



ENGINEERING
TEST REPORT

REPORT NUMBER:

TR-024485A

Eaton Hydraulics
Pune, India

TITLE: Summary Test Report of EC512-12 to -32 hose sizes produced at Eaton Cerkezkoy Hose Plant and qualified with Eaton TTC 1-pc 4S/6S fitting.

DATE: Monday, Dec 18, 2017

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TEST CATEGORY:

Summary Test Report

OBJECTIVE:

Eaton Winner Spiral hose EC512 produced at Eaton Cerkezkoj plant is qualified with TTC 1-pc 4S/6S fitting. The aim of this summary test report is to distribute to the customers whomsoever will be requiring summary report of EC512 hose sizes 4S/6S fitting for providing approval.

REFERENCE DOCUMENTS:

BS EN 856:2015 – Rubber Wire Spiral Hydraulic Hose Standard
ES5200 – Eaton Engineering Standard for EC512 Hose Product
EC512_SHT1 – Eaton Hose Drawing
TR-022521 : Formal Qualification Test of EC512-12
TR-018959 : Formal Qualification Test of EC512-16
TR-017549 : Formal Qualification Test of EC512-20
TR-018498 : Formal Qualification Test of EC512-24
TR-017840 : Formal Qualification Test of EC512-32
TR-021483 : Cold Temperature Flex Test of Tube and Cover and Ozone Resistance Test of Cover Compound
CCKY Lab Test No. 3373 and 3458 – Oil Resistance Test of Tube and Cover
TR-011493 : Global Cover Compounds Test Report
KK17-1192 : Adhesion test report



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Hose : EC512-12
Fitting Type : TTC 1-pc 4S
Crimp Diameter : 36.35+/-0.15mm (1.431+/-0.006in)
Manufacturing Location : EATON POLİMER KAÜÇUK (Turkey)

Hose : EC512-16
Fitting Type : TTC 1-pc 4S
Crimp Diameter : 43.50+/-0.15mm (1.713+/-0.006in)
Manufacturing Location : EATON POLİMER KAÜÇUK (Turkey)

Hose : EC512-20
Fitting Type : TTC 1-pc 4S
Crimp Diameter : 52.55+/-0.15mm (2.069+/-0.006in)
Manufacturing Location : EATON POLİMER KAÜÇUK (Turkey)

Hose : EC512-24
Fitting Type : TTC 1-pc 4S
Crimp Diameter : 60.15+/-0.15mm (2.368+/-0.006in)
Manufacturing Location : EATON POLİMER KAÜÇUK (Turkey)

Hose : EC512-32
Fitting Type : TTC 1-pc 4S
Crimp Diameter : 73.75+/-0.15mm (2.903+/-0.006in)
Manufacturing Location : EATON POLİMER KAÜÇUK (Turkey)



TEST PROCEDURES AND RESULTS:

Test procedures and results shown on the following pages of this report.

PROOF PRESSURE TEST

PROCEDURE:	The hose assemblies shall be connected to the test equipment in a manner which simulates service conditions for the product. Hose assemblies shall be subjected to the proof pressure specified below for at least 30 seconds, but no more than 60 seconds.
TEST FLUID:	Water (unless otherwise specified)
FAILURE CRITERIA:	There shall be no evidence of permanent deformation, damage or leakage from the hose assembly during or at the completion of this test.

HOSE	PROOF PRESSURE BAR (PSI)	PASS/FAIL
EC512-12	840 (12,200)	PASS
EC512-16	760 (11,000)	PASS
EC512-20	700 (10,200)	PASS
EC512-24	580 (8,400)	PASS
EC512-32	500 (7,300)	PASS



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ELONGATION OR CONTRACTION

SAMPLE PREPARATION:	As specified in the applicable engineering documents and with a free hose length of 600 mm (23.6 in.)
PROCEDURE:	Attach previously unaged and untested hose assembly to a pressure source in a straight position. Hose may be fastened laterally in a fashion to overcome natural curvature of hose if needed. Pressurize the hose to specified operating pressure for a period of 30 seconds and release. On the depressurized assembly, mark an exact 500 mm (19.7 in.) gage length on the outside diameter of the hose and centered on the hose (minimum distance of 50 mm (1.96 in.) from the socket. Pressurize the sample with water or system fluid for 30 seconds minimum at the hose operating pressure. With the hose assembly still under pressure, measure and record the distance between the gage marks with a steel scale or calipers. Calculate percent elongation or contraction as described as: $[(L_f - L_o) / L_o] * 100$
TEST FLUID:	Water (unless otherwise specified)
TEST PRESSURE:	See table below

HOSE	TEST PRESSURE Bar (psi)	ELONGATION & CONTRACTION TOLERANCE %	PASS/FAIL
EC512-12	420 (6,100)	+2% to -2%	PASS
EC512-16	380 (5,500)	+2% to -2%	PASS
EC512-20	350 (5,100)	+2% to -2%	PASS
EC512-24	290 (4,200)	+2% to -2%	PASS
EC512-32	250 (3,650)	+2% to -2%	PASS



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HYDRAULIC LEAKAGE

PROCEDURE:	Pressurize the sample to 70% of the hose minimum burst pressure. Maintain pressure for a period of 5 to 5½ minutes. Reduce pressure to 0 bar, repeat. If leakage occurs, record severity, location of leakage and time at which it started.
TEST FLUID:	Water (unless otherwise specified)
TEST PRESSURE:	See table below
FAILURE CRITERIA:	Any evidence of leakage from hose or fittings, hose burst, fitting blow-off or other malfunction shall constitute failure.

HOSE	TEST PRESSURE Bar (psi)	PASS/FAIL	DESCRIPTION
EC512-12	1,176 (17,080)	PASS	NO LEAKAGE
EC512-16	1,064 (15,400)	PASS	NO LEAKAGE
EC512-20	980 (14,280)	PASS	NO LEAKAGE
EC512-24	812 (11,760)	PASS	NO LEAKAGE
EC512-32	700 (10,220)	PASS	NO LEAKAGE



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BURST TEST

PROCEDURE:	One end of the assemblies shall be attached to the pressure source. The assemblies shall be extended straight and the free end shall not be constrained or fastened in any manner. All air shall be excluded from the hose bore and the free end suitably sealed. Pressure shall be applied at a uniform rate (pressurization time between 15 and 60 seconds) until failure occurs.
TEST FLUID:	Water (unless otherwise specified)
PRESSURE:	See table below
FAILURE CRITERIA:	The hose shall not burst, the fittings shall not blow off or loosen, and there shall be no leakage from the hose or fittings or other evidence of malfunction below the specified burst pressures. The type of failure shall be recorded.

HOSE	BURST PRESSURE Bar (psi)	PASS/FAIL
EC512-12	1,680 (24,400)	PASS
EC512-16	1,520 (22,000)	PASS
EC512-20	1,400 (20,400)	PASS
EC512-24	1,160 (16,800)	PASS
EC512-32	1,000 (14,600)	PASS



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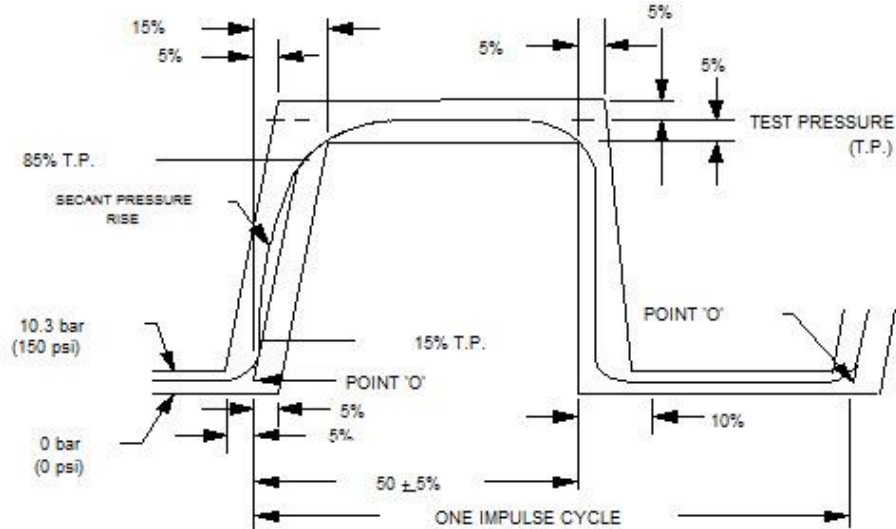
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IMPULSE TEST

PROCEDURE:	All sizes through -12 shall be bent in a 180° arc with a radius at the inside of the bend equal to the specified minimum bend radius. All sizes larger than -12 shall be bent in a 90° arc with the radius at the inside of the bend equal to the specified minimum bend radius. The rate of pressure impulse shall be 35-75 cycles per minute and the impulse pressures as measured by an electronic measuring device, shall conform to the graph in Figure 1. If required, cooldown leakage shall be performed as specified in ES2850T15. (Ref. SAE J1405.)
FAILURE CRITERIA	Any samples failing to meet the minimum impulse cycles required constitute failure of this test.
TEST PRESSURE:	See table below
MIN. CYCLES REQUIRED:	400,000
TEST FLUID:	Hydraulic Oil
FLUID TEMP:	100°C (212°F)
AMBIENT TEMP:	Uncontrolled

HOSE	TEST PRESSURE Bar (psi)	MINIMUM BEND RADIUS mm (inch)	CYCLES	PASS/FAIL
EC512-12	559 (8,113)	280 (11.02)	400,000	PASS
EC512-16	505 (7,315)	340 (13.39)	400,000	PASS
EC512-20	466 (6,783)	460 (18.11)	400,000	PASS
EC512-24	386 (5,586)	560 (22.05)	400,000	PASS
EC512-32	333 (4,855)	700 (27.56)	400,000	PASS

IMPULSE PRESSURE TRACE



IMPULSE PRESSURE TRACE

SECANT PRESSURE RISE	The straight line drawn through two points on the pressure rise curve, one point at 15% of the test pressure and other at 85% of the test pressure. SECANT PRESSURE RISE shall be targeted at 11.7x test pressure (with a tolerance of $\pm 10\%$).
POINT "0"	The intersection of the Secant Pressure Rise with 0 pressure
PRESSURE RISE RATE	The slope of the Secant Pressure Rise expressed in bar per second.



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COLD TEMPERATURE FLEXING TEST

REFERENCE:	ASTM D380		
SAMPLE NUMBERS:	Tube and Cover Compound Samples		
PROCEDURE:	Mount the test specimens in loop position between the plates of the flexing fixture, with the enlarged ends spaced at least 3.2 mm (0.125 in.) apart and held in the clamps for a distance of 6.3 mm (0.25 in.). With the plates in the open position separated 63.5 mm (2.5 in.), place the fixture containing the specimens in the cold chamber and expose for the specified period to cold, dry air or a mixture of air and carbon dioxide at the specified temperature. At the termination of the exposure period and while still in the cold chamber, move the plates of the flexing fixture as rapidly as possible from the 63.5-mm (2.5-in.) distance of separation to a position where they are 25 mm (1 in.) apart.		
AGING TEMPERATURE	-40°C (±2°C)	AGING PERIOD:	24 hrs.
FAILURE CRITERIA:	Examine the specimens for fracture or visible cracks.		

SAMPLE NUMBER	CRACK OBERVED	PASS/FAIL
Hose Inner Tube	No	Pass
Hose Outer Cover	No	Pass



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OIL RESISTANCE TEST

**SAMPLE
NUMBERS:**

Tube and Cover Compound Samples

PROCEDURE:

According to ISO 1817

**FAILURE
CRITERIA:**

Volume change outside of above limits

TUBE / COVER	MEDIUM TYPE	AGING TIME [h]	TEMPERATURE [°C]	MAX. ALLOWED VOLUME CHANGE [%]	PASSED YES / NO
Tube	IRM 903	168	100	60	YES
Tube	Water+Ethanol 50:50	168	70	25	YES
Tube	Water	168	70	25	YES
Cover	IRM 903	168	70	100	YES
Cover	Water+Ethanol 50:50	168	70	100	YES
Cover	Water	168	70	100	YES



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OZONE RESISTANCE TEST

REFERENCE:

ISO 7326 or ASTM D518 Method B

**SAMPLE
NUMBERS:**

Cover material

PROCEDURE:

The samples shall be subjected to the ozone resistance test of ASTM D 380, except the samples shall be bent around a mandrel with a diameter of twice the specified minimum bend radius. The samples shall be subjected to an atmosphere comprised of air and ozone. The ozone concentration shall be specified per the applicable engineering standard in parts per million (ppm) and shall be conducted at an ambient temperature of +40c (104F). **Where space limitations prohibit the use of hose, specimen cover stock may be tested in accordance with ASTM D 518, Method B.

AGING PERIOD:

70 hours (+/- 2 hours)

**OZONE
CONCENTRATION**

50 ppm 100 ppm other ppm (please specify)

**FAILURE
CRITERIA:**

After 70 hours of exposure, the samples shall not show evidence of cracking or deterioration while viewed under 7x magnification and still in the stressed condition.

SAMPLE NUMBER	CRACKS OBSERVED	PASS/FAIL
Cover	No	Pass



ABRASION RESISTANCE OF THE OUTER COVER

REFERENCE :	ISO 6945
PROCEDURE:	150mm±0,5mm length of test pieces shall be used. Before the test, maintain the test sample at least 3h at laboratory conditions. Weight the sample on or off the mandrel and record it. Mount the test sample and the mandrel in apparatus, ensuring that the test piece is restrained from axial movement. Apply the vertical static force and start the machine. Continue until the specified number of cycles reached. Then remove the test sample and reweigh. The loss of mass calculated. 1,25 Hz is the frequency of one cycle motion considering that one cycle equals to 200mm of travel.
SAMPLE NUMBERS:	Cover Compound
TEST CONDITONS:	Force 50(N) / Cycles 2000 (Number)
ALLOWABLE WEIGHT LOSS:	1 gram max.
TEST TEMPERATURE:	23°C ± 2 °C

SAMPLE	PASS/FAIL
Hose Cover	Pass



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ADHESION TESTING

REFERENCE

EN28033

ADHESION REQUIRED

>2,5 N/mm

SAMPLE	MIN. ADHESION REQUIRED [N/mm]	PASSED YES / NO
Hose Inner Tube	>2,5	YES
Hose Cover	>2,5	YES

As adhesion testing is independent from the hose construction (compound related only), specific size not indicated.

CONCLUSIONS:

EC512 hose successfully passed the performance requirement as mentioned in the summary report.

Arup Das

11th Jan'2018