THE WATER FAMILY

CS-320

THE SOFT PULSED-JET CARRIER

A creeper with a cast elastomeric bell where a propeller would be, rated to 30 m, that carries one neutral 2 kg cartridge the last, quiet kilometre.

16.34 kg
WET, WITH A NEUTRAL 2 KG CARTRIDGE; 15.95 L

30 m
DESIGN DEPTH, SAFETY FACTOR 3.41

0.25 m/s
TOP SPEED; THE VEHICLE HAS NO SPRINT

133.3 h
ENDURANCE AT A 1.0 W HOTEL LOAD, STILL WATER

Ø380 × 300 mm
THE CAST ELASTOMERIC BELL

2
ELECTRICAL CROSSINGS, PLUS ONE WATER PORT

AT A GLANCE

SLOWER THAN THE CURRENT ON PURPOSE. CLOSE TO THE WORK WHEN IT COUNTS.

A slow, soft-bodied carrier for piers, intakes, outfalls and listeners, carried to its start point by the larger hull or launched by hand.

NO SCREW

THE BELL IS THE MACHINE

A cast elastomeric bell contracts on a slow stroke and refills on the recovery. Propulsor, fairing and contact-compliance layer are one moulding: no shaft to seal, no gearbox and no blade tip to cavitate.

THE LAST KILOMETRE

DELIVERED CLOSE, THEN QUIET

CS-310 carries it in its bay and releases it at a surveyed point, so the expensive navigation stays on the larger hull and the creeper begins its leg close to the work.

DAYS ON 200 WH

ENDURANCE IS SET BY THE SLEEP STATE

At a 1.0 W silent-running load the vehicle runs 133.3 h and 71.1 km in still water, and at 0.5 W it runs 266.7 h and 112.9 km.

DOCTRINE

A CARRIER, NOT A MUNITION

Six non-kinetic cartridges and nothing else: no warhead, no fuze, no energetic material and no mechanism whose purpose is harm. No radio and no GPS aboard.

IN THIS SHEET

01 · SPECIFICATION

EVERY FIGURE BEHIND THE BELL. EACH WITH THE BASIS BESIDE IT.

The selected baseline of CS-320, grouped the way an integration engineer reads it: form, canister, mass, propulsion, endurance, current and drift, cradle, crossings, guidance and recovery.

01 VEHICLE AND ARRANGEMENT

PARAMETER	VALUE	BASIS
Form	Free-flooded elastomeric bell over a rigid polymer chassis, with a dry canister inside	three bodies, one of them dry
Bell	Ø380 × 300 mm	design value, the general arrangement
Exit nozzle	Ø40 mm	design value, the general arrangement
Inside the dry canister	Pulser actuator · ballast pump · avionics and compute · 0.2 kWh battery	the general arrangement; everything that must stay dry
Outside the canister	Ballast bladder · payload cradle · drop weight	the general arrangement
Structure	Polymer chassis and cast elastomer bell; no metal structure	the design definition
Bell material	Cast elastomer	propulsor, fairing and contact-compliance layer in one part
Chassis and fairings	Free-flooded moulded polymer, eligible for recycled PET	non-structural; the most-plastic platform in the fleet

02 PRESSURE CANISTER

PARAMETER	VALUE	BASIS
Architecture	Dry canister inside the flooded body	selected on serviceability over potted, oil-compensated electronics
Canister	Ø160 mm × 8 mm wall × 450 mm	design value, the selected baseline
End closures	Hemispherical, 6 mm	design value, the selected baseline
Canister material	Glass-filled nylon	the canister's material class
External pressure at 30 m	0.302 MPa	calculated, seawater
Critical length	816 mm	calculated; the 450 mm canister is a short cylinder
Effective unsupported length	503 mm	calculated, the closures' head depth included
Collapse, short-cylinder relation	2.94 MPa	calculated, Windenburg–Trilling, before knock-downs

PARAMETER	VALUE	BASIS
Collapse after creep and ovality	1.03 MPa	calculated, creep ×0.50 on modulus and ovality ×0.70 on pressure
Safety factor at 30 m	3.41	calculated
Closure collapse	5.20 MPa	calculated with a ×0.25 sphere knock-down; clear of the cylinder
Proof test	Every canister, before its first wet use	a rule on every canister built

03 MASS AND DISPLACEMENT

PARAMETER	VALUE	BASIS
Canister with 6 mm closures	3.62 kg · 11.19 L	calculated, the mass and displaced-volume ledger
Rigid chassis, cradle and fairings	2.02 kg · 1.50 L	calculated
Elastomeric bell	1.38 kg · 1.20 L	calculated; propulsor, fairing and contact layer
Battery pack, 0.2 kWh	1.43 kg	calculated, packaged pack; inside the canister
Avionics, compute and optional micro-modem	0.80 kg	ledger allocation; inside the canister
Pulser actuator, magnetic coupling and drive	0.90 kg	ledger allocation
Variable ballast, dry and water	1.00 kg	ledger allocation
Moving-mass trim	0.30 kg	ledger allocation
Penetrators and harness	0.40 kg	ledger allocation
Drop-weight abort, cast iron	0.80 kg · 0.10 L	ledger allocation
Dry mass	12.66 kg · 13.99 L	calculated, the sum of the ledger
Displacement in seawater	14.34 kg	calculated
Fixed trim and reserve	1.69 kg	calculated; 12% of displacement
Payload cartridge	2.00 kg	neutral by interface rule
Vehicle wet displacement	16.34 kg · 15.95 L	calculated, with the cartridge fitted
Fresh-to-salt buoyancy swing	0.35 kg	calculated on this displacement
Routine ballast authority	±0.5 kg	design value; the 0.35 kg fresh-to-salt swing sits inside it
Payload-release compensation	Up to ~2 kg	a separate ballast action; it sizes the system

04 PROPULSION

PARAMETER	VALUE	BASIS
Propulsor	Pulsed-jet elastomeric bell	contracts on a slow stroke and refills on the recovery; no screw

PARAMETER	VALUE	BASIS
Stroke	0.5 L expelled in 0.30 s through the Ø40 mm nozzle	the stroke the thrust figures are calculated on
Jet velocity	1.33 m/s	calculated
Momentum thrust during the stroke	2.27 N	calculated; the mean is this figure times the duty cycle
Overall propulsive efficiency	0.10	Froude efficiency of 0.203 at 0.15 m/s, about halved by drive and electrical losses
Drag to overcome	0.35 N at 0.15 m/s · 0.96 N at 0.25 m/s · 3.84 N at 0.50 m/s	calculated at a drag coefficient of 0.6 on 0.05 m² frontal area
Top speed	0.25 m/s	design value; the vehicle has no sprint
Thrust needed at 0.50 m/s	3.8× the mean thrust a stroke delivers	calculated; still 1.41× at half the drag coefficient and the highest stroke rate evaluated
Drive	Pulser actuator dry in the canister, magnetic coupling to the bell	torque only; no wire and no seal cross the boundary
Bell strain	25% volume change per stroke; about 7.7% linear strain	calculated, volumetric average on an isotropic conversion; local strain at crown and root runs higher
Refill stroke	Valved	requirement; an unvalved recovery stroke produces reverse thrust

05 ENDURANCE AND ENERGY

PARAMETER	VALUE	BASIS
Battery	0.2 kWh	design value; inside the canister
Endurance inputs	Drag coefficient 0.6 on 0.05 m² · overall propulsive efficiency 0.10 · 200 Wh	the inputs every endurance figure here is calculated on
Best range at a 0.5 W hotel load	0.118 m/s → 266.7 h, 112.9 km	calculated, 0.75 W total draw, still water
Best range at a 1.0 W hotel load	0.148 m/s → 133.3 h, 71.1 km	calculated, 1.50 W total draw, still water
Best range at a 2.0 W hotel load	0.187 m/s → 66.7 h, 44.8 km	calculated, 3.00 W total draw, still water
Best range at a 3.0 W hotel load	0.214 m/s → 44.4 h, 34.2 km	calculated, 4.50 W total draw, still water
At the 0.25 m/s creep	3.40 W → 59 h (2.4 d), 53 km	calculated at a 1.0 W hotel load, still water
Range against hotel load	Scales as hotel load to the power −2/3	calculated; doubling 1.0 W to 2.0 W costs 37% of range
Propulsion draw at best range	Half the hotel draw	calculated relation; efficiency moves the best speed and barely moves the best range

06 CURRENT, DRIFT AND DEPTH CONTROL

PARAMETER	VALUE	BASIS
Reachable cone half-angle	Unbounded at or below 0.25 m/s · 30.0° in 0.50 · 19.5° in 0.75 · 14.5° in 1.00 · 9.6° in 1.50 m/s	calculated, the arcsine of vehicle speed over current speed
Six-hour cross-track authority	5.4 km	calculated at 0.25 m/s
Ground speed against the design current	−0.50 m/s	calculated, 0.25 m/s in a 0.75 m/s set
Arrival error, six hours in a 0.75 m/s set	±1.62 km along-track per 10% current-speed error · ±2.81 km cross-track per 10° direction error	calculated; the two combine
Terminal leg in slack water	2 km in 2.2 h	calculated at 0.25 m/s
Local fix for arrival	Acoustic beacon at the target · fibre tether · delivery by CS-310 to a surveyed point	required; drift serves the transit, not the arrival
Tide and current data	A hard dependency of every mission plan	the terminal approach is timed to slack water, run down-current or held to a low-current pocket
Depth-band keeping in drift	101 J per stroke; 0.67 Wh over a six-hour drift, 0.34% of the battery	calculated: 0.1 L against 3.02 bar at 30% pump efficiency, 24 strokes
Primary flight control in drift	Variable ballast	sized for cycle count and duty life

07 PAYLOAD CRADLE AND INTERFACES

PARAMETER	VALUE	BASIS
Cradle envelope	2 kg / 2 L	design value; one cartridge at a time
Cartridge buoyancy	Neutral, ±0.2 kg in seawater	interface rule; a scaled member of the CS-310 bay interface family
Interface	Mechanical mount · electrical and data connector · retention and release	defined once, so a new cartridge is tooling rather than a redesign
Cartridges	Passive sensor node · tag or beacon · micro relay node · environmental sampler · inspection package · emplace and retrieve	six, non-kinetic
Carriage in CS-310	Inside the 20 kg / 20 L bay: 18% margin on mass, 20% on volume	calculated; one-way release, trim-neutral

08 PRESSURE-BOUNDARY CROSSINGS

PARAMETER	VALUE	BASIS
Electrical crossings	2	the shore umbilical and the cradle wet-mate
Shore umbilical	Charge and data	electrical; pre-dive only

PARAMETER	VALUE	BASIS
Cradle wet-mate	Power, data and the release command	electrical
Ballast port	Water in and out	hydraulic, not electrical
Pulser drive	No crossing	magnetic coupling, torque only
Depth cell	No crossing	reads through a diaphragm

09 GUIDANCE AND COMMUNICATIONS

PARAMETER	VALUE	BASIS
Tier 1	Preset: compass, depth cell, time and the tide table	legs planned against current predictions; the current term dominates the error
Tier 2	Fibre-guided, a person in the loop	spool volume competes with the 2 L cradle
Tier 3	Delivered precision	CS-310 carries the navigation and releases at a surveyed point
Radio and GPS	None aboard	RF and GPS do not penetrate seawater
Communications	Silent running by default; a micro acoustic modem as an option	never a control channel
Loss of confidence	Hold the depth band or bottom-sit, then surface at a planned point	safety function, inside geofenced corridors
Timer expiry	Return to recovery or surface	safety function
Critical fault	Drop-weight abort	safety function

10 ABORT, HANDLING AND ENVIRONMENT

PARAMETER	VALUE	BASIS
Abort	A normally-energized hold coil retains the drop weight	cutting power releases it and the vehicle rises
Drop weight	0.80 kg, cast iron	ledger allocation; every abort leaves it on the bottom
Recovery	A fault surfaces the machine with its core, battery and data	recoverability is a design requirement
Launch	By hand from a small boat or the shore, or released from the CS-310 bay	each vehicle is independently launchable
Recovery capture	A slow soft body is easy to net	the small platform's recovery advantage
Shore support	Charging and mission upload pre-dive; data offload after	over the shore umbilical
Design depth	30 m	the harbour, pier and approach work band
Cold water	Elastomer stiffens near 0 °C	changes the bell's stroke and rate together

02 · THE ARCHITECTURE

PROPULSOR, FAIRING AND SKIN ARE ONE CAST PART.

Three bodies, and only the smallest is dry. Everything outside the canister floods, so the one part that answers to 30 m is a tube 160 mm across.

THE BELL

Ø380 × 300 MM, CAST ELASTOMER

The bell contracts on a slow stroke, expels a ring of water through a Ø40 mm nozzle and refills on the recovery.

THE CORE

Ø160 × 8 MM, 450 MM LONG

A glass-filled nylon canister with 6 mm closures, holding the pulser actuator, the ballast pump, the avionics and the 0.2 kWh battery: the only volume aboard at one atmosphere.

THE CRADLE

ONE 2 KG / 2 L CARTRIDGE

A mechanical mount, a connector and a release, defined once, with the drop weight below. Every cartridge is a sensor, tag, relay, sampler or inspection tool.

With no screw, nothing turns in the water. Everything the water touches is free-flooded moulded polymer or cast elastomer, and the vehicle carries no metal structure: the most-plastic platform in the fleet, built on the fleet's own tooling.

A cast bell and a moulded chassis make a vehicle that can be fielded in numbers. Distance belongs to another machine: CS-310 runs the long transit on its screw and carries this one in its bay.

03 · THE PRESSURE ARCHITECTURE

DELETE THE AIR, AND THE LIFT GOES WITH IT. THE DRY CANISTER STAYS.

Two architectures were open at this scale: a small dry canister inside a flooded body, or no air volume anywhere, with potted electronics and oil-compensated cells at ambient pressure. The second deletes the collapse and crossing problems, and it is not free.

ARCHITECTURE	DISPLACED	BUOYANCY	MASS	NET
Dry canister with hemispherical ends	11.19 L	11.47 kg	3.62 kg structure + 2.23 kg contents	+5.62 kg
Potted and oil-compensated, no air volume	2.30 L	2.36 kg	3.40 kg	−1.04 kg

BUOYANCY MATERIAL TO BUY BACK 6.66 KG OF LIFT	VOLUME	POTTED-ROUTE MASS	AGAINST THE DRY CANISTER
Deep syntactic, 0.40 g/cm³	10.7 L	7.66 kg	+1.8 L / +1.8 kg
100 m-class syntactic, 0.25 g/cm³	8.6 L	5.55 kg	−0.3 L / −0.3 kg
Closed-cell PVC, 0.15 g/cm³	7.6 L	4.54 kg	−1.3 L / −1.3 kg

The air inside the canister is most of the vehicle's buoyancy budget. At a foam grade suited to the depth the potted route narrows to about a litre and a kilogram, and it stays open as an option, but it spends displacement, the currency this vehicle has least of, on the cheapest problem on the platform: at 30 m two millimetres of extra wall already solve collapse.

The dry canister is selected on serviceability. Potted assemblies are hard to rework and restrict component choice to parts with no air gaps and no hard-case cells, and being able to open the canister and change a component is worth more than the litre.

04 · THE CANISTER

THE RIGHT FORMULA FOR A SHORT TUBE. THEN CREEP AND OVALITY TAKE IT BACK.

External pressure at 30 m is 0.302 MPa. The critical length for a Ø160 × 8 mm cylinder is 816 mm and the canister is 450 mm, so it is a short cylinder and its end restraint carries load.

WALL	LONG-CYLINDER RELATION	SHORT-CYLINDER RELATION	AFTER CREEP AND OVALITY	SAFETY FACTOR AT 30 M	RESULT
4 mm	0.21 MPa	0.51 MPa	0.18 MPa	0.60	Fails
6 mm	0.72 MPa	1.43 MPa	0.50 MPa	1.65	Below a safety factor of 2
7 mm	1.15 MPa	2.10 MPa	0.74 MPa	2.44	Passes thinly
8 mm, selected	1.71 MPa	2.94 MPa	1.03 MPa	3.41	Passes

The short-cylinder relation is taken over an effective unsupported length of 503 mm, the closures' head depth included, with creep at 0.50 on the modulus and ovality at 0.70 on the pressure. On a short tube the long-cylinder relation understates strength by roughly 2.5 times, and the two knock-downs take it all back.

Going from 7 mm to 8 mm costs 0.28 kg and moves the safety factor from 2.44 to 3.41, an easy purchase on a vehicle meant to be fielded in numbers. The 6 mm closures reach 5.20 MPa after a 0.25 sphere knock-down, clear of the cylinder by a wide margin, so on this machine the closures do not govern. Every canister is proof-tested before its first wet use.

05 · THE STROKE

A BELL STROKE MAKES 2.27 NEWTONS. DUTY CYCLE DECIDES THE REST.

Take a credible stroke: 0.5 L expelled in 0.30 s through the Ø40 mm nozzle. That is a jet velocity of 1.33 m/s and 2.27 N of momentum thrust while the stroke runs, and the mean is that figure times the duty cycle.

SPEED THROUGH THE WATER	DRAG TO OVERCOME	AGAINST THE MEAN THRUST OF THE STROKE
0.15 m/s	0.35 N	Met at every stroke rate evaluated
0.25 m/s	0.96 N	Met at the two higher stroke rates evaluated
0.50 m/s	3.84 N	Met at none

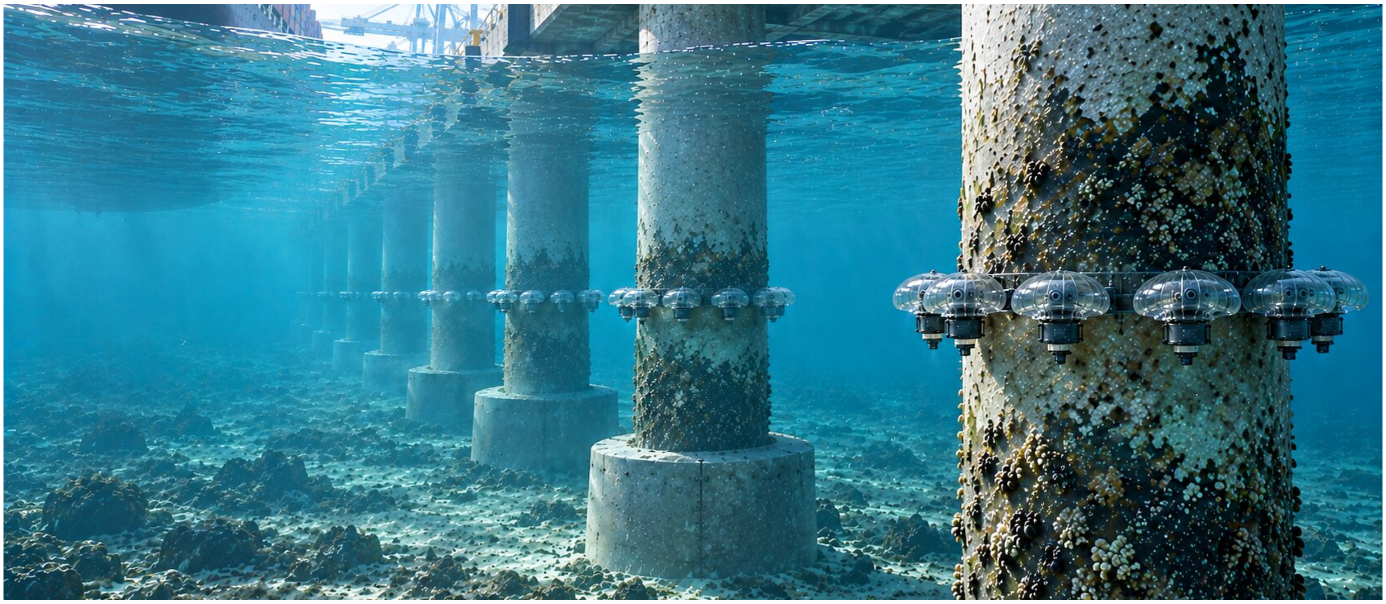
Froude efficiency on this jet is 0.203 at 0.15 m/s, and drive and electrical losses about halve it, to 0.10 overall. The top speed is 0.25 m/s, and that is the whole speed the machine has. Half a metre a second would need 3.8 times the mean thrust a stroke of this size delivers, and the shortfall survives a generous drag figure: at half the drag coefficient and the highest stroke rate evaluated it is still 1.41 times. A small screw would buy a sprint and give up the no-screw identity, so the mission set is sized around a creeper without one.

- ✓ The refill stroke is valved, because an unvalved recovery stroke produces reverse thrust.
- ✓ The ejected slug has a length-to-diameter ratio of 9.9, well past the vortex formation number of about 4, so a trailing jet forms and the thrust budget is written without a vortex bonus.
- ✓ A 0.5 L stroke from a bell of about 2 L is a 25% volume change, about 7.7% linear strain as a volumetric average; local strain at the crown and root runs several times higher, and fatigue answers to the local figure.
- ✓ Elastomer stiffens near 0 °C, which changes the stroke and the rate together in cold water.

06 · MASS AND DISPLACEMENT

SIXTEEN KILOGRAMS WET, EVERY LINE WITH ITS VOLUME.

A small submersible is bought twice, once in material and once in the buoyancy the material consumes, so every line of the ledger carries a mass and a displaced volume, and displacement is a sum.



12.66 kg
DRY MASS, 13.99 L DISPLACED

14.34 kg
DISPLACEMENT IN SEAWATER

1.69 kg
FIXED TRIM AND RESERVE, 12%

16.34 kg
WET WITH A NEUTRAL 2 KG CARTRIDGE, 15.95 L

The heaviest single item is the canister at 3.62 kg, and the air inside it is most of the vehicle's buoyancy. The fresh-to-salt swing on this displacement is 0.35 kg, inside the ±0.5 kg of routine ballast authority, and a separate compensation of up to about 2 kg on payload release is what sizes the ballast system.

At 16.34 kg and 15.95 L the creeper fits the 20 kg / 20 L wet bay of CS-310 with 18% margin on mass and 20% on volume. Releasing it from a 113 kg vehicle would otherwise be a 14% buoyancy transient at the moment the larger hull is trying to hold station; because every cartridge is neutral by rule, the transient is zero.

07 · ENDURANCE

THE BATTERY PAYS FOR STAYING AWAKE. MOVING COSTS UNDER A WATT.

At creep the propulsion draw is under a watt, so the silent-running hotel load governs. Every figure below is still water on 200 Wh, at a drag coefficient of 0.6 over 0.05 m² and an overall propulsive efficiency of 0.10.

HOTEL LOAD	BEST-RANGE SPEED	TOTAL DRAW	ENDURANCE	STILL-WATER RANGE
0.5 W	0.118 m/s	0.75 W	266.7 h (11.1 d)	112.9 km
1.0 W	0.148 m/s	1.50 W	133.3 h (5.6 d)	71.1 km
2.0 W	0.187 m/s	3.00 W	66.7 h (2.8 d)	44.8 km
3.0 W	0.214 m/s	4.50 W	44.4 h (1.9 d)	34.2 km

Range scales as hotel load to the power −2/3, so doubling the silent-running draw from 1.0 W to 2.0 W costs 37% of range. Underneath it is a small exact result: at the best-range speed the propulsion draw is half the hotel draw whatever the propulsive efficiency, so efficiency moves the best speed and barely moves the best range. A watt taken out of the sleep state is worth more on this machine than any refinement of hull or bell.

At the 0.25 m/s creep the vehicle draws 3.40 W for 59 h and 53 km. Froude efficiency itself rises with speed, at 0.166, 0.203 and 0.317 for 0.12, 0.15 and 0.25 m/s, so the true optimum sits a little above the table's.

08 · CURRENT AND DRIFT

DRIFT WORKS FOR GETTING THERE. IT CANNOT WORK FOR ARRIVING.

The vehicle adds at most 0.25 m/s to whatever the water is doing. After a time T its reachable set is a disc of radius 0.25·T centred U·T downstream, so the cone that bounds it from the release point has a half-angle of arcsin(v/U).

CURRENT SET	REACHABLE CONE HALF-ANGLE	SIX-HOUR ALONG-TRACK DRIFT	SIX-HOUR CROSS-TRACK AUTHORITY
0.20 m/s	Unbounded	4.3 km	5.4 km
0.25 m/s	Unbounded	5.4 km	5.4 km
0.50 m/s	30.0°	10.8 km	5.4 km
0.75 m/s	19.5°	16.2 km	5.4 km
1.00 m/s	14.5°	21.6 km	5.4 km
1.50 m/s	9.6°	32.4 km	5.4 km

At or below its own speed the vehicle can hold station or work upstream, and the reachable set is unbounded in angle; above it the cone closes quickly. The arrival error sits in the current forecast rather than in the vehicle. On a six-hour transit in a 0.75 m/s set, a 10% error in the predicted current speed puts the vehicle ±1.62 km off along-track and a 20% error ±3.24 km, and a 10° error in direction adds ±2.81 km across. The errors combine, so kilometre-class arrival error is a floor.

At 0.25 m/s in the 0.75 m/s set the design assumes, ground speed is −0.50 m/s. Authority binds rather than navigation, and three design constraints follow.

- ✓ The terminal approach is timed to slack water, run down-current or held to a low-current pocket, which makes tide and current data a hard dependency of the plan.

- ✔ A local fix is required for arrival: an acoustic beacon at the target, a fibre tether, or delivery by CS-310 to a surveyed release point.
- ✔ In slack water a 2 km terminal leg at 0.25 m/s takes 2.2 h, which the endurance carries comfortably; the tide window is what gates the mission.

Tidal currents are stratified by depth, so in a drift the way to steer is to change depth and ride a different stream. Moving 0.1 L against 3.02 bar at a pump efficiency of 30% costs 101 J a stroke, and 24 strokes over a six-hour drift cost 0.67 Wh, 0.34% of the battery. In drift the variable-ballast system is the primary flight control, and it is sized for cycle count and duty life rather than for authority alone.

09 · THE CRADLE

ONE CRADLE, SIX CARTRIDGES. ONE RIDE IN THE LARGER HULL.

The cradle takes one module at a time, about 2 kg and 2 L. Anything larger is the mothership's cargo, not this machine's.

PASSIVE SENSOR NODE

A LISTENER AT A SURVEYED POINT

Emplaces a small acoustic or environmental listener for persistent harbour and approach monitoring, at the node scale below the mothership's seabed packages.

TAG OR BEACON

SEABED OR FIXED CIVIL INFRASTRUCTURE

Delivers a small inert marker, transponder or instrumentation tag to the seabed or to fixed civil infrastructure, for sensing.

MICRO RELAY NODE

THE LAST-METRE EXTENSION

Drops a small acoustic-network relay below the mothership's moored relay class.

ENVIRONMENTAL SAMPLER

SONDE OR SEDIMENT SAMPLER

A water-quality sonde or a small sediment sampler: the civil work, on the same cradle.

INSPECTION PACKAGE

HULL, PIER, INTAKE, OUTFALL

A compact camera with lighting, or a small imaging sonar. The creep that makes the machine hard to find also lets it approach a structure without disturbing it.

EMPLACE AND RETRIEVE

A SMALL INERT PACKAGE

Low-signature delivery or recovery where a surface presence is unwanted. Export-sensitive in its own right.

The interface is defined once, as a mechanical mount, a connector, retention and release, so a new cartridge is tooling rather than a redesign. It is a scaled member of the CS-310 bay interface family, and every cartridge is neutrally buoyant to ±0.2 kg in seawater, which is what makes a release trim-neutral. The list ends there by rule: no warhead, no fuze, no energetic material, no terminal-effect payload and no mechanism whose purpose is harm.

Carriage in the larger hull is a cartridge fit, not a dock. The creeper rides in a retention cradle, leaves on a command the bay interface already carries and does not come back: CS-310 transits and releases at a surveyed point, and the creeper runs the last, quietest leg and surfaces at a planned point for its own recovery. The expensive navigation stays on the larger hull, and each vehicle stays independently launchable.

10 · THE BOUNDARY AND THE ABORT

TWO WIRES THROUGH THE WALL, ONE WATER PORT BESIDE THEM.

Every wire through a pressure boundary is a leak path, a pressure-test item and a cost line. The larger hull needs five electrical crossings; the creeper needs two, and a water port.

CROSSING	TYPE	CARRIES
Shore umbilical	Electrical	Charge and data, pre-dive only
Cradle wet-mate	Electrical	Power, data and the release command
Ballast port	Hydraulic	Water in and out
Pulser drive	Magnetic coupling	Torque only, not a crossing
Depth cell	Diaphragm	Reads pressure without a crossing

The pulser actuator and the ballast pump both live dry inside the canister and reach the water through a magnetic coupling and a hydraulic port. A water port is a far easier seal than a multi-conductor electrical penetrator, and it is the small platform's one structural advantage over the larger hull, which comes from scale.

The abort follows the fleet's inverted doctrine. A normally-energized hold coil retains the drop weight, so cutting power releases it: a flat battery, a hung computer or a severed harness all end the same way, with the weight gone and the vehicle rising. The weight is 0.80 kg of cast iron rather than lead, because every abort leaves it on the bottom, and a fault surfaces the machine with its core, its battery and its data.

11 · BUILDS

ONE CREEPER, THREE WAYS TO ARRIVE. THE MISSION PICKS ONE.

The bell, the canister, the cradle and the abort are common to every build. What differs is how the vehicle finds its start point, and whether a micro acoustic modem is fitted.

TIER 1

PRESET, ON THE TIDE TABLE

Pre-programmed legs on magnetic heading, a depth cell, time and a current prediction, with the drift planned against it. The current term dominates the error budget, so the drift plan is the mission plan.

TIER 2

FIBRE-GUIDED

A person in the loop over optical fibre from a payout spool, at walking-pace speeds with no launch shock. Spool volume competes with the 2 L cradle, which makes this the short-reach inspection build.

TIER 3

DELIVERED BY CS-310

The larger hull carries the navigation, transits and releases the creeper at a surveyed point for a short, bounded final leg on preset or fibre guidance, with one or two pre-emplaced acoustic beacons as a local fix where the mission needs one.

MICRO MODEM

AN OPTION, NEVER A BASELINE

A micro acoustic modem for scheduled, brief check-in, abort and retask contacts. Silent running stays the default, because every transmission spends the signature budget the platform exists to conserve.

12 · DOCTRINE AND SAFETY

SENSORS, SAMPLERS AND TOOLS, AND NOTHING ELSE. A FAULT BRINGS IT BACK TO THE SURFACE.

These lines hold on every build of the creeper and for every customer.

- Carriers, not munitions: no warhead, no fuze, no energetic material, no terminal-effect payload and no mechanism whose purpose is harm, in any cartridge, for any customer.
- No radio and no GPS aboard, and nothing guides on a link: silent running is the default, and the optional micro acoustic modem is never a control channel.
- Human safety comes first, on every line: the creeper goes into the water by hand from a small boat or the shore, or from the larger hull's bay, and a critical fault drops the weight and surfaces it.
- Human authority is exercised in the mission plan and the abort criteria, written before the dive.

THE CONVERSATION

BRING THE TIDE TABLE AND THE STRUCTURE. THE CREEPER IS SCOPED FROM THERE.

A first conversation needs the water, the tide and current the work is timed to, the depth band, and the thing that has to be placed, sampled or looked at. Enquiries are screened before anything is discussed.

Start a screened enquiry at cdnshield.ca/enquiries.

DOCUMENT	CDN-PROD-SPC-008 · CS-320 · Specification sheet
REVISION	R1.0 · issued 2026-09-10
WEB VERSION	cdnshield.ca/systems/water/spec-sheets/cs-320 · carries the current revision
RELATED SHEETS	CS-310 · KMM-01
ISSUED BY	Canadian Shield · cdnshield.ca