Typhoon

Coolant-Driven HSM Spindles 20K, 30K and 40K RPM for Small Diameter Tools

Speed:
20,000 rpm
30,000 rpm
40,000 rpm
4-5 Times Faster

Spindle:
Coolant Driven

Monitor:
Real time RPM
Wireless

Applications:
Milling
Thread Milling
Drilling
Grinding
Chamfering
Engraving & Chamfering

NEW PRODUCT ANNOUNCEMENT *2015*

Ingersoll is introducing Typhoon – unique, (patent-pending) coolant driven high speed compact spindles for small diameter tools on low RPM machine tools.

The new Typhoon spindles have been developed for use when high RPM is required for small diameter tools on limited RPM machines. The new spindles are for semi-finish and finish machining applications such as milling, drilling and grinding.

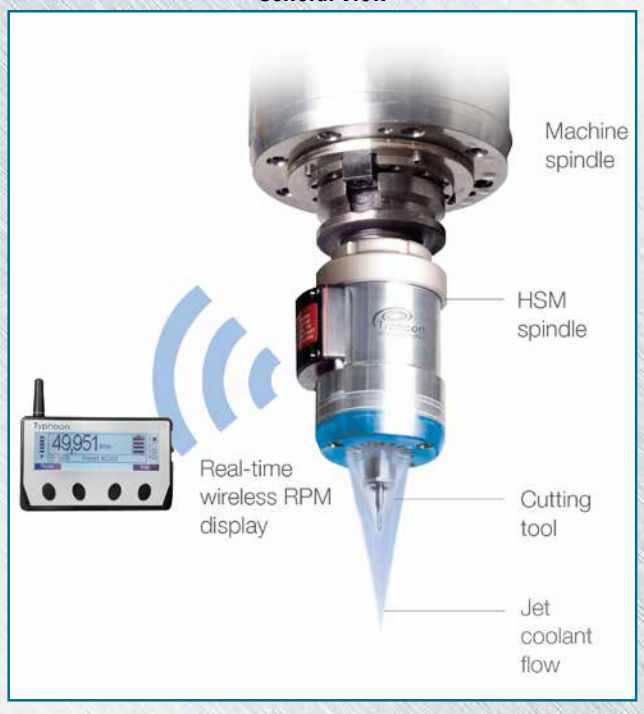
The system utilizes the machine tool's existing coolant supply, driven by a high pressure pump
(minimum 290 PSI) as an energy source to rotate a turbine up to 40,000 RPM.

Typhoon is not intended to replace the machine's spindle, but rather to upgrade the existing machine, providing improved performance, faster machining, better surface quality and extended tool life.

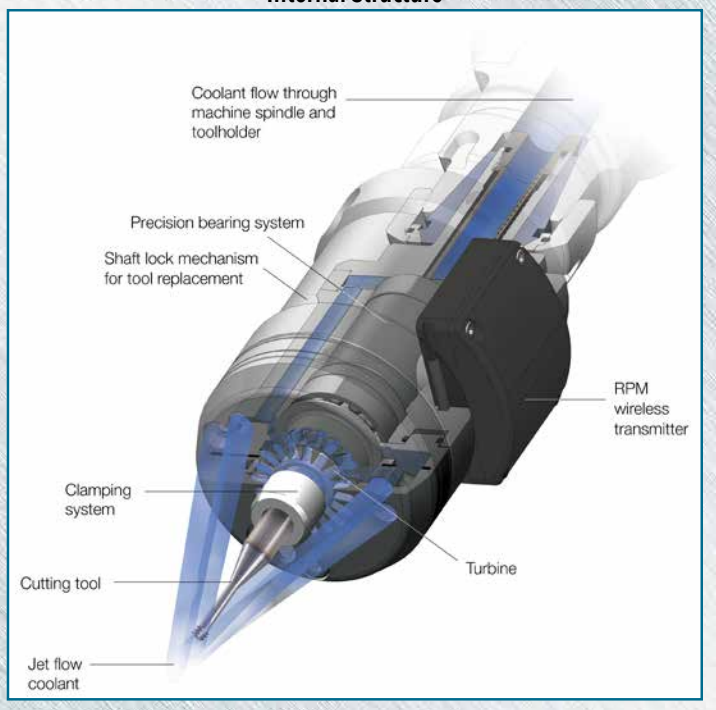
Member IMC Group
Ingersoll Cutting Tools

Highlights

General View



Internal Structure



Advantages

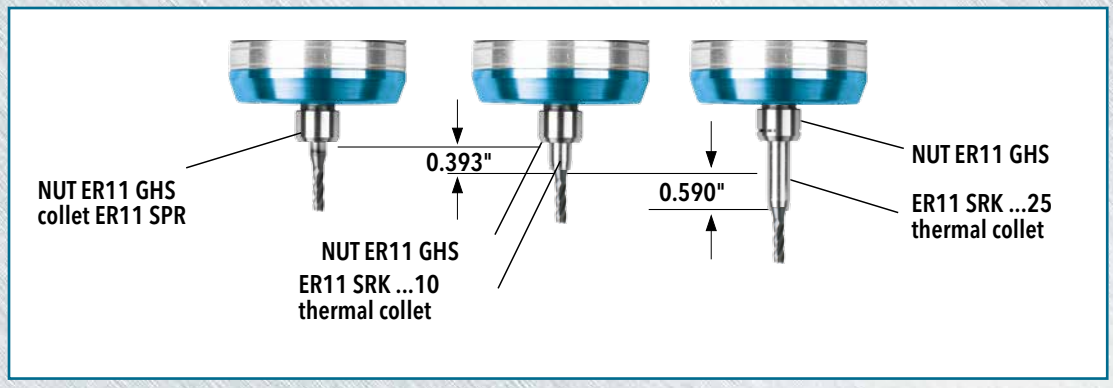
- Reduced machining time - High table speed, thus faster machining due to high rotation speed
- High efficiency - Up to 65% increased productivity compared to machining with the original machine with low RPM spindle
- Energy saving - The machine spindle is idle while the Typhoon is in operation
- High precision - Excellent surface quality due to optimized machining conditions
- Plug & play – Easy installation on existing machines with no adaptation required
- Extended tool life – As a result of optimal cutting conditions and strong coolant jet flow

Display

Direct wireless rotation speed display
Typhoon is equipped with an online speed display system, monitoring the actual cutting tool rotation speed during machining.

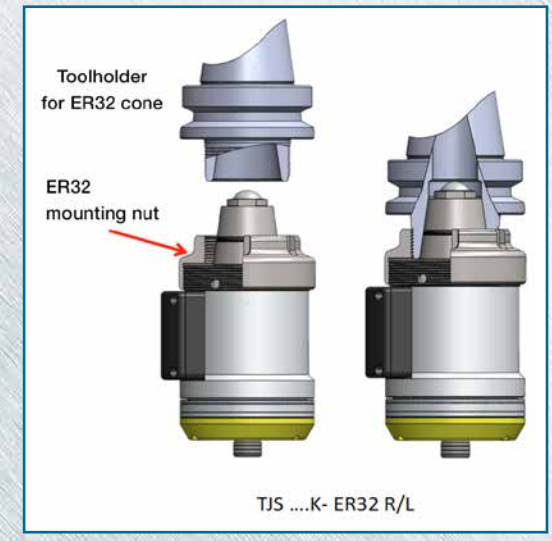
- 2.4 GHz radio frequency transmission
- Direct wireless rotational speed monitoring in a range of up to 16 feet
- Externally powered display, enables reading of all Typhoon systems being used on the machine

A new solution for cutting tool overhang



Built-in ER32 Collet Chuck

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



Target Markets and Industries

Typhoon spindles should be offered for applications requiring tool shanks of up to 0.250" (7mm) and cutting diameters of up to 0.137" (3.5mm). They can be applied on a variety of applications at workshops owning CNC machine tools with a spindle capacity of up to 15K RPM and coolant through the spindle with a minimum pressure of 290 PSI.

Turn Mill | Milling | Turning

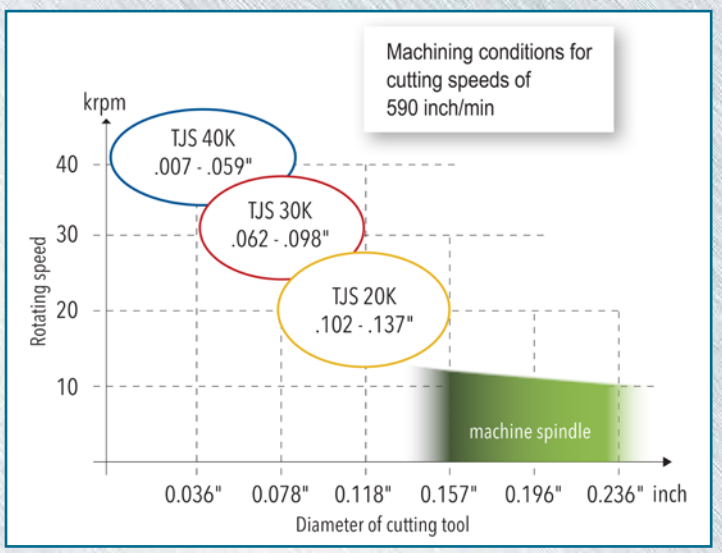
Productivity Booster

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

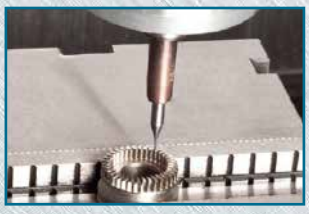
The coolant driven spindles lead to a significant widening of the application range on medium / large machine tools and thus help to improve their productivity, provide higher efficiency, minimal setup time, decrease machining time and reduce costs.

Operation Range

Operating speed range vs. tool diameter



Applications - Clamping type: ER11 collet size



Milling
Slotting - up to ae = 0.118" (3mm), ap = 0.1D
Shouldering – up to D = 0.137" (3.5mm), ae = D, ap = 0.25D

Thread milling
Maximum M5 thread
Right- or left-hand rotation

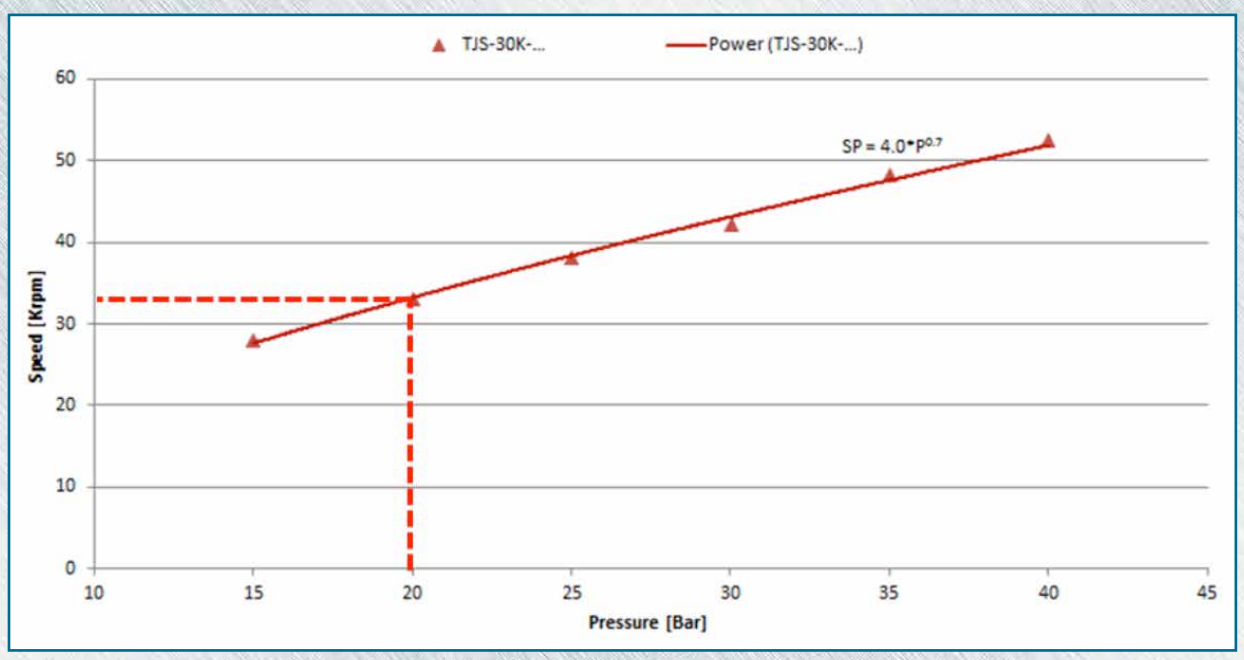
Drilling
Maximum drill diameter = 0.078" (2mm)

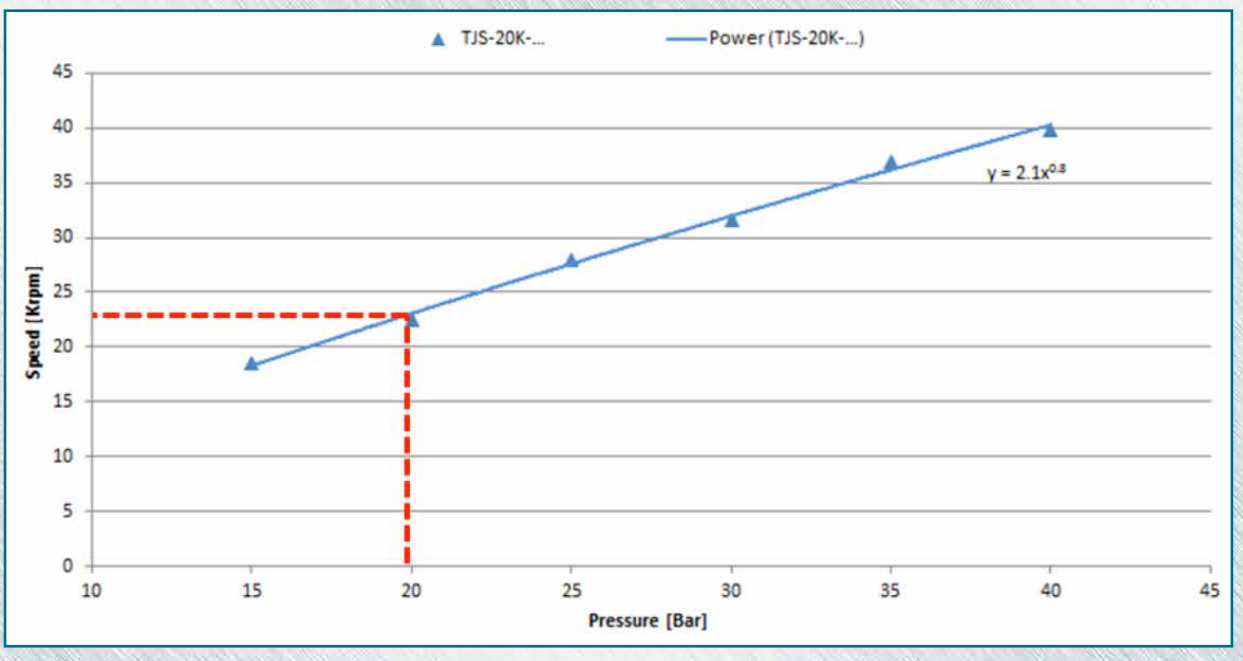
Engraving/Chamfering
Maximum shank diameter = 0.250" (7mm)

Fine radial grinding
Grinding wheels: 1A1W up to 0.393" (10mm)
Balanced WC shank
Maximum shank diameter = 0.250" (7mm)

Speed vs. Pressure

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



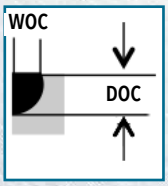


Typhoon Type/RPM	Coolant Pressure		
	20 Bar	30 Bar	40 Bar
TJS 20K-ER32	20000* RPM	30000* RPM	40000* RPM
TJS 30K-ER32	30000* RPM	40000* RPM	50000* RPM
TJS 40K-ER32	40000* RPM	50000* RPM	60000* RPM

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

Case Study - Milling/Profiling

Workpiece material: Electrolytic copper (C11000ASTMB 152/2009)
Machine type: OKUMA M650V
Machine pump pressure: 22 bar
Liquid type: Emulsion
Application type: Profiling



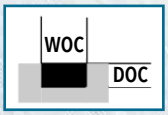
	Semi Finishing		Finishing	
Application type	Current Process	TYPHOON	Current Process	TYPHOON
Tool description	25B02012U0RB540 IN2005		25B01012U0RB540 IN2005	
Tool diameter (D)	0.078" (2mm)		0.039" (1mm)	
Number of teeth (Z) [per tool]	2		1	
Cutting width (ae)	0.0031" (0.08mm)		0.0015" (0.04mm)	
Depth of cut (ap)	0.0031" (0.08mm)		0.0015" (0.04mm)	
Runout (micron)	7	5	6	4
External pump pressure (bar)		30		30
	Machine Spindle	TJS 30K-ST20 R	Machine Spindle	TJS 30K-ST20 R
Spindle speed (n) [RPM]	10,000	29,000	11,000	30,000
Cutting speed (Vc) [feet/min]	206 (63m)	600 (183m)	114 (35m)	311 (95m)
Feed per tooth (fz)	0.0019" (0.05mm)	0.0039" (0.045mm)	0.0010" (0.027mm)	0.0009" (0.025mm)
Table feed (f) [per min]	39.37" (1,000mm)	102.36" (2,600mm)	23.62" (600mm)	59.05 (1,500mm)
Machining time [min per part]	17	10	30	10

Total machining time [min]
With machine spindle: 47 min.
With TYPHOON: 20 min.

Machining time reduction (per part): 58% and reduced spindle wear

Case Study - Milling a Turbine

Workpiece material: SAE 303
Hardness: 25 HRC
Machine type: LER
Machine pump pressure: 22 bar
Liquid type: Emulsion
Application type: Slotting



	CNC Center	TYPHOON
Tool description	25B01012U0RB540 IN2005	
Tool producer	ICTC	
Tool diameter (D)	0.039" (1.0mm)	
Number of teeth (Z) [per tool]	2	
Cutting width (ae)	0.003" (0.08mm)	
Depth of cut (ap)	0.003" (0.08mm)	
Runout (micron)	7	5
Spindle speed (n) [RPM]	Machine Spindle	TJS 30K-ST20 R
Spindle speed (n) [RPM]	9,000	35,600
Cutting speed (Vc) [feet/min]	92 (28m)	393 (120m)
Feed per tooth (fz)	0.0006" (0.016mm)	0.0006" (0.016mm)
Table feed (f) [per min]	11.81" (300mm)	47.24" (1,200mm)
Machining time [min per part]	60	13
Number of parts [per tool]	5	35
Surface quality	-	Good
Number of parts [per hour]	1	4.5
Number of tools to produce 35 parts	7	2
Number of hours to produce 35 parts	35	7.6

Reduction in machining time: 27.5 hours
Increased tool life: 300%
Decrease in spindle wear
With TYPHOON: 7.6 HOURS

Case Study - Milling Mold

Workpiece material: V2
Hardness: 57-60 HRC
Machine type: HAAS VM 3
Machine pump pressure: 20 bar
Liquid type: Emulsion
Application type: Profiling

	Rough		Finishing	
Application type	CNC Spindle	TYPHOON	CNC Spindle	TYPHOON
Tool description	45B03001U0RB500 IN2005		45B01001U0RB500 IN2005	
Tool diameter (D)	.157" (4mm)	.118" (3mm)	.039" (1mm)	.039" (1mm)
Number of teeth (Z) [per tool]	4		2	
Cutting width (ae)	0.0039" (0.1mm)	0.007" (0.2mm)	0.0039" (0.1mm)	0.0003-0.0007" (0.01-0.02mm)
Depth of cut (ap)	0.0039" (0.1mm)	0.007" (0.2mm)	0.0039" (0.1mm)	0.0003-0.0007" (0.01-0.02mm)
Cutting tool overhang (T)	1.00" (25mm)	1.00" (25mm)	0.590" (15mm)	0.590" (15mm)
Runout [micron]	10	8	10	6
	Machine Spindle	TJS 30K-ST20 R	Machine Spindle	TJS 30K-ST20 R
Spindle speed (n) [RPM]	8,500	27,000	10,500	29,000
Cutting speed (Vc) [feet/min]	393.7 (120m)	833.33 (254m)	108.27 (33m)	298.56 (91m)
Feed per tooth (fz)	0.0008" (0.021mm)	0.0065-0.0007" (0.0145-0.0185mm)	0.0016" (0.043mm)	0.0010-0.0020" (0.027-0.051mm)
Table feed (f) [per min]	31.4" (800mm)	62.9-78.7" (1,600-2,000mm)	35.43" (900mm)	62.99-118.11" (1,600-3,000mm)
Machining time [min per part]	03:07	0.5 (35 min)	10:17	05:06
Number of parts [per tool]	1	1	1	1

Total machining time [hours]
With machine spindle: 13:24
With TYPHOON: 05:41

Reduction in machining time: 7.30 hours per part.
Savings of 4 hours in polishing process (50% of time)
As a result of the machine control system limitation, the actually cutting table feed was relatively lower for Typhoon capabilities.
Decrease in spindle wear.

Case Study - Thread Milling

Workpiece material: SAE 4340
Hardness: 29 HRC
Pre-hole diameter: 1.6 inch
Machine type: Victor
Machine pump pressure: 20 bar
Liquid type: Emulsion
Typhoon Model: TJS 30K-ST20 R

	CNC Center	TYPHOON
Tool diameter (D)	0.078" (2mm)	
Number of teeth (Z) [per tool]	3	
Spindle speed (n) [RPM]	6,500	30,000
Cutting speed (VC) [feet/min]	134.51 (41m)	616.8 (188m)
Depth of thread	.196" (5mm)	.196" (5mm)
Number of passes/climb	1	1
Feed per tooth (fz)	0.0005" (0.014mm)	0.0005" (0.014mm)
Number of holes	81	280
Table feed (F) [per min]	10.74" (273mm)	49.60" (1,260mm)
Total machining time/hole [sec]	8	2
Tool condition	Wear	Good
Thread (GO-NOT GO gauge)	GO	GO

Machining time reduction (per part): 85%
Increased tool life: 200%

Spindle Offerings

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 as well.

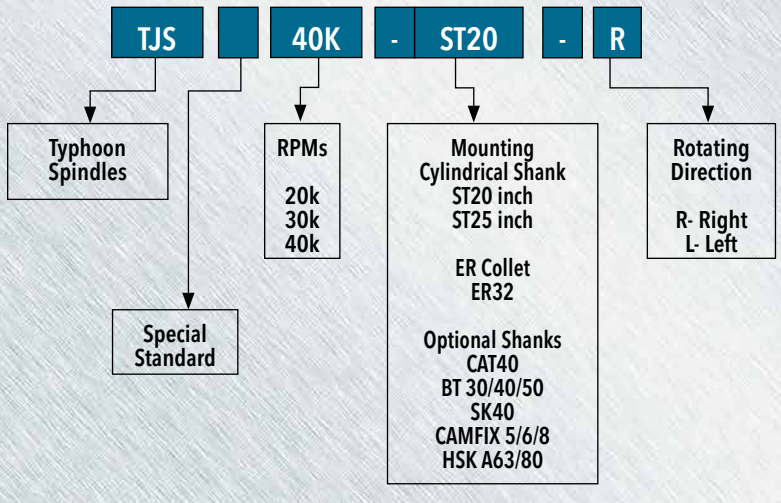
- Integral ER32 taper with a special tightening nut, suitable for all standard toolholders for ER32 collets
- Cylindrical 20mm diameter shank that can be clamped in ER32 19-20 sealed spring collet - on request
- Integral BT30,40,DIN69871 40,CAT 40, HSK A 63, CAMFIX C5,C6

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

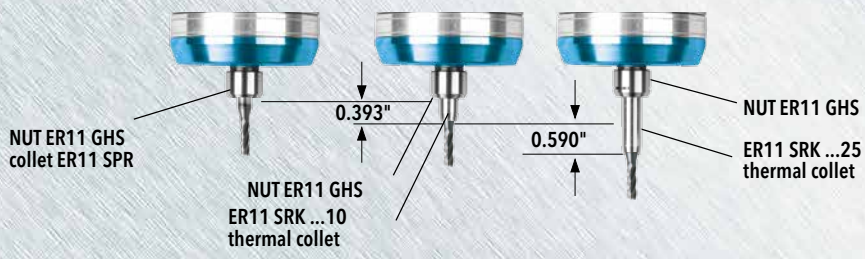
Product Description	TJS 20K-...	TJS 30K-...	TJS 40K-...
Rotation speed (RPM)	20,000	30,000	40,000
Coolant pump pressure (bar)	20		
Flow rate (G/min)	3:17		
Maximum tool shank diameter	0.250"		
Maximum tool diameter	0.137"	0.098"	0.059"

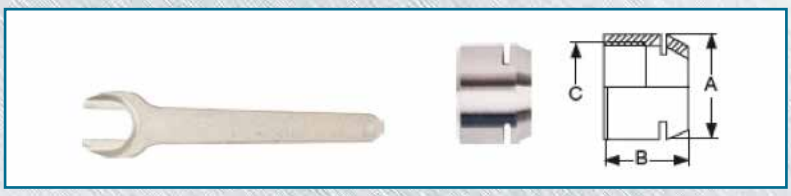
WRENCH DIA3.2X35 –Shaft lock for clamping

TJS TSD DISPLAY – RPM speed display

ER11 Collets

Tool clamping using ER11 collets





WRENCH ER11 SMS

NUT ER11 GHS

User Guide

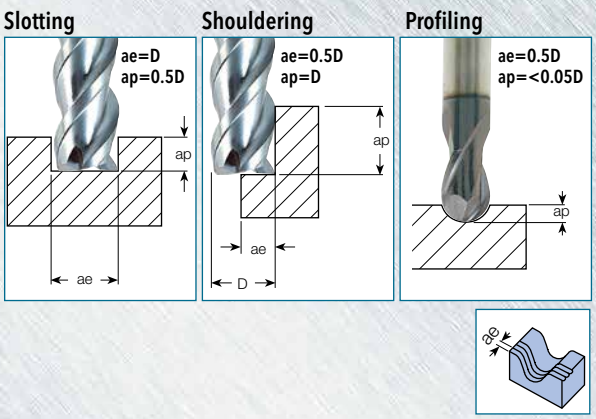
The Typhoon system was developed to enable to apply optimal cutting speed conditions for small diameter solid carbide tools which require very high RPM.

Recommended cutting speed for shouldering operations:
- Steel: up to 60 f/min
- Aluminum: 60 f/min and higher

Typhoon Type	TJS 20K	TJS 30K	TJS 40K
Driven spindles by	Based on pressure of 20 bar		
Tool diameter for steel	.102-.137"	.062-.098"	.0078-.0590"
Rotation speed RPM	20,000	30,000	40,000
Tool diameter for aluminum	.078-.137"	.141-.196"	.0196-.118"

Feed recommendations for small diameter solid carbide tools at high cutting speed

Recommended Feeds for Solid Carbide and Endmills



	Slotting		Shouldering / Profiling	
D_{inch}	F_z (min)	F_z (max)	F_z (min)	F_z (max)
.039	.00012	.00020	.00012	.00028
.051	.00012	.00039	.00012	.00047
.059	.00012	.00079	.00012	.00087
.071	.00020	.00098	.00020	.00110
.079	.00020	.00118	.00020	.00130
.091	.00020	.00118	.00020	.00130
.098	.00020	.00118	.00020	.00118
.110	.00039	.00138	.00039	.00150
.118	.00039	.00157	.00039	.00173

In order to obtain the advantages of high speed machining, minimize cutting forces and reduce wear, 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.

Installation

Installing the Typhoon on Existing CNC Machine:

The feed per tooth fz should remain constant while the table feed should be increased according to the Typhoon rotation speed.

Example:
Operation: Shoulder milling
Cutting tool: Endmill Ø 0.078" (suitable for HSM)
Current cutting conditions:
Spindle speed: 8000 RPM (machine spindle)
Table feed: f=6.299 inch/min
Typhoon spindle type: TJS 30K ER32R

The idle rotation speed with Typhoon spindle reached 33,000 RPM.
The Typhoon spindle speed dropped when the tool entered the workpiece in several thousand kRPM 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 x 6.299 = 23.62 inch/min.

Note: For the first trial, it is recoinchended 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 [inch/min] according to F= n * z * fz

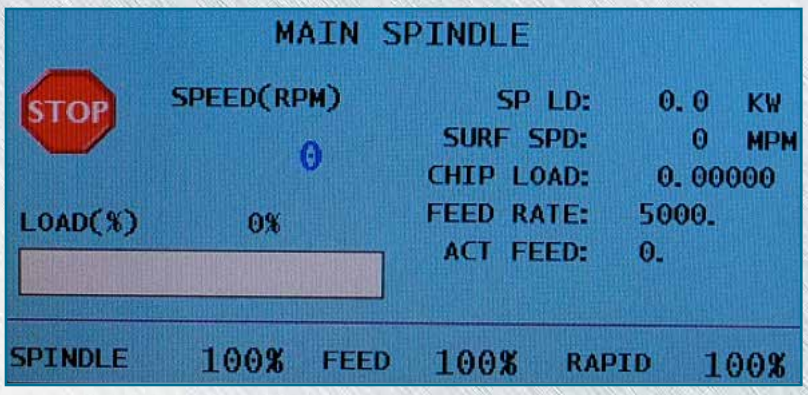
Feed per tooth fz (inch/tooth) - Select according to the recoinchendations of the tool's vendor, taking into consideration the machining material, application and the tool geometry.

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

Orientation

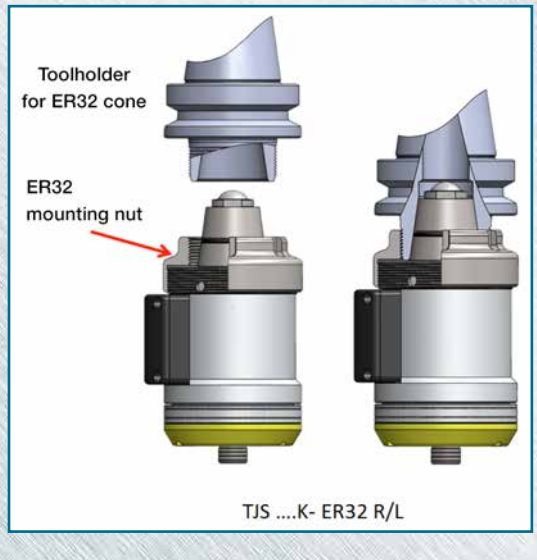
Typhoon Orientation on Main Machine Spindle unit is dynamically balanced.

⚠ While the Typhoon spindle is mounted on the machine, the main machine spindle should be stationary or 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.



Mounting

TJS-ER32



Placement in the Toolholder

Caution: Deviation from these steps might lead to locking of the tightening nut to the Typhoon.
The Typhoon can function only with toolholders that have coolant through holes.
Mounting the Typhoon in a toolholder:

1. Loosen the Typhoon tightening nut 1.5 turns to enable the differential clamping
2. Tightening the Typhoon clamping nut onto the collet chuck
3. Insert the locking pin to stop the spindle shaft
4. Fasten the tool into the Typhoon collet chuck. Do not hold the shaft during tightening the collet nut

1

2

3

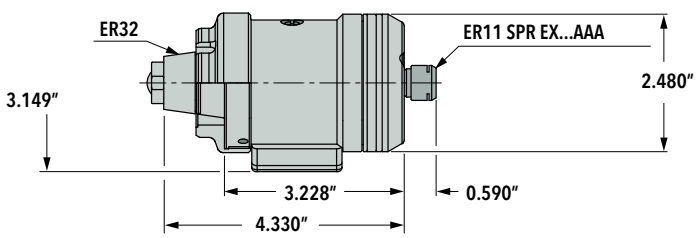
4

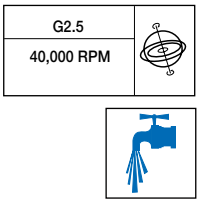
Basic Requirements for a CNC Machine

1. Coolant flow through the main machine spindle
2. High pressure coolant: minimum 20 bar, maximum 40 bar, recoinchended range 25-35 bar
3. Flow rate: minimum 3.17 G/min, recoinchended range 3.17-4.75 G/min
4. Coolant filtration level: minimum 100 µm
5. Machine tool ability to operate when its original spindle does not rotate. If not possible, use minimal possible RPM.
6. An active mist collector
7. With the emulsion coolant, use an anti-foaming agent additive suitable for your emulsion to prevent foaming.
8. With oil coolant, the high pressure increases the amount of oil fumes.
9. Use appropriate means of fire protection and extinguishing.
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





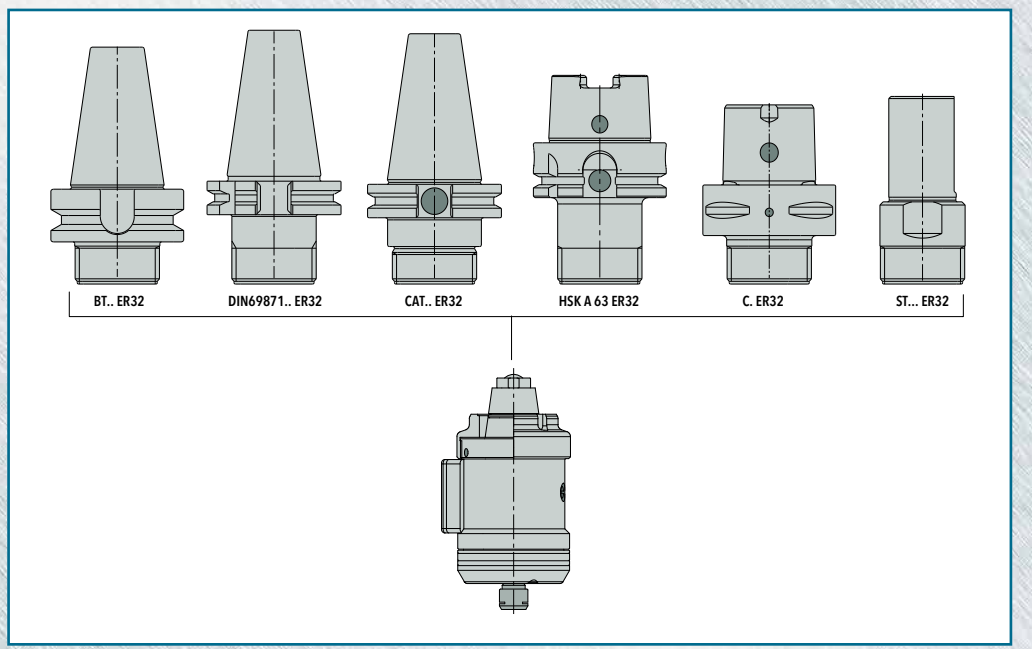
Designation	d max(1)	Lbs.
TJS-20K-ER32L	0.137	2.420
TJS-20K-ER32R	0.137	2.420
TJS-30K-ER32L	0.098	2.420
TJS-30K-ER32R	0.098	2.420
TJS-40K-ER32L	0.059	2.420
TJS-40K-ER32R	0.059	2.420

• Maximum tool shank diameter .250 inch • Minimum coolant pressure 20 bar and flow rate 3.17 G/min

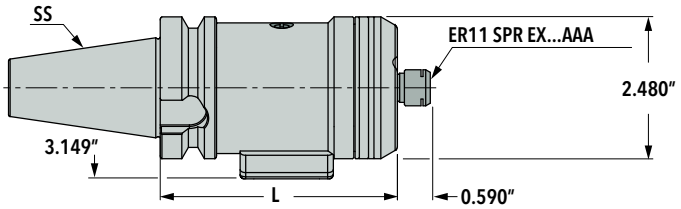
(1) Maximum cutting tool diameter

Spare Parts

			
	Mini ER Nut	ER Wrench	Locking Pin
TJS-ER32	ER11 GHS	ER11 SMS	DIA3.2x35



TJS-BT COOLANT DRIVEN HIGH SPEED COMPACT SPINDLES WITH BT SHANKS



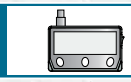
G2.5
40,000 RPM

Designation	SS	L	d max(1)	Lbs.
TJS 20K BT30L	BT30	4.566"	0.137"	3.300
TJS 20K BT30R	BT30	4.566"	0.137"	3.300
TJS 30K BT30L	BT30	4.566"	0.098"	3.300
TJS 30K BT30R	BT30	4.566"	0.098"	3.300
TJS 40K BT30L	BT30	4.566"	0.059"	3.300
TJS 40K BT30R	BT30	4.566"	0.059"	3.300
TJS 20K BT40L	BT40	4.133"	0.137"	4.188
TJS 20K BT40R	BT40	4.133"	0.137"	4.188
TJS 30K BT40L	BT40	4.133"	0.098"	4.188
TJS 30K BT40R	BT40	4.133"	0.098"	4.188
TJS 40K BT40L	BT40	4.133"	0.059"	4.188
TJS 40K BT40R	BT40	4.133"	0.059"	4.188

• Maximum tool shank diameter .250 inch • Minimum coolant pressure 20 bar and flow rate 3.17 G/min

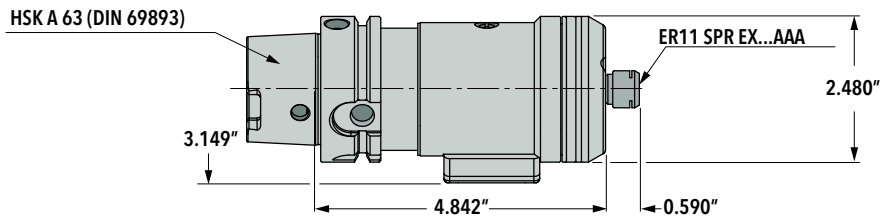
(1) Maximum cutting tool diameter

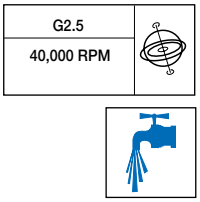
Spare Parts

	 Display	 Mini ER Nut	 ER Wrench	 Locking Pin
TJS-BT	TJS TSD Display*	ER11 GHS	ER11 SMS	DIA3.2x35

* Optional, should be ordered separately

TJS-HSK COOLANT DRIVEN HIGH SPEED COMPACT SPINDLES WITH HSK SHANKS





Designation	d max(1)	Lbs.
TJS 20K HSK A63L	0.137"	3.527
TJS 20K HSK A63R	0.137"	3.527
TJS 30K HSK A63L	0.098"	3.527
TJS 30K HSK A63R	0.098"	3.527
TJS 40K HSK A63L	0.059"	3.527
TJS 40K HSK A63R	0.059"	3.527

• Maximum tool shank diameter .250 inch • Minimum coolant pressure 20 bar and flow rate 3.17 G/min

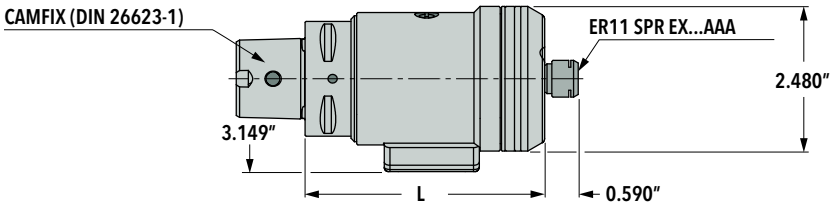
(1) Maximum cutting tool diameter

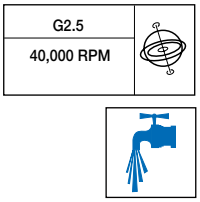
Spare Parts

	Display	Mini ER Nut	ER Wrench	Locking Pin
TJS-HSK A63	TJS TSD Display*	ER11 GHS	ER11 SMS	DIA3.2x35

* Optional, should be ordered separately

TJS-C# COOLANT DRIVEN HIGH SPEED COMPACT SPINDLES WITH (CAMFIX) ISO 26623-1 SHANKS



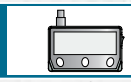


Designation	SS	L	d max(1)	Lbs.
TJS 20K C5L	C5	4.094"	0.137"	3.306
TJS 20K C5R	C5	4.094"	0.137"	3.306
TJS 30K C5L	C5	4.094"	0.098"	3.306
TJS 30K C5R	C5	4.094"	0.098"	3.306
TJS 40K C5L	C5	4.094"	0.059"	3.306
TJS 40K C5R	C5	4.094"	0.059"	3.306
TJS 20K C6L	C6	4.173"	0.137"	3.637
TJS 20K C6R	C6	4.173"	0.137"	3.637
TJS 30K C6L	C6	4.173"	0.098"	3.637
TJS 30K C6R	C6	4.173"	0.098"	3.637
TJS 40K C6L	C6	4.173"	0.059"	3.637
TJS 40K C6R	C6	4.173"	0.059"	3.637

• Maximum tool shank diameter .250 inch • Minimum coolant pressure 20 bar and flow rate 3.17 G/min

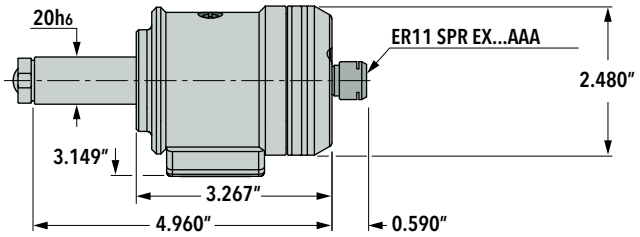
(1) Maximum cutting tool diameter

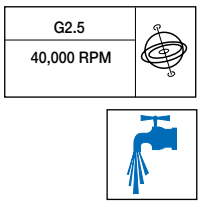
Spare Parts

	 Display	 Mini ER Nut	 ER Wrench	 Locking Pin
TJS-C#	TJS TSD Display*	ER11 GHS	ER11 SMS	DIA3.2x35

* Optional, should be ordered separately

TJS-ST COOLANT DRIVEN HIGH SPEED COMPACT SPINDLES WITH CYLINDRICAL SHANKS





Designation	d max(1)	Lbs.
TJS 20K ST20L	0.137"	2.420
TJS 20K ST20R	0.137"	2.420
TJS 30K ST20L	0.098"	2.420
TJS 30K ST20R	0.098"	2.420
TJS 40K ST20L	0.059"	2.420
TJS 40K ST20R	0.059"	2.420

• Maximum tool shank diameter .250 inch • Minimum coolant pressure 20 bar and flow rate 3.17 G/min

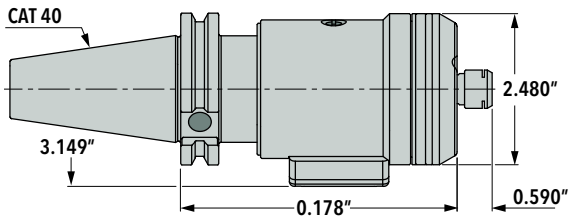
(1) Maximum cutting tool diameter

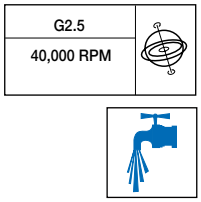
Spare Parts

	Display	Mini ER Nut	ER Wrench	Locking Pin
TJS-ST	TJS TSD Display*	ER11 GHS	ER11 SMS	DIA3.2x35

* Optional, should be ordered separately

TJS-CAT COOLANT DRIVEN HIGH SPEED COMPACT SPINDLES WITH CATERPILLAR TAPERED SHANKS



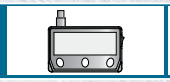


Designation	d max(1)	Lbs.
TJS 20K CAT40L	0.137"	3.528
TJS 20K CAT40R	0.137"	3.528
TJS 30K CAT40L	0.098"	3.528
TJS 30K CAT40R	0.098"	3.528
TJS 40K CAT 40L	0.059"	3.528
TJS 40K CAT 40R	0.059"	3.528

• Maximum tool shank diameter .250 inch • Minimum coolant pressure 20 bar and flow rate 3.17 G/min

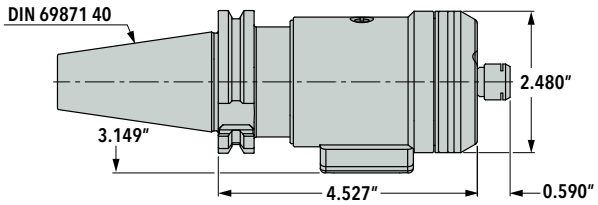
(1) Maximum cutting tool diameter

Spare Parts

	 Display	 Mini ER Nut	 ER Wrench	 Locking Pin
TJS-CAT	TJS TSD Display*	ER11 GHS	ER11 SMS	DIA3.2x35

* Optional, should be ordered separately

TJS-DIN69871 COOLANT DRIVEN HIGH SPEED COMPACT SPINDLES WITH DIN69871 SHANKS



G2.5
40,000 RPM

Designation	d max(1)	Lbs.
TJS 20K DIN69871 40L	0.137"	3.527
TJS 20K DIN69871 40R	0.137"	3.527
TJS 30K DIN69871 40L	0.098"	3.527
TJS 30K DIN69871 40R	0.098"	3.527
TJS 40K DIN69871 40L	0.059"	3.527
TJS 40K DIN69871 40R	0.059"	3.527

• Maximum tool shank diameter .250 inch • Minimum coolant pressure 20 bar and flow rate 3.17 G/min

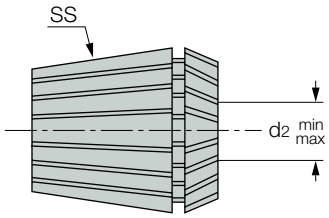
(1) Maximum cutting tool diameter

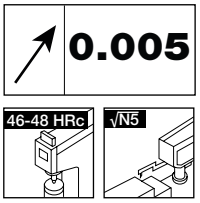
Spare Parts

	Display	Mini ER Nut	ER Wrench	Locking Pin
TJS-DIN69871	TJS TSD Display*	ER11 GHS	ER11 SMS	DIA3.2x35

* Optional, should be ordered separately

ER-SPR-AA DIN6499 'AA' ULTRA PRECISE ER SPRING COLLETS WITH HARD TOUCH COATING

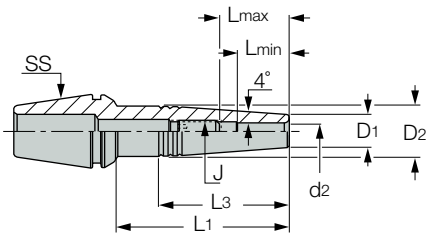


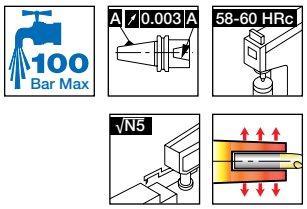


Designation	SS	$d_{2\ min}$	$d_{2\ max}$
ER11 SPR 0.5- 1 AA	ER11	0.50	1.00
ER11 SPR 1-2 AA	ER11	1.00	2.00
ER11 SPR 2-3 AA	ER11	2.00	3.00
ER11 SPR EX3.0AAA (1)	ER11	3.00	3.00
ER11 SPR 3-4 AA	ER11	3.00	4.00
ER11 SPR EX4.0AAA (1)	ER11	4.00	4.00
ER11 SPR 4-5 AA	ER11	4.00	5.00
ER11 SPR 5-6 AA	ER11	5.00	6.00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

(1) 0.0001" runout accuracy

ER-SRK THERMAL SHRINK CHUCKS WITH AN INTEGRAL ER COLLET





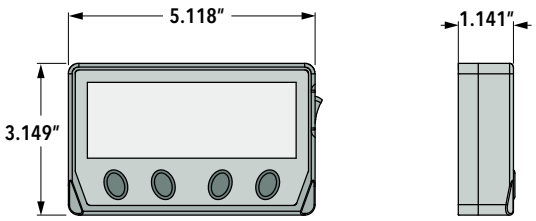
Designation	SS	d_2	L_1	L_{min}	D_2	D_1
ER11 SRK 3X10 (1)	ER11	0.118	0.393	0.374	0.374	0.299
ER11 SRK 3X25 (2)	ER11	0.118	0.984	0.452	0.374	0.299
ER11 SRK 4X10 (2)	ER11	0.157	0.393	0.374	0.374	0.299
ER11 SRK 4X25 (2)	ER11	0.157	0.984	0.452	0.374	0.299

• For carbide tools only. (1) To be used only for Typhoon spindles.

NUT ER11 GHS TIGHTENING NUT DIN 6499 FOR THERMAL COLLET

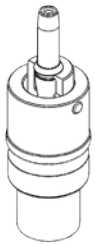
Designation	ØA	B	C	Wrench
Nut ER11 GHS	0.629	0.452	M13X0.75	WRENCH ER11 SMS

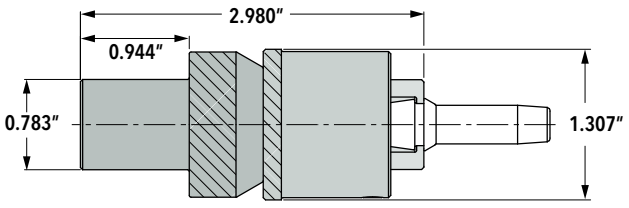
TJS TSD DISPLAY RPM SPEED DISPLAY FOR HIGH SPEED SPINDLES



Designation	Machines
TJS TSD DISPLAY	TJS Spindles

IND ER11 TOOL ADAPTER SHRINK COLLET ADAPTER FOR INDUCTION HEATING DEVICE





Designation
IND ER11 TOOL ADAPTER