Ventil Test Procedure: VTP-CLAMP-L1

Level 1 Clamping Performance Validation

(Force Consistency & Accuracy)

Doc Ver:	1.0 (Draft)
Date:	April 29, 2025
Author:	D. Suchanka
Approved:	*[Pending]*

1. Purpose

Standardized method to verify **accuracy** & **consistency** of clamping force for Ventil electro-mechanical spindle systems during Commissioning/QA, augmenting standard FAT/IAT checks.

2. Scope

Applies to Level 1 routine validation. Escalate if criteria unmet (Ref: [Framework Doc ID]).

3. Required Equipment

- Load Cell (Appropriate capacity, e.g., $10\,\mathrm{tonne}$. Record capacity & SN).
- Laptop w/ Ventil **PrevenTest Software** & connected Load Cell.
- Level 1 Data Sheet (Excel: **VAL-TMPL-001**).
- Timer.
- Standard safety gear.

4. Pre-Test Checks

1. **Verify Reqs:** Confirm Target Force (kN)/Range & Criteria (Std: CI$\geq$0.90, Acc$\pm$10%, Qual. Stable>90%, Jiggle Pass, Unclamp OKs) from Eng. Spec/Order. Record.
2. **Machine State:** Power on, controls active, safety functional.
3. **Load Cell Setup:** Place directly between clamp surfaces, centered, stable. No soft materials unless specified.
4. **Zero Load Cell:** Zero reading in **PrevenTest**.

5. Level 1 Test Procedure

Data Sheet: Use Excel Template `VAL-TMPL-001`.

5.1. Perform Slow Mode Cycles (N=15):

a. Initiate clamp: **SLOW MODE ONLY**. Confirm.
b. Wait $15\,\mathrm{s}$ after initial stabilization.
c. Record `Stabilized_Force_15s` (N).
d. Observe (12-15s): Record `Stability_Check (Y/N)` (Ignore <$20\,\mathrm{N}$ fluctuation).
e. Perform 'Jiggle Test'. Record `Jiggle_Test (Pass/Fail)`.
f. Unclamp. Note issues. Repeat N times.

5.2. Perform Fast Mode Unclamp Checks (M=3):

a. Initiate clamp: **FAST MODE**. **Caution**. Note if load capacity reached.
b. Attempt normal unclamp immediately.
c. Record `Fast_Mode_Unclamp_Check (OK/Stuck)`. Repeat M times.

5.3. Perform Extended Hold Tests (1 Cycle Each Mode):

a. **Slow Mode:** Clamp (Slow), hold $30\,\mathrm{s}$. Record F@15s, F@30s. Note Behavior. Attempt unclamp, record `Ext_Hold_Unclamp_Check`.
b. **Fast Mode:** Clamp (Fast), hold $30\,\mathrm{s}$. Record F@15s, F@30s (or Max). Note Behavior. Attempt unclamp, record `Fast_Mode_Ext_Unclamp_Check`.

6. Results & Evaluation

1. Enter 15 Slow Mode forces into template `VAL-TMPL-001`.
2. Review all check results (Stability, Jiggle, Unclamp).
3. Template calculates Avg Force & CI. (Formula: $\mathrm{CI} = 1 - (\mathrm{Range}/\mathrm{Avg\ Force})$).
4. Determine **Overall Result (PASS/FAIL)** based on meeting ALL criteria (Sec 4.1).
5. Record Overall Result & metrics on FAT/IAT, ref. Data Sheet ID.

7. Escalation Procedure

If **Overall Result is FAIL**, document failure mode(s) on Data Sheet & notify designated personnel (Eng/Analyst) for **Level 2 Investigation**. Attach Data Sheet. Do not ship/sign-off without resolution.