

# NEW PRODUCT NEWS



## High Speed Jet Spindle





## High speed jet spindle

TaeguTec has launched a revolutionary new high-speed spindle developed for applications using high RPM for small diameter tools that can be used on limited RPM machines. The new spindle is designed for high-speed machining in milling, holmaking and grinding applications.

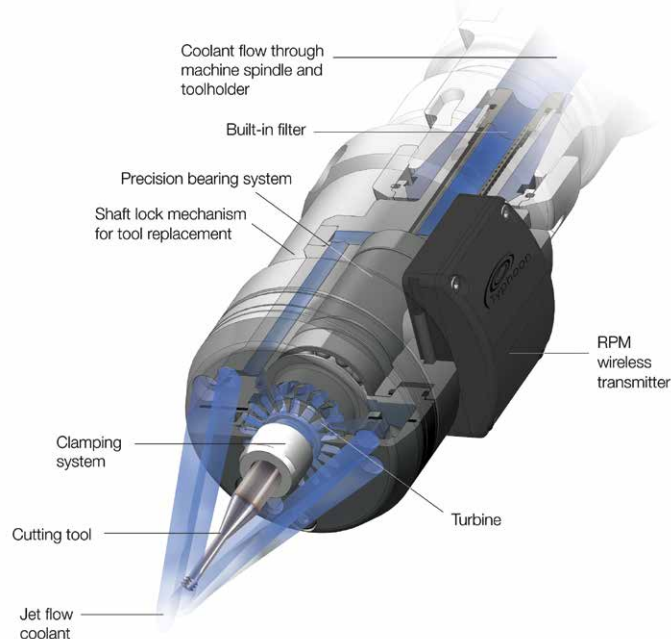
The system utilizes the machine tool's existing coolant supply, driven by a high-pressure pump (minimum 20 bars) as an energy source, to rotate a built-in turbine at speeds of up to 40,000 RPM.

The TYPHOON does not replace the existing machine's spindle. Instead, it improves the existing machine's performance, surface finish and tool life capabilities.

### General View



### Internal Structure



## ADVANTAGES

- **Reduced machining time**-Higher table speed means faster machining due to higher rotation speed.
- **High efficiency**-Up to 65% increased productivity on low RPM spindle machines.
- **Energy savings**-The machine spindle is idle while the TYPHOON is in operation.
- **High precision**-Excellent surface quality due to optimized machining conditions.
- **Plug & Play**-Easy installation on existing machines with no modification required.
- **Extended tool life**-Due to optimal cutting conditions and strong coolant jet flow.



## FEATURES

- **Direct wireless rotation speed display.**

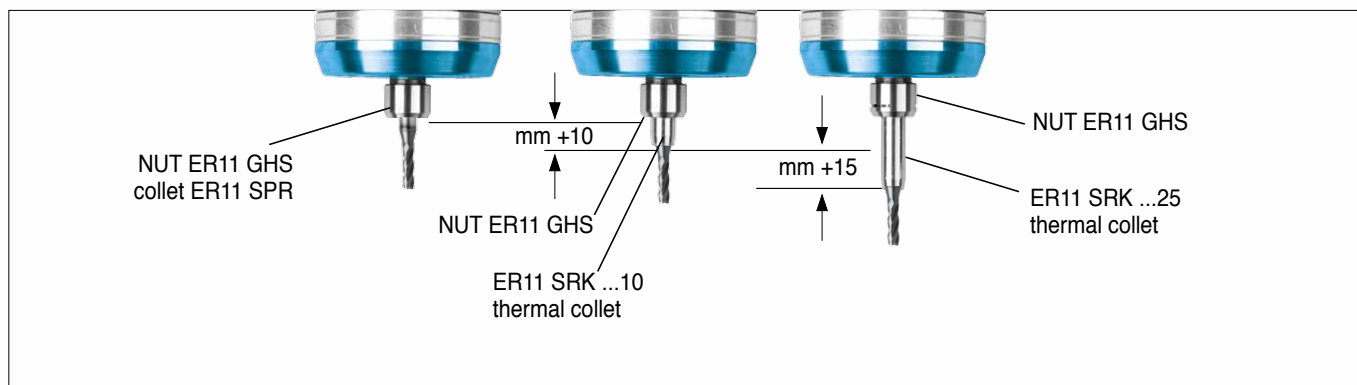
The Typhoon comes with an online speed display system that monitors the actual cutting rotation speed during machining.

- **2.4 GHz radio frequency transmission.**
- **Direct wireless rotational speed monitoring of up to 5 meters.**
- **Wireless LED display enables the reading of the TYPHOON's RPM in real time.**



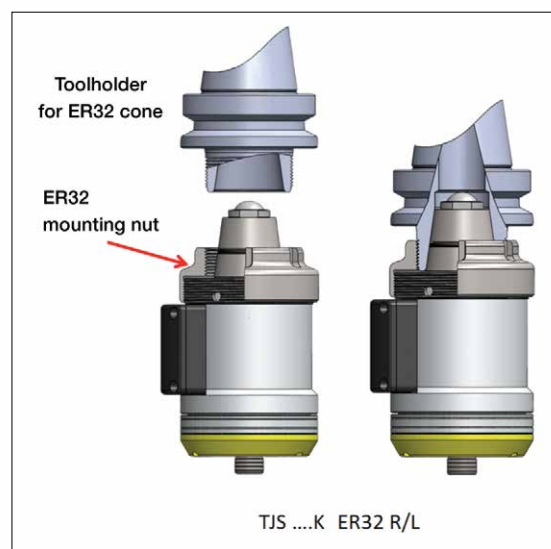


## A new solution for cutting tool overhang



## Built-in ER32 collet chuck

Featuring high precision and low runout, suitable for various standard toolholders with an ER32 taper.



## Target market and industries

- Typhoon is designed for applications requiring shanks of up to 6 mm and cutting diameters up to 3.5 mm.
- Specifically adapted to workshops where CNC machines have a spindle capacity of up to 15K RPM and through coolant with a minimum 20 bar.



Turn mill



Milling



Turning

The new spindles are an ideal solution for the growing demand in finish and semi-finish operations on a wide range of processed materials in the die and mould industry as well as high precision machining in the aerospace and medical industries.

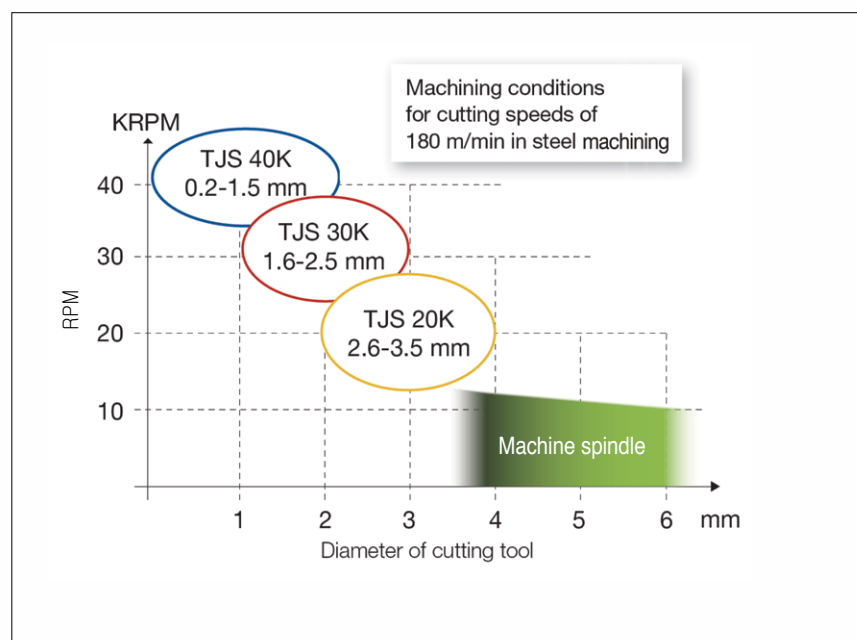
## Productivity booster

These coolant driven spindles lead to a significant widening of the application range on medium/large machine tools that lead to improved productivity, higher efficiency, minimal set-up time and decreased machining time, all of which reduce overall costs.



## TYPHOON operation range

Operation speed range vs tool diameter



## Applications

Clamping type: ER11 collet size



### Milling

Slotting-up to  $ae=3.0$  mm,  $ap=0.1D$   
Shouldering- up to  $D=3.5$  mm,  $ae=D$ ,  $ap=0.25D$



### Thread milling

Maximum M5 thread  
Right-or left-hand rotation



### Drilling

Maximum drill diameter=2 mm



### Engraving/Chamfering

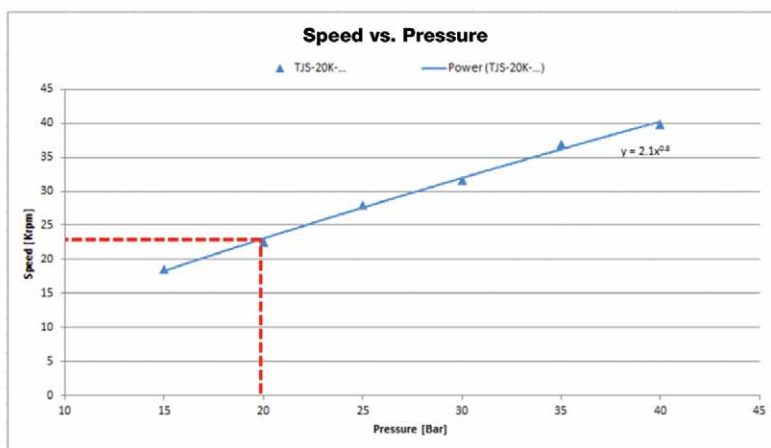
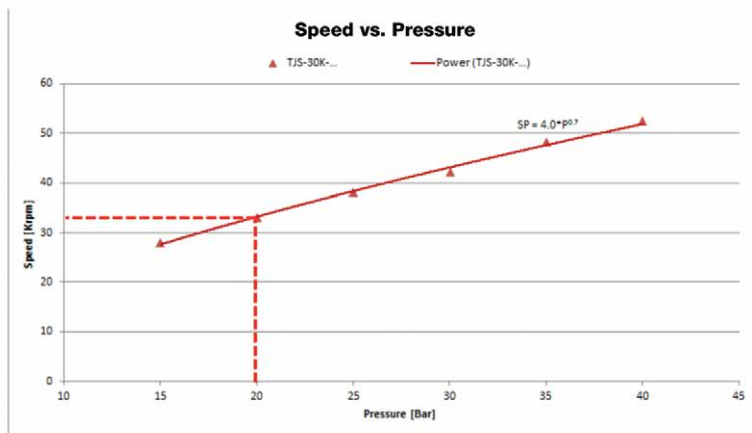
Maximum shank diameter=6 mm



### Fine radial grinding

Grinding wheels: 1A1W up to 10 mm  
Balanced WC shank  
Maximum shank diameter=6 mm

Increasing pressure and flow rate provides higher rotation speed and higher output



### Speed vs. Pressure

| TYPHOON type/RPM    | Coolant pressure |            |            |
|---------------------|------------------|------------|------------|
|                     | 20 Bar           | 30 Bar     | 40 Bar     |
| <b>TJS 20K ER32</b> | 20000* RPM       | 30000* RPM | 40000* RPM |
| <b>TJS 30K ER32</b> | 30000* RPM       | 40000* RPM | 50000* RPM |
| <b>TJS 40K ER32</b> | 40000* RPM       | 50000* RPM | 60000* RPM |

\* Approximate RPM values - dependent on pressure, flow rate and coolant type

## TYPHOON competitors

The existing solutions currently offered pose the following limitations vs. jet coolant driven spindles:

### Mechanical speed increaser gearbox

- No real-time speed monitoring.
- The spindle is not suitable for automatic tool changers.
- Special installations are required.
- The machine spindle rotates during machining, increasing its wear and reducing operating life.



### Electrical high-speed spindles

- Not suitable for automatic tool changing.
- Special installations are required.
- High cost



### Air turbine spindles

- High cost
- Air consumer
  - Extremely expensive resource
  - Air pipes installation necessary
  - High air flow rate
- Special installation required in order to work with the automatic tool changer.
- Limited placement in tool magazine due to large physical dimensions and weight.





**TYPHOON spindles are available in three versions. Each one covers a specific range of diameters and speeds for a wide range of workpiece materials and machine tools.**

**TYPHOON is available in several adaptation types:**

- Integral ER32 taper with a special tightening nut, suitable for all standard toolholders for ER32 collets.
- Cylindrical 20 mm diameter shank that can be clamped in ER32 19-20 sealed spring collet - on request.
- Integral BT30,40,DIN69871 40,CAT 40, HSK A 63, CAMFIX C5,C6



TJS ...K BT40 R/L

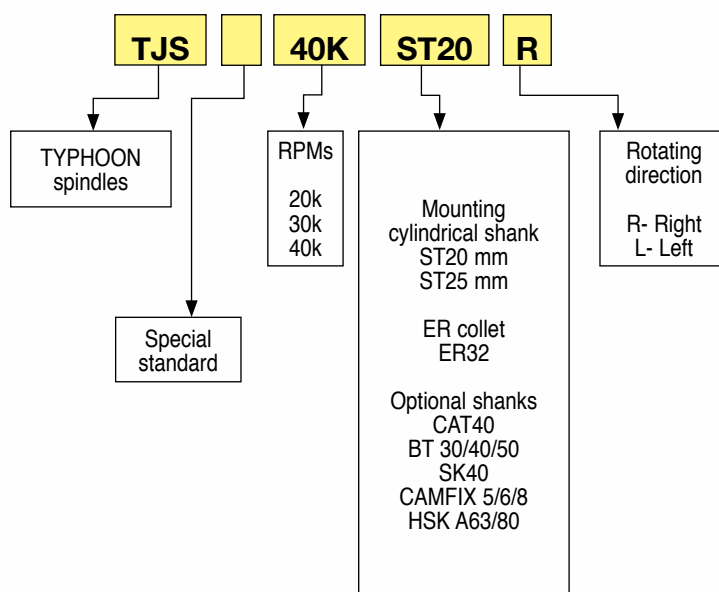


TJS ...K ER32 R/L



TJS ...K ST 20 R/L

**Order example**



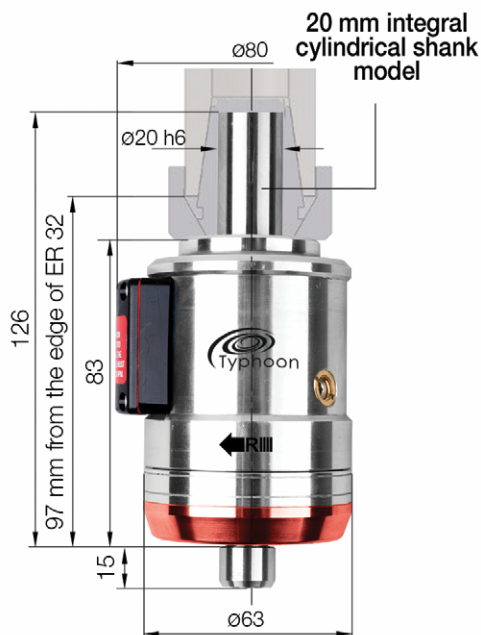
•The TYPHOON is offered with right-hand or left-hand direction of rotation.

**TYPHOON models:**

TJS □K ER32 R/L and TJS □K ST20 R/L



**TJS □K ER32 R/L**



**TJS □K ST20 R/L**

| Product description              | TJS 20K... | TJS 30K... | TJS 40K... |
|----------------------------------|------------|------------|------------|
| Rotation speed (RPM)             | 20,000     | 30,000     | 40,000     |
| Coolant pump pressure (bar)      | 20         |            |            |
| Flow rate (l/min)                | 12         |            |            |
| Maximum tool shank diameter (mm) | 6.0        |            |            |
| Maximum tool diameter (mm)       | 3.5        | 2.5        | 1.5        |

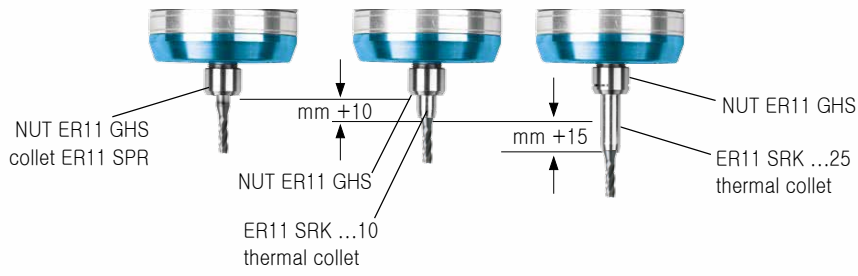
**WRENCH DIA3.2X35 –Shaft lock for clamping**



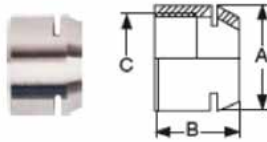
**TJS TSD DISPLAY – RPM display**



## Tool clamping using ER11 collets



WRENCH ER11 SMS



NUT ER11 GHS

## User guide

The TYPHOON system was developed to enable to apply optimal cutting speed conditions for small diameter solid carbide tools which require very high RPM.

Recommended cutting speed for shouldering operations

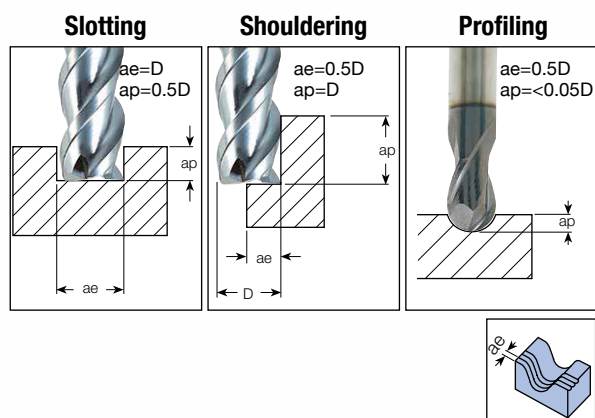
-Steel: up to 200 m/min

-Aluminum: 200 m/min and higher

| TYPHOON Type                         | TJS 20K                     | TJS 30K | TJS 40K |
|--------------------------------------|-----------------------------|---------|---------|
| Driven spindles by                   | Based on pressure of 20 bar |         |         |
| Tool diameter for <b>steel</b> mm    | 2.6-3.5                     | 1.6-2.5 | 0.2-1.5 |
| Rotation speed RPM                   | 2,000                       | 30,000  | 40,000  |
| Tool diameter for <b>aluminum</b> mm | 2.0-3.5                     | 3.6-5.0 | 0.5-3.0 |

## Feed recommendations for small diameter solid carbide tools at high cutting speeds

Recommended feeds for solid carbide and MULTI-MASTER endmills



| Slotting |          |          | Shouldering / Profiling |          |
|----------|----------|----------|-------------------------|----------|
| Dmm      | Fz (min) | Fz (max) | Fz (min)                | Fz (max) |
| 1        | 0.003    | 0.005    | 0.003                   | 0.007    |
| 1.3      | 0.003    | 0.010    | 0.003                   | 0.012    |
| 1.5      | 0.003    | 0.020    | 0.003                   | 0.022    |
| 1.8      | 0.005    | 0.025    | 0.005                   | 0.028    |
| 2        | 0.005    | 0.030    | 0.005                   | 0.033    |
| 2.3      | 0.005    | 0.030    | 0.005                   | 0.033    |
| 2.5      | 0.005    | 0.030    | 0.005                   | 0.030    |
| 2.8      | 0.010    | 0.035    | 0.010                   | 0.038    |
| 3        | 0.010    | 0.040    | 0.010                   | 0.044    |

In order to obtain the advantages of high-speed machining, minimize cutting forces and reduce wear, the tool diameter should be selected according to the spindle speed. (if possible)

- Always select the smallest tool diameter, according to the application requirements.
- Always select cutting tools in grades that are suitable for high-speed machining.



## Installing the TYPHOON on existing CNC machines

The feed per tooth  $f_z$  should remain constant while the table feed should be increased according to the TYPHOON's rotation speed.

### For example:

Operation: Shoulder milling

Cutting tool: Endmill  $\varnothing$  2.0 mm (suitable for HSM)

Current cutting conditions

Spindle speed: 8000 RPM (machine spindle)

Table feed:  $f=160$  mm/min

## TYPHOON spindle type: TJS 30K ER32R

The idle rotation speed with the TYPHOON spindle reached 33,000 RPM.

The TYPHOON spindle speed dropped when the tool entered the workpiece from several thousand kRPMs down to approximately 30,000 RPM. As the ratio between the machine spindle speed and TYPHOON speed is 1: 3.75, the table speed should be increased to  $3.75 \times 160 = 600$  mm/min.

**Note:** For the first trial, it is recommended to increase the table feed gradually by 3-3.5, before setting the table feed to the above-calculated value.

### New machining process

Calculate the table speed  $F$  [mm/min] according to  $F = n * z * f_z$

**Feed per tooth  $f_z$  (mm/tooth)** - Select according to the recommendations of the tool's vendor, taking into consideration the machining material, application and the tool geometry.

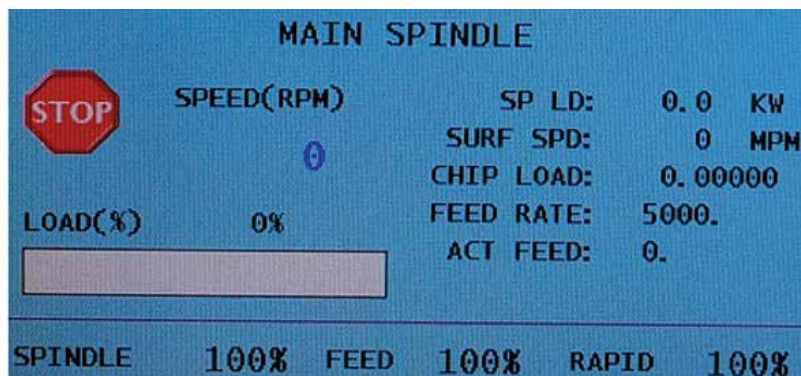
**Rotation speed  $n$  (RPM)** - The rotation speed for table speed calculations will be determined only after reading the actual rotation speed obtained when the tool has engaged the material.

## TYPHOON orientation on main machine spindle

⚠ While the TYPHOON spindle is mounted on the machine, the main machine spindle should be stationary or spin at a minimum RPM. (5-10 RPM)

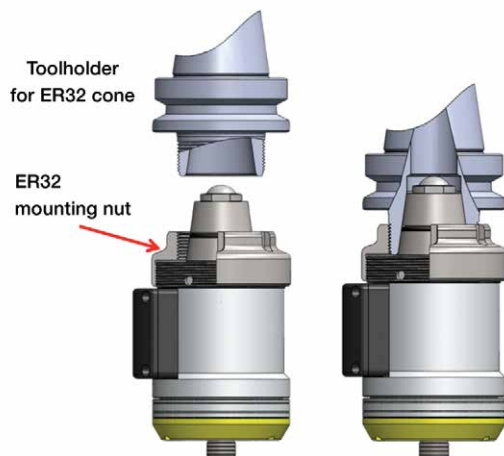
Allow the main machine spindle rotation (do not exceed 3000 RPM) only for tool runout optical check to avoid the main spindle rotations during the TYPHOON's operation, use correct M-code to lock the spindle orientation.

For example: "M19" code stops the spindle in a defined angle position.



## TYPHOON mounting

### TJS-ER32



TJS ....K ER32 R/L

## Placement of TYPHOON in the toolholder

Caution: Deviation from these steps might lead to the locking of the tightening nut to the TYPHOON tool.

The TYPHOON can function only with toolholders that have coolant through holes.

Mounting the TYPHOON in a toolholder:

- ❶ Loosen the TYPHOON tightening nut turning it 1.5 turns in order to enable the differential clamping.
- ❷ Tighten the TYPHOON clamping nut onto the collet chuck.
- ❸ Insert the locking pin to stop the spindle shaft from moving.
- ❹ Fasten the tool into the TYPHOON collet chuck. Do not hold the shaft while tightening the collet nut.



## Basic requirements for the CNC machine

1. Coolant flows through the main machine spindle.
2. High pressure coolant: **minimum** 20 bar, **maximum** 40 bar, **recommended range** 25-35 bar.
3. Flow rate: **minimum** 12 L/min, **recommended range** 18-25 L/min
4. Coolant filtration level: minimum 100  $\mu\text{m}$ .
5. Machine tool ability to operate when its original spindle does not rotate. If not possible, use minimal RPM.
6. An active mist collector.
7. With the emulsion coolant, use an anti-foaming agent additive to prevent foaming.
8. With oil coolant, the high pressure increases the amount of oil fumes.
9. Use appropriate means of fire protection.
10. Use anti-dissolution additive suitable for your oil.



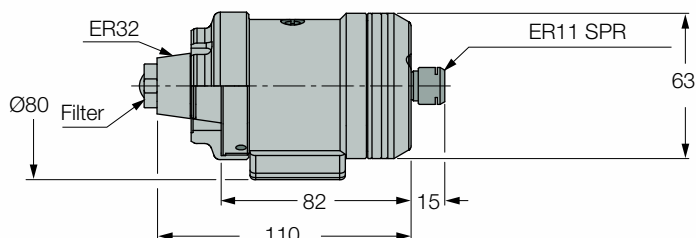
Example of a toolholder with a coolant hole





# TJS-ER32

Coolant driven high-speed compact spindles with ER32 shanks



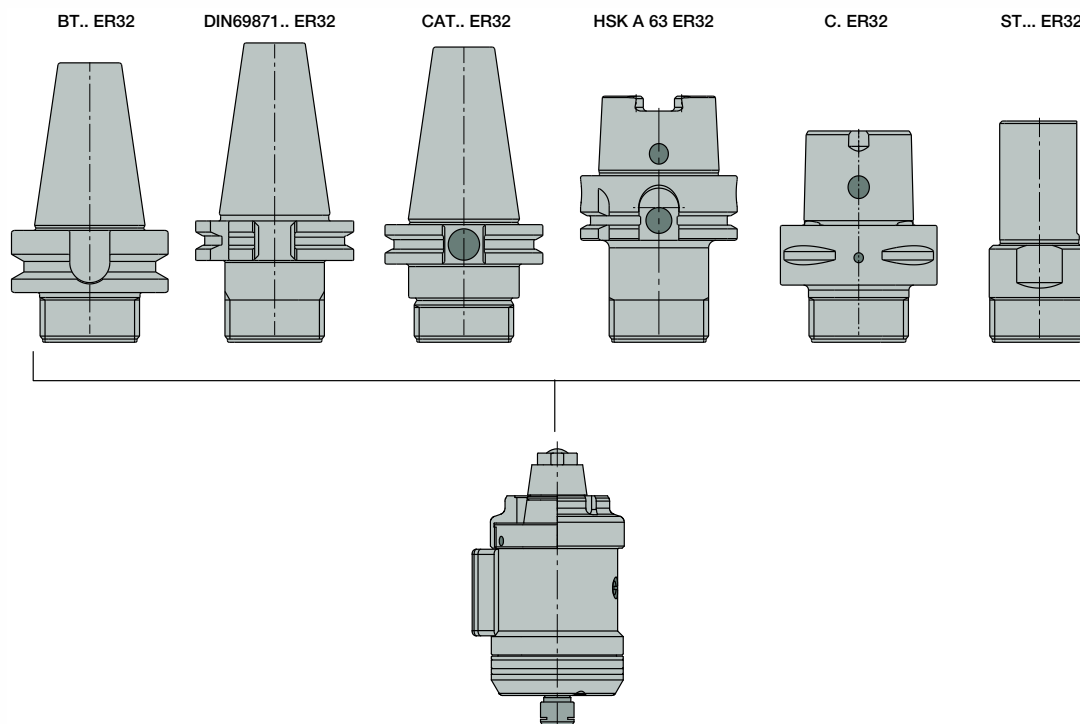
|            |  |  |
|------------|--|--|
| G2.5       |  |  |
| 40,000 RPM |  |  |

| Designation   | d max(1) | Kg   |
|---------------|----------|------|
| TJS 20K ER32L | 3.5      | 1.10 |
| TJS 20K ER32R | 3.5      | 1.10 |
| TJS 30K ER32L | 2.5      | 1.10 |
| TJS 30K ER32R | 2.5      | 1.10 |
| TJS 40K ER32L | 1.5      | 1.10 |
| TJS 40K ER32R | 1.5      | 1.10 |

• Maximum tool shank diameter 6.0 mm • Minimum coolant pressure 20 bar and flow rate 12 l/min  
(1) Maximum cutting tool diameter

## Spare parts

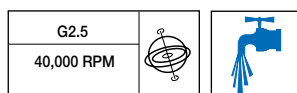
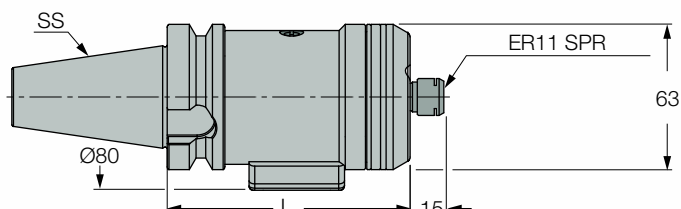
| Designation |                             |                              |                                 |
|-------------|-----------------------------|------------------------------|---------------------------------|
| TJS-ER32    | Mini ER nut<br>NUT ER11 GHS | ER wrench<br>WRENCH ER11 SMS | Locking pin<br>WRENCH DIA3.2X35 |





# TJS-BT

## Coolant driven high-speed compact spindles with BT shanks







| Designation   | SS   | L      | d max (1) | Kg   |
|---------------|------|--------|-----------|------|
| TJS 20K BT30L | BT30 | 116.00 | 3.5       | 1.50 |
| TJS 20K BT30R | BT30 | 116.00 | 3.5       | 1.50 |
| TJS 30K BT30L | BT30 | 116.00 | 2.5       | 1.50 |
| TJS 30K BT30R | BT30 | 116.00 | 2.5       | 1.50 |
| TJS 40K BT30L | BT30 | 116.00 | 1.5       | 1.50 |
| TJS 40K BT30R | BT30 | 116.00 | 1.5       | 1.50 |
| TJS 20K BT40L | BT40 | 105.00 | 3.5       | 1.90 |
| TJS 20K BT40R | BT40 | 105.00 | 3.5       | 1.90 |
| TJS 30K BT40L | BT40 | 105.00 | 2.5       | 1.90 |
| TJS 30K BT40R | BT40 | 105.00 | 2.5       | 1.90 |
| TJS 40K BT40L | BT40 | 105.00 | 1.5       | 1.90 |
| TJS 40K BT40R | BT40 | 105.00 | 1.5       | 1.90 |

• Maximum tool shank diameter 6.0 mm • Minimum coolant pressure 20 bar and flow rate 12 l/min

(1) Maximum cutting tool diameter

### Spare parts

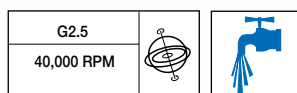
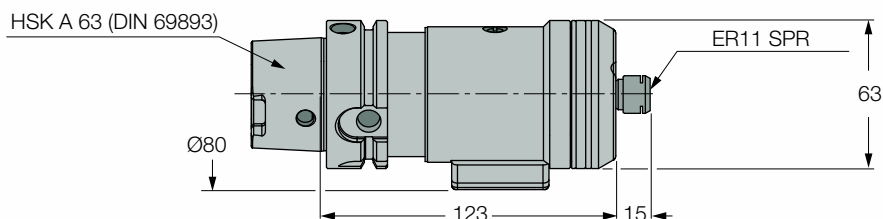
| Designation |  Display |  Mini ER nut |  ER wrench |  Locking pin |
|-------------|---|---|---|---|
| TJS-BT      | *TJS TSD DISPLAY  | NUT ER11 GHS  | WRENCH ER11 SMS   | WRENCH DIA3.2X35  |

\*Optional, should be ordered separately



## TJS-HSK A63

Coolant driven high-speed compact spindles with HSK shanks







| Designation      | d max (1) | Kg   |
|------------------|-----------|------|
| TJS 20K HSK A63L | 3.5       | 1.60 |
| TJS 20K HSK A63R | 3.5       | 1.60 |
| TJS 30K HSK A63L | 2.5       | 1.60 |
| TJS 30K HSK A63R | 2.5       | 1.60 |
| TJS 40K HSK A63L | 1.5       | 1.60 |
| TJS 40K HSK A63R | 1.5       | 1.60 |

• Maximum tool shank diameter 6.0 mm • Minimum coolant pressure 20 bar and flow rate 12 l/min

(1) Maximum cutting tool diameter

### Spare parts

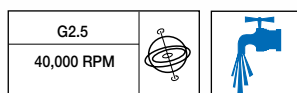
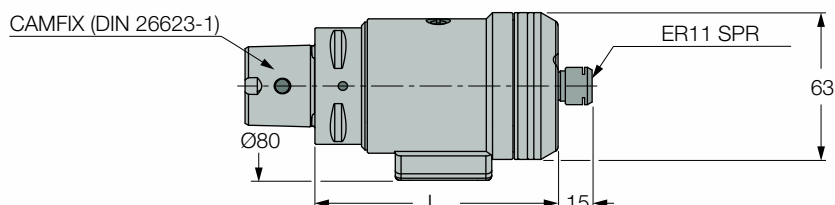
| Designation |  Display |  Mini ER nut |  ER wrench |  Locking pin |
|-------------|---|---|---|---|
| TJS-HSK A63 | *TJS TSD DISPLAY  | NUT ER11 GHS  | WRENCH ER11 SMS   | WRENCH DIA3.2X35  |

\*Optional, should be ordered separately



## TJS-C#

Coolant driven high-speed compact spindles with (CAMFIX) ISO 26623-1 shanks







| Designation        | SS | L      | d max (1) | Kg   |
|--------------------|----|--------|-----------|------|
| <b>TJS 20K C5L</b> | C5 | 104.00 | 3.5       | 1.50 |
| <b>TJS 20K C5R</b> | C5 | 104.00 | 3.5       | 1.50 |
| <b>TJS 30K C5L</b> | C5 | 104.00 | 2.5       | 1.50 |
| <b>TJS 30K C5R</b> | C5 | 104.00 | 2.5       | 1.50 |
| <b>TJS 40K C5L</b> | C5 | 104.00 | 1.5       | 1.50 |
| <b>TJS 40K C5R</b> | C5 | 104.00 | 1.5       | 1.50 |
| <b>TJS 20K C6L</b> | C6 | 106.00 | 3.5       | 1.65 |
| <b>TJS 20K C6R</b> | C6 | 106.00 | 3.5       | 1.65 |
| <b>TJS 30K C6L</b> | C6 | 106.00 | 2.5       | 1.65 |
| <b>TJS 30K C6R</b> | C6 | 106.00 | 2.5       | 1.65 |
| <b>TJS 40K C6L</b> | C6 | 106.00 | 1.5       | 1.65 |
| <b>TJS 40K C6R</b> | C6 | 106.00 | 1.5       | 1.65 |

• Maximum tool shank diameter 6.0 mm • Minimum coolant pressure 20 bar and flow rate 12 l/min

(1) Maximum cutting tool diameter

### Spare parts

| Designation   |  Display |  Mini ER nut |  ER wrench |  Locking pin |
|---------------|---|---|---|---|
| <b>TJS-C#</b> | *TJS TSD DISPLAY  | NUT ER11 GHS  | WRENCH ER11 SMS   | WRENCH DIA3.2X35  |

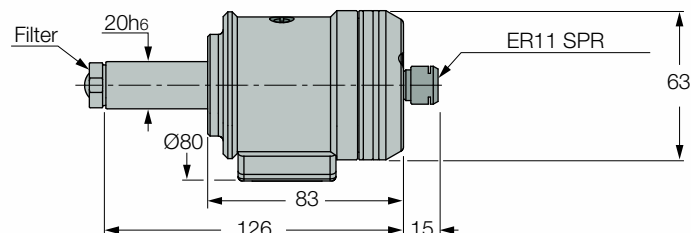
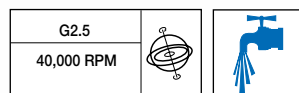
\*Optional, should be ordered separately





## TJS-ST

Coolant driven high-speed compact spindles with cylindrical shanks



| Designation   | d max (1) | Kg   |
|---------------|-----------|------|
| TJS 20K ST20L | 3.5       | 1.10 |
| TJS 20K ST20R | 3.5       | 1.10 |
| TJS 30K ST20L | 2.5       | 1.10 |
| TJS 30K ST20R | 2.5       | 1.10 |
| TJS 40K ST20L | 1.5       | 1.10 |
| TJS 40K ST20R | 1.5       | 1.10 |

• Maximum tool shank diameter 6.0 mm • Minimum coolant pressure 20 bar and flow rate 12 l/min

(1) Maximum cutting tool diameter

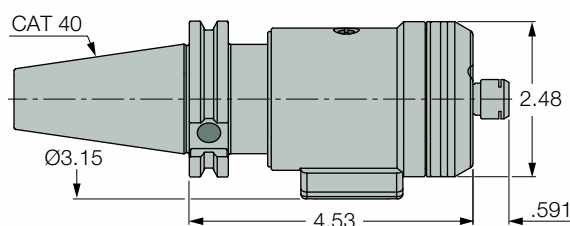
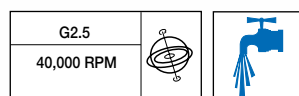
### Spare parts

| Designation | Display          | Mini ER nut  | ER wrench       | Locking pin      |
|-------------|------------------|--------------|-----------------|------------------|
| TJS-ST      | *TJS TSD DISPLAY | NUT ER11 GHS | WRENCH ER11 SMS | WRENCH DIA3.2X35 |

\*Optional, should be ordered separately

## TJS-CAT

Coolant driven high-speed compact spindles with caterpillar tapered shanks



| Designation     | d max (1) | Lbs   |
|-----------------|-----------|-------|
| TJS 20K CAT40L  | 138.      | 3.528 |
| TJS 20K CAT40R  | 138.      | 3.528 |
| TJS 30K CAT40L  | 100.      | 3.528 |
| TJS 30K CAT40R  | 100.      | 3.528 |
| TJS 40K CAT 40L | 060.      | 3.528 |
| TJS 40K CAT 40R | 060.      | 3.528 |

• Maximum tool shank diameter .236" • Minimum coolant pressure 290 psi and flow rate 3.17 GPM

(1) Maximum cutting tool diameter

### Spare parts

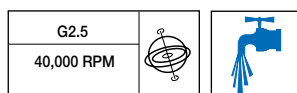
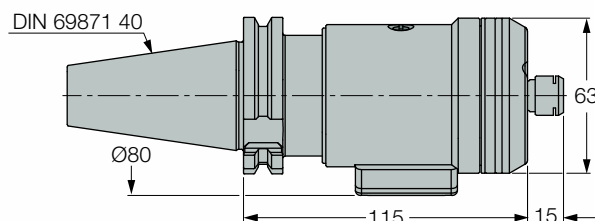
| Designation | Display          | Mini ER nut  | ER wrench       | Locking pin      |
|-------------|------------------|--------------|-----------------|------------------|
| TJS-CAT     | *TJS TSD DISPLAY | NUT ER11 GHS | WRENCH ER11 SMS | WRENCH DIA3.2X35 |

\*Optional, should be ordered separately



## TJS-DIN69871

Coolant driven high-speed compact spindles with DIN69871 shanks







| Designation                 | d max (1) | Kg   |
|-----------------------------|-----------|------|
| <b>TJS 20K DIN69871 40L</b> | 3.5       | 1.60 |
| <b>TJS 20K DIN69871 40R</b> | 3.5       | 1.60 |
| <b>TJS 30K DIN69871 40L</b> | 2.5       | 1.60 |
| <b>TJS 30K DIN69871 40R</b> | 2.5       | 1.60 |
| <b>TJS 40K DIN69871 40L</b> | 1.5       | 1.60 |
| <b>TJS 40K DIN69871 40R</b> | 1.5       | 1.60 |

• Maximum tool shank diameter 6.0 mm • Minimum coolant pressure 20 bar and flow rate 12 l/min

(1) Maximum cutting tool diameter

### Spare parts

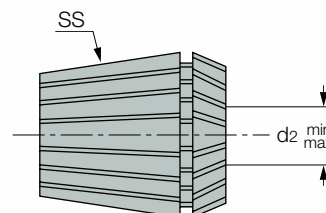
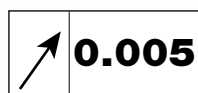
| Designation         |  Display |  Mini ER nut |  ER wrench |  Locking pin |
|---------------------|---|---|---|---|
| <b>TJS-DIN69871</b> | *TJS TSD DISPLAY  | NUT ER11 GHS  | WRENCH ER11 SMS   | WRENCH DIA3.2X35  |

\*Optional, should be ordered separately



## ER-SPR-AA

DIN 6499 'AA' ultra precise ER spring collets with hard touch coating



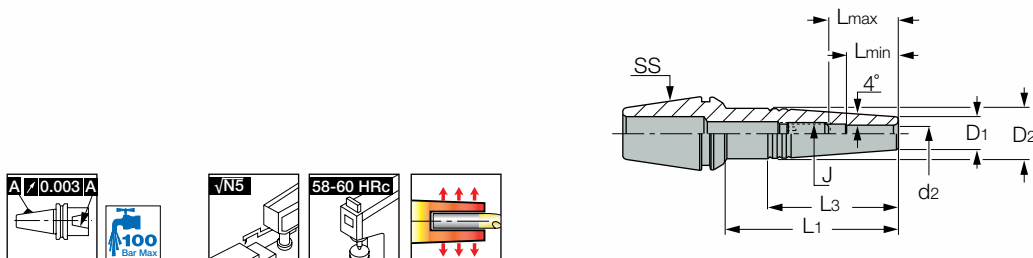
| Designation           | SS   | d2 min | d2 max |
|-----------------------|------|--------|--------|
| ER11 SPR 0.5- 1 AA    | ER11 | 0.50   | 1.00   |
| ER11 SPR 1-2 AA       | ER11 | 1.00   | 2.00   |
| ER11 SPR 2-3 AA       | ER11 | 2.00   | 3.00   |
| ER11 SPR EX3.0AAA (1) | ER11 | 3.00   | 3.00   |
| ER11 SPR 3-4 AA       | ER11 | 3.00   | 4.00   |
| ER11 SPR EX4.0AAA (1) | ER11 | 4.00   | 4.00   |
| ER11 SPR 4-5 AA       | ER11 | 4.00   | 5.00   |
| ER11 SPR 5-6 AA       | ER11 | 5.00   | 6.00   |
| ER11 SPR EX6.0AAA (1) | ER11 | 6.00   | 6.00   |
| ER11 SPR 6-7 AA       | ER11 | 6.00   | 7.00   |

(1)0.003mm runout accuracy



## ER-SRK

Thermal shrink chucks with an integral ER collet



| Designation              | SS   | d2   | L1   | L min | D2   | D1  |
|--------------------------|------|------|------|-------|------|-----|
| <b>ER11 SRK 3X10 (1)</b> | ER11 | 3.00 | 10.0 | 9.5   | 8.50 | 7.6 |
| <b>ER11 SRK 3X25</b>     | ER11 | 3.00 | 25.0 | 11.5  | 8.50 | 7.6 |
| <b>ER11 SRK 4X10</b>     | ER11 | 4.00 | 10.0 | 9.5   | 8.50 | 7.6 |
| <b>ER11 SRK 4X25</b>     | ER11 | 4.00 | 25.0 | 11.5  | 8.50 | 7.6 |

- For carbide tools only
- (1) To be used only for TYPHOON spindles

## NUT ER11 GHS

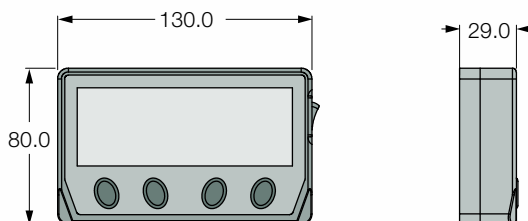
Tightening nut DIN 6499 for thermal collet

| Product description | ØA    | B    | C        | Wrench          |
|---------------------|-------|------|----------|-----------------|
| Nut ER11 GHS        | 16.00 | 11.5 | M13X0.75 | WRENCH ER11 SMS |



## TJS TSD DISPLAY

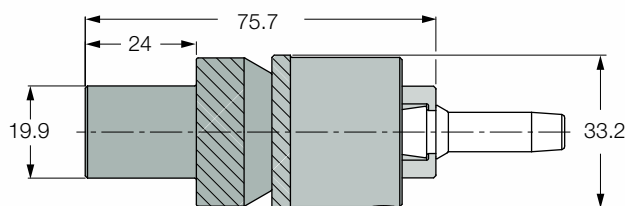
RPM speed display for TYPHOON high-speed spindles



| Designation            | Machines     |
|------------------------|--------------|
| <b>TJS TSD DISPLAY</b> | TJS spindles |

## IND ER11 TOOL ADAPTER

ER 11 shrink collet adapter for induction heating device



| Designation                  |
|------------------------------|
| <b>IND ER11 TOOL ADAPTER</b> |



## Compatible solid carbide tools from TaeguTec program

| Designation |              |     |              |     |                 |     |                 |
|-------------|--------------|-----|--------------|-----|-----------------|-----|-----------------|
| AEB         | 3020M        | HSB | 2008 008 020 | HSB | 2020 030 180    | HSB | 2020 030 160 S6 |
|             | 3030M        |     | 2008 008 030 |     | 2020 030 200    |     | 2010S           |
| AES         | 2010         |     | 2008 008 040 |     | 2020 030 250    |     | 2015S           |
|             | 2010-6       |     | 2008 008 050 |     | 2020 030 300    |     | 2020S           |
|             | 2015-6       |     | 2008 008 060 |     | 2025 035 080    |     | 2030S           |
|             | 2020         |     | 2008 008 080 |     | 2025 035 100    | HSF | 2003 004 010    |
|             | 2020-6       |     | 2008 008 100 |     | 2025 035 120    |     | 2003 004 020    |
|             | 2025         |     | 2008 008 120 |     | 2025 035 160    |     | 2003 004 030    |
|             | 2025-6       |     | 2010 010 030 |     | 2025 035 200    |     | 2004 006 010    |
|             | 2030         |     | 2010 010 040 |     | 2030 040 080    |     | 2004 006 015    |
|             | 2035         |     | 2010 010 050 |     | 2030 040 100    |     | 2004 006 020    |
|             | 2020XL       |     | 2010 010 060 |     | 2030 040 120    |     | 2004 006 025    |
|             | 2030XL       |     | 2010 010 070 |     | 2030 040 140    |     | 2004 006 030    |
|             | 3020-6       |     | 2010 010 080 |     | 2030 040 160    |     | 2004 006 040    |
|             | 3030         |     | 2010 010 090 |     | 2030 040 180    |     | 2004 006 050    |
|             | 3030ML       |     | 2010 010 100 |     | 2030 040 200    |     | 2004 006 060    |
| HSB         | 2003 003 010 |     | 2010 010 120 |     | 2030 040 250    |     | 2005 007 010    |
|             | 2003 003 020 |     | 2010 010 140 |     | 2030 040 300    |     | 2005 007 015    |
|             | 2003 003 030 |     | 2010 010 160 |     | 2030 040 350    |     | 2005 007 020    |
|             | 2004 004 010 |     | 2010 010 180 |     | 2030 040 400    |     | 2005 007 025    |
|             | 2004 004 015 |     | 2010 010 200 |     | 2006 006 020 S6 |     | 2005 007 030    |
|             | 2004 004 020 |     | 2012 012 040 |     | 2006 006 040 S6 |     | 2005 007 040    |
|             | 2004 004 025 |     | 2012 012 060 |     | 2006 006 060 S6 |     | 2005 007 050    |
|             | 2004 004 030 |     | 2012 012 080 |     | 2008 008 020 S6 |     | 2005 007 060    |
|             | 2004 004 040 |     | 2012 012 100 |     | 2008 008 040 S6 |     | 2005 007 080    |
|             | 2005 005 010 |     | 2012 012 120 |     | 2008 008 060 S6 |     | 2006 009 020    |
|             | 2005 005 015 |     | 2015 015 040 |     | 2008 008 080 S6 |     | 2006 009 030    |
|             | 2005 005 020 |     | 2015 015 060 |     | 2010 010 030 S6 |     | 2006 009 040    |
|             | 2005 005 025 |     | 2015 015 080 |     | 2010 010 040 S6 |     | 2006 009 050    |
|             | 2005 005 030 |     | 2015 015 100 |     | 2010 010 060 S6 |     | 2006 009 060    |
|             | 2005 005 040 |     | 2015 015 120 |     | 2010 010 080 S6 |     | 2006 009 080    |
|             | 2005 005 050 |     | 2015 015 140 |     | 2010 010 100 S6 |     | 2006 009 100    |
|             | 2005 005 060 |     | 2015 015 160 |     | 2015 015 040 S6 |     | 2007 012 020    |
|             | 2005 005 080 |     | 2015 015 180 |     | 2015 015 060 S6 |     | 2007 012 040    |
|             | 2006 006 020 |     | 2015 015 200 |     | 2015 015 080 S6 |     | 2007 012 060    |
|             | 2006 006 030 |     | 2020 030 060 |     | 2015 015 100 S6 |     | 2007 012 080    |
|             | 2006 006 040 |     | 2020 030 080 |     | 2015 015 120 S6 |     | 2007 012 100    |
|             | 2006 006 050 |     | 2020 030 100 |     | 2020 030 060 S6 |     | 2008 012 020    |
|             | 2006 006 060 |     | 2020 030 120 |     | 2020 030 080 S6 |     | 2008 012 040    |
|             | 2006 006 080 |     | 2020 030 140 |     | 2020 030 100 S6 |     | 2008 012 060    |
|             | 2006 006 100 |     | 2020 030 160 |     | 2020 030 120 S6 |     | 2008 012 080    |

| Designation |              |            |              |            |              |            |              |
|-------------|--------------|------------|--------------|------------|--------------|------------|--------------|
| <b>HSF</b>  | 2008 012 100 | <b>HSF</b> | 2030 045 080 | <b>HSR</b> | 2005 005 010 | <b>HSR</b> | 2010 030 030 |
|             | 2008 012 120 |            | 2030 045 100 |            | 2005 005 015 |            | 2010 030 040 |
|             | 2010 015 030 |            | 2030 045 120 |            | 2005 005 025 |            | 2010 030 060 |
|             | 2010 015 040 |            | 2030 045 160 |            | 2005 005 030 |            | 2010 030 080 |
|             | 2010 015 060 |            | 2030 045 180 |            | 2005 005 040 |            | 2010 030 100 |
|             | 2010 015 080 |            | 2030 045 200 |            | 2006 005 020 |            | 2012 010 040 |
|             | 2010 015 100 |            | 2030 045 250 |            | 2006 005 040 |            | 2012 010 060 |
|             | 2010 015 120 |            | 2030 045 300 |            | 2006 005 060 |            | 2012 010 080 |
|             | 2010 015 140 |            | 2030 045 350 |            | 2006 010 020 |            | 2012 010 100 |
|             | 2010 015 160 |            | 2030 045 400 |            | 2006 010 040 |            | 2012 020 040 |
|             | 2010 015 180 |            | 4010 015 030 |            | 2006 010 060 |            | 2012 020 060 |
|             | 2010 015 200 |            | 4010 015 040 |            | 2006 020 020 |            | 2012 020 080 |
|             | 2012 018 040 |            | 4010 015 060 |            | 2006 020 040 |            | 2012 020 100 |
|             | 2012 018 060 |            | 4010 015 080 |            | 2006 020 060 |            | 2012 030 040 |
|             | 2012 018 080 |            | 4010 015 100 |            | 2008 005 020 |            | 2012 030 060 |
|             | 2012 018 100 |            | 4015 025 040 |            | 2008 005 040 |            | 2012 030 080 |
|             | 2012 018 120 |            | 4015 025 060 |            | 2008 005 060 |            | 2012 030 100 |
|             | 2012 018 160 |            | 4015 025 080 |            | 2008 005 080 |            | 2015 005 040 |
|             | 2015 023 040 |            | 4015 025 100 |            | 2008 010 020 |            | 2015 005 060 |
|             | 2015 023 060 |            | 4015 025 120 |            | 2008 010 040 |            | 2015 005 080 |
|             | 2015 023 080 |            | 4015 025 160 |            | 2008 010 060 |            | 2015 005 100 |
|             | 2015 023 100 |            | 4020 030 060 |            | 2008 010 080 |            | 2015 005 120 |
|             | 2015 023 120 |            | 4020 030 080 |            | 2008 020 020 |            | 2015 010 040 |
|             | 2015 023 140 |            | 4020 030 100 |            | 2008 020 040 |            | 2015 010 060 |
|             | 2015 023 160 |            | 4020 030 120 |            | 2008 020 060 |            | 2015 010 080 |
|             | 2015 023 180 |            | 4020 030 160 |            | 2008 020 080 |            | 2015 010 100 |
|             | 2015 023 200 |            | 4020 030 200 |            | 2010 005 030 |            | 2015 010 120 |
|             | 2020 030 060 |            | 4030 045 080 |            | 2010 005 040 |            | 2015 020 040 |
|             | 2020 030 080 |            | 4030 045 100 |            | 2010 005 060 |            | 2015 020 060 |
|             | 2020 030 100 |            | 4030 045 120 |            | 2010 005 080 |            | 2015 020 080 |
|             | 2020 030 120 |            | 4030 045 160 |            | 2010 005 100 |            | 2015 020 100 |
|             | 2020 030 160 |            | 4030 045 200 |            | 2010 010 030 |            | 2015 020 120 |
|             | 2020 030 180 |            | 6030M        |            | 2010 010 040 |            | 2015 030 040 |
|             | 2020 030 200 | <b>HSR</b> | 2003 005 010 |            | 2010 010 060 |            | 2015 030 060 |
|             | 2020 030 250 |            | 2003 005 020 |            | 2010 010 080 |            | 2015 030 080 |
|             | 2020 030 300 |            | 2003 005 030 |            | 2010 010 100 |            | 2015 030 100 |
|             | 2025 040 080 |            | 2004 005 010 |            | 2010 020 030 |            | 2015 030 120 |
|             | 2025 040 100 |            | 2004 005 015 |            | 2010 020 040 |            | 2015 050 040 |
|             | 2025 040 120 |            | 2004 005 025 |            | 2010 020 060 |            | 2015 050 060 |
|             | 2025 040 160 |            | 2004 005 030 |            | 2010 020 080 |            | 2015 050 080 |
|             | 2025 040 200 |            | 2004 005 040 |            | 2010 020 100 |            | 2015 050 100 |

| Designation  |              |                  |               |     |              |                  |                  |               |
|--------------|--------------|------------------|---------------|-----|--------------|------------------|------------------|---------------|
| HSR          | 2015 050 120 | HSR              | 2030 010 200  | HSR | 4020 030 080 | TMTECS           | 06028C10 0.6 ISO |               |
|              | 2020 010 060 |                  | 2030 020 080  |     | 4020 050 060 |                  | 06031C12 0.7 ISO |               |
|              | 2020 010 080 |                  | 2030 020 100  |     | 4020 050 080 | TMTECSH          | 03011C4 0.3 ISO  |               |
|              | 2020 010 100 |                  | 2030 020 120  |     | 4030 010 080 |                  | 03012C5 0.35 ISO |               |
|              | 2020 010 120 |                  | 2030 020 160  |     | 4030 010 100 |                  | 03016C6 0.4 ISO  |               |
|              | 2020 010 160 |                  | 2030 020 200  |     | 4030 010 120 |                  | 06016C4 0.4 ISO  |               |
|              | 2020 010 200 |                  | 2030 030 080  |     | 4030 010 160 |                  | 06017C5 0.45 ISO |               |
|              | 2020 020 060 |                  | 2030 030 100  |     | 4030 010 200 |                  | 0602C5 0.45 ISO  |               |
|              | 2020 020 080 |                  | 2030 030 120  |     | 4030 020 080 |                  | 06024C6 0.5 ISO  |               |
|              | 2020 020 100 |                  | 2030 030 160  |     | 4030 020 100 |                  | 06028C7 0.6 ISO  |               |
|              | 2020 020 120 |                  | 2030 030 200  |     | 4030 020 120 |                  | 06031C9 0.7 ISO  |               |
|              | 2020 020 160 |                  | 2030 050 080  |     | 4030 020 160 |                  | TMTECS           | 06014C3 72 UN |
|              | 2020 020 200 |                  | 2030 050 100  |     | 4030 020 200 | 06014C3 64 UN    |                  |               |
|              | 2020 030 060 |                  | 2030 050 120  |     | 4030 030 080 | 06016C4 56 UN    |                  |               |
|              | 2020 030 080 |                  | 2030 050 160  |     | 4030 030 100 | 06019C5 48 UN    |                  |               |
|              | 2020 030 100 |                  | 2030 050 200  |     | 4030 030 120 | 06021C8 40 UN    |                  |               |
|              | 2020 030 120 |                  | 2030 100 080  |     | 4030 030 160 | 06021C6 40 UN    |                  |               |
|              | 2020 030 160 |                  | 2030 100 100  |     | 4030 030 200 | 06024C7 40 UN    |                  |               |
|              | 2020 030 200 |                  | 2030 100 120  |     | 4030 050 080 | 06033C9 36 UN    |                  |               |
|              | 2020 050 060 |                  | 2030 100 160  |     | 4030 050 100 | 06025C7 32 UN    |                  |               |
|              | 2020 050 080 |                  | 2030 100 200  |     | 4030 050 120 | 06032C9 32 UN    |                  |               |
|              | 2020 050 100 |                  | 4010 010 030  |     | 4030 050 160 | 06012C4 80 UN    |                  |               |
|              | 2020 050 120 |                  | 4010 010 040  |     | 4030 050 200 | 03015C6 72 UN    |                  |               |
|              | 2020 050 160 |                  | 4010 010 060  |     | 4030 100 080 | 03016C6 56 UN    |                  |               |
|              | 2020 050 200 |                  | 4010 020 030  |     | 4030 100 100 | 06016C6 56 UN    |                  |               |
|              | 2025 020 080 |                  | 4010 020 040  |     | 4030 100 120 | 06024C9 40 UN    |                  |               |
|              | 2025 020 100 |                  | 4010 020 060  |     | 4030 100 160 | 03026C10 32 UN   |                  |               |
|              | 2025 020 120 |                  | 4010 030 030  |     | 4030 100 200 | 06032C12 32 UN   |                  |               |
|              | 2025 020 160 |                  | 4010 030 040  |     | TMTECS       | 06016C4 0.4 ISO  | TMTECSH          | 06014C3 72 UN |
|              | 2025 030 080 |                  | 4010 030 060  |     |              | 06017C5 0.45 ISO |                  | 06014C3 64 UN |
|              | 2025 030 100 |                  | 4015 010 040  |     |              | 0602C5 0.45 ISO  |                  | 06016C4 56 UN |
|              | 2025 030 120 |                  | 4015 010 060  |     |              | 06024C6 0.5 ISO  |                  | 06019C5 48 UN |
| 2025 030 160 | 4015 020 040 | 06028C7 0.6 ISO  | 06021C6 40 UN |     |              |                  |                  |               |
| 2025 050 080 | 4015 020 060 | 06031C9 0.7 ISO  | 06024C7 40 UN |     |              |                  |                  |               |
| 2025 050 100 | 4015 030 040 | 03007C2 0.25 ISO | 06033C9 36 UN |     |              |                  |                  |               |
| 2025 050 120 | 4015 030 060 | 03009C3 0.25 ISO | 06025C7 32 UN |     |              |                  |                  |               |
| 2025 050 160 | 4020 010 060 | 03011C4 0.3 ISO  | 06032C9 32 UN |     |              |                  |                  |               |
| 2030 010 080 | 4020 010 080 | 03012C5 0.35 ISO |               |     |              |                  |                  |               |
| 2030 010 100 | 4020 020 060 | 03016C6 0.4 ISO  |               |     |              |                  |                  |               |
| 2030 010 120 | 4020 020 080 | 0602C7 0.45 ISO  |               |     |              |                  |                  |               |
| 2030 010 160 | 4020 030 060 | 06024C9 0.5 ISO  |               |     |              |                  |                  |               |