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 standard CRTi tool uses intuitive operations for pipe engagement and release – stab, rotate to the right to engage and reverse to disengage. A simple rig-up and rig-down further increases operational efficiency.

The CRTi3-7.0 is available with various retrofit upgrades to improve function and performance, as well as enable a broader range of applications. The ActiveSET™ upgrade enables all variants of the CRTi3-7.0 to engage in one step by stabbing the tool into the casing joint; the high-capacity mandrel upgrade (CRTi3-7.0HC$_{350}$) uses higher strength material to achieve an increased rated hoist capacity; the high-flow mandrel (CRTi3-7.0HF$_{240}$) has a larger through hole and a modified casing seal assembly arrangement to support higher fluid flow rate requirements for Casing while Drilling (CwD) operations. All CRTi3-7.0 tools now come standard with upgraded low-release cams that reduce the turns required to set and release the tool. All configurations are mechanically activated in tension and both rotational directions by top drive control using patented TAWG™ torque activated wedge grip.

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]

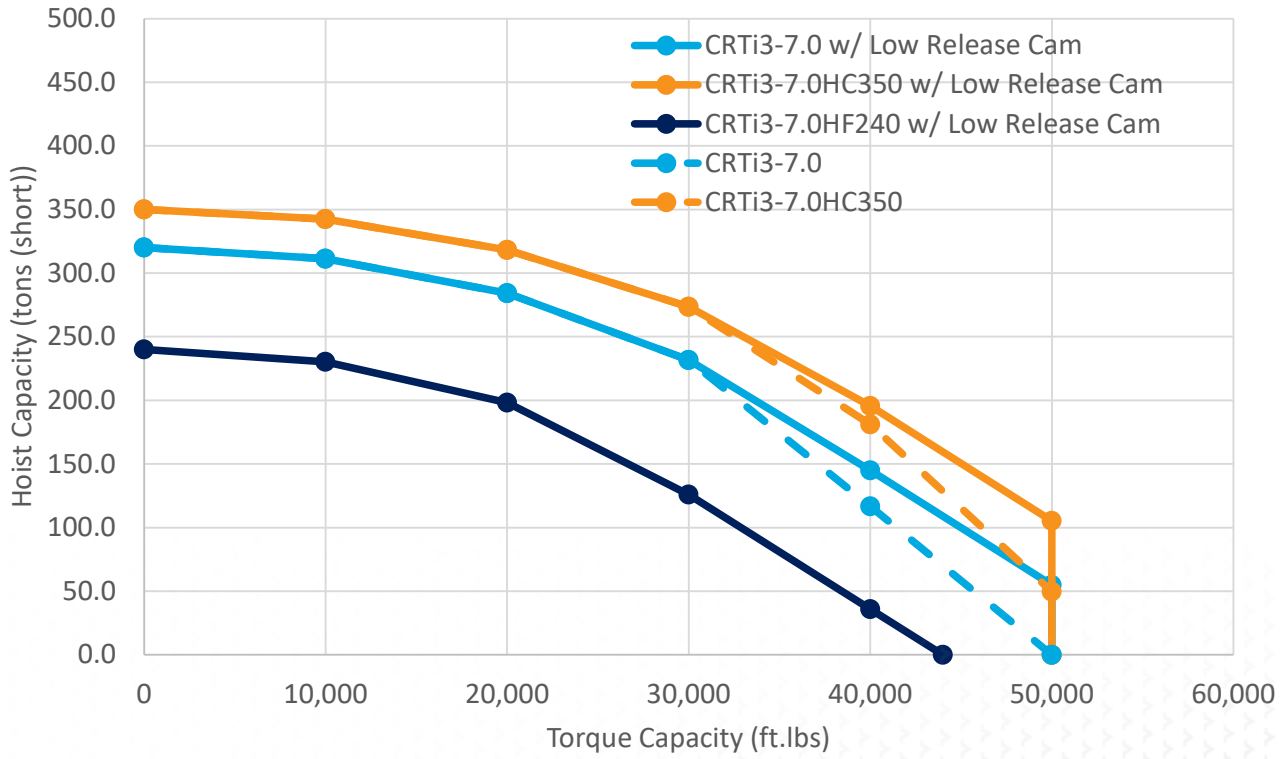
			CRTi3-7.0	CRTi3-7.0HC350	CRTi3-7.0HF240
CRTi Rated Load Capacity	Hoist	ton (tonne)	320 (290)	350 (317)	240 (217)
	Torque	ft.lbs (N.m)	50,000 (67,700)	50,000 (67,700)	44,000 (59,600)
Set-Down Load Capacity[2]		ton (tonne)	100 (90)	100 (90)	100 (90)
Typical Circulation Pressure Limit[3]		psi (MPa)	5,000 (34.4)	5,000 (34.4)	5,000 (34.4)
Maximum Pressure End Load		ton (tonne)	250 (226)	250 (226)	190 (172)
Base Tool Length		in. (mm)	53.2 (1,355)[4]	53.2 (1,355)[4]	67.5 (1,715)[5]
Base Tool Weight[6]		lbs (kg)	649 (295)	649 (295)	644 (293)
Die Range		in. (mm)	7.0 (177.8) – 20.0 (508.0)	7.0 (177.8) – 20.0 (508.0)	7.0 (177.8) – 20.0 (508.0)
Diametrical Stroke		in. (mm)	0.61 (15.5)	0.61 (15.5)	0.61 (15.5)
Through Hole		in. (mm)	1.5 (38.1)	1.5 (38.1)	2.25 (57.5)
Maximum Flow Rate[7]		gpm (m^3/min)	660 (2.50)	660 (2.50)	1,460 (5.55)
Maximum Rotational Speed[8]		RPM	Unlimited	Unlimited	Unlimited
Tool Joint			NC50 or 6-⅝ REG	NC50 or 6-⅝ REG	NC50 or 6-⅝ REG
Turns to Stroke Out[9]			1.48 / 0.72	1.48 / 0.72	1.48 / 0.72

Casing Seal Assembly and Overall Tool Length

Casing Seal Description	Seal Type	Casing Size in. (mm)	CRTi3-7.0 CRTi3-7.0HC350 Overall Tool Length in. (mm)	CRTi3-7.0HF240 Overall Tool Length[5] in. (mm)
Fixed Casing Seal	Packer Cup	7.0 (177.8)	62.5 (1,590)	-
		7.63 (193.8)	62.3 (1,585)	-
		8.63 (219.1)	62.5 (1,590)	-
		9.63 (244.5)	63.1 (1,605)	-
		10.75 (273.1)	63.5 (1,615)	-
		11.75 (298.5)	64.6 (1,645)	-
		12.75 (323.9) - 13.38 (339.7)	66.0 (1,680)	-
Swivel Casing Seal	Packer Cup	7.0 (177.8) - 13.38 (339.7)	64.5 (1,640)	67.5 (1,715)
		8.63 (219.1) - 13.38 (339.7)	67.5 (1,715)	67.5 (1,715)
	Wedge Seal™	13.38 (339.7) - 20.0 (508.0)	62.6 (1,595)	67.5 (1,715)

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
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 below Die Sizes tables for every die) and F_{casing} is the pipe body yield 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 82157 used to run this casing is 75%. Therefore, the die hoist limit is:

75% × 916,000 lbs = 687,000 lbs = 343.5 ton

or

75% × 415.5 tonne = 311.6 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 82157 to run 9.63 in. x 40.0 ppf L80 (244.5 mm x 59.53 kg/m L80) casing, the die torque capacity is:

0.01587 ft.lbs/psi/ppf × 40.0 ppf × 80,000 psi = 50,784 ft.lbs

or

2.097 N.m/MPa/(kg/m) × 59.53 kg/m × 551.6 MPa = 68,858 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 the standard CRTi3-7.0 tool reduces to 320.0- 30.0 = 290.0 ton (262.8 tonne) or the maximum hoist for die 82157 (in step 3) must reduce to 343.5- 30.0 = 313.5 ton (284.4 tonne).

Please contact Volant for further information.

Summary of Selected Die Sizes[10]

Die P/N	Nominal Pipe Size		CRTi3-7.0 CRTi3-7.0HC350 CRTi3-7.0HF240 Max. Pipe Weight[11] (W_{casing})		CRTi3-7.0HC350 Min. Pipe Weight[12] (W_{casing})		CRTi3-7.0 CRTi3-7.0HF240 Min. Pipe Weight[12] (W_{casing})		Slip to Pipe Body Load Efficiency	Torque Factor (K_{torque})	
	(in.)	(mm)	(ppf)	(kg/m)	(ppf)	(kg/m)	(ppf)	(kg/m)	(% Fy)	(ft.lbs/psi/ppf)	(N.m/MPa/(kg/m))
80928	7.0	177.8	26.0	38.69	17.0	25.30	17.0	25.30	77%	0.01643	2.171
104759	7.0	177.8	32.0	47.62	26.0	38.69	23.0	34.23	80%	0.01822	2.408
81062	7.0	177.8	35.0	52.09	29.0	43.16	26.0	38.69	80%	0.01899	2.509
105854[13]	7.0	177.8	42.7	63.54	38.0	56.60	38.0	56.60	80%	0.02094	2.767
80986	7.63	193.7	33.7	50.15	26.0	38.69	24.0	35.72	71%	0.01512	1.998
82279	7.63	193.7	39.0	58.04	33.7	50.15	29.7	44.20	76%	0.01632	2.156
80987	8.63	219.1	32.0	47.62	24.0	35.72	24.0	35.72	80%	0.01744	2.304
80824	8.63	219.1	36.0	53.57	28.0	41.67	28.0	41.67	80%	0.01744	2.304
82118	9.63	244.5	36.0	53.57	32.3	48.07	32.3	48.07	73%	0.0153	2.021
82749	9.63	244.5	40.0	59.53	36.0	53.57	32.3	48.07	73%	0.01235	1.631
80825	9.63	244.5	43.5	64.74	40.0	59.53	36.0	53.57	74%	0.01561	2.062
82157	9.63	244.5	47.0	69.94	43.5	64.74	40.0	59.53	75%	0.01587	2.097
80988	9.63	244.5	53.5	79.62	53.5	79.62	47.0	69.94	76%	0.01628	2.151
82021	10.75	273.1	40.5	60.27	32.8	48.81	32.8	48.81	63%	0.01296	1.712
102335	10.75	273.1	45.5	67.71	40.5	60.27	35.8	53.28	63%	0.01331	1.759
81323	10.75	273.1	51.0	75.90	45.5	67.71	45.5	67.71	66%	0.01386	1.831
81085	10.75	273.1	60.7	90.33	55.5	82.59	55.5	82.59	68%	0.01429	1.888
104435	10.75	273.1	65.7	97.77	60.7	90.33	60.7	90.33	69%	0.01447	1.913
81955	11.75	298.5	47.0	69.94	42.0	62.50	42.0	62.50	55%	0.01141	1.507
80833	11.75	298.5	54.0	80.36	47.0	69.94	47.0	69.94	56%	0.01171	1.547
82070	11.75	298.5	60.0	89.29	54.0	80.36	54.0	80.36	58%	0.01198	1.583
83052	12.75	323.9	52.0	77.38	47.1	70.09	47.1	70.09	51%	0.01088	1.437
83002	12.75	323.9	58.4	86.91	50.0	74.41	50.0	74.41	51%	0.01098	1.450
82327	13.38	339.7	54.5	81.10	48.0	71.43	48.0	71.43	45%	0.00934	1.234
80828	13.38	339.7	61.0	90.78	61.0	90.78	54.5	81.10	47%	0.00977	1.291
81064	13.38	339.7	72.0	107.15	68.0	101.20	68.0	101.20	49%	0.01033	1.366
81504	15.0	381.0	92.5	137.66	92.5	137.66	92.5	137.66	45%	0.00949	1.254
80826	16.0	406.4	65.0	96.73	65.0	96.73	65.0	96.73	25%	0.00545	0.72
82440	16.0	406.4	75.0	111.61	75.0	111.61	75.0	111.61	27%	0.00593	0.783
100078	16.0	406.4	84.0	125.01	84.0	125.01	84.0	125.01	29%	0.0063	0.832

Summary of Selected Die Sizes[10] (continued)

Die P/N	Nominal Pipe Size		CRTi3-7.0 CRTi3-7.0HC350 CRTi3-7.0HF240 Max. Pipe Weight[11] (W_{casing})		CRTi3-7.0HC350 Min. Pipe Weight[12] (W_{casing})		CRTi3-7.0 CRTi3-7.0HF240 Min. Pipe Weight[12] (W_{casing})		Slip to Pipe Body Load Efficiency	Torque Factor (K_{torque})	
	(in.)	(mm)	(ppf)	(kg/m)	(ppf)	(kg/m)	(ppf)	(kg/m)	(% Fy)	(ft.lbs/psi/ ppf)	(N.m/MPa/ (kg/m))
100079	16.0	406.4	109.0	162.21	109.0	162.21	109.0	162.21	33%	0.00715	0.944
83003	16.77	426.0	77.0	114.59	77.0	114.59	73.3	109.08	24%	0.00568	0.75
80832[14]	18.63	473.1	87.5	130.21	87.5	130.21	87.5	130.21	22%	0.00489	0.646
81292[14]	18.63	473.1	97.7	145.39	97.7	145.39	97.7	145.39	25%	0.00659	0.87
82956[14]	18.63	473.1	106.0	157.75	106.0	157.75	106.0	157.75	26%	0.00683	0.902
81293[14]	18.63	473.1	111.0	165.19	111.0	165.19	111.0	165.19	27%	0.00669	0.884
101407[14]	18.63	473.1	115.0	171.14	115.0	171.14	115.0	171.14	25%	0.00567	0.749
81991[14]	20.0	508.0	94.0	139.89	94.0	139.89	94.0	139.89	27%	0.00591	0.780
81799[14]	20.0	508.0	111.0	165.19	111.0	165.19	111.0	165.19	27%	0.00603	0.796

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. CRTi3-7.0 and CRTi3-7.0HC350 base tool length does not include casing seal assembly. To find overall tool length see *Casing Seal Assembly and Overall Tool Length* table.
5. CRTi3-7.0HF240 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 in. 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. When rotating a casing/liner string during running/drilling operations, maximum rotational speeds are governed by top drive or casing connection specific limits.
9. Turns to Stoke Out is the rotational limit during tool makeup (this may be exceeded in combined load scenarios). The old style cams require 1.48 turns to stroke out and Low-Release Cams only require 0.72 turns to stroke out.
10. Common die sizes shown. All API casing sizes and weights with drift diameter above 5.87 in. (149.1 mm) are available.
11. 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.
12. 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.
13. Cage (P/N: 105853) must be run in conjunction with Keeper (P/N: 83001) and Integral Slips (P/N: 105854) to enable running 7.0 in. 38.0- 42.7ppf casing, with a reduced torque capacity of 35,000 ft.lbs. All other CRTi3-7.0 Integral Slips and Dies can be run with Cage (P/N: 105853) with a reduced torque capacity of 35,000 ft.lbs.
14. Hoist limited to 320 tons (290 tonne).