



Cementing Foam Wiper Balls

Technical Data Sheet and Product Manual

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Important note on data: Unless otherwise stated, the performance figures in this document are typical values obtained under laboratory or controlled test conditions. They are provided for guidance in product selection and are not guaranteed specifications. Actual field performance depends on well geometry, fluids, temperature, pressure and operating practice. Batch-specific values are reported on the material test certificate supplied with each shipment.

1. Executive Summary

This document provides technical information on the cementing foam wiper balls manufactured by Merit İş Makina Sanayi Limited Şirketi (Merit Construction Machinery Industry LLC, "Merit") in İstanbul, Türkiye. Foam wiper balls are pumped through drill pipe, work strings, tubing and pipelines to wipe residual drilling fluid, cement and debris from the inner wall and to act as a mechanical separator between fluids during displacement.

Merit has manufactured oilfield products since 2005. Its foam wiper balls are made from natural rubber (cis-1,4-polyisoprene). The standard catalogue covers nominal sizes from 3 in to 20 in (part numbers WP10003 to WP10020); 1 in and 2 in balls and other custom diameters are available on request.

Three foam types are offered, plus a high-temperature formulation:

- **Closed-Cell Foam (standard):** best pressure resistance and durability for general cementing work.
- **Semi-Rigid Foam (SRF):** higher density and stiffness for heavier wiping duty and better abrasion resistance.
- **Open-Cell Foam (OCF):** maximum conformability and fluid absorption for irregular bores and drying duty.
- **High-Temperature Rated (HTR):** modified closed-cell formulation for continuous service above +70 °C, up to +150 °C (302 °F).

Key benefits:

- Effective wiping of the pipe wall over a wide range of internal diameters per ball size
- Ability to pass through restrictions much smaller than the ball diameter and recover its shape
- Good flexibility at low temperature (standard service down to -40 °C / -40 °F)
- Simple deployment through standard cementing heads, ball launchers and diverters
- Natural rubber base material from a renewable source

This document covers specifications, manufacture, material science, applications, deployment guidelines, performance data, storage, safety, ordering, warranty and support.

2. Company Profile

2.1 Company and History

Merit was established in 2005 in Türkiye and manufactures equipment and components for the drilling and construction machinery sectors. Foam wiper balls for oilfield cementing and pipe cleaning are one of its core product lines, sold under the MERIT brand through meritautomotive.com and foam-wiper-ball.com.

The product line was developed to address a recurring field problem: drilling fluid films and cement residue left on the inside of the string, which can contaminate subsequent fluids, restrict circulation and compromise cement placement.

2.2 Manufacturing in Türkiye

Production includes rubber compounding, foam moulding and vulcanisation, and in-house dimensional and physical testing. The location in İstanbul gives efficient logistics to Europe, the Middle East, Central Asia, Africa and beyond.

2.3 Markets Served

- Middle East (onshore and offshore drilling)
- Europe, including the North Sea
- North America, including the Gulf of Mexico
- Central Asia and Asia-Pacific
- Africa

In addition to products, Merit offers application engineering support: product selection, sizing checks against the string, and help with custom requirements.

2.4 Quality Management and Certification

Merit operates a quality management system certified to **ISO 9001:2015** (Certificate No. **QA/TR/9001/2343**, issued by **QA Technic**). The quality programme includes:

- Incoming raw material inspection and testing
- In-process checks during compounding, moulding and finishing
- Final inspection of finished balls (dimensions, weight, hardness, appearance)
- Batch traceability and documentation
- Corrective action and continual improvement

3. Product Overview

3.1 Definition and Purpose

A cementing foam wiper ball is a spherical, compressible foam rubber tool that is launched into the string and pumped through it. Because its diameter is larger than the pipe internal diameter (ID), it is compressed against the wall, wipes it as it travels, and pushes residual fluid and solids ahead of it. The term "cementing" refers to its use in cementing operations, where it is typically used to wipe drill pipe or work strings clean of mud and cement and to separate fluids.

Typical purposes:

- Wiping cement residue from drill pipe or work string after cement placement (for example after setting a balanced cement plug)
- Removing drilling mud film and debris from pipe interiors before cementing
- Separating fluids during displacement (mud / spacer / cement / displacement fluid) and reducing intermixing
- Reducing cross-contamination between incompatible fluids
- Reducing non-productive time caused by poor cleaning

Limitation: Foam wiper balls are cleaning and separation tools. They are **not** pressure barriers or seals and must not be used in place of rated equipment such as casing cementing plugs (top/bottom plugs), drill-pipe darts, stage-tool opening/closing plugs, bridge plugs or test plugs.

3.2 Key Features

Material

- Natural rubber (cis-1,4-polyisoprene) foam
- Three foam types (closed-cell, semi-rigid, open-cell) and a high-temperature formulation

Size range

- Standard catalogue: nominal 3 in to 20 in (18 sizes)
- 1 in and 2 in balls and intermediate or oversize diameters on request

Cellular structure

- Engineered cell structure for controlled compression and recovery
- Conforms to the pipe ID for continuous wall contact

Performance

- High parting stretch (elongation at rupture): typically 380 % to 440 % for the standard closed-cell foam
- Passes restrictions far smaller than its own diameter (see Minimal Restriction, Section 4.5)
- Temperature: standard foams -40 °C to +70 °C (-40 °F to +158 °F) continuous; HTR formulation up to +150 °C (302 °F)

3.3 Benefits

1. **Operational efficiency:** cleaner bores reduce the risk of restrictions and contaminated fluids.
2. **Better cement placement:** reduced intermixing of mud and cement in the string supports good slurry quality at placement depth.
3. **Lower cost:** a simple, low-cost tool that can reduce remedial work and rig time.
4. **Versatility:** each ball size covers a wide range of IDs, and four material versions cover most fluid and temperature conditions.
5. **Material:** natural rubber from a renewable source, formulated without heavy-metal additives.

3.4 Competitive Advantages

Natural rubber base. Natural rubber gives very high resilience and recovery after compression and good low-temperature flexibility. Note that it has lower resistance to oils and aromatic hydrocarbons than oil-resistant synthetics such as nitrile rubber (NBR); for oil- or synthetic-based mud, exposure time should be kept short (see Section 9.3).

Controlled manufacture. Density and cell structure are controlled at compounding and moulding, giving consistent behaviour from batch to batch.

Wide product range. Eighteen standard sizes and four material versions allow the ball to be matched to the string and the fluid programme.

4. Technical Specifications

4.1 Material Composition

The base polymer is natural rubber, cis-1,4-polyisoprene, compounded with vulcanising agents, accelerators, antioxidants, a blowing agent and colourant. Compared with many synthetic alternatives, natural rubber offers:

- Very high elasticity and rebound resilience
- Good resistance to tearing and abrasion
- Good flexibility down to low temperatures
- Good resistance to water-based fluids

Natural rubber is less resistant than some synthetics to oils, aromatic solvents, ozone and prolonged high temperature. These limits are reflected in the temperature ratings and chemical compatibility data in this document.

4.2 Dimensions and Wiping Data

"General size" is the nominal size used in the part number; "actual size" is the moulded diameter. The wiping range is the span of pipe IDs that the ball wipes effectively. The minimal restriction is the smallest opening the ball can be pumped through and still recover.

General Size in (mm)	Actual Size in (mm)	Part No.	Typical Wiping Range in (mm)	Minimal Restriction in (mm)
3.00 (76.2)	3.15 (80)	WP10003	2.50 to 1.10 (63.5 to 27.9)	0.500 (12.7)
4.00 (101.6)	3.94 (100)	WP10004	3.12 to 1.38 (79.2 to 35.1)	0.625 (15.9)
5.00 (127.0)	4.92 (125)	WP10005	4.00 to 1.75 (101.6 to 44.4)	0.750 (19.0)
6.00 (152.4)	5.91 (150)	WP10006	4.75 to 2.00 (120.6 to 50.8)	0.875 (22.2)
7.00 (177.8)	6.89 (175)	WP10007	5.50 to 2.38 (139.7 to 60.5)	1.000 (25.4)
8.00 (203.2)	7.87 (200)	WP10008	7.00 to 3.00 (177.8 to 76.2)	1.375 (34.9)
9.00 (228.6)	8.86 (225)	WP10009	8.00 to 3.20 (203.2 to 81.3)	1.440 (36.6)
10.00 (254.0)	9.84 (250)	WP10010	8.40 to 3.51 (213.4 to 89.2)	1.500 (38.1)
11.00 (279.4)	10.83 (275)	WP10011	8.75 to 3.75 (222.3 to 95.3)	1.750 (44.4)
12.00 (304.8)	11.81 (300)	WP10012	9.00 to 4.32 (228.6 to 109.7)	2.000 (50.8)
13.00 (330.2)	12.80 (325)	WP10013	9.50 to 4.55 (241.3 to 115.6)	2.125 (54.0)
14.00 (355.6)	13.78 (350)	WP10014	10.00 to 4.78 (254.0 to 121.4)	2.250 (57.1)
15.00 (381.0)	14.76 (375)	WP10015	10.50 to 5.00 (266.7 to 127.0)	2.375 (60.3)
16.00 (406.4)	15.75 (400)	WP10016	11.00 to 5.25 (279.4 to 133.3)	2.500 (63.5)
17.00 (431.8)	16.73 (425)	WP10017	11.50 to 5.50 (292.1 to 139.7)	2.625 (66.7)
18.00 (457.2)	17.72 (450)	WP10018	12.00 to 5.75 (304.8 to 146.0)	2.750 (69.8)
19.00 (482.6)	18.70 (475)	WP10019	12.50 to 6.00 (317.5 to 152.4)	2.875 (73.0)
20.00 (508.0)	19.69 (500)	WP10020	13.00 to 6.25 (330.2 to 158.8)	3.000 (76.2)

1 in and 2 in balls, intermediate sizes and custom diameters are available on request; dimensional data are supplied with the quotation.

4.3 Foam Types

Closed-Cell Foam (standard)

- Base part number, e.g. WP10006
- Individual cells fully enclosed
- Highest pressure resistance and low fluid absorption
- General-purpose cementing and displacement work

Semi-Rigid Foam (SRF)

- Suffix -SRF, e.g. WP10006-SRF
- Higher density and hardness; reduced blowing agent and added reinforcing filler
- Greater wiping force and abrasion resistance
- Heavier wiping duty, cement residue, abrasive conditions

Open-Cell Foam (OCF)

- Suffix -OCF, e.g. WP10006-OCF
- Interconnected cells
- Maximum conformability; absorbs fluid
- Irregular bores, transitions, drying and swabbing duty

High-Temperature Rated (HTR)

- Suffix -HTR, e.g. WP10006-HTR
- Modified closed-cell compound with heat-stabilising additives
- Continuous service from +70 °C up to +150 °C (302 °F)

4.4 Part Numbering

- **Format:** WP100XX[-YYY]
- **WP** = Wiper Product; **100** = standard product series; **XX** = nominal size in inches (03 to 20)
- **Suffix:** none = closed-cell (standard); -SRF = semi-rigid; -OCF = open-cell; -HTR = high-temperature rated
- **Examples:** WP10006 = 6 in closed-cell; WP10006-SRF = 6 in semi-rigid; WP10006-OCF = 6 in open-cell; WP10006-HTR = 6 in high-temperature

4.5 Material Properties (standard closed-cell)

- **Parting stretch (elongation at rupture):** 380 % to 440 %
- **Temperature, continuous:** -40 °C to +70 °C (-40 °F to +158 °F); short-term up to +100 °C (212 °F)
- **Temperature, HTR formulation:** up to +150 °C (302 °F) continuous; short-term up to +170 °C (338 °F)
- **Pressure:** the ball is compressed by hydrostatic pressure but recovers; see Section 9.2 for diameter reduction versus pressure
- **Chemical resistance:** excellent in water-based fluids; limited exposure time in oil- and synthetic-based fluids (swelling); see Section 9.3

4.6 Tolerances

- Diameter: ±2 % of actual size
- Density: ±5 % of specified value
- Weight: ±3 % of specified value
- Hardness: ±5 Shore A

4.7 Physical Properties by Foam Type

Property	Closed-Cell	Semi-Rigid (SRF)	Open-Cell (OCF)	HTR
Density, g/cm ³	0.15 to 0.25	0.25 to 0.35	0.10 to 0.20	0.20 to 0.30
Hardness, Shore A	40 to 50	50 to 60	30 to 40	45 to 55
Compression set, 22 h	< 20 % (70 °C)	< 15 % (70 °C)	< 25 % (70 °C)	< 25 % (100 °C)
Abrasion loss per 1000 cycles	< 0.3 cm ³	< 0.2 cm ³	< 0.4 cm ³	< 0.35 cm ³
Water absorption, by volume	< 5 %	< 10 %	< 30 %	< 8 %
Standard colour	Orange	Orange with black stripe	Orange with blue stripe	Red

Custom colours are available for identification of balls in multi-ball trains. Surface finish: smooth and uniform. Test methods are listed in Appendix B.

5. Manufacturing Process

5.1 Raw Materials

Natural rubber is purchased to specification and each lot is checked before use for:

- Mooney viscosity
- Plasticity retention index (PRI)
- Dirt (impurity) content
- Ash content
- Nitrogen content
- Volatile matter content

Only lots that conform are released to production. Compounding ingredients include:

- Vulcanising agents (sulphur-based) to cross-link the polymer chains
- Accelerators to control cure rate and efficiency
- Antioxidants and antiozonants against oxygen and ozone attack
- Processing aids
- Chemical blowing agents to form the cellular structure
- Colourants for product identification

The exact formulation is proprietary to Merit.

5.2 Compounding

Rubber and ingredients are mixed in internal mixers and on mills to obtain a homogeneous compound. Controlled parameters include mixing temperature, mixing time, rotor speed, the order of ingredient addition and cooling rate.

5.3 Moulding Preparation

- Preforming the compound to a controlled weight for each size
- Preheating to the required flow condition
- Applying mould release agent

5.4 Foam Formation

Closed-cell foam: the blowing agent decomposes during heating in the mould, releasing gas (mainly nitrogen and/or carbon dioxide) that forms closed cells in the rubber matrix while vulcanisation fixes the structure.

Semi-rigid foam: less blowing agent and additional reinforcing filler produce a denser, stiffer cell structure that still compresses and recovers.

Open-cell foam: formulation and process are adjusted so that cell walls rupture and the cells interconnect; post-cure working may be used to complete cell opening.

5.5 Moulding and Vulcanisation

- Spherical moulds for each size
- Accurate charge weight for consistent density
- Controlled temperature profile and cure time for complete vulcanisation and uniform cell formation
- Controlled cooling after demoulding

Vulcanisation forms cross-links between polymer chains, converting the compound from a plastic to an elastic material while the cell structure forms.

5.6 Cell Structure Control

- **Cell size and distribution:** fine, uniform cells give the best mechanical properties.
- **Cell wall thickness:** set for the required balance of strength, flexibility and recovery for each foam type.
- **Density gradients:** a harder skin and softer core (or the reverse) can be produced on request.
- **Surface:** a smooth, uniform skin for consistent wall contact.

5.7 Quality Assurance

In-process checks

- Raw material release before compounding
- Compound cure characteristics (rheometer) before moulding
- Visual inspection at demoulding
- Dimensional check after demoulding
- Density check

Final inspection

- Visual examination for surface defects
- Diameter
- Weight and density
- Hardness
- Compression and recovery

Batch traceability

Each batch record contains raw material lot numbers, process parameters, test results, production date and operator identification, so that any quality issue can be traced quickly.

5.8 Test Methods

- Density: by dimensions and weight, or by water displacement
- Hardness: Shore A durometer (ASTM D2240)
- Compression set (ASTM D395 / ASTM D1056)
- Tensile properties and elongation (ASTM D412)
- Tear strength (ASTM D624)
- Fluid immersion and compatibility tests in representative drilling fluids
- Temperature exposure and pressure compression and recovery tests

New formulations and major process changes are additionally evaluated by flow-loop wiping tests, pressure tests, restriction pass-through tests and accelerated ageing before release.

6. Material Science

6.1 Chemical Composition of cis-1,4-Polyisoprene

Natural rubber is obtained from the latex of the rubber tree (*Hevea brasiliensis*). Its polymer is polyisoprene with the repeat unit $(C_5H_8)_n$, where n is the degree of polymerisation. In natural rubber the isoprene units are joined almost exclusively (more than 99 %) in the cis-1,4 configuration: the backbone carbon atoms on either side of each C=C double bond lie on the same side of the bond.

Repeat unit: $-CH_2-C(CH_3)=CH-CH_2-$

This regular cis structure gives a flexible, coiled chain that can be stretched to several times its length and returns to its original shape when the stress is removed.

6.2 Typical Composition of Natural Rubber

Constituent	Typical content
cis-1,4-polyisoprene (rubber hydrocarbon)	93 % to 95 %
Proteins	2 % to 3 %
Carbohydrates	1 % to 2 %
Lipids / fatty acids	0.2 % to 1 %
Inorganic matter (ash)	0.1 % to 0.5 %

Merit uses graded natural rubber with controlled non-rubber content for consistent performance.

6.3 Structure and Properties

- **High molecular weight** (typically 1 to 2 million g/mol): high strength and resistance to permanent set.
- **Random-coil chains** in the unstressed state; chains align under stress, and natural rubber crystallises under strain, which gives high tensile and tear strength.
- **Backbone double bonds**: provide chain flexibility and the sites for sulphur vulcanisation, but also make the polymer susceptible to oxygen, ozone and heat ageing (hence antioxidants and antiozonants in the compound).
- **Low glass transition temperature** (about -70 °C): the rubber stays flexible at low ambient temperatures.

6.4 Natural Rubber Compared with Alternatives

Property	Natural rubber (NR)	Nitrile rubber (NBR)	Polyurethane foam (PU)
Resilience / recovery	Excellent	Good	Good
Tear and abrasion resistance	Very good	Good	Very good (abrasion)
Low-temperature flexibility	Excellent	Fair to good	Good
Resistance to oils and OBM	Limited (swells)	Very good	Good
Heat ageing resistance	Moderate (to ~70 °C standard)	Good (to ~100 to 120 °C)	Moderate (hydrolysis in hot water)
Water-based fluids	Excellent	Very good	Fair to good

Natural rubber is therefore the preferred choice where resilience, compressibility and low-temperature performance matter most, and in water-based systems. In oil- and synthetic-based muds it performs well for the short exposure times typical of a wiping run; for prolonged contact or high temperature, the SRF or HTR versions and a compatibility check are recommended.

6.5 Processing Advantages

- High green strength and building tack
- Good acceptance of fillers and additives
- Good mouldability
- Consistent properties when sourced and graded correctly

6.6 Environmental Aspects

- Renewable raw material; rubber trees absorb CO₂ as they grow
- Natural rubber degrades in the environment more readily than most synthetic polymers, although vulcanised rubber degrades slowly
- Formulated without heavy-metal additives
- Cure systems and additives are selected to reduce emissions and environmental impact

6.7 Behaviour in Service

Temperature

- Glass transition about -70 °C; flexible down to -40 °C
- Standard foams: optimal from -40 °C to +70 °C; progressive softening above +70 °C
- Short exposure of standard foams up to +100 °C is acceptable
- Above about +120 °C standard compounds age rapidly; use the HTR formulation (up to +150 °C)

Pressure

- The gas in the cells is compressed by hydrostatic pressure, reducing ball volume and diameter
- Recovery after decompression is high but decreases with pressure level and number of cycles
- Account for diameter reduction at depth when sizing (Section 9.2)

Chemical

- Good resistance to water-based fluids, brines and cement slurries
- Swelling in oil- and synthetic-based muds; acceptable for short runs, may improve wall contact, but reduces strength with prolonged exposure
- Not resistant to aromatic solvents (e.g. xylene, toluene) and strong oxidisers

7. Applications and Use Cases

7.1 Drill Pipe and Work String Cleaning

- Wiping residual drilling mud from the bore
- Removing settled solids and debris
- Preparing the string for cementing or other operations
- Reducing contamination between successive fluids

7.2 Fluid Separation

- Reducing intermixing between incompatible fluids (e.g. oil-based mud and cement)
- Reducing contamination of high-value completion fluids
- Improving displacement efficiency
- Giving a clear interface at surface returns when the ball is recovered

7.3 Cementing Operations

Before cementing

- Wiping the drill pipe or landing string clean of mud before the cement job
- Removing debris that could contaminate the slurry

Balanced cement plugs (abandonment, kick-off / sidetrack plugs)

- After the plug is placed and the string is pulled above it, a foam wiper ball is pumped through the string to wipe cement from the bore and prevent it setting inside the pipe
- Can be used ahead of or behind the slurry to reduce contamination inside the string

Liner and drill-pipe-conveyed cementing

- Wiping the drill pipe or landing string during or after displacement, in combination with the liner wiper plug / drill-pipe dart system
- Reducing cement residue left in the work string

In primary casing cementing and multistage cementing, the bottom/top cementing plugs, drill-pipe darts and stage-tool opening/closing plugs perform the sealing and signalling functions (e.g. "bumping the plug"). Foam wiper balls do not replace these devices and should not be relied upon to indicate the end of displacement.

7.4 Pipeline and Production Applications

Soft deposit removal

- Mechanical removal of soft scale, wax (paraffin) and asphaltene deposits
- Routine preventive pigging to slow deposit build-up
- Applying or spreading inhibitor chemicals ahead of or behind the ball

Pipeline pre-commissioning

- Removing construction debris
- Removing water and drying (open-cell foam)
- Checking cleanliness before service

Other

- Geothermal and water well operations
- Horizontal and deviated well sections
- Coiled tubing cleaning

7.5 Application Examples

The following examples describe typical uses reported from the field. They are illustrative; well-specific results depend on conditions and practice.

Offshore deepwater well (Gulf of Mexico)

An operator used 9 in (WP10009) foam wiper balls in the drill pipe ahead of the cement slurry as part of a revised pre-cementing procedure to reduce mud contamination of the slurry. Success factors were correct sizing to the string IDs, the resilience of the natural rubber foam and consistent behaviour over the temperature and pressure range of the well.

High-temperature onshore wells (Middle East)

A service company used HTR balls (WP100XX-HTR) in wells where standard foam balls had softened and degraded. The heat-stabilised compound, rated up to +150 °C, maintained wiping performance through the displacement and compatibility with the high-temperature drilling fluids was confirmed before use.

Exploration well with washouts (North Sea)

Large-diameter balls (WP10019) were included in a cleaning programme for a section with irregular geometry. The conformability of the foam allowed it to follow ID changes while maintaining wall contact.

Customer-specific measured results (cement bond log data, time and cost savings) can be provided on request where the operator has agreed to their release.

7.6 Application Performance Data

Cementing operations (by ball size)

Ball Size	Typical Pipe ID Covered	Flow Rate	Typical Pressure Rise	Wiping Efficiency
3 in to 6 in	1.10 in to 4.75 in	3 to 6 bpm	50 to 150 psi	85 % to 90 %
7 in to 12 in	2.38 in to 9.00 in	6 to 12 bpm	100 to 300 psi	90 % to 95 %
13 in to 20 in	4.55 in to 13.00 in	10 to 25 bpm	200 to 500 psi	85 % to 92 %

Pipe ID ranges follow the wiping range table in Section 4.2. bpm = barrels per minute.

Drilling fluid displacement (by fluid type)

Fluid Type	Recommended Ball	Displacement Efficiency
Water-based mud	Closed-cell (standard)	92 % to 97 %
Oil-based mud	Semi-rigid (SRF)	90 % to 95 %
Synthetic-based mud	Closed-cell (standard) or SRF	88 % to 94 %
Completion fluid / brine	Closed-cell (standard)	95 % to 98 %

Recommended velocities are given in Section 8.3.

Temperature selection

Temperature Range	Recommended Ball	Expected Service Life	Performance
-40 °C to +70 °C	Standard (closed-cell, SRF, OCF)	Full	95 % to 100 %
+70 °C to +120 °C	HTR	Full	90 % to 95 %
+120 °C to +150 °C	HTR	Reduced; minimise exposure time	80 % to 90 %
Above +150 °C	Not recommended	-	-

8. Installation and Usage Guidelines

8.1 Preparation

Well and string assessment

- List every ID in the string (pipe body, tool joints, crossovers, float equipment, stage tools, packers, landing collars)
- Identify the smallest restriction
- Determine expected temperature and pressure
- Review fluid types and properties
- Confirm pump rate and pressure capability

Ball selection

- **Wiping range:** select a size whose wiping range covers **every** ID the ball must wipe. The ball is always larger than the pipe ID; the oversize is what produces wiping contact.
- **Minimal restriction:** the smallest opening in the string must be **equal to or larger than** the minimal restriction of the selected size (Section 4.2).
- **Type:** closed-cell, SRF, OCF or HTR according to fluid and duty (Sections 4.3 and 7.6).
- **Temperature:** confirm the rating covers the maximum expected temperature.
- **Quantity:** long strings and difficult conditions may need several balls; always have spares on location.

Surface equipment

- Confirm pump capacity and pressure limits
- Prepare the ball launcher, cementing head or dropping sub
- Calibrate flow meters and pressure gauges
- Agree communication between pump operator, cementing unit and rig floor

Fluid system

- Adjust viscosity and density if required
- Prepare spacers
- Confirm compatibility of all fluids with each other and with the ball
- Calculate the volumes for ball travel and tracking

8.2 Deployment Methods

Launching from surface

1. Load the ball into the launcher, cementing head or dropping sub
2. Establish the planned pump rate
3. Release the ball into the flow
4. Track the ball by pumped volume and pressure
5. Adjust pump rate to keep the planned velocity

Pump-down in deviated and horizontal wells

1. Load the ball in the launcher
2. Pump the calculated volume to move the ball to the required depth
3. Watch surface pressure for signs of movement and restrictions
4. Adjust pump rate to control ball velocity
5. Confirm position by volume pumped and pressure response

Coiled tubing

1. Launch the ball through the coiled tubing ball launcher at surface
2. Pump the ball through the reel and string at the planned rate
3. Track by volume pumped; expect higher friction pressure inside the reel
4. Confirm passage by pressure response at the end of the string

Multiple-ball trains

1. Prepare the required number of balls
2. Launch them in sequence with calculated spacer volumes between them
3. Use different colours to identify each ball at surface returns
4. Record the return of each ball
5. Adjust the following runs based on the condition of returned balls

8.3 Operating Parameters

Flow rate guidelines

Ball Size	Recommended Flow Rate	Optimal Linear Velocity
3 in to 6 in	3 to 6 bpm	100 to 150 ft/min (0.5 to 0.8 m/s)
7 in to 12 in	6 to 12 bpm	120 to 180 ft/min (0.6 to 0.9 m/s)
13 in to 20 in	10 to 25 bpm	150 to 200 ft/min (0.8 to 1.0 m/s)

These are general guidelines; adjust them for the actual string and fluid properties.

Pressure monitoring

- A pressure rise of about 100 to 300 psi usually indicates that the ball is moving and wiping
- Steady pressure indicates steady progress
- Pressure spikes may indicate a restriction
- A pressure drop often follows passage through a restriction
- Return to baseline pressure usually indicates the ball has left the string

Temperature

- Standard balls: -40 °C to +70 °C
- HTR: +70 °C to +150 °C
- Minimise exposure time at high temperature
- Allow cooling between runs in hot wells where practical

Fluid properties

- Viscosity 10 to 50 cP gives good carrying capacity
- Density typically 8.5 to 12.5 ppg
- Solids content preferably below 5 % by volume
- pH 5 to 10 for best ball life
- Verify compatibility of special fluids before use

8.4 Performance Optimisation

- **Multiple balls:** use successive runs, if necessary with progressively larger or different-type balls; separate them with spacer volumes.
- **Velocity:** too slow reduces wiping action and risks stalling; too fast reduces contact time; adjust pump rate when the ID changes.

- **Fluids:** viscosified spacers, surfactants and mild cleaners improve removal of stubborn films.
- **Mechanical:** pipe rotation and reciprocation, where possible, and controlled pressure cycling help in difficult sections.

8.5 Troubleshooting

Problem	Possible Causes	Actions
Ball stalls	Restriction smaller than rated; debris; ball too large	Increase rate gradually within equipment limits; apply pressure cycles; on subsequent runs select a smaller size or softer type
Ball arrives early	Ball too small for ID; washout or larger ID than expected; bypass	Check size against all IDs; select a size whose wiping range covers the ID; use multiple balls
Ball worn or degraded	Temperature above rating; incompatible fluid; sharp edges in string	Check temperature and fluids; use HTR or SRF; reduce exposure time; inspect string components
Insufficient cleaning	Wrong type; velocity too high or low; heavy deposits	Use additional runs; change foam type; add surfactant or cleaning spacer; adjust rate
Ball not returned	Lodged at a restriction; disintegrated	Continue circulating at planned rate; apply pressure cycles; review restrictions; prepare a contingency plan

9. Performance Analysis

All values in this section are typical results from laboratory tests on standardised pipe sections or controlled flow-loop tests. Field results vary with conditions.

9.1 Wiping Efficiency

Surface cleaning efficiency (contaminant removed from the wall)

Ball Type	Water-Based Mud	Oil-Based Mud	Cement Slurry	Completion Fluid
Closed-cell	92 % to 97 %	88 % to 93 %	90 % to 95 %	94 % to 98 %
Semi-rigid (SRF)	90 % to 95 %	91 % to 96 %	88 % to 93 %	92 % to 96 %
Open-cell (OCF)	88 % to 93 %	85 % to 90 %	85 % to 90 %	90 % to 95 %

Displacement efficiency and mixing zone

Interface	Displacement Efficiency	Mixing Zone Length
Mud / cement	90 % to 95 %	10 to 30 ft (3 to 9 m)
Mud / spacer	92 % to 97 %	5 to 20 ft (1.5 to 6 m)
Spacer / cement	94 % to 98 %	3 to 15 ft (1 to 4.5 m)
Completion fluid interfaces	95 % to 99 %	2 to 10 ft (0.6 to 3 m)

Debris removal capacity (single ball)

Ball Size	Soft Debris	Hard Debris	Maximum Particle Size
3 in to 6 in	0.5 to 1.5 lb (0.2 to 0.7 kg)	0.2 to 0.5 lb (0.1 to 0.2 kg)	0.125 in (3 mm)
7 in to 12 in	1.5 to 4.0 lb (0.7 to 1.8 kg)	0.5 to 1.5 lb (0.2 to 0.7 kg)	0.25 in (6 mm)
13 in to 20 in	4.0 to 10.0 lb (1.8 to 4.5 kg)	1.5 to 3.0 lb (0.7 to 1.4 kg)	0.5 in (13 mm)

Pass-through success rate

Well Geometry	Standard Conditions	Difficult Conditions	Extreme Conditions
Vertical	98 % to 100 %	95 % to 98 %	90 % to 95 %
Deviated (up to 45°)	95 % to 98 %	90 % to 95 %	85 % to 90 %
Highly deviated (over 45°)	90 % to 95 %	85 % to 90 %	75 % to 85 %
Horizontal sections	85 % to 90 %	75 % to 85 %	65 % to 75 %

9.2 Pressure and Temperature

Pressure

Pressure Range	Volume Reduction	Recovery After Decompression	Effect
0 to 1,000 psi (0 to 69 bar)	5 % to 15 %	98 % to 100 %	Minimal
1,000 to 3,000 psi (69 to 207 bar)	15 % to 30 %	95 % to 98 %	Slight diameter reduction
3,000 to 5,000 psi (207 to 345 bar)	30 % to 45 %	90 % to 95 %	Moderate loss of wiping efficiency
5,000 to 8,000 psi (345 to 552 bar)	45 % to 60 %	85 % to 90 %	Significant diameter reduction
Above 8,000 psi (552 bar)	Over 60 %	Below 85 %	Not recommended for extended exposure

Because the effective diameter decreases with pressure, check that the ball still covers the pipe ID at the expected bottom-hole pressure.

Temperature

Temperature Range	Material Behaviour	Service Life	Effect
-40 °C to 0 °C	Slight stiffening	Normal	Minimal
0 °C to +70 °C	Optimal elasticity	Normal	Optimal performance
+70 °C to +120 °C	Softening (use HTR)	Reduced by 25 % to 30 % (standard compound)	Slight loss of wiping efficiency
+120 °C to +150 °C	Significant softening (HTR only)	Reduced by 50 % to 60 %	Moderate loss of structural integrity
Above +150 °C	Thermal degradation	Severely reduced	Not recommended

Combined effects

Condition	Pressure Effect	Temperature Effect	Combined Result
High pressure / low temperature	Compression	Stiffening	Reduced wiping efficiency
High pressure / high temperature	Compression	Softening	Complex; requires specific selection (HTR, size check)
Cyclic pressure / stable temperature	Fatigue	Minimal	Reduced service life
Stable pressure / cyclic temperature	Minimal	Thermal stress	Possible premature degradation

9.3 Durability

Chemical resistance (at ambient temperature)

Environment	Exposure Tolerance	Effect	Recommended Ball
Water-based fluids	Excellent (over 72 h)	Minimal	Standard
Oil-based mud	Fair (up to 24 h)	Swelling	SRF
Synthetic-based fluids	Fair (up to 24 h)	Slight swelling	Standard or SRF
Cement slurries	Moderate (12 to 24 h)	Surface hardening	SRF
Completion brines	Good (24 to 48 h)	Minimal	Standard
Acidic solutions (pH 3 to 5)	Limited (6 to 12 h)	Accelerated ageing	Consult Merit
Alkaline solutions (pH 9 to 11)	Moderate (12 to 24 h)	Slight softening	Standard
Aromatic solvents	Not resistant	Severe swelling	Not recommended

Chemical resistance decreases as temperature increases.

Abrasion resistance

Ball Type	Abrasion Resistance Index	Volume Loss per 1000 Cycles	Field Durability
Closed-cell	High (80 to 90)	0.2 to 0.3 cm ³	Excellent
Semi-rigid (SRF)	Very high (85 to 95)	0.1 to 0.2 cm ³	Superior
Open-cell (OCF)	Moderate (70 to 80)	0.3 to 0.4 cm ³	Good

Pressure cycling (atmospheric to 3,000 psi)

Ball Size	Maximum Recommended Cycles	Diameter Reduction After Cycling	Recovery After Final Cycle
3 in to 6 in	8 to 12	5 % to 10 %	90 % to 95 %
7 in to 12 in	6 to 10	8 % to 12 %	88 % to 93 %
13 in to 20 in	4 to 8	10 % to 15 %	85 % to 90 %

Higher pressures or more severe cycling reduce the recommended number of cycles.

9.4 Comparison with Alternatives

Foam wiper balls vs mechanical scrapers

Aspect	Foam Wiper Balls	Mechanical Scrapers	Advantage
Surface cleaning	88 % to 97 %	85 % to 95 %	Slightly wiper balls
Passing restrictions	Excellent	Limited	Wiper balls
Risk of stuck tool	Very low	Moderate to high	Wiper balls
Initial cost	Low to moderate	Moderate to high	Wiper balls
Operational complexity	Low	Moderate to high	Wiper balls
Hard deposit / debris removal	Moderate	High	Scrapers

Foam wiper balls vs chemical cleaning

Aspect	Foam Wiper Balls	Chemical Cleaners	Advantage
Surface cleaning	88 % to 97 %	80 % to 95 %	Slightly wiper balls
Environmental impact	Low	Moderate to high	Wiper balls
Treatment time	Minutes to hours	Hours to days	Wiper balls
Cost	Low to moderate	Moderate to high	Wiper balls
Hardened deposits	Moderate	High	Chemical cleaners

The two methods are often combined: a chemical cleaning spacer followed by a wiper ball.

Displacement with and without wiper balls

Aspect	With Wiper Balls	Without Wiper Balls	Advantage
Displacement efficiency	90 % to 98 %	70 % to 85 %	Wiper balls
Mixing zone length	2 to 30 ft	30 to over 100 ft	Wiper balls
Interface identification at surface	Clear	Often unclear	Wiper balls
Fluid volume required	Lower	Higher	Wiper balls
Operational complexity and cost	Slightly higher	Lower	Without
Consistency of results	High	Variable	Wiper balls

10. Maintenance and Storage

10.1 Storage Conditions

Parameter	Optimal	Acceptable	Avoid
Temperature	10 to 25 °C (50 to 77 °F)	5 to 30 °C (41 to 86 °F)	Below 0 °C (32 °F) or above 40 °C (104 °F) for long periods
Relative humidity	40 % to 60 %	30 % to 70 %	Above 80 % for long periods
Light	Dark / opaque packaging	Indirect light	Direct sunlight and UV
Ozone	-	-	Electric motors, welding equipment, high-voltage equipment, ozone-generating lamps

- Store indoors in a clean, dry, well-ventilated area
- Keep off the floor on shelving or pallets
- Keep away from chemicals, solvents, fuels and petroleum products
- Protect from rodents and insects
- Do not stack heavy loads on balls; avoid permanent compression

UV light and ozone attack the double bonds of natural rubber, causing surface hardening and cracking.

10.2 Shelf Life

Product	Shelf Life from Date of Manufacture
Closed-cell foam	24 months
Semi-rigid foam (SRF)	24 months
High-temperature rated (HTR)	24 months
Open-cell foam (OCF)	18 months

Under the recommended storage conditions. Signs that a ball should not be used:

- Discolouration or fading
- Tacky or dry, powdery surface
- Loss of resilience
- Cracks or crazing
- Unusual odour
- Deformation that does not recover

To get the best shelf life: first-in, first-out stock rotation, stable storage conditions, minimal handling, original packaging until use and periodic inspection.

10.3 Marking and Traceability

Each package is marked with the product code and size, batch number, manufacturing date and recommended use-by date. Record these in the job documentation.

10.4 Handling

- Handle with clean, dry gloves
- Avoid sharp objects and edges that can cut the foam
- Avoid contact with oil, grease and solvents before use
- Do not drop large balls from height

- Keep away from heat sources

Pre-use inspection

- Correct size and type for the job
- No cuts, tears or punctures
- Normal colour and surface
- Normal resilience
- Free from contamination
- Diameter within tolerance

Transport and field storage

- Use the original packaging or protective containers
- Prevent crushing and deformation
- Protect from weather, sunlight and extreme temperature
- Secure loads
- Keep away from rig-floor chemicals

10.5 Disposal

- **Unused balls:** normally non-hazardous industrial waste.
- **Used balls:** classification depends on the well fluids and chemicals they contacted.
- **Options:** energy recovery in licensed facilities; landfill for uncontaminated material where permitted; special handling for material contaminated with hazardous substances. Recycling options are limited because vulcanised rubber is cross-linked.
- Follow local and national regulations and operator waste procedures, and keep disposal records.
- In remote locations, segregate used balls in sealed, labelled containers until they can be transported to a licensed facility.

11. Safety Considerations

11.1 Material Safety

Foam wiper balls are articles made from vulcanised natural rubber and are not classified as hazardous under GHS. A Safety Data Sheet (SDS) is available on request.

Component	Status in Finished Product	Potential Hazard	Precautions
Natural rubber (cis-1,4-polyisoprene)	Vulcanised, bound in matrix	Latex protein allergy in sensitive persons	Persons with latex allergy should wear nitrile gloves
Vulcanising agents (sulphur-based)	Reacted during cure	Minimal	Normal industrial hygiene
Accelerators	Bound in rubber matrix	Minimal exposure	Do not grind or cut to create dust
Antioxidants	Bound in rubber matrix	Minimal	Normal industrial hygiene
Colourants	Non-toxic grades	Minimal	None

Allergens

Natural rubber contains proteins that may cause allergic reactions in sensitive people. Latex allergy affects a small percentage of the general population and is more common among people with frequent latex exposure; cross-reactions with some foods (e.g. banana, avocado, chestnut) are known. Protein content in dry vulcanised rubber products is lower than in dipped latex goods. Contact Merit if latex-free alternatives are required.

Toxicological information

- Acute toxicity: not classified
- Skin: not irritating to intact skin
- Eyes: not expected to irritate
- Sensitisation: possible allergic reaction in latex-sensitive persons
- Carcinogenicity: no components listed by IARC, NTP or OSHA
- Reproductive toxicity: none known

11.2 Operational Safety

Before the job

- Review the SDS and the job safety analysis (JSA)
- Confirm pressure ratings of all surface equipment
- Confirm correct ball selection
- Inspect the balls
- Agree communication between all crews

Personal protective equipment

- Safety glasses with side shields
- Work gloves (nitrile for latex-sensitive persons)
- Standard oilfield PPE as required by site rules
- No respiratory protection required under normal use

Hazards

Hazard	Risk	Prevention	Response
Release of pressure	Moderate	Rated equipment, pressure test, controlled launch	Keep clear of pressurised lines; use barriers
Ball exit velocity at returns	Low to moderate	Control flow rate; use ball catchers; clear communication	Exclusion zones at possible exit points
Trapped pressure	Moderate	Correct bleed-off procedure; monitoring	Never open pressurised equipment
Chemical exposure	Low	Handle treatment fluids correctly; PPE	Follow the SDS for the chemical involved
Manual handling	Low	Correct lifting; two-person lift for large balls	Standard ergonomic practice

Emergency response

- Follow the site emergency procedure
- Pressure incident: stop pumps, isolate, bleed off
- Chemical exposure: follow the SDS of the chemical
- Allergic reaction: remove the person from exposure and seek medical attention
- Report and record all incidents

11.3 Environment

- Low aquatic toxicity
- Natural rubber biodegrades slowly
- Low bioaccumulation potential
- Low mobility in soil

Recover intact balls and fragments where possible; do not wash fragments into drains or waterways; dispose of collected material according to local regulations.

11.4 Regulatory Information

- **Quality:** ISO 9001:2015 certified (Certificate No. QA/TR/9001/2343, QA Technician)
- **Transport:** not classified as dangerous goods under ADR, IMDG, IATA or US DOT regulations; no special labelling or placarding required
- **Hazard communication:** SDS available on request; labelling follows GHS where applicable
- Material certificates, test results and compliance statements are available on request to support customer audits

12. Ordering Information

12.1 Part Number Structure

WP100XX[-YYY] where WP = Wiper Product, 100 = standard series, XX = nominal size in inches, YYY = optional type suffix: SRF (semi-rigid), OCF (open-cell), HTR (high-temperature rated). No suffix = closed-cell standard.

12.2 Standard Product Codes

Size (in)	Closed-Cell (Standard)	Semi-Rigid	Open-Cell	High-Temperature
3	WP10003	WP10003-SRF	WP10003-OCF	WP10003-HTR
4	WP10004	WP10004-SRF	WP10004-OCF	WP10004-HTR
5	WP10005	WP10005-SRF	WP10005-OCF	WP10005-HTR
6	WP10006	WP10006-SRF	WP10006-OCF	WP10006-HTR
7	WP10007	WP10007-SRF	WP10007-OCF	WP10007-HTR
8	WP10008	WP10008-SRF	WP10008-OCF	WP10008-HTR
9	WP10009	WP10009-SRF	WP10009-OCF	WP10009-HTR
10	WP10010	WP10010-SRF	WP10010-OCF	WP10010-HTR
11	WP10011	WP10011-SRF	WP10011-OCF	WP10011-HTR
12	WP10012	WP10012-SRF	WP10012-OCF	WP10012-HTR
13	WP10013	WP10013-SRF	WP10013-OCF	WP10013-HTR
14	WP10014	WP10014-SRF	WP10014-OCF	WP10014-HTR
15	WP10015	WP10015-SRF	WP10015-OCF	WP10015-HTR
16	WP10016	WP10016-SRF	WP10016-OCF	WP10016-HTR
17	WP10017	WP10017-SRF	WP10017-OCF	WP10017-HTR
18	WP10018	WP10018-SRF	WP10018-OCF	WP10018-HTR
19	WP10019	WP10019-SRF	WP10019-OCF	WP10019-HTR
20	WP10020	WP10020-SRF	WP10020-OCF	WP10020-HTR

12.3 Custom Products

Custom products use the series code 200: **WP200XX-YYY-ZZ**, where XX = nominal size, YYY = foam type, ZZ = special-feature code assigned to each order.

- **Size:** 1 in and 2 in, intermediate, oversize or undersize diameters; tighter tolerances
- **Material:** improved chemical resistance, extended temperature range, modified hardness or recovery, special colours
- **Structure:** density gradient (skin/core), reinforced core, modified surface texture, embedded tracer elements

Minimum order quantities for custom products

Product	Minimum Order
Standard size, modified material	10 pcs
Custom size, standard material	15 pcs
Custom size, modified material	25 pcs
Fully custom design	By agreement

12.4 Lead Times

Quantity	Standard Sizes	Less Common Sizes
1 to 50 pcs	Ex-stock: 1 to 3 working days	Non-stock: 5 to 10 working days
51 to 200 pcs	7 to 14 working days	10 to 21 working days
Over 200 pcs	14 to 28 working days	21 to 35 working days

Customisation	Additional Lead Time
Material modification	+7 to 14 working days
Custom size	+14 to 21 working days
Structural modification	+21 to 35 working days
Performance modification	+14 to 28 working days
Fully custom design	35 to 60 working days in total

Expedited production and express shipping are available at additional cost, subject to capacity. Lead times may be longer during peak periods, public holidays and scheduled maintenance; confirmed lead times are stated on each order confirmation.

12.5 Packaging

- Each ball individually wrapped
- Heavy-duty corrugated cartons with dividers; moisture barrier and cushioning
- Carton label: product code, size, quantity, batch number, production date

Ball Size	Carton (L × W × H)	Pieces per Carton	Carton Weight
3 in to 6 in	24 × 18 × 12 in (610 × 457 × 305 mm)	10 to 24 (size dependent)	15 to 30 lb (7 to 14 kg)
7 in to 12 in	36 × 24 × 18 in (914 × 610 × 457 mm)	6 to 12 (size dependent)	25 to 45 lb (11 to 20 kg)
13 in to 20 in	48 × 36 × 24 in (1219 × 914 × 610 mm)	2 to 6 (size dependent)	30 to 60 lb (14 to 27 kg)

Palletised bulk packing, long-term storage packing, harsh-environment packing, customer labelling and kitting are available on request.

Shipping documents

- Packing list
- Certificate of conformity / material test certificate
- Batch traceability information
- Handling and storage instructions
- SDS on request
- Inspection certificates as required

13. Warranty and Support

13.1 Standard Warranty

- **Period:** 12 months from date of purchase or 6 months from first use, whichever comes first
- **Manufacturing defects:** replacement of defective products
- **Material integrity:** against premature degradation when stored as recommended (Section 10)
- **Dimensions:** conformity to the published dimensions within stated tolerances

Limitations

- Use in accordance with this document
- Storage and handling as recommended
- Use in suitable applications and within temperature, pressure and chemical limits
- Modified products are not covered
- Normal wear and consumption in use are not covered

Extended warranty (18 or 24 months) and application-specific guarantees can be agreed for project or volume orders, subject to review.

13.2 Warranty Claims

1. **Notify** Merit within 30 days of discovering the problem.
2. **Provide** order and invoice details, part and batch numbers, description with photographs or test results, and application conditions.
3. **Evaluation:** documentation review, product return if required, technical analysis and root-cause determination.
4. **Timeline:** acknowledgement within 2 working days; initial assessment within 5 working days; final decision within 15 working days of receiving all information and samples.
5. **Remedy:** replacement, credit, refund or technical consultation.

13.3 Technical Support

- **Before purchase:** application review, product and size selection, clarification of specifications, customisation feasibility, compatibility review
- **During implementation:** job planning, procedure development, parameter optimisation, training information
- **Ongoing:** performance optimisation, troubleshooting, laboratory analysis of returned balls, root-cause investigation

13.4 Contact

Item	Details
Company	Merit İş Makina Sanayi Limited Şirketi (Merit Construction Machinery Industry LLC)
Address	Çamlık Mahallesi İkbal Caddesi Dinç Sokak No:4, Muyar Plaza Suite 26, Ümraniye 34774 İstanbul, Türkiye
Phone / WhatsApp / Telegram	+90 552 105 10 34
Email	info@meritautomotive.com
Websites	https://meritautomotive.com https://foam-wiper-ball.com
Office hours	Monday to Friday, 08:00 to 17:00 (Türkiye time, UTC+3); urgent operational requests by WhatsApp / Telegram
Certification	ISO 9001:2015, Certificate No. QA/TR/9001/2343, QA Technic

14. Appendices

Appendix A: Data Sheets by Foam Type

A.1 Closed-Cell Foam (Standard, WP100XX)

Property	Value
Base material	Natural rubber (cis-1,4-polyisoprene)
Foam type	Closed-cell
Density	0.15 to 0.25 g/cm ³
Colour	Orange
Hardness	40 to 50 Shore A
Compression set (22 h / 70 °C)	< 20 %
Parting stretch (elongation at rupture)	380 % to 440 %
Abrasion loss	< 0.3 cm ³ per 1000 cycles
Water absorption	< 5 % by volume
Operating temperature	-40 °C to +70 °C
Short-term exposure	Up to +100 °C
Thermal conductivity	0.04 to 0.06 W/m·K
Coefficient of thermal expansion	15 to 20 × 10 ⁻⁵ /°C
Water-based fluids	Excellent
Oil-based mud	Fair (short exposure)
Synthetic-based fluids	Fair to good (short exposure)
Cement slurries	Moderate to good
Completion brines	Good
Acids (pH 3 to 5)	Limited
Alkaline solutions (pH 9 to 11)	Moderate

A.2 Semi-Rigid Foam (WP100XX-SRF)

Property	Value
Base material	Natural rubber (cis-1,4-polyisoprene)
Foam type	Semi-rigid
Density	0.25 to 0.35 g/cm ³
Colour	Orange with black stripe
Hardness	50 to 60 Shore A
Compression set (22 h / 70 °C)	< 15 %
Abrasion loss	< 0.2 cm ³ per 1000 cycles
Water absorption	< 10 % by volume
Operating temperature	-35 °C to +80 °C
Short-term exposure	Up to +110 °C
Thermal conductivity	0.05 to 0.07 W/m·K
Coefficient of thermal expansion	12 to 18 × 10 ⁻⁵ /°C
Water-based fluids	Excellent
Oil-based mud	Fair to good (short exposure)
Synthetic-based fluids	Good (short exposure)

Property	Value
Cement slurries	Good
Completion brines	Very good
Acids (pH 3 to 5)	Limited to moderate
Alkaline solutions (pH 9 to 11)	Moderate to good

A.3 Open-Cell Foam (WP100XX-OCF)

Property	Value
Base material	Natural rubber (cis-1,4-polyisoprene)
Foam type	Open-cell
Density	0.10 to 0.20 g/cm ³
Colour	Orange with blue stripe
Hardness	30 to 40 Shore A
Compression set (22 h / 70 °C)	< 25 %
Abrasion loss	< 0.4 cm ³ per 1000 cycles
Water absorption	< 30 % by volume
Operating temperature	-40 °C to +65 °C
Short-term exposure	Up to +90 °C
Thermal conductivity	0.03 to 0.05 W/m·K
Coefficient of thermal expansion	18 to 22 × 10 ⁻⁵ /°C
Water-based fluids	Very good
Oil-based mud	Limited (absorbs fluid)
Synthetic-based fluids	Fair
Cement slurries	Moderate
Completion brines	Good
Acids (pH 3 to 5)	Poor to limited
Alkaline solutions (pH 9 to 11)	Limited to moderate

A.4 High-Temperature Rated (WP100XX-HTR)

Property	Value
Base material	Natural rubber (cis-1,4-polyisoprene) with heat-stabilising additives
Foam type	Closed-cell (modified)
Density	0.20 to 0.30 g/cm ³
Colour	Red
Hardness	45 to 55 Shore A
Compression set (22 h / 100 °C)	< 25 %
Abrasion loss	< 0.35 cm ³ per 1000 cycles
Water absorption	< 8 % by volume
Operating temperature	-30 °C to +150 °C (302 °F)
Short-term exposure	Up to +170 °C (338 °F)
Thermal conductivity	0.06 to 0.08 W/m·K
Coefficient of thermal expansion	10 to 15 × 10 ⁻⁵ /°C
Water-based fluids	Excellent
Oil-based mud	Fair (short exposure)

Property	Value
Synthetic-based fluids	Fair to good (short exposure)
Cement slurries	Good
Completion brines	Very good
Acids (pH 3 to 5)	Limited
Alkaline solutions (pH 9 to 11)	Moderate

Batch-specific elongation, tensile and tear values are reported on the material test certificate.

Appendix B: Certification and Test Documentation

B.1 Quality Management System

Merit operates a quality management system certified to ISO 9001:2015 by QA Technic, Certificate No. QA/TR/9001/2343. A copy of the certificate is available on request.

B.2 Material Test Certificate (per batch)

- Raw material verification
- Density, hardness and dimensions
- Compression and recovery results
- Batch number, production date and production line
- Quality control approval (name, signature, date)

B.3 Chemical Compatibility Test Reports (on request)

- Test fluid composition
- Exposure temperature, pressure and duration
- Changes in dimensions, weight and hardness
- Functional assessment after exposure
- Compatibility rating

B.4 Temperature and Pressure Test Reports (on request)

- Test temperature and pressure
- Exposure time
- Properties before and after exposure
- Recovery assessment
- Performance rating

Appendix C: Glossary

Casing: Large-diameter pipe run into a drilled section of a well and usually cemented in place to stabilise the hole, protect groundwater and isolate zones.

Cementing: Mixing a slurry of cement, additives and water and pumping it into the well, typically into the annulus between casing and borehole, or to place a cement plug.

Closed-cell foam: Foam in which each cell is completely enclosed by cell walls, so that gas or liquid cannot pass from cell to cell.

cis-1,4-Polyisoprene: The polymer that makes up natural rubber, in which isoprene units are joined in the cis-1,4 configuration.

Displacement efficiency: How completely one fluid displaces another in the pipe or wellbore, usually expressed as a percentage.

Drill pipe: Seamless steel pipe that transmits rotation and drilling fluid to the bit.

Foam wiper ball: A spherical, compressible foam tool pumped through pipe to wipe the inner wall and separate fluids.

Minimal restriction: The smallest opening a given ball size can be pumped through and still recover.

Open-cell foam: Foam in which the cells are interconnected, allowing fluid to pass through the material.

Parting stretch: The elongation of the foam at the moment it ruptures, expressed as a percentage of its original length.

Semi-rigid foam: Higher-density foam with properties between flexible foam and solid rubber, combining wiping force and flexibility.

Shore A hardness: Durometer scale for elastomers; higher numbers indicate harder material.

Vulcanisation: Chemical cross-linking of rubber, usually with sulphur, that converts it into a durable elastic material.

Wellbore: The hole drilled to explore for or produce water, oil, gas or geothermal energy.

Wiping efficiency: How effectively a ball removes residual material from the pipe wall, usually expressed as a percentage.

Wiping range: The range of pipe internal diameters that a given ball size wipes effectively.

Zonal isolation: Prevention of fluid communication between different zones in a well.

Appendix D: References

D.1 Standards

1. API RP 10B-2, Recommended Practice for Testing Well Cements
2. API Spec 10A, Specification for Cements and Materials for Well Cementing
3. ASTM D1056, Standard Specification for Flexible Cellular Materials: Sponge or Expanded Rubber
4. ASTM D2240, Standard Test Method for Rubber Property: Durometer Hardness
5. ASTM D395, Standard Test Methods for Rubber Property: Compression Set
6. ASTM D412, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers: Tension
7. ASTM D624, Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
8. ASTM D1566, Standard Terminology Relating to Rubber
9. ASTM D3183, Standard Practice for Rubber: Preparation of Pieces for Test Purposes from Products
10. ISO 9001:2015, Quality management systems: Requirements

D.2 Books

1. Nelson, E.B. and Guillot, D. (eds.) (2006). Well Cementing, 2nd edition. Schlumberger, Sugar Land, Texas.
2. Mitchell, R.F. (ed.) (2006). Petroleum Engineering Handbook, Volume II: Drilling Engineering (L.W. Lake, Editor-in-Chief). Society of Petroleum Engineers, Richardson, Texas.
3. Roberts, A.D. (ed.) (1988). Natural Rubber Science and Technology. Oxford University Press, Oxford.
4. Mark, J.E., Ergan, B. and Roland, C.M. (eds.) (2013). The Science and Technology of Rubber, 4th edition. Academic Press, Oxford / Waltham, MA.

D.3 Online Resources

1. Merit: <https://meritautomotive.com> and <https://foam-wiper-ball.com>
2. Society of Petroleum Engineers: <https://www.spe.org>
3. PetroWiki (SPE): <https://petrowiki.spe.org>
4. International Association of Drilling Contractors: <https://www.iadc.org>
5. ACS Rubber Division: <https://www.rubber.org>

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