

Stacker Reclaimer Cable Selection Guide

General Engineering Edition | Reeling · Festoon · Drag Chain · Fixed Connections

APPLICATION

Stacker-reclaimers, stackers, reclaimers and similar bulk-material handling equipment

VOLTAGE COVERAGE

LV 0.6/1 kV; common MV classes 6/10, 8.7/15 and 12/20 kV

CONTENTS

Project Inputs | Construction | Electrical Checks | Reel Matching | Worked Example | Procurement
| Inspection and Maintenance

Version V1.0 | English Edition | 2026-10-29

Use statement: This guide supports concept design, enquiry and technical-specification preparation. It does not replace product-specific datasheets, equipment-manufacturer confirmation or applicable local regulations. Worked examples do not constitute a final purchasing specification.

Contents

Update the field in Word/WPS to refresh table-of-contents page numbers.

Selection at a Glance	3
1 Selection Principles and Scope	4
1.1 Scope	4
1.2 Hierarchy of Standards and Data	4
1.3 Key Terms	5
2 Selection Workflow and Project Inputs	6
2.1 Seven-step Workflow	6
2.2 Operating-condition Checklist	6
3 Cable Type and Construction	8
3.1 Selection by Movement	8
3.2 Selection by Circuit Function	8
3.3 LV and MV Construction	9
3.4 Insulation and Sheath Materials	10
4 Electrical Sizing and Verification	11
4.1 Load Current and Ampacity	11
4.2 Voltage Drop	12
4.3 Short Circuit and Protective Earthing	12
4.4 VFD and EMC	13
4.5 Additional MV Checks	13
5 Mechanical and Reel Compatibility	14
5.1 Bending Radius and Reel Geometry	14
5.2 Tension, Torsion and Speed	14
5.3 Cable Length and Termination	15
6 Environmental Suitability and Service Life	16
7 Recommended Selection Matrix	17
8 LV Reeling Cable Worked Example	18
8.1 Example Inputs	18
8.2 Calculations and Candidate Assessment	18
9 Procurement Clauses and Deliverables	20
10 Inspection, Installation and Maintenance	22
Appendix A Supplier Selection Confirmation Sheet	24
Appendix B Standards and Public References	26

Selection at a Glance

The essential principle

Motor power, system voltage and travel length alone are not sufficient to select a trailing cable for a stacker-reclaimer. Reel geometry, dynamic bending radius, continuous and peak tension, speed, acceleration, moving temperature, number of winding layers and termination arrangement can all change the candidate specification.

Seven-step closed-loop workflow

Step	Required work	Output
1 Define circuits	Separate main power, auxiliary power, control, bus, fibre-optic and fixed-connection circuits.	Circuit schedule and voltage classes
2 Define movement	Confirm reeling/festoon/drag chain, centre/end feed, horizontal/vertical arrangement, travel and duty cycles.	Motion load spectrum
3 Collect equipment limits	Core diameter, reel width, layers, guide sheaves, fleet angle, slip rings, clamps and available space.	Equipment interface conditions
4 Select construction	Fine-stranded conductors, insulation, screen/PE, load-bearing and anti-torsion elements, sheath and integrated communications.	Candidate cable construction
5 Verify electrical design	Ampacity corrections, running/starting voltage drop, short circuit, PE, EMC and MV-specific checks.	Candidate cross-section
6 Verify mechanics and environment	Radius, tension, speed, torsion, temperature, oil, UV, abrasion and fire performance.	Dynamic suitability conclusion
7 Freeze the specification	Use the exact product datasheet, drawing, test reports and deviation schedule to control supply.	Purchasable and inspectable specification

Table 0-1 Closed-loop selection process for stacker-reclaimer cables

Five unacceptable shortcuts

- Do not transfer fixed-installation ampacity, bending-radius or tension limits directly to continuous reeling duty.
- Do not specify only 'abrasion resistant, oil resistant, flame retardant and high tensile strength' without test references, an exact product and dynamic operating limits.
- Do not treat published values such as 5D, 6D, 12D or 15/20 N/mm² as universal defaults for every cable.
- Do not assume that ordinary communication pairs or optical fibres acquire the same dynamic life when placed inside a composite cable.
- Do not release a final purchase order based only on a cross-section table before mechanical, thermal and termination conditions are confirmed.

1 Selection Principles and Scope

1.1 Scope

This guide covers power and control connections for travel, slewing, luffing and auxiliary mechanisms of stacker-reclaimers, with emphasis on cables repeatedly bent, reeled, suspended or moved with the machine. Fixed wiring is addressed only at its interface with the mobile cable; complete fixed-distribution design is outside the scope.

'Stacker Reclaimer Cable' is not a single standard product. It may mean an LV reeling power cable, MV reeling cable, control cable, screened VFD cable, fibre-optic composite, flat festoon cable or drag-chain cable. The correct approach is to define the machine circuits and motion envelope before selecting a product platform.

1.2 Hierarchy of Standards and Data

IEC 60502-1:2021 defines construction, dimensions and tests for extruded-insulation power cables rated 1 kV and 3 kV; its published scope expressly concerns cables for fixed installations.¹

IEC 60502-2:2014+AMD1:2024 CSV covers cables rated from 6 kV up to 30 kV; at the time of retrieval, the IEC page listed a corrected version dated 2026-07. The series provides an electrical and construction baseline for MV cables but does not, by itself, demonstrate continuous reeling capability.²

Conductor sizes, construction and resistance may be checked against IEC 60228:2023 and the equivalent or modified adoption named in the contract.³ LV NSHTÖU-type products may use DIN VDE 0250-814:1985-02 as a product basis, but the exact manufacturer datasheet remains mandatory.⁴

For projects in China, GB/T 12706.1-2020 and GB/T 12706.2-2020 may be contractually adopted as baseline standards for extruded-insulation power cables at the corresponding voltage classes. The national open-standards system listed both as current when retrieved for this guide.⁵⁶

Document level	Question answered	How to use it
Law, regulation and project specification	Target market, fire, mining/port, safety and conformity-assessment requirements.	Highest priority; state editions and scope.
Product/application standards	Whether cable construction, materials, tests and application classification comply.	State the complete standard number, year and deviations.
Equipment-manufacturer documents	Whether reel, slip-ring, guidance, drive and termination interfaces match.	Dynamic interfaces require equipment-OEM confirmation.

¹IEC 60502-1:2021, official IEC scope: <https://webstore.iec.ch/en/publication/68535> (retrieved 2026-10-29).

²IEC 60502-2:2014+AMD1:2024 CSV, including 2026-07 correction information: <https://webstore.iec.ch/en/publication/95394> (retrieved 2026-10-29).

³IEC 60228:2023, Conductors of insulated cables, Edition 4.0: <https://webstore.iec.ch/en/publication/1065>.

⁴DIN VDE 0250-814:1985-02, DIN Media: <https://www.dinmedia.de/en/standard/din-vde-0250-814/1180059>.

⁵GB/T 12706.1-2020, national open-standards system: <https://openstd.samr.gov.cn/bzgk/std/newGbInfo?hcno=7593C7389ACDA76E0D40F6985E3A839D>.

⁶GB/T 12706.2-2020, national open-standards system: <https://openstd.samr.gov.cn/bzgk/std/newGbInfo?hcno=FF02D64568B22C7D9BF3462B27B2CB8E>.

Document level	Question answered	How to use it
Exact product datasheet and drawing	Actual OD, mass, ampacity, radius, tension, speed and temperature.	Direct basis for quotation, verification and acceptance.
Type/routine/FAT reports	Whether auditable evidence exists for the design family and delivered batch.	Check tested specimen, report number and scope of supply.

Important boundary

Compliance with an IEC/GB power-cable standard and suitability for high-mechanical-stress continuous reeling are separate conclusions. Manufacturer publications also distinguish LV reeling, MV reeling, festoon and drag-chain platforms. The supplier must demonstrate dynamic suitability for the exact product.

1.3 Key Terms

Term	Meaning in this guide	Selection implication
U_0 /U (U_m)	Rated conductor-to-earth/conductor-to-conductor voltage and maximum system voltage designation.	Determine from system earthing and the project standard, not only the machine nameplate voltage.
D	Actual finished cable OD; preferably the maximum datasheet value.	Do not substitute an estimated OD for the approved drawing value.
Rmin	Minimum permissible dynamic bending radius for the stated movement.	Reeling, festoon, drag-chain and fixed-installation values may differ.
Continuous/peak tension	Permissible sustained operating load and short-time load from acceleration or emergency stop.	Verify both the cable and the termination anchorage.
Centre/end feed	Reel arrangement supplying the machine from the midpoint or end of travel.	Affects paid-out length, tension, voltage drop and reel control.
One cycle	The complete motion sequence defined by the project.	Life validation must state whether this is one pass, one wind/unwind or a return trip.
Composite cable	Power, control, bus or fibre elements integrated in one cable.	Every element must satisfy the same dynamic and termination envelope.

2 Selection Workflow and Project Inputs

2.1 Seven-step Workflow

Proceed in the order: circuit, movement, equipment, construction, electrical, mechanical/environmental and technical agreement. Electrical cross-section and mechanical construction are not isolated sequential decisions. A larger cross-section normally increases OD and mass, affecting reel core, reel width, tension, voltage drop and guidance. If verification fails, iterate the cable or system design.

2.2 Operating-condition Checklist

Category	Parameters to confirm	Selection impact
System	Nominal voltage, U_0 /U (U_m), frequency and earthing arrangement.	Voltage class, insulation, screening and protection.

Category	Parameters to confirm	Selection impact
Load	Continuous power/current, maximum demand, diversity and duty.	Thermal size and equivalent current.
Starting	DOL/soft starter/VFD, starting current and duration, minimum permissible voltage.	Starting drop, EMC and protection coordination.
Fault	Prospective short-circuit current, clearing time, protective device and earth-fault requirements.	Phase, PE and screen thermal withstand.
Motion	Travel, centre/end feed, speed, acceleration, emergency stop and daily cycles.	Tension, fatigue, control and length.
Orientation	Horizontal/vertical reeling, suspension height, S-bends and free hanging length.	Load-bearing construction and maximum tension.
Reel	Motorised/torque/hysteresis type; core, width, flanges, layers and spooling.	OD, bending, crushing and thermal derating.
Guidance	Sheave diameter and groove, fleet angle, direction changes and roller spacing.	Local bending, abrasion and torsion.
Slip rings	Voltage, current, PE/screen ways, fibre rotary joint and spare ways.	Circuit configuration and continuous earthing.
Environment	Minimum/maximum moving temperature, sunlight, ozone, humidity, salt mist and immersion.	Materials, temperature correction and protection.
Contaminants	Oil/chemical identity, concentration, exposure time, slurry and abrasive particles.	Sheath formulation and test conditions.
Fire	Single-cable/bunched flame spread, low-smoke zero-halogen, fire resistance and market requirements.	Material system and conformity assessment.
Control	Core count, voltage, current, spare cores, screening and pair impedance.	Control layout and signal integrity.
Communications	Bus protocol, fibre type/count, loss budget, connectors and spare fibres.	Dynamic optical cable and EMC.
Termination	Fixed/mobile ends, glands, clamps, plugs, terminals and minimum tail length.	Strain relief, sealing and maintenance.
Life	Design years, operating cycles, maintenance strategy, spares and permissible downtime.	Verification level and spares strategy.
Delivery	Order length, negative tolerance, drums, marking, document language and witness points.	Purchasing and acceptance clauses.

Table 2-1 Project inputs required before enquiry

When information is incomplete

A candidate design may proceed, but label it 'conditional selection'. At minimum, make the reel drawing, motion load spectrum, slip-ring schedule and exact product datasheet mandatory inputs before design freeze.

3 Cable Type and Construction

3.1 Selection by Movement

Movement	Dominant stresses/failures	Preferred construction direction	Mandatory confirmation
Horizontal reeling	Repeated bending, wind/unwind tension, multilayer crushing, heat accumulation and torsion.	Fine-stranded conductors, anti-torsion reinforcement and abrasion-resistant sheath; load-bearing element where required.	Reel type, layers, speed, tension curve and spooling.
Vertical reeling	Suspended mass, acceleration shock, sway and termination load.	Independent strength member or certified reinforced design with strict torsion control.	Maximum free suspension, peak tension, anchorage and sway.
Festoon	Catenary bending, carriage synchronisation, clamp-exit stress and wind sway.	Round or flat highly flexible cable matched to carriages and clamps.	Festoon depth, carriage pitch, speed and clamp dimensions.
Drag chain	High-frequency planar travel, conductor migration and interlayer friction.	Explicit continuous-flex drag-chain product matched to chain pitch and radius.	Travel, acceleration, cycle count and chain fill.
Trailing/rollers	Ground abrasion, impact, crushing and multi-plane redirection.	Heavy-duty trailing construction and sheath; monitoring cores where required.	Path, rollers, impact and ground contaminants.
Fixed connection	Heating, voltage drop, short circuit, environment and installation method.	Select within the fixed power/control cable system.	Bending transition and termination to the mobile section.

3.2 Selection by Circuit Function

Circuit	Typical configuration direction	Specific checks
LV main power 0.6/1 kV	3+PE, 4G or distributed-PE construction; heavy-duty rubber reeling platform.	Ampacity, voltage drop, starting, PE, tension and reel thermal derating.
LV VFD power	Symmetrical PE, overall screen or drive-manufacturer-approved mobile VFD cable.	Screen coverage/transfer impedance, 360° termination, bearing currents and drive length limit.
MV main power	Three insulated cores, semiconductive layers, screen/distributed PE and anti-torsion sheath.	Electric-field control, PD if specified, earth fault, charging current and accessories.
Control	Multicore, group-screened or individual pairs; may be integrated with power.	Spare cores, voltage drop, interference, core identification and minimum bending.
Industrial bus	Dynamic bus elements meeting protocol impedance/capacitance/screening requirements.	Do not substitute ordinary multicore control cable; verify connectors and topology.
Fibre optics	Dynamic loose-tube/reinforced fibre unit, single-mode or multimode, with spares.	Dynamic attenuation, microbending, rotary joint, splicing/pretermination and spares.
Monitoring	Insulation/earth monitoring, temperature or strain-sensing elements.	Monitoring-system compatibility, alarms and test method.

3.3 LV and MV Construction

Typical heavy-duty reeling cables use fine-stranded copper conductors, elastomeric insulation, inner sheath, anti-torsion reinforcement and outer sheath. MV products also require electric-field control and a designed screen/earthing system. Permissible speed, tension, bending and temperature vary significantly between manufacturers and product ranges; use the exact product datasheet.⁷

Layer	Function	Specify in procurement
Conductor	Carries current and withstands repeated bending; commonly fine or extra-fine stranded copper.	Plain/tinned copper, conductor class, cross-section, resistance and whether it may carry tension.
Insulation	Provides electrical insulation and contributes to mechanical cushioning.	Material system, rated temperature, thickness and applicable product standard.
Semiconductive layers (MV)	Control electric stress at conductor and insulation-screen interfaces.	Inner/outer semicon construction, strippability and accessory workmanship.
Core screen/PE	Provides a fault path, earthing and, where required, electric-field control.	Cross-section, distribution, short-circuit withstand, continuity and slip-ring way.
Inner sheath/bedding	Maintains a round core, stabilises lays and cushions compression.	Material, water-blocking needs and bond to reinforcement.
Strength member	Carries vertical or high-tension loads and limits conductor stress.	Material, position, permissible load, elongation and termination anchorage.
Anti-torsion braid	Limits torsion and relative sheath movement during reeling.	Whether embedded between sheaths, permissible twist angle and validation conditions.
Outer sheath	Resists abrasion, tearing, oil, UV, ozone and weather.	Material, colour, tests, actual OD and repair compatibility.
Communication elements	Carry control/data/video or monitoring signals.	Electrical/optical performance, dynamic life, screening and termination.

Published MV reeling-cable information shows designs with three cores, distributed earth conductors, EPR insulation and semiconductive electric-field control. Permissible tension, speed and temperature remain specific to the exact product datasheet.⁸

A type designation is not a performance guarantee

Designations such as NSHTÖU, (N)SHTÖU and (N)TSCGEWÖU help identify a product platform but do not replace dynamic ratings. Interpret J/O, C, FO and other suffixes using the manufacturer's definition. Products with similar names may have different ODs, tests and mechanical limits.

3.4 Insulation and Sheath Materials

Material/system	Selection value	Misuse to avoid
EPR/rubber insulation	Flexibility and dynamic capability; common in heavy-duty reeling platforms.	Do not infer temperature, tension or life from the material name alone.

7Prysmian Group, Cable Solutions for the Crane industry: <https://www.prysmian.com/staticres/Cable-Solutions-for-the-Crane-industry/>.

⁸Prysmian PROTON(SMK) public datasheet:
<https://na.prysmian.com/sites/na.prysmian.com/files/media/documents/PROTON%28SMK%29%20%28N%29TSCGEWOEU.pdf>.

Material/system	Selection value	Misuse to avoid
XLPE/HEPR	Established power-insulation systems; flexibility depends on the complete design.	A fixed-installation XLPE cable is not automatically a continuous-reeling cable.
CR/PCP-type sheath	Common for heavy duty, weather, ozone and abrasion resistance.	Confirm oil, flame and low-temperature performance for the exact compound and tests.
CSM/CPE and other elastomers	May support weather, chemical and mechanical-protection designs.	Compounds vary significantly; make no generic performance promise.
PUR/TPU	Advantages in abrasion, tear resistance and flexibility.	Verify hydrolysis, temperature, flame and long-term reeling performance by product.
TPE/special drag-chain systems	Suitable for some high-frequency travel and small-radius chains.	Do not directly substitute for long-travel, multilayer, heavy-duty rubber reeling cables.
Low-smoke zero-halogen systems	Meet specific fire and life-safety requirements.	Do not assume abrasion, low-temperature and reeling equivalence to rubber/PUR.

4 Electrical Sizing and Verification

4.1 Load Current and Ampacity

Estimate design current for a three-phase motor or balanced three-phase load using the equation below. For multi-mechanism machines, use actual simultaneous operating cases and the load spectrum. Do not simply add every nameplate rating or apply an unjustifiably low diversity factor.

$$I_b = P / (\sqrt{3} \cdot U \cdot \eta \cdot \cos\phi)$$

Here I_b is design current (A), P is shaft output or project-defined active power (W), U is line voltage (V), η is efficiency and $\cos\phi$ is power factor. If P is already electrical input power, do not divide by efficiency again. For a multi-stage duty cycle, an RMS-equivalent current may be calculated from the squared-current/time integral, but starting, stall and acceleration peaks still require separate verification.

$$I_{z,ref} \cdot k_{temp} \cdot k_{reel} \cdot k_{group} \cdot k_{duty} \geq I_b$$

$I_{z,ref}$ is the manufacturer's reference ampacity under stated baseline conditions. The correction factors address ambient temperature, reel winding, grouping/proximity and duty. If the manufacturer provides a combined correction, do not apply it twice. Corrections must correspond to actual layers, wound state, energisation duration and the hottest operating position.

Check	Correct input	Common error
Continuous ampacity	Most unfavourable steady load and actual heat-dissipation conditions.	Direct use of free-air or single-layer ampacity.
Multilayer winding	Actual layers, heat dissipation within the reel and manufacturer's correction method.	Correcting for ambient temperature only.
Intermittent duty	Complete load spectrum and an adequate thermal time window.	Linearly reducing current only by the idle-time ratio.
Starting/acceleration	Peak current, duration and repetition rate.	Treating RMS-equivalent current as the only criterion.

Check	Correct input	Common error
Harmonics/VFD	Drive output, switching frequency and harmonic effects.	Using mains-frequency data without drive/cable-manufacturer review.

4.2 Voltage Drop

On long-travel machines, adequate ampacity does not guarantee acceptable motor starting, torque or control stability. Estimate three-phase AC voltage drop using the equation below and compare both steady-state and starting values with equipment limits.

$$\Delta U = \sqrt{3} \cdot I \cdot (R_{\theta} \cdot \cos\phi + X \cdot \sin\phi) \cdot L$$

$$\Delta U\% = 100 \cdot \Delta U / U \quad ; \quad R_{\theta} = R_{20} \cdot [1 + \alpha \cdot (\theta - 20)]$$

R_{θ} is AC conductor resistance at operating temperature (Ω/km), X is reactance (Ω/km), L is one-way circuit length (km), and $\alpha \approx 0.00393/\text{K}$ may be used to estimate copper resistance change. Obtain R_{20} , X , operating temperature and any skin/proximity-effect allowance from the supplier or design tool. For starting, use starting current and the corresponding power factor, and include upstream cable and transformer voltage drops.

Circuit length

Calculate the most unfavourable energised path from source to machine; this is not simply total machine travel. Centre feed, end feed, tail cables and energised cable remaining on the reel must be considered from the actual arrangement.

4.3 Short Circuit and Protective Earthing

Verify phase conductors, PE, screens and distributed earth conductors against the project protection design. The adiabatic equation below may be used for estimation, but k , initial/final temperatures, fault current and clearing time must come from the applicable standard, protection study and product data.

$$S \geq I_k \cdot \sqrt{t} / k$$

- Confirm the complete PE path from machine to source, including terminations, slip rings, connectors and distributed earth cores. A green/yellow core alone does not prove a verified path.
- Whether a metallic screen may also serve as an earth or fault path must be determined by construction, standards and protection design; never assume it without verification.
- For MV systems, also verify screen/earth-core earth-fault thermal withstand, earthing arrangement, earth-fault monitoring and bonding workmanship.

4.4 VFD and EMC

A VFD-fed mobile cable is not selected by current and voltage drop alone. Use a symmetrical earthing and screening concept approved by the drive manufacturer, and review cable length, output filters, switching frequency, common-mode voltage and motor insulation together.

Item	Recommended practice	Acceptance evidence
Cable construction	Symmetrical PE; overall screen or dedicated mobile VFD construction.	Construction drawing, screen parameters and drive-compatibility statement.
Screen termination	Prefer low-impedance 360° bonding; a single pigtail is not an HF substitute.	Termination drawing, connector specification and physical inspection.

Item	Recommended practice	Acceptance evidence
Earthing strategy	Follow the drive manufacturer and project EMC design; avoid arbitrary single-point bonding.	Earthing diagram and PE/screen continuity records.
Control and communications	Maintain segregation, screening and correct pair/bus elements.	Protocol parameters, screen termination and communication tests.
Drive length limit	Check output filters, reflected voltage and maximum permissible cable length.	Drive calculation or manufacturer confirmation.

4.5 Additional MV Checks

- Determine U_0 / U (U_m) from nominal system voltage, earthing and maximum operating voltage; '10 kV cable' is not a complete specification.
- Confirm electrical continuity, cross-section, earthing and accessory stress control for conductor screen, insulation screen, metallic screen/distributed PE.
- Specify PD, AC withstand, impulse or other type/routine tests according to the product standard and contract; never copy LV test values.
- For long cables, evaluate capacitive charging current, protection sensitivity, earth-fault current and slip-ring/connector suitability.
- Where monitoring cores or fibres are included, verify monitoring-system insulation coordination, termination and post-dynamic function.

5 Mechanical and Reel Compatibility

5.1 Bending Radius and Reel Geometry

Use the exact product's dynamic bending radius for the target movement. When measured to the cable centreline, reel-core diameter and bending radius have the geometric relationship below. Where the supplier directly specifies a drum or sheave diameter, use the supplier's definition.

$$R_{\min} = k \cdot D \quad ; \quad D_{\text{core}} \geq 2 \cdot R_{\min} - D = (2k - 1) \cdot D$$

D is actual cable OD and D_{core} is reel-core diameter. A more conservative project convention, $D_{\text{core}} \geq 2R_{\min}$, gives $D_{\text{core}} \geq 2kD$. Do not mix these conventions. Guide sheaves, S-bends and multilayer winding may require larger radii or additional clearance.

Item	Minimum verification	Action if not compliant
Reel core	Diameter, width, flanges, rotation, spooling and minimum remaining wraps.	Increase core, modify reel or reselect construction.
Guide sheaves	Diameter, groove, wrap angle, fleet angle and surface condition.	Correct sheaves, guidance and alignment.
Multilayer winding	Interlayer compression, spooling faults, jumping, maximum layers and thermal derating.	Modify spooling, limit layers or repeat thermomechanical design.
Festoon clamps	Clamp width, bending exit, suspension depth and strain relief.	Replace clamps or adjust carriage pitch.
Drag chain	Chain height, bend radius, separators, fill and fixed end.	Rearrange according to chain-manufacturer rules.

5.2 Tension, Torsion and Speed

Determine operating tension from suspended/moving cable mass, acceleration, guide friction, wind, reel-control deviation and shock. Verify continuous and peak values separately and include stress concentration at termination clamps. The equipment safety review should also cover torque or hysteresis reel-control failure.

$$F_{\text{running}} \leq F_{\text{allow,continuous}} ; F_{\text{peak}} \leq F_{\text{allow,peak}}$$

- A supplier value in N/mm² is a stress limit, not a whole-cable force. Convert to N only using the supplier's stated basis and cross-section.
- The exact construction and manufacturer declaration determine whether anti-torsion braid, load-bearing fibres or a central element contribute to permissible load.
- Maximum speed, acceleration and permissible twist angle must be satisfied simultaneously; meeting maximum speed alone does not prove safe stopping and reversal.
- Dynamic-life validation must record radius, speed, acceleration, tension, torsion, temperature, cycle definition and failure criteria.

5.3 Cable Length and Termination

$$L_{\text{order}} = L_{\text{active}} + L_{\text{fixed_tail}} + L_{\text{reel_reserve}} + L_{\text{termination}} + L_{\text{margin}}$$

Determine active length, fixed tail, reel safety reserve, termination allowance and installation allowance separately from equipment drawings and the installation method. The equipment manufacturer should confirm remaining wraps, end fixings and maximum paid-out position. Do not add an arbitrary uniform percentage.

- Termination clamps must grip the designed load-bearing part; terminals or conductors alone must not carry cable tension.
- Maintain an adequate bending transition at the moving end; a gland must not create a hard point outside the permitted radius.
- Install MV accessories, fibres and power terminals using manufacturer procedures where practicable, with phase, screen, PE and fibre identification retained.
- State order length, length tolerance and drum pay-off direction on the order; do not reverse the winding direction on site without approval.

6 Environmental Suitability and Service Life

Environment	What to specify	Not automatically implied
Low temperature	Minimum moving and installation temperatures; low-temperature bending/impact tests.	Fixed-installation low-temperature compliance at the same reeling temperature.
High temperature/sun	Maximum ambient, conductor temperature, solar exposure and reel heat accumulation.	Insulation temperature rating alone guarantees sheath life.
UV/ozone	Outdoor-use declaration, material/product tests and colour-stability requirements.	A black sheath automatically provides long-term UV resistance.
Oil/chemicals	Fluid identity, concentration, temperature, exposure cycle and test method.	'Oil resistant' means resistant to every hydraulic oil, fuel and cleaning agent.

Environment	What to specify	Not automatically implied
Salt mist/moisture	Tinned conductors, termination corrosion protection, sealing and water-blocking needs.	Weather resistance permits long-term immersion or seawater submersion.
Abrasion/tearing	Sheath system, abrasion/tear tests, guidance and ground-trailing limits.	A material abrasion value directly predicts field life.
Flame retardance	Single-cable or bunched test, standard number and installation category.	Single-cable flame retardance means bunched retardance, fire resistance or LSZH.
Low smoke/zero halogen	Materials, smoke/halogen tests and fire-zone requirements.	Automatic dynamic equivalence to heavy-duty rubber.
Hazardous areas	Zone classification, equipment protection and cable/accessory certification scope.	An ordinary heavy-duty cable is directly suitable for hazardous areas.

Assess service life using the combined motion, energisation and environmental spectra plus maintenance conditions. Catalogue cycle counts are meaningful only when radius, speed, tension, torsion, temperature and failure criteria are identical or comparable. For critical long-travel machines, include post-dynamic conductor resistance, insulation, sheath, screen continuity and fibre attenuation in validation.

7 Recommended Selection Matrix

Scenario	Recommended candidate platform	Mandatory verification	Unacceptable shortcut
A LV mains-fed power reel	0.6/1 kV heavy-duty rubber reeling cable; 3+PE/4G or distributed PE.	Thermal, voltage drop, starting, short circuit and reel thermomechanics.	Substitution with an ordinary fixed-installation flexible cable.
B LV VFD power reel	Dedicated mobile VFD cable with symmetrical PE and overall screen.	A plus EMC, drive length limit and screen termination.	Adding a copper braid without checking HF termination.
C MV main-power reel	Three-core MV reeling cable with semiconductive field control and screen/distributed PE.	Insulation coordination, PD if specified, earth fault, charging current and dynamics.	Using a fixed MV cable with only a sheath change.
D Multicore control reel	Heavy-duty control reeling cable or power/control composite.	Core count, spares, voltage drop, interference, bending and termination.	Using ordinary control cable to carry reel tension.
E Power + fibre composite	Dynamic reeling cable integrating fibre with power/control.	All power checks plus dynamic attenuation, rotary joint and termination.	Accepting ordinary fibre on static attenuation only.
F Festoon power/control	Dedicated round or flat highly flexible festoon cable.	Suspension, carriage pitch, clamps, wind sway and cycles.	Directly applying reeling radius and speed ratings.
G Drag-chain power/control	Explicit continuous-flex drag-chain cable.	Chain radius, acceleration, separators, fill and cycles.	Equating heavy-duty reeling capability with drag-chain life.
H Fixed tail	Fixed power/control cable or manufacturer-approved transition assembly.	Thermal, voltage drop, short circuit, environment and mobile transition.	Ignoring fixed-end hard points and gland bending.

Table 7-1 Generic candidate platforms; no brand-specific type is implied

Recommended specification format

Example clause: LV reeling power cable

0.6/1 kV heavy-duty reeling power cable; fine-stranded copper conductors, elastomeric insulation and anti-torsion reinforced sheath; core count and cross-sections according to the approved selection schedule; suitable for the project's horizontal motorised reel and stated number of layers. The supplier shall guarantee maximum actual OD, unit mass, reference ampacity and reeling corrections, dynamic minimum bending radius, continuous/peak tension, speed, permissible torsion, moving temperature and environmental performance, and shall submit datasheets, construction drawings, test reports and a deviation schedule.

Example clause: MV reeling power cable

Rated U_0/U (Um) determined from the system; three-core MV reeling construction with complete electric-field control, screen/distributed PE and monitoring or fibre elements where required. The supplier shall verify insulation coordination, earth fault, charging current, slip rings and accessories, and demonstrate suitability for the specified reel geometry, speed, tension, temperature and duty cycles.

8 LV Reeling Cable Worked Example

8.1 Example Inputs

The following values demonstrate the calculation process only and do not represent an actual machine or product. Candidate resistance, reactance and OD are assumed supplier inputs; replace them with approved project data.

Parameter	Example value	Note
Motor shaft output P	160 kW	Three-phase motor.
Line voltage U	400 V	Mains-frequency supply.
Efficiency η / power factor $\cos\phi$	0.95 / 0.86	Running condition.
Maximum one-way length L	0.180 km	Includes actual supply path.
Combined ampacity correction	0.80	Example only; determine from temperature, winding, etc.
Candidate cross-section	120 mm ²	Candidate only; compliance is not presumed.
Candidate R_2 / X	0.153 / 0.080 Ω/km	Assumed supplier data.
Conductor calculation temperature θ	90 °C	For voltage-drop estimation.
Candidate maximum OD D	40 mm	Assumed approved drawing value.
Dynamic radius factor k	6	Assumed product value for this movement.
Steady-state voltage-drop target	$\leq 5\%$	Example only; project limits may be stricter.

8.2 Calculations and Candidate Assessment

Step 1: Calculate design current

$$I_b = 160000 / (\sqrt{3} \times 400 \times 0.95 \times 0.86) = 282.7 \text{ A}$$

Step 2: Determine required reference ampacity

$$I_{z,\text{ref}} \geq I_b / 0.80 = 282.7 / 0.80 = 353.4 \text{ A}$$

The 120 mm² candidate passes this check only if the supplier's reference ampacity under stated baseline conditions is at least 353.4 A and the 0.80 correction represents the actual reel and environment. If the supplier gives a corrected ampacity directly, that value must be at least 282.7 A; do not apply the correction again.

Step 3: Estimate steady-state voltage drop

$$\begin{aligned}
 R_{90} &= 0.153 \times [1 + 0.00393 \times (90 - 20)] = 0.1951 \text{ } \Omega/\text{km} \\
 \sin\phi &= \sqrt{(1 - 0.86^2)} = 0.5103 \\
 \Delta U &= \sqrt{3} \times 282.7 \times (0.1951 \times 0.86 + 0.080 \times 0.5103) \times 0.180 = 18.4 \text{ V} \\
 \Delta U\% &= 100 \times 18.4 / 400 = 4.60\%
 \end{aligned}$$

Against the example 5% steady-state target, the 120 mm² candidate passes. If the project limit is 4%, it fails and requires a larger cross-section, shorter supply path or revised system design. Starting voltage

drop has not been calculated and cannot be inferred from the steady-state result.

Step 4: Check reel geometry

$$R_{\min} = 6 \times 40 = 240 \text{ mm}$$

$$D_{\text{core}} \geq (2 \times 6 - 1) \times 40 = 440 \text{ mm; conservative simplification: } 2 \times 240 = 480 \text{ mm}$$

If the existing reel core is below the requirement under the selected convention, modify the reel or candidate cable; do not solve the mismatch by reducing k. Guide sheaves, reel width, layers and spooling still require separate verification.

Step 5: Issue a conditional-selection conclusion

Check	Status in example	Next action
Running current/ampacity	Awaiting product data	Obtain $I_{z,\text{ref}}$ or corrected ampacity and baseline conditions.
Steady-state voltage drop	Passes example calculation	Recalculate using approved R, X and actual length.
Starting voltage drop	Not checked	Obtain starting current, duration and minimum permissible voltage.
Short circuit/PE	Not checked	Obtain fault current, clearing time and protective path.
Reel-core geometry	Minimum requirement stated	Check against reel drawing using the supplier's convention.
Tension/speed/torsion	Not checked	Obtain motion load spectrum and product dynamic limits.
Environment/termination/tests	Not checked	Complete technical agreement and evidence review.

Example conclusion

The 120 mm² size may enter the candidate list only; it is not a final purchasing conclusion. Ampacity, starting voltage drop, short circuit, OD, mass, tension or reel geometry may still require a different size or design.

9 Procurement Clauses and Deliverables

Convert the following into a datasheet and line-by-line deviation schedule. The supplier should answer 'compliant / deviation / not applicable' with an evidence reference for every line. A bare statement of 'full compliance' without product data is not an auditable technical conclusion.

Clause	Specify in procurement	Deliverable evidence
1 Product identity	Manufacturer, range, complete type, construction drawing and manufacturing location.	Datasheet, drawing and certificate scope.
2 Application	Machine, circuit, reel/festoon/drag chain and centre/end feed.	Application confirmation or selection calculation.
3 Standards	Complete numbers, editions, target market and deviations.	Declaration of conformity and applicable reports.
4 Voltage	U_0 /U (Um), frequency and system earthing.	Electrical parameter schedule.

Clause	Specify in procurement	Deliverable evidence
5 Cores and sizes	Phase, PE, control, screen, monitoring and spare cores.	Core layout and identification drawing.
6 Conductor	Material, plating, stranding class, R_{20} and cross-section.	Conductor-resistance and construction records.
7 Insulation/screen	Materials, semiconductive layers, screen cross-section and termination.	Construction drawing, material and test records.
8 Sheaths	Inner/outer sheath, anti-torsion layer, strength member, colour and environment.	Material declarations and relevant tests.
9 Dimensions/mass	Maximum OD, tolerance, unit mass and minimum delivery length.	Approved drawing and factory records.
10 Ampacity	Reference value, baseline, temperature/reeling/grouping corrections.	Ampacity table and project corrections.
11 Drop/short circuit	R, X, permissible conditions and project verification responsibility.	Calculation or confirmed input data.
12 Dynamic radius	Rmin for reel, guide, festoon or chain and the D convention.	Exact-product dynamic parameter table.
13 Tension	Continuous/peak values, stress-conversion basis and termination limits.	Mechanical parameters and test basis.
14 Speed/torsion	Speed, acceleration, twist angle, reversal and cycle limits.	Application statement or dynamic validation.
15 Temperature/environment	Moving/fixed temperatures, oil, UV, ozone, water, salt and abrasion.	Test reports and product declaration.
16 Fire/EMC	Flame class, LSZH if required, screening and VFD requirements.	Corresponding tests and termination drawing.
17 Fibre/bus	Protocol/fibre type, count, attenuation and post-dynamic performance.	Optical/communication tests and accessory list.
18 Testing	Type, routine, FAT, dynamic tests and witness points.	ITP, reports, calibration and traceability.
19 Marking/packing	Metre marks, drum number, length, pay-off direction, drum and protection.	Packing list, photographs and dispatch inspection.
20 Documents/spares	Installation, termination, maintenance, spares and deviation closure.	Final document package and approved deviations.

Table 9-1 Clause framework ready for a technical procurement specification

Recommended order-description structure

Product platform and complete type + rated voltage + cores/cross-sections/communication configuration + individual lengths and quantity + reel and motion limits + guaranteed dynamic parameters + environmental and fire requirements + termination accessories + tests and documents + packaging/pay-off direction + approved deviations. Reassess every substitute product against the same checklist for equivalence.

10 Inspection, Installation and Maintenance

10.1 Inspection and Acceptance Matrix

Stage	Recommended activities	Key acceptance criteria
Design review	Selection calculations, reel drawing, motion spectrum, datasheet and deviations.	Every dynamic input has a source; candidate conditions are closed.
Type evidence	Construction, material, electrical, mechanical, environmental and dynamic tests.	Reported type/size is relevant to the supplied scope.
Routine tests	Conductor resistance, withstand/spark, dimensions, appearance and marking.	According to product standard and approved ITP.
FAT	Length, construction, screen/PE continuity, accessories, fibres and documents.	Drum traceability; deviations closed.
Receipt	Drums, seals, appearance, metre marks, certificates and transport damage.	No crushing, moisture, loosening or incorrect drum.
After installation	Route, radius, kinks, termination, phase sequence, PE, insulation and communications.	Matches approved drawings and procedures.
Commissioning	Full-travel wind/unwind, spooling, guidance, tension, temperature, alarms and communications.	No obstruction, flange jumping or abnormality at the worst position.

10.2 Installation Essentials

- Pay off according to drum arrows and manufacturer procedures; avoid pulling over the drum flange, ground abrasion and vehicle crushing.
- Remove kinks before installation; do not hide existing torsion by forcibly rotating an end.
- Check minimum bending positions, guide fleet angles, flange clearance and multilayer spooling over full travel, not only the static route.
- Maintain the specified straight tail and bending transition before and after termination; clamps must not crush fibres or cores.
- Work to phase, PE, screen and communication drawings; MV accessories and fibre terminations require competent personnel and approved workmanship.
- Start with low-speed jogging, then progressively cover full travel and rated speed; stop for spooling faults, abnormal tension or sheath rubbing.

10.3 Inspection and Replacement Triggers

Observation	Possible risk	Recommended action
Sheath cracks, exposed braid, local flattening or diameter change	Ingress, core instability and loss of mechanical strength.	Stop and assess; repair or replace within manufacturer limits.
Kinks, corkscrewing, core migration or end displacement	Excess tension/torsion or anchorage failure.	Inspect reel control, guidance and clamps, not only visible damage.
Polishing, cutting or eccentric wear at guides	Sheave groove, fleet-angle or alignment problem.	Eliminate the mechanical root cause, then reassess the cable.
PE/screen discontinuity or adverse insulation trend	Protection failure, electric shock and fault escalation.	Act immediately under electrical-safety procedures.

Observation	Possible risk	Recommended action
Increasing fibre loss or motion-dependent communication dropout	Microbending, termination or rotary-joint problem.	Localise by section and perform dynamic communication tests.
Spooling disorder, flange jumping or local abnormal heating	Multilayer crushing, heat-dissipation and mechanical damage.	Stop and review the reel and thermal corrections.

Set inspection intervals and discard criteria with the equipment manufacturer, cable supplier and site duty cycle. For critical machines, maintain a life record by drum number, installation date, cycles, faults, repairs and spares; this is more traceable than replacement based only on calendar age.

Appendix A Supplier Selection Confirmation Sheet

Instructions: the project team completes 'Project input'; the supplier then completes 'Supplier confirmation' for the exact product. Blank fields are intentional working spaces, not missing guide content.

Confirmation item	Project input	Supplier confirmation / evidence ref.
Project / equipment tag		
Circuit name and duty		
System voltage / frequency / earthing		
Continuous/peak current and duty		
Starting method and current		
Short-circuit current / clearing time		
Permissible steady/starting drop		
Movement and centre/end feed		
Travel / speed / acceleration / E-stop		
Daily cycles / design life		
Core / width / layers / spooling		
Guide sheaves / fleet angle / reversals		
Continuous / peak tension		
Moving / installation temperature		
Oil, UV, salt mist, water, abrasion		
Fire / hazardous-area requirements		
Cores / sizes / PE / screen		
Control / bus / fibre configuration		
Slip rings and fibre rotary joint		
Termination and sealing accessories		
Order length / quantity / tolerance		
Recommended complete type		
Maximum OD / unit mass		
Reference / corrected ampacity		
R_2 / X / short-circuit parameters		

Confirmation item	Project input	Supplier confirmation / evidence ref.
Dynamic Rmin and D convention		
Permissible tension / speed / torsion		
Environmental performance and test basis		
Dynamic-life validation conditions		
Type / routine / FAT documents		
Technical deviations and closure evidence		

Review: ☐ Approved ☐ Conditionally approved ☐ Rejected | Project: _____ Supplier: _____ Date: _____

For conditional approval, list every open condition in the technical agreement and ITP, with an owner and latest closure milestone. Do not release on verbal confirmation alone.

Appendix B Standards and Public References

These sources were used to check standard scopes, product platforms and published dynamic parameters. Retrieval date: 2026-10-29. Recheck standard status, amendments and contractual editions at design freeze and purchase. Use legally obtained official texts for paid standards.

[1] IEC 60502-1:2021

Power cables with extruded insulation... Part 1: Cables for rated voltages of 1 kV and 3 kV. Official IEC page.

<https://webstore.iec.ch/en/publication/68535>

[2] IEC 60502-2:2014+AMD1:2024 CSV

Part 2: Cables for rated voltages from 6 kV up to 30 kV; includes 2026-07 correction information. Official IEC page.

<https://webstore.iec.ch/en/publication/95394>

[3] IEC 60228:2023

Conductors of insulated cables, Edition 4.0. Official IEC publication information.

<https://webstore.iec.ch/en/publication/1065>

[4] DIN VDE 0250-814:1985-02

Rubber-insulated flexible cable NSHTÖU. DIN Media standards page.

<https://www.dinmedia.de/en/standard/din-vde-0250-814/1180059>

[5] GB/T 12706.1-2020

Extruded-insulation power cables rated 1 kV and 3 kV. Listed as current in the national open-standards system when retrieved.

<https://openstd.samr.gov.cn/bzgk/std/newGblInfo?hcno=7593C7389ACDA76E0D40F6985E3A839D>

[6] GB/T 12706.2-2020

Extruded-insulation power cables rated from 6 kV up to 30 kV. Listed as current in the national open-standards system when retrieved.

<https://openstd.samr.gov.cn/bzgk/std/newGblInfo?hcno=FF02D64568B22C7D9BF3462B27B2CB8E>

[7] Prysmian Group

Cable Solutions for the Crane industry: overview of LV/MV reeling, festoon and drag-chain platforms.

<https://www.prysmian.com/staticres/Cable-Solutions-for-the-Crane-industry/>

[8] Prysmian PROTOCOLON(SMK)

Public MV reeling-cable datasheet: three cores, distributed earth, EPR insulation and electric-field control.

<https://na.prysmian.com/sites/na.prysmian.com/files/media/documents/PROTOCOLON%28SMK%29%20%28N%29TSCGEWOU.pdf>

Final reminder

This guide does not provide cross-brand universal ampacity, permissible tension, minimum bending radius or service-life values. For procurement, replace example assumptions with the approved exact-product datasheet and equipment interface documents, and retain complete calculations and verification records.