TECHNICAL REPORTS 2006–2021

# ChME3 locomotives: diesel and compressor restored, the same units — again

PrJSC Zaporizhzhia Iron Ore Plant, railway shop · treatment and measurements carried out by plant commissions together with XADO LLC

**Ukraine · reports from 11.09.2006 to 28.07.2021 · six locomotives, fourteen reports**

**PRODUCT**

XADO revitalizant compounds

treatment of the diesel oil and fuel systems and of the compressor oil system — without disassembling the units

**TEST OBJECT**

ChME3 shunting locomotives

No. 3719 · 3721 · 3722 · 4041 · 4042 · 4370 · K6S310DR diesel and K-2LOK-1 compressor

**DOCUMENT TYPE**

14 technical reports of the plant's railway shop

| LOCOMOTIVE | REPORT DATE | TREATMENT CYCLE | RUNNING HOURS BEFORE CONTROL MEASUREMENT |
|---|---|---|---|
| ChME3 No. 3719 | 2007 | first | **514 h** |
| ChME3 No. 3719 | 05.08.2020 | repeat | **880 h** |
| ChME3 No. 3721 | 12.06.2019 | first | **580 h** |
| ChME3 No. 3721 | 28.07.2021 | repeat | **487 h** |
| ChME3 No. 3722 | 15.05.2007 | first | **547 h** |
| ChME3 No. 3722 | 11.11.2015 | repeat | **412 h** |
| ChME3 No. 3722 | 01.08.2018 | third | **388 h** |
| ChME3 No. 4041 | May 2007 | first | **472 h** |
| ChME3 No. 4041 | 01.08.2018 | repeat | **412 h** |
| ChME3 No. 4042 | 11.09.2006 | first | **585 h** |

| LOCOMOTIVE | REPORT DATE | TREATMENT CYCLE | RUNNING HOURS BEFORE CONTROL MEASUREMENT |
|---|---|---|---|
| ChME3 No. 4042 | 24.09.2008 | repeat | **537 h** |
| ChME3 No. 4042 | 11.11.2015 | third | **533 h** |
| ChME3 No. 4042 | 05.08.2020 | fourth | **600 h** |
| ChME3 No. 4370 | 12.06.2019 | first | **540 h** |

The locomotives were treated in regular service, without being taken out for repair; control measurements were taken after 388-880 hours of operation.

## What was repeated on every unit

**↑ 11-20 %**

cylinder compression, 16-33 → 22-36 kgf/cm²

**↑ 9-17 %**

peak combustion pressure, 20-49 → 29-50 kgf/cm²

**↓ 10-23 %**

air system charging time by the compressor, 30-73 → 26-55 s

**↓ 36-45 %**

engine block vibration velocity, 0.9-11.3 → 0.4-9.1 mm/s

## K6S310DR diesel: cylinder compression, kgf/cm²

| LOCOMOTIVE AND REPORT DATE | BEFORE TREATMENT | AFTER | GAIN |
|---|---|---|---|
| No. 4042 · 11.09.2006 | **24-32** | **26-36** | **13 %** |
| No. 3719 · 2007 | **23-26** | **27-28** | **14 %** |
| No. 3722 · 15.05.2007 | **26-28** | **28-30** | **8 %** |
| No. 4041 · May 2007 | **20-24** | **22-30** | **18 %** |
| No. 4042 · 24.09.2008 | **24-26** | **24-30** | **12 %** |
| No. 3722 · 11.11.2015 | **20-25** | **32-34** | **52 %** |
| No. 4042 · 11.11.2015 | **25-31** | **30-36** | **11 %** |
| No. 3722 · 01.08.2018 | **20-32** | **30-35** | **20 %** |
| No. 4041 · 01.08.2018 | **16-27** | **29-34** | **39 %** |

| LOCOMOTIVE AND REPORT DATE | BEFORE TREATMENT | AFTER | GAIN |
|---|---|---|---|
| No. 3721 · 12.06.2019 | 25-32 | 28-34 | 9 % |
| No. 4370 · 12.06.2019 | 21-26 | 28-32 | 25 % |
| No. 3719 · 05.08.2020 | 26-33 | 30-36 | 12 % |
| No. 4042 · 05.08.2020 | 24-30 | 29-35 | 19 % |
| No. 3721 · 28.07.2021 | 24-30 | 27-32 | 11 % |

Measured with a KU 5501 maximeter on a warmed-up engine. Compression runs up against the factory nominal: the more worn the cylinder was, the larger the gain.

## K6S310DR diesel: peak combustion pressure, kgf/cm²

| LOCOMOTIVE AND REPORT DATE | BEFORE TREATMENT | AFTER | GAIN |
|---|---|---|---|
| No. 4042 · 11.09.2006 | 30-40 | 34-44 | 13 % |
| No. 3719 · 2007 | 26-34 | 32-38 | 16 % |
| No. 3722 · 15.05.2007 | 34-40 | 36-40 | 5 % |
| No. 4041 · May 2007 | 26-40 | 30-44 | 12 % |
| No. 4042 · 24.09.2008 | 26-49 | 29-49 | 6 % |
| No. 3722 · 11.11.2015 | 24-32 | 36-49 | 54 % |
| No. 4042 · 11.11.2015 | 30-41 | 32-44 | 10 % |
| No. 3722 · 01.08.2018 | 20-48 | 30-50 | 10 % |
| No. 4041 · 01.08.2018 | 20-39 | 37-48 | 33 % |
| No. 3721 · 12.06.2019 | 25-41 | 30-46 | 9 % |
| No. 4370 · 12.06.2019 | 23-40 | 30-45 | 17 % |
| No. 3719 · 05.08.2020 | 33-45 | 36-49 | 9 % |
| No. 4042 · 05.08.2020 | 27-40 | 36-46 | 18 % |
| No. 3721 · 28.07.2021 | 26-40 | 29-45 | 10 % |

The same instrument and the same modes as for compression: combustion pressure rises in step with the restored sealing of the cylinders.

## K6S310DR diesel: block vibration velocity, mm/s

| LOCOMOTIVE AND REPORT DATE | BEFORE TREATMENT | AFTER | REDUCTION |
|---|---|---|---|
| No. 4042 · 11.09.2006 | 7.3-11.3 | 3.3-9.1 | 45 % |
| No. 3719 · 2007 | 2.2-3.9 | 1.1-1.4 | 60 % |
| No. 3722 · 15.05.2007 | 4.5-5.7 | 2.2-3.5 | 40 % |
| No. 4041 · May 2007 | 2.2-4.1 | 1.0-1.9 | 59 % |
| No. 4042 · 24.09.2008 | 2.1-4.7 | 1.2-3.6 | 34 % |
| No. 3722 · 11.11.2015 | 1.5-3.6 | 0.8-2.3 | 43 % |
| No. 4042 · 11.11.2015 | 1.8-3.9 | 1.1-2.2 | 45 % |
| No. 3722 · 01.08.2018 | 1.1-1.4 | 0.7-0.9 | 41 % |
| No. 4041 · 01.08.2018 | 0.9-1.0 | 0.4-0.7 | 39 % |
| No. 3721 · 12.06.2019 | 3.8-5.1 | 2.1-3.7 | 31 % |
| No. 4370 · 12.06.2019 | 4.0-6.0 | 1.3-3.8 | 48 % |
| No. 3719 · 05.08.2020 | 1.1-4.2 | 0.8-2.6 | 36 % |
| No. 4042 · 05.08.2020 | 1.2-3.3 | 1.1-3.1 | 21 % |
| No. 3721 · 28.07.2021 | 4.9-9.9 | 2.2-6.0 | 39 % |

SENDING 911 vibrometer, six points on the engine block at idle: even cylinder operation is a direct consequence of the evened-out compression.

## K-2LOK-1 compressor: air system charging time, s

| LOCOMOTIVE AND REPORT DATE | CHARGING | BEFORE | AFTER | REDUCTION |
|---|---|---|---|---|
| No. 4042 · 11.09.2006 | 7 → 8 kgf/cm² | 30 | 29 | 3 % |
| No. 3719 · 2007 | 7 → 8 kgf/cm² | 35 | 31 | 11 % |
| No. 3722 · 15.05.2007 | 7 → 8 kgf/cm² | 30 | 28 | 7 % |
| No. 4041 · May 2007 | 7 → 8 kgf/cm² | 36 | 32 | 11 % |
| No. 4042 · 24.09.2008 | 7 → 8 kgf/cm² | 30 | 27 | 10 % |
| No. 3722 · 11.11.2015 | 7 → 8 kgf/cm² | 36 | 26 | 28 % |

| LOCOMOTIVE AND REPORT DATE | CHARGING | BEFORE | AFTER | REDUCTION |
|---|---|---|---|---|
| No. 4042 · 11.11.2015 | 7 → 8 kgf/cm² | 41 | 33 | 20 % |
| No. 3722 · 01.08.2018 | 7 → 8 kgf/cm² | 54 | 43 | 20 % |
| No. 3721 · 12.06.2019 | 7 → 7.6 kgf/cm² | 25 | 20 | 20 % |
| No. 4370 · 12.06.2019 | 7 → 8 kgf/cm² | 52 | 41 | 21 % |
| No. 3719 · 05.08.2020 | 7 → 8 kgf/cm² | 34 | 31 | 9 % |
| No. 4042 · 05.08.2020 | 7 → 8 kgf/cm² | 53 | 35 | 34 % |
| No. 3721 · 28.07.2021 | 7 → 8 kgf/cm² | 73 | 55 | 25 % |

Stopwatch and the locomotive's standard pressure gauge. Charging time is the working measure of compressor output: fewer seconds mean more air delivered.

## What the commissions recorded

Fourteen reports of the railway shop are signed off with one and the same conclusion: cylinder compression and peak combustion pressure rose, engine and compressor vibration fell, compressor output increased — and all of this without disassembling the units and without taking the locomotive out of service for repair. The 2008 report on locomotive No. 4042: «the compression value has evened out across practically all cylinders, which makes it possible to eliminate crankshaft imbalance during engine operation», and applying the technology «makes it possible to increase the service life of these units by at least **1.5×** without stopping the locomotive for repair». The 2015 report on No. 3722 records a compression gain of **9 to 14 kgf/cm²** on a machine that before treatment delivered **20-25 kgf/cm²**. The weightiest argument is the depot's own decisions: five of the six locomotives were treated a second time, and No. 4042 four times between 2006 and 2020.

XADO


The results apply to ChME3 shunting locomotives with the K6S310DR diesel and the K-2LOK-1 air compressor under the conditions of the railway shop of an iron ore plant; on other equipment and in other operating modes the figures may differ. The originals of all fourteen reports, with the signatures and stamps of the enterprise, are published in full and available for download.