

Casing Running Tool with Internal Grip (CRTi™)

Volant's CRTi is designed for casing drilling or running with top drive equipped rigs to makeup, breakout, reciprocate, rotate, fill, circulate, and cement casing and liner strings, reducing nonproductive time and associated costs. This tool is mechanically activated in tension and both rotational directions solely by top drive control using TAWG™ (Torque Activated Wedge Grip) technology.

This patented architecture puts control in the hands of the driller, reducing the need for third party support to run casing. Simple intuitive operating steps for pipe engagement and release closely emulate the familiar make and break steps used to run drill pipe – stab, rotate to the right to engage and reverse to disengage. Similarly, rig-in and rig-out steps are simple, intuitive and efficient.

Starting from the insertion diameter of the base tool (cage OD), selectable sizes of integral jaws/dies are used to configure the CRTi to support gripping casing of increasing internal diameter. Through the use of a patent pending extended reach die structure, the gripping diameter can be further increased to include casing sizes much greater than the base tool.

Tool Model: CRTi4-7.0 Specification Summary

Base Tool Characteristics¹

CRTi Rated Load Capacity	Hoist	ton (tonne)	420 (381)
	Torque	ft.lbs (N.m)	50,000 (67,791)
Combined Load Large Hoist	Hoist	ton (tonne)	300 (272)
	Torque	ft.lbs (N.m)	30,000 (40,675)
Combined Load High Torque	Hoist	ton (tonne)	200 (181)
	Torque	ft.lbs (N.m)	50,000 (67,791)
Set-Down Load Capacity ²		ton (tonne)	110 (100)
Typical Circulation Pressure Limit ³		psi (MPa)	5,000 (34)
Maximum Pressure End Load		ton (tonne)	250 (227)
Base Tool Length ⁴		in (mm)	59.0 (1,499)
Diametrical Stroke		in (mm)	0.61 (15.5)
Through Hole		in (mm)	1.5 (38.1)
Maximum Flow Rate ⁵		gpm (m ³ /min)	660 (2.5)
Tool Joint			6-5/8 REG
Turns to Stroke Out			1.1

Tool Configuration with

Integral Slip Dies

Extended Slip Dies

Extended Slip Dies
and Bumper Extension



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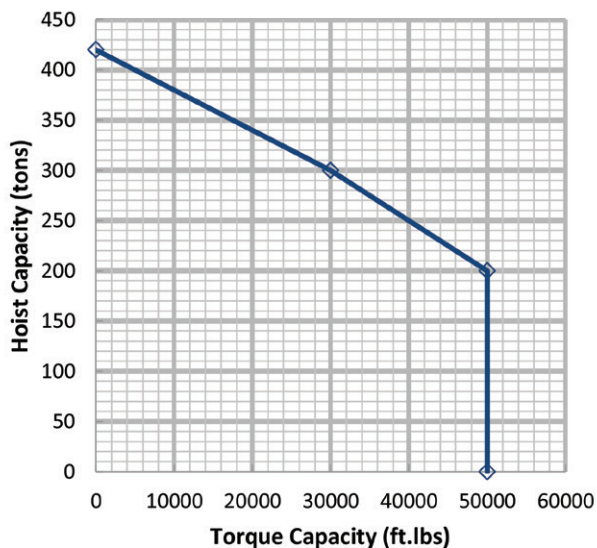
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Casing Seal Assembly and Tool Length⁴

Casing Seal Description	Seal Type	Casing Size in (mm)	Overall Tool Length in (mm)
Swivel Casing Seal	Packer Cup	7.0 (177.8)	70.3 (1,785)
		7.63 (193.7)	70.3 (1,785)
		8.63 (219.1)	73.3 (1,862)
		9.63 (244.5)	73.3 (1,862)
		10.75 (273.1)	73.3 (1,862)
		11.75 (298.5)	73.3 (1,862)
		12.75 (323.9)	73.3 (1,862)
	Wedge Seal	13.38 (339.7)	73.3 (1,862)
		13.0 (330.2)	73.3 (1,862)
		16.0 (406.4)	73.3 (1,862)
		16.77 (426.0)	73.3 (1,862)
		18.63 (473.1)	73.3 (1,862)
		20.0 (508.0)	73.3 (1,862)

Combined Load Operation Curve

Please refer to the Base Tool Characteristics table on page 1 of this Specification Summary for numeric values (CRTi Rated Load Capacity, Combined Load Large Hoist, Combined Load High Torque) illustrated in the graph below.



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Tool Selection Guide

Step 1: Base Tool Selection The CRTi is available in a variety of dimensions and ratings. The Base Tool Characteristics table contains the ratings and overall dimensions of the tool. The required hoist, torque, set-down load capacity and maximum flow rate must be lower than or equal to the base tool rating. If combined hoist and torque is required for the casing running job, the combined hoist and torque point must fall below or on the combined load operation curve.

Step 2: Die Selection All API casing sizes and weights with drift diameter above 5.87 in (149.1 mm) are available for this tool. Find the appropriate die for casing size and weight in the die table below. Some dies can run a range of casing weights.

Step 3: Die Hoist Capacity Tool hoist rating is based on API Specification 8C; however, casing load limit is further constrained by local interaction of slip dies with casing, which must not exceed the efficiency indicated for individual slip die sizes to avoid excess deformation. The slip to casing interaction hoist limit (F_{die}) can be found by the following formula, where efficiency is the slip to pipe body load efficiency number (listed in the following table for every die) and F_{casing} is the casing hoist limit found in API Bulletin 5C2.

$$F_{die} = \text{efficiency} \times F_{casing}$$

For example, from API 5C2 the pipe body yield for 9.63 in x 40.0 ppf L80 (244.5 mm x 59.53 kg/m L80) casing is 916,000 lbs (415 tonne). The slip efficiency for die 81793 used to run this casing is 80%. Therefore, the die hoist limit is:

$$80\% \times 916,000 \text{ lbs} = 732,800 \text{ lbs} = 366.4 \text{ ton}$$

or

$$80\% \times 415.5 \text{ tonne} = 332.4 \text{ tonne}$$

In case the base tool hoist rating is smaller than the calculated die hoist limit, the base tool hoist rating will be limiting.

Step 4: Die Torque Capacity Torque capacity may be limited by slip die/casing interaction. Where torque factors (K_{torque}) are provided, the slip die/casing interaction torque limit (T_{die}) is:

$$T_{die} = K_{torque} \times W_{casing} \times \sigma Y_{casing}$$

Where W_{casing} is the desired casing weight in ppf (kg/m), and σY_{casing} is the casing yield strength in psi (MPa). If no value is provided, tool rating will be limiting for all standard casing grades. For example, for die 81793 to run 9.63 in x 40.0 ppf L80 (244.5 mm x 59.53 kg/m L80) casing, the die torque limit is:

$$0.02834 \text{ ft.lbs/psi/ppf} \times 40.0 \text{ ppf} \times 80,000 \text{ psi} = 90,688 \text{ ft.lbs}$$

or

$$3.745 \text{ N.m/MPa/(kg/m)} \times 59.53 \text{ kg/m} \times 551.6 \text{ MPa} = 122,974 \text{ N.m}$$

Where the base tool torque capacity is lower than the die torque capacity, the tool is limited to base tool torque capacity.

Step 5: Effect of Circulation Pressure CRTi hoist capacity must be reduced by the pressure end load during circulation.

The hoist reduction ($F_{EndPressure}$) depends on circulation pressure (P), casing nominal ID (ID_{casing}) and CRTi through hole ($ID_{mandrel}$).

$$F_{EndPressure} = 0.79 \times P \times (ID_{casing}^2 - ID_{mandrel}^2)$$

For example, for circulation pressure of 1,000 psi (6.89 MPa) and casing nominal ID of 8.84 in (224.5 mm) the hoist reduction is:

$$0.79 \times 1,000 \text{ psi} \times ((8.84 \text{ in})^2 - (1.5 \text{ in})^2) = 59,958 \text{ lbs} \sim 30.0 \text{ ton}$$

or

$$0.79 \times 6.9 \text{ MPa} \times ((224.5 \text{ mm})^2 - (38.1 \text{ mm})^2) = 266,432 \text{ N} \sim 27.2 \text{ tonne}$$

Therefore, the maximum hoist for this tool reduces to 420.0 - 30.0 = 390.0 ton (353.8 tonne) or the maximum hoist for die 81793 (in step 3) must reduce to 366.4 - 30.0 = 336.4 ton (305.2 tonne).

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Casing Running Tools (CRTi 4-7.0)

Summary of Selected Slip Die Sizes⁶

Die P/N	Nominal Pipe Size		Max. Pipe Weight ⁷ (W _{casing})		Min. Pipe Weight ⁸ (W _{casing})		Die Curv. Diameter		Max. Tool Diameter		Approximate Tool Weight		Slip to Pipe Body Load Efficiency	Torque Factor (K _{torque})	
	(in)	(mm)	(ppf)	(kg/m)	(ppf)	(kg/m)	(in)	(mm)	(in)	(mm)	(lbs)	(kg)		(% Fy)	(ft.lbs/psi/ppf)
81277	7.0	177.8	26.0	38.69	17.0	25.3	6.42	163.1	16.3	414	1,100	499	80%	0.03031	4.005
81508	7.0	177.8	35.0	52.09	26.0	38.69	6.16	156.3	16.3	414	1,100	499	80%	0.02892	3.821
81884	7.63	193.7	33.7	50.15	24.0	35.72	6.62	168.2	16.3	414	1,100	499	80%	0.02592	3.425
82750	7.63	193.7	55.3	82.3	51.2	76.19	6.28	159.4	16.3	414	1,100	499	80%	-	-
81421	8.63	219.1	36.0	53.57	28.0	41.67	8.02	203.8	16.3	414	1,100	499	80%	0.0243	3.211
81793	9.63	244.5	43.5	64.74	36.0	53.57	8.89	225.9	16.3	414	1,100	499	80%	0.02834	3.745
81420	9.63	244.5	53.5	79.62	47.0	69.94	8.67	220.3	16.3	414	1,100	499	80%	0.0225	2.973
82812	9.63	244.5	59.4	88.4	53.5	79.62	8.57	217.7	16.3	414	1,100	499	80%	-	-
82276	10.75	273.1	40.5	60.27	32.8	48.74	10.22	259.5	16.3	414	1,300	590	80%	0.0206	2.722
82275	10.75	273.1	51.0	75.9	45.5	67.71	10.02	254.4	16.3	414	1,300	590	80%	0.02178	2.878
82910	10.75	273.1	60.7	90.33	55.5	82.59	9.83	249.6	16.3	414	1,300	590	80%	-	-
81255	10.75	273.1	65.7	97.77	60.7	90.33	9.73	247.0	16.3	414	1,300	590	80%	-	-
81494	10.75	273.1	73.2	108.93	71.1	105.81	9.57	243.1	16.3	414	1,300	590	80%	-	-
81138	10.75	273.1	79.2	117.86	79.2	117.86	9.4	238.8	16.3	414	1,300	590	80%	-	-
81495	11.75	298.5	60.0	89.29	54.0	80.36	10.94	277.8	16.3	414	1,400	635	80%	0.01931	2.552
81757	11.75	298.5	71.0	105.66	65.0	96.73	10.75	273.1	16.3	414	1,400	635	80%	-	-
82039	12.75	323.9	58.4	86.91	50.0	74.41	12.03	305.5	16.3	414	1,650	748	71%	0.01675	2.214
82168	13.38	339.7	54.5	81.1	48.0	71.43	12.78	324.6	16.3	414	1,900	862	74%	0.01705	2.253
81897	13.38	339.7	61.0	90.78	54.5	81.1	12.68	322.1	16.3	414	1,900	862	75%	0.01743	2.303
82164	13.38	339.7	68.0	101.2	61.0	90.78	12.58	319.6	16.3	414	1,900	862	75%	0.01557	2.058
81150	13.38	339.7	72.0	107.15	68.0	101.2	12.52	317.9	16.3	414	1,900	862	76%	0.01772	2.342
82588	13.38	339.7	77.0	114.59	72.0	107.15	12.44	315.9	16.3	414	1,900	862	76%	-	-
81431	16.0	406.4	65.0	96.73	65.0	96.73	15.42	391.8	16.3	414	2,300	1,043	59%	0.01356	1.792
81645	16.0	406.4	84.0	125.01	84.0	125.01	15.18	385.7	16.3	414	2,300	1,043	63%	0.01486	1.964
82100	16.0	406.4	97.0	144.35	96.0	142.86	15.03	381.9	16.3	414	2,300	1,043	63%	-	-
81758	16.0	406.4	109.0	162.21	109.0	162.21	14.88	378.0	16.3	414	2,300	1,043	64%	-	-
82532	16.77	426.0	77.0	114.59	73.3	109.08	16.09	408.7	21.0	533	2,400	1,089	55%	0.01288	1.702
81752	17.88	454.0	105.0	156.26	105.0	156.26	16.96	430.7	21.0	533	2,450	1,111	54%	-	-
82976	18.63	473.1	87.5	130.21	87.5	130.21	17.88	454.2	21.0	533	2,600	1,179	45%	0.01059	1.399
81566	18.63	473.1	97.7	145.39	97.7	145.39	17.85	453.4	21.0	533	2,600	1,179	55%	0.01272	1.681
82101	18.63	473.1	111.0	165.19	111.0	165.19	17.71	449.9	21.0	533	2,600	1,179	56%	-	-
82675	18.63	473.1	117.0	174.12	117.0	174.12	17.63	447.8	21.0	533	2,600	1,179	56%	-	-
81880	18.63	473.1	139.0	206.85	139.0	206.85	17.39	441.7	21.0	533	2,600	1,179	56%	-	-
82300	20.0	508.0	94.0	139.89	94.0	139.89	19.31	490.6	21.0	533	2,800	1,270	49%	0.01136	1.501
81759	20.0	508.0	106.5	158.49	106.5	158.49	19.19	487.4	21.0	533	2,800	1,270	49%	0.01157	1.529
81483	20.0	508.0	133.0 ⁹	197.93	133.0 ⁹	197.93	18.92	480.7	21.0	533	2,800	1,270	51%	-	-

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Casing Running Tools (CRTi 4-7.0)

- 1 Characteristics are based on standard tool components and are independent of specific limitations of cage and accessories.
- 2 Maximum allowable set-down load applied to the tool. Some set-down load may be reacted through the coupling. This rating does not take into account bearing load limitations of the coupling.
- 3 CRTi circulation pressure capacity is generally governed by packer cup pressure capacity. Pressure capacity may be less than indicated if alternative seal arrangements are used.
- 4 Base tool length does not include casing seal assembly. Overall tool length depends on the casing seal arrangement.
- 5 Maximum flow rate is based on minimizing erosion rates when using typical fluids. Erosion rates may vary based on fluid contents. Please inspect tool bore regularly.
- 6 Common die sizes shown. All API casing sizes and weights with drift diameter above 5.87 in (149.1 mm) are available.
- 7 Maximum pipe weight is defined by the API Specification 5CT drift diameter of the heaviest weight casing into which the CRTi assembled with the specified die set will fit.
- 8 Indicated minimum pipe weight is based on the assumption that control of average pipe inside diameter over die grip interval does not allow pipe body area reduction less than 3.5% from nominal and additionally takes into account tool wear allowances, die penetration, casing deformation and diametrical stroke.
- 9 Non-standard radial stroke limit for this casing weight only.

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