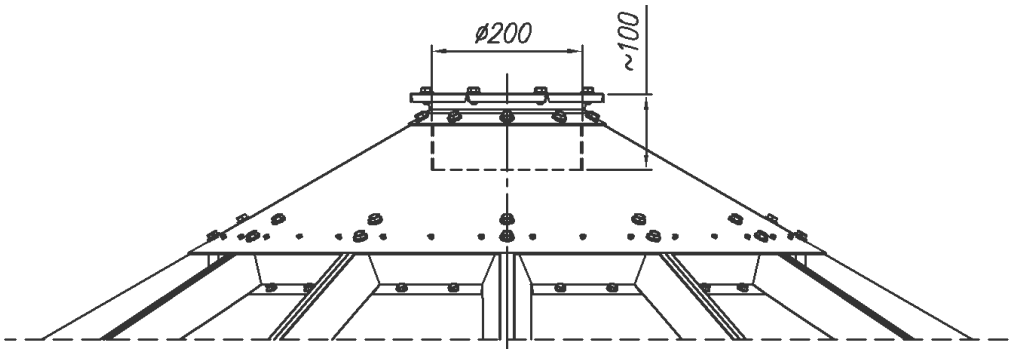


Figure 10 A diagram showing a central loading inlet together with conditions and options for connecting loading equipment to the collar of silos of the BIN10, BIN20, BIN40 and BIN60 type.

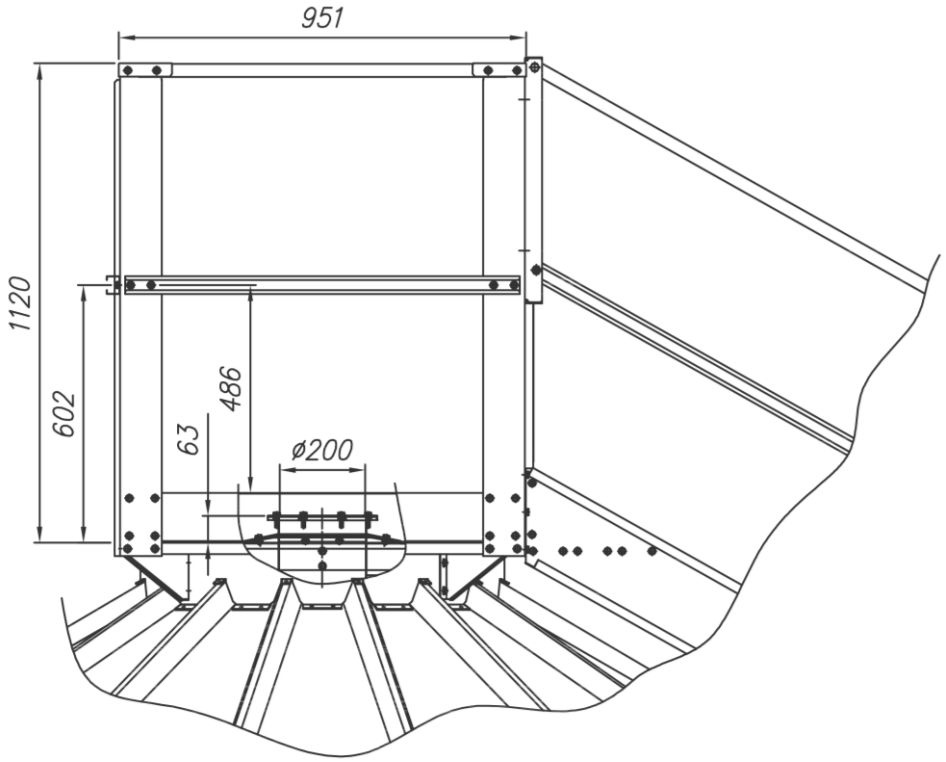


Figure 11 A diagram showing a central loading inlet together with conditions and options for connecting loading equipment to the collar of silos of the BIN100 and BIN200 type.

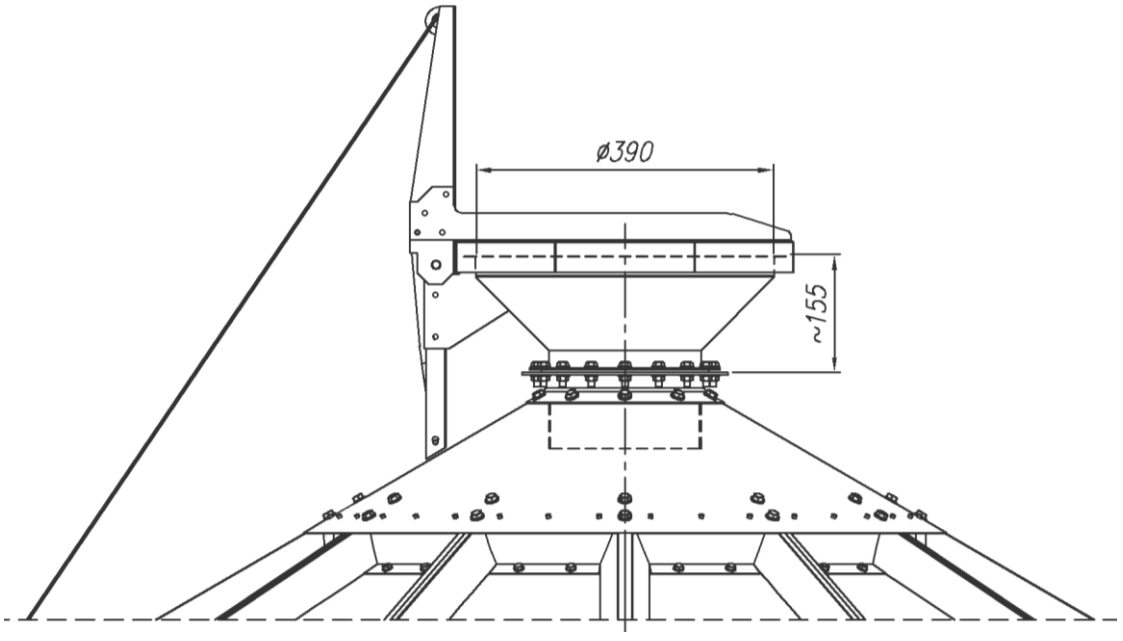


Figure 12 A diagram showing a central loading inlet of 200 mm in diameter equipped with a hopper with a flap, with the inlet opened and closed from the ground level.

y) SUCTION FAN

A radial suction fan with a side outlet is an additional equipment in the BIN silos. It is designated for ventilation of a space above grain stored in the silo. During the technological process of storage of corn and maize grain, and oilseeds, contaminations are formed in the air being in a direct contact with stored material. Usually, the air is contaminated with excessive water, various dust, and similar. To improve safe storage conditions in the silos the contaminated air must be removed. Silo ventilation is also recommended during loading and unloading, and cleaning of the silo. The fan should be installed using a special duct in the upper part of the silo. It is recommended to construct an electrical system in such way that the exhaust fan is switched on each time when loading and/or unloading equipment, as well as active grain ventilation is switched on. Ventilation should be conducted throughout the grain loading, unloading or active ventilation. When the exhaust fan is used this way, accumulation of large quantities of dust in the silo is limited.

Basic technical characteristics of the suction fan: type WVPKH-250, power supply 3~, engine power 0.55 kW, engine rotations 1380 rpm, engine current 1.5 A, max. capacity 4040 m^3/h, weight 25 kg.

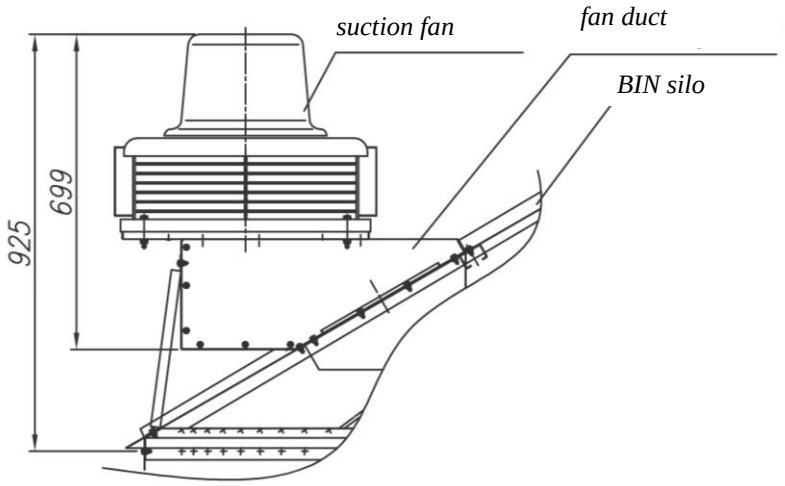


Figure 13. *A suction fan installed on silos of the BIN10, BIN20, BIN40, BIN60, BIN100 and BIN200 type.*

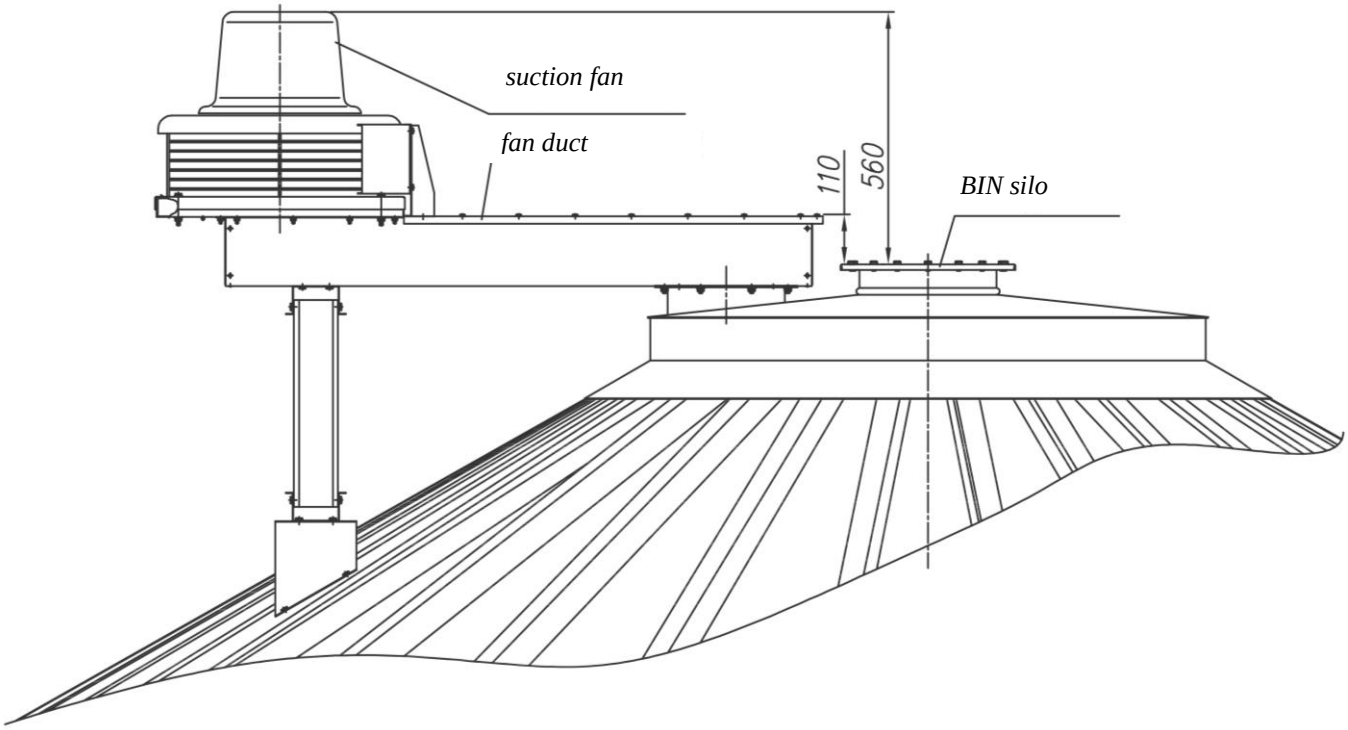


Figure 14. A suction fan installed on silos of the BIN500, BIN1000, and BIN1500 type.

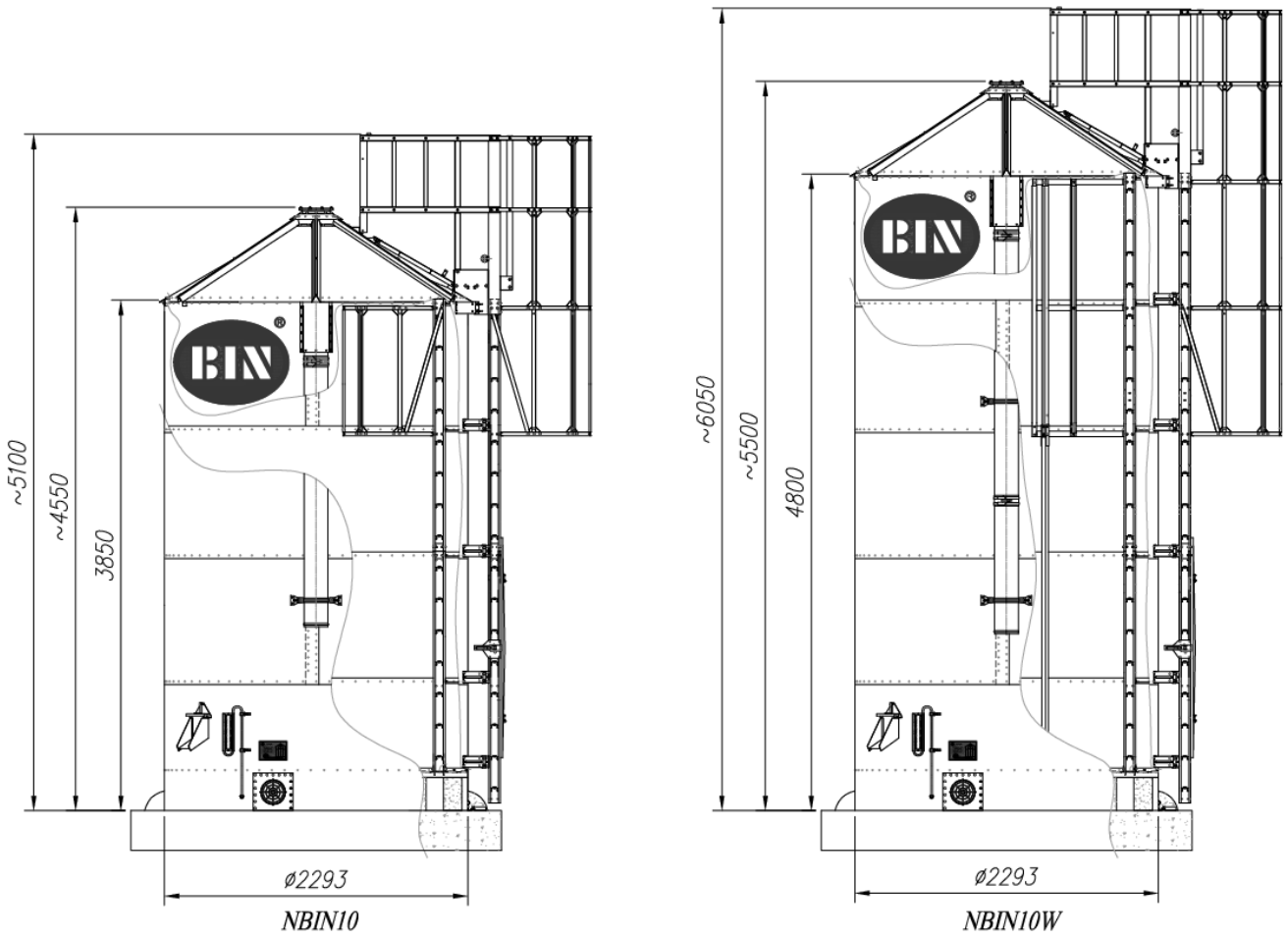


Figure 15. A construction diagram for silos of the BIN10 type (model: NBIN10 and NBIN10W)

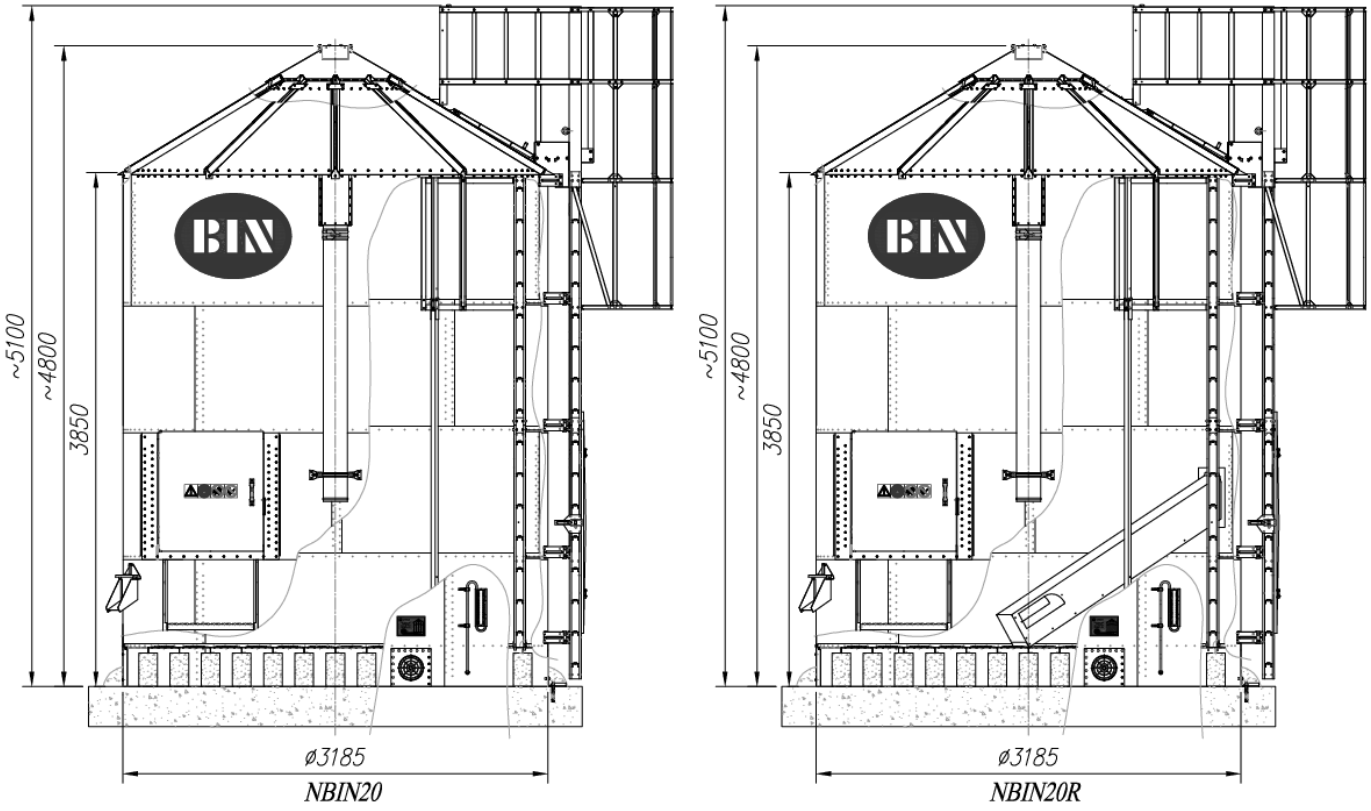


Figure 16. A construction diagram for silos of the BIN20 type (model: NBIN20 and NBIN20R)

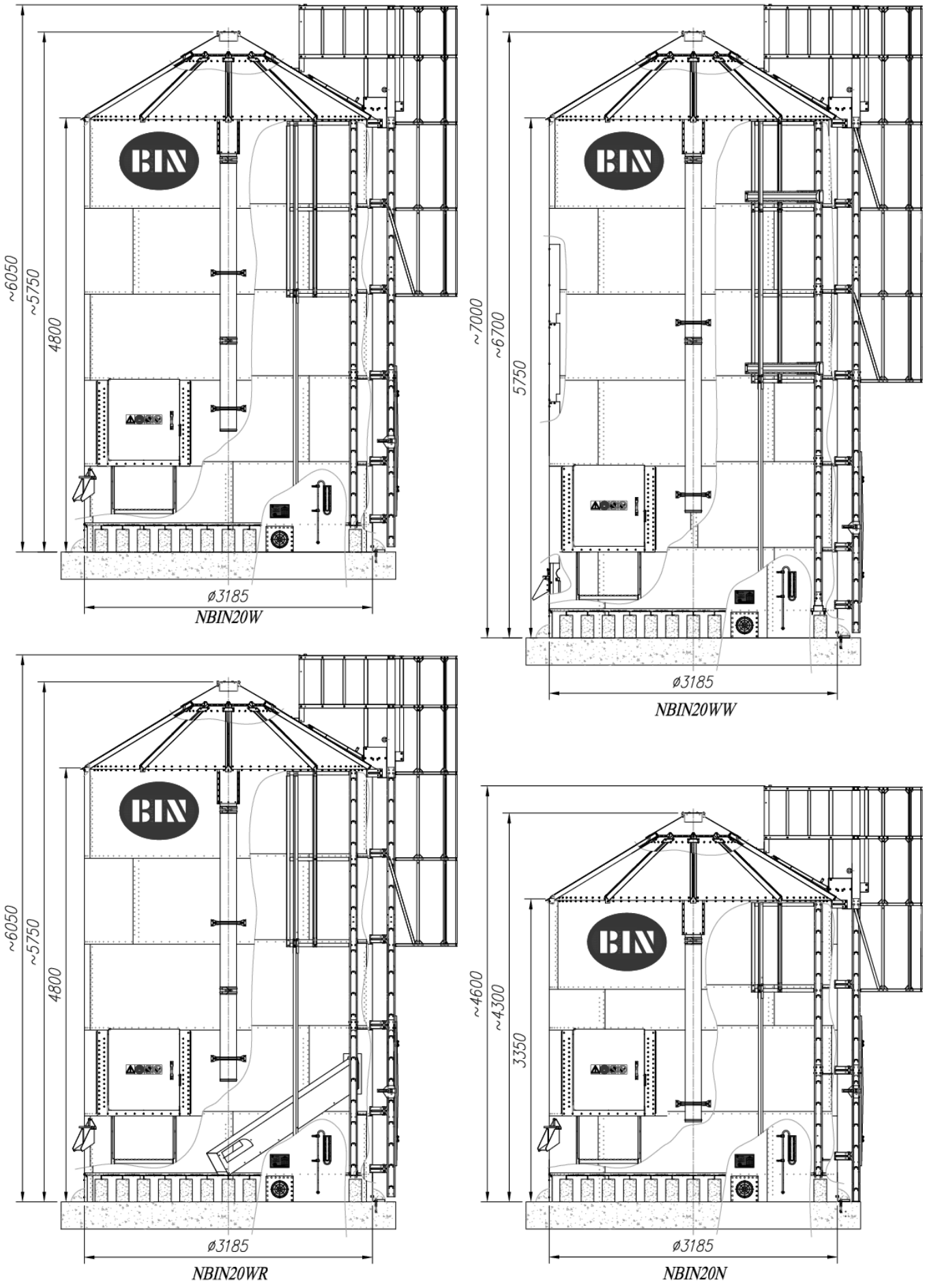


Figure 17. A construction diagram for silos of the BIN20 type (model: NBIN20N, NBIN20WR, NBIN20W and NBIN20WW)

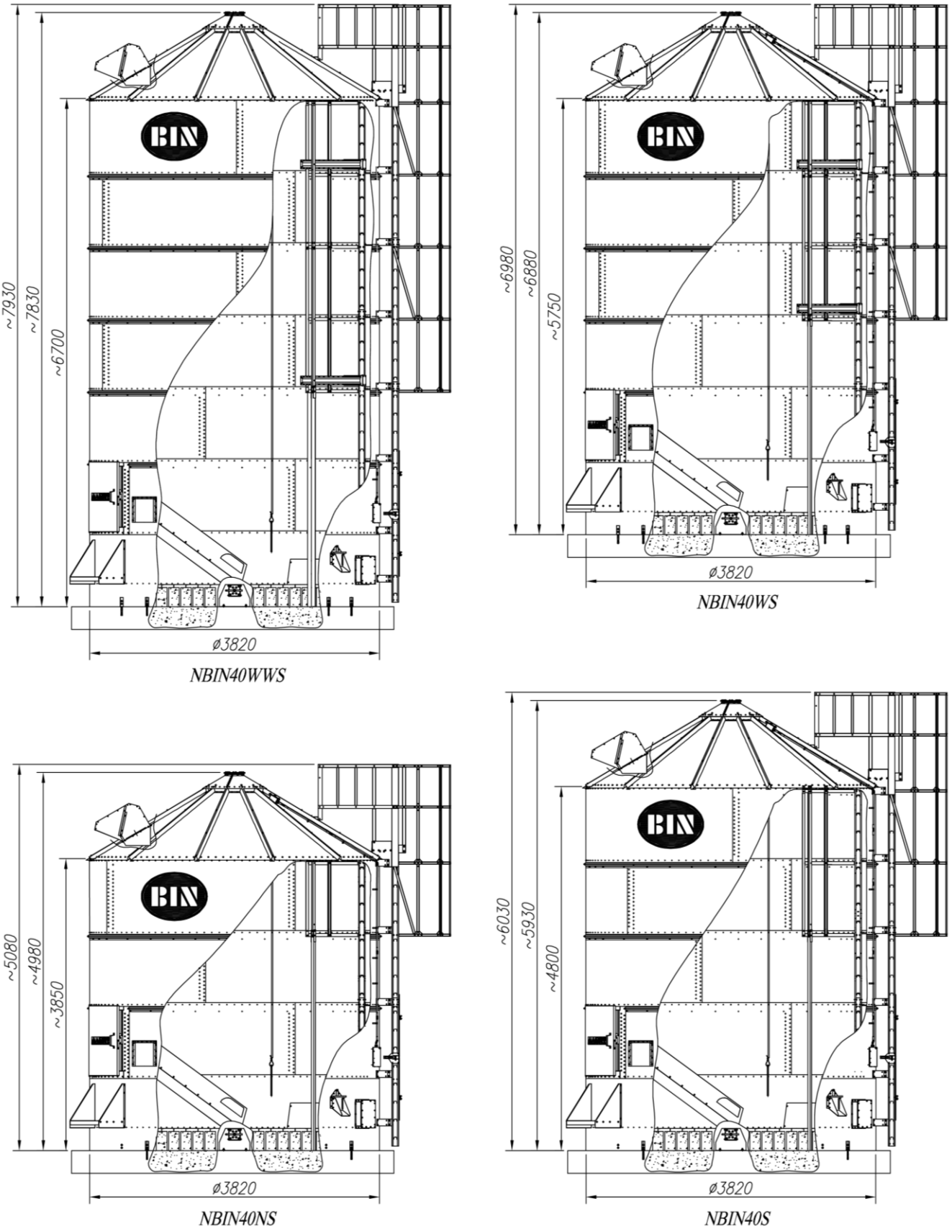


Figure 18. A construction diagram for silos of the BIN40 type (model: NBIN40NS, NBIN40S, NBIN40WS, and NBIN40WWS)

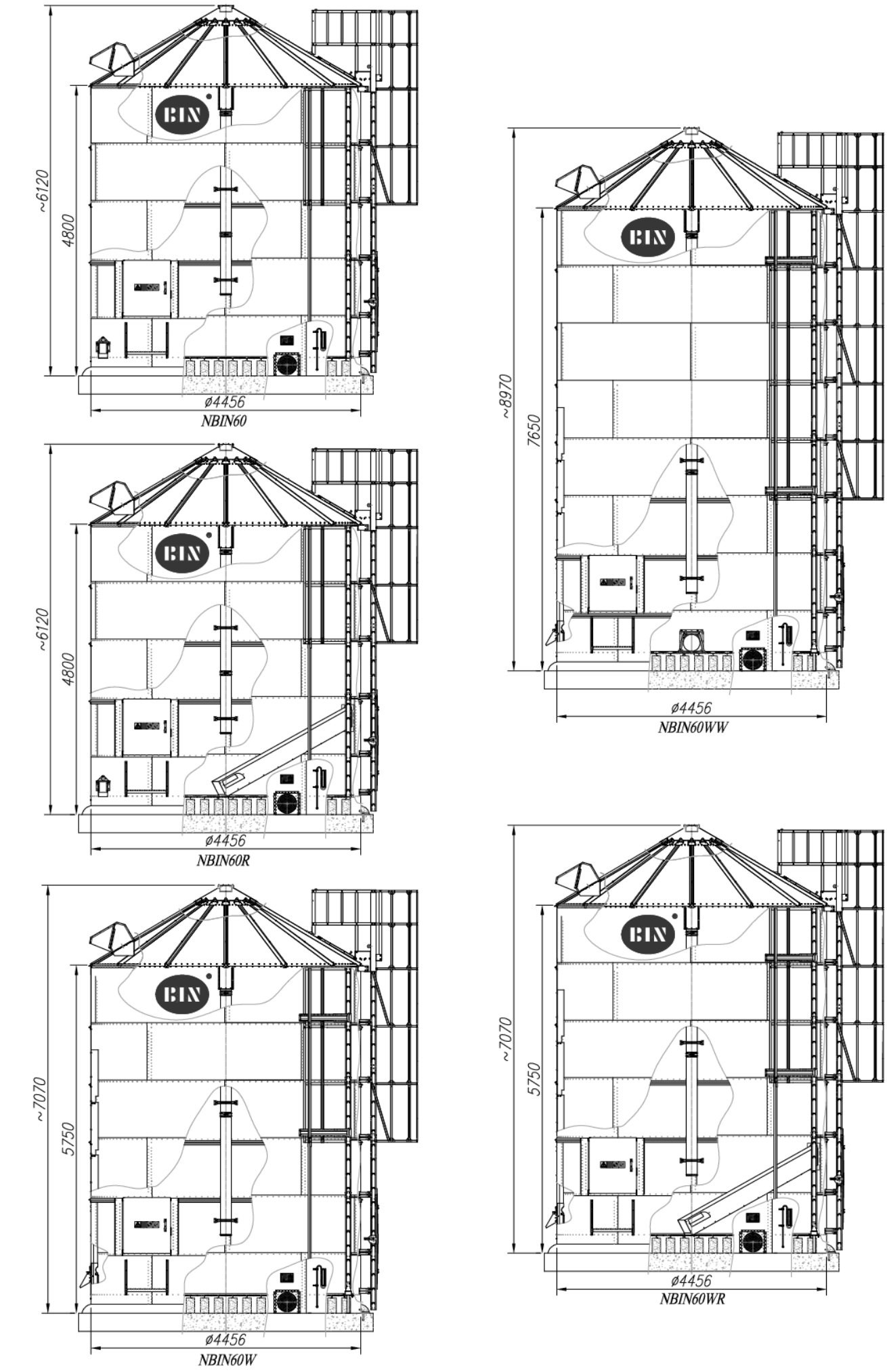


Figure 19. A construction diagram for silos of the BIN20 type (model: NBIN60, NBIN60R, NBIN60W, NBIN60WW, and NBIN60WR)

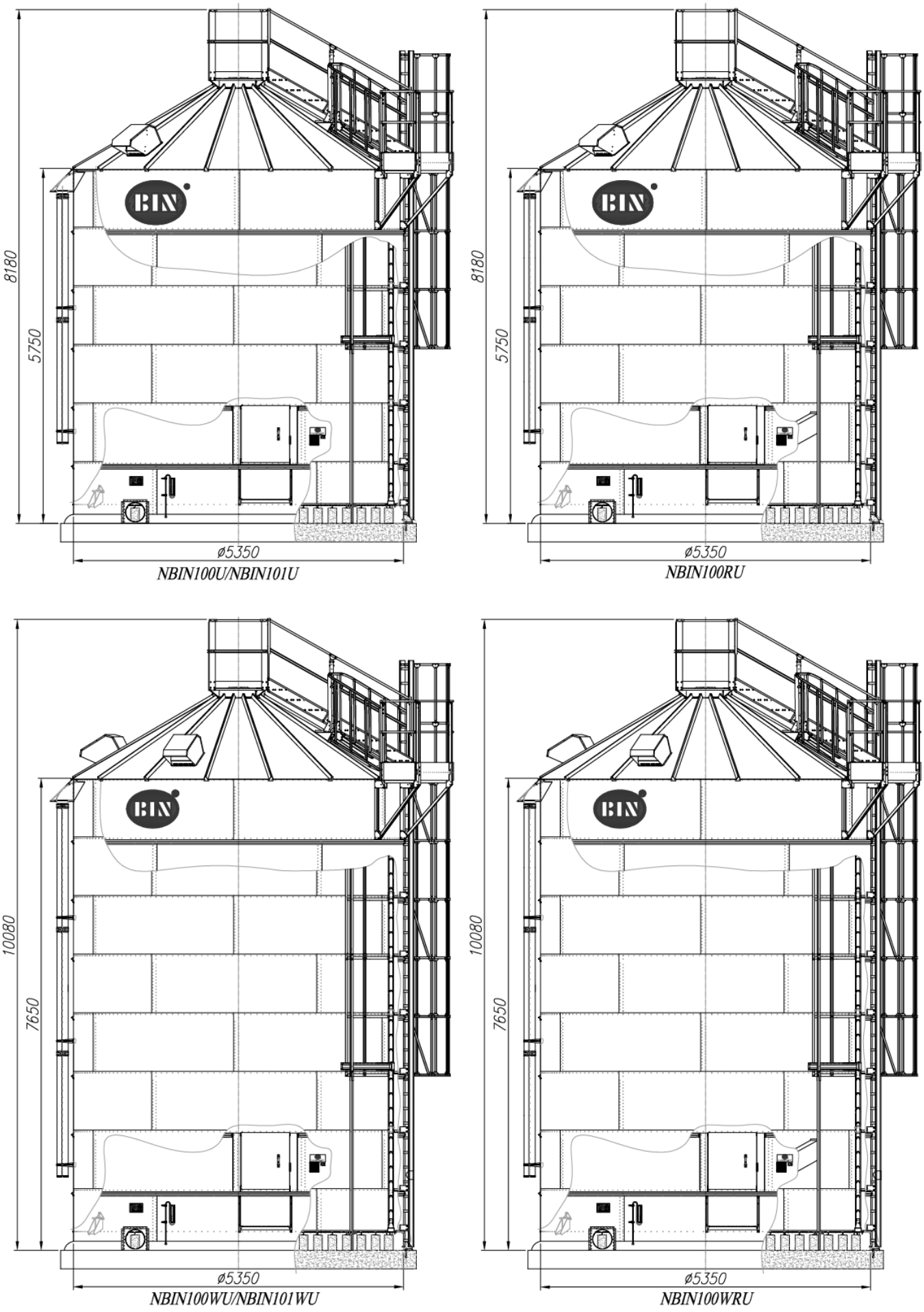


Figure 20. A construction diagram for silos of the BIN100 type (model: NBIN100U, NBIN101U, NBIN100RU, NBIN100WU, NBIN101WU, and NBIN100WRU)

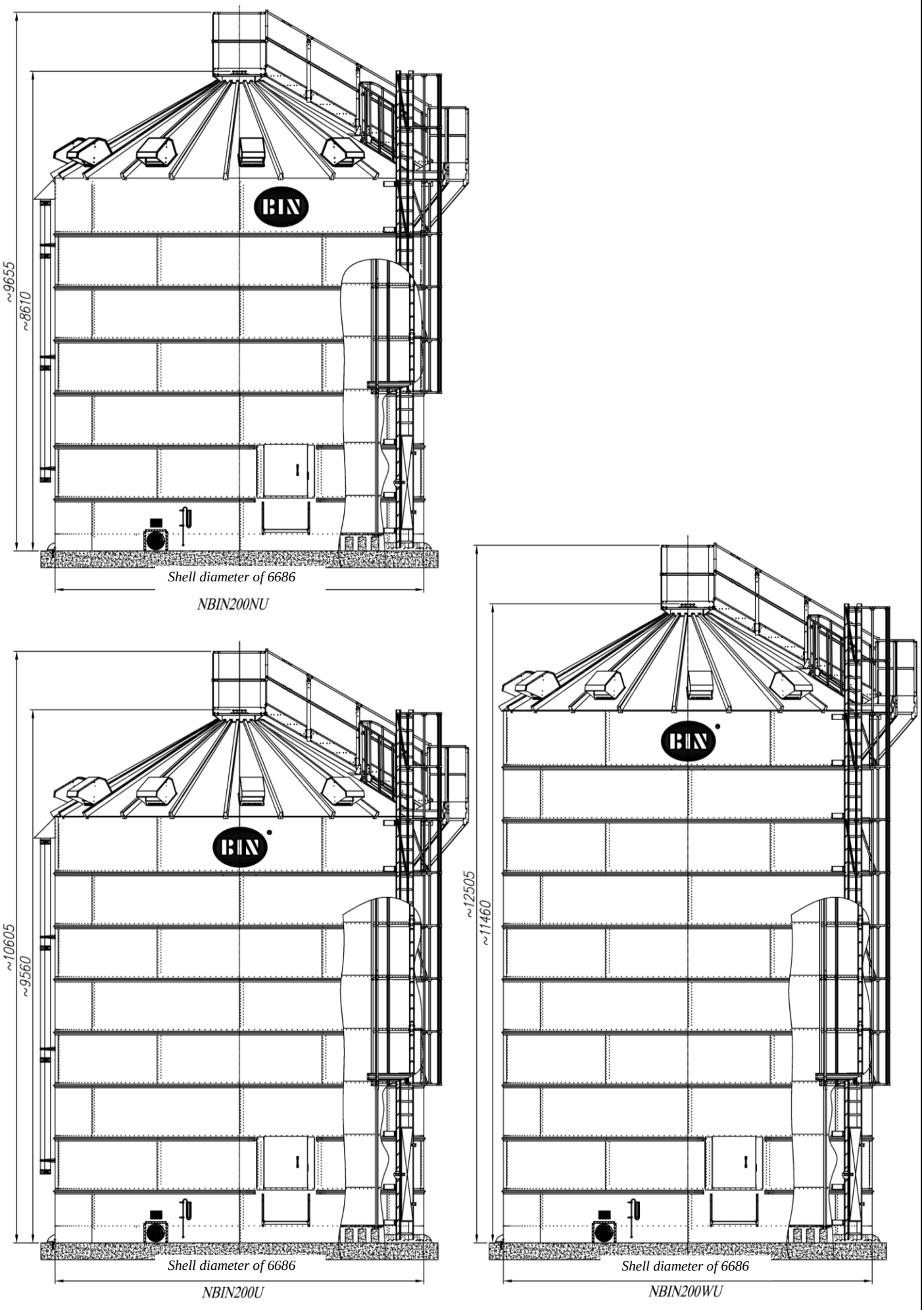


Figure 21. A construction diagram for silos of the BIN200 type (model: NBIN200NU, NBIN200U, NBIN200WU)

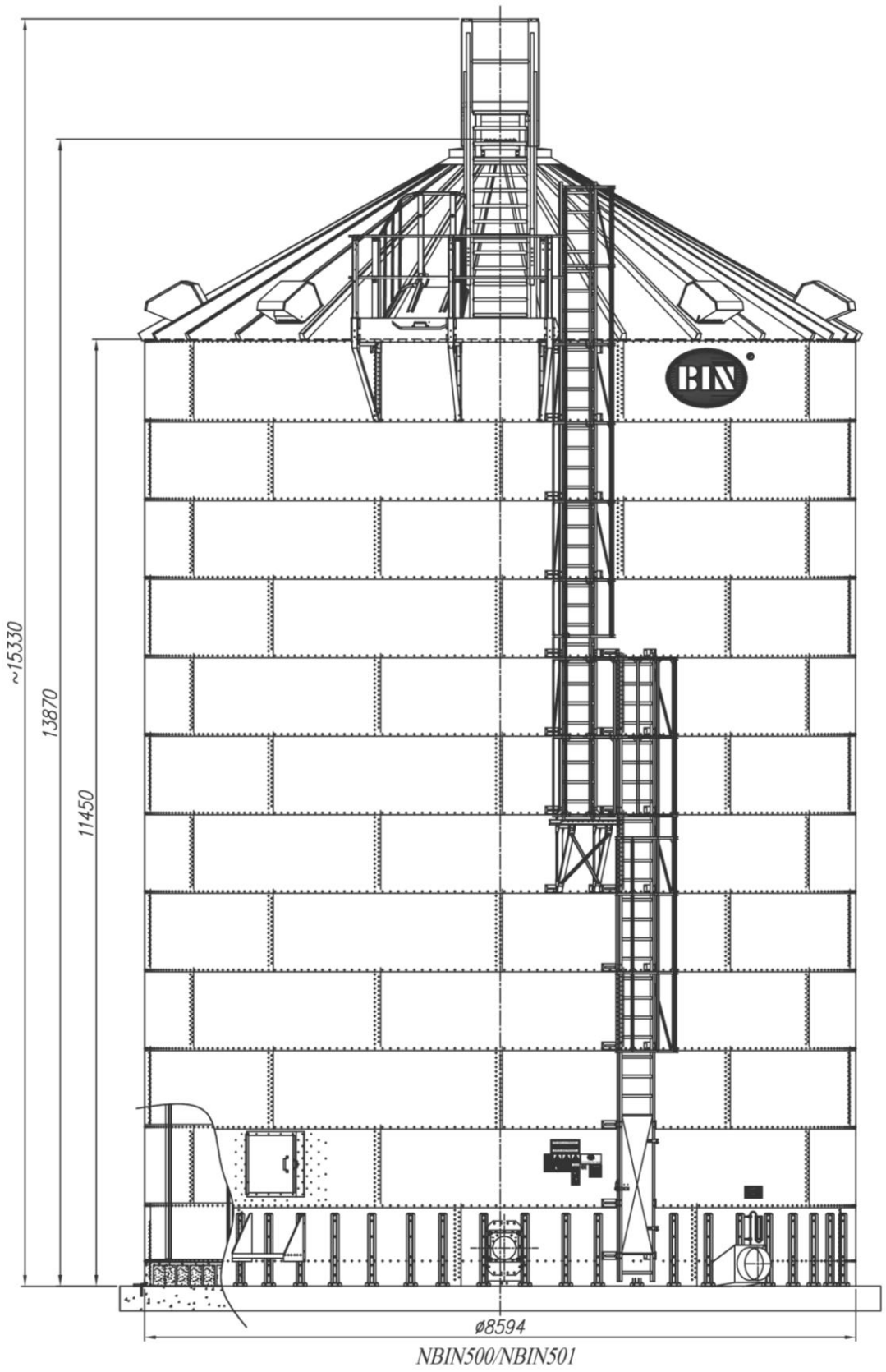


Figure 22. A construction diagram for silos of the BIN500 type (model: NBIN500, NBIN501)

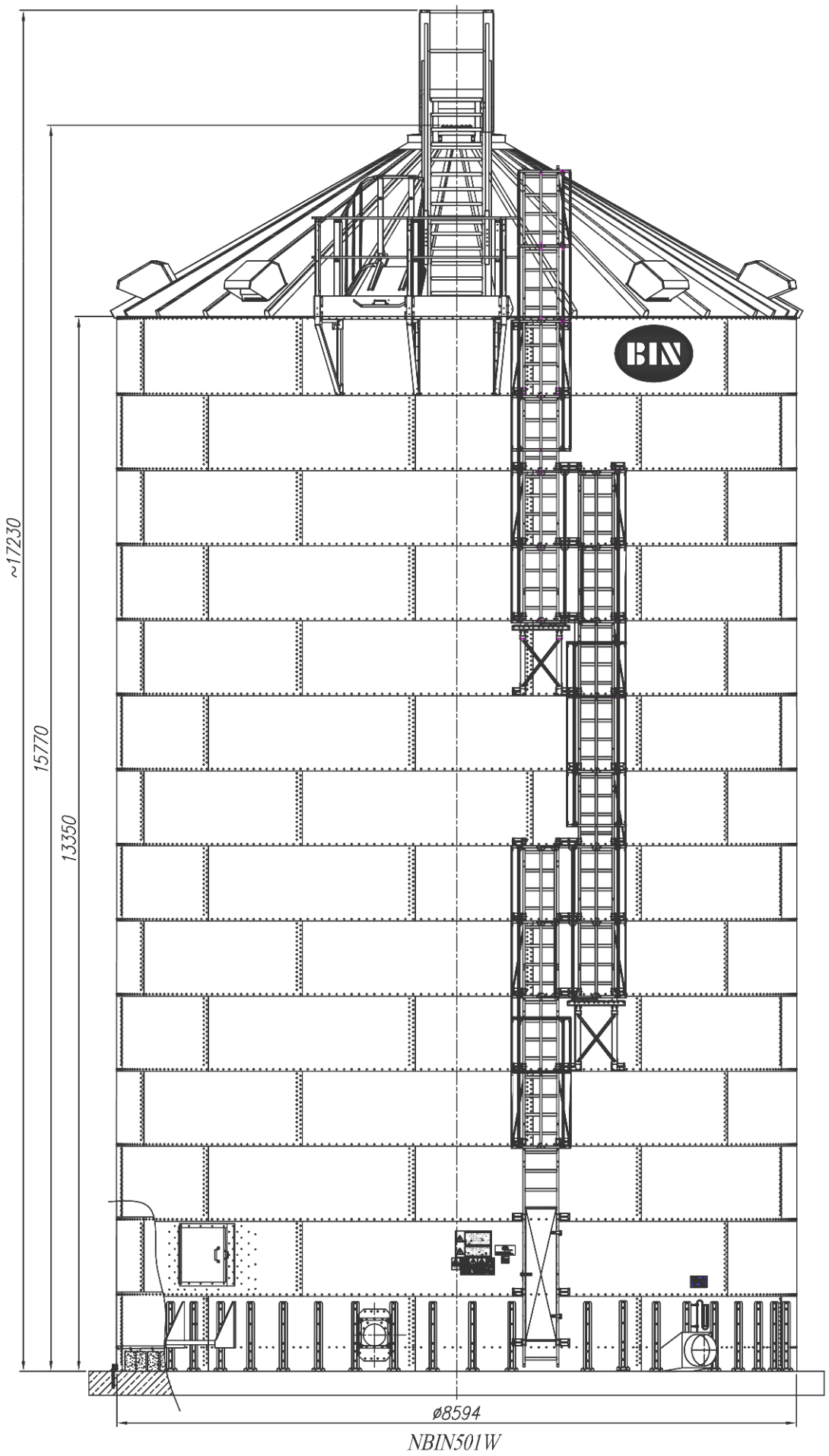


Figure 23. A construction diagram for the NBIN501W silos

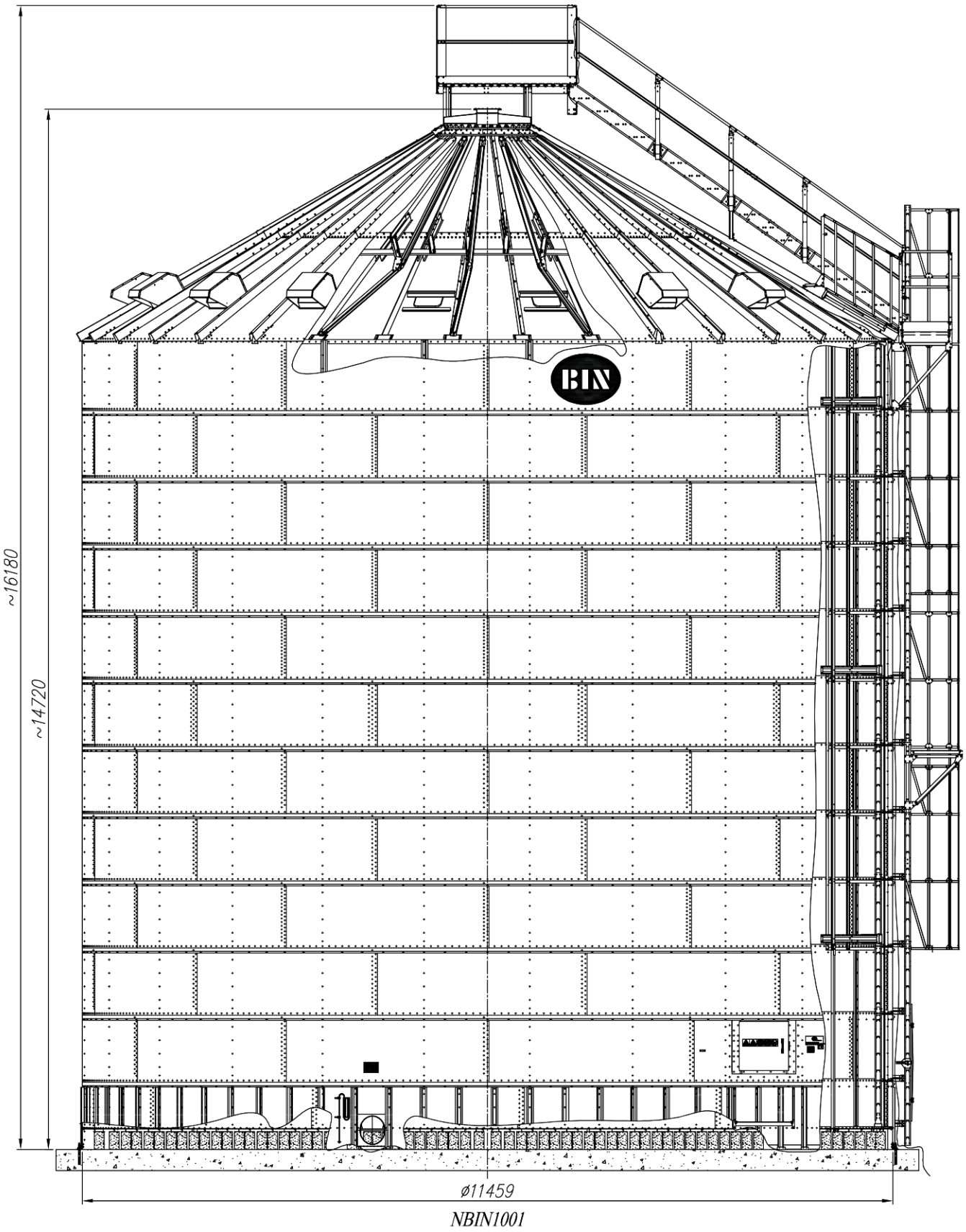


Figure 24. A construction diagram for the NBIN1001 silos

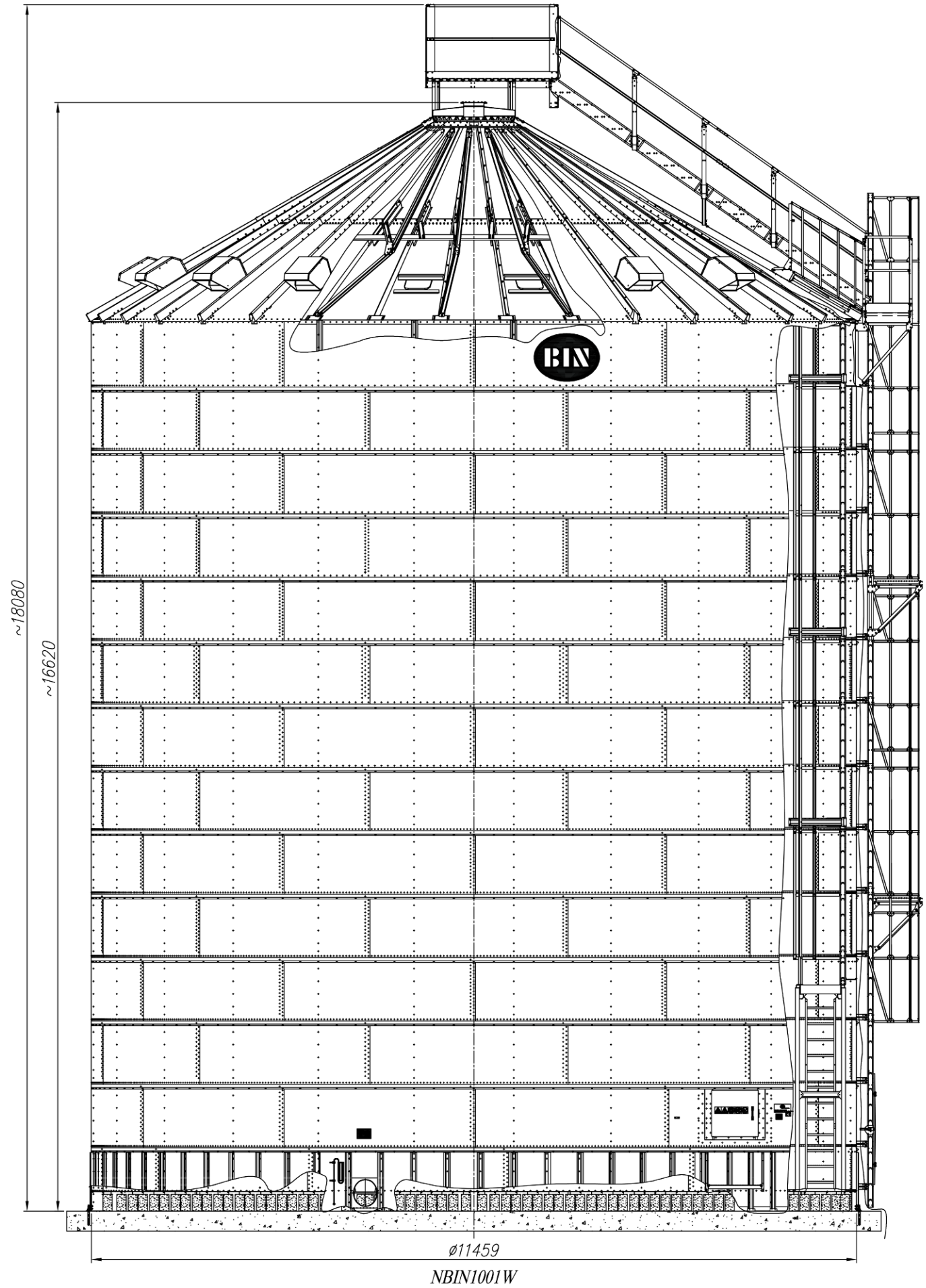


Figure 25. A construction diagram for the NBIN1001W silos

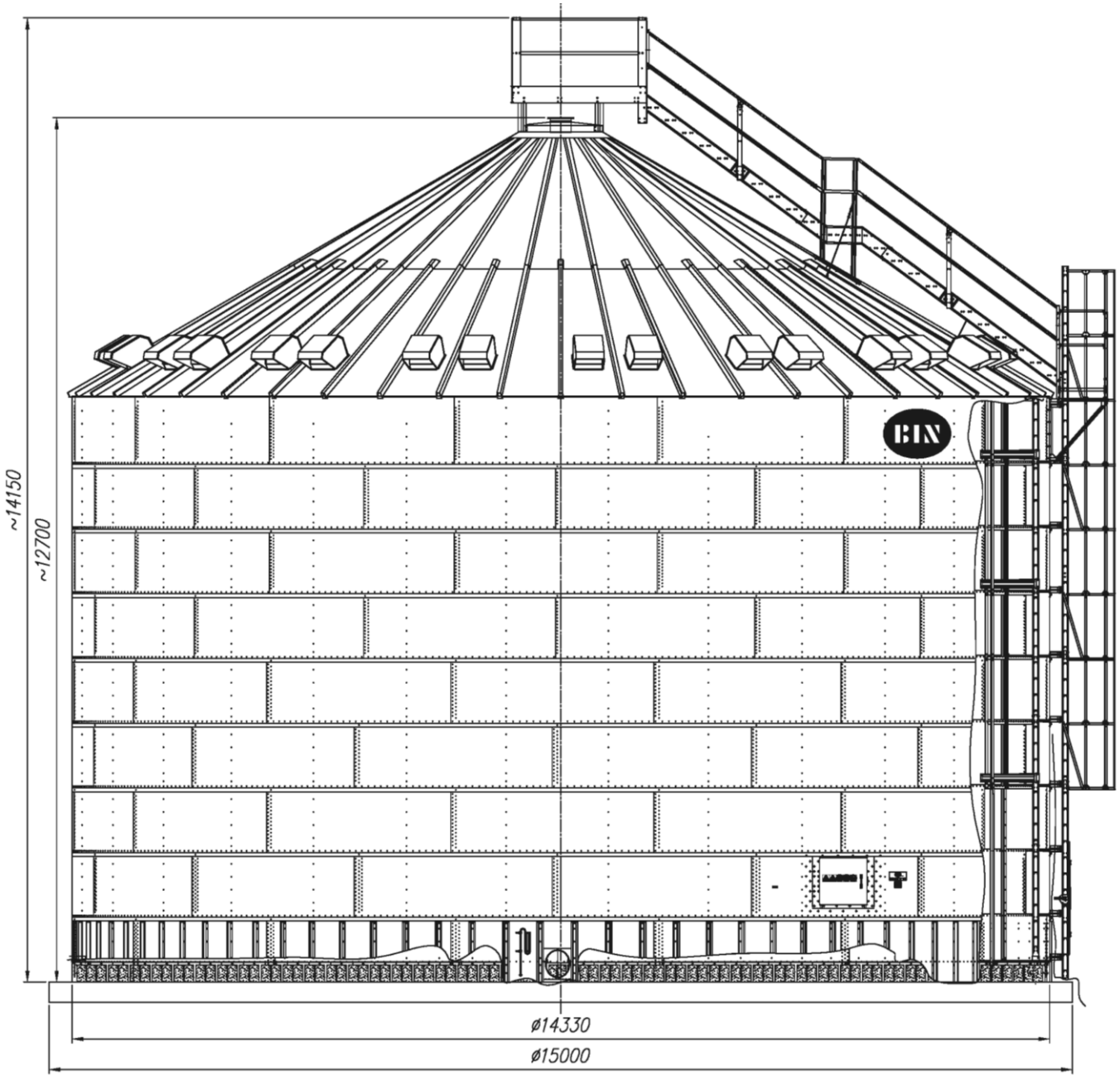


Figure 26. A construction diagram for the NBIN1500_N silos

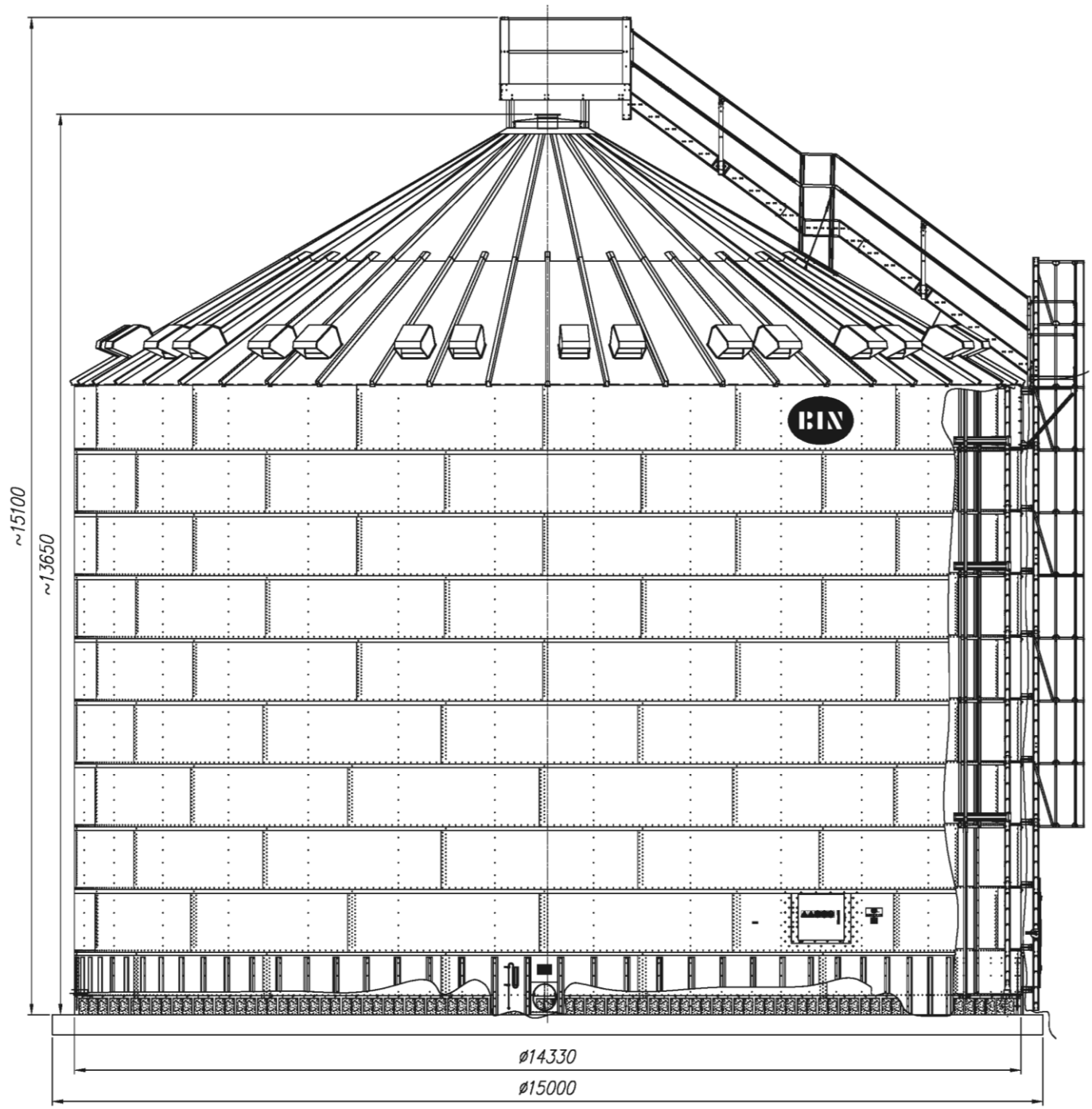


Figure 27. A construction diagram for the NBIN1500_P silos

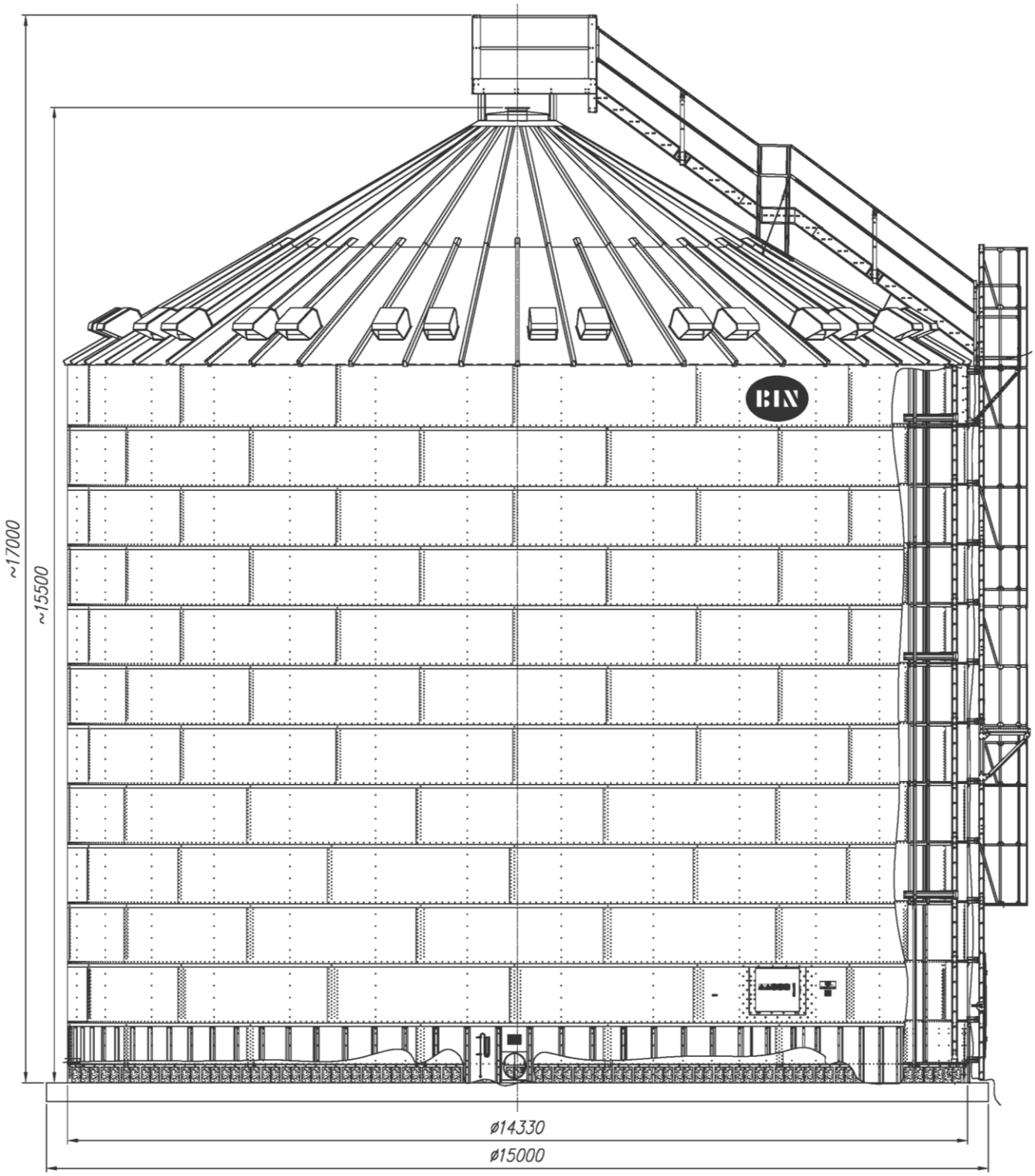


Figure 28. A construction diagram for the NBIN1500 silos

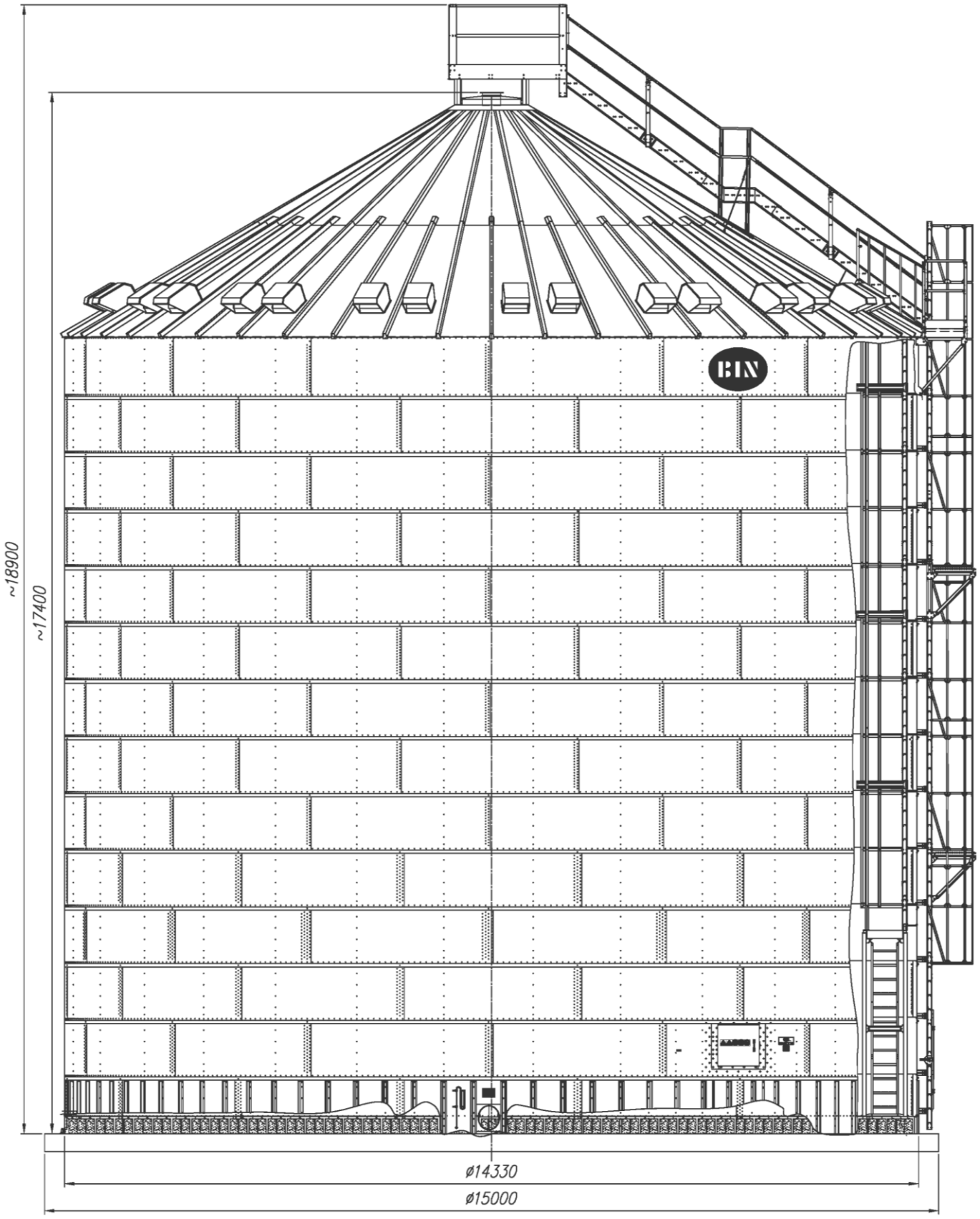


Figure 29. A construction diagram for the NBIN1500_W silos

2.5. Standard and additional silo accessories.

Table 4. A list of equipment for silos of the BIN10 to BIN1500 type
(S: standard - included in the silo price, O: optional - available for additional fee, ND: not available/not acceptable)

SILO TYPE	BIN10	BIN20	BIN40	BIN60			BIN100		BIN200		BIN500	BIN1000	BIN1500
SILO MODEL	NBIN10 NBIN10 W	NBIN20N NBIN20 NBIN20R NBIN20W NBIN20WR NBIN20WW	NBIN40NS NBIN40S NBIN40WS NBIN40WWS	NBIN60 NBIN60R	NBIN60W NBIN60WR	NBIN60WW	NBIN100U NBIN101U NBIN100RU	NBIN100WU NBIN101WU NBIN100WRU	NBIN200NU NBIN200U	NBIN200WU	NBIN500 NBIN501 NBIN501W	NBIN1001 NBIN1001W	NBIN1500_N NBIN1500_P NBIN1500 NBIN1500_W
1	2	3	4	5	6	7	8	9	10	11	12	13	14
VENT (EXHAUSTER)	NA	NA	S (1 pc)	S (1 pc)	S (1 pc)	S (1 pc)	S (2 pcs)	S (3 pcs)	S (10 pcs)	S (10 pcs)	S (12 pcs)	S (18 pcs)	S (32 pcs)
UNLOADING SACK-FILLING DEVICE	S	S	S	S	S	O	O	O	NA	NA	NA	NA	NA
ANTI-DYNAMIC PIPE OF THE SACK-FILLING DEVICE	NA	S (NBIN20WW) NA (other)	S (NBIN40WS NBIN40WWS) NA (other)	NA	S	O	O	O	NA	NA	NA	NA	NA
AIR INLET	S (ø310)	S (ø310)	S (ø310)	S (ø310)	S (ø310)	S (ø310)	S (ø310)	S (ø310)	S (ø400)	S (ø400)	S (ø400)	S (ø400)	S (ø400)
UNIVERSAL AIR INLET	NA	NA	NA	NA	NA	NA	NA	NA	O	O	O	O	O
AIR SEPARATOR	NA	NA	NA	NA	NA	NA	NA	NA	O	O	O	O	O
UNLOADING SLEEVE	NA	S (NBIN20R NBIN20WR) O (other)	O	S (NBIN60R) O (other)	S (NBIN60WR) O (other)	NA	S (NBIN100RU) O (other)	S (NBIN100WRU) O (other)	NA	NA	NA	NA	NA
CENTRAL LOADING INLET	S	S	S	S	S	S	S	S	S	S	S	S	S
SIDE LOADING INLET	S	S	O	S	S	O	S	S	O	NA	NA	NA	NA
EMERGENCY DUCT	NA	NA	O	O NA (NBIN60R)	O NA (NBIN60WR)	S	S NA (NBIN100RU)	S NA (NBIN100WRU)	S	S	S	S	S
WATER MANOMETER	S	S	O	S	S	S	S	S	S	S	S	S	S
EXTERNAL LADDER	S	S	S	S	S	S	S	S	O	O	O	O	O
INTERNAL LADDER	S	S	S	S	S	S	S	S	S	S	S	S	S
SPIRAL STAIRS	NA	NA	NA	NA	NA	NA	NA	NA	O	O	O	O	O
ROOF STAIRS	NA	NA	NA	NA	NA	NA	O	O	O	O	O	O	O
COLLAR PLATFORM	ND	NA	NA	NA	NA	NA	O	O	O	O	O	O	O
SERVICE CATWALK	NA	NA	NA	O	O	O	O	O	O	O	O	O	O
THERMOMETER STW-100	O	O	O	O	O	O	O	O	O	O	O	O	O
SILO CONTROL MODULE	O	O	O	O	O	O	O	O	O	O	O	O	O
WPR FAN	O	O	O	O	O	O	O	O	O	O	O	O	O
SUCTION FAN	O	O	O	O	O	O	O	O	O	O	O	O	O
ELECTRIC HEATER	O (4.5 kW)	O (4.5 kW)	O (4.5 kW)	O (4.5 kW)	O (4.5 kW)	O (4.5 kW)	O (4.5 kW)	O (4.5 kW)	O (9kW)	O (9kW)	NA	NA	NA
BOTTOM MANHOLE	NA	O (WLAZDOLNY20)	O (WLAZDOLNY20)	O (WLAZDOLNY60)	O (WLAZDOLNY60)	S	S	S	S	S	S	S	S
BOTTOM PLATFORM	NA	O	O	O	O	S	S	S	S	S	S	S	S
ROOF MANHOLE	S	S	S	S	S	S	S	S	S	S	S	S	S
UNDERFLOOR UNLOADING CONVEYOR	O (PS160)	O (PS160)	O (PS160)	O (PS160)	O (PS160)	O (PS160/PS220)	O (PS160/PS220)	O (PS160/PS220)	O (PS160/PS220)	O (PS160/PS220)	O (PS220)	O (PS220)	O (PS220)
INTERNAL SCREW CONVEYOR PSW	NA	NA	NA	O (PSW60)	O (PSW60)	O (PSW60)	O (PSW220-BIN100)	O (PSW220-BIN100)	O PSW220-BIN200	O PSW220-BIN200	O PSW500	O PSW1000	O PSW1500
INSTALLATION SET	S	S	S	S	S	S	S	S	S	S	S	S	S

A fan is a necessary accessory in each silo.

It is forbidden to install the sack-filling device without an aerodynamic pipe in silos of the BIN100, NBIN60WW, NBIN40WS, NBIN40WWS, and NBIN20WW type.

When an unloading duct is not included in a design of silos of the BIN60, BIN40 and BIN100 type, an appropriate emergency duct should be installed.

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3. Initial operations and preparing the silo for operation

3.1. Investor initial activities

3.1.1. Formal and legal arrangements for the investment

Silos should be erected in accordance with the current Construction Law:

- the Construction Law of 7 July 1994 (Journal of Laws No. 89, item 414, as amended)
- Minister of Agriculture and Food Economy Regulation of 13/01/2023 concerning technical requirements that should be met by agricultural construction and their location - Journal Laws No. 2023, item 297, as amended.

The investor is obliged to provide the user with necessary information concerning rules of operation (starting, stopping, controlling, signalisation, etc.) for all equipment used together with the silo, including emergency procedures in the event of a fire, trapping, blocking of material in the equipment, and similar situations.

A construction permit is required for the construction of a silo (an exception concerns all silos of the BIN10, BIN20, BIN40, BIN60, BIN100, and NBIN200NU type) [1)]1 . Before construction of all silos, a relevant organ should be notified. The investor responsible for meeting all formal and legal issues, together with a design. The designer is responsible for designing foundation slabs for silos and other equipment (when used) and for drawing up a land development plan. Guidelines for design of foundations and silo dimensions are specified in this Operating Manual. The whole silo design documentation was drawn up at BIN spółka z o.o.

The silos were designed in accordance with current standards and legislation, and are intended to be used in climate conditions of Poland for:

a) wind load

The II terrain category was selected, defined in the standard PN-EN 1991-1-4 as terrains with low vegetation and with low isolated obstacles with separations of at least 20 obstacle heights. II, III and IV terrain categories are also accepted, but the design does not provide for construction of silos with catwalks at the sea and shore terrains, lakes and terrains without terrain obstacles, belonging to more stringent terrain categories.

In 1 and 3 wind zones, for the height A≤ of 300 m amsl, construction of all BIN silos without additional anchoring is permitted (basic wind velocity, $v_{b,o}$ = 22 m/s).

In 1 and 3 wind zones, for the height A of ≤ 600 m amsl, and in the 2 wind zone regardless of the height, construction of the following silos is permitted (basic wind velocity, $v_{b,o}$= 26 m/s):

- silos of BIN10, BIN40, BIN60, BIN200, BIN500, BIN1000, and BIN1500 type,
- silos of the BIN20 type, provided additional anchoring is ensured.
- silos of the BIN100 type without a service catwalk;
- NBIN100U, NBIN100RU and NBIN101U silos with a service catwalk;
- NBIN100WU, NBIN100WRU and NBIN101WU silos with a service catwalk, provided additional anchoring is ensured;

b) Snow load

For all BIN silos, assumptions for snow load zones correspond to the snow load on the ground of a specific value of s_k = 1.6kN/m^2. This value corresponds to 2 and 4 zones, and zone 1 to the height of 428 m amsl, and zone 3 to the height of 366 m amsl (according to PN-EN 1991-1-3).

3.1.2. Silo location

The silos are designated to be installed outdoors. The silo can be installed in a building, provided a sufficient space is ensured. It was recommended to install the silo on a slope of a maximum incline not exceeding 5%.

Due to the installation technology and future operational and maintenance activities, it is required for all structures and machines to be located at least 1.0 m away from the silo shell. It is forbidden to install a silo near or under power lines.

Silos can be erected at a minimum distance of 15 m away from storage of organic fertilisers: manure, liquid manure, and similar.

[1] *On a basis of Article 29.1.1.d of the Construction Law*

3.1.3. Silo ordering

Orders for silos and spare parts can be placed with BIN Sp. z o.o. or with authorised BIN sales representatives.

Each time, before purchasing any components a customer should consult the manufacturer or a sales representative in detail about planned investment.

The manufacturer prepares the silo before shipment in accordance with the specification. The specification is attached to the shipped components.

3.2. Transport of silo components

Silos are delivered as components packed on pallets. Transport of the components is arranged by a seller or a customer, under an additional agreement. The components require a transport vehicle of dimensions and capacity resulting from data - Table 5. The cargo body of the vehicle must be provided with a tight tarpaulin. In transport, all equipment must be secured against sudden movement.

Loading and unloading should be performed with forklift trucks of capacity resulting from data included - Table 5. During a delivery acceptance, a silo buyer is obliged to check the delivery completeness against the specification attached to the components.

SILO COMPONENTS MUST BE SECURED AGAINST MOISTURE DURING THEIR TRANSPORT AND STORAGE.

When the components get wet, they must be thoroughly dried. This applies, in particular, to the silo shell and roof components. Storage of wet components may result in development of impossible to remove white spots on a surface of metal sheets of which the silo is constructed. The manufacturer shall not be held responsible for the above-mentioned defects resulting from a failure to observe the above recommendations.

Table 5. Dimensions of the longest and the heaviest pallets with silo components prepared for transport.

SILO	The length of the longest pallet does not exceed [m]	The weight of the heaviest pallet does not exceed [kg]
BIN10	2.1	550
BIN20	2.1	1000
BIN40	2.1	1000
BIN60	3.15	1800
BIN100	3.15	2900
BIN200	3.15	2500
BIN500	4.0	2700
BIN1000	4.0	2500
BIN1500	4.0	2700

Concrete floor supports are delivered on pallets - weight of a pallet with concrete supports does not exceed 2000kg.

IT IS FORBIDDEN TO CARRY THE PALLETS ABOVE PEOPLE AND ANIMALS

3.3. Information on installation

Installation of the silo requires use of special equipment, and relevant know-how. Therefore, the silo can only be installed by an installation company authorised by BIN. The installation company should cooperate with an entity ordering installation, in terms of works organisation, financial settlements, and acceptance of installation works. Due to risks related to the installation works, it is forbidden for the investor or other companies not authorised by BIN to perform these works. The installation works can be started when a correct foundation slab is constructed and all silo components, including concrete floor supports and machines working with the silo (such as unloading conveyors PS/PSW) are gathered in a relevant location.

Furthermore, during installation, the installation company authorised by BIN should install the specified silo equipment, excluding construction of and connection to the power supply grid. The investor is responsible for construction of the required electrical system. The investor should order a licensed electrician to perform these works in accordance with current legislation and an individual facility plan.

3.4. Investor final activities

FAILURE TO ANCHOR THE SILO CORRECTLY POSES A THREAT OF ITS DESTRUCTION AND OF A SITUATION THAT IS HAZARDOUS TO HUMAN HEALTH AND LIFE.

3.4.1. Silo anchoring with rawlplugs

Silo anchoring with rawlplugs consists of fixing the silo to the foundation with steel anchors and rawlplugs. Each anchor is fixed to the silo shell with two M10x20 bolts and fixed to the foundation with one steel M12x160 rawplug. The basic installation conditions for steel M12x160 STS rawlplugs:

- torque T_{inst} = 65Nm,
- hole diameter – d_0 = 18mm,
- minimum distance from the foundation edge – c_{min} = 165 mm,

The silo should be anchored taking into account rules and conditions for installation of steel rawlplugs, specified by their manufacturer in a relevant installation instruction. The silo is installed by an installation company under a direct order of the investor. During the installation works the investor is obliged to personally check and ensure itself that all above activities are performed correctly.

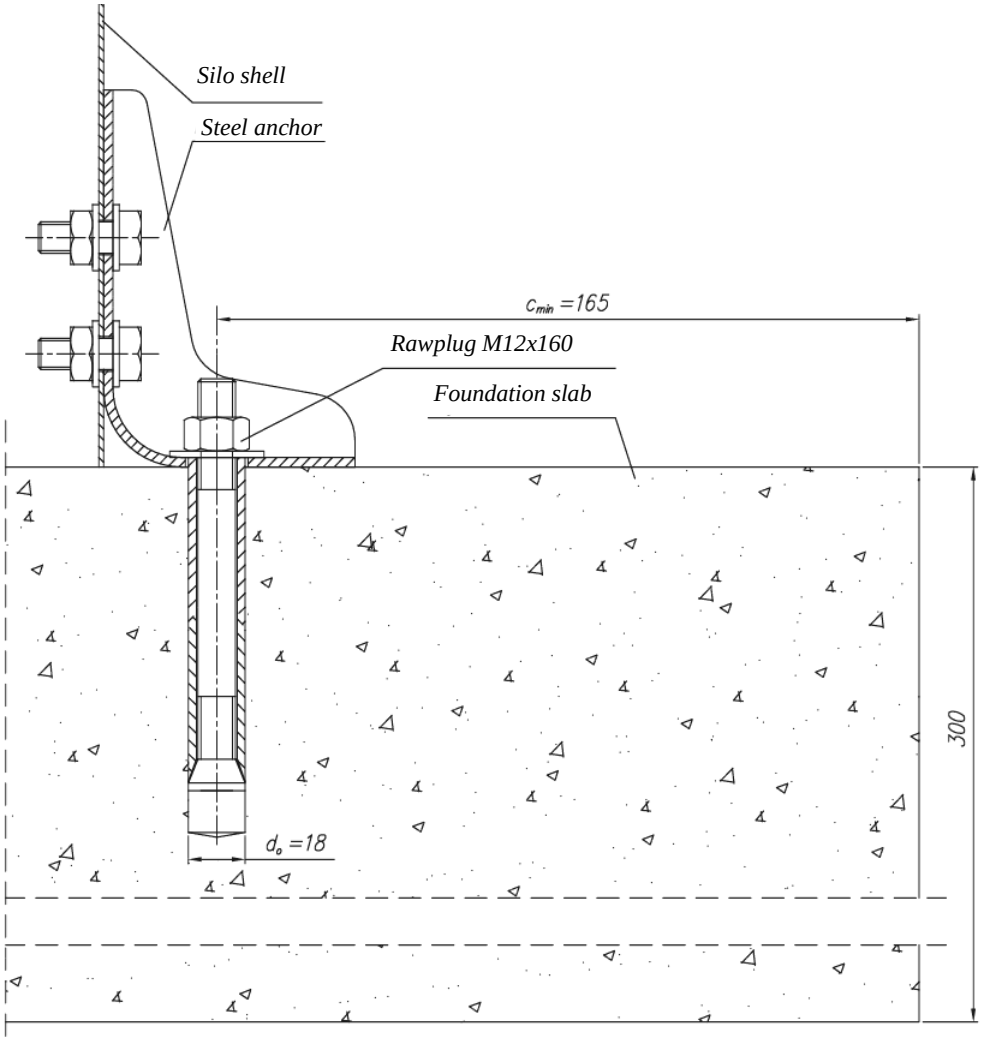


Figure 30. A diagram for silo anchoring with rawlplugs

3.4.2. Silo anchoring with chemical anchors

Silo anchoring with chemical anchors consists of fixing 8mm-thick steel anchoring sheets to the foundation slab with M20 or M24 steel glued-in anchors with a resin ampoule.
The silo should be anchored taking into account rules and conditions for installation of glued anchors, specified by their manufacturer in a relevant installation instruction. The silo is installed by an installation company under a direct order of the investor. During the installation works the investor is obliged to personally check and ensure itself that all above activities are performed correctly.

Table 6. Details of gluing chemical anchors in.

Chemical anchor	Effective anchoring depth h_{ef} [mm]	Torque for Fisher anchor [Nm]	Torque for Hilti anchor [Nm]	Drilled hole diameter d_o [mm]	Wire brush diameter d_b [mm]
M20	170	120	150	24	27
M24	210	150	200	28	30

A minimum distance from the concrete edge specified by a manufacturer of chemical anchors is 120mm. However, the required minimum distance is specified in a specific silo construction design.

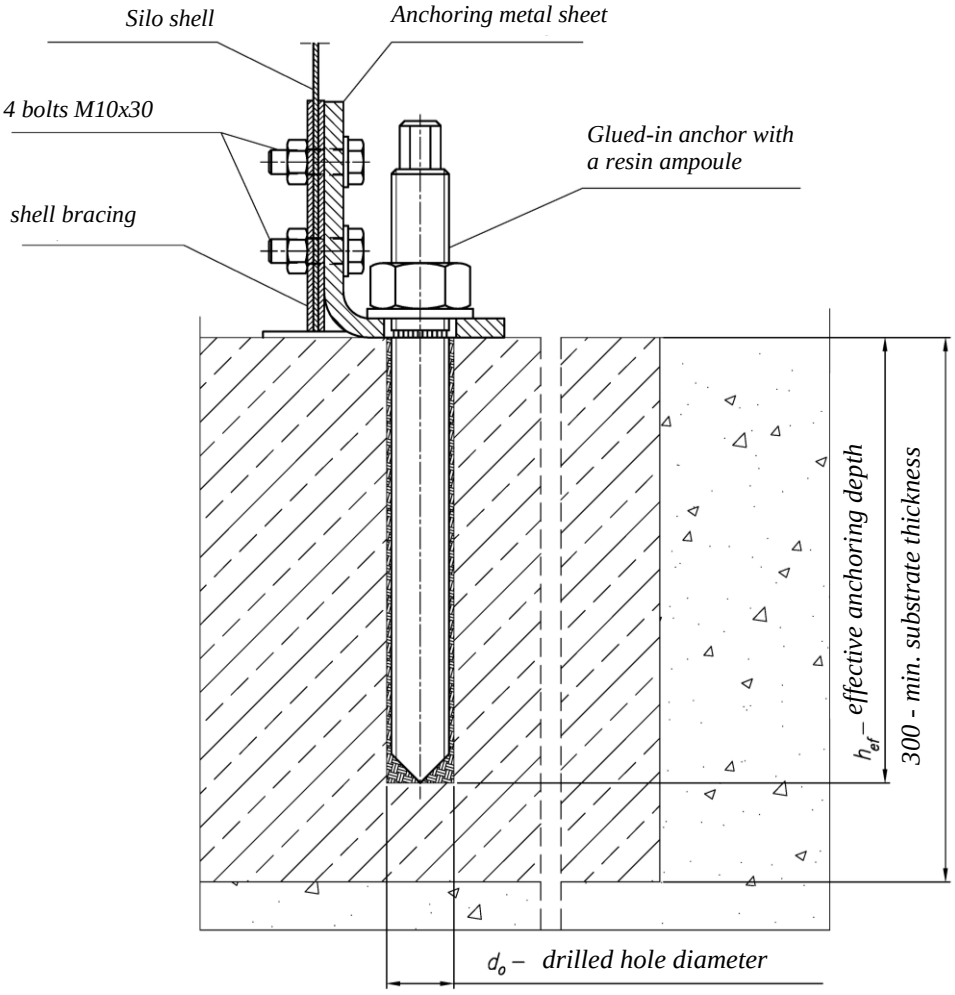


Figure 31. A diagram for silo anchoring with chemical anchors

3.4.3. Electric shock protection - lightning arrestor system

The silos should be protected against consequences of a lightning. A system must be provided, protecting people and animals against the electric shock related to devices and machines installed in the silo. The investor is obliged to provide the electric shock protection for people and animals, and to construct the lightning arrestor system and the protective earthing of the silo. Construction and performance verification of the lightning arrestor system and the protective earthing of the silo should be ordered at a person with required qualifications.

3.4.4. Fire prevention

The investor is responsible for meeting all requirements related to fire prevention. They include ensuring of: access and emergency escape routes, access to sources of water for extinguishing, distribution of extinguishing equipment and fire safety instructions. Fire prevention issues are governed by the Minister of Interior and Administration Regulation of 7 June 2010 concerning fire prevention in buildings, other structures, and terrains (Journal of Laws, 2010, No. 109, item 719) and the Minister of Interior and Administration Regulation of 24 July 2009 concerning supplies of water for extinguishing purposes and fire department access roads (Journal of Laws 2009, No. 124, Item 1030).

3.4.5. Shell sealing at the base edge

The investor installs the shell sealing at the edge base after the silo is anchored.
The sealing is installed to:

1. Level the foundation slab when necessary, so the silo shell rests on the foundations along its complete circumference.
2. Prevent penetration of precipitation water flowing down the silo into the space under the floor.
3. Prevent air losses during grain drying with a fan.

The sealing has a form of a reinforced concrete overlay along the whole circumference of the silo shell base. When concrete hardens, the overlay should be additionally sealed with sealant (trade name - BOLL brushable sealant) along the whole silo circumference, where the overlay joins the foundation slab and the silo shell..
"BOLL brushable sealant" is a rubber (caoutchouc)-based one-component sealant that hardens at a room temperature through solvent evaporation.
The sealant can be purchased at BIN Sp. z o.o. (not a standard silo accessory). The sealant can be used on silos constructed in previous years. Defects or damages in the sealing coating must be repaired with the same sealant.

The overlay dimensions must conform to a description in the diagram below. Failure to construct the overlay will void the warranty.

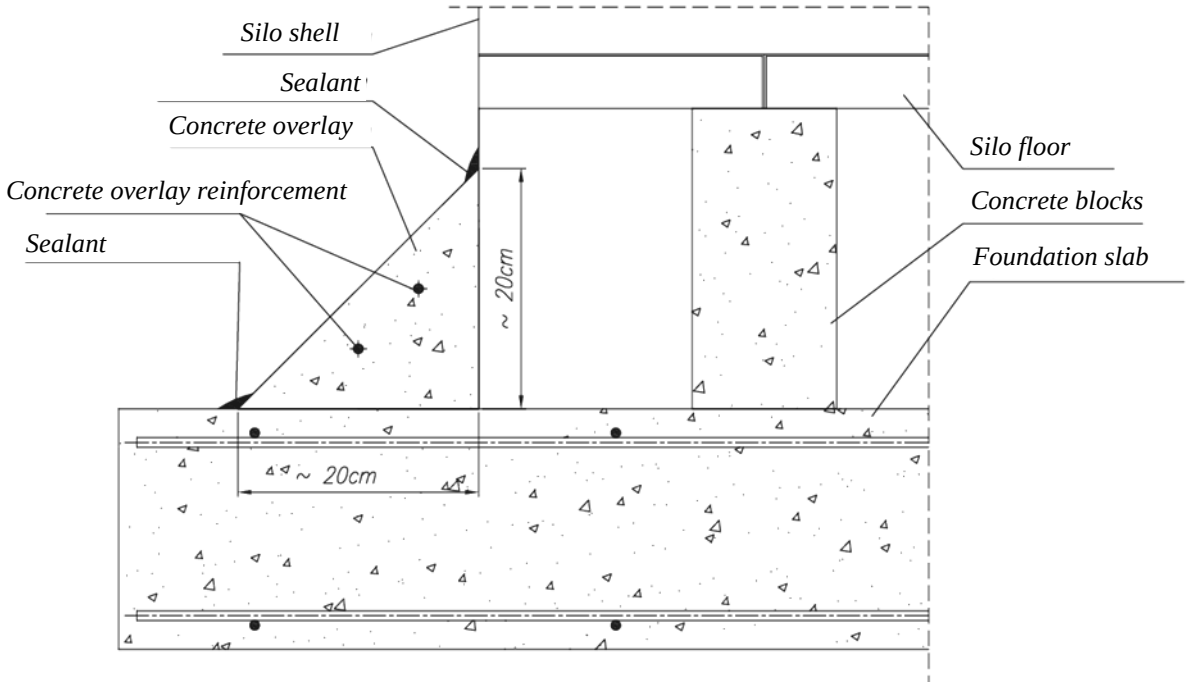


Figure 32. Diagram of shell sealing at the base edge

3.4.6. Installation of power delivery points

Installation of power delivery points and suppling of auxiliary devices should be performed by a licensed electricians according to the current law and an individual facility plan.

4. Operation

4.1. Silo operation

A sequence of operations during silo loading (

***Figure 33*) - Example:**

1) close the unloading shutter Z2;
2) open the loading shutter Z1;
3) set the five-way separator, R5, in a position to the loading conveyor PZ;
4) start the loading conveyor, PZ;
5) start the bucket elevator, PK;
6) start the inlet hopper, KP;
7) unload the transport vehicle, PT.

When the silo loading is completed, stop the specified equipment in the order reverse to the described above.

A sequence of operations during silo unloading (*Figure 34*)– Example:

1) set the five-way separator, R5, in a position to a transport vehicle, PT;
2) check, and when necessary, close the unloading shutter, Z2,
3) start the bucket elevator, PK;
4) start the underfloor conveyor, PP;
5) gradually and slowly open the unloading shutter Z2 (open the shutter Z2 so the PP, PK or other conveyors are not blocked); the silo unloading process can be stopped by performing in reverse the actions described above.

When the transported material stops to gravitationally feed the shutter Z2, stop the unloading (in accordance with guidelines in section 5). Check whether the opening of the shutter Z2 and the internal conveyor PW (in the silo axis) are not covered by the material stored in the silo.

When the above conditions are met, further unloading can be performed as follows:

6) check and, whenever necessary, set the five-way separator, R5, in a position to a transport vehicle, PT;
7) start the bucket elevator, PK;
8) start the underfloor conveyor, PP;
9) start the internal conveyor, PW;

When the transported material stops to feed the shutter Z2, stop the unloading (in accordance with guidelines in section 5). The internal conveyor PW should be removed from a special support, open covers, etc. (depending on the silo model and the internal conveyor).

When the above conditions are met, further unloading can be performed as follows:

10) check and, whenever necessary, set the five-way separator, R5, in a position to a transport vehicle, PT;
11) start the bucket elevator, PK;
12) start the underfloor conveyor, PP;
13) start the internal conveyor, PW;

The unloading can be continued until the transported material stops to feed the shutter Z2, then stop the unloading (in accordance with guidelines in section 5).

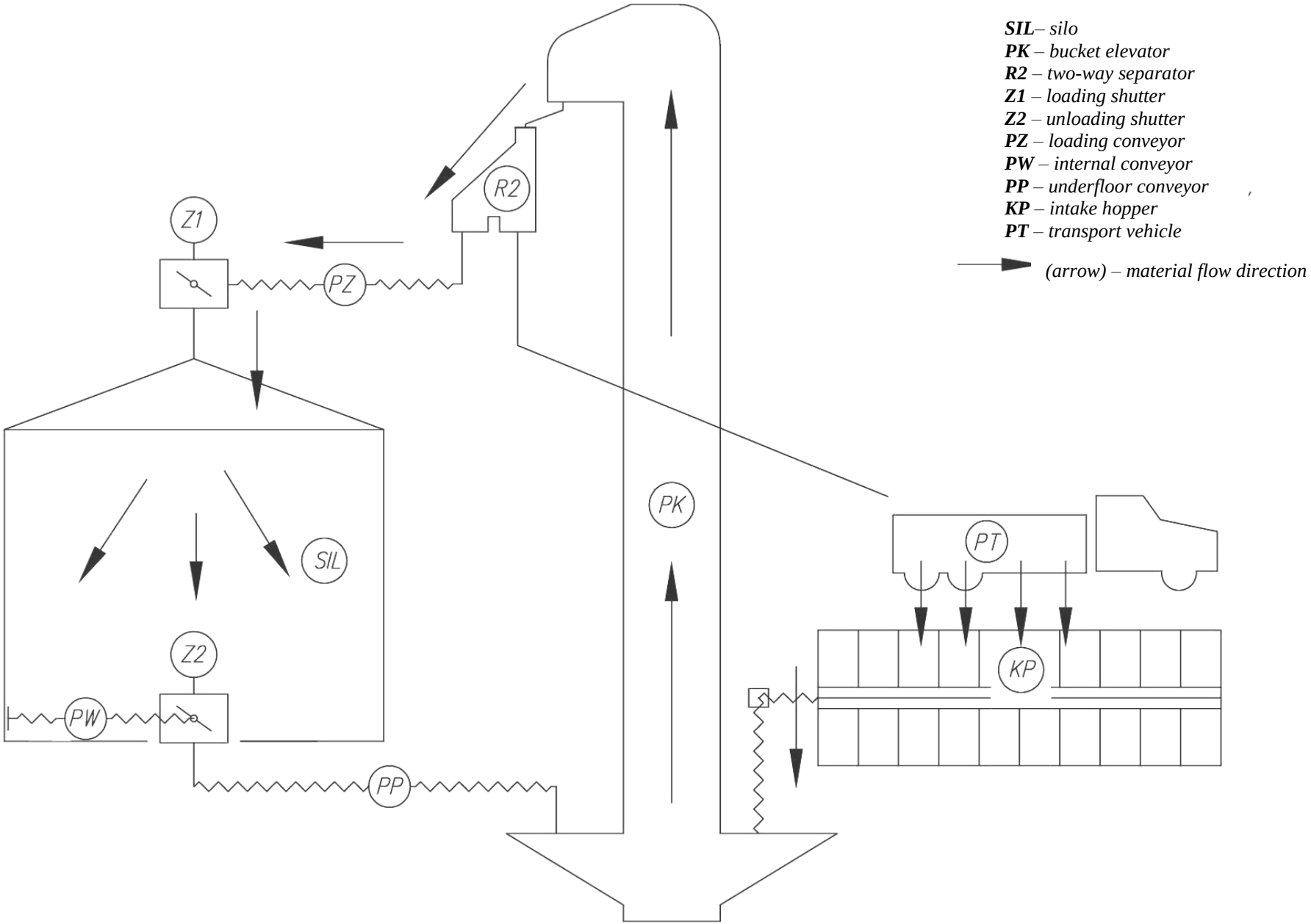


Figure 33. A diagram for loading of an BIN silo with most common sets of equipment.

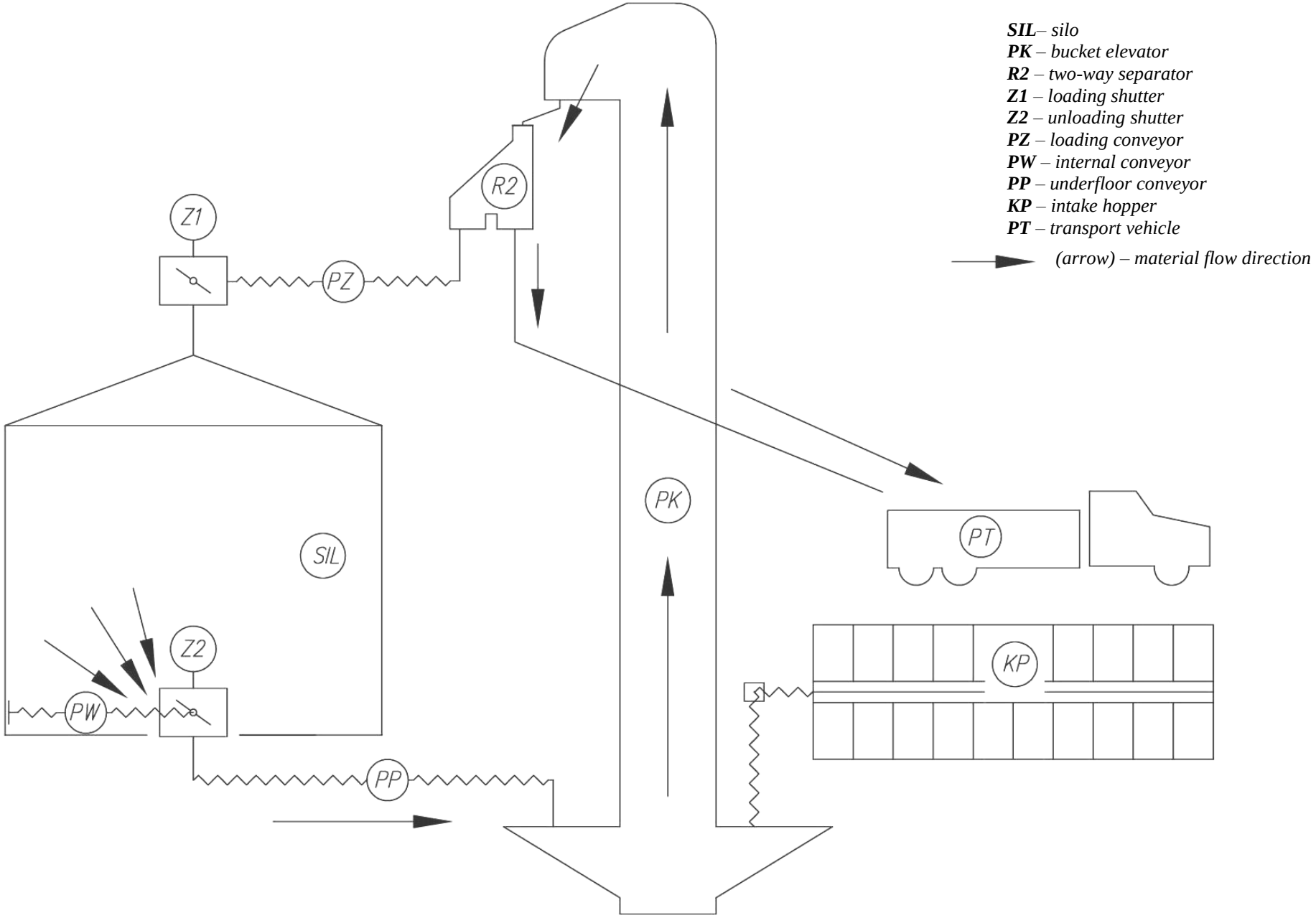


Figure 34. A diagram for unloading of an BIN silo with most common sets of equipment.

4.1.1. Loading grain into the silo

Each silo should be equipped with devices for loading of grain. Loading can be performed with pneumatic transport or with a screw or a bucket elevator. Recommended loading methods, depending on needs and silo equipment, are provided in - *Table 2*.

All silos have the grain inlet installed in the silo axis (centrally). This location of the inlet guarantees even loading of the silo walls (even grain pressure on the walls on the entire circumference).

In silos of the BIN10, BIN20, BIN40, BIN60, BIN100, NBIN200NU, and NBIN200U type, a side inlet for pneumatic loading can also be used. All loading equipment attached to the silo should be installed in a way not damaging the silo (*Figure 35*). This applies, in particular, to loading pipes of bucket elevators supported on the silo roof. These pipes should only be connected to special spigots in the silo collar. A downpipe of a bucket elevator must be connected to an inlet spigot in a way preventing load transfer from the bucket elevator onto the silo roof.

The producer shall not be held responsible for any silo defects resulting from non-adherence to the above recommendations.

1. The pneumatic loading is conducted through an inlet pipe of ϕ180 mm in diameter, installed in the silo. This loading method is recommended for smaller silos, i.e., when a rate of a few tonnes per hour can be considered satisfying. It should be noted that the blower efficiency to a large extent depends on the silo height. During the pneumatic loading, the silo manhole should be kept open.
2. Loading with a vertical screw conveyors is intended for small silos (from BIN10 to BIN200) or small groups of silos.
3. Loading with a bucket elevator usually is used for large silos (BIN500, BIN1000, and BIN1500) or sets of silos.

During the silo loading the speed of 60 tonnes per hour for silos of the BIN10 to BIN200 type, and 150 tonnes for silos of the BIN500 type and larger should not be exceeded; higher speeds may result in the permanent deformation of the silo.

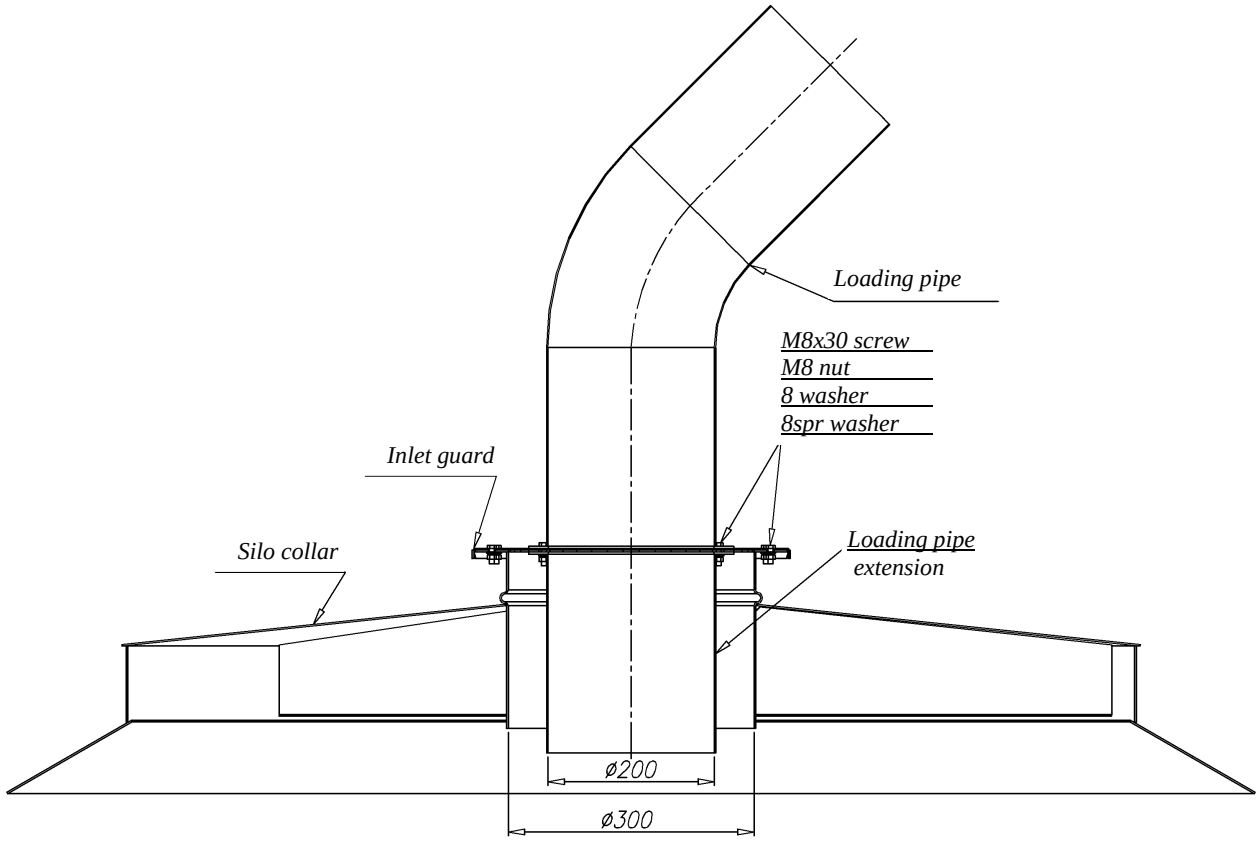


Figure 35. Correct installation of loading pipes in the roof collar of silos of the BIN500, BIN1000, and BIN1500 type.

Before starting loading:

1) check the operational condition of the silo and its accessories;
2) make sure there are no people in the silo;
3) close the bottom access manhole of the silo (if installed);
4) close openings for grain unloading.

During loading continuously monitor the level of silo filling.

For loading equipment, strictly adhere to rules of their operation as described in the relevant Operating Manual.

4.1.2. Grain storage

Grain in the silo can be stored for a long time without losing its quality, provided the following rules are observed:

1. grain cannot be contaminated;
2. it should have a correct moisture content (*Table 7*);
3. the user should monitor the temperature of the stored grain on a regular basis;
4. freshly poured grain must be well cooled;
5. regardless of its moisture content, the grain should be regularly aired using an appropriate fan;
6. when the grain is infested with pests, perform fumigation activities;
7. always remember to secure the silo against penetration of precipitation water;
8. when grain becomes wet, remove it from the silo immediately and dry.

Grain stored in the silo should be inspected at least once a week.

The rules for correct storage of grain are discussed in more detail in a textbook by A. Ryniecki “Dobrze przechowane zboże”. This textbook can be purchased from BIN.

A failure to follow rules for grain storage may result in a significant deterioration of its quality or to destruction of entire silo contents. This may lead to many situations affecting safety of the silo and its operators.

The worst hazard is so-called grain bridging. This situation can:

- completely prevent silo unloading;
- result in the silo destruction due to "bump" of the bridged mass after the silo is partly emptied;
- result in formation of empty cavities in the mass of grain during its unloading.

Due to the above-mentioned hazards it is strictly forbidden to climb onto a layer of grain.

Table 7. Safe moisture content for grain (for the Polish climate, Data prepared on a basis of the study "Dobrze przechowane zboże” by A. Ryniecki)

Grain type and storage duration	*Safe grain moisture content [%]*
Wheat, rye, triticale, barley, and oats:	
storage for up to 6 months	14
storage for more than 6 months	13
Rapeseed:	
storage for up to 6 months	8
storage for more than 6 months	7
Maize:	
feed, used before spring	15.5
stored for 6–12 months	14
storage for more than 12 months	13

Cereal and maize grain, and oilseeds are nearly always stored in the silo with some contaminations, pests and microorganisms, therefore, they are a very difficult material for storage. Their physical and biological parameters may change within a relatively extensive range, and during various periods of storage. Basic parameters decisive for the condition of the stored material, and relatively easy to monitor during storage are temperature and moisture content of the stored material. The temperature and moisture content have a crucial influence on a length of a period for which grain or seed can be (safely) stored, as shown in diagrams in *Figure 36 and Figure 37*.

BIN silos and other machines and devices working with them do not have any design limitations concerning temperature and moisture content of materials stored in them within the scopes presented in *Figure 36 and Figure 37*. However, acceptable periods for safe storage must be strictly adhered to due to a risk of deterioration in the material quality which may lead to bridging of grain or seeds, and in consequence, prevent the silo unloading or loading, create empty spaces in the material, etc. Bridging or forming of empty spaces (cavities) in the stored material may result in complete deformation of the silo and thus its irreversible damage requiring its withdrawal from operation.

For example: the chart shows that cereal grain of 5ºC and moisture content of ca. 14% can be stored safely for ca. 2.5 years, while cereal grain of 15ºC and moisture content of ca. 16% can be stored safely for only ca. 3 months.

Maintaining required temperature and moisture content throughout the material storage is equally important as achieving these parameters. For this purpose BIN silos were equipped with active ventilation devices that must be used regularly to ventilate grain and seeds.

When the temperature or moisture content increase despite ventilation, then:
- shorten the storage period accordingly;
- when technically feasible, use unloading/loading equipment for grain circulation in a closed flow circuit, that is, unload the silo directly into its loading equipment (simultaneous unloading and loading of the same silo);
- unload the silo and dry grain in a continuous, batch, or other dryer.

The examples presented above are most common methods for bringing the stored material to required storage parameters.

Grain stored in the silo should be periodically inspected by collecting samples and testing them for moisture content. When necessary and possible, also test other parameters important for storage conditions in the silo.

Sampling frequency should depend on a condition of the stored material. Grain temperature is another important parameter besides the moisture content, and it can be measured, e.g., with the STW-100 thermometer produced by BIN.

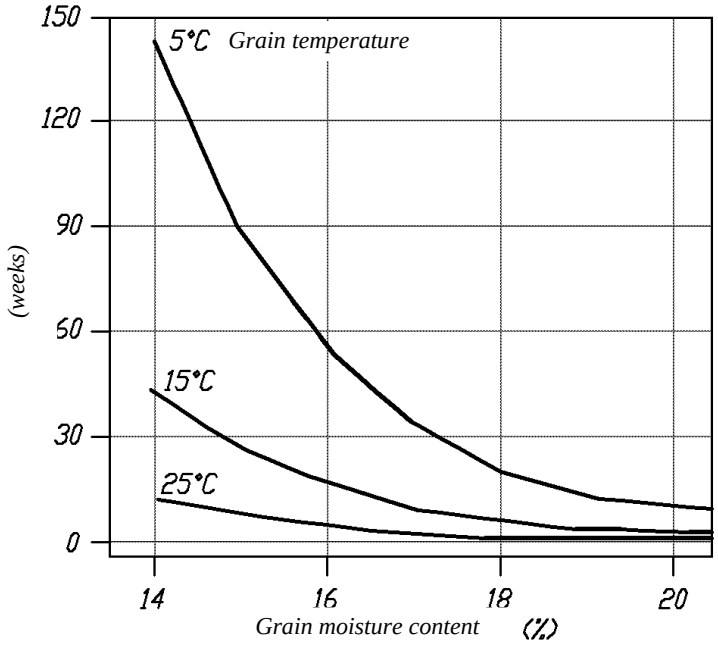


Figure 36. A time of safe grain storage depending on visible mould development (sometimes called an acceptable storage time); this time strongly depends on grain moisture content and temperature [after "Dobrze Przechowywane Zboże" by A. Ryniecki and P. Szymański].

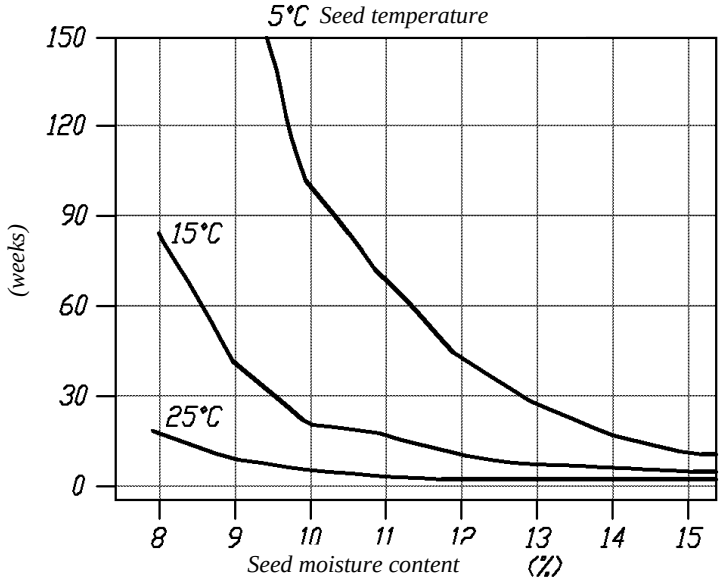


Figure 37. A time of safe rapeseed storage depending on visible mould development (sometimes called an acceptable storage time); this time strongly depends on seed moisture content and temperature [after "Dobrze Przechowywane Zboże" by A. Ryniecki and P. Szymański].

4.1.3. Fan selection

A standard feature of each silo is a perforated floor facilitating even flow of air through a whole layer of grain stored in the silo when using an appropriate fan.

A correctly selected fan ensures an appropriate dose of air to flow through the grain layer. The dose here is understood as an amount of air flowing through 1 tonne of grain during one hour. E.g., when a capacity of the fan connected to the silo containing 60 tonnes of grain is 6000 m^3/h then the hourly dose is 100 m^3/tonne. It should be remembered that when grain is dried in a silo with air of relatively low moisture content, then the larger the air dose, the better the results of drying. When planning to purchase a new fan the user should consult the silo manufacturer about its usefulness, or can itself establish its required capacity and fan pressure using the provided chart and the description below:

1. Determine the loading capacity of a silo: e.g., NBIN60 - 60 ton (Wall height of 4.75m).
2. Determine the required air dose: e.g. 55m^3/tonne.
3. Calculate the fan capacity: Capacity = Load capacity x Dose; Capacity = 60 tonnes x 55 m^3/tonne = 3300 m^3/hour
4. In the chart, draw a vertical line representing the height of the grain layer in the silo. Example: Line 1.
5. In the chart, draw a horizontal line at a point where the vertical line crosses the line for the required dose. Example: Line 2.
6. Where the horizontal line crosses the vertical axis of the chart read the required fan pressure. Example: Pressure = 8cm of the water column = 8cm x 100 = 800Pa.

The above calculations show that to provide a dose of 55 m^3/tonne of air in the NBIN60 silo, a fan of 3300 m^3/h capacity and pressure of 800 Pa must be used.

Below the examples for using WPR fans with specific BIN silos are provided.

Table 8. Selection of a WPR fan, an air inlet and a confusor for BIN silos, in which grain of wheat or other cereals and maize will be stored.
(S) / (O) – standard / optional equipment of a silo

Silo type	Silo model	Recommended fan	Confusor	Air inlet to a silo
1	2	3	4	5
BIN10	NBIN10	WPR-2	WPR-2-K400	WLOT_POW/310 (S)
	NBIN10W			
BIN20	NBIN20N			
	NBIN20			
	NBIN20R			
	NBIN20W			
	NBIN20WR			
	NBIN20WW			
BIN40	NBIN40NS			
	NBIN40S			
	NBIN40WS			
	NBIN40WWS			
BIN60	NBIN60			
	NBIN60R			
	NBIN60W			
	NBIN60WR			
	NBIN60WW			
BIN100	NBIN100U	WPR-4	WPR-4-5-K400	
	NBIN101U			
	NBIN100RU			
	NBIN100WU			
	NBIN101WU			
	NBIN100WRU			
BIN200	NBIN200NU			WLOT_POW/400 (S)
	NBIN200U	WPR-5		
	NBIN200WU	WPR-7	WPR-7-K400	
BIN500	NBIN500			
	NBIN501			
	NBIN501W	WPR-11	WPR-11-K400	
BIN1000	NBIN1001			
	NBIN1001W			
BIN1500	NBIN1500_N	WPR-7	WPR-7-K400	
	NBIN1500_P			
	NBIN1500	WPR-11	WPR-11-K400	
	NBIN1500_W			

Table 9. Selection of a WPR fan, an air inlet and a confusor for BIN silos, in which, rapeseed grain of wheat or other cereals and maize will be stored.
(S) / (O) – standard / optional equipment of a silo

Silo type	Silo model	Recommended fan	Confusor	Air inlet to a silo
1	2	3	4	5
BIN10	NBIN10	WPR-2	WPR-2-K400	WLOT_POW/310 (S)
	NBIN10W			
BIN20	NBIN20N			
	NBIN20			
	NBIN20R			
	NBIN20W			
	NBIN20WR			
	NBIN20WW			
BIN40	NBIN40NS			
	NBIN40S			
	NBIN40WS	WPR-5	WPR-4-5-K400	
	NBIN40WWS			
BIN60	NBIN60	WPR-4		
	NBIN60R			
	NBIN60W			
	NBIN60WR			
	NBIN60WW	WPR-7	WPR-7-K400	WLOT_POW/400 (O)
BIN100	NBIN100U	WPR-4	WPR-4-5-K400	
	NBIN101U			
	NBIN100RU			
	NBIN100WU	WPR-7	WPR-7-K400	
	NBIN101WU			
	NBIN100WRU			
BIN200	NBIN200NU		WPR-7-K400	WLOT_POW/400 (S)
	NBIN200U	WPR-11	WPR-11-K400	
	NBIN200WU	WPR-18	UWLP/KONF + WPR18-UWLP/K	UWLP/200 (O)
BIN500	NBIN500	WPR-11	WPR-11-K400	WLOT_POW/400 (S)
	NBIN501			
	NBIN501W			
BIN1000	NBIN1001	WPR-11		
	NBIN1001W	WPR-15	UWLP/KONF + WPR18-UWLP/K	UWLP/1000 (O)
BIN1500	NBIN1500_N	WPR-11	WPR-11-K400	WLOT_POW/400 (S)
	NBIN1500_P			
	NBIN1500	WPR-15	UWLP/KONF + WPR18-UWLP/K (2 pcs for NBIN1500_W)	UWLP/1500 (O) (2 pcs for NBIN1500_W)
	NBIN1500_W	2xWPR-18		

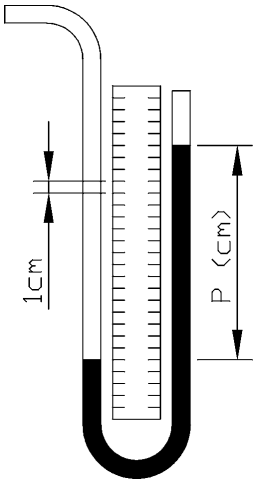
The WPR fan requires construction of a special connection at the silo installation stage, so the fan can be used in one or in two adjoining silos. Therefore, installation of the WPR fan should be provided for at the design stage and during the construction of silo foundation slabs. Guidelines for construction of appropriate foundation slabs should be obtained from BIN Sp. z o.o.

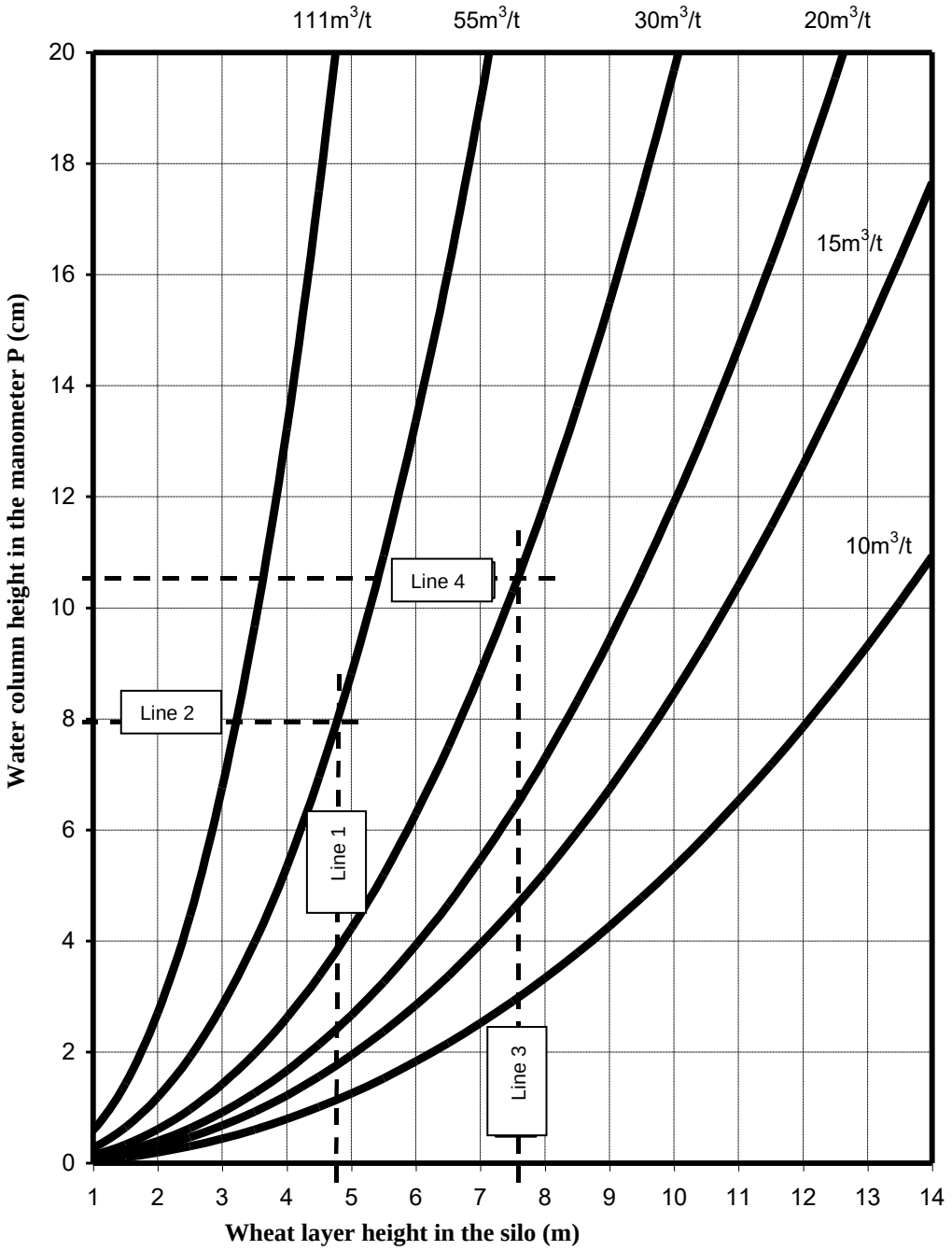
4.1.4. Measurements of an air dose flowing through a silo

When a user has its own fan, it can be connected to the silo, and the dose of air flowing through a grain layer in the silo can be determined using the installed manometer and the provided chart, as follows:

1. Fill the manometer tube with clean water to the half of the tube height.
2. Level the layer of grain in the silo and determine the layer height as m.
3. Start the fan.
4. Read a distance between the water surfaces in both manometer tubes using a scale on its casing. Scale notches are spaced every 1 cm. Example: 10.5 cm.
5. In the chart, draw a vertical line representing the height of the grain layer in the silo. Example: Line 3.–7.5m
6. In the chart, draw a vertical line representing the height of the water column in the manometer. Example: Line 4.
7. Read the obtained air dose in the chart. In the example shown in the chart a dose of 30 m^3/tonne was obtained.

A chart for calculation of an hourly dose of air flowing through wheat





The chart shown above is indicative only. The actual air flow parameters depend on the grain type, moisture content, contamination level, loading method, storage time, type of the fan connection and other factors.

4.1.5. Grain sampling for moisture content measurements

To measure the moisture content of grain, its samples must be collected. Samples can either collected from a top layer, entering the silo on the internal ladder or by starting the unloading equipment and unloading certain amount of grain from the silo. This second method is considered to be more reliable because grain from various layers is mixed.

4.1.6. Grain unloading

Each silo should be equipped with devices for unloading of grain.

The following unloading methods are acceptable:

- unloading through a factory-installed sack-filling device;
- unloading with an universal screw conveyor inserted into the unloading sleeve;
- unloading with a system of BIN PS/PSW conveyors.

Recommended unloading methods, depending on a silo type, needs, and silo equipment, are provided in - *Table 2*.

Because the silo bottom is flat, some grain (*Table 10*) cannot be get into the outlet automatically. Therefore, regardless of the unloading method, it is performed in two stages:

- stage 1 - when grain spontaneously (gravitationally) moves into an unloading device;
- stage 2 - at the end of unloading, when grain remaining in the silo (*Table 10*) must be shovelled (manual or mechanically) to the inlet of the unloading device.

For silos of the BIN10 and BIN20 type unloading with an in-built sack-filling device or the universal conveyor through an unloading duct is foreseen. For silos of the BIN600 type and larger it is recommended to use a system of PW/PSW screw conveyors manufactured by BIN, allowing completely mechanical unloading of grain from the silo.

Before starting the unloading equipment:

- check the operational condition of the unloading equipment;
- make sure there are no people in the silo.

The following rules should be observed during unloading:

- Silo unloading requires permanent supervision.
- For unloading equipment, strictly adhere to rules of their operation as described in the relevant Operating Manual.
- Manual shovelling of grain into the silo unloading sleeve or to the discharge opening in the floor requires all silo auxiliary equipment to be stopped first.
- In the event of the unloading equipment failure, when it cannot be repaired due to large quantities of grain stored in the silo, unload the grain through a sack-filling device or through an emergency duct in the silo, at the speed not exceeding 20 tonnes per hour. Higher speed may cause permanent silo deformation and, in consequence, its damage.
- It is forbidden to cut any holes in the silo shell or floor, for an emergency silo unloading.
- During the silo unloading the speed of 60 tonnes per hour for the silos of the BIN10 to BIN200 type and 150 tonnes for silos of the BIN500 type and larger should not be exceeded; higher speeds may result in the permanent deformation of the silo and, in consequence, its damage.

Silos of the BIN20 to BIN100 type (except for the NBIN60WW silo) can also be unloaded through an inclined unloading duct - *Table 4*.
In the NBIN60WW silos, and BIN200 to BIN1500 silos, an option for the emergency unloading is foreseen, through a special emergency unloading duct - *Table 4*.
These ducts can be used for inserting into the silo a conveyor to transport the stored material outside the silo. The unloading conveyors are not standard silo equipment.

Basic parameters for a conveyor for unloading silos of the BIN20 to BIN100 type (except for the NBIN60WW silo):

- conveyor type - screw (recommended);
- external diameter - 250 mm (maximum external diameter);
- flow rate - 20 tonnes/h (maximum)
- length (minimum) – BIN20 – ca.3 m, BIN60 – ca.3.8 m, BIN100 – ca.4 m

Basic parameters for a conveyor for emergency unloading silos of the BIN200 to BIN1500 type and for NBIN60WW:

- conveyor type - screw (recommended);
- external diameter - 250 mm (maximum external diameter);
- flow rate - 20 tonnes/h (maximum)
- length (minimum) – NBIN60WW – ca.2 m, BIN200 – ca.3 m, BIN500 – ca.4 m, BIN1000 – ca.5 m, BIN1500 – ca.6 m,

Table 10. An indicative quantity of stored material (grain) that will remain in the silo after gravitational unloading through a central inlet is completed.

Silo type	*Silo model*	*Remaining quantity of grain [t]*)*
BIN 10	NBIN10, NBIN10W	1.1
BIN 20	NBIN20N, NBIN20, NBIN20R, NBIN20W, NBIN20WR, NBIN20WW	3
BIN40	NBIN40NS, NBIN40S, NBIN40WS, NBIN40WWS	5.3
BIN 60	NBIN60, NBIN60R, NBIN60W, NBIN60WR, NBIN60WW	8.5
BIN 100	NBIN100U, NBIN101U, NBIN100RU, NBIN100WU, NBIN100WRU	14.5
BIN 200	NBIN200U, NBIN200WU	28
BIN 500	NBIN500, NBIN501, NBIN500W, NBIN501W	59
BIN 1000	NBIN1001, NBIN1001W	138
BIN 1500	NBIN1500_N, NBIN1500_P, NBIN1500, NBIN1500_W	270

*) - for wheat grain of density of 750 kg/m^3 and a natural grain slope angle of 25°.

4.2. Silo maintenance.

Correct and punctual maintenance inspections, maintenance and possible repairs guarantee availability of the full storage capacity of the silo and prevent its premature and excessive wear.

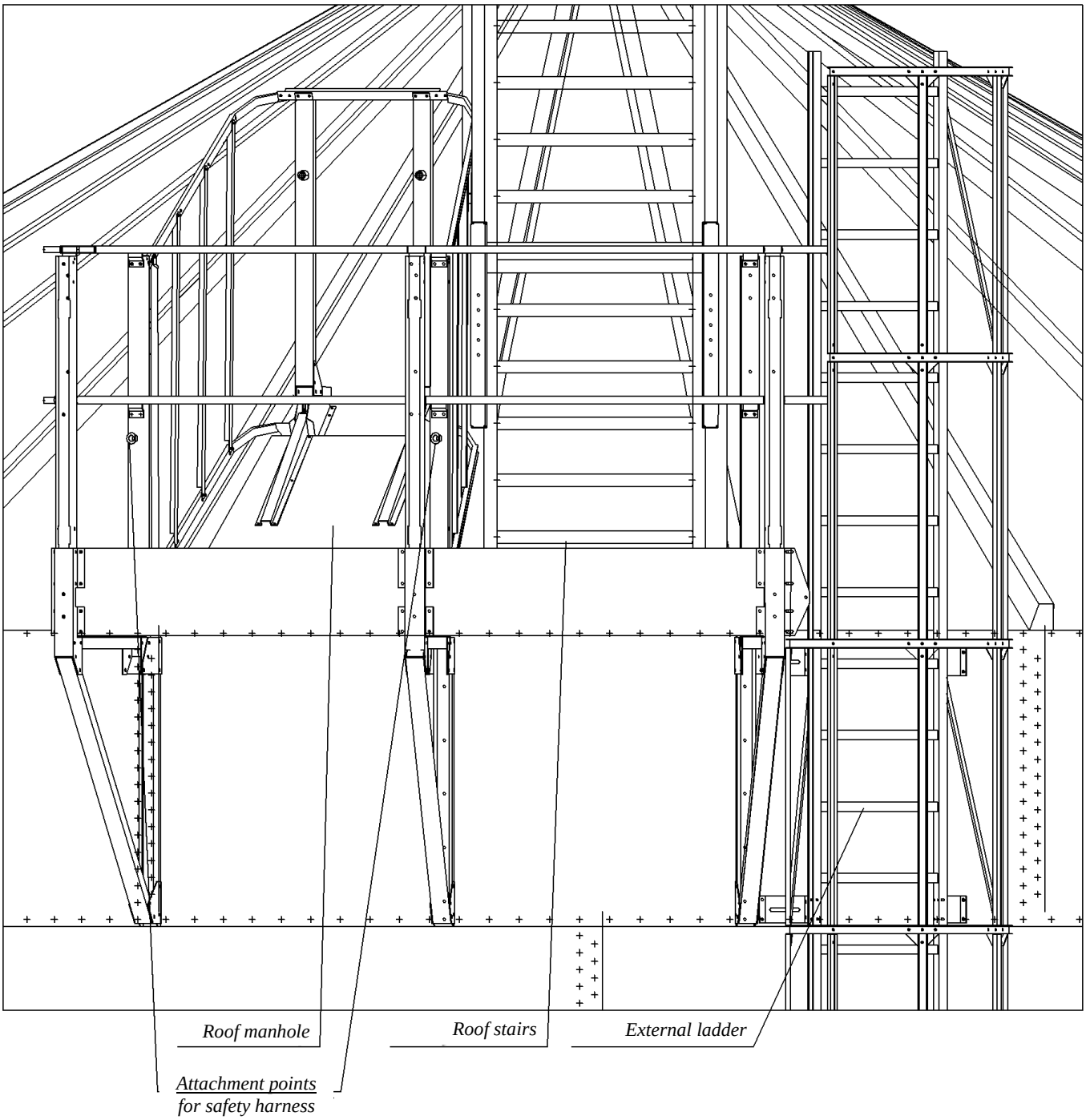


Figure 38. Access through an upper manhole to silos of the BIN100, BIN200, BIN500, BIN1000, and BIN1500 type.

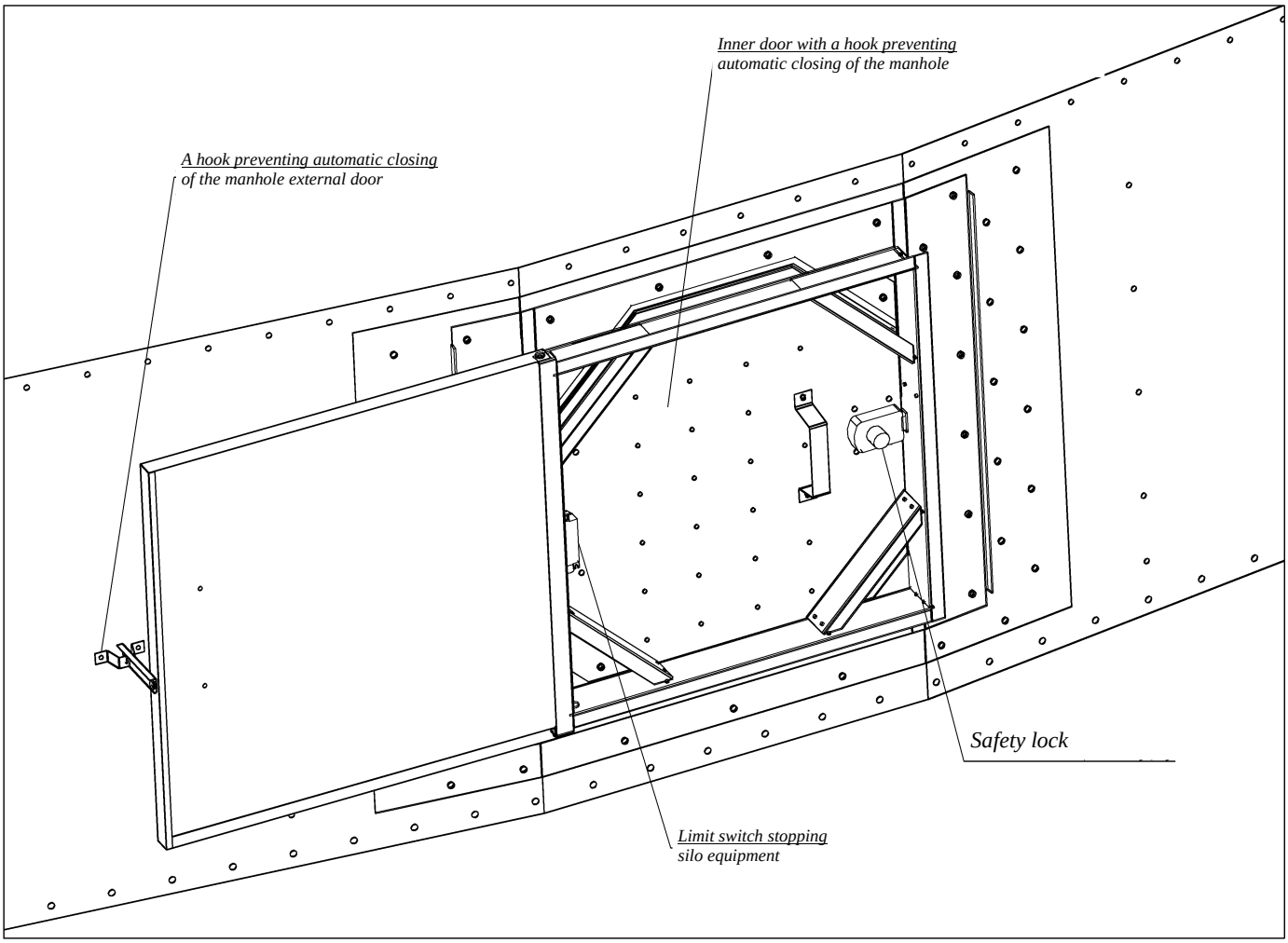


Figure 39. Access to a silo through a bottom manhole.

4.2.1. Periodic maintenance and regular overhauls

Periodic maintenance covers:

- inspection of ladders and safety devices (secure fixing);
- inspection of a technical condition of a silo shell and bolted joints;
- inspection of fixing of covers, manholes and hatches, hinges, locks and devices securing against their automatic closure, as well as handles for their opening;
- inspection of closing of unloading openings;
- inspection of anti-corrosion coatings.

The technical condition of the bottom access manhole must be checked after each unloading of the silo and before its each loading.

Before each loading of the silo, check the technical condition of the loading and unloading equipment, i.e., the conveyors installed in the silo (internal, underfloor, and other).

All safety devices, i.e., ladder covers, ladder safety equipment, safety railings, ladder fixing, and covers fixing must be inspected at least once a month.

Other silo components must be inspected at least once every 12 months.

The regular repairs include small repairs, applying solid lubricant onto hinges and possible repairs of anti-corrosion coats.

At least once every two years anti-corrosion coating of the shell below the floor level should be checked. When any corrosion foci are found, they should be removed, and anti-corrosion coating applied.

Anti-corrosion coating of screws can be damaged during installation (tightening). In such case, regular repairs include applying anti-corrosion coatings onto damaged surfaces.

The annual maintenance of the silo should be performed with a person authorised to perform maintenance of construction structures. The person conducting the maintenance should draw up a report on verification of the silo operational condition. A silo user should keep silo maintenance records.

4.2.2. General overhaul

The general overhaul is performed at least once every 8 years. It covers the scope of regular maintenance and:

- painting of steel components;
- inspection of the lightning arrestor system by a licensed electrician, and drawing up of a report;
- tests of fixing and security measures, with their possible strengthening;
- other relevant repairs.

All damages must be repaired immediately, and parts that are damaged or worn must be repaired or replaced with new ones.

4.2.3. Spare parts

When any silo components are worn, damaged or lost, they can be purchased from BIN. The manufacturer does not provide for the use of spare parts from manufacturers other than BIN. To purchase spare parts, contact BIN in writing, specifying the following details:

- Name of the product
- Proof of purchase
- Product model
- Year of production
- Serial number

Before placing an order, define precisely (on phone) types of spare parts ordered. A need for BIN representative's visit to correctly identify a part cannot be excluded. The manufacturer does not provide the silo with spare parts.

4.2.4. Pest control (disinfestation)

Pest control activities should be performed each time any grain pests are found. A general principle should be applied that no fresh grain is poured into the silo after grain affected by pests was unloaded before conducting pest control activities. Pest control should be ordered at specialist companies, as there is a high risk of poisoning with chemical agents.

4.2.5. Disassembling and disposal

Silos are devices made of materials not harmful to the environment and can be scrapped, and all their components can be recycled. During disassembling, particular attention should be paid to safety, due to components large dimensions and the height. Disassembling should be ordered at a specialist company.

As of 30/08/2023 I approve for use the Operating Manual:
title - "Flat bottom BIN silos"
revision - 48
issued on - 10/08/2023

Chief Constructor
Mieczysław Laskowski

……
(signature)

5. Warranty

BIN Spółka z o. o. guarantees correct operation of the purchased product from our company. The warranty covers 12 months from the date of sales and is valid only together with a proof of sales issued to a user by us or by our representative. The warranty covers free of charge removal of defects significantly affecting product performance. Therefore, application of warranty provisions under Article 558.1 of the Civil Code is explicitly excluded.

General Guarantee Terms And Conditions

1. The territory of the Guarantee Application
   This guarantee is valid within the territory of Poland. The warrantor shall cover costs of transport related to an accepted warranty complaint for a distance of up to 250 kilometres covered, according to standard rates.
2. The warranty does not apply to defects resulting from incorrect or excessive operation, natural wear of parts, or other reasons outside the manufacturer's control.
3. The warranty shall not cover any other costs unspecified above, especially costs being a consequence of the equipment stoppage.
4. The warranty becomes invalid when:
   -use of the product contrary to its intended use;
   -installation was incorrect or any unapproved changes are made;
   -works requiring specialist licences are performed by unauthorised persons.

Specific Guarantee Terms And Conditions

1. In the case of products:
   - with electric motors, warranty for motors is granted by their manufacturer.
   - delivered as components - a customer will verify condition of these components on delivery, and then will store them on its own responsibility until they are assembled. Flat components of galvanised sheets require special attention. They should be stored in a way ensuring a free flow of air around each component. When wet galvanised metal sheets are in contact, this results in formation of irremovable spots even during a short storage.
2. BIN Sp. z o.o. guarantees correct anti-corrosion protection for manufactured hot-dip galvanised products. A minimum weight of zinc coating of 200 g/m^2 for all products made of hot-dip galvanised steel is required.
   Furthermore, products can have parameters of no importance from an anti-corrosion protection point of view, and thus not covered by a warranty, such as:
   - different colouring, zinc coat shade, etc., on individual product components (depending on a material supplier);
   - visible cracks and scratches created in the metal sheet production process with a minimum zinc coating weight maintained.
3. When arrangements made during placement of an order or included in the Operating Manual include obligations for a buyer, then the warranty does not cover consequences of failure to perform or incorrect performance of these obligations.
4. Outdated financial liabilities of a buyer towards the warrantor or the seller result in a loss of the warranty rights until the outstanding liabilities are covered.

Exercising of warranty rights

Any defects found a customer notifies to the seller in writing. The seller shall notify the customer about a way of handling its complaint, a place and a time of warranty repair no later than within 14 days.

.....

Seller

Manufacturer:

BIN Sp. z o.o.
87-700 Aleksandrów Kujawski
at Narutowicza 12

(*seller's signature is not required when an invoice includes a note of granting the warranty)*