# MDG 41TR - Technical Reference - 1

# 420 Bar Super Staple-lock fittings and adaptors for hydraulic power-transmission circuits.

This document is an appendix to MDG 41 – Guideline for fluid power system safety at mines

# Foreword

This Technical Reference document is adjoined to MDG 41 “Guidelines for Fluid Power Systems Safety at Mines” for the purposes of adding clarity to the guideline. The Technical Reference document is intended to add clarity to some design aspects of 420 bar Super Staple-Lock Fittings and Adapters. Super Staple-Lock Fittings and Adaptors are used to connect hydraulic fluid based power transmission systems. Such equipment is primarily used in high pressure applications within the mining industry.

This equipment is intended to be used in accordance with the principles referred to within MDG 41. It is to be noted that the content of this document is assisted with information from DIN 20043 “Staple-Lock Couplings for Hydraulic transmission Circuits”, SAE J 1467 “Clip Fastener Fittings”, NCB 638 and BS 6537 “Specification for staple type connectors for hydraulic fluid power application”.

*Format based on DIN 20043 / SAE 1467 / NCB 638 / BS 6537*

## General

This technical reference document applies to 420 bar super staple-lock fittings and adaptors, which are used to connect hydraulic fluid based systems. The proposed standard seeks to clarify minimum material and dimensional requirements for a 420 bar connection, whilst maintaining a 4:1 factor of safety (FOS).

This document defines:-

1. **minimum working pressure of the assembled fitting (including its staple)**
2. **relevant testing and conformance standards**
3. **arrangement of components & their individual dimensions**
4. **material specifications for the components**
5. **corrosion resistance of metal components**
6. **identification**
7. **minimum burst pressure**
8. **impulse requirements of the assembled fitting**

## Section 1. Minimum working pressure

**Table 1** Minimum working pressure of the assembled Super staple-lock fitting. This table is based on 4:1 FOS per ISO 7751 "Rubber and plastic hoses and hose assemblies. Ratios of proof and burst pressure to design working pressure."

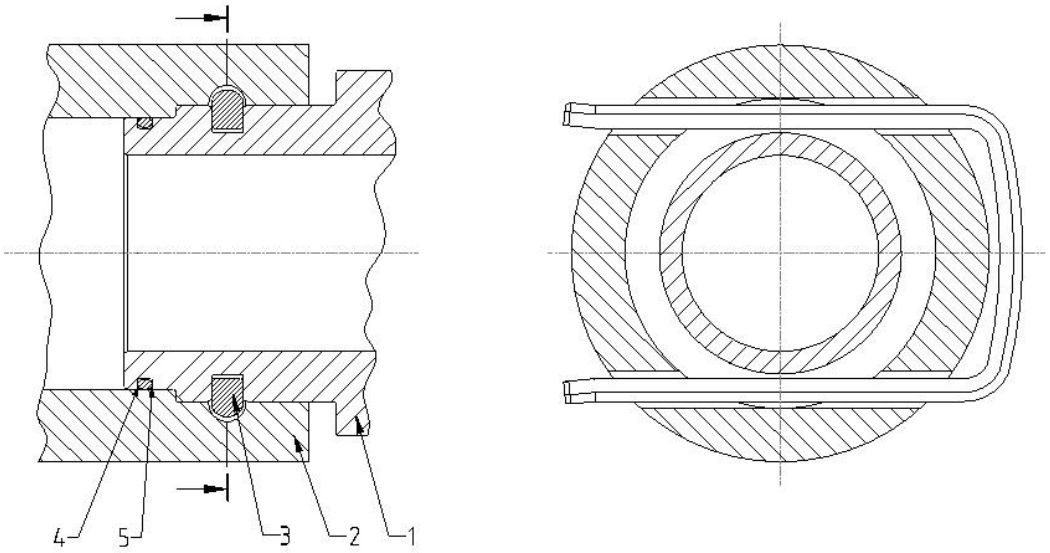
| Nominal size DN | Maximum Working Pressure bar |
|---|---|
| 25 | 420 |
| 32 | 420 |
| 40 | 420 |
| 50 | 420 |

## Section 2. Relevant standards

| | |
|---|---|
| ISO 471 | Rubber….Temperature, humidities and times for conditioning and testing. |
| ISO 1043-1 | Plastics – Symbols and abbreviated terms – Part 1 – Basic polymers and their special characteristics. Refer to this standard for Back-up Rings. |
| ISO 1629 | Rubber and lattices – Nomenclature – refer for O-Rings (also ref DIN 3771-4 “Fluid systems; O-rings; quality acceptance criteria”). |
| ISO 1402:1994 | Rubber and plastic hoses and hose assemblies – Hydrostatic testing. Refer to for hydrostatic testing. |
| ISO 6803: 1994 | Rubber and plastic hoses and hose assemblies – Hydraulic-pressure impulse test without flexing. Refer for hydraulic pressure impulse test without flexing. |
| ISO 7751:1991 | Rubber and plastic hoses and hose assemblies. Ratios of proof and burst pressure to design working pressure. Refer to for ratios of proof pressure to design working pressure. |
| ASTM B117 | Salt spray testing Refer to for methods of salt spray (fog) testing. |

## Section 3. General arrangement and component tolerances

### Description of Super staple-lock assembly




**Legend**
1. Male Super staple-lock nipple
2. Female Super staple lock coupler
3. Staple
4. O-Ring
5. O-Ring Back-up Washer

## Dimensional details of male Super Staple Lock coupler

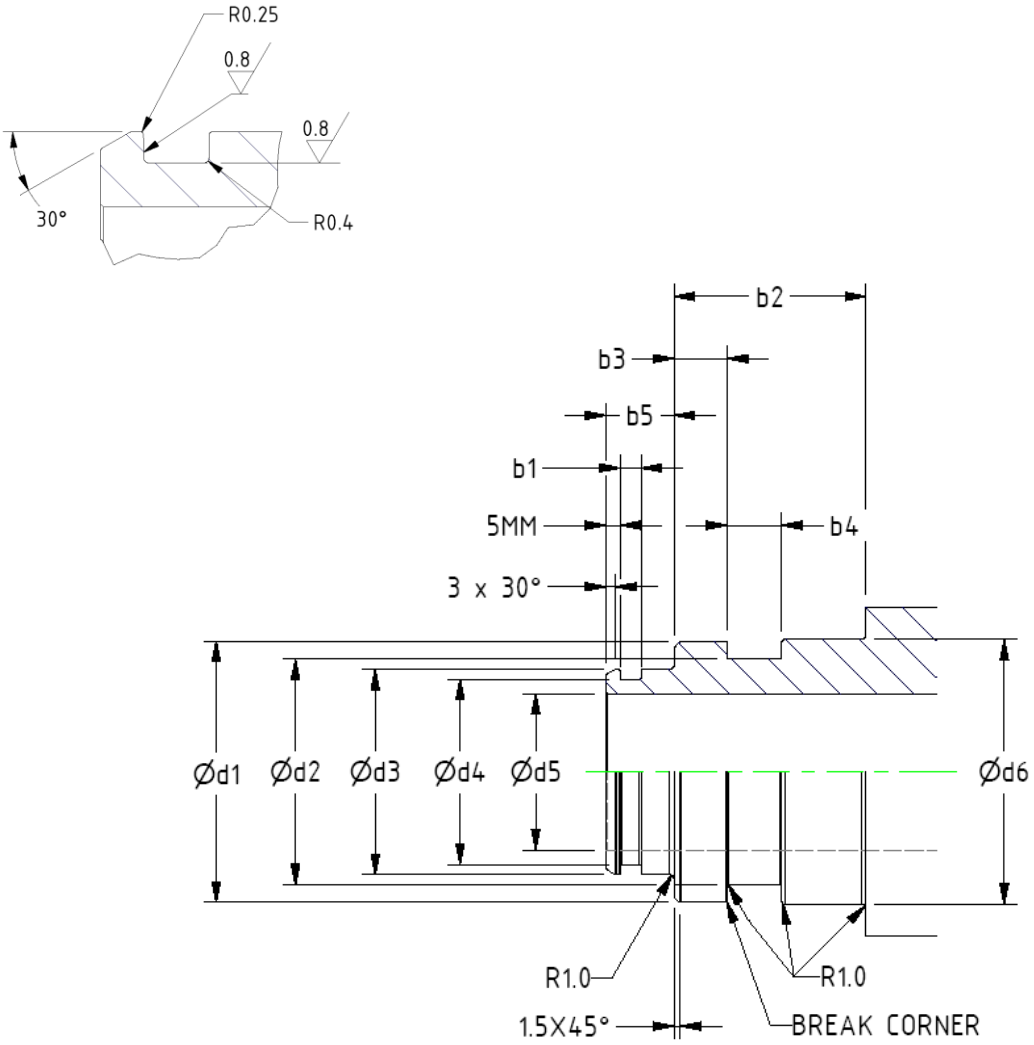



**Table 2.** Male Super Staple Lock nipple (all dimensions in millimetres)

| Nominal size DN | b1 ± 0.1 | b2 | b3 ± 0.1 | b4 ± 0.1 | b5 ± 0.2 | d1 ± 0.03 | d2 ± 0.05 | d3 ± 0.03 | d4 ± 0.03 | d5 ± 0.2 | d6 ± 0.03 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 12 | 3.6 | 21 | 4.9 | 9.1 | 11.0 | 23.66 | 17.4 | 15.87 | 11.97 | 8.9 | 24.16 |
| 20 | | 27 | 7.1 | | | 28.66 | 22.4 | 21.89 | 17.97 | 15.3 | 29.16 |
| 25 | | 40 | 10.1 | 13.1 | 15.0 | 38.39 | 29.9 | 30.87 | 26.96 | 22.2 | 39.39 |
| 32 | | 43 | | | | 45.39 | 36.9 | 37.87 | 33.95 | 27.2 | 46.39 |
| 40 | 5.1 | 47 | 12.6 | | 16.0 | 54.36 | 45.9 | 43.87 | 38.95 | 32.2 | 55.36 |
| 50 | | 47 | 12.9 | | 16.5 | 63.40 | 54.9 | 49.90 | 44.95 | 38.0 | 64.40 |

**Dimensional details of female Super Staple Lock coupler**

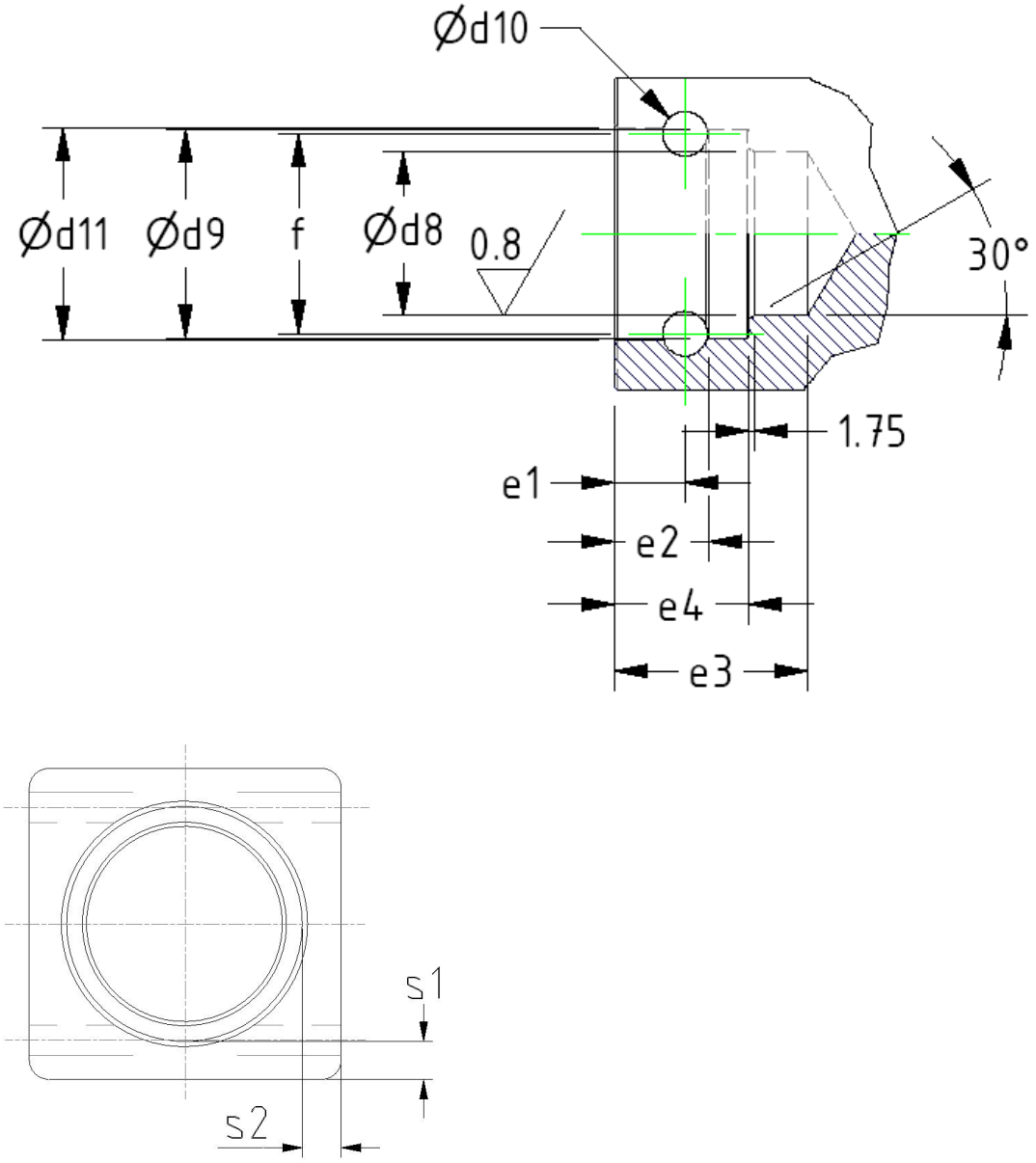



**Table 3**. Female super Staple Lock coupler (all dimensions in millimetres)

| Nominal size DN | d8 ± 0.015 | d9 ± 0.04 | d10 ± 0.14 | d11 ± 0.04 | e1 ± 0.2 | e2 ± 0.2 | e3 min | e4 ± 0.1 | f | s1 min | s2 min |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 12 | 16.03 | 23.86 | 9.0 | 24.36 | 9.7 | 14.7 | 28 | 19.2 | 22 | 8.0 | 8.0 |
| 20 | 22.04 | 28.86 | | 29.36 | 12.7 | 17.7 | 39 | 24.4 | 27 | 8.0 | 8.0 |
| 25 | 31.05 | 38.63 | 13.64 | 39.63 | 18.6 | 26.3 | 53 | 35.5 | 36 | 12.0 | 12.0 |
| 32 | 38.05 | 45.63 | | 46.63 | 19.6 | | | 36.5 | 43 | 13.5 | 13.5 |
| 40 | 44.02 | 54.66 | | 55.66 | 21.6 | 28.3 | 57 | 40.0 | 52 | 15.3 | 15.3 |
| 50 | 50.02 | 63.67 | | 64.67 | | | 59 | 41.0 | 61 | 17.2 | 17.2 |

## Dimensional Details of Super Staple

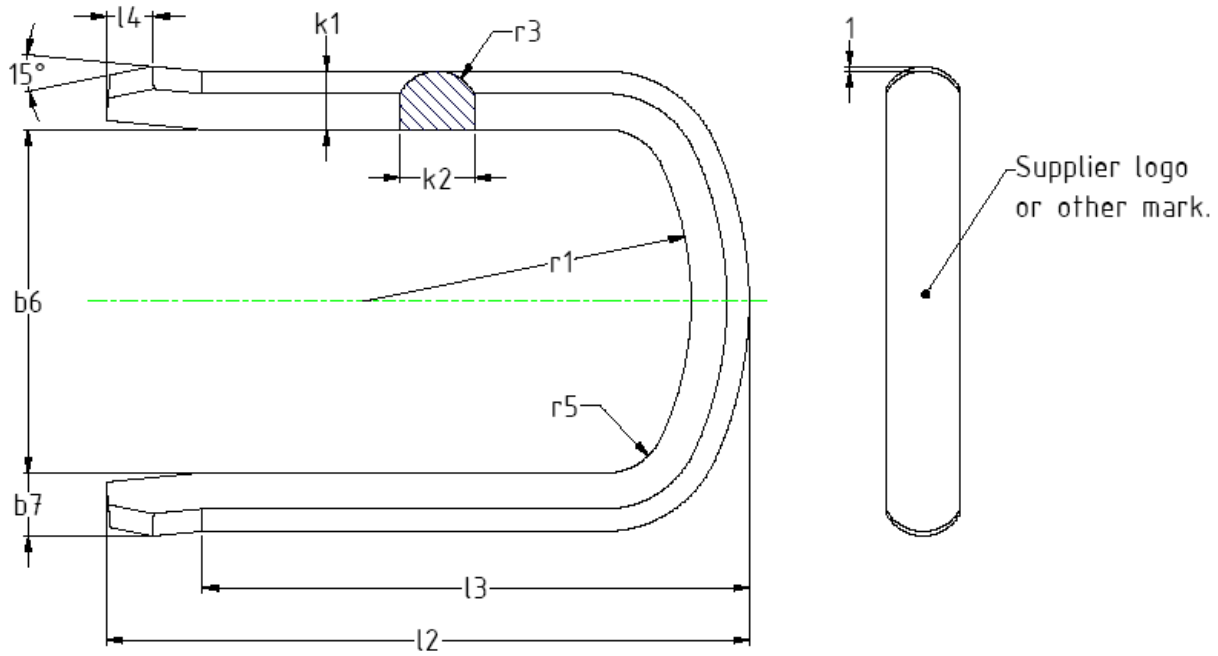



**Table 4**. Super staple (all dimensions in millimetres)

| Nominal size DN | b6 ± 0.5 | b7 ± 0.25 | k1 ± 0.1 | k2 ± 0.1 | l2 | l3 | l4 ± 0.5 | r1 min | r3 ± 0.025 | r5 min |
|---|---|---|---|---|---|---|---|---|---|---|
| 12 | 17.5 | 7.0 | 6.4 | 7.9 | 53 | 45 | 5.5 | 8.75 | 4.475 | - |
| 20 | 22.5 | | | | 60 | 52 | | 11.25 | | - |
| 25 | 30 | 10.25 | 9.3 | 11.9 | 75 | 60 | 7.0 | 35.0 | 6.73 | 10 |
| 32 | 37 | | | | 85 | 70 | | 40.0 | | |
| 40 | 46 | | | | 92 | 77 | | 47.0 | | |
| 50 | 55 | | | | 103 | 88 | 7.5 | 52.5 | | |

## Dimensional details of O-Ring

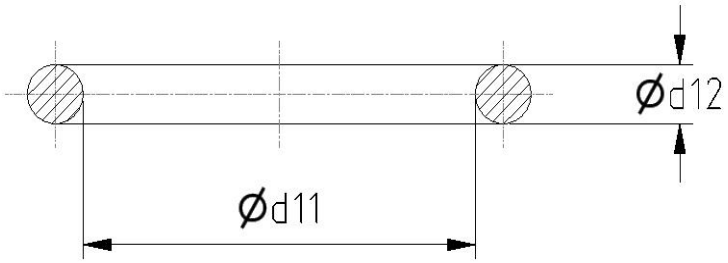



**Table 5**. O-Ring (all dimensions in millimetres)

| Nominal size DN | d11 | | d12 ± 0.08 |
|---|---|---|---|
| 12 | 11.0 | ± 0.15 | 2.5 |
| 20 | 17.0 | | |
| 25 | 25.0 | ± 0.25 | |
| 32 | 33.0 | ± 0.30 | |
| 40 | 37.0 | | 3.0 |
| 50 | 43.0 | | |

## Dimensional details of O-Ring Back-up washer

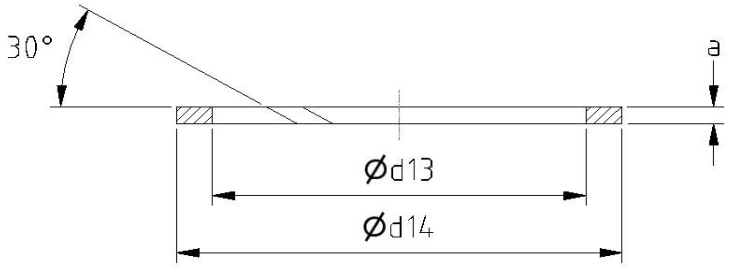



**Table 6.** O-Ring Back-up washer (all dimensions in millimetres)

| Nominal size DN | d13 ± 0.10 | d14 | | a ± 0.1 |
|---|---|---|---|---|
| 12 | 12.00 | 16.00 | ± 0.02 | 0.8 |
| 20 | 17.95 | 21.95 | ± 0.05 | |
| 25 | 27.05 | 31.05 | | |
| 32 | 34.00 | 38.00 | | |
| 40 | 39.15 | 43.95 | | 1.5 |
| 50 | 45.15 | 49.95 | | |

## Section 4. Materials

The male staple-lock nipple shall be manufactured from 1.0718 steel per EN10277-3 (Bright steel products. Technical delivery conditions. Free cutting steels), minimum tensile 345 Mpa, minimum UTS 200 Mpa.

The female staple-lock adaptor shall be manufactured from 1.0718 steel per EN10277-3 minimum tensile 345 Mpa, minimum UTS 200 Mpa.

Note: All male and female 420 bar rated nipples and couplers shall be constructed from one (1) piece forgings, cold headed or machined from bar stock. Fittings fabricated from multiple components are not permissible without written approval by customer's engineers.

The staples shall be manufactured from Stainless Steel.

Stainless steel staples shall be manufactured from 420S45 stainless steel
The hardness of the staples shall be Rc28 $^{+/-}$ 3

The O-ring shall be manufactured per ISO 1629 "Rubber and lattices – Nomenclature" and made from Nitrile (NBR) rubber having a Shore A hardness of 88 $^{+/-}$3 unless otherwise specified

The O-ring Back-up washer shall be manufactured per ISO 1043-1 and made from a Polyamide, such as Teflon (PTFE), Acetal homopolymer

## Section 5. Corrosion resistance (of metal components)

When the assembled male nipple, female coupler & staple are salt spray tested in accordance with ASTM B117 "Salt spray testing". A minimum of 400 hrs (before red rust) shall be required.

## Section 6. Identification

The male staple-lock nipples and female staple-lock couplers should be marked with the manufacturer's identity (logo) and traceability details. All staples should have the manufacturers identity (logo) permanently marked on them.

## Section 7. Burst

Minimum burst qualification of the assembled male nipple (c/w O-Ring, backup washer), female coupler and staple shall be per table 7, when tested per ISO 1402 “Rubber and plastic hoses and hose assemblies – Hydrostatic testing”.

**Table 7.** Minimum burst pressure of assembly

| Nominal size DN | Minimum Burst Pressure bar |
|---|---|
| 25 | 1680 |
| 32 | 1680 |
| 40 | 1680 |
| 50 | 1680 |

## Section 8. Impulse

Minimum qualification requirement is 500,000 impulse cycles at 1.33 times max rated pressure (i.e. 560 bar) per ISO 6803 “Rubber and plastic hoses and hose assemblies – Hydraulic– pressure impulse test without flexing” is required per assembly size.