

Late to the Party?

How to Read Valve Specs and Where Continental Hydraulics Fits

A guide to proportional valve stats, the Continental Hydraulics lineup, and the speed you can count on.

Picture a hydraulic cylinder pushing a part into place. It has to move fast, slow down smoothly and stop right on the mark. The **proportional valve** decides how much oil goes where, like a faucet you can open a little or a lot. If the valve is slow, the cylinder shows up late. If the valve is far more than you need, you pay for speed you will never use.

This issue does three things:

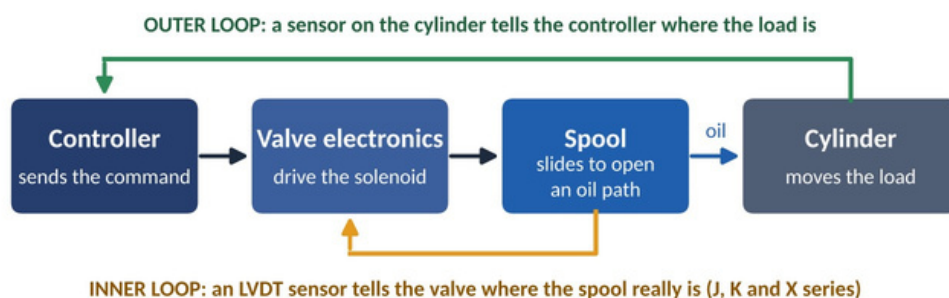
1. **Reading the stats:** how to read a valve datasheet.
2. **The Continental Hydraulics lineup:** the five valve series and how they stack up.
3. **The performance you can get:** real numbers from the datasheets.



The Continental Hydraulics VED family runs from small, direct-acting D03 valves to large pilot-operated valves up to D11.

First, how a proportional valve works

The controller sends a signal. Electronics drive a solenoid that slides the **spool**, a precision-machined rod inside the valve that controls flow. Where the spool sits decides how much oil reaches the cylinder. Valves with spool feedback use an **LVDT** sensor to check where the spool really is and correct it on the fly.



Open the spool a little = a little oil, slow cylinder. Open it a lot = lots of oil, fast cylinder.

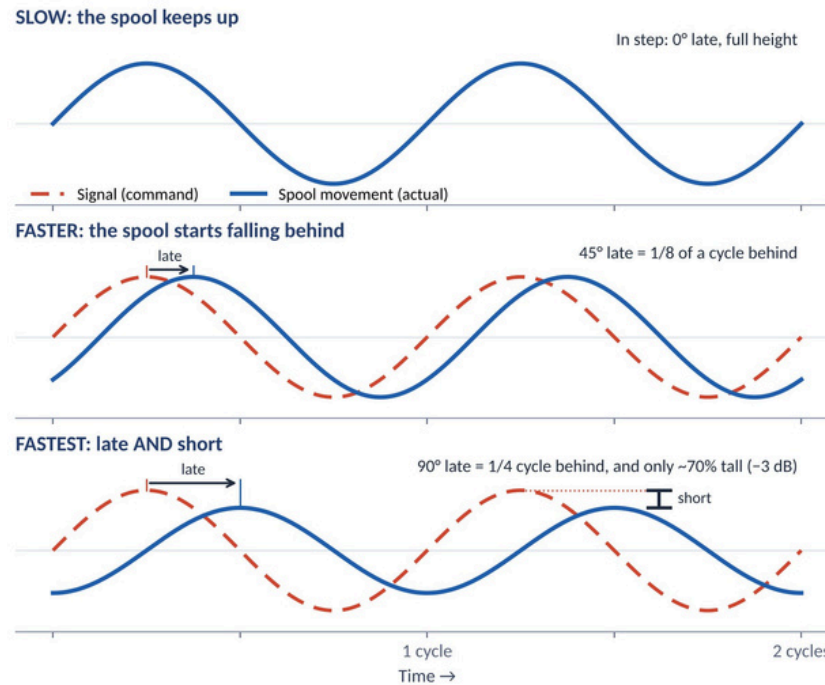
The valve sits between the brains (controller) and the muscle (cylinder).

PART 1 | READING THE STATS

Phase lag and amplitude: the copy-me game

Play copy-me with a friend. You wave your hand and they copy you. Wave slowly and they keep up. Wave faster and they fall behind: that is **phase lag**. Wave faster still and they cannot lift their hand as high: that is lost **amplitude**.

A valve spool plays the same game with its command signal. Each full back-and-forth “wiggle” is called one cycle. The spool has weight (inertia), so it takes time to start, stop and turn around. As Jim Kortman, our VP Technical / Sales, puts it: a slow valve is **late to the party**, and if the commands come fast enough, it **never gets to the party** at all.



Word	What it means
Hertz (Hz)	Cycles per second. 100 Hz = 100 complete back-and-forth cycles every second.
Phase lag (°)	How late the spool is. 45° = 1/8 of a cycle late. 90° = 1/4 of a cycle late.
Amplitude (dB)	How much of the move happens. 0 dB = all of it. -3 dB = about 70%.
Quick math	At 160 Hz, one cycle takes 6.25 milliseconds (ms). A quarter of that, 90°, is only about 1.6 ms late.

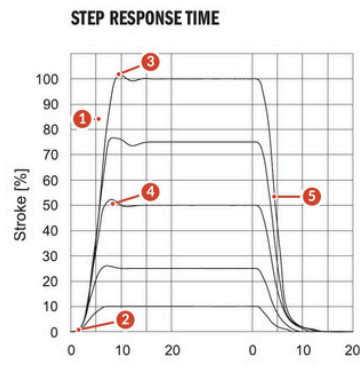
Two tests on every datasheet

STEP RESPONSE

The “hands up!” test. The command jumps all at once. How long until the spool gets there? Measured in milliseconds (ms). **Shorter is faster.**

FREQUENCY RESPONSE

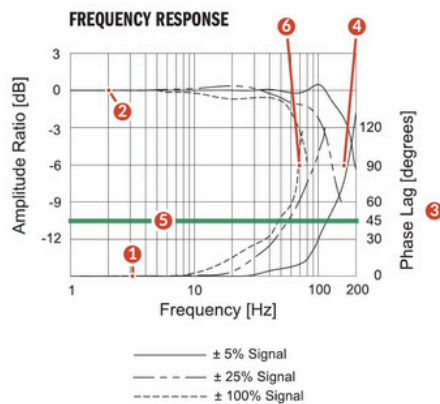
The “copy-me” test. The command oscillates back and forth, faster and faster. How late and how short does the spool get? Measured in Hz at a set phase lag. **Higher is faster.**



How to read it

- 1 **The command jumps**
to 10, 25, 50, 75 or 100% in one step, then holds.
- 2 **A short wait**
about 1–2 ms before the spool starts to move (inertia).
- 3 **Full stroke, fast**
the D03 MX datasheet rates it at 8 ms.
- 4 **A tiny overshoot**
a percent or two past the target, then it settles.
- 5 **Command drops to zero**
the clock restarts at 0; the spool is back near zero in about 8 ms.

Real datasheet chart: Continental Hydraulics D03 MX step response.



How to read it

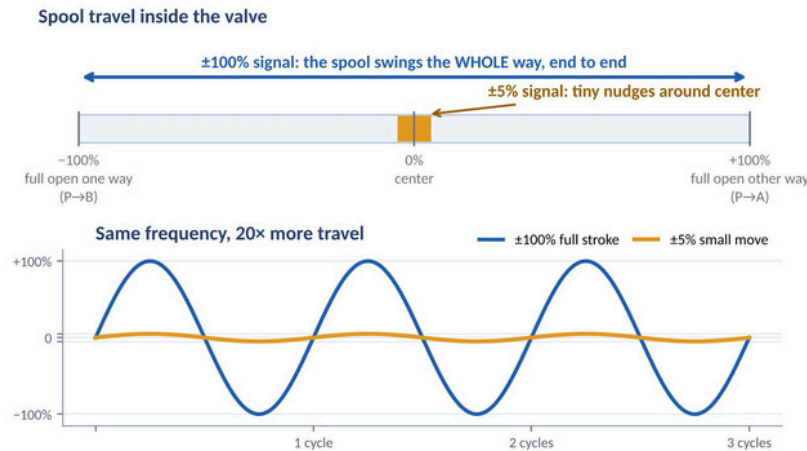
- 1 **Frequency (bottom)**
cycles per second, in hertz (Hz).
1, 10 and 100 are evenly spaced: 10 $\times$ per step.
- 2 **Amplitude (top lines, left scale)**
0 dB = the full move happens.
–3 dB = only about 70% happens.
- 3 **Phase lag (bottom lines, right scale)**
how late the spool is, in degrees.
- 4 **±5% line reaches 90° near 160 Hz**
that is the headline datasheet rating.
- 5 **45° line (green)**
the rule-of-thumb limit for position control.
- 6 **Full stroke (±100%, fine dashes)**
reaches 90° much sooner: roughly 70 Hz.

Real datasheet chart: Continental Hydraulics D03 MX frequency response.

Small moves vs. full stroke (±5% vs. ±100%)

Datasheets test valves at different signal sizes. A $\pm 5\%$ signal moves the spool just a little either side of center, like the tiny corrections a machine makes to hold a position. A $\pm 100\%$ signal swings the spool all the way from full open one way to full open the other way.

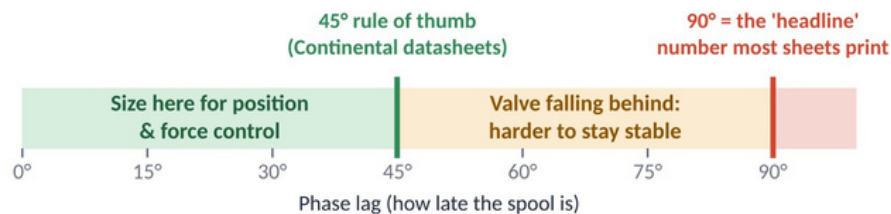
Small strokes are easier to repeat quickly, the same way you can tap a finger faster than you can swing your whole arm. On the D03 MX chart above, the $\pm 5\%$ line keeps going to about **160 Hz**, but the full $\pm 100\%$ line reaches 90° at roughly **70 Hz**. Same valve, very different numbers. **Always check the signal size printed next to the Hz rating.**



At the same frequency, a $\pm 100\%$ cycle moves the spool 20 times farther than a $\pm 5\%$ cycle.

Which phase lag number should you use?

Most data sheets brag about the 90° number. At 90° , the spool is already a full quarter-cycle late. Continental Hydraulics' own datasheets give a better rule of thumb: for any position control loop, use the 45° (or lower) rating for stable, repeatable and consistent control of the cylinder (muscle) and the entire system.



Match the number to the job

Your machine needs to...	Look at...	Good fit
Move a cylinder at set speeds with smooth starts and stops	Step response and flow. The Hz rating matters less.	M, G
Hold an exact position or force	Hz at 45° or less, at the signal size you will really use (often small moves)	J, K, X
Shake or cycle a part fast (test stands)	The full chart, at the stroke size your test uses	X

COMPARING BRANDS? MATCH THE FINE PRINT FIRST

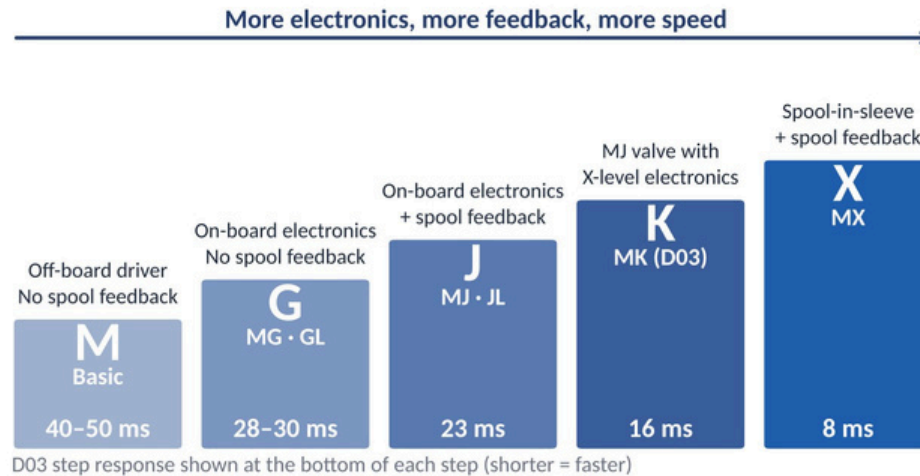
Comparing a Continental Hydraulics valve with an alternative option? Two numbers only compare if they were tested the same way. Check:

- Signal size:** $\pm 5\%$, $\pm 10\%$, $\pm 25\%$ or $\pm 100\%$?
- Phase lag point:** 45° or 90° ? Is -3 dB also listed?
- Test conditions:** oil, temperature, and pressure.
 - Check the pressure drop at a given flow and speed performance and compare values. Some will show great performance, but with a significant pressure drop across the valves (wasted energy and heat build-up). Your rated flow data indicates this inconsistency in test data reporting.
- Rated flow:** at what pressure drop? (D03 and D05 MX: 70 bar. Pilot MX: 10 bar.)

If the fine print doesn't match, the numbers don't either. Send us both datasheets, and we'll line them up for you.

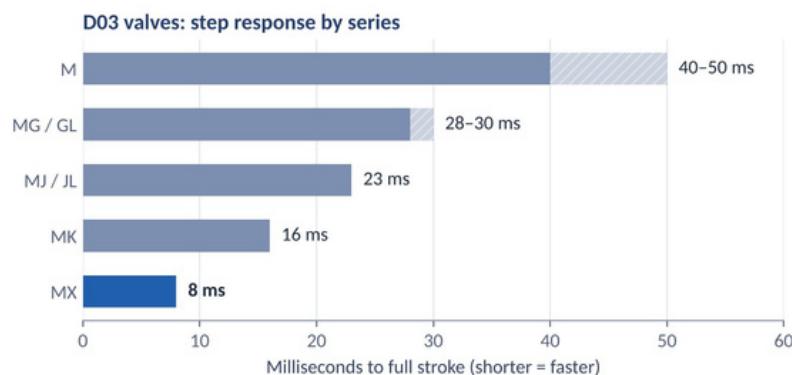
PART 2 | THE CONTINENTAL HYDRAULICS LINEUP

Continental Hydraulics builds its VED proportional valves in five steps, from simple and rugged to servo-proportional. Each step adds electronics, feedback or speed.



Series	What it is	On-board electronics	Spool feedback	Connector	D03 step response
M	Basic, rugged valve. Runs from a separate CEM-AA driver card.	No	No	DIN or Deutsch	40-50 ms
G	MG / GL: rugged valve with built-in electronics.	Yes	No	7-pin (MG), 5-pin with IO-Link (GL)	28-30 ms
J	MJ / JL: adds an LVDT that checks the spool position.	Yes	Yes	7-pin (MJ), 5-pin with IO-Link (JL)	23 ms
K	MK (D03 only): the MJ valve with high-performance X electronics, priced the same as the MJ.	Yes	Yes	7-pin	16 ms
X	MX: precision lapped spool in a sleeve (in the pilot stage on larger sizes), with a fail-safe 4th position.	Yes	Yes (pilot + main on pilot sizes)	7-pin, or fieldbus (XH)	8 ms

Fieldbus “H” versions (GH, JH, XH) connect to EtherCAT, EtherNet/IP and PROFINET. Step response values are from Continental Hydraulics’ product overview and the D03 MX datasheet.



How does Continental Hydraulics stack up?

- **Drops in where others sit.** Continental Hydraulics valves use standard ISO 4401 / NFPA mounting patterns, and MG and MJ valves are usually a drop-in replacement for competitors' valves on the common 7-pin connector.
- **Speed without the price jump.** The MK puts X-level electronics on the MJ valve, at the same price as the MJ.
- **More ways to connect.** 5-pin GL and JL valves add IO-Link. XH valves connect to EtherCAT, EtherNet/IP and PROFINET.
- **Built-in tuning help.** The CEM-AA driver used with M valves has a built-in oscilloscope and linearization feature.
- **Tuned for real-world control.** MX valves are critically tuned for the most Hz at 45° and 30° of phase lag, the zone where position control actually lives.
- **Ready for tough spots.** HL valves are built for hazardous locations under ATEX.

PART 3 | THE PERFORMANCE YOU CAN GET

8 ms

D03 MX step response

160 Hz

D03 MX at 90°, ±5% signal

≈15°

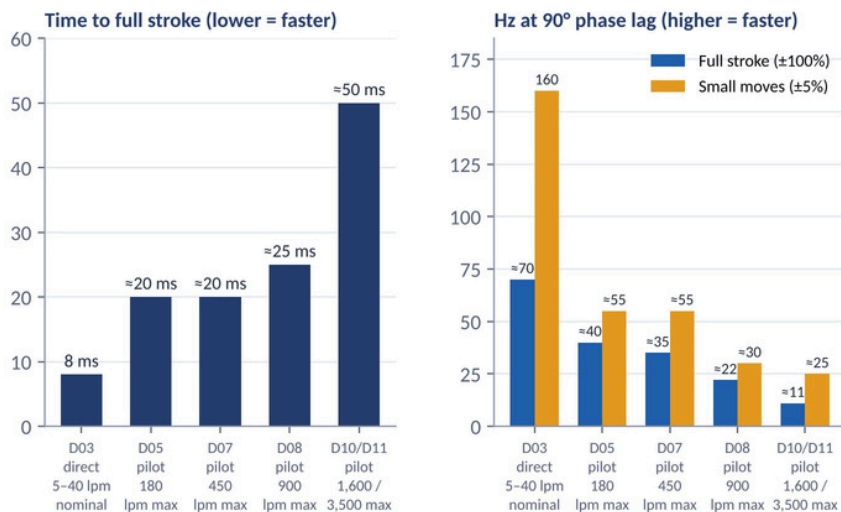
D03 MX lag at 80Hz, ±5% signal

3,500 lpm

Here is what the headline number does not show. On the D03 MX ±5% curve, the spool is only about **15° late at 80 Hz** and about **30° late at 100 Hz**, while still making the full move. That is deep in the green zone from Part 1, where position and force control do their best work.

Bigger valves: more oil, same smart design

Big valves move a lot more oil, but their spools are heavier, so they respond more slowly. Continental Hydraulics' pilot-operated MX valves fight back with a high-flow pilot valve and LVDT feedback on both the pilot spool and the main spool.



D03 MX: 8 ms and 160 Hz are datasheet ratings; all other values are read from the Continental datasheet curves (≈). Pilot MX curves: ZC spool, 36 cSt oil at 50 °C, step tests at 100 bar.

MX valve	Flow	Time to full stroke	Hz at 90°, full stroke (±100%)	Hz at 90°, small moves (±5%)
D03 (direct)	5–40 lpm nominal at 70 bar	8 ms	≈70 Hz	160 Hz
D05 (direct)	60–100 lpm nominal at 70 bar	20 ms	n/a ≈40	80 Hz at ±10%
D05 (pilot)	100 lpm rated at 10 bar, 180 max	≈20 ms	Hz ≈35	≈55 Hz
D07 (pilot)	120–220 lpm rated, 450 max	≈20 ms	Hz ≈22	≈55 Hz
D08 (pilot)	250–400 lpm rated, 900 max	≈25 ms	Hz ≈11	≈30 Hz
D10 (pilot)	800 lpm rated, 1,600 max	≈50 ms	Hz ≈11	≈25 Hz
D11 (pilot)	1,000 lpm rated, 3,500 max	≈50 ms	Hz	≈25 Hz

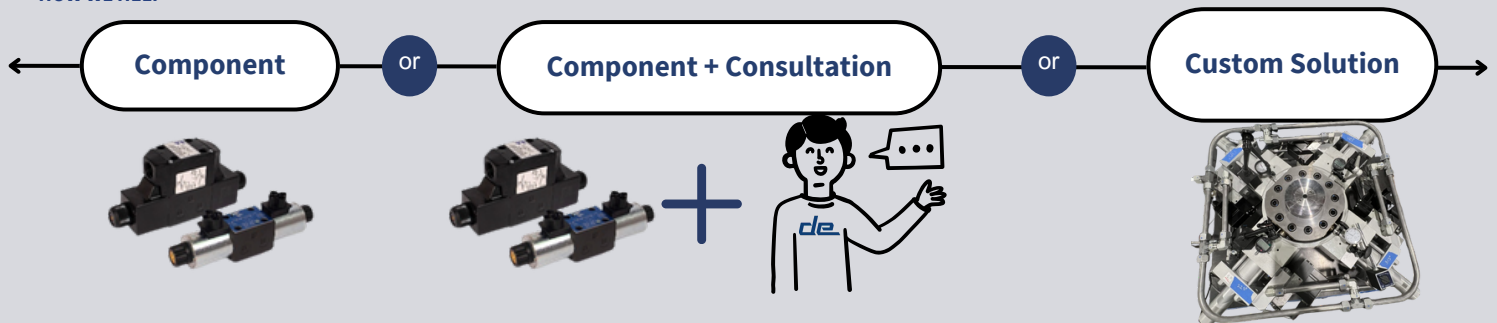
Values without ≈ are datasheet ratings. ≈ Values are read from the Continental Hydraulics datasheet curves (Pilot MX: ZC spool, 36c Stoil at 50 °C, step tests at 100 bar; D10 and D11 share one curve). Pilot MX rated flow is at 10 bar p.

Servo-style control, proportional-valve ownership

Compared with a servo valve system, Continental Hydraulics' product team points to four MX advantages:

Lower purchase cost Servo-proportional control without the servo price tag.	More dirt-tolerant MX datasheets call for ISO 16/14/11 oil (17/15/12 maximum).
Less heat, less energy Performance comes at lower pressure drops in the valve and system.	Lower cost to own More dirt tolerance means less routine maintenance.

HOW WE HELP



Whether your machine needs smoother speed changes, accurate positioning, or responsive force control, start with the application.

Bring Donald Engineering your required flow, force, motion accuracy, cycle time, operating conditions, and existing controls. We can help select the valve size, spool, electronics, and performance level suited to the job.

Let's work together.

Contact our team today!

(616) 538-8340

sales@donaldengineering.com

APPENDIX

Spec Reference and Sources

Series	Size	Step response	Frequency (90° phase lag)	Source
M	D03	40–50 ms	See catalog	Continental Hydraulics product overview (4/18/25)
M	D05	50 ms	See catalog	Continental Hydraulics product overview
MG / GL	D03	28–30 ms	See catalog	Continental Hydraulics product overview
MJ / JL	D03	23 ms	See catalog	Continental Hydraulics product overview
MJ	D05	50 ms	See catalog	Continental Hydraulics product overview
MK	D03	16 ms	See catalog	Continental Hydraulics product overview
MX	D03	8 ms	160 Hz at $\pm 5\%$ signal	VED03M X Series datasheet 1021357 Rev 08/26
MX	D05 (direct)	20 ms	80 Hz at $\pm 10\%$ signal	VED05MX datasheet 1025336
MX	D05 (pilot)	≈ 20 ms	≈ 40 Hz ($\pm 100\%$), ≈ 55 Hz ($\pm 5\%$)	VED*MX datasheet 1021358 Rev 08/26, curves
MX	D07	≈ 20 ms	≈ 35 Hz ($\pm 100\%$), ≈ 55 Hz ($\pm 5\%$)	VED*MX datasheet 1021358, curves
MX	D08	≈ 25 ms	≈ 22 Hz ($\pm 100\%$), ≈ 30 Hz ($\pm 5\%$)	VED*MX datasheet 1021358, curves
MX	D10 / D11	≈ 50 ms	≈ 11 Hz ($\pm 100\%$), ≈ 25 Hz ($\pm 5\%$)	VED*MX datasheet 1021358, curves

$\approx$ = read from the datasheet curve. Product photos: Continental Hydraulics datasheets.