

Our tradition is one of innovation. We have been delivering our connectors to the aviation industry for 70 years. During this period our products and solutions have earned a reputation for leading-edge reliability, safety and weight reduction. And today, we're a trusted industry partner: many of our parts are now standard in aircraft around the world. Still, we're committed to pushing innovation to new heights, always looking for new ways to further drive development – and set new standards for the future.



Headquartered in Germany, NORMA Group has been awarded all major international aviation-industry certificates.





Your development partner

NORMA Group is more than the industry benchmark for innovative, high-quality, and reliable products. We’ve got the resources, insight, and know-how to deliver solutions tailored to your needs. Trust our wide array of engineering, product-development and prototyping services to support you from concept all the way through pre-production to serial production, and to help shorten development cycles and improve quality and functionality.

Bionic Engineering and FEM Calculations

Working with us, you profit not only from our extensive knowledge of legislation and global market trends but also from the capabilities of one of the best-equipped lab test facilities in the world. Here, NORMA Group engineers work constantly to optimize our materials, shapes and structures. They use bionic engineering principles taken from growing bones and trees to design stronger products that require less material. And they use complex computer simulations based on the finite element method (FEM) to test their prototypes.

Thanks to these tools, our experts are capable of developing and improving existing standards to meet or exceed your required performance specs.



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## Fixation Clips



Ideal for holding pipes, hoses, and cables in position. Light, reliable and easy to install, these components keep weight, costs, and assembly time at a minimum. Can also be engineered for use in special applications.



FIXATION CLIPS

FIXATION CLIPS – INTERNATIONAL AVIATION STANDARDS

ABS0396



ABS1494



ASNA2683



NSA5528



NSA5519



NSA5575



NSA935807



AS5587



FIXATION CLIPS – INTERNATIONAL AVIATION STANDARDS



FIXATION CLIPS – GENERAL STANDARDS

All pipe retaining clips are available with a special sound damping rubber profile as optional equipment. The standard version RS/RSGU clips (**Type 1**) are also available in a round shape (RS/RSGU **Type 0**) or open shaped (RS/RSGU **Type 2**).



## FIXATION CLIPS

### RSV/RSGU-V WITH PRE-ASSEMBLY FUNCTION

In addition to the designs already mentioned, we also offer the V-feature clip. This special design, a variation of the standard RS/RSGU Type 1, is provided with an integrated mounting fastener. When the clip ends are compressed, the fastener locks into place and locks the clip. Thus, the RS/RSGU clip with V-feature can be easily preassembled on the pipe.

- Diameters and band widths will be furnished on request



### RLGU CLIP

The RLGU is a new clip that was recently added to our retaining products range. It is also a variation of the standard Type 1, but without reinforced band ends. This makes it suitable for use in applications subjected to only slight mechanical loads, such as the fastening of cables.

- RLGU are only available in band width 12.7 mm
- For the complete program please refer to the table of sizes



## Worm Drive Hose Clamps



WORM DRIVE HOSE CLAMPS

WORM DRIVE HOSE CLAMPS – INTERNATIONAL AVIATION STANDARDS



TORRO® – WORM DRIVE HOSE CLAMPS TO DIN 3017

TORRO® hose clamps are specially suitable for applications under high mechanical loads. Since we are continuously working to improve its features, this clamp is still setting standards for modern hose clamp design.

The distinguishing feature of the TORRO® is the asymmetrical construction which tells you at first sight whether it is a genuine TORRO® or not.



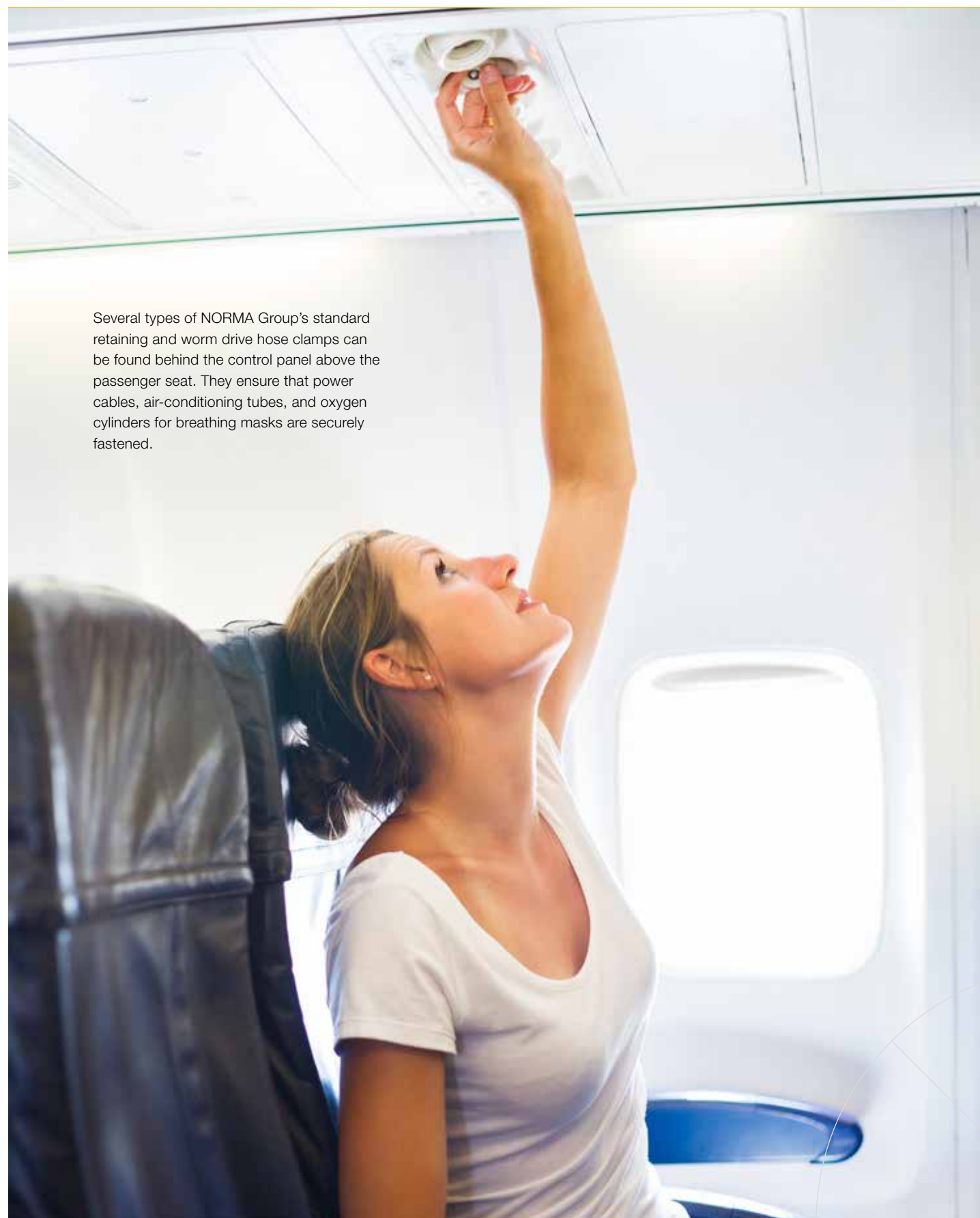
The advantages at a glance

- Multi-range hose clamp
- Material: W1, W2, W3, W4, W5
- Chromium VI free: compliant with ROHS, WEEE and ELV Environmental Directives
- Clamping ranges to DIN 3017: 8–16 mm up to 140–160 mm
- Larger diameters on demand

- 1 Improved asymmetric housing**  
– even distribution of forces and safe assembly
- 2 Screw support**  
– Ease of assembly due to the safe guidance of the emerging band end
- 3 Material and clamping range stamped on the band**  
– prevention of errors
- 4 Asymmetric extension**  
– prevents housing from tilting over when the clamp is tightened
- 5 Short housing saddle**  
– even contact pressure  
– improved efficiency
- 6 Smooth or stamped inside of band**  
– optimal hose protection



## WORM DRIVE HOSE CLAMPS



Several types of NORMA Group's standard retaining and worm drive hose clamps can be found behind the control panel above the passenger seat. They ensure that power cables, air-conditioning tubes, and oxygen cylinders for breathing masks are securely fastened.

## WORM DRIVE HOSE CLAMPS

### Modular System

#### TORRO®

The TORRO® modular system offers several features that can be added to the clamp in order to modify its technical characteristics. You are free to combine two or more of these accessories according to your requirements.



##### The Notch

The notch is a clever means for pre-positioning the TORRO® hose clamp on the hose. In this case the oval hole in the clamp band finds its exact counter part on the hose surface. Thus the TORRO® is safely and accurately kept in place prior to the final assembly.

- Safe pre-assembly on the hose
- Smart weight-saving option without weakening the performance of the clamp



##### The Prefix Clip

With this accessory the TORRO® can also be pre-positioned on the hose. The two 'teeth' of this device keep the TORRO® hose clip safely in place if it needs to be stocked or transported prior to its final assembly.

- Safe pre-assembly on the hose



##### The Spring Insert

For this version of the TORRO® the standard hose clamp is equipped with a spring insert on the inside of the clamp band. When tightening the screw the spring is loaded and stores sufficient clamping force to ensure a long-lasting automatic retensioning effect. Thus the radial clamping force achieved will be sufficient even under extremely low temperatures. Therefore, the TORRO® is an optimal solution for applications under extreme temperature changes.

- Automatic re-tensioning effect in the event of hose relaxation
- Increased sealing reliability across a wide temperature range



##### The PreFix System

The PreFix System is a concept for integrated clamps and clips on hoses and pipes. The demand for complete systems that include the appropriate sealing function is increasing.

- Safe pre-assembly on the hose



##### The Radial Insert

The Radial® Spring Clamp consists of a Standard riveted clamp with a stainless steel liner. This insert in the Radial acts as a spring. Inward radial pressure on the hose is made possible as the material between the cut-outs and the longitudinal beads acts as leaf springs.

- Radial integrated element located on the inside of the clamp band
- High contact pressure due to the radially corrugated design
- There are also dynamic properties
- Only available in 9 mm bandwidth





# Pipe Connections

Robust, lightweight and easy to assemble, our pipe couplings can also be engineered for use in special applications.



## V-BAND CLAMPS

The V-Band clamps are reliable and time-effective connection elements for industrial and automotive use. They are made to customer requirements and can be supplied with various profiles, band widths and closure types.

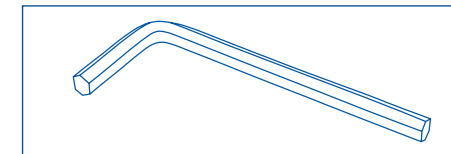


### The advantages at a glance

- Quick assembly
- Compact design
- Lightweight
- No loose closure parts
- Wide range of existing profiles

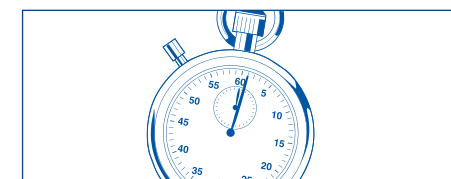
- 1 Coverband**  
— optimal distribution of clamping forces
- 2 Closure**
- 3 Three profile segments**  
— ease of assembly

## PRODUCT ADVANTAGES



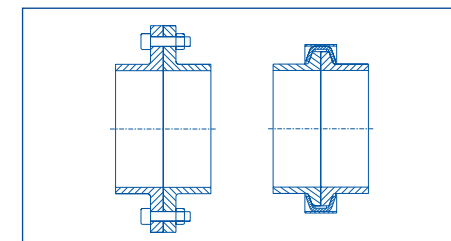
### Easy handling

V-Band clamps are easy to handle and assemble, requiring less operator effort.



### Quick assembly

V-Band clamps are quick to assemble, saving time and money. With a single closure design, only one bolt has to be tightened to produce a secure joint.



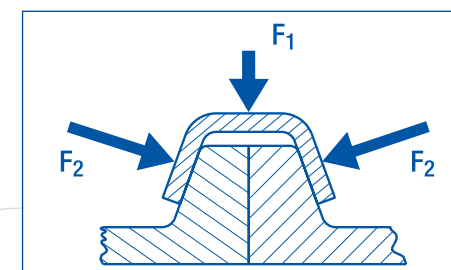
### Compact design

In contrast to conventional flanges, V-Band clamps require only minimal space and can therefore be used in critical fitting situations



### Lightweight

Compared to flanges, profile clamps are extremely lightweight. This helps reduce the total weight of the system.



### Product function

The V-Band clamp works on the principle of the inclined plane: when the closure is tightened, a circumferential force  $F_1$  is exerted on the profile segments. By means of the profile, the two flange parts are pressed together (see drawing). The exerted circumferential force is converted into a considerably higher axial force  $F_2$ .

PIPE CONNECTIONS

CLOSURE TYPES

STC – Straight trunnion closure



With the STC type closure we offer a cost-effective alternative to conventional T-bolt closures.

- Advantages:**
- Low friction losses
  - High-strength precision-machined components
  - Manufactured from consistently high-quality materials
  - State-of-the-art automated manufacturing
  - Competitively priced

QRC – Quick release closure



The revolutionary QRC closure has significant advantages over conventional T-bolt closures.

- Advantages:**
- All the advantages of STC-type closures
- Plus**
- Rapid closing and opening
  - Captive closure components
  - Significantly shorter installation times
  - Closure bolt secured during tightening

Band & Closure Dimensions

V-Band clamps are manufactured with band and closure dimensions according to the profile selected.

Closure type	Cover band 1.0 x 20 mm	Cover band 1.5 x 25 mm
STC	Screw	Screw
QRC	M 6 x 50	M 8 x 70

V-BAND CLAMPS – ROLL FORMED



Roll Formed V-clamp Unequal Straps

- **Materials:** Corrosion and heat resistant steels
- **Fasteners:** 1/4" (6.4 mm)
- **Sizes:** 3.5" (89 mm) to 12" (305 mm) diameter
- **Options:** Short loop configuration for added clearance, drain holes in V-retainer.

- Features**
- Continuous V-retainer and partial outer band, compact profile to fit flanges having limited clearance.

- Applications**
- Turbochargers



Roll Formed V-clamp Assembly



Roll Formed V-clamp with Equal Straps



PIPE CONNECTIONS

BREEZE V-BAND

Breeze V-Band clamps provide fast, secure coupling for connecting flanged joints. The V-Band clamp features high strength and positive sealing integrity.



- Custom designs and sizes available
- Typical applications include heavy duty diesel engine exhaust and turbochargers

V PP – PROFILE CLAMP WITHOUT COVER BAND

The V PP profile clamps are reliable and efficient connection elements.



- 1 Integral clamping device
- 2 Closure
- 3 Pressed profile

- Material 1.4301 (other materials on demand)
  - Internal profile diameters available: \*
    - Closure with bolt 20 mm–180 mm
    - Snap-in closure 20 mm–45 mm
- \* depending on the closure design and the type of profile

Closure with bolt



Closure with additional support



VPP Clip (Snap-in closure)



## PIPE CONNECTIONS

### SEC – BALL ZONE EXHAUST GAS CLAMP

The SEC is the ideal problem solver for connection points in the central and rear exhaust gas area. During assembly, in combination with flange connections there is the option to swivel the exhaust silencer.



## The advantages at a glance

- Angle compensation in the exhaust gas system  $\pm 3^\circ$
- The muffler can be swiveled during assembly
- Simplified assembly and disassembly owing to the increased system flexibility
- Higher torsion moment as compared to standard ball-type flange connections
- Low leakage rate
- Low weight
- PIA clip optional

### Technical features

- System tightness with new part (start of service): Leakage rate  $\leq 2$  Ltr./min
- System tightness after temperature ageing (after full load): 8 h  $> 400^\circ\text{C}$  Leakage rate  $\leq 2$  Ltr./min
- Bending moment:  $> = 150$  Nm
- Torsion moment (twisting) of the joint:  $> = 150$  Nm
- Band material: Steel 1.4301 or 439 Stainless steel
- Screw: Steel, class 10.9
- Solid trunnion: Steel 1.0718/C45

### Applications in the industry

- Connecting pipes in the central and rear exhaust gas area

- 1 Torx screw with integrated washer**  
– simplified assembly and disassembly  
Also offers hexhead
- 2 Convex-shaped band fitting ball-shaped flanges**  
– perfectly adapted to the system
- 3 Chromium VI-free, non-seizing coating**  
– improved clamping force
- 4 Solid trunnion, Chromium VI-free coating**  
– high temperature resistance; withstanding high clamping forces

### Corrosion resistance



Corrosion resistance in salt spray testing = Min. 96 h







# Specials

Unique demands? Whatever the application, NORMA Group will help develop, validate and manufacture your solution.



SPECIALS – INTERNATIONAL AVIATION STANDARDS



The landing gear and turbines are two of the most critical systems in an aircraft. Here, NORMA Group's standard connecting solutions secure power cables and hydraulic components to the fuselage and help establish the complex tube routings in the nozzles.