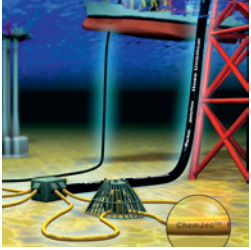
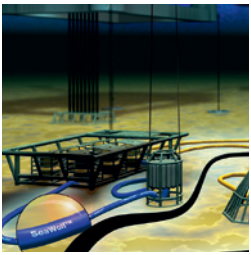
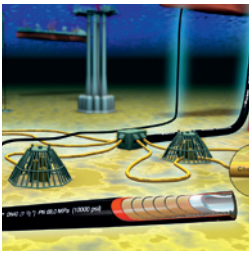




aerospace
climate control
electromechanical
filtration
fluid & gas handling
hydraulics
pneumatics
process control
sealing & shielding



Black Eagle Product Manual

Catalogue 4466-UK

Parker

ENGINEERING YOUR SUCCESS.

Facilities

Hüttenfeld / Germany

Wissembourg / France

Almelo / Netherlands

Ravenna / Ohio

Stafford / Texas

For Your Safety

The hose assemblies listed in this catalogue are all special constructions with the hose having up to eight spiral layers of steel wire. Due to this construction, pressures are achieved which far exceed German and international standards. These hose types are manufactured and tested according to the ***polyflex***® standards which have proved to be effective over many years.

polyflex® hose assemblies are used at considerable working pressures. The critical area of a hose assembly is the connection between flexible hose and rigid fitting (crimping area). Only the use of original ***polyflex***® components (hose, fittings and tooling) and full compliance with the ***polyflex***® assembly instructions can guarantee safety and conformity with standards. It is essential that training be given to customers in the hose assembly process in order to make high quality ***polyflex***® maximum pressure hose assemblies.

For the production and testing of the hose assemblies relevant to the applications, the guidelines and technical regulations as well as the protection and hazard prevention rulings must be adhered to.

You as the manufacturer of ***polyflex***® hose assemblies are obliged to mark these hose assemblies according to the regulations and to verify their safety by a final pressure test.

Non-compliance with these rules can lead to the premature failure of the hose assembly and the loss of warranty.

Contents

DET NORSKE VERITAS

MANAGEMENT SYSTEM CERTIFICATE

Certificate No.: 74824-2010-AQ-GER-TGA

This is to certify that

Parker Hannifin GmbH
Polyflex Division Europe
An der Tuchbleiche 4
68623 Lampertheim - Germany

has been found to conform to the Management System Standard

ISO 9001:2008

This certificate is valid for the following product or service ranges:

Development, production and sales of thermoplastic tubing, high pressure and ultra hight pressure hoses and hose assemblies and of the respective fittings and components.

Initial Certification date:
30.06.2010
This certificate is valid until:
30.06.2013
The audit has been performed under the supervision of
Frank Nicolaus
Lead Auditor

Deutscher Akkreditierungs Rat
TGA-ZM-04-92-00

Place and date:
Essen, 01.07.2010
for the Accredited Unit:
DNV ZERTIFIZIERUNG UND UMWELTGUTACHTER GMBH
Nikolaus Kim
Management Representative

Lack of fulfilment of conditions as set out in the Certification Agreement may render this Certificate invalid.
DNV Zertifizierung und Umweltgutachter GmbH, Schnieringshof 14, 45329 Essen, Tel: +49 201 7296 300 Fax: +49 201 7296 333 - www.dnv.de/zertifizierung

1 Introduction

Hoses for oilfield applications

This product manual provides details about design, qualification tests, application and recommended practices for the use of BLACK EAGLE family in oilfield applications.

About Parker Hannifin

The Polyflex division of Parker Hannifin has been supplying a wide range of thermoplastic hose products to the oil and gas market for over 30 years.

With production plant in Europe supported by Parker's global sales and distribution network, customers can benefit from local service and the supply of quality parts wherever they are situated.

With annual sales exceeding $10 billion in fiscal year 2009, Parker Hannifin is the world's leading diversified manufacturer of motion and control technologies and systems, providing precision-engineered solutions for a wide variety of mobile, industrial and aerospace markets. The company employs approximately 52,000 people in 48 countries around the world.

2 Product description

BLACK EAGLE family is a series of multi-spiral wire reinforced hoses specifically designed for oilfield applications.

- Working pressure from 5,000 psi (345 bar) up to 15,000 psi (1035 bar)
- COLORGARD, dual colour safety feature with extra thick cover for superior abrasion resistance
- Long continuous lengths, no splicing – up to 9800 ft (3000 m)
- Polyamide (PA11) core tube and Fluorpolymer technology for cleanliness
- Temperature up to 158 ° F (70 ° C), short term 125 °C
- Smaller OD than flexible pipe allows more hose per reel
- Excellent chemical resistance providing long service life

3 Field application

• Well services:

For many years this range of hoses have enabled our customers to optimize well production by performing operations such as: acidizing, well abandonment, well stimulation and maintenance of subsea facilities.

• Well intervention:

A light weight intervention (LWI) application for offshore projects, the hose is used as a fluid connector from dynamically positioned intervention vessels to subsea intervention devices or subsea trees.

Polyflex hoses improve operational efficiency with a portfolio of pumping and kill lines that can be deployed in single lengths up to 3000 meters for offshore operations, faster and safer with less connections and less risk to personnel.

• Drilling rig equipment

High pressure circulating mud system, flow line, cementing skid on board platforms, high pressure pumping lines etc.

• Offshore – Subsea services

This is the most challenging application in this subsector of the oil and gas industry. Seawater resistance and fast impulse response time. Typical continuous length up to 3,000 meters with max working pressure up to 15,000 psi.

4 Benefits

- Improve operations and reduction of labor due to easier handling and quicker deployment.
- External thermoplastic sheath is up to 15 times more resistant to environmental impacts and working conditions than rubber materials, reducing maintenance cost and frequent hose replacements.
- 70% Lighter than flexible pipe and 45% than rigid pipe.
- Eliminates the joining and potential for leakage therefore avoiding spills and environmental damage
- Safer field operations and less risk to personnel in pressure management

5 Construction method

Polyflex hoses are designed to meet the criteria of the following oilfield considerations:

- Compositions of fluids
- Temperatures and pressures
- Short-term pressure fluctuations
- Static and dynamic loads

Thermoplastic core tube: The first requirement of a hose is to contain and transmit a fluid or gas. The core tube of a thermoplastic hose has this function. The selection of core tube is dependent on fluid compatibility, service temperature, and diffusion rate under operating conditions. The materials selected include:

Polyamides (PA11)	It is used in high-performance applications for oil and gas flexible pipes and control fluid umbilicals. Wide range of working temperatures (-40°C / +70°C), high dimensional stability and low density.
Fluropolymer technology	Designed for use in chemical injection systems, in response to Oil and gas market moving into HT/HP environments. Low permeability and excellent chemical resistance combined with higher working temperatures. Proven to handle methanol at 100 °C and 15,000 psi working pressure. Core tube with reduced rate of permeation by a factor of at least 50.

Thermoplastic core tubes are manufactured by continuous extrusion without mandrel. Dimensional control by vacuum calibration results in an extremely smooth and clean inner surface. This provides minimum flow resistance and pressure drop in service.

Reinforcement with wire spiral technology: The reinforcement allow flexibility in service without compromising fluid transportation under pressure, the core tube is reinforced by several layers of steel wire. Various tensile wires are used to arrive at the optimum combination of pressure, flexibility, finished dimensions and volumetric expansion.

External thermoplastic sheath: The function of this cover is to protect all wire reinforcement layers from aggressive actions of the working conditions and environmental impacts.

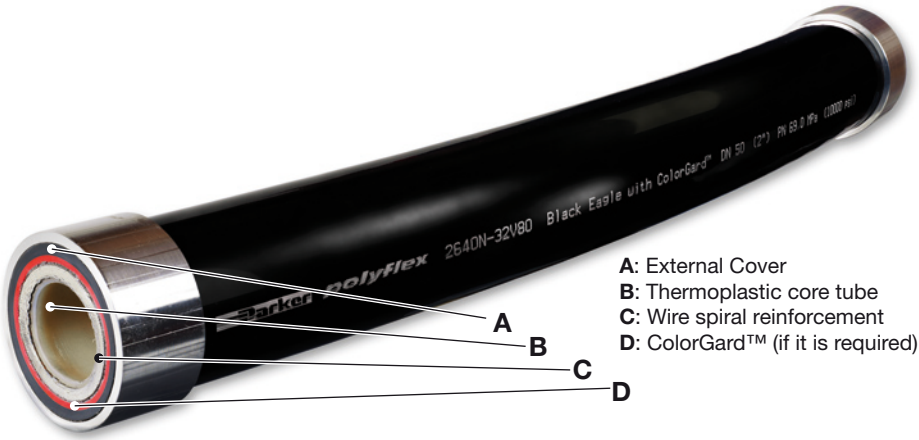
Comparative abrasion tests according international standards measure the material weight loss in determined number of reciprocating cycles against a sharp surface. This procedure gives comparative measurements among various material used in hose construction.

Comparative abrasion tests according international standards measure the material weight loss in determined number of reciprocating cycles against a sharp surface. This procedure gives comparative measurements among various material used in hose construction.

Polyamides	This material offers good properties compared to rubber, it can be further improved by the use of special additives to give even better performance, 24 mg of material loss
Polyurethane (TPU)	The best abrasion resistance material widely used in thermoplastic hoses where this feature is critical, 3 mg of material loss.
Polyvinylidenefluoride (PVDF)	Excellent abrasion resistance 5 mg of material loss

Reference: Taber abrasion, CS17 wheel, 1000 gm weight, 5000 revolutions, Ref: Handbook of Thermoplastic Elastomers, Litton Educational Publishing, 1979

Cover COLORGARD: For extreme conditions additional protection is added by incorporating a dual color extra thick sheath as a visual safety feature. This concept is an early warning system for detection of excessive abrasion. This feature avoids possible injuries and reduction of downtime by anticipating failure.



A: External Cover
B: Thermoplastic core tube
C: Wire spiral reinforcement
D: ColorGard™ (if it is required)

6 Overview of Hoses

PHalcon + ColorGard®

#						Max. length		Collapse pressure
	size *DN*	inch *mm*	inch *mm*	psi *MPa*	psi *MPa*	ft *m*	lbs/ft *kg/m*	psi *MPa*
2440N-16V80	-16 *25*	1 *26.0*	1.77 *45.0*	7,500 *51.7*	30,000 *207.0*	6,550 *2,000*	2.02 *3.00*	900 *6.5*
2440N-24V80	-24 *40*	1 1/2 *38.0*	2.56 *65.0*	5,000 *34.5*	20,000 *138.0*	4,900 *1,500*	2.82 *4.20*	950 *6.5*
2448N-32V80	-32 *50*	2 *50.5*	3.17 *80.5*	5,000 *34.5*	20,000 *138.0*	3,280 *1000*	5.71 *8.50*	710 *4.9*

Black Eagle + ColorGard®

#						Max. length		Collapse pressure
	size *DN*	inch *mm*	inch *mm*	psi *MPa*	psi *MPa*	ft *m*	lbs/ft *kg/m*	psi *MPa*
2640N-16V80	-16 *25*	1 *26.0*	1.57 *40.0*	15,000* *103.5**	43,500 *300.0*	5,900 *1,800*	1.95 *2.90*	1,200 *8.0*
2640N-24V80	-24 *40*	1 1/2 *38.0*	2.76 *70.0*	10,000* *69.0**	33,350 *230.0*	4,900 *1,500*	4.85 *7.20*	950 *6.5*
2580N-32V80	-32 *50*	2 *50.5*	3.31 *84.0*	10,000* *69.0**	25,000 *172.5*	1,970 *600*	6.31 *9.40*	826 *5.7*
2440N-48V80	-48 *78*	3 *75.0*	4.80 *122.0*	10,000* *69.0**	25,000 *172.5*	1,476 *450*	12.5 *18.60*	580 *4.0*
2640N-48V80	-48 *78*	3 *75.0*	5.12 *130.0*	15,000* *103.5**	33,750 *233.0*	1,300 *400*	18.5 *27.50*	1,160 *8.0*

Golden Eagle + ColorGard®

#						Max. length		Collapse pressure
	size *DN*	inch *mm*	inch *mm*	psi *MPa*	psi *MPa*	ft *m*	lbs/ft *kg/m*	psi *MPa*
2640M-16V88	-16 *25*	1 *26.0*	1.57 *40.0*	10,000* *69.0**	33,350 *230.0*	6,550 *2,000*	1.95 *2.90*	900 *6.5*
2640M-24V88	-24 *40*	1 1/2 *38.0*	2.78 *70.5*	10,000* *69.0**	33,350 *230.0*	4,900 *1,500*	4.84 *7.20*	940 *6.5*
2448M-32V88	-32 *50*	2 *51.0*	3.17 *80.5*	5,000 *34.5*	20,000 *138.0*	3,280 *1000*	5.71 *8.50*	710 *4.9*
2580M-32V88	-32 *50*	2 *51.0*	3.33 *84.5*	10,000* *69.0**	25,000 *172.5*	3,280 *1000*	6.32 *9.40*	940 *6.5*

product under development. All values for these hoses are estimated ones.

*: working pressures for these hoses are based on safety factors lower than 4:1.

For detailed hose datasheets, see Section 10.

Temperature ranges

Phalcon/Black Eagle	Low	High
	–40 °C –40 °F	70 °C 158 °F

Golden Eagle	Low	High	Short term
	–40 °C –40 °F	100 °C 212 °F	125 °C 257 °F

7 Qualification tests

7.1 Lab tests

Before Polyflex hoses and fittings enter the market, they are subjected to a rigorous test program. With the specialized test equipment the hoses and fittings are verified according to recognized international standards such as:

- ISO 13628-5:2009 Petroleum and natural gas industries - Design and operation of subsea production systems -- Part 5: Subsea umbilicals
- API SPEC 17J Specification for Unbonded Flexible Pipe.
- API SPEC 16C Specification for Choke and Kill Systems.

Test	Standard	Objective
Visual and dimensional check	ISO 13628-5:2009 Section 7.3.7.3	One sample of 150 mm (5,91 in) minimum length shall be taken from each end of a manufactured hose length. During the dimensional tests, the hose shall be visually examined and shall be free from damage, irregularities and visual non-conformances in each part of the construction. Measurements of the following parameters of each sample shall be made in accordance with the manufacturer‘s written procedure: – internal diameter; – diameter over reinforcement; – external diameter; – hose concentricity; – liner wall thickness. The manufacturer‘s written specification shall include a dimensional specification for the hose, clearly stating the values and manufacturing tolerances for all the above parameters.
Change-in-length test	ISO 13628-5:2009 Section 7.3.7.4	Two samples taken from each manufactured hose length measured between hose end and fittings not less than 400 mm (15,75 in), following the change-in-length test for hydraulic hoses specified in ISO 1402.
Burst test	ISO 13628-5:2009 Section 7.3.7.6	One sample shall be taken from each end of a manufactured hose length and assembled with the intended material and design of end fitting incorporated at each end of each sample. Two further samples shall be prepared with a minimum of one splice in the reinforcement of each sample made in accordance with the manufacturer‘s written specification. These particular samples shall be clearly marked showing the position of each splice. The sample length, measured between the hose end fittings, shall not be less than 400 mm (15,75 in). Each sample shall be tested using the burst pressure test for hydraulic hoses specified in ISO 1402 at the standard laboratory/ambient temperature. Test results for samples with splices and samples without splices shall be recorded. The burst pressure shall not be less than the value specified in the specification.
Pressure cycling test	Polyflex Standard	The unique construction of the black eagle family crosses de boundaries between hydraulic applications and API applications. Therefore the testing criteria incorporated the relevant elements of API-16C and ISO 13628-5.

Test	Standard	Objective
Cold bend test	ISO 13628-5:2009 Section 7.3.7.8	One sample shall be taken from the end of a manufactured hose length. The sample length, measured between the hose end fittings, shall not be less than 400 mm (15,75 in). The test shall be carried out in accordance with the cold flexibility test in accordance with ISO 4672:1997, method B, where the test temperature is –40 °C ± 3 °C (–40 °F ± 5 °F). The sample shall fail the test if any signs of leakage, distortion or cracking are apparent.
Collapse test	ISO 13628-5:2009 Section 7.3.7.9	A sample of hose, with a length of not less than 500 mm (19,69 in) between end fittings, shall be installed in a pressure vessel and bent to its minimum bend radius. The hose shall be filled with water until the water reaches a burette on the end of the hose. The vessel shall be filled with water and the pressure gradually increased at a rate in accordance with the manufacturer's written specification. As the pressure increases, there is an increase in fluid volume expelled into the burette at a small but discernible rate. The pressure at which this volume rapidly increases shall be noted. This is the pressure at which the hose has collapsed.
Volumetric expansion test	ISO 13628-5:2009 Section 7.3.7.10	Representative sample shall be subject to volumetric expansion testing in accordance to ISO 6801, the results from this test shall be used to characterize a hose design and do not constitute acceptance/rejection criteria.
Material Certificates	ISO 9001	Certified Material Test Reports Raw material quality assurance
Third Party Certification	DNV Lloyd's Bureau Veritas SGS	When required by customers

7.2 Compatibility tests

Verified by Third party external labs:

- Materials Engineering Research Laboratory Limited (MERL) - Hertfordshire, UK
- Zwick GmbH & Co KG – Ulm, Germany
- Laboratorio Prevenzione Incendi SPA (LAPI) – Prato, Italy

Test	Standard	Objective
H2S permeation-Sour Gas testing	API 17J ISO 13628-2 RP 17B	Verify the performance in sour service conditions, this test may be used to generate realistic sour service environment in the pipe annulus containing the steel wires and at the cable surface, injection of mixture H2S/Co2. A burst test should be carried out in stages, raising the pressure by 20% of the design from the exposed test pressure with a hold time of at least 3 hours between each step.

Test	Standard	Objective
Nitrogen Permeability Test - Blistering Resistance Rapid Gas Decompression (RGD	API 17J Section 6.2.3.2 ISO 13628-2 RP 17B	Blistering resistance tests shall reflect the design requirements, relating in particular to fluid conditions, pressure, temperature, number of decompressions, and decompression rate. As a minimum, the following conditions shall apply: a. Fluid mixtures - Use gas components of specified environment as documented in the test procedure. b. Soak time-Use sufficient to ensure saturation. c. Test cycles-If available, use expected number of decompressions, or else use 20 cycles as a minimum. d. Decompression rate-If available, use expected decompression rate, or else use as a minimum 70 bar per minute. e. Thickness-Internal pressure sheath wall thickness as a minimum. f. Temperature-Use the expected decompression temperature. g. Pressure-Use design pressure as a minimum. h. Procedure-After each depressurization the sample shall be examined at a magnification of ×20 for signs of blistering, swelling, and slitting. The acceptance criteria shall be that no blister formulation or slitting is observed.
Liquid permeation through hose liners – Methanol	ISO 13628-5 ISO 8308	It is a requirement of ISO 13628-5:2001, that liquid permeability testing to ISO 8308 be undertaken. This standard specifies two methods for the determination of transmission of liquids through hose liners.
Tensile strength Pull tension test	ASTM E8 D638	Tension tests provide information on the strength and ductility of materials under axial tensile stress. This information may be useful in comparisons of materials, alloy development, quality control, and design under certain circumstances. These test methods are considered satisfactory for acceptance testing of commercial shipments. The test methods have been used extensively in the trade for this purpose.
Fire testing	ISO 15540:1999	This International Standard specifies a test procedure for determining the fire resistance of hose assemblies with nominal diameters of at least 100 mm. It serves for proving whether, after the period of fire effect on the test bench specified in ISO 15541, hose assemblies continue to be tight, even when subjected to proof pressure. Only water is permitted as a test medium. With a view to ensuring maximum safety for both the operating personnel and the test bed in the event of damage to the hose during the test, the use of combustible test media is excluded.

7.2.1 H_2S permeation (Sour gas testing)

This test describes the exposure testing undertaken to determine whether permeation of sour gas through the lining of Black Eagle series can cause deterioration of the wire reinforcement. The assessment followed procedures and recommendations laid down in API standards 17J (Specification for Unbounded Flexible Pipe) and RP17B (Recommended Practice for Flexible Pipe).

The assessment of the hydrogen sulphide (H2S) resistance of Black Eagle series was completed. The exposure to 2% of H2S at working pressure (WP) during 30 days was followed by a proof testing at 1.5 times WP while 20 times. No leaks or failure was detected. The hose was exposed to another exposure cycle of 47 days and again proof testing 20 times. The burst testing result showed, the hose exceeded by 20% the minimum burst test pressure rated after the H2S exposure.

Black Eagle hose is to perform over the long term in sour environments up to 2% H2S without deterioration. Analysis of the reinforcement wires by scanning electron microscope (SEM) showed only ductile failure of the wires at the burst region confirming that sulphide stress corrosion cracking was not an issue.

7.2.2 Nitrogen Permeability Test - Blister testing

Black Eagle hose was pressure tested to determine whether permeation through the liner was sufficient to cause blistering of the cover or pressure build-up in the carcass of the hose occurs in the short term with applications that include annulus venting and chemical injection lines in well intervention.

- The hose was pressurized with the test gas (N2) to working pressure and allowed to soak for a period of 24 hours. During this time the test pressure and temperature were maintained.
- The hose was decompressed at a rate of 70 bar/min and the hose cover visually inspected for signs of blistering.
- After leaving for at least 12 hours, the pressure cycles were repeated a further two times (with a total test period of 7 days).
- During this time, no leakages at the connections were observed, no ballooning of the cover was seen and there were no other signs of permeation.

The 3 decompression cycles were completed during a total period of 7 days. Th objective of this test is the evaluation of evidence of blistering or slitting of the outer cover.

These were qualification tests according to API 17J / ISO 13628-2:2000, Section 6.2.3.2, “Flexible Pipe Systems for Subsea and Marine Applications”, Section 6.2.3.2. No evidence of decompression damage (e.g., blistering, slitting) was found in the hose PA 11 (Methanol washed) liner after each multi-cycle test. Hence the hose passed the test by meeting the acceptance criterion of no blister formation or slitting observed, at 20X magnification.

Figure. Photograph of hose cover after the N2 pressure test

7.2.3 Methanol permeation

Parker Polyflex wished to demonstrate the improved permeability of Coextruded Fluorpolymer based hose –Golden Eagle when compared to the current – Black Eagle

It is a requirement of the new ISO standard (ISO/FDIS 13628-5:2001 (E)) that liquid permeability testing to ISO 8308 be undertaken. This standard specifies two methods for the determination of transmission of liquids through hose liners. For this work, method A was used as a practical comparative test, simulating service conditions.

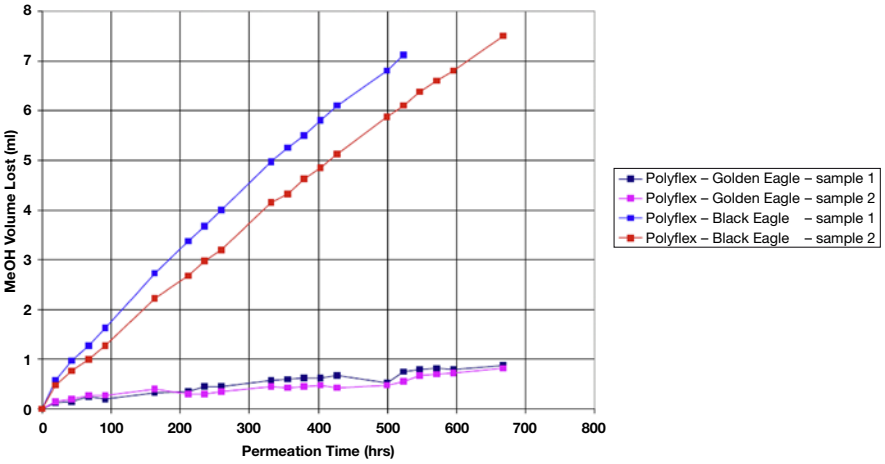
The liquid permeability of methanol at 60ºC through two Parker Polyflex hose types has been determined in accordance with ISO 8308. The hose identities were:

- Co-extruded Fluorpolymer based hose –Golden Eagle
- Polyamide (PA11) hose – Black Eagle

After 30 days of permeation testing none of the hoses tested showed any visible external sign of blistering or other deterioration.

Permeation rates for each sample tested are shown in the following Table.

Black Eagle Polyamide (PA11)	After 30 days of permeation testing none of the hoses tested showed any visible external sign of blistering or other deterioration at 60ºC Permeation rate 43.93 [g.mm/m^2/day]
Golden Eagle Fluropolymer technology	The test results showed that the Parker Polyflex co-extruded Fluorpolymer based hose has reduced methanol permeation rates at 60ºC when compared with the PA11 Permeation rate 4.80 [g.mm/m^2/day] The average permeation rate for co-extruded Fluorpolymer based hose is reduced by a factor of approximately nine when compared with the PA11



Note: For more information see general chemical resistance table

7.2.4 Tensile strength

Parker Black Eagle hose has been manufactured since several years, long length production capability has attracted great interest within the offshore industry for existing and new applications. Lab tests were done to obtain maximum tensile axial loads; when Black Eagle operates under critical working conditions, for both onshore and offshore applications.

The reason of this test was to determine the hose change in length behavior under tensile load with and without internal pressure. To determine maximum tensile load and confirm that the hose may be used under tensile load. The information should be taken in the context that a hose assembly should not normally be exposed to tensile loads. Any external loads applied to a hose or hose assembly may result in premature failure.

Test Samples and Procedure

- Black Eagle assemblies fitted, were prepared using the standard Polyflex assembly procedure
- Assemblies were proof tested prior to the tensile testing. The hoses used in the assemblies were from different production batches
- Special connections were also prepared to make connection to the tensile machine possible

The first test procedure was to extend the hose to set levels and determine the resultant tensile load. At each stage of the testing the extension was held for one minute to assess if there was any marked decrease in the tensile load

The second procedure was to hold the assembly at a set elongation for fifteen minutes, again to see if there was any marked decrease in the tensile load or failure.

Yield strength values in the following table refer to the point on the engineering stress strain curve beyond which the material begins deformation that cannot be reversed upon removal of the loading. All values with safety factor.

Hose part number	Max. recommended tensile loads
2448N-32V80	20KN
2640N-24V80	20KN
2580N-32V80	35KN
2440N-48V80	70KN
2640N-48V80	100KN
2640M-24V88	20KN
2448M-32V88	20KN
2580M-32V88	35KN

7.2.5 Hose flexibility and bending

Flexibility and minimum bending radius are important factors in the design and selection of hoses, especially if the hose is to be subject to extreme bending during use, this test was carried on accordingly to ISO 13628-5 Section 7.9.7.8
The radius is measured when the hose is in service at proof test (1.5 x WP), this procedure is designed to simulate the effect of flexing of any Black eagle hose under similar conditions.

Conclusions

The tests help to confirm Black Eagle hoses as being a tough, resilient hose ideally suited to the offshore environment.

Test to establish the effect of continuous flexing on the reinforcement layers when the hose is pressurized.

- Assembly length approx. 3 m.
- Specified minimum dynamic bend radius 1,25 m.
- Specified test pressure 1.035 bar (15.000 psi).
- Hose assembly cycled in a circular motion @ 10 cycles/ 65 sec.
- Specified cycles: min. 50.000.
- Actual results , 85,000 cycles at 15,000psi, no failure,
- After flexing , assembly proof tested for 1 hour at 1,5 x WP (1.555 bar, 22.500 psi). No Failures.

Effects of decreasing the minimum recommended bending radius:

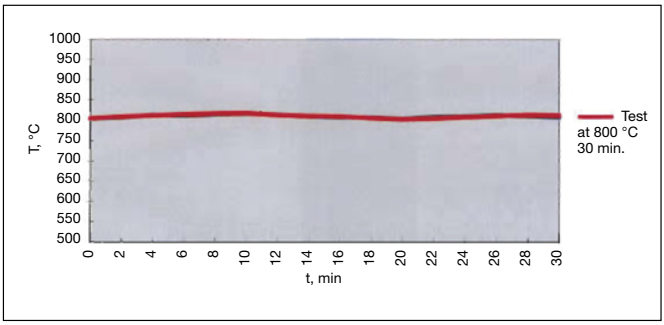
- Hose can kink creating damage in the reinforcement, polymeric cover and inner liner.
- Contraction in the hose cross-section, compromising flow rate
- Reduction of service life of the hose
- Operational and Safety issues

Black eagle hoses are designed for safe operation down to -40 deg C, with not presence of cracks, failures or leakages. The minimum bending radius of Black eagle hose is indicated in this catalogue.

7.2.6 Fire testing

ISO 15540:1999 Ships and marine technology -- Fire resistance of hose assemblies, the scope of work of this standard cover standardization of design, construction, equipment and technology for piping and machinery used in shipbuilding and the operation of ships, comprising sea-going ships, fishing vessels and trawlers, vessels for inland navigation, offshore structures, ship-to-shore interfaces, and all other marine structures subject to IMO requirements. Lab test done in Laboratorio de Prevenzione Incendi srl.

Test conditions:	
Working pressure during the test:	5 +/- 0.2 bar.
Duration of flame application:	30 min
Water flow velocity:	0.1 m/s
Static pressure following flame application:	1360 bar
Duration of static pressure load following flame application: 2 min	



The temperature of the test medium in front of test specimen was 80 °C +/- 2 °C, being the medium behind test specimen 85 °C +/- °2 C. The flame temperature was 800 °C +/- 50 °C, with actual test duration of 30 min. The measurement records showed satisfactory results.

8 Chemical resistance

Ratings code

Symbol	Meaning	Explanation
–	Swelling	Indicates that this was not tested. Increase of volume of material, due to absorption of a solvent.
X	Unsatisfactory	Poor or unsatisfactory. Not recommended without extensive and realistic testing.
B	Limited	Marginal or conditional. Noticeable effects but not necessarily indicating lack of serviceability. Further testing suggested for specific application. Very long-term effects such as stiffening or potential for crazing should be evaluated.
A	Good	Good. Little or no swelling, tensile or surface changes. Limitations with temperature and type of fluid.
E	Excellent	Good to excellent. Little or no swelling, tensile or surface changes. Preferred choice.

Materials for hose core tubes

Hose	Material
Black Eagle	Polyamide (PA11)
Golden Eagle	Coextruded tube with Fluorpolymer inner liner

Notes on the chemical resistance table

(1) The fluid resistance tables are simplified rating tabulations based on immersion tests at 24° C. Higher temperatures tend to reduce ratings. Since final selection depends on pressure, fluid and ambient temperature and other factors not known to Parker Hannifin , no performance guarantee is expressed or implied. The indications do not imply any compliance with standards and regulations and do not refer to possible changes of colour, taste or smell. For food and drinking water specially approved materials have to be used. For fluids not listed or for advice on particular applications, please consult Parker Hannifin GmbH, ***polyflex***™ Division in Hüttenfeld, Germany.

(2) Hose applications for these fluids must take into account legal and insurance regulations. The chemical resistance indicated does not express or imply approval by certain institutions.

(3) Satisfactory at some concentrations and temperatures, unsatisfactory at others.

(4) For gas applications, the cover should be pin-pricked and the pressure must not be released quickly. Special safety guard accessories are to be used to prevent damage or personal injury in the event of failure.

(5) Chemical resistance does not imply low permeation rates. Please consult Parker Hannifin for a recommendation for your specific requirements.

(6) The indication of chemical resistance does not imply any special food compatibility; it refers only to the chemical resistance of the material.

(7) Chemical resistance does not imply acceptability for use in airless paintspray applications. These applications require a special, electrically conductive hose.

Not all remarks may apply to Oil&Gas products

Fluid	Concentration	Black Eagle Polyamide (PA11)			Golden Eagle Fluoropolymer
		20°C (68°F)	40°C (104°F)	60°C (140°F)	100°C (212°F)
Acetaldehyde		A	B	X	A
Acetic Acid	5%	A	A	X	E
Acetic Acid	10%	A	A	B	E
Acetic Acid	50%	B	X	X	E
Acetic Anhydride		B	X	X	E
Acetone	Pure	A	A	A	A
Acetylene		A	A	A	-
Aluminium Sulfate	Sat. Sol	A	A	A	A
Ammonia	Liquid or Gas	A	A	A	A
Ammonium Chloride		A	A	A	A
Ammonium Hydroxide	Concentrated	A	A	A	A
Ammonium Nitrate		A	A	A	A
Ammonium Sulfate	Saturated Solution	A	A	B	E
Amyl Acetate		A	A	A	A
Aniline		B	X	X	E
Barium Chloride	Saturated Solution	A	A	A	A
Benzaldehyde		A	B	X	E
Benzene		A	A	B	E
Bezyl Alcohol		A	B	X	E
Butane		A	A	A	A
Butyl Alcohol		A+	B	X	E
Calcium Arsenate		A	A	A	A
Calcium Chloride	Saturated Solution	A	A	A	A
Calcium Nitrate		A	A	A	A
Camphor		A	X	X	A
Carbon Disulfide		A	B	X	A
Carbon Tetrachloride		B	X	X	A
Cement Slurry		A	A	A	A
Chloroform		B	X	X	E
Chromic Acid		B	X	X	E
Citric Acid	Saturated Solution	A	A	B	E
Copper Sulfate		A	A	A	A

Fluid	Concentration	Black Eagle Polyamide (PA11)			Golden Eagle Fluoropolymer
		20°C (68°F)	40°C (104°F)	60°C (140°F)	100°C (212°F)
Cyclohexane		A	A	B	A
Cyclohaxanol		A	B	X	E
Cyclohexanone		A	B	X	E
Chlorinated Solvents		B	X	X	E
Diammonium Phosphate		A	A	B	E
Dichloroethyle		B	X	X	E
Diesel		A	A	A	A
Diethanolamine	20%	A	A	A	A
Diethyl Ether		A	X	X	E
Dioctylphthalate		A	A	A	A
Ethanol Pure		A	B	X	E
Ethyl Acetate		A	A	A	A
Ethylene Glycol		A	A	B	E
Ethylene Oxide		A	A	B	E
Fatty Acid Esters		A	A	A	A
Formaldehyde	Technical	A	B	X	E
Formic Acid	9%	A	B	X	E
Furfuryl Alcohol		A	A	B	E
Gas	Coal	A	A	X	A
Gasoline (High Octane)		A	A	A	A
Glucose		A	A	A	A
Glycerine	Pure	A	A	B	E
Glycol		A	A	B	A
Heptane		A	A	A	A
Hydrogen		A	A	A	A
Hydrogen Peroxide	20%	A	B	X	E
Hydrochloric Acid	15%	A	B	B	E
Hydrochloric Acid	25%	X	X	X	E
Hydrochloric Acid	37%	X	X	X	A
Hydrofloric Acid	3%	A	B	X	E
Isocyanates		B	X	X	E
Isopropyl Alcohol		A	X	X	E

Fluid	Concentration	Black Eagle Polyamide (PA11)			Golden Eagle Fluoropolymer
		20°C (68°F)	40°C (104°F)	60°C (140°F)	100°C (212°F)
LP-Gas		A	B	X	E
Kerosene		A	A	B	A
Latic Acid		A	A	A	E
Magnesium Chloride	50%	A	A	A	A
Mercury		A	A	A	A
Methane		A	A	B	E
Methanol	Pure	A	B	B	E
Methyl-Cellosolve		A	A	A	A
Methyl-Acetate		A	A	A	A
Methyl-Bromide		A	X	X	E
Methyl-Chloride		A	B	X	E
Methyl-Sulfate		A	A	B	E
Methyl Ethyl Ketone		A	A	B	-
Methyl Isobutyl Ketone		B	X	X	E
Monochlorobenzene		A	A	A	A
Natural Gas		A	B	X	E
Naphta		A	A	A	A
Naphtaleno		A	A	A	A
Nitrogen Gas		A	A	B	E
Oil Crude		A	A	A	A
Oils Refined		A	A	A	A
Oleic Acid		A	A	A	A
Oxalic Acid		A	A	B	E
Perchloroethylene		B	X	X	E
Phosphoric Acid	40%	A	B	X	E
Petroleum Ether		B	X	X	E
Picric Acid		B	X	X	E
Perchloric Acid		B	X	X	B
Potassium Carbonate		A	A	B	E
Potassium Chloride		A	A	B	E
Potassium Hydroxide	50%	A	B	X	E
Potassium Nitrate		A	B	X	E

Fluid	Concentration	Black Eagle Polyamide (PA11)			Golden Eagle Fluoropolymer
		20°C (68°F)	40°C (104°F)	60°C (140°F)	100°C (212°F)
Potassium Sulfate		A	A	A	A
Propane		A	A	A	A
Pydraul F9		A	A	A	A
Pyridine	Pure	B	X	X	E
Sodium Carbonate	Saturated Solution	A	A	B	E
Sodium Chloride	Saturated Solution	A	A	A	A
Sodium Hydroxide	50%	A	B	X	E
Sodium Hypochlorite	Concentrated	B	X	X	E
Sodium Hypochlorite	Dilute Commercial	A	B	X	E
Sodium Sulfide		A	B	B	E
Stearin		A	B	B	E
Stearic Acid		A	A	A	A
Styrene Monomer		A	A	B	E
Sulfic Anhydride		B	X	X	E
Tartaric Acid		A	A	A	A
Tettraethyl Lead		A	X	X	E
Tetrahydrofurane		A	A	B	E
Toluene		A	A	B	E
Trichloroethane		B	X	X	E
Trichloroethylene		B	X	X	E
Tricresyl Phosphate		A	A	A	A
Tributyl Phosphate		A	A	A	A
Trisodium Phosphate		A	A	A	A
Tributyl Phosphate		A	A	B	A
Turpentine		A	A	B	A
Urea		A	A	B	E
Uric Acid		A	A	A	A
Vinager		A	A	A	A
Water		A	A	A	A
Sea Water		A	A	A	A
Soda Water		A	A	A	A
Xylene		A	A	B	E
Zinc Choloride		A	A	B	E

9 Handling, maintenance, inspection and safety – PDFE ES-28

Parker engineering manual

INSTRUCTIONS FOR THE HANDLING, MAINTENANCE, INSPECTION AND REPAIR OF PARKER POLYFLEX LARGE BORE (1” – 3”) HOSES AND ASSEMBLIES USED IN OIL & GAS APPLICATIONS

Parker Publication No. PFDE-ES28
Revised: 18 August 2010

1 SCOPE

This engineering standard is focused mainly on larger bore (1”-3”) long length Parker Polyflex multispiral wire reinforced hoses used in well service operations. It is also relevant for shorter length hose assembly applications such as chemical injection, stimulation, cementing, flexible and testing lines. It provides information on recommended practices for handling, maintenance, inspection, and repair of hose assemblies.

Deployed as single line hoses or used in bundles, the hoses are available in sizes from 3/16” to 3” inside diameter and working pressures up to 1035bar/15,000psi and continuous lengths greater than 3000m depending on size.

Hose can be self supporting, clamped, supported by a guide wire or strengthened with an additional tensile reinforcement.

Parker Polyflex have certified several specialized testing facilities and their personnel to assemble, inspect, test and repair hose assemblies. Hose management is an essential part of the service they provide.

SAE J1273 and API RP 17B and ISO 13628 are excellent documents providing general guidelines for selection, routing, fabrication, installation, replacement, maintenance, and storage of hose and hose assemblies. Together with Parker Polyflex field experience, they provide the basis for the recommendations included in this engineering standard.

2 HOSE FEATURES

Parker Polyflex Oil & Gas multispiral wire reinforced hoses have been used for over 30 years in both onshore and offshore applications. They are proven to be tough, easy to handle, lightweight compared with alternatives and offer excellent chemical resistance, integral external collapse, ozone and microbiological resistance.

In extreme, abrasive applications, Polyflex offers an additional extra thick ColorGard™ sheath incorporating a dual colour “early warning” safety feature.

3 STORAGE

Hoses and hose assemblies should be stored, wherever possible, protected from the elements in a stress free condition either straight, in a coil, or on a drum. The inside diameter of the coil or drum should not be less than two times the minimum bend radius.

The fittings should be capped to prevent ingress of dirt or other contamination and any exposed threads protected from damage.

Storage of hoses and hose assemblies should take into account potential exposure to corrosive liquids, rodents, insects, UV light and high temperatures.

4 HANDLING

4.1 Personnel

Only trained personnel shall handle and connect hose assemblies.

Incorrect handling will seriously reduce the lifetime of the hose and could cause dramatic failure. The use of wire rope or chains directly against the outer cover should be avoided, and the routing of the assembly should ensure the hose is never bent below its minimum bend radius or twisted. Special attention should be paid to the area at the back of the fitting.

4.2 Spooling and reeling

When reeling long length hose onto a drum it is essential to minimize the tension on the hose. Proof testing of a “stretched” hose while on the drum can cause premature failure of the hose or damage to the drum.

When operating from a vessel it is recommended that the hose is pressurized during the subsea deployment and retrieving operation. This recommendation is based on the fact that during these operations the hose is always subjected to tensile force, at least due to its own weight. Tensile forces will result in hose elongation and possible deformation.

This is significantly reduced by pressurizing the hose, especially important if it is planned to proof test the hose assembly while coiled on a drum or winch. Deployment and retrieving pressures up to 200 bar had been found to be sufficient but this depends on the hose type and local safety regulations. For recommendations of pressure / load values see appendix 2.

When re-spooling a long length assembly, the pay-off and take-up drums should be inline and a minimum of 10m apart. The hose shall also be spooled from the top of the pay-off drum onto the top of the take-up drum. See Fig. 1.

It is also recommended, when deploying the hose though a moon pool or over the side of a vessel, to align the hose routing in the same manner. See Fig 2.

Note: When first supplied, the layline printed on the hose is normally straight and visible. Twisting of the layline is an early indication of poor alignment or high tensile loading.

Fig.1 Hose re-spooling

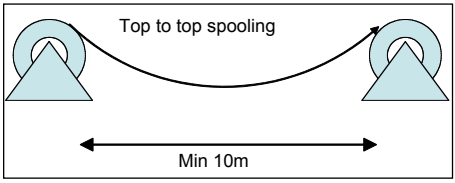
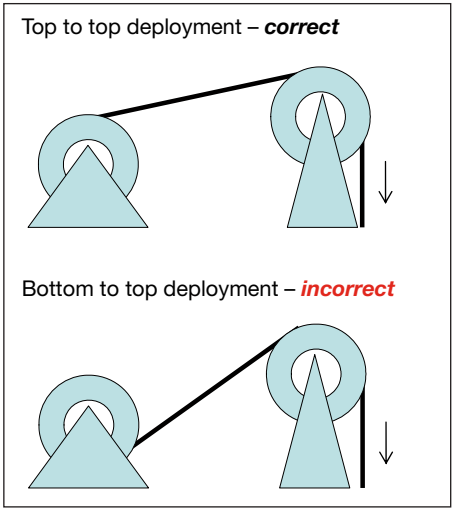


Fig 2 Hose deployment.



5 POSSIBLE CAUSES OF PREMATURE FAILURE, AND SUGGESTED PREVENTATIVE MEASURES

5.1 Bending the hose below the minimum bend radius

This is most likely to occur if the end fitting is not supported during lifting, a support sling wrongly positioned, or the hose being pulled round a tight corner. It is important that hose should not be bent close to the end fittings. The straight section should be at least two times the outside diameter of the hose before it starts to bend.

Bend restrictors, lifting clamps and containment grips are useful accessories that help to reduce this type of handling problem.

5.2 Damage of the hose cover

Polyflex ColorGard™ extra thick, dual colour cover significantly reduces the risk of exposing the reinforcing wires.

If the outer black cover has been abraded to the point that the “early warning” red inner cover can be seen, but the wire reinforcement has not been exposed, the assembly is still fit for use but shall be scheduled for inspection. Alternatively, a repair according to section 8.1.1 may be considered.

If the hose cover is damaged to the extent that the reinforcing wires are exposed, localized corrosion of the wires could occur causing a progressive reduction in burst pressure, and ultimately failure. If used subsea, a damaged cover will allow water to ingress into the carcass of the hose and could cause the corrosion of the wire reinforcement and/or collapse of the core tube.

It is strongly recommended to immediately remove from service any hose assembly with exposed wires. See also section 8.1.2 for details. A Parker Polyflex specialized testing facility should be contacted and the procedure described in section 7.1.shall be followed.

5.3 Kinked, crushed, or twisted hose

If the assembly has been exposed to a high tensile load causing visible distortion of the hose (kinked, crushed, twisted) it will have an impact on the function and lifetime of the hose. Reduction of burst pressure and external collapse pressure could result in a sudden failure of the hose assembly.

Maintaining pressure in the hose will significantly reduce the risk of such distortion occurring.

5.4 Chemical attack or ageing of the core tube

The use of chemicals at differing concentrations and/or temperatures can have a major effect on the life of a hose and may cause dramatic hose failure. It is important to reference the chemical compatibility chart in the appendix of this document and keep the temperatures and concentrations within the specified limits.

Note: It is critical that the hose is thoroughly flushed with water after each use. If the hose is not flushed, the concentration of the fluid that is left in the assembly can increase and cause localised failure of the core tube.

5.5 Damage or corrosion of the end fitting

Incorrect handling or insufficient flushing after use could result in damage or corrosion of the end fitting. This will make connection difficult, probably cause leakage, and could result in sudden failure of the connection.

5.6 Flow rates

Depending on the abrasive properties of the fluid, high flow rates can result in erosion in the core tube or in the bore of the end fitting. The maximum recommended flow rate is 15 m/sec, although much higher rates have been used short term with non abrasive fluids.

Note: The condition of the core tube and end fittings are checked as part of the full inspection.

6 ROUTINE IN-FIELD PRE JOB MAINTENANCE, INSPECTION AND TESTING

6.1. Routine in-field Pre Job Maintenance, Inspection and testing

The operator shall visually inspect the hose assembly during every deployment. If any of the following conditions are found the hose shall be removed from service and scheduled for inspection.

- Damage to the outer cover which exposes the reinforcing wires.
- Kinked, crushed, or twisted hose.
- Reduction in the outside diameter of the hose
- Blistered, soft, degraded, or loose outer cover.
- Cracked, damaged, or badly corroded fittings.

If in doubt, contact the original supplier or a Parker Polyflex approved testing facility for advice.

Regular in-field pressure testing, (normally required after attaching connectors prior to hose deployment), should be restricted to a test pressure of 1.1 x actual operating pressure, or the maximum stated working pressure of the hose assembly.

6.2 Routine in-field Post Job Maintenance, Inspection and testing.

On completion of each operation both inside and outside hose surfaces should be flushed/ cleaned with sufficient clean water to ensure that all chemicals or residues are fully removed from the hose assembly.

The operator should visually inspect the hose assembly during every recovery. If any of the following conditions are found the assembly should be removed from service and scheduled for inspection.

- Damage to the outer cover which exposes the reinforcing wires.
- Kinked, crushed, or twisted hose.
- Reduction in the outside diameter of the hose
- Blistered, soft, degraded, or loose outer cover.
- Cracked, damaged, or badly corroded fittings.

If in doubt, contact the original supplier or a Parker Polyflex specialized testing facility for advice.

6.3. Recertification of hose assemblies

Parker Polyflex require that all hose assemblies shall be returned to the original supplier or a Parker Polyflex specialized testing facility at least once a year for full inspection/recertification.

The supplier will issue a report detailing the condition of the assembly, and recommend recertification, repair, or replacement.

7 PROCEDURE FOR FULL INSPECTION

Note: In addition to the standard marking (WP, month and year of production, hose assembly manufacturer and serial number) all hose assemblies will be marked with the recertification date (RECERT. MM / YYYY). It is the responsibility of the purchaser to track the location of the hose assembly and the responsibility of the supplier to inform the purchaser a month before the hose assembly is due for full inspection/recertification.

Parker Polyflex have trained and certified specialized facilities and their personnel to assemble, inspect, test, repair and recertify hose assemblies.
Hose management is an essential part of the service they provide.

The history of each assembly must be logged showing the results of previous inspections and any repairs.

7.1. Customer Pre-dispatch procedure before returning a hose assembly for inspection/repair

- The object is to make sure the hose assembly can be safely handled and the condition of the assembly will justify the transportation and inspection costs.
- The chosen inspection facility should be contacted if doubtful about any of the points below .
- Check and record assembly serial number. (send information to test facility)
- Assembly must be free of chemical residues inside and outside. (could result in refusal to handle returned assembly)
- Report on any findings out of section 6.1
- Method of transport, size and weight, (Long length hose assemblies on drums or reels may require special handling equipment such as drums and re-spooling machinery).
- Customer will receive a budget price for inspection based on the information given by the end user.

7.2. Full inspection of the returned hose assembly includes the following:

- Safety inspection, condition of assembly as received
  - Check for chemical residue inside and outside (may require flushing or cleaning),
  - Assembly serial number (check assembly history including previous repairs)
- External inspection
- Internal inspection
- Inspection report.

7.2.1 External inspection

- Damage to the outer cover (abrasion, incorrect routing!!)
- Exposed reinforcing wires. (damaged outer cover,)
- Kinked, crushed, or twisted hose. (high tensile loading, incorrect routing)
- Reduction in the outside diameter of the hose (high tensile loading with pressure)
- Blistered, soft, degraded, or loose outer cover. (chemical attack, leak fitting, permeation or high temperature)
- Cracked, damaged, or badly corroded fittings (chemical attack, poor handling, old hose assembly)
- Damage or wear on fitting threads (poor handling, old hose assembly)
- Condition of containment grips / clamps. (abrasion, frayed wires, distortion)

7.2.2 Internal inspection

Internal inspection shall be done with an endoscope.

- Check for damage to bore of the fitting, cracks, severe abrasion, corrosion
- Scope maximum length of the core tube possible.
- Look for uneven surface (sign of wire fatigue, abrasion, chemical attack).
- Condition of core tube at the back of the fitting (critical area).

7.2.3 Inspection Report

The testing facility will advise on the overall condition of the hose and end connections. Customer will receive detailed report of the findings, including recommended actions:

- Repair
- Recertification
- Scrapping

8 PROCEDURE FOR REPAIR AND RECERTIFICATION

8.1 Repair

It is recommended, that all repairs are done by certified specialized testing facilities. Some repairs (see examples below) could be done in field. Be sure to maintain safety requirements.

8.1.1 Twisted hose. Hose with the reduced OD. Flattened hose.

A hose with signs of twisting or deformation will need to be unreeled, as straight as possible, from the winch/drum in a safe environment and pressurized to working pressure for at least 1 hour and then pressure released. The hose shall be re-inspected to see if the hose has returned to its “untwisted, undistorted” original shape. If so the hose should be again pressurized before rewinding back onto the winch/drum. Any sections of hose still misshapen should be cut out of the assembly.

8.1.2 Hose with cover damage.

- No reinforcement wires exposed.
  Temporary solution, the damaged area can be cleaned and protected by wrapping with a strong adhesive “duct / riggers” tape. If abraded to the point where the red Color-Gard is visible, the damaged area should be thoroughly cleaned with mild solvent, a thin plastic sheet wrapped around the hose to form a mould. A two pack polyurethane mixture can then be poured into the mould and allowed to set. Remove mould after the polyurethane is set.
- Reinforcement wires exposed.
  It is strongly recommended to remove the hose assembly from service immediately. Any ingress of water into hose carcass will initiate corrosion of the reinforcement wire. It is difficult to estimate the rate of corrosion. At best, the hose could function for months, at worst, possibly one week. It is also possible that the core tube could have collapsed if the external pressure acting within the carcass is greater then internal pressure within the hose.
  In any case, the lifetime of the hose assembly will be significantly reduced, and the hose assembly shall be immediately scheduled for inspection at certified specialized testing facility.
  Decision to further use a hose assembly with exposed wire shall be based on a proof pressure test for 1.1 x maximum working pressure of the hose assembly. This test shall be conducted prior to every further job.
  Repair of such a hose assembly is possible, but it will include cutting out the section of the hose, where the wires have been subjected to water. Obviously, this will require new fittings to be crimped and hose assembly to be proof pressure tested. The testing facility will recommend if the condition of the hose warrants the cost of assembling new fittings, joining the lengths together and proof testing.

8.2 Recertification

Recertification shall include full inspection acc. to section 7.2 and a hydrostatic pressure test.

Unless otherwise agreed between customer and test facility, test conditions are:

Test pressure = 1.5 x maximum working pressure of hose assembly. Allow for at least 30 minutes stabilization time before starting recording pressure decay.

Pressure hold time = 1 hour

Pressure decrease of maximum 5% is allowed.

After successfully passing pressure test, hose assembly shall be permanently marked with the new recertification

date (see section 7).

RECOMMENDATIONS FOR TENSILE FORCES ON POLYFLEX HOSES.

Two questions are usually asked:

What maximum tensile force can the hose take under pressure / unpressurized?

Shall I reel / unreel the hose under pressure and if yes, what is the recommended one?

The assumption behind the calculations is that the unpressurized hose can take the tensile force equal to 0,1 of axial force induced by minimum hose burst pressure, and the hose, pressurized to 40% of the min. burst pressure can take the double tensile force. In both cases, hose would elongate approx. 10%. These values have been confirmed by testing.

The recommended values are:

$$F = \frac{\pi d^2}{16}\left(P + \frac{Pb}{2,5}\right)$$

$$P = \frac{16F}{\pi d^2} - \frac{Pb}{2,5}$$

Where

F – tensile force including hose own weight, N

Pb – min. hose burst pressure, MPa

P – pressure at reeling / unreeling operation, MPa. Note that P shall not exceed the working pressure, specified for the hose.

d – hose ID, mm

Below there are some examples:

a) What is the recommended reeling / unreeling pressure for 2" Black Eagle hose with 3 ton tensile force?

$$P = \frac{16 \times 30000}{\pi 50^2} - \frac{172,5}{2,5} = -7,86\ MPa$$

The negative value appears if the tensile force is less than 0,1 of axial force induced by minimum hose burst pres-sure. In this case hose could be deployed unpressurized and it would elongate less than 10%.

b) What is the recommended reeling / unreeling pressure for 2" Black Eagle hose with 10 ton tensile force?

$$P = \frac{16 \times 100000}{\pi 50^2} - \frac{172,5}{2,5} = 134,8\ MPa$$

Note that the pressure value exceeds the hose working pressure (69,0 MPa). The consequence is that the tensile force of 10 ton is too high and should be reduced by means of buoyancy, additional tensile members, etc.

c) What is the recommended reeling / unreeling pressure for 2" Black Eagle hose with 5 ton tensile force?

$$P = \frac{16 \times 50000}{\pi 50^2} - \frac{172,5}{2,5} = 32,9\ MPa$$

At this pressure, hose will elongate approx. 10%.

d) What is the maximum tensile force Black Eagle hose can take under the working pressure?

$$F = \frac{\pi 50^2}{16}\left(69 + \frac{172,5}{2,5}\right) = 67706\ N$$

e) What is the maximum tensile force Black Eagle hose can take unpressurized?

$$F = \frac{\pi 50^2}{16}\left(\frac{172,5}{2,5}\right) = 33853\ N$$

Job safety analysis Check List

Job Safety Analysis (JSA) is a method utilized by end-users to identify, analyze and record potential hazards that can be manifested in a loss by lack of planning and control. Parker Hannifin recommends series of actions that will reduce these hazards and the risk of a jobsite injury or illness.

Installation and Removal

Evacuation of all fluids from the hose	Personal severe injury by exposition of residual chemical, acids or toxics fluids over the skin. Flush through the hose assembly before and after operation with water
Handling	Only personnel trained in manual handling can carry out installation. Risk of slipping Crane or folk lifts operations just in case of excessive weight. Locals and end-user regulations apply all times Use containments grips and bend restrictors to reduce handling problems See recommendations in specification PFDE-ES28 in this manual
Making up connection to pumping equipment	While hammering unions or flanges make sure to use proper equipment Avoid hammering gaps between fitting and hose assembly end Bleed off all pressure from the hose assembly, after operation
Pumping fluids at pressure	Make sure any operation pressure does not exceed hose assembly rated pressure Pressure testing of piping takes in consideration % volumetric expansion of the hose assembly (2 to 5%) Abrupt pressure changes can generate risk of injuries due to erratic movement of the hose assembly
Environmental precautions	Spill of chemicals and damage to environment due to poor control measurements

10 Detailed product data sheets

ISSUED	PARKER ENGINEERING MANUAL	SPEC.
M. Levin 16 Feb 2009		HS-2448N-32V80
REVISED H. Krapp 15 April 2010	**Parker Hannifin Corporation** **POLYFLEX DIVISION EUROPE**	Revision: B
SUBJECT **Schlauchspezifikation/ *Hose Specification* 2448N-32V80 (PHALCON5000 2 with COLORGARD)**		PAGE 1 of 1

Konstruktion/ *Construction*	**Material**
Innenschicht/ *Inner core:*	Plasticised Nylon 11
Bindung/ *Bond:*	
Druckträger/	
Pressure reinforcement:	Four spiral layers of high tensile steel wire.
Bindung/ Bond:	
Außenschicht/ Outer cover:	TPU red inner sheath plus extra thick TPU black outer sheath

Maße/ *Dimensions*

Innendurchmeser/ *Inner diameter:*	50,5 mm ± 1,0 mm
Außendurchmesser/ *Outer diameter:*	80,5 mm ± 1,0 mm
Biegeradius/Min *Bend radius :*	500 mm
Gewicht/ *Weight:*	8,5 kg/m

Leistungsdaten/ *Performances*

Berstdruck/ *Burst pressure:*	138,0 MPa (20000 psi)
Betriebsdruck/ *Operating pressure:*	34,5 MPa (5000 psi)
Sicherheitsfaktor/ *Safety factor:*	1:4
Längenänderung bei Betriebsdruck/ *Change in length at working pressure:*	+2% / -1,5% acc. to ISO 13628-5
Impulsfestigkeit/ *Impulse strength:*	200.000 cycles acc. to POLYFLEX works standard (@ 34,5 MPa)
Volumetrische Expansion bei Betriebsdruck/ *Volumetric expansion at operating pressure:*	Typical value: 2,8% (@ 34,5 MPa)
Betriebstemperatur/ *Operating temperature:*	-40°C - +70°C
Beständigkeit/ *Chemical resistance:*	PFDE-ES28
Elektrische Leitfähigkeit/ *Electrical conductivity:*	Ja / *Yes*
Außendruckbeständigkeit/ *External collapse resistance:*	Typical value ≥ 4,9 MPa (710 psi) @ minimum bend radius acc. to ISO 13628-5
Maximale Zugbelastung/ *Maximum tensile loading:*	20 kN
Armaturen Serien / *Fitting Series:*	BL series fittings (see assembly instruction PFDE-C2448N-32-OF)

Anwendungsbereich/ *Application*

Offshore, (Control Fluids, Acidising, Cementing, Methanol Injection,Well Stimulation), Long length (up to 1000m). High pressure delivery hose.

Bemerkung/ *Remarks*

Extra thick, dual colour, abrasion resistant Colorgard™ sheath improves durability and acts as an early warning system to prevent hose failure due to excessive abrasion.

Die obengenannten Leistungsdaten sind nur gültig, wenn spezifizierte Armaturen verwendet werden und diese nach der geprüften Parker Polyflex Montageanweisung montiert wurden.
The above hose performance data is only relevant if used with the specified fittings and assembled according to the approved Parker Polyflex assembly procedure.

Recommendations for storage, handling, maintenance and inspection see PFDE-ES28.

ISSUED H. Krapp 12 September 2003	**PARKER ENGINEERING MANUAL** **Parker Hannifin Corporation** **POLYFLEX DIVISION EUROPE**	SPEC. HS-2640N-24V80
REVISED G. Ford 13 April 2005		Revision: A
SUBJECT **Schlauchspezifikation/ *Hose Specification* 2640N-24V80 (with ColorGard™)**		PAGE 1 of 1

Konstruktion/ *Construction*	**Material**
Innenschicht/ *Inner core:*	Plasticised Nylon 11
Bindung/ *Bond:*	
Druckträger/	
Pressure reinforcement:	6 layers of high tensile steel wires.
Bindung/ Bond: -	
Außenschicht/ Outer cover:	TPU Red inner sheath (OD 61,0 + 1,0 mm) plus extra thick TPU Black outer sheath

Maße/ *Dimensions*

Innendurchmeser/ *Inner diameter:*	38,0 mm +/- 0,5 mm
Außendurchmesser/ *Outer diameter:*	70,0 mm + 1,0 mm
Biegeradius/Min *Bend radius :*	500 mm (static) 1250 mm (dynamic)
Gewicht/ *Weight:*	7,2 kg/m

Leistungsdaten/ *Performances*

Berstdruck/ *Burst pressure:*	2300 bar (33350 psi)
Betriebsdruck/ *Operating pressure:*	690 bar (10000 psi)
Sicherheitsfaktor/ *Safety factor:*	1:3,3
Längenänderung bei Betriebsdruck/ *Change in length at working pressure:*	+2% / -1,5% acc. to ISO 13628-5
Impulsfestigkeit/ *Impulse strength:*	> 200.000 cycles acc. to POLYFLEX works standard
Volumetrische Expansion bei Betriebsdruck/ *Volumetric expansion at operating pressure:*	approx. 13,6 % (at 690 bar) according ISO 6801
Betriebstemperatur/ *Operating temperature:*	-40°C - +70°C (intermittent +100°C)
Beständigkeit/ *Chemical resistance:*	PFDE-ES28
Elektrische Leitfähigkeit/ Electrical conductivity:	Yes
Außendruckbeständigkeit/ *External collapse resistance:*	approx. 65 bar
Maximum tensile loading:	20 kN
Armaturen Serien / Fitting Series:	5X

Anwendungsbereich/ *Application*

Offshore, (Control Fluids, Acidising, Cementing, Methanol Injection,Well Stimulation), Long length (up to 600m). High pressure delivery hose.

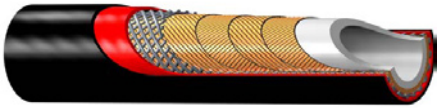
Bemerkung/ *Remarks*

Extra thick, dual colour, abrasion resistant Colorgard™ sheath improves durability and acts as an early warning system to prevent hose failure due to excessive abrasion.

Die obengenannten Leistungsdaten sind nur gültig, wenn spezifizierte Armaturen verwendet werden und diese nach der geprüften Parker Polyflex Montageanweisung montiert wurden.
The above hose performance data is only relevant if used with the specified fittings and assembled according to the approved Parker Polyflex assembly procedure.

Recommendations for storage, handling, maintenance and inspection see PFDE-ES28.

ISSUED H. Krapp 23 July 2007	**PARKER ENGINEERING MANUAL** **Parker Hannifin Corporation** **POLYFLEX DIVISION EUROPE**	SPEC. HS-2580N-32V80
REVISED H. Krapp 15 April 2010		Revision: D
SUBJECT **Schlauchspezifikation/ *Hose Specification* 2580N-32V80** **(BLACK EAGLE 2 with COLORGARD)**		PAGE 1 of 1



Konstruktion/ *Construction*	**Material**
Innenschicht/ *Inner core:*	Plasticised Nylon 11
Bindung/ *Bond:*	
Druckträger/ *Pressure reinforcement:*	Four spiral layers and two open spiral layers of high tensile steel wire.
Bindung/ Bond:	
Außenschicht/ Outer cover:	TPU red inner sheath plus extra thick TPU black outer sheath

Maße/ *Dimensions*	
Innendurchmeser/ *Inner diameter:*	50,5 mm ± 1,0 mm
Außendurchmesser/ *Outer diameter:*	84,5 mm ± 1,0 mm
Biegeradius/Min *Bend radius :*	800 mm
Gewicht/ *Weight:*	9,4 kg/m

Leistungsdaten/ *Performances*	
Berstdruck/ *Burst pressure:*	172,5 MPa (25000 psi)
Betriebsdruck/ *Operating pressure:*	69,0 MPa (10000 psi)
Sicherheitsfaktor/ *Safety factor:*	1:2,5
Längenänderung bei Betriebsdruck/ *Change in length at working pressure:*	+2% / -1,5% acc. to ISO 13628-5
Impulsfestigkeit/ *Impulse strength:*	75.000 cycles acc. to POLYFLEX works standard (@ 75,0 MPa)
Volumetrische Expansion bei Betriebsdruck/ *Volumetric expansion at operating pressure:*	Typical value: 8% (@ 69,0 MPa)
Betriebstemperatur/ *Operating temperature:*	-40°C - +70°C
Beständigkeit/ *Chemical resistance:*	PFDE-ES28
Elektrische Leitfähigkeit/ *Electrical conductivity:*	Ja / *Yes*
Außendruckbeständigkeit/ *External collapse resistance:*	Typical values: 6,5 MPa (940 psi) straight, 5,7 MPa (826 psi) @ minimum bend radius acc. to ISO 13628-5
Maximale Zugbelastung/ *Maximum tensile loading:*	35 kN
Armaturen Serien / *Fitting Series:*	BL series fittings (see assembly instruction PFDE-C2580N-32-OF)

Anwendungsbereich/ *Application*

Offshore, (Control Fluids, Acidising, Cementing, Methanol Injection,Well Stimulation), Long length (up to 1000m). High pressure delivery hose.

Bemerkung/ *Remarks*

Extra thick, dual colour, abrasion resistant Colorgard™ sheath improves durability and acts as an early warning system to prevent hose failure due to excessive abrasion.

Die obengenannten Leistungsdaten sind nur gültig, wenn spezifizierte Armaturen verwendet werden und diese nach der geprüften Parker Polyflex Montageanweisung montiert wurden.
The above hose performance data is only relevant if used with the specified fittings and assembled according to the approved Parker Polyflex assembly procedure.

Recommendations for storage, handling, maintenance and inspection see PFDE-ES28.

ISSUED	PARKER ENGINEERING MANUAL	SPEC.
M. Levin 18 November 2009		HS-2440N-48V80
REVISED M. Levin 13 April 2010	**Parker Hannifin Corporation** **POLYFLEX DIVISION EUROPE**	Revision: -
SUBJECT **Schlauchspezifikation/ *Hose Specification* 2440N-48V80**		PAGE 1 of 1

Konstruktion/ *Construction*	**Material**
Innenschicht/ *Inner core:*	Plasticised Nylon 11
Bindung/ *Bond:*	
Druckträger/ *Pressure reinforcement:*	Four spiral layers of high tensile steel wire.
Bindung/ *Bond:*	
Außenschicht/ *Outer cover:*	TPU red inner sheath plus extra thick TPU black outer sheath

Maße/ *Dimensions*

Innendurchmeser/ *Inner diameter:*	75,0 mm ± 1,0 mm
Außendurchmesser/ *Outer diameter:*	122,0 mm ± 2,0 mm
Biegeradius/ *Min Bend radius :*	1100 mm
Gewicht/ *Weight:*	18,7 kg/m

Leistungsdaten/ *Performances*

Berstdruck/ *Burst pressure:*	172,5 MPa (25000 psi)
Betriebsdruck/ *Operating pressure:*	69,0 MPa (10000 psi)
Sicherheitsfaktor/ *Safety factor:*	1:2,5
Längenänderung bei Betriebsdruck/ *Change in length at working pressure:*	+2% / -2% acc. to API 16C
Pressure Cycling Test	Achieved ≥30000 cycles acc. to POLYFLEX works standard (Square pressure wave form @ W.P.)
Volumetrische Expansion bei Betriebsdruck/ *Volumetric expansion at operating pressure:*	Typical value: 8% @ W.P.*
Betriebstemperatur/ *Operating temperature:*	-40°C - +70°C
Beständigkeit/ *Chemical resistance:*	PFDE-ES28
Elektrische Leitfähigkeit/ *Electrical conductivity:*	Yes
Außendruckbeständigkeit/ *External collapse resistance:*	Typical value ≥ 4,0 MPa (580 psi) straight*
Maximale Zugbelastung/ *Maximum tensile loading:*	70 kN*
Armaturen Serien / *Fitting Series:*	Special LX series fittings

Anwendungsbereich/ *Application*

Offshore, (Control Fluids, Acidising, Cementing, Methanol Injection,Well Stimulation), Long length (up to 450 m). High pressure delivery hose.

Bemerkung/ *Remarks*

Extra thick, dual colour, abrasion resistant Colorgard™ sheath improves durability and acts as an early warning system to prevent hose failure due to excessive abrasion.

Note: The above data is calculated or evaluated and has not been confirmed by testing.*

Die obengenannten Leistungsdaten sind nur gültig, wenn spezifizierte Armaturen verwendet werden und diese nach der geprüften Parker Polyflex Montageanweisung montiert wurden.
The above hose performance data is only relevant if used with the specified fittings and assembled according to the approved Parker Polyflex assembly procedure.

Recommendations for storage, handling, maintenance and inspection see PFDE-ES28.

ISSUED	PARKER ENGINEERING MANUAL	SPEC.
H. Krapp 26 January 2009		HS-2640N-48V80
REVISED M. Levin 01 June 2010	**Parker Hannifin Corporation** **POLYFLEX DIVISION EUROPE**	Revision: -
SUBJECT **Schlauchspezifikation/ *Hose Specification* 2640N-48V80** **3 "BLACK EAGLE with COLORGARD**		PAGE 1 of 1

Konstruktion/ *Construction*	**Material**
Innenschicht/ *Inner core:*	Plasticised Nylon 11
Bindung/ *Bond:*	
Druckträger/ *Pressure reinforcement:*	Six spiral layers of high tensile steel wire.
Bindung/ *Bond:*	
Außenschicht/ *Outer cover:*	TPU red inner sheath plus extra thick TPU black outer sheath

Maße/ *Dimensions*	
Innendurchmeser/ *Inner diameter:*	75,0 mm ± 1,0 mm
Außendurchmesser/ *Outer diameter:*	130,0 mm ± 2,0 mm
Biegeradius/ *Min Bend radius :*	1200 mm
Gewicht/ *Weight:*	27,5 kg/m

Leistungsdaten/ *Performances*	
Berstdruck/ *Burst pressure:*	233,0 MPa (33750 psi)
Betriebsdruck/ *Operating pressure:*	103,5 MPa (15000 psi)
Sicherheitsfaktor/ *Safety factor:*	1:2,25
Längenänderung bei Betriebsdruck/ *Change in length at working pressure:*	+2% / -2% acc. to API 16C
Pressure Cycling Test	Achieved ≥30000 cycles acc. to POLYFLEX works standard (Square pressure wave form @ W.P.)
Volumetrische Expansion bei Betriebsdruck/ *Volumetric expansion at operating pressure:*	Typical value: 10% @ W.P.*
Betriebstemperatur/ *Operating temperature:*	-40°C - +70°C
Beständigkeit/ *Chemical resistance:*	PFDE-ES28
Elektrische Leitfähigkeit/ *Electrical conductivity:*	Yes
Außendruckbeständigkeit/ *External collapse resistance:*	Typical value ≥ 8,0 MPa (1160 psi) straight
Maximale Zugbelastung/ *Maximum tensile loading:*	100 kN*
Armaturen Serien / *Fitting Series:*	Special 5X series fittings

Anwendungsbereich/ *Application*

Offshore, (Control Fluids, Acidising, Cementing, Methanol Injection,Well Stimulation), Long length (up to 400 m). High pressure delivery hose.

Bemerkung/ *Remarks*

Extra thick, dual colour, abrasion resistant Colorgard™ sheath improves durability and acts as an early warning system to prevent hose failure due to excessive abrasion.

Note: The above data is calculated or evaluated and has not been confirmed by testing.*

Die obengenannten Leistungsdaten sind nur gültig, wenn spezifizierte Armaturen verwendet werden und diese nach der geprüften Parker Polyflex Montageanweisung montiert wurden.
The above hose performance data is only relevant if used with the specified fittings and assembled according to the approved Parker Polyflex assembly procedure.
Recommendations for storage, handling, maintenance and inspection see PFDE-ES28.

ISSUED	PARKER ENGINEERING MANUAL	SPEC.
M. Levin 05 May 2010		HS-2640M-24V88
REVISED H. Krapp 05 May 2010	Parker Hannifin Corporation POLYFLEX DIVISION EUROPE	Revision: -
SUBJECT		PAGE
Schlauchspezifikation/ *Hose Specification* 2640M-24V88 1 ½" GOLDEN EAGLE (CHEMJEC with COLORGARD)		1 of 1

Konstruktion/ *Construction*	**Material**
Innenschicht/ *Inner core:*	Proprietary Specification, based on fluoropolymer technology.
Bindung/ *Bond:*	
Druckträger/ *Pressure reinforcement:*	Six spiral layers of high tensile steel wire
Bindung/ *Bond:*	
Außenschicht/ *Outer cover:*	TPU Red inner sheath plus extra thick TPU golden outer sheath

Maße/ *Dimensions*

Innendurchmeser/ *Inner diameter:*	38,0 mm ± 1,0 mm
Außendurchmesser/ *Outer diameter:*	70,5 mm ± 1,0 mm
Biegeradius/Min *Bend radius :*	500 mm (static) 1250 mm (dynamic)
Gewicht/ *Weight:*	7,2 kg/m

Leistungsdaten/ *Performances*

Berstdruck/ *Burst pressure:*	230,0 MPa (33350 psi)
Betriebsdruck/ *Operating pressure:*	69,0 MPa (10000 psi)
Sicherheitsfaktor/ *Safety factor:*	1:3,3
Längenänderung bei Betriebsdruck/ *Change in length at working pressure:*	+2% / -1,5% (acc. to ISO 13628-5)
Impulsfestigkeit/ *Impulse strength:*	200.000 Impulse cycles @ 91,8 MPa (13300 psi) acc. to POLYFLEX works standard
Volumetrische Expansion/ *Volumetric expansion:*	Typical value: 13,6% @ W.P.
Betriebstemperatur/ *Operating temperature:*	-40°C - +70°C, short term 100°C
Beständigkeit/ *Chemical resistance:*	Catalogue No. 4465
Elektrische Leitfähigkeit/ Electrical conductivity:	Yes
Außendruckbeständigkeit/ *External collapse resistance*	Typical value 6,5 MPa (940 psi) straight
Maximum tensile loading:	20 kN
Armaturen Serien / Fitting Series:	Special 5X series fittings (see assembly instruction PFDE-C2640M-24-OF1)

Anwendungsbereich/ *Application*

Offshore, (Control Fluids, Acidising, Chemical Injection,Well Stimulation), Long length (up to 1500m).
High pressure delivery hose.

Bemerkung/ *Remarks*

Extra thick, dual colour, abrasion resistant COLORGARD sheath improves durability and acts as an early warning system to prevent hose failure due to excessive abrasion.

Die obengenannten Leistungsdaten sind nur gültig, wenn spezifizierte Armaturen verwendet werden und diese nach der geprüften Parker Polyflex Montageanweisung montiert wurden.
The above hose performance data is only relevant if used with the specified fittings and assembled according to the approved Parker Polyflex assembly procedure.

Recommendations for storage, handling, maintenance and inspection see PFDE-ES28.

ISSUED	PARKER ENGINEERING MANUAL	SPEC.
H. Krapp 24 February 2010		HS-2448M-32V88
REVISED	**Parker Hannifin Corporation** **POLYFLEX DIVISION EUROPE**	Revision:
M. Levin 24 February 2010		-
SUBJECT		PAGE
Schlauchspezifikation/ *Hose Specification* 2448M-32V88 (2" PHALCON5000 CHEMJEC with COLORGARD)		1 of 1

Konstruktion/ *Construction*	**Material**
Innenschicht/ *Inner core:*	Proprietary Specification, based on fluoropolymer technology.
Bindung/ *Bond:*	
Druckträger/	
Pressure reinforcement:	Four spiral layers of high tensile steel wire.
Bindung/ Bond:	
Außenschicht/ Outer cover:	TPU red inner sheath plus extra thick TPU golden outer sheath

Maße/ *Dimensions*

Innendurchmeser/ *Inner diameter:*	51,0 mm ± 1,0 mm
Außendurchmesser/ *Outer diameter:*	80,5 mm ± 1,0 mm
Biegeradius/Min *Bend radius :*	500 mm
Gewicht/ *Weight:*	8,5 kg/m

Leistungsdaten/ *Performances*

Berstdruck/ *Burst pressure:*	138,0 MPa (20000 psi)
Betriebsdruck/ *Operating pressure:*	34,5 MPa (5000 psi)
Sicherheitsfaktor/ *Safety factor:*	1:4
Längenänderung bei Betriebsdruck/ *Change in length at working pressure:*	+2% / -1,5% acc. to ISO 13628-5
Impulsfestigkeit/ *Impulse strength:*	200.000 cycles acc. to POLYFLEX works standard (@ 133% of 34,5 MPa)
Volumetrische Expansion bei Betriebsdruck/ *Volumetric expansion at operating pressure:*	Typical value: 2,8 % (@ 34,5 MPa)
Betriebstemperatur/ *Operating temperature:*	-40°C - +70°C
Beständigkeit/ *Chemical resistance:*	PFDE-ES28
Elektrische Leitfähigkeit/ *Electrical conductivity:*	Ja / *Yes*
Außendruckbeständigkeit/ *External collapse resistance:*	Typical value ≥ 4,9 MPa (710 psi) @ minimum bend radius acc. to ISO 13628-5
Maximale Zugbelastung/ *Maximum tensile loading:*	20 kN
Armaturen Serien / *Fitting Series:*	BL series fittings (see assembly instruction PFDE-C2448M-32-OF)

Anwendungsbereich/ *Application*

Offshore, (Control Fluids, Acidising, Chemical Injection,Well Stimulation), Long length (up to 1000m). High pressure delivery hose.

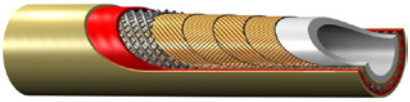
Bemerkung/ *Remarks*

Extra thick, dual colour, abrasion resistant COLORGARD sheath improves durability and acts as an early warning system to prevent hose failure due to excessive abrasion.

Die obengenannten Leistungsdaten sind nur gültig, wenn spezifizierte Armaturen verwendet werden und diese nach der geprüften Parker Polyflex Montageanweisung montiert wurden.
The above hose performance data is only relevant if used with the specified fittings and assembled according to the approved Parker Polyflex assembly procedure.

Recommendations for storage, handling, maintenance and inspection see PFDE-ES28.

ISSUED H. Krapp 24 February 2010	**PARKER ENGINEERING MANUAL** **Parker Hannifin Corporation** **POLYFLEX DIVISION EUROPE**	SPEC. HS-2580M-32V88
REVISED M. Levin 13 April 2010		Revision: A
SUBJECT **Schlauchspezifikation/ *Hose Specification* 2580M-32V88** **2" GOLDEN EAGLE (CHEMJEC with COLORGARD)**		PAGE 1 of 2



Konstruktion/ *Construction*	**Material**
Innenschicht/ *Inner core:*	Proprietary Specification, based on fluoropolymer technology.
Bindung/ *Bond:*	
Druckträger/ *Pressure reinforcement:*	Four spiral layers and two open spiral layers of high tensile steel wire.
Bindung/ Bond:	
Außenschicht/ Outer cover:	TPU red inner sheath plus extra thick TPU golden outer sheath

Maße/ *Dimensions*	
Innendurchmeser/ *Inner diameter:*	51,0 mm ± 1,0 mm
Außendurchmesser/ *Outer diameter:*	84,5 mm ± 1,0 mm
Biegeradius/Min *Bend radius :*	800 mm
Gewicht/ *Weight:*	9,4 kg/m

Leistungsdaten/ *Performances*	
Berstdruck/ *Burst pressure:*	172,5 MPa (25000 psi)
Betriebsdruck/ *Operating pressure:*	69,0 MPa (10000 psi)
Sicherheitsfaktor/ *Safety factor:*	1:2,5
Längenänderung bei Betriebsdruck/ *Change in length at working pressure:*	+2% / -1,5% acc. to ISO 13628-5
Impulsfestigkeit/ *Impulse strength:*	200.000 cycles acc. to POLYFLEX works standard (@ 108,7% of 69,0 MPa @approx. 40°C) 10.000 cycles acc. to POLYFLEX works standard (square pressure curve @ 133% of 69,0 MPa @100°C)
Volumetrische Expansion bei Betriebsdruck/ *Volumetric expansion at operating pressure:*	Typical value: 8% (@ 69,0 MPa)
Betriebstemperatur/ *Operating temperature:*	-40°C - +70°C, see above data for 100°C
Beständigkeit/ *Chemical resistance:*	PFDE-ES28
Elektrische Leitfähigkeit/ *Electrical conductivity:*	Ja / *Yes*
Außendruckbeständigkeit/ *External collapse resistance:*	Typical values: 6,5 MPa (940 psi) straight, 5,7 MPa (826 psi) @ minimum bend radius acc. to ISO 13628-5
Maximale Zugbelastung/ *Maximum tensile loading:*	35 kN
Armaturen Serien / *Fitting Series:*	BL series fittings (see assembly instruction PFDE-C2580M-32-OF)

Anwendungsbereich/ *Application*

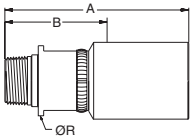
Offshore, (Control Fluids, Acidising, Chemical Injection,Well Stimulation), Long length (up to 1000m). High pressure delivery hose.

Bemerkung/ *Remarks*

Extra thick, dual colour, abrasion resistant COLORGARD sheath improves durability and acts as an early warning system to prevent hose failure due to excessive abrasion.

Fittings

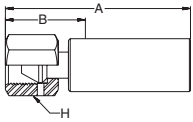
6015X/101BL – NPT Male fitting



MATERIAL Nipple zinc plated high strength special steel, shell stainless steel (AISI 316), other materials on request.

#	O		A	B	ØR	
	size *DN*	inch *mm*		inch *mm*	inch *mm*	inch *mm*	psi *MPa*
6015X-32-24-TC	-24 *40*	1 1/2 *38.0*	2" - NPT	9.09 *231.0*	4.21 *107.0*	3.35 *85.0*	10,000 *69.0*
101BL-32-32	-32 *50*	2 *50.5*	2" - NPT	10.51 *267.0*	4.09 *104.0*	3.27 *83.0*	10,000 *69.0*

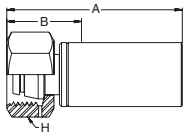
6AYHX – Type "M" swivel female fitting



MATERIAL Stainless steel (AISI 316), other materials on request.

#	O		A	B	H	
	size *DN*	inch *mm*		inch *mm*	inch *mm*	inch *mm*	psi *MPa*
6AYHX-16-16C-TC	-16 *25*	1 *25.4*	1 5/16 - 12UNF	4.76 *121.0*	2.17 *55.0*	1.97 *50*	15,000 *103.5*

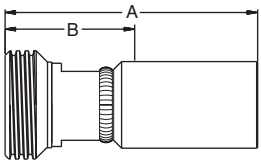
6C9HX/1C95X – Metric swivel fitting with O-ring



MATERIAL Stainless steel (AISI 316), other materials on request.

#	O		A	B	H	
	size *DN*	inch *mm*		inch *mm*	inch *mm*	inch *mm*	psi *MPa*
6C9HX-30-16C-TC	-16 *25*	1 *25.4*	*M42 x 2*	4.76 *121.0*	2.17 *55.0*	1.97 *50*	15,000 *103.5*
1C95X-38-24COSK	-24 *40*	1 1/2 *38.0*	*M52 x 2*	*5.63* *143.0*	*1.97* *50.0*	*2.56* *65*	*15,000* *103.5*

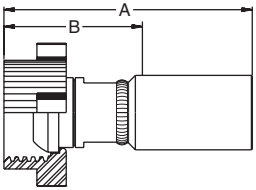
6HN5X/1HNBL – Hammerlug union female



MATERIAL Nipple zinc plated high strength special steel, shell stainless steel (AISI 316), other materials on request.

#				A	B	
	size *DN*	inch *mm*		inch *mm*	inch *mm*	psi *MPa*
6HN5X-32-24-TC	-24 *40*	1 1/2 *38.1*	4 1/8"-3 ACME	10.71 *272.0*	5.79 *147.0*	10,000 *69.0*
1HNBL-32-32	-32 *50*	2 *50.8*	4 1/8"-3 ACME	11.26 *286.0*	5.87 *149.0*	10,000 *69.0*

6HE5X/1HEBL – Hammerlug union male



MATERIAL Nipple zinc plated high strength special steel, shell stainless steel (AISI 316), other materials on request.

#				A	B	
	size *DN*	inch *mm*		inch *mm*	inch *mm*	psi *MPa*
6HE5X-32-24-TC	-24 *40*	1 1/2 *38.1*	4 1/8"-3 ACME	9.13 *232.0*	4.25 *108.0*	10,000 *69.0*
1HEBL-32-32	-32 *50*	2 *50.8*	4 1/8"-3 ACME	9.49 *241.0*	4.13 *105.0*	10,000 *69.0*

11 Pressure drop and allowed flow rates

Pressure drop tables for different hose sizes

Remarks

Figures shown in the table are for 1 m of hose without fittings.
Figures derived from calculation. not from testing.
The recommended max fluid velocity is 7.6 m/s. Hoses have been used at higher fluid velocities. However this may result in cavitation. These flow figures are marked with a grey background.

Fluid:	water
Dyn. viscosity:	1002 mPa s
Kin. viscosity:	1002 cSt
Temperature:	20 °C

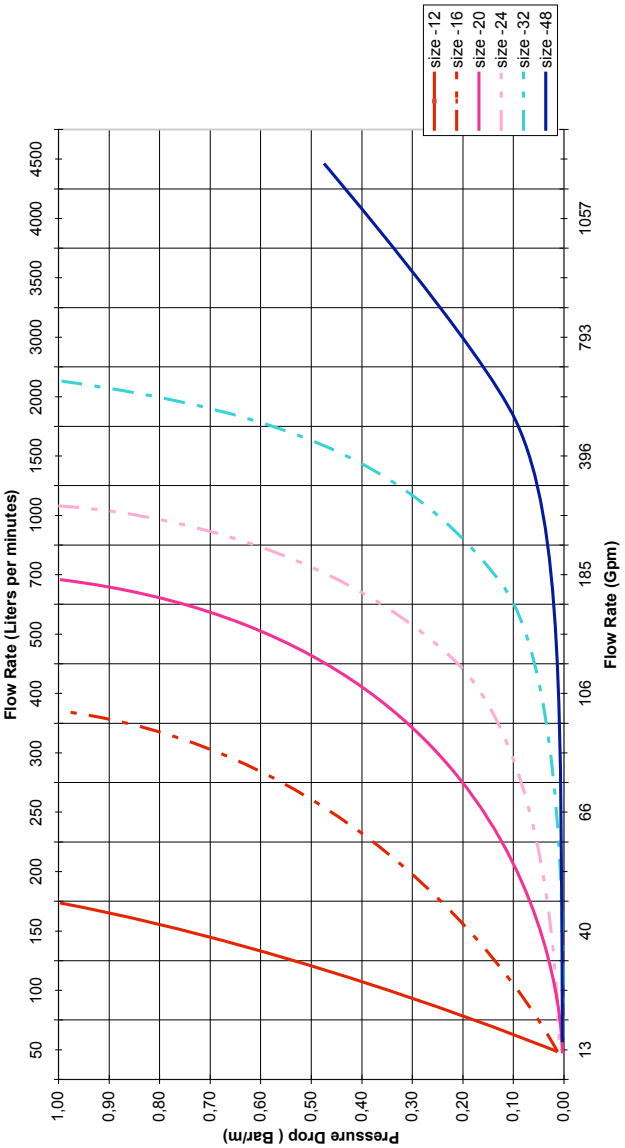
Flowrates 50 up to 4500 l/min. sizes 20 mm (-12) up to 76 mm (-48)

Flowrate			Pressure drop in bar/m					
			nominal IDs					
l/min	US Gal/min	Oilfield BBL/min	20 mm -12	25 mm -16	32 mm -20	38 mm -24	50 mm -32	76 mm -48
50	13	0,31	0,01	0,01	0,00	0,00	0,00	0,00
100	26	0,62	0,16	0,04	0,01	0,01	0,00	0,00
150	40	0,95	0,36	0,09	0,03	0,01	0,00	0,00
200	53	1,26	0,61	0,15	0,05	0,02	0,01	0,00
250	66	1,57	0,91	0,22	0,07	0,03	0,01	0,00
300	79	1,88	1,27	0,31	0,10	0,04	0,01	0,00
400	106	2,52		0,54	0,17	0,07	0,02	0,00
500	132	3,14		0,81	0,26	0,11	0,03	0,00
700	185	4,41			0,49	0,21	0,05	0,01
1000	264	6,29			0,94	0,40	0,10	0,01
1500	396	9,43				0,86	0,21	0,03
2000	528	12,57					0,36	0,05
3000	793	18,88						0,11
3500	925	22,02						0,14
4000	1057	25,17						0,18
4500	1189	28,30						0,22

Maximum flowrates for sizes 20 mm (-12) up to 76 mm (-48)

Maximum fluid horizontal velocity is 15 m/s (laminar flow)	Max. volumetric flowrate					
	nominal IDs					
	20 mm -12	25 mm -16	32 mm -20	38 mm -24	50 mm -32	76 mm -48
Max. flowrate m3/min	0,3	0,4	0,7	1,0	1,8	4,1
Max. flowrate Gallons/min	74,7	116,6	191,1	269,5	466,6	1078,0
Max. flowrate Liter/min	282,6	441,6	723,5	1020,2	1766,3	4080,7
Max. flowrate bbl/min	1,8	2,8	4,6	6,4	11,1	25,7

Hydraulic chart sizes 20 mm (-12) up to 76 mm (-48)



Parker's Motion & Control Technologies

At Parker, we're guided by a relentless drive to help our customers become more productive and achieve higher levels of profitability by engineering the best systems for their requirements. It means looking at customer applications from many angles to find new ways to create value. Whatever the motion and control technology need, Parker has the experience, breadth of product and global reach to consistently deliver. No company knows more about motion and control technology than Parker. For further information call free on 00800 27 27 5374.

AEROSPACE

Key Markets

- Aircraft engines
- Business & general aviation
- Commercial transports
- Land-based weapons systems
- Military aircraft
- Missiles & launch vehicles
- Regional transports
- Unmanned aerial vehicles

Key Products

- Flight control systems & components
- Fluid conveyance systems
- Fluid metering delivery & atomization devices
- Fuel systems & components
- Hydraulic systems & components
- Inert nitrogen generating systems
- Pneumatic systems & components
- Wheels & brakes

HYDRAULICS

Key Markets

- Aerospace
- Aerial lift
- Agriculture
- Construction machinery
- Forestry
- Industrial machinery
- Mining
- Oil & gas
- Power generation & energy
- Truck hydraulics

Key Products

- Diagnostic equipment
- Hydraulic cylinders & accumulators
- Hydraulic motors & pumps
- Hydraulic systems
- Hydraulic valves & controls
- Power take-offs
- Rubber & thermoplastic hose & couplings
- Tube fittings & adapters
- Quick disconnects

CLIMATE CONTROL

Key Markets

- Agriculture
- Air conditioning
- Food, beverage & dairy
- Life sciences & medical
- Precision cooling
- Processing
- Transportation

Key Products

- CO_2 controls
- Electronic controllers
- Filter driers
- Hand shut-off valves
- Hose & fittings
- Pressure regulating valves
- Refrigerant distributors
- Safety relief valves
- Solenoid valves
- Thermostatic expansion valves

PNEUMATICS

Key Markets

- Aerospace
- Conveyor & material handling
- Factory automation
- Life science & medical
- Machine tools
- Packaging machinery
- Transportation & automotive

Key Products

- Air preparation
- Brass fittings & valves
- Manifolds
- Pneumatic accessories
- Pneumatic actuators & grippers
- Pneumatic valves & controls
- Quick disconnects
- Rotary actuators
- Rubber & thermoplastic hose & couplings
- Structural extrusions
- Thermoplastic tubing & fittings
- Vacuum generators, cups & sensors

PROCESS CONTROL

Key Markets

- Chemical & refining
- Food, beverage & dairy
- Medical & dental
- Microelectronics
- Oil & gas
- Power generation

Key Products

- Analytical sample conditioning products & systems
- Fluoropolymer chemical delivery fittings, valves & pumps
- High purity gas delivery fittings, valves & regulators
- Instrumentation fittings, valves & regulators
- Medium pressure fittings & valves
- Process control manifolds

ELECTROMECHANICAL

Key Markets

- Aerospace
- Factory automation
- Life science & medical
- Machine tools
- Packaging machinery
- Paper machinery
- Plastics machinery & converting
- Primary metals
- Semiconductor & electronics
- Textile
- Wire & cable

Key Products

- AC/DC drives & systems
- Electric actuators
- Controllers
- Gantry robots
- Gearheads
- Human machine interfaces
- Industrial PCs
- Inverters
- Linear motors, slides and stages
- Precision stages
- Stepper motors
- Servo motors, drives & controls
- Structural extrusions

FILTRATION

Key Markets

- Food & beverage
- Industrial machinery
- Life sciences
- Marine
- Mobile equipment
- Oil & gas
- Power generation
- Process
- Transportation

Key Products

- Analytical gas generators
- Compressed air & gas filters
- Condition monitoring
- Engine air, fuel & oil filtration & systems
- Hydraulic, lubrication & coolant filters
- Process, chemical, water & microfiltration filters
- Nitrogen, hydrogen & zero air generators

SEALING & SHIELDING

Key Markets

- Aerospace
- Chemical processing
- Consumer
- Energy, oil & gas
- Fluid power
- General industrial
- Information technology
- Life sciences
- Military
- Semiconductor
- Telecommunications
- Transportation

Key Products

- Dynamic seals
- Elastomeric o-rings
- EMI shielding
- Extruded & precision-cut, fabricated elastomeric seals
- Homogeneous & inserted elastomeric shapes
- High temperature metal seals
- Metal & plastic retained composite seals
- Thermal management

FLUID & GAS HANDLING

Key Markets

- Aerospace
- Agriculture
- Bulk chemical handling
- Construction machinery
- Food & beverage
- Fuel & gas delivery
- Industrial machinery
- Mobile
- Oil & gas
- Transportation
- Welding

Key Products

- Brass fittings & valves
- Diagnostic equipment
- Fluid conveyance systems
- Industrial hose
- PTFE & PFA hose, tubing & plastic fittings
- Rubber & thermoplastic hose & couplings
- Tube fittings & adapters
- Quick disconnects

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