



THE METROLOGIST

SUBSEA SPOOL METROLOGY

User Manual

Hub-to-hub metrology for spools and jumpers,
with PASS / FAIL checks and PDF reports

Version 1.0

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1 Introduction

The **Metrologist** works out the information needed to make a spool or jumper between two subsea hubs from an acoustic (LBL) metrology survey. From the field data it calculates:

- the horizontal distance between the two hubs' metrology reference points;
- the difference in height (ΔZ) between them, from Digiquartz (DQZ) level loops;
- the heading of each hub, from a gyro docked in the hub at several rotations;
- the pitch and roll of each hub, from inclinometers at several rotations, so that sensor offsets cancel;
- the angles α and β between each hub's heading and the line between the hubs, and each hub's attitude along and across that line;
- the seabed profile along the route and each hub's height above the seabed;
- an independent direct-range distance as a check on the LBL positions.

The program follows the order of a typical metrology task plan. Each step explains what to collect offshore and what to enter, checks the results against your limits (PASS / FAIL), and finishes with a PDF report.

2 Getting started

2.1 What you need

- A Windows PC.
- The program file, **TheMetrologist.exe**. Nothing else needs to be installed.

2.2 Installing and starting

Copy **TheMetrologist.exe** into a folder of your choice and double-click it. There is no installer. You can also drag a project file onto the program's icon to open it.

Note

The first time you start the program, Windows may show a **Windows protected your PC** message. Click **More info**, then **Run anyway**.

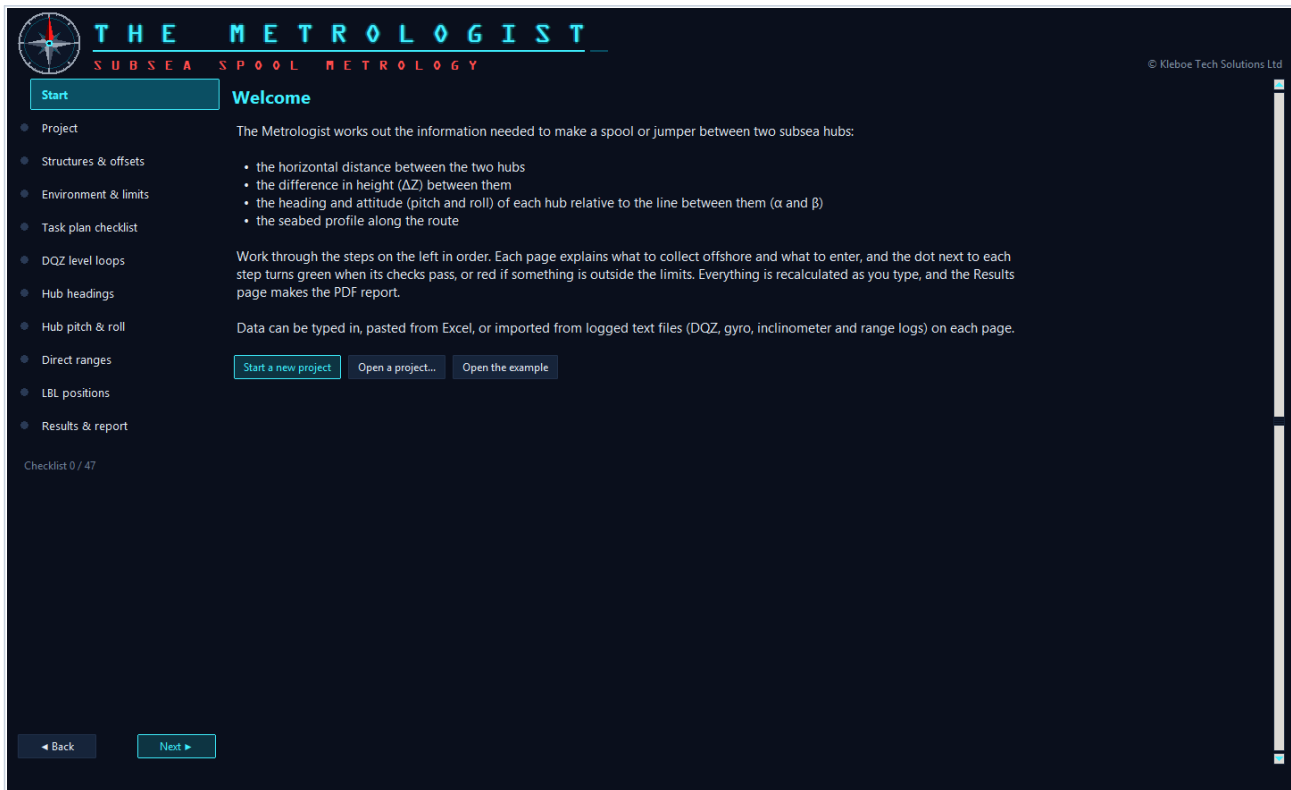
2.3 Projects

All the data for one metrology is kept in a project file (**.metrology**). Use the File menu to start a **New project** (Ctrl+N), **Open** one (Ctrl+O) and **Save** it (Ctrl+S). The Start page also has **Open the example**, a complete project with made-up data that shows every step filled in. The screenshots in this manual are of the example.

Tip

To open **.metrology** files with a double-click, right-click one, choose **Open with > Choose another app**, pick **TheMetrologist.exe** and tick **Always use this app**.

3 The main window



The Start page. The steps are listed down the left.

- **Steps** down the left, in the order of the task plan. The dot beside each step is green when its checks pass, red when something is outside a limit, amber when partly done, and grey when it has no data yet. **Back** and **Next** move through them in order.
- **Summary** under the steps: distance, ΔZ , α , β , how many checks pass and how much of the checklist is done.
- **Guide** at the top of each page: what to collect offshore and what to enter.
- **Menus**: File (projects and the PDF report), Go to (any step) and Help.
- **Project** name and spool ID at the top right, once entered.

Everything is recalculated as you type, so results appear as soon as there is enough data.

4 Entering data

4.1 Tables

To	Do this
Edit a cell	Double-click it (or select a row and press Enter), type, then press Enter or Tab. Esc cancels. Role and type columns give a list to choose from.
Add a row	Add adds to the end, Insert adds above the selected row.
Remove or reorder	Delete , Up and Down act on the selected row.
Bring in many rows	Paste rows takes rows copied from Excel or a text file, filling the columns in the order shown.

Columns in cyan after the ones you type are calculated by the program.

4.2 Readings

Each loop station, gyro docking, inclinometer position and range set can hold either a typed mean value or all of its logged readings. Select the row and click **Readings...** (or the travel-time buttons on the ranges page) to see the readings with their mean, standard deviation and duration, and to **Import file...**, **Paste** or **Clear** them. When readings are present their mean is used; otherwise the typed value is used.

Readings used for this set. Import them from a logged text file, paste columns copied from Excel, or clear them to type a mean value instead.

Time	Heading	Pitch	Roll
08:41:00	128.5730	0.8630	-0.4290
08:41:01	128.6000	0.8470	-0.4230
08:41:02	128.6270	0.8520	-0.4200
08:41:03	128.5920	0.8610	-0.4200
08:41:04	128.5880	0.8400	-0.4240
08:41:05	128.5570	0.8370	-0.4350
08:41:06	128.5210	0.8480	-0.4220
08:41:07	128.5600	0.8510	-0.4330
08:41:08	128.5680	0.8520	-0.4120
08:41:09	128.5450	0.8460	-0.4400
08:41:10	128.5550	0.8280	-0.4340
08:41:11	128.6030	0.8280	-0.4120
08:41:12	128.5800	0.8470	-0.4150
08:41:13	128.5860	0.8600	-0.4220
08:41:14	128.5520	0.8440	-0.4300
08:41:15	128.5690	0.8420	-0.4090
08:41:16	128.5140	0.8390	-0.4300
08:41:17	128.5070	0.8690	-0.4440
08:41:18	128.5620	0.8450	-0.4030
08:41:19	128.5100	0.8610	-0.4370

300 readings · duration 0:04:59 · Heading: mean 128.5682 sd 0.0283 · Pitch: mean 0.8488 sd 0.0099 · Roll: mean -0.4250 sd 0.0150

Import file... Paste Clear Close

Five minutes of gyro readings for one docking, with the mean, standard deviation and duration.

4.3 Importing logged files

The import window reads text logs in columns (comma, tab, semicolon or space separated, and NMEA-style lines with a time in front).

1. Check the preview. Change the **Separator** or **Skip first lines** if the columns don't line up.
2. If the log mixes several kinds of line, type text that only the wanted lines contain in **Only lines containing** (for example \$HEHDT) and click **Apply**.
3. Under **Columns**, choose which column holds each value. The program guesses these for you.
4. To take one docking or one station out of a long log, enter a **Time window**.
5. Click **Import**. Rows where a required value isn't a number are skipped.

5 Step by step

5.1 Project

The client, project, location, vessel, spool ID, a from-to description, the date, the task plan reference and the people who prepared, checked and approved the work. These appear on the report, with any comments typed in the box below.

5.2 Structures and offsets

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SUBSEA SPOOL METROLOGY

EXAMPLE-01 · J-01 jumper
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Start

- Project
- Structures & offsets**
- Environment & limits
- Task plan checklist
- DQZ level loops
- Hub headings
- Hub pitch & roll
- Direct ranges
- LBL positions
- Results & report

Distance: 38.407 m
 $\Delta Z = +0.419$ m
 $\alpha = 36.12^\circ$
 $\beta = -32.79^\circ$
21 checks pass, 0 fail
Checklist 0 / 47

Structures, COMPATTs and offsets

GUIDE
Structure A is the upstream hub and structure B the downstream hub. For each, enter the COMPATT on the hub receptacle and the offset from the receptacle base plate to the top of the transducer (negative = transducer above). The metrology reference point (usually the hub / flange face) is given relative to the receptacle from the dimensional control: X across, Y along the structure heading, Z down. Add the other array COMPATTs (seabed frames, other receptacles) with their offsets so their depths can be found from the loops.

STRUCTURE A (upstream)

Structure name	MAN-1
Hub / receptacle	Hub
Met ref point	Hub face e.g. hub face
COMPATT address	2401
Receptacle to TDCR (m)	-0.95 -ve = transducer above
Met ref point X (m)	0 across, +stbd
Met ref point Y (m)	0 along heading
Met ref point Z (m)	0.25 +ve down
Receptacle yaw (*)	0 to structure
Receptacle pitch (*)	0 to structure
Receptacle roll (*)	0 to structure
Met ref point yaw (*)	0 to structure
Met ref point pitch (*)	0 to structure
Met ref point roll (*)	0 to structure

STRUCTURE B (downstream)

Structure name	MAN-2
Hub / receptacle	Hub
Met ref point	Hub face e.g. hub face
COMPATT address	2402
Receptacle to TDCR (m)	-0.95 -ve = transducer above
Met ref point X (m)	0 across, +stbd
Met ref point Y (m)	0 along heading
Met ref point Z (m)	0.25 +ve down
Receptacle yaw (*)	0 to structure
Receptacle pitch (*)	0 to structure
Receptacle roll (*)	0 to structure
Met ref point yaw (*)	0 to structure
Met ref point pitch (*)	0 to structure
Met ref point roll (*)	0 to structure

DQZ
DQZ tooling offset (m) 0.15 +ve down: from the DQZ sensor reference to the base of its frame / stab

OTHER ARRAY COMPATTs (seabed frames, other receptacles)

Name	Address	Offset to TDCR (m)
Seabed Frame #1	2403	-0.9
Seabed Frame #2	2404	-0.9

◀ Back Next ▶

Structures, COMPATTs and offsets.

Structure A is the upstream hub and structure B the downstream hub. For each:

Setting	Meaning
COMPATT address	The transponder in the hub's metrology receptacle.
Receptacle to TDCR (m)	From the receptacle base plate (stab) to the top of the transducer, measured on deck. Negative = transducer above.
Met ref point X / Y / Z (m)	The metrology reference point (usually the hub or flange face) relative to the receptacle, from the dimensional control: X across (+ starboard), Y along the structure heading, Z down.
Receptacle yaw / pitch / roll	How the receptacle sits relative to the structure.
Met ref point yaw / pitch / roll	How the reference point sits relative to the structure.

The DQZ tooling offset is from the Digiquartz sensor's reference to the base of its frame (positive down). Add the other array COMPATTs (seabed frames, other receptacles) with their offsets, so their depths can be found from the loops.

5.3 Environment and limits

Setting	Used for
Latitude, longitude, central meridian	Local gravity (with the depth) and the grid convergence. Either can be typed instead.
Mean density, sound velocity	From the processed CTD / SV profile. Density turns DQZ pressure into depth; the velocity is a default for the ranges.
Gyro output, gyro C-O	Whether the gyro gives true or grid heading, and the C-O from the deck calibration (added to every heading).
Limits	The PASS / FAIL limits (appendix A).
Sensor accuracy	Used for the error budget (section 6.4).
Design values	Optional expected distance, ΔZ and headings, to catch gross errors.
Height above seabed	Altimeter clearances, used when there is no seabed station in the loops.

5.4 Task plan checklist

The checklist follows a typical task plan: deck preparation, subsea preparation, hub headings, level loops, hub attitude and direct ranges, the array calibration and post-metrology. Tick each task as it is done and add notes. It is saved with the project.

5.5 DQZ level loops



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EXAMPLE-01 · J-01 jumper

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Start

Project

Structures & offsets

Environment & limits

Task plan checklist

DQZ level loops

Hub headings

Hub pitch & roll

Direct ranges

LBL positions

Results & report

Distance: 38.407 m

$\Delta Z = 0.419$ m

$\alpha = 36.12^\circ$

$\beta = 32.79^\circ$

21 checks pass, 0 fail

Checklist 0 / 47

Loop 1 - Array loop

New loop...

Duplicate

Delete loop

Loop name: Loop 1 - Array loop

Type: array

DQZ data: dBar

GUIDE

For each loop, list the stations in the order visited, starting and finishing on the same benchmark (normally hub A). Enter the mean DQZ and atmospheric readings and the time at each station, or click Readings... to import all of the logged readings for a station. Mark each station's role so its offsets are used: hub A / hub B receptacle, another COMPATT, seabed below a hub, or a profile point (add its distance along the route from hub A). The misclosure is spread over the loop by time; loops are tied together on the first loop's benchmark.

Loop settings

Loop name: Loop 1 - Array loop

Type: array

DQZ data: dBar

STATIONS (in the order visited, back to the start)

Station	Role	Dist. (m)	Time	DQZ obs.	Atmos. (dBar)	n	Depth	Corr.	Adjusted	TDCR
MAN-1 Hub	Hub A - MAN-1		08:05:00	1521.1253	10.1314		1502.850	0.0000	1503.000	1502
Seabed Frame #1	COMPATT - Seabed Frame #1		08:08:17	1524.1447	10.1311		1505.853	-0.0072	1505.996	1505
MAN-2 Hub	Hub B - MAN-2		08:12:00	1521.5591	10.1309		1503.282	-0.0153	1503.416	1502
Seabed Frame #2	COMPATT - Seabed Frame #2		08:15:45	1524.4661	10.1306		1506.173	-0.0234	1506.300	1505
MAN-1 Hub	Hub A - MAN-1		08:19:25	1521.1563	10.1308		1502.881	-0.0314	1503.000	1502

Add

Insert

Delete

Up

Down

Paste rows

Readings...

Misclosure -0.0314 m (limit 0.05 m) · duration 0:14:25 · PASS

ALL LOOPS COMBINED

Station	Loops	Measure point depth	Spread	TDCR depth	Relative to benchmark
MAN-1 - Hub	4	1503.000	0.0000	1502.050	0.000
Seabed Frame #1	1	1505.996	0.0000	1505.096	2.996
MAN-2 - Hub	4	1503.416	0.0076	1503.460	0.419

An array loop with its calculated depths, and all loops combined below.

Each loop is a list of stations in the order visited, starting and finishing on the same benchmark (normally hub A). Click **New loop...** and choose its type; the stations are filled in from the task plan, ready to edit:

Type	Stations	Limit
Array loop	Hub A, the other COMPATTs, hub B, hub A	Loop limit
Hub loop (incl. seabed)	Hub A, seabed below A, seabed below B, hub B, hub A	Loop limit

Type	Stations	Limit
Seabed profile	Hub A, seabed, every 5 m along the route, hub B, hub A	Profile limit
Hub to hub	Hub A, hub B, hub A	Loop limit

For each station enter the time, the mean DQZ reading and the atmospheric reading (or import the readings). The **Role** tells the program which offsets to use:

Role	Meaning
Hub A / Hub B	The DQZ on the hub receptacle; gives the hub's depths.
COMPATT - ...	On another COMPATT's measure point; gives its transducer depth.
Seabed below hub A / B	Gives each hub's height above the seabed and anchors the profile.
Profile point / other	A seabed point along the route; enter its distance from hub A.

Below the stations the program shows the misclosure and duration with PASS / FAIL. **All loops combined** lists every station's depth averaged over the loops it appears in, the spread between loops, and its transducer depth.

5.6 Hub headings

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EXAMPLE-01 · J-01 Jumper
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Distance: 38.407 m
ΔZ: -0.419 m
α: 36.12°
β: -32.79°

21 checks pass, 0 fail
Checklist 0 / 47

Hub headings (gyro)

GUIDE
Dock the gyro in the hub receptacle in direction A and log about 5 minutes, then rotate 90° clockwise each time (or use towards / away dockings at 180°) and finish back in direction A. Each docking's mean heading less its rotation gives direction A. Import the logged headings (and pitch / roll if you want them for the attitude) with Readings..., or type the mean heading.

Docking	Rotation from A (°)	Mean heading (typed)	Readings	Mean	Std dev	Direction A (grid)	Deviation
Direction A	0	128.57		128.570		128.522	0.098
Rotated 90	90	218.44		218.440		128.392	-0.032
Rotated 180	180	308.39		308.390		128.342	-0.082
Rotated 270	270	38.47		38.470		128.422	-0.002
Back to direction A	0	128.49		128.490		128.442	0.018

Add Insert Delete Up Down Paste rows Readings... Task plan sets (A, 90, 180, 270, A) Towards / away / towards

Receptacle heading 128.424° grid · structure 128.424° · met ref point 128.424°
Spread 0.180° · misclosure -0.080° · convergence 0.1976°, C-O 0.150° · PASS

Back Next

Five gyro dockings on hub A, each giving an estimate of direction A.

The gyro is docked in the hub receptacle in direction A, then turned clockwise between dockings. Enter each docking's rotation from direction A and its mean heading, or import the readings. Two buttons fill in the usual sequences:

- **Task plan sets:** direction A, 90°, 180°, 270° and back to direction A;
- **Towards / away / towards:** three dockings at 180°, 0° and 180°.

Each docking gives an estimate of direction A. The program shows the spread between them and the misclosure between the first and last dockings when both are at the same rotation.

5.7 Hub pitch and roll

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EXAMPLE-01 · J-01 jumper
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Start

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- Hub pitch & roll**
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- Results & report

Distance 38.407 m
 ΔZ -0.419 m
 α 36.12°
 β -32.79°

21 checks pass, 0 fail
Checklist 0 / 47

Hub pitch and roll

GUIDE
Pitch and roll of each receptacle from the hub COMPATT inclinometers (or the gyro), taken at several rotations of the COMPATT in the receptacle (A, B, C, D). Each position is turned back to direction A so the sensor's own offsets cancel. Pitch is positive with the direction A side up; roll is positive with the starboard side down.

Hub A Hub B

Sensor TQI COMPATT

Position	Rotation from A (°)	Pitch (typed)	Roll (typed)	Readings	Mean pitch	Mean roll	Pitch dir. A	Roll dir. A
Position A	0	0.901	-0.43		0.901	-0.430	0.901	-0.430
Position B	90	-0.346	-0.877		-0.346	-0.877	0.877	-0.346
Position C	180	-0.805	0.368		-0.805	0.368	0.805	-0.368
Position D	270	0.459	0.814		0.459	0.814	0.814	-0.459

Add Insert Delete Up Down Paste rows Readings... Positions A-D Positions A / B Copy from gyro dockings

Receptacle pitch -0.849°, roll -0.401° · tilt 0.939° towards 333.7° grid
Spread between positions: pitch 0.096°, roll 0.113° · sensor offset pitch -0.052°, roll -0.031°
Met ref point pitch -0.849°, roll -0.401° (to its heading) · PASS

◀ Back Next ▶

Pitch and roll from an inclinometer in four positions.

The inclinometer COMPATT (or the gyro) is placed in the receptacle at several rotations, for example positions A to D at 0°, 90°, 180° and 270°. Each position is turned back to direction A and averaged. Because the sensor turns with the COMPATT, its own zero offset cancels; the program reports it when the positions balance out. **Copy from gyro dockings** uses the pitch and roll logged with the headings instead.

Note

Pitch is positive with the direction A side up; roll is positive with the starboard side down. Confirm the sensor's axes and signs on deck before deployment.

5.8 Direct ranges

Ranges between the two hub COMPATTs, both ways, in each rotation position. Enter the sound velocity and turn-around time (TAT, ms) for each direction and import or paste the two-way travel times, or type the mean slant ranges. The program reduces the mean slant range to horizontal with the transducer depths from the loops and corrects it for the tilt of each COMPATT. The result is a receptacle-to-receptacle distance to compare with the LBL distance.

5.9 LBL positions

Enter the calibrated LBL positions of the hub COMPATT transducers (and the other array COMPATTs) from the array calibration report, with its overall RMS and unit variance. USBL positions can be entered and used instead as a contingency. The table at the bottom lists the DQZ transducer depths to enter as manual depth measurements in the array calibration.

6 Results



The Results page of the example: the result tiles, the plan view and the seabed profile.

6.1 Summary

Tiles across the top show the horizontal distance, ΔZ (positive when hub B is deeper), the bearing from A to B, α, β and the checks. The **Hubs** table gives each hub's heading, pitch and roll, attitude along and across the bearing, depth, position and height above the seabed.

6.2 Plan view, α and β

The plan view shows the hubs, their headings, the line between them, and the other COMPATTS.

Angle	Definition
α	Hub A heading minus the bearing from A to B
β	The bearing from B to A minus hub B heading

Both are given between -180° and +180°, so the sign shows which side of the line the hub points.

6.3 Seabed profile

The depth of each profile point below hub A's reference point, against its distance along the route. Remaining differences at hub B are spread over the loop in time.

6.4 Checks and error budget

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EXAMPLE-01 - J-01 jumper
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Start

- Project
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Distance 38.407 m
 ΔZ -0.419 m
 α 36.12°
 β -32.79°
21 checks pass, 0 fail
Checklist 0 / 47

	Hub A	Hub B
Name	MAN-1 - Hub	MAN-2 - Hub
Met ref point heading (grid)	128.424 °	305.092 °
Pitch / roll (to hub heading)	0.849 / -0.401	-0.299 / 0.623
Pitch along / roll across bearing	0.450 / -0.824	-0.086 / -0.686
Met ref point depth	1503.250 m	1503.668 m
Met ref point easting	745049.996	745088.372
Met ref point northing	1141730.001	1141728.459
Height above seabed	2.85 m	3.00 m
Direct-range distance (receptacles)	38.400 m	

CHECKS

Check	Value	Limit	Result
Loop misclosure - Loop 1 - Array loop	-0.031 m	0.050 m	PASS
Loop duration - Loop 1 - Array loop	14.417 min	30.000 min	PASS
Loop misclosure - Loop 2 - Hub loop	-0.022 m	0.050 m	PASS
Loop duration - Loop 2 - Hub loop	11.983 min	30.000 min	PASS
Loop misclosure - Loop 3 - Seabed profile	-0.045 m	0.250 m	PASS
Loop duration - Loop 3 - Seabed profile	21.433 min	30.000 min	PASS
Loop misclosure - Loop 4 - Hub to hub	-0.014 m	0.050 m	PASS
Loop duration - Loop 4 - Hub to hub	6.800 min	30.000 min	PASS
Heading spread - MAN-1	0.180 °	0.500 °	PASS
Heading misclosure - MAN-1	-0.080 °	0.500 °	PASS

ERROR BUDGET (estimated)

Quantity	1 σ	2 σ ($\approx$ 95 %)	Based on
ΔZ (B - A)	0.015 m	0.029 m	DQZ accuracy at both hubs and the spread between loops
Horizontal distance	0.030 m	0.060 m	position accuracy of both hubs (LBL RMS) and agreement with the direct ranges
Hub-to-hub bearing	0.0443 °	0.0886 °	position accuracy across the line between the hubs
Hub A heading	0.1043 °	0.2087 °	gyro accuracy and the scatter between dockings
α	0.1133 °	0.2267 °	hub A heading and the bearing
Hub A pitch / roll	0.0754 °	0.1509 °	inclinometer accuracy and the spread between positions
Hub B heading	0.1030 °	0.2060 °	gyro accuracy and the scatter between dockings
β	0.1121 °	0.2243 °	hub B heading and the bearing

◀ Back Next ▶

Lower on the Results page: the hubs table, the checks and the error budget.

Checks lists every PASS / FAIL test: loop misclosures and durations, heading spread and misclosure, pitch / roll spread, range spread, the LBL RMS and unit variance, and the comparison with the design values. The **error budget** combines the sensor accuracies with the scatter of the observations into an estimated 1 σ and 2 σ (about 95 %) for ΔZ , distance, bearing, headings, α , β and pitch / roll. It is an estimate to support the agreed tolerances, not a formal error analysis.

7 The PDF report

Click **Create PDF report...** at the bottom of the Results page (or **File > Create PDF report**, Ctrl+R). Untick any detail tables you don't want. The report contains:

- the job details and the results;
- the quality checks with PASS / FAIL;
- the plan view and seabed profile;
- the error budget and comparison with design;
- the level loops, headings, pitch / roll and range tables;
- positions, parameters and offsets, comments and a sign-off box.

SPOOL METROLOGY REPORT

EXAMPLE-01 · J-01 jumper

Spool Metrology Report

MAN-1 hub to MAN-2 hub

Client	Example Client	Project	EXAMPLE-01
Location	Example Field	Vessel	MV Example
Spool / jumper	J-01 jumper	Date	17/10/2026
Task plan	Example data (made up)	Report date	20/10/2026

1 Results

Result	Value	Notes
Horizontal distance, met ref point A to B	38.407 m	From calibrated LBL positions
ΔZ, met ref point B - A (+ = B deeper)	0.419 m	From the DQZ level loops
3D distance, met ref point A to B	38.409 m	
Bearing A → B (grid)	92.30 °	
α (hub A heading - bearing A→B)	36.12 °	
β (bearing B→A - hub B heading)	-32.79 °	
Horizontal distance from direct ranges (receptacles)	38.400 m	Differs from LBL by -0.009 m

Hub	MAN-1	MAN-2
Hub / receptacle	Hub	Hub
Met ref point	Hub face	Hub face
Met ref point heading (grid)	128.42 °	305.09 °
Pitch (relative to hub heading)	0.849 °	-0.299 °
Roll (relative to hub heading)	-0.401 °	0.623 °
Pitch along the bearing A→B	0.450 °	-0.086 °
Roll across the bearing A→B	-0.824 °	-0.686 °
Tilt / tilt direction (grid)	0.939 ° / 333.68 °	0.691 ° / 9.43 °
Met ref point depth	1,503.250 m	1,503.668 m
Met ref point easting	745,049.996	745,088.372
Met ref point northing	1,141,730.001	1,141,728.459
Height above seabed	2.85 m	3.00 m

Pitch is positive bow (heading direction) up; roll is positive starboard down, as observed by the inclinometers. Headings are grid, corrected for the gyro C-O and grid convergence.

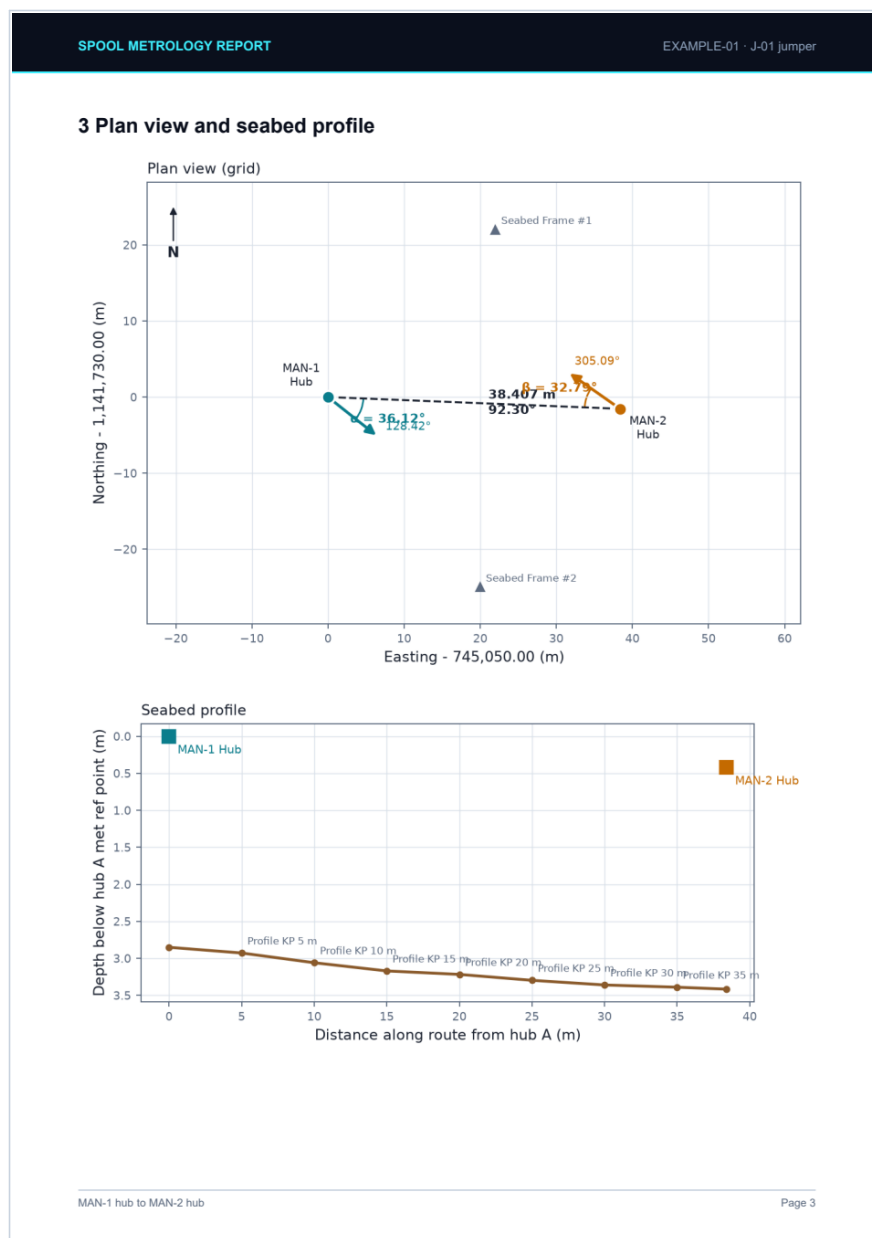
2 Quality checks

Check	Value	Limit	Result
Loop misclosure - Loop 1 - Array loop	-0.031 m	0.050 m	PASS
Loop duration - Loop 1 - Array loop	14.417 min	30.000 min	PASS
Loop misclosure - Loop 2 - Hub loop	-0.022 m	0.050 m	PASS
Loop duration - Loop 2 - Hub loop	11.983 min	30.000 min	PASS
Loop misclosure - Loop 3 - Seabed profile	-0.045 m	0.250 m	PASS
Loop duration - Loop 3 - Seabed profile	21.433 min	30.000 min	PASS
Loop misclosure - Loop 4 - Hub to hub	-0.014 m	0.050 m	PASS
Loop duration - Loop 4 - Hub to hub	6.800 min	30.000 min	PASS
Heading spread - MAN-1	0.178 °	0.500 °	PASS
Heading misclosure - MAN-1	-0.078 °	0.500 °	PASS
Pitch / roll spread - MAN-1	0.113 °	0.300 °	PASS

MAN-1 hub to MAN-2 hub

Page 1

The first page of the example's report.



The plan view and seabed profile page.

8 How the results are calculated

8.1 Depths

$$\text{depth} = (P - P_{\text{atm}}) \times 10000 / (g \times \rho)$$

with P and P_{atm} in dBar ($\text{psi} \times 0.6894757$), ρ the mean density and g the local gravity:

$$g = 9.780318 \times (1 + (5.2788 \times 10^{-3} + 2.36 \times 10^{-5} \sin^2 \phi) \sin^2 \phi) + 1.092 \times 10^{-6} \times \text{depth}$$

The misclosure (first reading minus last at the benchmark) is spread over the loop in proportion to time, which removes a steady tide. Adding the DQZ offset gives the measure point depth; adding the receptacle-to-TDCR offset gives the transducer depth. Every loop is shifted onto the first loop's benchmark and the stations are averaged.

8.2 Headings

$$\text{direction } A = \text{docking heading} - \text{rotation} - \text{convergence (if true)} + C-0$$

with convergence = (longitude – central meridian) × sin(latitude). The dockings are averaged as angles. The structure heading is the receptacle heading less the receptacle yaw, and the reference point heading adds the reference point yaw.

8.3 Pitch and roll

$$\text{pitch}_A = p \cos \theta - r \sin \theta \quad \text{roll}_A = p \sin \theta + r \cos \theta$$

for a position rotated θ clockwise from direction A. The averages give the receptacle pitch and roll, the total tilt ($\arccos(\cos p \times \cos r)$) and its direction. These are corrected to the structure and the reference point with the dimensional control angles.

8.4 Positions and ranges

The receptacle position is the transducer position less the horizontal displacement caused by the tilt over the receptacle-to-TDCR offset. The reference point adds the dimensional control offsets, rotated by the structure heading and tilt. Each slant range is $(\text{TWTT} - \text{TAT}) / 2000 \times \text{SV}$, reduced to horizontal with the transducer depth difference.

9 Trial and licence

The program runs as a free 48-hour trial with everything working. The bar under the title shows how long is left:

FREE TRIAL · 47 h 58 min left of your 48-hour trial

Buy the licence...

Enter licence key...

The trial bar.

After that it needs a Survey Software Utilities licence key: click **Enter licence key...**, paste the key from the email and click **Activate**. One key unlocks every Survey Software Utilities program on the PC, on up to 4 PCs. With a licence the bar goes, and the window title shows **Licensed until** and the date. The licence is checked online now and then and works for up to 30 days at a time without internet.

10 Troubleshooting

Problem	What to check
A loop fails its misclosure	Stations in the wrong order, the last benchmark row missing, a wrong unit (dBar / psi / m), or a missing atmospheric value.
ΔZ or depths out by centimetres	The DQZ offset, the met ref point Z, and that each station has the right role.
Headings out by a fraction of a degree	Gyro output true / grid, the C-O, and the latitude, longitude and central meridian (convergence).
Heading misclosure large	A docking with the wrong rotation, or the gyro not seated; repeat the sequence.
Pitch / roll spread large	Wrong rotations, or the sign convention of the sensor axes.
Plan view empty	Both hub LBL (or USBL) positions are needed.
Import finds no rows	Check the separator, the column choices, the line filter and the time window.
Results show —	Some data needed for that result has not been entered yet.

Appendix A: default limits

Check	Default	Check	Default
Loop misclosure	0.05 m	Heading misclosure	0.5°
Profile loop misclosure	0.25 m	Heading spread	0.5°
Loop duration	30 min	Pitch / roll spread	0.3°
Range spread	0.05 m	LBL RMS	0.05 m
Unit variance	0.8 – 1.2		

All limits can be changed on the Environment & limits page, and are saved with the project.

Keyboard shortcuts

Keys	Command
Ctrl+N / Ctrl+O / Ctrl+S	New, open and save project
Ctrl+R	Create PDF report
Double-click / Enter	Edit a table cell
Esc	Cancel an edit