

FP-01 Conveyor Centreline Survey and Extension Set-out

Item	Detail
Document	FP-01
Revision / status	1.0 · Issued for reference
Date	09 Oct 2026
Equipment	GNSS RTK rover with Leica CS20 controller (Leica Captivate), network RTK corrections
Application	Belt conveyors in open-pit mines; C1 and C2 are generic designations
Prepared by	Milan Bogić, Mining Engineer
Site approval	To be completed by the user before site use
Centreline tolerance	As specified by site / project

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1. Safety first

Golden rules (apply at every step)

- 1. Never work alone.** At least two people in the field at all times. Without the second team member, work does not start.
- 2. Always notify** before entering and after leaving the area: control room / dispatcher, conveyor supervisor, responsible engineer. State who, where, what and for how long.
- 3. Watch the traffic around you.** When looking at the controller or doing calculations, stop in a safe place off the road and away from equipment. Never walk while looking at the screen.
- 4. Never cross over or under a conveyor.** Use designated crossovers only. Stay clear of rotating parts (idlers, pulleys, take-ups).
- 5. Keep clear of mobile equipment** (excavators, spreaders, dozers, pipe-layers, trucks). Make eye or radio contact with the operator before approaching.
- 6. Bench edges and ground.** Stay away from bench crests and slopes; avoid wet, soft or unstable ground, drains and water.
- 7. Weather.** Stop work immediately during thunderstorms: the pole and antenna attract lightning. Assess strong wind, fog and poor visibility before working.
- 8. PPE** at all times: hard hat, high-visibility clothing, safety footwear, plus eye, hand and hearing protection as required.
- 9. Stop and ask.** If anything is unclear or unsafe, stop and contact the supervisor or responsible engineer.

Hazards and controls

Hazard	Control
Running conveyor: entanglement in rotating parts	Stay clear; do not rest the pole on moving parts; survey from the outside of the structure
Crossing the conveyor	Designated pedestrian crossovers only
Falling material at transfer points and stations	Do not stand under chutes; hard hat
Vehicles and mobile equipment	High-visibility clothing; stay off roads; contact operator before approaching
Using the controller while walking	Calculations and settings only while stationary in a safe place
Bench edge, slumping ground, mud, water	Inspect ground before entering; keep away from crests; avoid drains
Thunderstorm	Stop work, shelter in vehicle, lower the pole
Lone work, loss of communication	Always in pairs; working radio; notification and sign-off
Heat / cold / long shifts	Water, rest breaks, weather-appropriate clothing

Controls are general; align them with the site's safety rules and risk assessment.

2. Purpose and scope

This procedure describes how to determine the centreline of an existing belt conveyor from a survey of its structure using a GNSS RTK rover, and how to set out the direction of the conveyor extension from the intersection with the centreline of a crossing conveyor.

- Conveyor centreline = line through the midpoints of two sections (left and right point on the same structural element).
- The crossing conveyor centreline is surveyed only to obtain the intersection point IP. IP is chainage 0.
- The extension is set out as a point on the line through IP along the centreline, at the required chainage, with zero offset.
- The crossing angle does not affect the method.
- Not covered: extensions with a change of direction, vertical control (grade), structural erection tolerances.

3. Responsibilities

Role	Responsibility
Rover operator (surveyor)	Leads the field work, measures, computes in CS20, completes the field log.
Assistant	Watches surroundings and traffic, carries equipment, marks points, second pair of eyes for safety.
Conveyor supervisor	Grants access to the conveyor area, informs on conveyor and equipment status.
Control room / dispatcher	Receives notification and sign-off, knows the team's location.
Responsible engineer	Issues the work instruction, approves the procedure for site use, decides on deviations.

4. Definitions

Term	Meaning
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C1	conveyor to be extended
C2	conveyor crossing C1
L, R	point on the structure, left / right (looking in the direction of increasing chainage)
A1, B1	section midpoints on C1 – define the C1 centreline
A2, B2	section midpoints on C2 – define the C2 centreline
IP	intersection of the C1 and C2 centrelines; chainage 0
P	set-out point of the extension at chainage d
CP	known control point
Offset	perpendicular distance from the line; 0 for the centreline
Network RTK	RTK corrections from a CORS network (e.g. national network)

5. Before going to the field

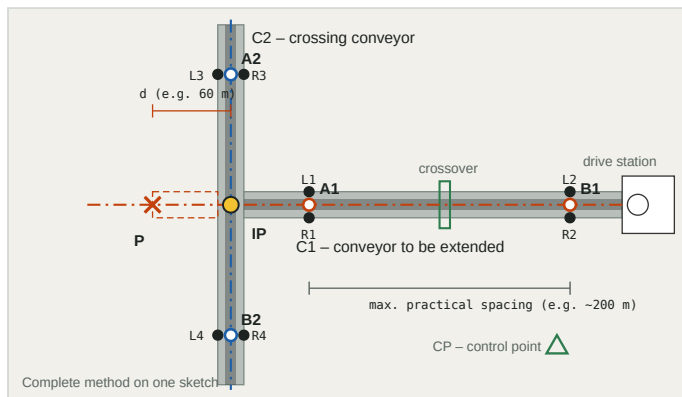
Planning

- Receive the work instruction: which conveyor, from which point, extension length, deadline. Confirm with the responsible engineer.
- Review the mine layout: positions of C1 and C2, crossovers, access road, nearby control points.
- Plan the driving route to the work area and the parking position; check the road is passable (rain, works, equipment movements).
- Plan the point sequence so conveyors are crossed as few times as possible and only at crossovers.
- Check the weather forecast (thunderstorms, strong wind, fog).
- Notify the conveyor supervisor the day before or in the morning; confirm whether the conveyor will be running or stopped.
- Prepare the control point list with coordinates and the field log.

Equipment (tick)

- ☐ GNSS RTK rover, pole with bubble, Leica CS20 controller
- ☐ Charged batteries (rover, CS20) + spares
- ☐ Network RTK access (SIM / account) active
- ☐ Two-way radio, mobile phone
- ☐ Pegs, hammer, marking paint
- ☐ Tape measure (L–R width check)
- ☐ PPE
- ☐ Field log, pen, control point list
- ☐ Water, first-aid kit in vehicle

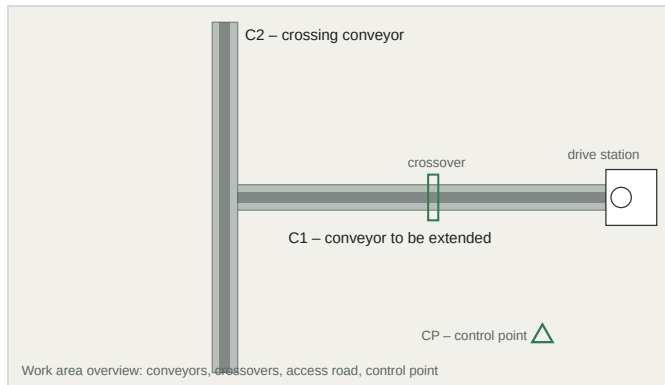
Method overview



- S0–S2: arrival, notification, rover, network RTK, control point
- S3–S5: two sections on C1 → midpoints A1, B1 → C1 centreline
- S6: same on C2 → A2, B2 → C2 centreline
- S7: centreline intersection → IP
- S8–S9: Stake to line from IP → point P, check
- S10: check, export, sign-off

6. Field procedure

S0 Arrival, notification and site assessment



Schematic sketch, not to scale.

ACTION

- Park the vehicle off the haul road and clear of mobile equipment, facing the exit.
- Notify the control room / dispatcher, the conveyor supervisor and the responsible engineer by radio: who, where, what, how long.
- Walk the work area: crossovers, transfer points, drains, bench edges, wet or soft ground.
- Agree the point sequence and walking route with the assistant so conveyors are crossed only at crossovers.

HAZARD / CAUTION

- Never work alone. If the second team member is not present, do not start.
- If the conveyor is running, stay clear of rotating parts (idlers, pulleys).

CHECK

- Notification acknowledged by the control room.
- Crossovers and hazards known to the whole team.

S1 Start-up: rover, CS20, job and network RTK

LEICA CS20 Captivate

job RTK fix · network RTK

RTK status

Home → RTK status

RTK profile	Network RTK
Solution	Fix
Coordinate system	per job
Antenna height	check
Batteries	rover / CS20

OK

Schematic CS20 (Captivate) screen. Field names indicative; may vary by software version.

ACTION

- Power on the rover and CS20 and create a new job (name: date + location).
- Check the job coordinate system and the antenna height / pole length.
- Start the network RTK profile and wait for a fixed solution (Fix).

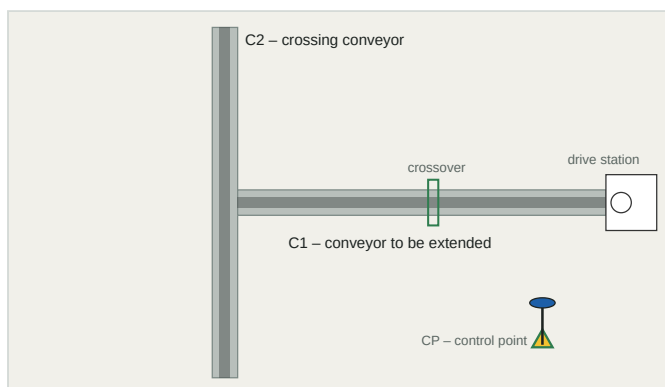
HAZARD / CAUTION

- Configure equipment while stationary in a safe place or in the vehicle, never on the road or next to the conveyor.

CHECK

- Fixed solution, precision within job limits.
- Coordinate system: as *specified by site / project*

S2 Check on a known control point (CP)



Schematic sketch, not to scale.

LEICA CS20 Captivate

job RTK fix · network RTK

Measure

Home → Measure

Point ID	CP-check
Code	CONTROL
Solution	RTK fix
ΔE / ΔN	record in field log

Measure Page

Schematic CS20 (Captivate) screen. Field names indicative; may vary by software version.

ACTION

- Measure a known control point and compare with its published coordinates.
- Record the difference in the field log.

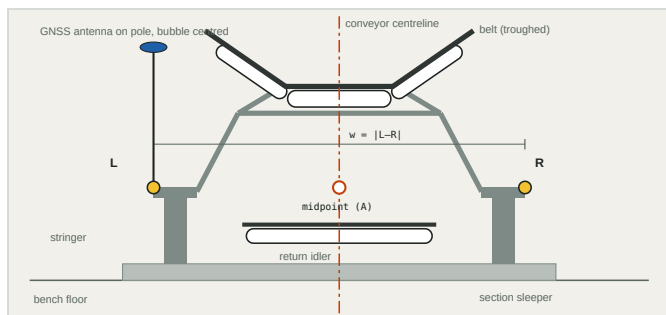
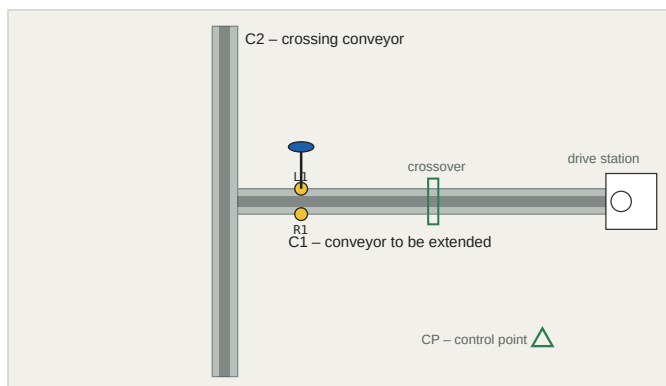
HAZARD / CAUTION

- If the difference is outside tolerance, stop: check the job, coordinate system and antenna height.

CHECK

- Allowable CP difference: as *specified by site / project*

S3 Survey section 1 on conveyor C1 (L1 and R1)



Schematic sketch, not to scale.

ACTION

- Select a structural element present on both sides (e.g. outer edge of the stringer).
- Place the pole tip on that element on the left side, pole plumb, measure L1.
- Cross to the other side at a crossover and measure the same element on the right: R1.

HAZARD / CAUTION

- Never cross over or under the conveyor. Use crossovers only.
- Do not rest the pole against moving parts.

CHECK

- Measure in Fix only.
- Record which element was surveyed.

LEICA CS20 Captivate

job RTK fix · network RTK

Measure

Home → Measure

Point ID

Code CONV

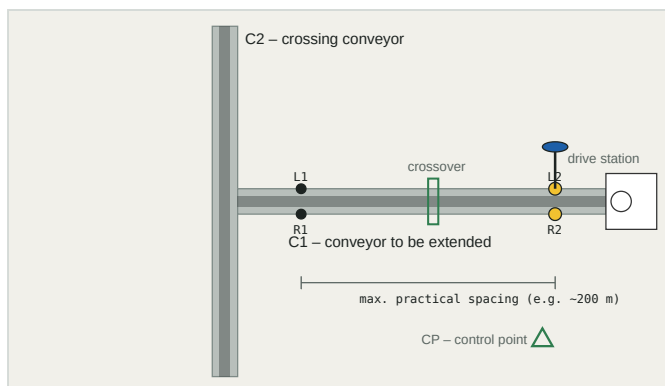
Antenna height m

Solution RTK fix

Measure					Page

Schematic CS20 (Captivate) screen. Field names indicative; may vary by software version.

S4 Survey section 2 on conveyor C1 (L2 and R2)



Schematic sketch, not to scale.

LEICA CS20		Captive	
job	RTK fix · network RTK		
Measure			
Home → Measure			
Point ID	L2		
Code	CONV		
Solution	RTK fix		
Measure			Page

Schematic CS20 (Captive) screen. Field names indicative; may vary by software version.

ACTION

- At the maximum practical distance from section 1 (e.g. ~200 m), survey the same element: L2 and R2.
- Walk along the outside of the conveyor, clear of traffic.

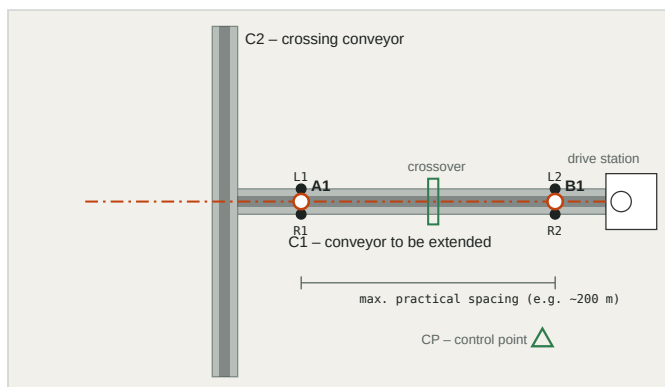
HAZARD / CAUTION

- Watch for vehicles and ancillary equipment along the alignment; keep high-visibility clothing visible.

CHECK

- L–R width at section 2 approximately equal to section 1 (same element).

S5 Midpoints A1 and B1 – centreline of C1



Schematic sketch, not to scale.

LEICA CS20		Captive	
job	RTK fix · network RTK		
COGO – Line/Arc calculations			
Home → COGO → Line/Arc calculations			
Method	Segment a line		
Start point	L1		
End point	R1		
No. of segments	2		
New point	A1		
Calc			Page

Schematic CS20 (Captive) screen. Field names indicative; may vary by software version.

ACTION

- In COGO, divide line L1–R1 into 2 segments: the midpoint is A1 (or use an equivalent midpoint function).
- Repeat for L2–R2: point B1.
- Line A1–B1 is the centreline of conveyor C1.

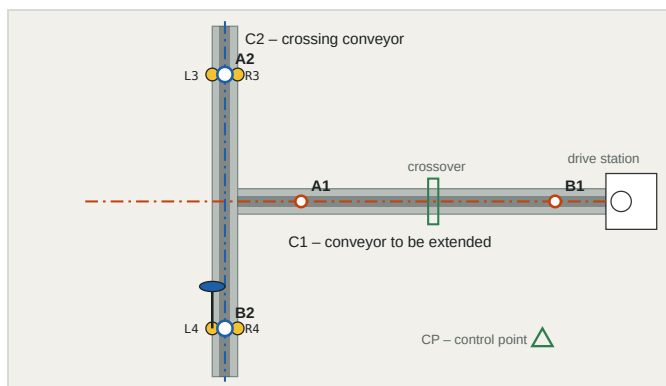
HAZARD / CAUTION

- Do calculations while stationary in a safe place. Never walk while looking at the screen.

CHECK

- A1 and B1 stored in the job.

S6 Conveyor C2: L3, R3, L4, R4 and midpoints A2, B2



Schematic sketch, not to scale.

LEICA CS20 Captivate

job RTK fix · network RTK

COGO – Line/Arc calculations

Home → COGO → Line/Arc calculations

Method	Segment a line
Start point	L4
End point	R4
No. of segments	2
New point	B2

Calc Page

Schematic CS20 (Captivate) screen. Field names indicative; may vary by software version.

ACTION

- Same method as on C1: two sections as far apart as practical.
- Midpoints: L3–R3 → A2, L4–R4 → B2. Line A2–B2 is the centreline of C2.
- The C2 centreline is used only to compute the intersection point IP.

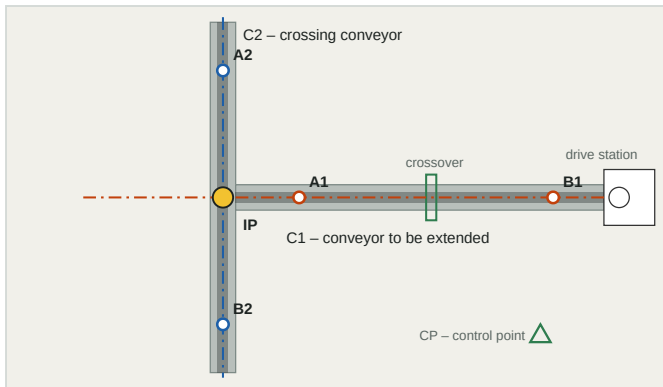
HAZARD / CAUTION

- Transfer points and stations: do not stand under transfer chutes; watch for falling material.

CHECK

- A2 and B2 stored in the job.

S7 Centreline intersection – point IP



Schematic sketch, not to scale.

LEICA CS20 Captive

job RTK fix · network RTK

COGO – Intersection

Home → COGO → Intersection

Method	Four points
Point 1	A1
Point 2	B1
Point 3	A2
Point 4	B2
New point	IP

Calc Page

Schematic CS20 (Captive) screen. Field names indicative; may vary by software version.

ACTION

- COGO → Intersection, method Four points: A1, B1 (C1 centreline) and A2, B2 (C2 centreline).
- Store the result as point IP. IP is chainage 0 for the extension.

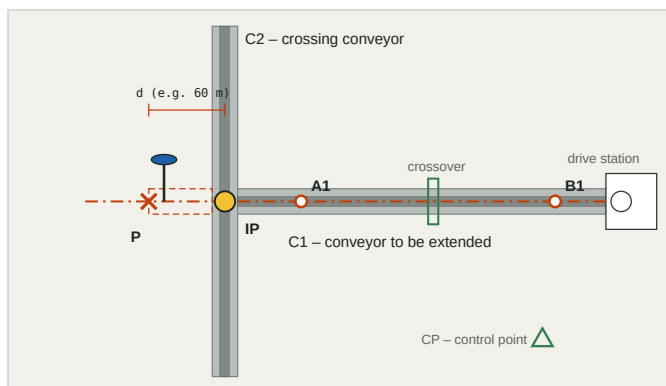
HAZARD / CAUTION

- The crossing angle does not matter; IP is the intersection of two lines at any angle.

CHECK

- IP stored.
- On the ground IP lies on the C2 centreline, in line with the C1 centreline (visual check).

S8 Set-out: Stake to line from IP



Schematic sketch, not to scale.

LEICA CS20 Captivate

job RTK fix · network RTK

Stake to line

Home → Stake to line

Line start	IP
Line end	B1
Chainage	-60.000
Offset	0.000
Δ chainage	EXAMPLE
Δ offset	EXAMPLE

Measure Page

Schematic CS20 (Captivate) screen. Field names indicative; may vary by software version.

ACTION

- Define the line from IP through B1 (C1 centreline direction).
- Enter chainage d and offset 0. If the extension lies on the side opposite to B1, the chainage is negative (e.g. -60 m).
- Guide the rover until Δ chainage and Δ offset are zero, then mark point P (peg, paint).

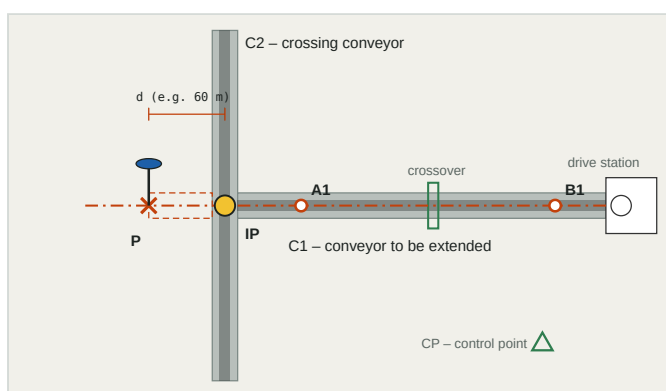
HAZARD / CAUTION

- The extension corridor is often unprepared ground: check ground conditions, bench edges, water and drains before entering.

CHECK

- Extension length and intermediate points: as specified by site / project

S9 Check of the marked point



Schematic sketch, not to scale.

LEICA CS20 Captivate

job RTK fix · network RTK

Measure to line

Home → Measure to line

Line	IP → B1
Measured point	P
Chainage	EXAMPLE
Offset	EXAMPLE

Measure Page

Schematic CS20 (Captivate) screen. Field names indicative; may vary by software version.

ACTION

- Re-measure the marked point relative to the line.
- Record chainage and offset in the field log.

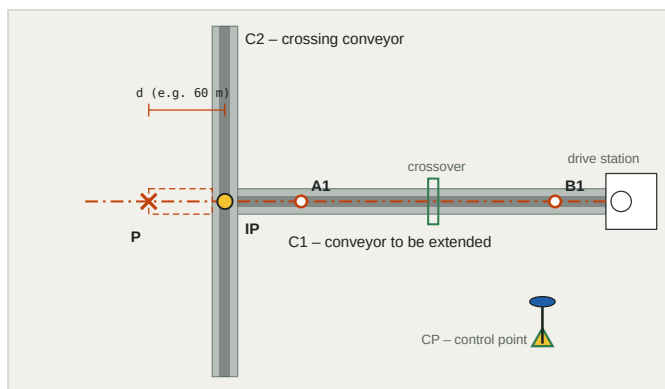
HAZARD / CAUTION

- Before driving a peg, confirm there are no buried cables (conveyor power and signal cables).

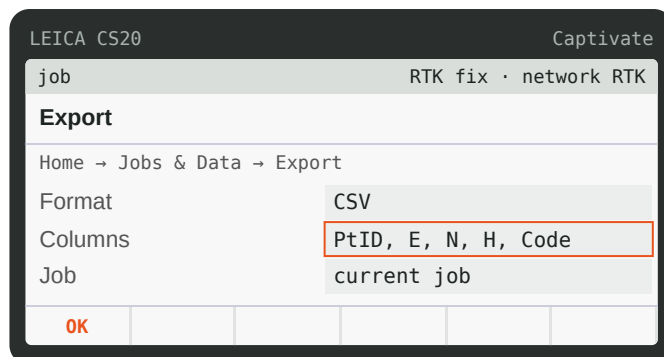
CHECK

- Allowable offset: as specified by site / project

S10 Close-out: check, export, sign-off



Schematic sketch, not to scale.



Schematic CS20 (Captivate) screen. Field names indicative; may vary by software version.

ACTION

- Re-measure control point CP and record the difference.
- Export points to CSV and save the job.
- Notify the control room and the supervisor that work is complete and the team has left the area.

HAZARD / CAUTION

- Sign-off is mandatory: without it nobody knows the team has left safely.

CHECK

- Field log completed.
- Photos of the marked point and, where possible, the CS20 screen.

7. Quality checks before leaving site

- ☐ CP check at start and end, differences recorded.
- ☐ All points measured in Fix.
- ☐ L–R width equal on both sections of the same conveyor (same element).
- ☐ A1, B1, A2, B2, IP stored in the job.
- ☐ Marked point P re-measured; offset recorded.
- ☐ Visual check: pegs in line with the conveyor centreline.
- ☐ Photos: marked point, structure, CS20 screen.
- ☐ CSV + job exported.
- ☐ Sign-off to control room and supervisor.

Acceptance limits (CP difference, L–R width, offset of P): as specified by site / project.

8. Processing and handover

- Save CSV (PtID, E, N, H, Code) and the job in the job folder (date + location).
- Include the completed field log and photos.
- Hand over to the responsible engineer in the format required by site.

9. Common errors

Error	Consequence
L and R on different structural elements	centreline shifted
Sections too close together	direction error grows towards the end of the extension
Only 2 sections per conveyor	no check that the conveyor is straight; equal L–R width is the control
Wrong chainage sign (+/–)	point P on the wrong side of IP
Pole not plumb, wrong antenna height	wrong L/R coordinates
Measuring in Float or next to steelwork without checking	coordinate jumps
Wrong coordinate system in the job	mismatch with other mine data

10. Revision history

Rev.	Date	Description
1.0	09 Oct 2026	First issue

Reference: Leica Captivate Technical Reference Manual (COGO; Measure to line / Stake to line).

11. Field log (appendix)

Date	Team	C1 (ID)	C2 (ID)	Coord. system	Rover / CS20

Point	E	N	H	Fix (Y/N)	Note (element, Δ , offset)
CP (start)					
L1					
R1					
L2					
R2					
A1					
B1					
L3					
R3					
L4					
R4					
A2					
B2					
IP					
P					
CP (end)					

Check	Value
Width L1–R1 / L2–R2	
Width L3–R3 / L4–R4	
Chainage d and offset of P	
CP difference start / end	
Notification / sign-off (time)	