CRTi® Internal Grip Casing Running Tool

Volant's CRTi® casing running tool is fully mechanical and designed for casing running or drilling with top drive equipped rigs to makeup, breakout, reciprocate, rotate, fill, circulate and cement casing and liner strings, reducing non-productive time and associated costs. The tool is available with upgraded parts to suit diverse applications; High-flow CwD Mandrel (CRTi4-7.0HF311) has a larger through hole for higher fluid flow and Low-Release Cams reduce the turns to stroke out needed to set and release the tool. All configurations are mechanically activated in tension and both rotational directions by top drive control using TAWG™ wedge grip technology.

This patented architecture puts control in the hands of the driller, reducing the need for third party support to run casing. Intuitive operations 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 patented extended reach die structure, the gripping diameter can be further increased to include casing sizes much greater than the base tool.

Base Tool Characteristics[1]

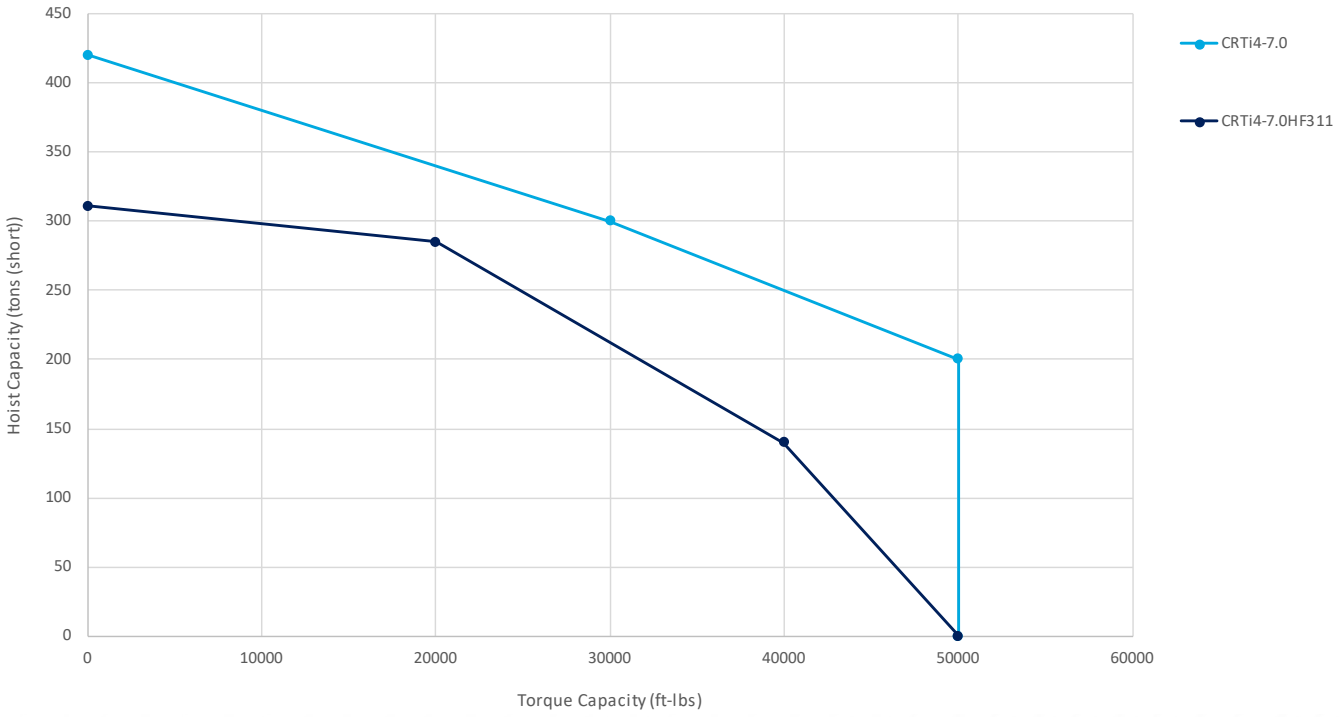
			CRTi4-7.0	CRTi4-7.0HF311
CRTi Rated Load Capacity	Hoist	ton (tonne)	420 (381)	311 (282)
	Torque	ft.lbs (N.m)	50,000 (67,700)	50,000 (67,700)
Combined Load Large Hoist	Hoist	ton (tonne)	300 (272)	285 (258)
	Torque	ft.lbs (N.m)	30,000 (40,600)	20,000 (27,100)
Combined Load High Torque	Hoist	ton (tonne)	200 (181)	140 (127)
	Torque	ft.lbs (N.m)	50,000 (67,700)	40,000 (54,200)
Set-Down Load Capacity[2]		ton (tonne)	110 (99)	110 (99)
Typical Circulation Pressure Limit[3]		psi (MPa)	5,000 (34.4)	5,000 (34.4)
Maximum Pressure End Load		ton (tonne)	250 (226)	250 (226)
Base Tool Length		in (mm)	59.0 (1,500)[4]	74.0 (1,880)[5]
Base Tool Weight[6]		lbs (kg)	892 (405)	877 (398)
Diametrical Stroke		in (mm)	0.61 (15.5)	0.61 (15.5)
Through Hole		in (mm)	1.5 (38)	2.25 (57)
Maximum Flow Rate[7]		gpm (m^3/min)	660 (2.50)	1,460 (5.55)
Tool Joint			6.63 REG	6.63 REG
Turns to Stroke Out[8]			1.1 / 0.72	1.1 / 0.72

Casing Seal Assembly and Overall Tool Length

Casing Seal Description	Seal Type	Casing Size in (mm)	CRTi4-7.0 Overall Tool Length in (mm)	CRTi4-7.0HF311 Overall Tool Length[5] in (mm)
Swivel Casing Seal	Packer Cup	7.0 (177.8)- 7.63 (193.8)	70.3 (1,790)	74.0 (1,880)
		8.63 (219.1) - 13.38 (339.7)	73.3 (1,865)	74.0 (1,880)
	Wedge Seal™	13.38 (339.7) - 20.0 (508.0)	73.3 (1,865)	74.0 (1,880)

Combined Load Operation Curve

Please refer to the Base Tool Characteristics on page 1 of this Specification Summary for the numeric values such as CRTi Rated Load Capacity, Combined Load Large Hoist, and Combined Load High Torque illustrated in the graph below:



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 Specifications 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} = efficiency x 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 (415.5 tonne). The slip efficiency for slip die 81793 used to run this casing is 80%. Therefore, the die hoist limit is:

80% × 916,000 lbs = 732,800 lbs = 366.4 ton

or

80% × 415.5 tonne = 332.4 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
$T_{die} = K_{torque} \times W_{casing} \times \sigma Y_{casing}$

where T_{die} is the torque limit due to slip die/casing interaction,
K_{torque} is the torque factor,
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:

0.02835 ft.lbs/psi/ppf × 40.0 ppf × 80,000 psi = 90,720 ft.lbs

or

3.746 N.m/MPa/(kg/m) × 59.53 kg/m × 551.6 MPa = 123,006 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 ($ID_{mandrel}$).

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

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 × 1,000 psi × ((8.84 in)^2- (1.5 in)^2) = 59,958 lbs ~ 30.0 ton

or

0.79 × 6.89 MPa × ((224.5 mm)^2- (38.1 mm)^2) = 266,432 N ~ 27.2 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).

Please contact Volant for further information.

Summary of Selected Slip Die Sizes[9]

Die P/N	Nominal Pipe Size		CRTi4-7.0 CRTi4-7.0HF311 Max. Pipe Weight[10] (W_{casing})		CRTi4-7.0 CRTi4-7.0HF311 Min. Pipe Weight[11] (W_{casing})		Slip to Pipe Body Load Efficiency	Torque Factor (K_{torque})	
	(in)	(mm)	(ppf)	(kg/m)	(ppf)	(kg/m)	(% Fy)	(ft.lbs/psi/ppf)	(N.m/MPa/(kg/m))
81277	7.0	177.8	26.0	38.69	17.0	25.30	80%	0.03032	4.006
81508	7.0	177.8	35.0	52.09	26.0	38.69	80%	0.03102	4.098
83000[12]	7.0	177.8	42.7	63.54	38.0	56.55	80%	-	-
81884	7.63	193.7	33.7	50.15	24.0	35.72	80%	0.02592	3.425
83345	7.63	193.7	39.0	58.04	29.7	44.20	80%	0.02721	3.595
82750	7.63	193.7	55.3	82.30	51.2	76.19	80%	-	-
81421	8.63	219.1	36.0	53.57	28.0	41.67	80%	0.02688	3.551
101755	8.63	219.1	44.0	65.48	36.0	53.57	80%	0.02267	2.995
83041	8.63	219.1	59.6	88.69	59.6	88.69	80%	-	-
81793	9.63	244.5	43.5	64.74	36.0	53.57	80%	0.02835	3.746
81420	9.63	244.5	53.5	79.62	47.0	69.94	80%	0.02513	3.320
82812	9.63	244.5	59.4	88.40	53.5	79.62	80%	-	-
82276	10.75	273.1	40.5	60.27	32.8	48.81	80%	0.02060	2.722
82275	10.75	273.1	51.0	75.90	45.5	67.71	80%	0.02179	2.879
102777	10.75	273.1	55.5	82.59	51.0	75.90	80%	0.02201	2.908
82910	10.75	273.1	60.7	90.33	55.5	82.59	80%	-	-
81255	10.75	273.1	65.7	97.77	60.7	90.33	80%	-	-
81494	10.75	273.1	73.2	108.93	71.1	105.81	80%	-	-
81138	10.75	273.1	79.2	117.86	79.2	117.86	80%	-	-
83096	10.75	273.1	109.0	162.21	109.0	162.21	80%	-	-
81495	11.75	298.5	60.0	89.29	54.0	80.36	80%	0.01932	2.552
81757	11.75	298.5	71.0	105.66	65.0	96.73	80%	-	-
100703	11.75	298.5	82.6	122.92	78.0	116.08	80%	-	-
82039	12.75	323.9	58.4	86.91	50.0	74.41	79%	0.01675	2.213
82168	13.38	339.7	54.5	81.10	48.0	71.43	80%	0.01705	2.252
81897	13.38	339.7	61.0	90.78	54.5	81.10	80%	0.01743	2.303
82164	13.38	339.7	68.0	101.20	61.0	90.78	80%	0.01773	2.342
81150	13.38	339.7	72.0	107.15	68.0	101.20	80%	0.01784	2.357
82588	13.38	339.7	77.0	114.59	72.0	107.15	80%	-	-
83154	13.38	339.7	86.0	127.98	85.0	126.49	80%	-	-
81431	16.0	406.4	65.0	96.73	65.0	96.73	72%	0.01452	1.918
81645	16.0	406.4	84.0	125.01	84.0	125.01	72%	0.01486	1.963
82100	16.0	406.4	97.0	144.35	96.0	142.86	71%	-	-
81758	16.0	406.4	109.0	162.21	109.0	162.21	72%	-	-

Summary of Selected Slip Die Sizes[9] (continued)

Die P/N	Nominal Pipe Size		CRTi4-7.0 CRTi4-7.0HF311 Max. Pipe Weight[10] (W_{casing})		CRTi4-7.0 CRTi4-7.0HF311 Min. Pipe Weight[11] (W_{casing})		Slip to Pipe Body Load Efficiency	Torque Factor (K_{torque})	
	(in)	(mm)	(ppf)	(kg/m)	(ppf)	(kg/m)	(% Fy)	(ft.lbs/psi/ppf)	(N.m/MPa/(kg/m))
82532	16.77	426.0	77.0	114.59	73.3	109.08	67%	0.01388	1.834
102675	17.0	431.8	77.5	115.33	77.5	115.33	64%	0.01332	1.760
81752	17.88	454.0	105.0	156.26	105.0	156.26	61%	-	-
100665	18.0	457.2	117.0	174.12	117.0	174.12	63%	-	-
82976	18.63	473.1	87.5	130.21	87.5	130.21	58%	0.01180	1.559
81566	18.63	473.1	97.7	145.39	97.7	145.39	63%	0.01273	1.682
82101	18.63	473.1	111.0	165.19	111.0	165.19	63%	-	-
82675	18.63	473.1	117.0	174.12	117.0	174.12	64%	-	-
103097	18.63	473.1	126.0	187.51	123.4	183.64	64%	-	-
81880	18.63	473.1	139.0	206.85	139.0	206.85	64%	-	-
82300	20.0	508.0	94.0	139.89	94.0	139.89	56%	0.01136	1.501
81759	20.0	508.0	106.5	158.49	106.5	158.49	57%	0.01157	1.528
81483	20.0	508.0	133.0[13]	197.93	133.0[13]	197.93	58%	-	-
101434	20.0	508.0	147.0	218.76	147.0	218.76	57%	-	-

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 tool 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. CRTi4-7.0 base tool length does not include casing seal assembly. To find overall tool length see ***Casing Seal Assembly and Overall Tool Length*** table.
5. CRTi4-7.0HF311 base tool length does not change with casing seal assembly, base tool length is the same as overall tool length. Fixed Casing Seal is not available with this tool model.
6. Tool weight is approximate and represents 7.0" base tool configuration. Contact Volant sales for further information on tool weight at +1 780.784.7099
7. Maximum flow rate is based on minimizing erosion rates when using typical fluids. Erosion rates may vary depending upon the fluid contents. Please inspect tool bore regularly.
8. Turns to Stoke Out is the rotational limit during tool makeup (this may be exceeded in combined load scenarios). The old style cams require 1.10 turns to stroke out and Low-Release Cams only require 0.72 turns to stroke out.
9. Common die sizes shown. All API casing sizes and weights with drift diameter above 5.87 in (149.1 mm) are available.
10. Maximum pipe weight is defined by the API Specification 5CT drift diameter of the heaviest weight casing into which the CRTi tool assembled with the specified die set will fit.
11. 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.
12. Cage (P/N: 82999) must be run in conjunction with Keeper (P/N: 83001) and Integral Slips (P/N: 83000) to enable running 7.0" 38.0 - 42.7ppf casing, with a reduced torque capacity of 35,000 ft.lbs. All other CRTi4-7.0 Integral Slips and Dies can be run with Cage (P/N: 82999) with a reduced torque capacity of 35,000 ft.lbs.
13. Non-standard radial stroke limit for this casing weight only.