TIDYNE INC.

Advanced engineering solutions.

Operator's

Manual

Operation, Maintenance & Service
Self-Contained 48 V Electric Personnel & Cargo Winch

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TIDYNE Inc. · tidyne.com · solutions@tidyne.com

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A complete reference for safe operation, inspection, and service of the TIDYNE unit.

1. Introduction & Scope

This manual covers the TIDYNE unit — a self-contained, 48 V DC battery-powered electric winch engineered and certified for both lifting and lowering of personnel and cargo. The TIDYNE unit is human-rated and built for SOLAS-compliant pilot ladder and deck operations, life-saving and emergency evacuation, cargo hold access and confined-space personnel retrieval, and general emergency rescue at height or over water. It is designed to be installed without permanent hull or structural modification: the mounting bracket clamps securely to booms, jib arms, king posts, pad eyes, and docking stations.

TIDYNE Inc. produces lifting equipment engineered to the highest safety and durability standards. This manual is the authoritative operating, inspection, and service reference for the TIDYNE unit. Operators must also consult the on-unit nameplate and the unit-specific commissioning sheet shipped with each winch for serial-number-specific configuration data. Specifications not published here are available from TIDYNE factory support — do not assume generic industry values.

CLASSIFICATION IN PROGRESS

Lloyd's Register Classification — In Progress

The TIDYNE unit is **in the process of pursuing classification** under the **Lloyd's Register Code for Lifting Appliances in a Marine Environment (LR-CO-001)**, whose scope explicitly covers the handling and transfer of personnel on ships. This equipment and its supporting documentation are engineered to this code; formal Lloyd's Register classification is being actively progressed with the class society. Contact solutions@tidyne.com for the current certification status and certificate references for a specific configuration or hull.

1.1 Audience

- Trained and qualified TIDYNE operators and riggers.
- Maintenance technicians performing inspection, charging, lubrication, and component replacement.
- Supervisors, safety officers, and competent persons (OEM-certified) responsible for lift planning and oversight.
- Equipment inspectors performing pre-use, frequent, and annual inspections.

1.2 How to Use This Manual

Chapters 1 through 7 cover orientation, equipment identification, and day-to-day operation of the TIDYNE unit. Chapters 8 through 11 cover the maintenance program — daily through annual — plus lubrication, the triple-redundant brake system, and wire rope. Chapters 12 through 16 address troubleshooting, hazard control, failure analysis, storage, and the regulatory framework. Chapter 17 outlines minimum operator training. Chapter 18 and the appendices provide service log templates, a glossary, fastener torque guidance, and TIDYNE support contacts.

1.3 Safety Signal Words

DANGER	Imminent hazard that **will** result in death or serious injury if not avoided.
WARNING	Potential hazard that **could** result in death or serious injury.
CAUTION	Potential hazard that may result in minor or moderate injury, or property damage.
NOTICE	Information related to property damage, equipment integrity, or best practice.

1.4 General Warnings

- Never exceed the TIDYNE unit's rated Working Load Limit of 400 lb (180 kg).

• The TIDYNE unit is dual-certified for personnel and cargo. The 400 lb (180 kg) WLL is the absolute cargo limit; when hoisting personnel with the unit crane-suspended, the total suspended load (person + harness + rigging) must not exceed **50% of rated capacity — i.e. 200 lb (90 kg)** — per OSHA 29 CFR 1926.1431(d)(1). Always operate under a written personnel-lift plan and confirm the unit, rigging, and anchor structure are within rated capacity.

• Never operate with a damaged wire rope, missing guard, malfunctioning brake (B1/B2/B3), failed solenoid, or undervoltage battery condition.

• Never stand in line with, under, or near a loaded line — a parted wire rope can recoil with lethal force.

• Always perform the Home routine at startup before lifting personnel or cargo (see §6.2).

• Treat suspended loads as live until the load is fully landed, blocked, and the line is slack.

• All inspection, repair, maintenance, training, and testing of the TIDYNE unit shall be performed only by TIDYNE OEM-certified technicians or engineers. Unauthorized service voids certification and warranty.

2. Winch Types & Classification

Winches are classified by power source, mechanical configuration, and intended duty. Selecting the correct winch type for a given application is the first step in safe operation. This chapter summarizes the principal configurations encountered in industrial and marine service.

2.1 By Power Source

Type	Description	Typical Use
Manual / Hand Crank	Operator-powered via crank handle and gear reduction. Typically equipped with automatic load-holding brake.	Trailers, light recovery, marine cabin hoists, low-duty positioning.
Lever / Come-Along	Ratcheting lever winch; chain or wire rope. Portable, no fixed mount required.	Field recovery, pulling fence, tensioning, emergency rigging.
Electric (AC/DC)	Driven by AC induction or DC permanent-magnet motor through gear reduction.	Vehicle recovery, industrial pulling, stage rigging, assembly lines.
Hydraulic	Driven by a hydraulic motor; high torque density, excellent for sustained heavy duty.	Cranes, tow trucks, marine deck machinery, oilfield, forestry.
Pneumatic (Air)	Driven by a vane or piston air motor; intrinsically spark-resistant.	Hazardous (Class I Div 1/2) areas, refineries, mines, shipyards.
Internal Combustion	Direct gasoline or diesel drive, often via PTO.	Remote sites without electrical or hydraulic infrastructure.

2.2 By Mechanical Configuration

Configuration	Characteristics	Notes
Drum Winch	Wire rope spools onto a cylindrical drum. The most common configuration.	Line pull varies with rope layer; lowest layer = highest pull.
Capstan Winch	Rope passes around a powered vertical or horizontal drum; operator tails the line.	Constant line pull regardless of rope length; no storage.
Worm-Gear Winch	Worm and worm wheel reduction; inherently self-locking under most loads.	Compact, quiet, load-holding without external brake.
Planetary Winch	Multi-stage planetary gear reduction concentric with the drum.	High power-to-weight ratio; requires external brake for load holding.
Spur-Gear Winch	Parallel-shaft spur gear train.	High efficiency; common in mid-duty industrial applications.
Lever Hoist	Ratchet-and-pawl with hand lever; chain or wire rope.	Portable, no power required; rated for pull, not overhead lift unless marked.

2.3 Duty Classification

Industrial winches are commonly classified by ASME HST and CMAA service classes (H1 light-duty intermittent, through H5 severe continuous duty). Marine deck machinery follows IACS and class society rules. Always match the duty class to the actual cycle rate, ambient temperature, and dynamic loading profile of the work — running an H2-rated winch on an H4 duty cycle is the single most common cause of premature gearbox and brake failure.

3. Anatomy of a Mechanical Winch

Understanding the function of each major component is essential for safe operation, accurate inspection, and effective troubleshooting. The following section describes the components common to most powered drum winches.

3.1 Major Components

Drum	Cylindrical spool that stores the wire rope. Drum diameter (D) must be sized to the rope diameter (d); D/d ≥ 18 is typical for general lifting, with higher ratios required for personnel hoisting and frequent bending duty.
Gearbox / Reducer	Reduces motor speed and multiplies torque. Common configurations: worm, planetary, spur, or combinations. Lubricated with extreme-pressure (EP) gear oil or grease per the OEM specification.
Prime Mover	The electric motor, hydraulic motor, air motor, or hand crank that supplies input power. Sized to develop rated line pull at first-layer rope position.
Primary (Holding) Brake	A spring-applied, power-released friction brake that holds the load when the prime mover is de-energized. Considered the safety-critical element of the winch.
Secondary / Dynamic Brake	A mechanical load brake (e.g., Weston-style) or counterbalance valve that controls lowering speed and prevents free-fall on power loss.
Clutch	Engages and disengages the drum from the drivetrain to allow free-spooling of rope for rigging. Never engage under load.
Wire Rope / Cable	The tension-bearing medium. Construction (e.g., 6×19 IWRC, 6×36 IWRC) and grade (EIPS, EEIPS) are matched to the winch duty.
Drum Anchor	Wedge socket, set-screw clamp, or U-bolt that secures the rope dead-end to the drum. Manufacturers require a minimum of 5 wraps remain on the drum at full extension.
Fairlead	Roller or hawse guide that aligns the rope onto the drum at the correct fleet angle.
Sheaves & Blocks	Grooved pulleys that redirect rope and provide mechanical advantage. Sheave groove radius must match rope radius within +5%/-0%.
Hook & Latch	Load-engaging end fitting. Must include a functional safety latch and be marked with WLL.
Controls	Pendant, joystick, foot pedal, or air valve assembly. Must include emergency stop where applicable.
Limit Devices	Upper- and lower-travel limit switches (geared or weighted) prevent two-blocking and end-of-rope spool-off.
Nameplate	Permanent placard showing manufacturer, model, serial number, WLL, duty class, and date of manufacture.

3. Anatomy (continued)

3.2 Drum Geometry & Fleet Angle

The fleet angle is the angle formed between the rope leaving the drum and a line perpendicular to the drum axis through the lead sheave. Excessive fleet angle causes rope to climb, cross-wrap, and abrade. Limits:

- Smooth (ungrooved) drum: maximum 2.0° fleet angle.
- Grooved drum: maximum 4.0° fleet angle.
- Minimum fleet angle: 0.5° to either side, to ensure rope tracks properly across the drum face.

3.3 Brake Architecture

The TIDYNE unit uses a triple-redundant brake architecture — three fully independent braking systems, each individually capable of holding the full rated load. This goes beyond the ASME B30.7 minimum, which requires that the primary holding brake alone be capable of holding at least 125% of the rated load.

ID	Brake	Location	Function
B1	Motor Torque Control	Servo motor	The 1 kW servo motor actively governs descent speed using regenerative torque. Precise, smooth, electronically controlled.
B2	High-Ratio Worm Gear	Gear reducer	Inherently self-locking worm geometry — the load cannot backdrive the motor. Mechanically prevents free-fall with zero power.
B3	Emergency Gravity Brake	Drum shaft	Normally-engaged fail-safe brake on the rope drum shaft. Held open electromagnetically by a linear solenoid actuator during lifting; any power loss closes it instantly via gravity. Solenoid is off ≥50% of the time to prevent overheating.

In addition to B1 / B2 / B3, an **automatic centrifugal brake** is mounted on the extended worm (high-speed) shaft of the gear reducer. It activates automatically on overspeed — no operator action required — and limits descent rate during a controlled power-loss recovery via manual brake release.

The TIDYNE unit's primary holding brake (B3) meets and exceeds the ASME B30.7 125%-of-rated-load requirement. Free-fall operation is not supported and is prohibited for personnel hoisting in any configuration.

3.4 Wire Rope Termination

Common terminations include wedge sockets, swaged sockets (poured zinc or resin), and Flemish-eye / mechanical splices with thimbles. Each termination has a rated efficiency relative to nominal rope strength:

Termination	Efficiency	Notes
Poured-zinc / resin socket	100%	Highest efficiency; requires controlled installation.
Swaged socket	95 – 100%	Common for crane and winch ropes.
Wedge socket	80%	Field-replaceable; requires dead-end tail clip.
Flemish eye + swaged sleeve	90 – 95%	Industry standard for slings and pendants.
Hand-tucked splice	80 – 90%	Largely obsolete for industrial winch service.
U-bolt cable clips	80%	Only for temporary or emergency terminations.

4. Specifications & Load Ratings

4.1 Working Load Limit (WLL)

Working Load Limit, also called Safe Working Load (SWL), is the maximum mass or force that a winch is authorized to handle under specified conditions of use. WLL is established by the manufacturer based on the nominal breaking strength of the weakest component divided by the applicable design (safety) factor.

4.2 Design Factor (Safety Factor)

Design factor is the ratio of the minimum breaking strength of a rope, sling, or structural element to the working load limit. Typical minimum design factors in U.S. industrial practice:

Application	Design Factor	Reference
General-purpose wire rope sling	5 : 1	OSHA 1910.184, ASME B30.9
Wire rope used as running rope on hoists	5 : 1	ASME B30.7, B30.30
Wire rope for overhead crane hoists	5.0 : 1 (minimum)	ASME B30.2 / B30.5
Wire rope used to support personnel platforms	10 : 1	OSHA 1926.1431, ASME B30.23
Manila fiber rope sling	10 : 1	OSHA 1910.184
Synthetic web sling	5 : 1	ASME B30.9
Alloy chain sling	4 : 1	ASME B30.9

4.3 Line Pull & Drum Layer

The mechanical advantage of a drum winch decreases as wire rope accumulates on the drum, because the effective drum radius grows with each layer. Rated line pull is normally specified at the first (innermost) layer. Use the relationship below to estimate line pull at any layer:

$$F_n = F_1 \times (D_1 / D_n)$$ where D_n is the effective drum diameter at layer n (drum + rope layers × rope dia.).

4.4 Duty Cycle

Duty cycle is the percentage of any reference period (typically 10 minutes per IEC and 60 minutes per CMAA) during which the winch is under load. Operating beyond the rated duty cycle drives motor and gearbox temperatures outside their design envelope and accelerates brake-disc and lubricant degradation.

4.5 TIDYNE Published Specifications

Rated Capacity (WLL)	400 lb (180 kg) — dual-certified for personnel and cargo lifting and lowering
Rated Line Speed (lift and lower)	~193 ft/min (3.2 ft/s, 0.98 m/s) — reference descent: 45 ft in ~14 s
Power Supply	Self-contained 48 V DC battery pack; no vessel power required during operation
Battery Backup	Onboard dedicated lithium battery backup for control and brake-release power
Charging	Regenerative braking on descent (typ. up to 10 lift/descent cycles per charge); secondary 110 V AC top-up charger included
Motor	1 kW servo motor with absolute encoder; electronic drive with programmable features
Gear Reducer	Low-ratio self-locking worm gear reducer

Drum Drive	Heavy-duty nickel-plated chain and sprocket secondary reduction
Drum	Helically-grooved wire rope drum (controls layering)
Wire Rope	Factory-specified construction and diameter — consult TIDYNE for replacement spec and refer to commissioning sheet
Braking	Triple-redundant: B1 motor torque control, B2 self-locking worm gear, B3 normally-engaged emergency gravity brake on drum shaft; plus automatic centrifugal overspeed brake on worm high-speed shaft
Brake Hold Capacity	Each of B1/B2/B3 independently rated to hold the full WLL
Mounting	Clamp-style bracket — booms, jib arms, king posts, pad eyes, docking stations; no permanent structural modification
Enclosure	Marine-grade enclosure; suitable for deck and shipboard environments
Telemetry	Onboard analytics: real-time load, speed/encoder, brake-engagement status, anomaly alerts, operational data logging
Overspeed Sensing	Drum rotation speed sensor; overspeed → drive stop + automatic emergency brake engagement
Operator Controls	Up button, Down button, Home button (underside of control enclosure), Emergency Stop (E-Stop)
Approved Use Cases	SOLAS pilot ladder / deck ops, life-saving evacuation, cargo hold and confined-space personnel retrieval, man-overboard and rescue-at-height
Roadmap (not current spec)	Solar and wind power versions in development at TIDYNE

5. Pre-Operation Inspection

A documented pre-shift / pre-use inspection is required by OSHA and ASME B30.7 every shift the winch is used, or before each lift if used intermittently. The inspection is visual and functional; no disassembly is required. Defects identified must be tagged out and corrected before placing the winch in service.

Personnel requirement: daily pre-use checks may be conducted by trained TIDYNE operators. All frequent (monthly) and periodic (annual) inspections shall be performed only by TIDYNE OEM-certified technicians, engineers, or inspectors.

5.1 Daily / Pre-Use Inspection Checklist

#	Item	Acceptance Criteria	OK / NG
1	Nameplate & WLL placard	Legible; matches lift plan.	☐
2	Wire rope — full length	No broken wires above ASME B30.30 limits; no kinks, birdcaging, or corrosion.	☐
3	Drum anchor & dead wraps	Anchor tight; minimum 5 wraps on drum at full extension.	☐
4	Drum spooling	Even, layer-by-layer; no cross-winds or gaps.	☐
5	Hook & latch	Latch closes fully; throat not opened; no cracks.	☐
6	Sheaves & fairlead	Rotate freely; groove undamaged; no wobble.	☐
7	Fasteners & guards	No missing bolts; all guards in place.	☐
8	Oil & grease	No active leaks; sight glass within range.	☐
9	Controls & E-stop	Functional; return to neutral; E-stop latches.	☐
10	Limit switches	Function-test upper and lower limits without load.	☐
11	Brake test (no load)	Holds drum stationary when power removed.	☐
12	Brake test (rated load)	Holds rated load with no creep over 10 minutes.	☐
13	Audible / visual alarms	Operate as designed.	☐
14	Operator station	Clean, dry, slip-free; visibility unobstructed.	☐
15	Surroundings	Clear of personnel; barricades and signs in place.	☐

5. Pre-Operation Inspection (continued)

5.2 Frequent Inspection (Monthly)

Frequent inspections are conducted at intervals between daily and periodic, typically monthly for normal service and weekly for heavy or severe service. A TIDYNE OEM-certified technician shall perform and document the inspection.

- All daily checks, plus:
- Wire rope inspection per ASME B30.30 — broken wire count over a full rope lay and at end terminations.
- Hook measurement — throat opening, twist, and wear; compare to original dimensions on file.
- Brake friction surfaces — measure lining thickness and inspect drum / disc for heat checking and scoring.
- Hydraulic hoses — inspect for blisters, leaks, kinks, and approaching service life limit.
- Electrical wiring — inspect for chafing, loose terminals, and contactor pitting.
- Gearbox oil level and condition — sample for moisture and metallic particulate.

5.3 Periodic Inspection (Annual)

Periodic inspection is a comprehensive examination conducted at least annually (more often for heavy or severe service) by a TIDYNE OEM-certified inspector. It includes all frequent inspection items plus:

- Disassembly of brake to measure lining, drum, and spring tension.
- Gearbox oil change with ferrous-particle analysis on the drain sample.
- Non-destructive examination (dye-penetrant or magnetic-particle) of load hooks and load-bearing weldments.
- Load test at 100% to 125% of WLL per the OEM and ASME B30.7 procedures, with brake drift measurement.
- Verification and recalibration of overload protection devices.
- Inspection-tag update and entry into the equipment maintenance file.

6. Safe Operating Procedures

The procedures below apply to the TIDYNE unit in routine personnel and cargo service. They supplement the unit-specific commissioning sheet and the site-specific lift plan but establish the minimum operational baseline.

6.1 Before the Lift

- Review the lift plan; confirm load weight, center of gravity, rigging configuration, and travel path.
- Confirm load weight does not exceed the TIDYNE unit's 400 lb (180 kg) Working Load Limit after de-rating for any reeving and dynamic factors.
- Verify 48 V battery state-of-charge is adequate for the planned mission profile (a fully charged unit typically supports up to 10 lift/descent cycles). Top up via the 110 V charger if marginal.
- Complete and sign the pre-use inspection (Chapter 5).
- Confirm all personnel are clear of the load path, drum, and any potential snap-back zone of the rope.
- Establish positive communication: hand signals per ASME B30.5 standard, or two-way radio with confirmed call-signs.
- Don required PPE: hard hat, safety glasses, leather gloves (never wear gloves when handling spooling rope by hand), steel-toe boots, and high-visibility clothing.

6.2 Startup & Homing

The TIDYNE unit requires a Home reference at every startup. The Home button is located on the underside of the control enclosure to prevent accidental actuation. Homing aligns the absolute encoder with the upper mechanical reference and validates the integrity of the drive and brake interlocks before any load is presented.

- Energize the 48 V system at the main disconnect. Confirm the control enclosure indicators report normal status and no anomaly alerts.
- With no load on the hook, press **Up** to lift the hook (stirrup) until it is within a few inches of the head pulley.
- Press the **Home** button on the underside of the control enclosure. The drive registers the reference position and clears the homing interlock.
- Verify telemetry: load reads zero, brake engagement reads B3-engaged at rest, no fault alerts.
- The TIDYNE unit is now ready for service. E-Stop activation does not lose the Home position; routine power-cycle does require re-homing.

6.3 Operating the Winch

- Take up slack slowly with the **Up** button until the rope is just taut. Pause and verify the rigging and load have not shifted.
- Initiate the lift smoothly — the electronic drive provides programmed acceleration / deceleration ramps to prevent shock loading. Rated lifting speed is ~193 ft/min (3.2 ft/s, 0.98 m/s).
- To lower, press and hold **Down**. Releasing the Down button cuts solenoid power and engages B3 immediately — a controlled stop, not free-fall.
- Maintain constant visual contact with the load and the rope on the drum.
- Do not side-load the drum or rope — keep the line within the allowed fleet angle (see §3.2).
- Land the load on a stable surface, slack the line, and disengage controls before approaching the load.

6.4 Emergency Stop

Pressing E-Stop cuts solenoid power to the B3 emergency gravity brake. The brake engages instantly and the drum locks. The drive disables. The Home reference is retained. To resume, clear the hazard, release the E-Stop button, and continue normal operation — no re-homing is required.

6.5 Power-Loss Recovery

If main battery power is lost while a personnel load is suspended, the B3 brake engages automatically and the drum is locked. The onboard lithium backup powers the control system. To recover the suspended occupant:

- Confirm the load is supported by the engaged B3 brake (visible on telemetry; no drift).
- Alternately press the **Up** and **Home** buttons to incrementally lift the stirrup using stored energy in the backup pack.
- Once the occupant is at a safe boarding position, press **Home** to set the reference and secure.
- If lifting is not possible, use the manual brake release — descent will be governed automatically by the centrifugal overspeed brake on the worm high-speed shaft.
- After recovery, recharge the 48 V battery via the 110 V top-up charger before returning to service.

6.6 Prohibited Practices

- Exceeding the 400 lb (180 kg) Working Load Limit by any means.
- Wrapping the rope around the load instead of using a rated sling.
- Side-pulling, dragging, or using the winch to free a stuck load by impact loading.
- Operating with twisted, kinked, knotted, or improperly terminated rope.
- Leaving a suspended personnel load unattended.
- Removing or defeating guards, sensors, the solenoid feedback line, or the E-Stop circuit.
- Operating with anomaly alerts active on the telemetry display.

6. Safe Operating Procedures (continued)

6.4 Hand Signals (ASME B30.5)

Signal	Meaning
Arm extended, palm down, hand moves horizontally	STOP
Both arms extended, palms down, swing horizontally	EMERGENCY STOP
Forearm vertical, forefinger up, hand rotates in small circle	HOIST (raise load)
Arm extended downward, forefinger down, rotate in small circle	LOWER load
Hand open, palm down, fingers closing slowly	Lower load slowly / inch
Clenched fist, thumb pointing in direction of travel	Move boom / travel
Both hands clasped in front of body	DOG everything (operator hands off controls)

6.5 Environmental Limits

Ambient Temperature	Standard service: –20 °C to +40 °C (–4 °F to +104 °F). Arctic and high-temp packages available; de-rate per OEM curves.
Wind	Suspend outdoor lifts at sustained winds ≥ 20 mph (32 km/h) unless lift plan provides a wind-load analysis.
Visibility	Suspend operations if the operator or signal person cannot maintain unbroken visual contact with the load.
Lightning	Suspend outdoor lifting on suspended wire rope if lightning is observed within 10 mi (16 km).
Humidity / Marine	Use sealed-bearing and stainless-fastener variants in salt spray. Rinse and dry rope after each shift.

6.6 Shutdown

At the end of each shift: land all loads; spool the rope back to the stowed configuration with at least 5 dead wraps on the drum and tension on the spooling; place all controls in neutral or off; engage the master disconnect; remove and secure the pendant if portable; complete the operator log entry; and lock out the disconnect if the winch will not be operated again before the next inspection cycle.

7. Rigging, Wire Rope & Accessories

7.1 TIDYNE Drum & Rope

The TIDYNE unit uses a **helically-grooved wire rope drum** that ensures even layer-by-layer rope spooling without operator-side level-wind hardware. Drive to the drum is by **heavy-duty nickel-plated chain and sprocket** from the worm gear reducer output, providing an additional reduction stage and corrosion-resistant service in marine environments.

The TIDYNE unit ships with a factory-installed wire rope sized and certified for the unit's WLL and duty. **Replacement rope must be factory-specified — consult TIDYNE for the current replacement specification and refer to the unit commissioning sheet.** Do not substitute generic wire rope of equivalent diameter; rope construction, lay, core, grade, and end-termination interact with the helically-grooved drum geometry and the drum anchor.

7.2 Wire Rope Fundamentals (Reference)

Wire rope is specified by diameter, construction (number of strands × wires per strand), core (FC = fiber core, IWRC = independent wire rope core), grade (IPS, EIPS, EEIPS), and lay direction (right-regular, left-regular, right-lang, left-lang). These parameters are set by TIDYNE for the TIDYNE unit — do not modify.

7.3 Sling Selection

Sling Type	Strengths	Cautions
Wire Rope Sling	High strength, heat tolerant, abrasion resistant.	Damaged by sharp edges; protect with softeners.
Alloy Chain	Highest temperature tolerance; field-repairable links.	Heaviest; inspect every link for stretch, gouges, twist.
Synthetic Web (polyester)	Lightweight, protects load surface, flexible.	Cut-sensitive; UV-degraded; chemical-sensitive.
Round Sling	High capacity-to-weight; conforms to load.	Cover damage invalidates rating; difficult to inspect core.
Personnel Stirrup / Harness	Approved interface for personnel hoisting on the TIDYNE unit.	Must be in-date, inspected, and rated for the load and use case.

7.4 Sling Angle De-Rating

When two or more sling legs support a load, the tension in each leg increases as the angle from horizontal decreases. Operators must use a load chart or calculate tension as $T = (W / n) / \sin \theta$, where W is the load weight, n is the number of legs supporting the load, and θ is the angle of the leg measured from horizontal. Sling angles below 30° from horizontal are prohibited by OSHA 1910.184 and ASME B30.9 for general rigging.

Angle from Horizontal	Load on Each Leg (2-leg, 1,000 lb load)	Tension Multiplier
90°	500 lb	1.000
60°	577 lb	1.155
45°	707 lb	1.414
30°	1,000 lb	2.000 (minimum allowable)

7.5 Head Pulley & Fairlead

The head pulley above the TIDYNE unit redirects the rope from the drum to the working load. Inspect the groove with a gauge at each periodic inspection; a worn groove will flatten the rope and dramatically reduce service life. The Home position aligns the hook within inches of the head pulley — do not modify the head-pulley geometry or position without factory approval, as it is referenced by the absolute encoder Home routine.

8. Maintenance Schedule

The following schedule is suitable for general medium-duty service (ASME H3). Heavier service, dusty or wet environments, or marine salt-spray exposure typically requires intervals halved. Maintain a written record of all maintenance activity in the equipment service file.

Personnel requirement: only daily pre-use checks (§8.1) may be carried out by the trained TIDYNE operator. All weekly, monthly, quarterly, semi-annual, annual, and five-year maintenance activities shall be performed exclusively by TIDYNE OEM-certified technicians or engineers. Unauthorized service voids certification and warranty.

8.1 Daily (Each Shift of Use)

Task	Procedure
Visual inspection	Complete the daily checklist in §5.1.
Brake function test	Verify holding brake stops and holds the drum.
Wire rope wipe-down	Wipe accessible rope to remove grit; note any damage.
Control function	Cycle controls through full range, including E-stop.
Operator log entry	Record hours, lifts, defects, and operator initials.

8.2 Weekly

Task	Procedure
Lubricate hook bearing	Apply NLGI #2 EP grease via Zerk; wipe excess.
Lubricate sheaves & fairlead rollers	Grease per OEM; rotate while lubricating.
Drum brake inspection	Listen for grinding; check for visible wear.
Wire rope dressing	Apply approved penetrating lubricant; rotate drum to coat full length.
Hydraulic / pneumatic leaks	Inspect hoses, fittings, valves for weeping.

8.3 Monthly

Task	Procedure
Full ASME B30.30 wire rope inspection	Document broken wire count and rope diameter at three points.
Fastener torque audit	Check critical fasteners against Appendix B values.
Brake lining thickness	Measure and compare to OEM minimum; replace at limit.
Gearbox oil level & sample	Top off; pull 100 mL sample for visual moisture/metallics check.
Electrical inspection	Inspect contactors, terminals, grounding straps.
Limit switch verification	Bump-test all travel limit devices without load.

8. Maintenance Schedule (continued)

8.4 Quarterly / Semi-Annual

Task	Procedure
Wire rope reversal (drum)	Where OEM permits, reverse rope to redistribute fatigue.
Gearbox oil change	Drain, flush if required, refill with specified oil grade.
Brake test under load	Load-hold test at 100% WLL for 10 minutes; measure drift.
NDT of load hook	Magnetic-particle or dye-penetrant inspection.
Hydraulic filter change	Replace return and pressure filters.
Motor insulation resistance	Megger test motor windings; record values.

8.5 Annual

Task	Procedure
Comprehensive periodic inspection	Full ASME B30.7 inspection by TIDYNE OEM-certified inspector.
Brake overhaul	Disassemble; replace linings, springs, and seals as required.
Drum & sheave bearing service	Inspect, regrease or replace bearings.
Wire rope replacement (criterion-based)	Replace if any §11 criterion is met or rope is at OEM age limit.
Proof / load test	Conduct 125% WLL static test per ASME B30.7.
Update equipment maintenance file	File all reports; affix new inspection tag.

8.6 Five-Year / Major Overhaul

Industrial winches in continuous service typically receive a major overhaul on a five-year cycle: complete disassembly, replacement of all bearings and seals, NDT of all load-bearing components, recoating, and re-commissioning. Marine deck machinery follows the survey schedule of the governing class society.

9. Lubrication Guide

Correct lubrication is the single most effective maintenance task an operator can perform. Use only the lubricants specified by the equipment OEM, or an approved cross-reference of equivalent grade. Never mix lubricants of different soap base (e.g., lithium with calcium) without flushing the bearing or component.

Personnel requirement: all lubrication, oil changes, and lubrication-point service on the TIDYNE unit shall be performed only by TIDYNE OEM-certified technicians.

9.1 TIDYNE Lubrication & Service Schedule

Point	Lubricant / Service	Method	Interval	Quantity / Notes
Wire rope	Penetrating wire rope lubricant compatible with factory rope	Drip while spooling	Weekly	To light saturation
Helically-grooved drum bearings	NLGI #2 EP marine grease	Zerk fitting	Monthly	3 – 5 strokes
Chain & sprocket drive	Open-chain marine lubricant	Brush or aerosol	Monthly	Thin even coat; wipe drips
Worm gear reducer	Per factory commissioning sheet (synthetic EP gear oil)	Fill to sight glass	Inspect monthly; change annually or per factory	Refer to TIDYNE — do not substitute oil grade
Head pulley bearing	NLGI #2 EP marine grease	Zerk; rotate while greasing	Weekly	2 – 3 strokes
Hook / stirrup bearing	NLGI #2 EP marine grease	Zerk	Weekly	2 strokes
B3 solenoid actuator	Light penetrating oil; verify free plunger stroke (no grease in coil)	Inspect; wipe — do not pack	Monthly	Per factory — over-lubrication causes thermal issues
Centrifugal brake (worm h.s. shaft)	Inspect for free rotation; no operator lubrication	Visual	Quarterly	Refer service to TIDYNE
48 V main battery	Battery health check via telemetry; recharge	110 V top-up charger	After each mission / weekly when idle	Maintain ≥ 50% SOC during storage
Onboard lithium backup	Verify backup voltage via telemetry; replace per factory life	Telemetry / factory service	Quarterly inspection; replacement per TIDYNE schedule	Factory-replaceable
Marine enclosure seals	Silicone dielectric grease on O-rings at service	Wipe	Quarterly	Verify enclosure resealed before service

9.2 Lubrication Notes

- Always clean Zerk fittings before applying grease to avoid pumping contamination into the bearing.
- Do not lubricate inside the B3 solenoid coil bore — apply only to external plunger surfaces, and only if a stuck plunger is observed.

- Use wire rope lubricant compatible with the original factory rope dressing.
- TIDYNE specifies synthetic gear oil for the worm reducer — do not substitute a mineral grade.
- Dispose of used lubricants per local regulation. Failed lithium cells must go to a certified battery recycler.

10. Brake System Service & Testing

The TIDYNE unit brake system is the most safety-critical subsystem on the unit. It is engineered as a **triple-redundant architecture** — three independent brakes (B1, B2, B3), each individually capable of holding the full 400 lb (180 kg) Working Load Limit — supplemented by an automatic centrifugal overspeed brake. ASME B30.7 acceptance for primary brake hold is 125% of WLL; the TIDYNE unit meets this requirement on each independent stage. Any abnormal noise, smell, drift, or failure of brake-engagement telemetry is grounds for immediate removal from service.

Personnel requirement: all brake system service, adjustment, and functional testing of the TIDYNE unit shall be performed exclusively by TIDYNE OEM-certified technicians or engineers. Brake work is not an operator-level activity.

10.1 TIDYNE Brake Architecture

B1 — Motor Torque Control	The 1 kW servo motor actively governs descent using regenerative torque under closed-loop control of the absolute encoder. Smooth, electronically modulated, and the source of regenerative charging back into the 48 V battery during lowering.
B2 — Self-Locking Worm Gear	The low-ratio worm gear reducer is geometrically self-locking. The load cannot backdrive the motor; with zero applied power the worm mechanically prevents free-fall.
B3 — Emergency Gravity Brake	Normally-engaged fail-safe brake on the drum shaft, held open by a linear solenoid actuator. A gravity mass acts as a mechanical servo on release. Any loss of solenoid power (E-Stop, Down-button release, power failure) closes the brake instantly and locks the drum. The solenoid duty cycle is managed so that it is de-energized ≥ 50% of operating time to prevent overheating.
Centrifugal Overspeed Brake	Mounted on the extended worm (high-speed) shaft of the gear reducer. Activates automatically on overspeed — no operator action required. Provides controlled descent if an upstream failure has occurred and the manual brake release is applied.

10.2 Failure-Response Behavior

- Releasing the Down button or pressing E-Stop cuts solenoid power → B3 gravity brake engages → drum locks.
- Overspeed detected by the drum rotation sensor → electronic drive stops + B3 emergency brake engages automatically.
- Power failure → solenoid de-energizes → B3 engages. Manual brake release allows controlled descent governed by the centrifugal brake.
- Solenoid failure → the unit can still lift (B3 freewheels in the lifting direction). Plan removal from service at end of mission and replace solenoid.
- E-Stop activation does **not** lose the Home reference position.

10.3 Brake Inspection

- Visual: check the B3 gravity brake and solenoid actuator for oil contamination, debris, or visible wear. Verify the solenoid plunger strokes freely.
- Telemetry: review the onboard analytics log for brake-engagement events, anomaly alerts, and any logged solenoid duty exceedance.
- Verify the centrifugal brake shoes rotate freely on the worm high-speed shaft; inspect for glazing or unequal wear of the friction surface.
- Inspect the drum-shaft mating surface where the B3 brake engages for heat-checking, bluing, or scoring deeper than 0.005 in (0.13 mm).
- Verify air gap / actuator stroke is within tolerance per the factory commissioning sheet.

10.4 Functional Brake Test

Conduct the brake test at least annually, after brake or solenoid service, and any time brake performance is in question. Procedure: (1) attach a test load equal to 100% WLL (400 lb / 180 kg) at no more than 4 ft above the landing surface; (2) raise to test height under controlled conditions; (3) press E-Stop to verify B3 engagement and load hold; (4) hold for 10 minutes — acceptance criterion: zero observable drift and zero acceleration. Repeat with controlled descent to confirm B1 regenerative control. Periodically verify B2 self-lock by powering off the drive at the lowered position and confirming no backdrive.

10.5 Brake Service Safety

Brake springs and the B3 gravity mass store substantial energy. Always follow TIDYNE factory procedure and use the correct retention tooling. Lock out and tag out the 48 V main battery disconnect **and** the onboard lithium backup before removing brake covers. Never substitute non-OEM friction or solenoid components — friction coefficient and solenoid stroke determine holding behavior. Refer all major brake service to TIDYNE factory support.

11. Wire Rope Inspection & Replacement (ASME B30.30)

Wire rope is a consumable component with a finite service life. ASME B30.30-2019 (Ropes) consolidates the wire rope removal criteria previously found in B30.2, B30.5, and B30.7. The rope must be removed from service when any single criterion below is met — no judgment, no exceptions.

Personnel requirement: wire rope replacement decisions and end-termination work shall be made and performed only by a TIDYNE OEM-certified inspector or technician. Daily visual checks may be conducted by the trained operator.

11.1 Removal-from-Service Criteria

Criterion	Removal Threshold (Running Rope)	Removal Threshold (Standing Rope)
Broken wires in one rope lay	6 randomly distributed, or 3 in one strand	3 in one rope lay
Broken wires at end termination	2 or more in any strand	2 or more in any strand
Wear of outside wires	1/3 of original diameter of outer wire	1/3 of original outer wire diameter
Reduction in rope diameter	> 5% of nominal diameter	> 5% of nominal diameter
Corrosion (pitting / discoloration)	Severe; any pitting visible to the eye	Severe; any pitting visible to the eye
Kinking, crushing, birdcaging, popped core	Any occurrence	Any occurrence
Heat damage (welding, electric arc, torch)	Any occurrence	Any occurrence
Severely corroded / damaged end attachment	Any occurrence	Any occurrence

11.2 Inspection Procedure

Inspect the full length of wire rope at the interval required (daily visual, monthly competent person, annual qualified inspector — both monthly and annual inspections must be TIDYNE OEM-certified). Pay particular attention to:

- Sections that repeatedly contact sheaves (highest bending fatigue).
- Wire rope at end terminations and within 12 in (300 mm) of the dead end.
- Sections at and near pickup / pickup-and-carry points on the drum where the rope is loaded against the drum face.
- Sections exposed to environment extremes — heat, chemicals, abrasive media.

11.3 Diameter Measurement

Measure the rope diameter at three locations along the rope, ideally on a straight unloaded section, using a caliper that spans the crowns of opposite strands (not the valleys). Record the largest of three measurements. Compare to the nominal diameter as supplied. A reduction greater than 5% of nominal is cause for removal.

11. Wire Rope Inspection (continued)

11.4 Installation of New Wire Rope

- Inspect the new reel for shipping damage; verify the certificate of conformance and break-strength tag.
- Match construction, grade, lay, and diameter to the OEM rope specification and existing termination hardware.
- Mount the supply reel on a stand that allows free rotation — do not pull rope off the side of a flat-laid reel; this induces twist.
- Maintain back-tension on the rope during installation (typically 2 – 5% of breaking strength) for tight drum spooling.
- Anchor the dead-end per the OEM method; never substitute U-bolt clips for an OEM wedge socket without engineering approval.
- Break in the new rope with three to five cycles at no more than 25% WLL, then progressively to full load.

11.5 Wire Rope Storage

Store wire rope reels indoors, on end (drum vertical), on wood blocking, away from welding, chemical fumes, and direct sunlight. Re-lubricate stored rope every six months by surface application of an approved rope lubricant. Rope older than five years from manufacture should be inspected and tested before installation, regardless of apparent condition.

11.6 Documentation

ASME B30.30 requires that monthly and periodic rope inspections be documented. The minimum record includes: date, inspector identity, equipment identifier, rope identifier (date of installation, manufacturer, lot), findings (with location measured from a reference such as the dead end), and disposition (continued service / monitored / removed).

11.7 Common Wire Rope Defects

Birdcage	Outer strands separate from the core, usually from sudden release of tension. Always cause for removal.
Kink	Permanent strand distortion from loop pulled tight. Wire rope at the kink loses up to 50% strength.
High Stranding	A strand pushed out of position by torsional imbalance. Indicates rope at end of fatigue life.
Core Protrusion	"Popped core" — internal core extruded between outer strands; severe overload.
Peening / Mashing	Localized flat spots from impact against rigid object or drum flange.
Corrosion	Surface or pitting corrosion; pitting is grounds for immediate removal.

12. Troubleshooting Guide

The table below cross-references common symptoms with probable causes and immediate corrective action. Items involving brake, control, or load-path failure must be addressed before returning the winch to service.

Symptom	Probable Cause	Action
TIDYNE unit will not power on	48 V main battery disconnected or fully discharged; main fuse open; control enclosure unplugged.	Verify disconnect engaged; charge via 110 V top-up charger; inspect fuse and harness.
Drive will not enable / homing required	Startup Home routine not completed; absolute encoder fault.	Lift hook within inches of head pulley and press Home (§6.2). If fault persists, contact TIDYNE support.
Press Home — no response	Hook not at home position; encoder out of range; Home button stuck or solenoid feedback open.	Verify hook height; inspect Home button on underside of control enclosure; check anomaly log.
Drum will not turn under Up command	B3 solenoid not releasing; brake stuck engaged; chain or sprocket failure.	Listen for solenoid actuation; verify 48 V at solenoid; inspect chain & sprocket; check anomaly log.
Solenoid does not release (no click)	Failed linear solenoid actuator; open solenoid harness; thermal cutout (solenoid duty exceeded).	Allow cool-down; verify duty did not exceed ≥50% off-time limit; replace solenoid if confirmed failed.
Load drifts after stop / E-Stop	B3 friction surface contaminated or worn; gravity mass binding; rare combined-mode fault.	Remove from service. Inspect B3 per Chapter 10. Contact TIDYNE — drift on a triple-redundant brake is a major event.
Overspeed trip during descent	Operator override / runaway; failed B1 control; centrifugal brake activated correctly.	After load is secured, review anomaly log; verify drum-speed sensor calibration; remove from service until cause identified.
Battery will not charge / charger fault	Defective 110 V charger; open charge harness; battery management system protection event; faulty 110 V source.	Verify 110 V source; inspect charger LED status; check telemetry battery-fault flag; refer to TIDYNE if BMS fault persists.
Short runtime / few cycles per charge	Aged battery cells; cold weather de-rating; excessive solenoid duty; regenerative braking disabled.	Verify recent charge history in telemetry; review descent-cycle log; schedule factory battery service if capacity is below threshold.
Anomaly alert on telemetry display	Onboard analytics detected out-of-band load, speed, or brake event.	Stop operations; export the log; clear alert only after root-cause is identified. Do not silence alerts.
Wire rope spools unevenly	Excessive fleet angle from head pulley misalignment; helically-grooved drum damaged.	Re-survey head pulley alignment; inspect drum grooving; consult TIDYNE if drum damage suspected.
Rope crushing on drum	Insufficient back-tension during installation; fewer than 5 dead wraps at full extension.	Re-spool under tension; verify ≥ 5 wraps remain at full extension.
Erratic control response	Worn or damp control enclosure cabling; intermittent button; salt corrosion.	Inspect cables and connectors; clean and dry enclosure; replace suspect components.

Audible knock on stop	Loose chain/sprocket; brake stroke long; loose drum hardware.	Inspect chain tension and sprocket fasteners; verify B3 stroke per commissioning sheet.

13. Lockout / Tagout & Hazard Controls

Lockout / Tagout (LOTO) per 29 CFR 1910.147 controls hazardous energy during service and maintenance. A winch stores energy in several forms — electrical, mechanical (springs, suspended loads), hydraulic, and pneumatic — and each must be isolated and dissipated before any service activity that places a worker in the danger zone.

13.1 Energy Sources

Energy Source	Isolation Method	Verification
Electrical (main feed)	Open and lock disconnect at panel.	Try-start; measure zero voltage at motor terminals.
Control circuit (24 V / 120 V)	Open control-power disconnect or remove fuses.	Press start buttons; observe no response.
Hydraulic pressure	Close shutoff valves; relieve pressure to reservoir.	Read 0 psi on pressure gauge at multiple points.
Pneumatic pressure	Close air supply; bleed downstream.	Confirm 0 psi at gauge; disconnect supply hose.
Suspended load (gravity)	Land load; block / crib securely.	Verify rope is slack and load is supported independently of the winch.
Stored spring energy (brake)	Use OEM spring-compression tool before disassembly.	Visual confirmation that springs are captured.
Stored rotational inertia	Allow drum to come to full rest.	Observe drum stationary for ≥ 30 s.

13.2 LOTO Procedure

- Notify all affected employees that service will commence.
- Identify all energy sources for the winch (electrical, hydraulic, pneumatic, mechanical).
- Shut down the winch using normal stopping procedure.
- Isolate every energy source identified.
- Apply a personally assigned lock and tag to each isolation point — one lock per worker.
- Dissipate or restrain all stored energy (relieve pressure, block load, capture springs).
- Verify isolation by attempting to start the equipment and by direct measurement (voltage, pressure).
- Perform the service work.
- On completion, inspect tooling clear, replace guards, notify personnel, remove locks and tags, restore energy.

13.3 Hazard Controls Summary

Engineering controls	Guards over drum and gearing, two-blocking limit switches, overload protection, anti-collision and zone-limit devices.
Administrative controls	Written lift plans, hand signals, designated rigger and signaler, exclusion zones, daily inspection sign-off.
PPE	Hard hat, safety glasses, leather gloves (except when handling spooling rope), steel-toe boots, high-visibility clothing, hearing protection where required.

14. Common Failure Modes & Root Causes

Industrial failure investigations of winches consistently identify the same handful of failure mechanisms. Awareness of these allows operators and maintainers to detect early warning signs and prevent catastrophic events.

Failure Mode	Typical Root Cause	Early Warning Signs
Wire rope rupture	Exceeded fatigue life; sheave under-size; corrosion; shock loading.	Broken-wire count rising; diameter loss; outer-wire wear.
Brake failure to hold	Worn lining; oil contamination; weak spring; mis-adjustment.	Load creep; squeal; longer-than-normal stopping distance.
Gearbox tooth failure	Overload; inadequate lubrication; misalignment; debris ingestion.	Metallic particles in oil; vibration; intermittent knock.
Drum collapse	Excessive crushing load from undertensioned spooling; wrong rope size.	Visible deformation of drum flange; rope embedding.
Hook deformation / fracture	Tip loading; overload; hydrogen embrittlement; manufacturing defect.	Throat opening growth; surface cracks under dye-penetrant.
Motor burnout	Single-phasing; over-cycling; bearing failure; insulation breakdown.	Elevated case temperature; megger value declining trend.
Hydraulic motor leakage	Worn case drain; failed shaft seal; cavitation damage.	Drop in lifting capacity; oil at motor housing; reservoir level loss.
Limit switch defeat	Operator bypass; mechanical wear allowing override.	Operator complaints; rope spool-off events; flagged audits.
Fastener loosening	Vibration; under-torque on installation; lack of thread-locking.	Audible rattle; visual gaps; torque-stripe misalignment.
Bearing seizure	Lubrication failure; contamination; over-greasing causing churning.	Heat; noise; current spike on motor amperage.

14.1 Investigating a Failure

- Preserve evidence — do not move, clean, or dispose of failed components until photographed in place.
- Document the loading condition — load weight, lift geometry, environmental conditions, control inputs.
- Retain a fractured rope sample including 6 ft (1.8 m) of intact rope back from the failure for laboratory analysis.
- Interview operators and witnesses promptly; record statements in writing.
- Notify the OEM and regulatory authorities where required (OSHA, USCG, MSHA, class society).

15. Storage, Decommissioning & Disposal

15.1 Short-Term Storage (≤ 30 days)

- Land all loads; relieve tension on the wire rope and rigging.
- Spool the rope fully onto the helically-grooved drum under back-tension.
- Apply a coat of wire-rope lubricant compatible with the factory rope.
- Charge the 48 V main battery to ≥ 50% state-of-charge via the 110 V top-up charger; verify telemetry shows nominal SOC.
- Place controls in neutral; press E-Stop and open the main 48 V disconnect.
- Cover the unit with a breathable cover; do not use plastic that traps condensation.

15.2 Long-Term Storage (> 30 days)

- Perform all short-term steps plus the following.
- Charge the 48 V main battery to ~70 – 80% SOC (do not store fully discharged; do not store at 100% for extended periods).
- Top-up the 48 V pack via the 110 V charger every 90 days during storage; verify the lithium backup voltage at each check.
- Rotate the drum two full turns by hand (after manual brake release) every 90 days to redistribute lubricant on the worm and chain.
- Apply rust-preventive coating to exposed machined surfaces; verify enclosure seals are intact.
- Tag the unit with the date of storage, last charge date, and inspection due date.

15.3 Re-Commissioning

- Perform a full periodic inspection (Chapter 5.3) before returning to service.
- Charge the 48 V battery to full via the 110 V charger; review the telemetry health log for any storage-period anomalies.
- Replace gear-reducer oil if storage exceeded 12 months.
- Inspect wire rope per ASME B30.30; re-spool with proper back-tension.
- Conduct the Home routine and the functional brake test (§10.4) at 100% WLL.
- Update the equipment file and affix a new inspection tag.

15.4 Decommissioning & Disposal

When a TIDYNE reaches end of service life, follow a structured decommissioning to prevent re-introduction of unsafe equipment into commerce:

- Drain and recycle the worm-reducer oil per local environmental regulations.
- Remove the 48 V main battery and the onboard lithium backup; deliver both to a certified battery recycler — do not dispose of in general waste.
- Remove and dispose of wire rope as scrap steel; do not return to inventory.
- Permanently mark the nameplate with "DO NOT USE — DECOMMISSIONED" using a hardened-tip engraver.
- Disassemble or destroy the load hook and personnel stirrup interface to prevent reuse.
- Retain the maintenance file for the duration required by local regulation (typically 5 years).
- Recycle ferrous and non-ferrous components through a licensed scrap processor.

16. Regulatory Standards Reference

Mechanical winch operation is governed by a layered framework of regulations, consensus standards, and industry guidance. The U.S. references below identify the documents most relevant to industrial winch use; the Canadian column maps each to its equivalent for operations under Canadian federal and maritime jurisdiction. International users should likewise map equivalent national and class-society standards. Where two standards both apply, the more stringent requirement governs.

Standard	Title / Scope
OSHA 29 CFR 1910.179	Overhead and gantry cranes — general industry.
OSHA 29 CFR 1910.180	Crawler, locomotive, and truck cranes.
OSHA 29 CFR 1910.184	Slings — wire rope, alloy chain, metal mesh, fiber, synthetic.
OSHA 29 CFR 1910.147	The control of hazardous energy (Lockout / Tagout).
OSHA 29 CFR 1926 Subpart CC	Cranes and derricks in construction.
OSHA 29 CFR 1926.1431	Hoisting personnel — requirements for personnel platforms.
ASME B30.7	Winches — construction, installation, operation, inspection, testing, maintenance.
ASME B30.30	Ropes — selection, installation, inspection, maintenance, and removal of wire rope.
ASME B30.9	Slings.
ASME B30.10	Hooks.
ASME B30.26	Rigging hardware (shackles, eyebolts, turnbuckles, swivel hoist rings).
ASME HST-4	Performance standard for overhead electric wire rope hoists.
ANSI/ASSE A10.42	Safety requirements for rigging qualifications and responsibilities.
ANSI Z535.4	Product safety signs and labels (signal words and color coding).
ISO 4309	Cranes — wire ropes — care and maintenance, inspection and discard.
SAE J1853 / J706	Industrial winch and hoist standards.
Lloyd's Register LR-CO-001	Code for Lifting Appliances in a Marine Environment — scope explicitly covers handling/transfer of personnel on ships. The TIDYNE unit is in the process of pursuing Lloyd's Register classification under this code.
ABS / DNV / Lloyd's Register	Marine classification society rules for deck machinery.
IMO SOLAS Ch. V Reg. 23	Pilot transfer arrangements — applicable to pilot ladder & deck operations using the TIDYNE unit.
IMO LSA Code / SOLAS Ch. III	Life-saving appliance requirements relevant to rescue/evacuation use cases.
NFPA 70 (NEC)	National Electrical Code — applicable to winch electrical installations.
NFPA 70E	Standard for electrical safety in the workplace.

16.1 Canadian OHS & Maritime Equivalents

For deployments under Canadian jurisdiction, the occupational health-and-safety (OHS) and maritime framework below replaces or supplements the U.S. references above. The marine (IMO/SOLAS) standards are international and apply unchanged.

Subject	U.S. Reference	Canadian Equivalent
General OHS duty	OSHA General Duty Clause	Canada Labour Code, Part II (federal workplaces).
Marine-sector OHS	OSHA maritime standards	Maritime Occupational Health and Safety Regulations (SOR/2010-120).
Vessel safety / construction	USCG regulations	Canada Shipping Act, 2001; Transport Canada Marine Safety.
Fall protection / arrest	OSHA 1926.502	CSA Z259 series (Z259.10 harnesses, Z259.11 energy absorbers, Z259.16 design of active fall-protection systems).
Confined-space entry	OSHA 1910.146	CSA Z1006 (Management of Work in Confined Spaces); applicable provincial OHS regs.
Lifting / rigging hardware	ASME B30 series	CSA equivalents and class-society rules; ASME B30 accepted as recognized good practice.
Hazardous-energy control	OSHA 1910.147 (LOTO)	CSA Z460 (Control of Hazardous Energy — Lockout and Other Methods).

The most current revision of each standard governs. Maintain a controlled copy of the standards applicable to your operation in the equipment maintenance file and update annually.

17. Operator Training & Certification

Only trained, qualified, and (where required) certified personnel may operate a powered winch. OSHA defines a qualified person as one who, by possession of a recognized degree, certificate, or professional standing, or by extensive knowledge, training, and experience, has demonstrated the ability to solve problems relating to the subject matter and the work. ASME B30.7 places explicit responsibility on the operator's employer to verify and document operator qualification.

OEM-certified training requirement: all initial and refresher training on the TIDYNE unit — operator, rigger, inspector, and maintenance technician — shall be delivered only by TIDYNE OEM-certified trainers. Training delivered by any other party does not qualify a person to operate, inspect, or service the TIDYNE unit.

17.1 Minimum Training Topics

- Equipment-specific operating instructions (this manual + OEM datasheet).
- Applicable regulatory standards (Chapter 16) and site-specific procedures.
- Pre-use inspection procedure and acceptance criteria.
- Rigging fundamentals: sling angles, load weight estimation, center of gravity.
- Hand signal communication and radio etiquette.
- Wire rope inspection per ASME B30.30.
- Recognition and response to abnormal operating conditions.
- Lockout / Tagout procedures.
- Emergency procedures including dropped load, parted rope, brake failure.
- Maintenance and operator log documentation.

17.2 Training Format

Classroom	Minimum 4 hours for initial certification; 2 hours for annual refresher.
Practical	Minimum 4 hours of supervised hands-on with a qualified evaluator; 2 hours for annual refresher.
Evaluation	Written exam (minimum 80% pass) and practical proficiency demonstration.
Refresher	Annual; or immediately following any incident, near-miss, or change in equipment.
Records	Maintain training records for the duration of employment plus three years.

17.3 Qualification of Inspectors and Riggers

Persons performing periodic (annual) inspection must be designated as qualified inspectors with documented training in the inspection of mechanical lifting equipment. Riggers who select rigging gear and direct lifts must meet the ANSI/ASSE A10.42 qualification criteria — Level I (basic), Level II (intermediate), or Level III (advanced / master rigger) — appropriate to the complexity of the lift.

18. Service Log Template

Reproduce this template in the equipment maintenance file. One row per service event. Retain records for the operational life of the equipment plus the period required by the governing regulation.

Date	Hours	Activity / Inspection	Findings / Parts	Technician	Signature
2026-__-__	_____	Daily inspection	_____	_____	_____
2026-__-__	_____	Weekly lubrication	_____	_____	_____
2026-__-__	_____	Monthly inspection	_____	_____	_____
2026-__-__	_____	Wire rope inspection	_____	_____	_____
2026-__-__	_____	Brake function test	_____	_____	_____
2026-__-__	_____	Gearbox oil change	_____	_____	_____
2026-__-__	_____	Annual inspection	_____	_____	_____
2026-__-__	_____	Load test (100% / 125%)	_____	_____	_____
2026-__-__	_____	Wire rope replacement	_____	_____	_____
2026-__-__	_____	_____	_____	_____	_____
2026-__-__	_____	_____	_____	_____	_____
2026-__-__	_____	_____	_____	_____	_____

Defect / Out-of-Service Log

Date	Defect	Action Taken	Date Returned to Service	Authorized By
2026-__-__	_____	_____	_____	_____
2026-__-__	_____	_____	_____	_____
2026-__-__	_____	_____	_____	_____
2026-__-__	_____	_____	_____	_____
2026-__-__	_____	_____	_____	_____

Appendix A — Glossary

ASME	American Society of Mechanical Engineers — publisher of B30 safety standards for cableways, cranes, derricks, hoists, hooks, jacks, and slings.
B1 / B2 / B3	The three independent brakes of the TIDYNE unit: motor torque control (B1), self-locking worm gear (B2), and emergency gravity brake on the drum shaft (B3).
Absolute Encoder	A position sensor on the TIDYNE unit's servo motor that retains exact shaft position through power cycles; referenced by the Home routine.
Birdcage	Permanent deformation of wire rope in which the outer strands separate from the core; an automatic discard condition.
Bridle	A rigging assembly with multiple legs converging on a master link.
Capstan	A vertical-axis powered drum used to apply tension to a line that is tailed by the operator.
Come-along	A portable lever-operated ratchet winch.
Competent Person	OSHA designation: one capable of identifying hazards and authorized to take corrective action.
D/d Ratio	Ratio of sheave or drum tread diameter to wire rope diameter; controls fatigue life.
Drift	Downward motion of a load after the brake is set; a measure of brake integrity.
Duty Cycle	Percentage of a defined reference period during which the equipment is under load.
Fairlead	A guide that aligns a rope onto a drum.
Fleet Angle	Angle between the rope and a plane perpendicular to the drum axis through the first sheave.
Home (TIDYNE)	Reference position established at startup by lifting the hook within inches of the head pulley and pressing the Home button on the underside of the control enclosure.
Helically-Grooved Drum	Drum machined with a continuous helical groove sized to the wire rope; ensures even single-layer spooling without operator intervention.
IWRC	Independent Wire Rope Core — a wire rope inside the main rope used as the core element.
Lay (rope)	The direction and pattern in which strands are wound around the core; also the linear distance for one complete strand twist.
LOTO	Lockout / Tagout — the procedure to isolate hazardous energy.
Personnel Hoisting	Use of a winch or hoist to lift people; requires special man-rated equipment.
Proof Test	A non-destructive load test, typically 125% to 200% of WLL, used to validate strength.
Qualified Person	OSHA designation: one with recognized credentials and experience to perform a task.
Reeve	To pass rope around sheaves to gain mechanical advantage.
Sheave	A grooved pulley for wire rope or chain.
Snap-back Zone	The area into which a parted rope under tension is likely to recoil; a no-entry zone during loaded operation.

SWL	Safe Working Load — equivalent to WLL.
Two-Blocking	Contact between the load block and the boom tip or upper sheave; a high-energy failure event prevented by limit devices.
WLL	Working Load Limit — the maximum permissible static load on the equipment under specified conditions.

Appendix B — Typical Torque Specifications

The values below are guidance for ungalled, lightly lubricated SAE Grade 5, Grade 8, and metric Class 8.8 / 10.9 fasteners. Always defer to OEM-published values for safety-critical applications. Re-torque after first 25 hours of service on new or rebuilt machinery.

Bolt Size	SAE Grade 5 (lb·ft)	SAE Grade 8 (lb·ft)	Metric 8.8 (N·m)	Metric 10.9 (N·m)
1/4 in / M6	8	12	10	14
5/16 in / M8	17	24	24	34
3/8 in / M10	30	45	47	67
7/16 in / M12	50	70	82	116
1/2 in / M14	75	110	130	184
9/16 in / M16	110	155	205	290
5/8 in / M18	150	210	285	400
3/4 in / M20	265	375	400	565
7/8 in / M22	420	605	550	775
1 in / M24	640	910	700	985

General Torque Notes

- Use a calibrated click or beam-type torque wrench; verify calibration annually.
- Apply torque smoothly and continuously; do not snap or impulse-load the wrench.
- Tighten in a crisscross pattern on flanged joints to ensure even seating.
- Replace single-use fasteners (yield-stretched bolts, lock nuts with deformed sections) — do not reinstall.
- Use thread locker grade and color specified by the OEM; do not substitute.

Appendix C — Contact & Support

TIDYNE Inc. provides factory technical support, training, spare parts, and service for the full TIDYNE product line. For service of third-party equipment, contact the original manufacturer or an authorized service partner.

Company	TIDYNE Inc.
Web	tidyne.com
General Inquiries	solutions@tidyne.com
Engineering / Founder	ron@tidyne.com
Technical Support	Available via web portal — submit equipment serial number with inquiry.
Training	In-person and remote operator and inspector training programs available on request.
Document Reference	TDY-MAN-WCH-001 Rev. 2.0
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This manual is provided for informational and training purposes. TIDYNE Inc. makes no warranty that the procedures herein are suitable for any specific equipment or application. The user is responsible for verifying compliance with the

equipment OEM documentation, applicable regulations, and site-specific safety requirements.