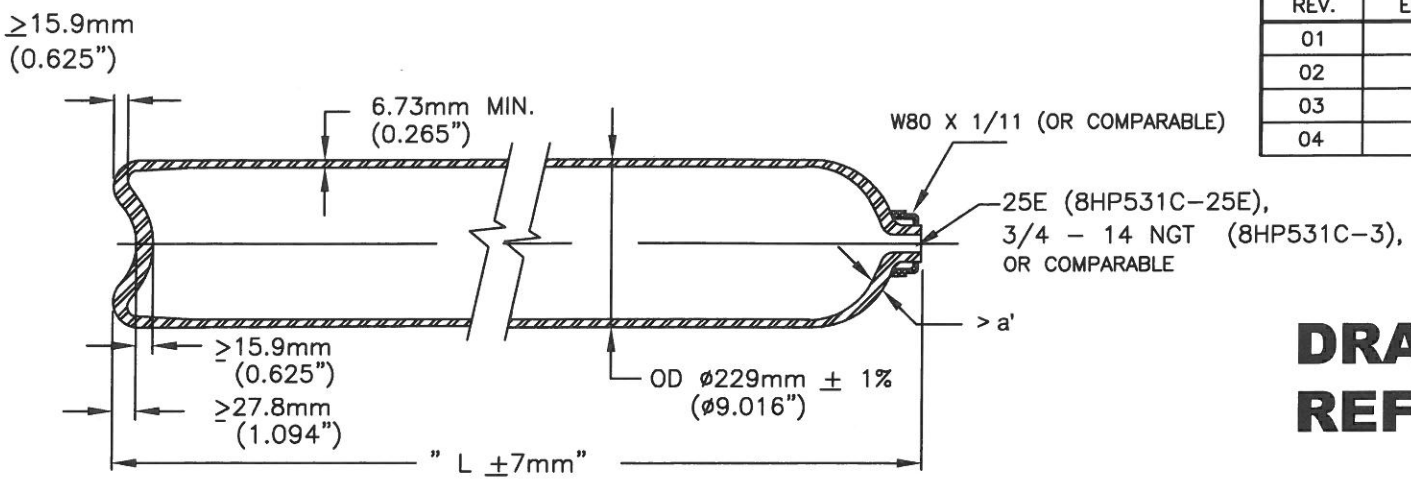
REV.	ECN – DESCRIP.	DATE	DRWN.	CHKD.	APP.
01	2807	11/14/08	JJM		
02	2808	11/18/08	JJM		
03	2934	1/29/10	JJM	SAM	
04	2988	11/9/10	JJM		



DRAWING FOR REFERENCE ONLY

SPECIFICATION: ISO 9809–2: 2000

1. Service Conditions:
- Working pressure: 310 bar (4496 psi)
- Hydraulic test pressure: 465 bar (6744 psi)

(1 bar = 14.5 psi)

2. Material:

Cr–Mo–steel complying with the requirements. of clause 6.2 of ISO 9809–2. Norris' specification EO–A6 for 4133M4 is currently a qualified steel.

3. Manufacture:

Hot billet extrusion followed by hot drawing

4. Heat Treatment: Quenched and Tempered

–Austenitize: ~899°C (1650°F)

–Quenchant: Water based polymer (temperature ≤ 60°C(140°F))

–Temper: >565°C (1050°F) (Min. 30 minutes at temp.)

5. Mechanical Properties: (at room temperature)
- Tensile (Rg): 1100 – 1220 MPa (159.6 – 177 ksi)
- Yield (Re): ≥ 935 MPa (135.6 ksi)
- Elong (A): ≥ 12% (ON 5.65 $\sqrt{S_o}$)

5. Mechanical Properties: (continued)
- Out–of–roundness, Straightness, and Verticality per ISO 9809–2 sections 8.5– <2%, 8.7– <3 mm/m, and 8.8– <10 mm/m.
- Hydraulic and volumetric expansion test per 11.2 of ISO 9809–2.
- Hardness test: Each end of every cylinder
  4133M4: HB315–370
- Flattening test: Flatten to 10 x t_m without cracks
- Charpy test (–50°C, Trans): ≥ 35 J/cm² (avg.)
  4133M4 Approved B for 5 – 7.5 mm: 53.6 J/cm²
- UT flaw detection: Each cyld. per ISO 9809–2
- Batch burst test: Pb ≥ 744 bar (10, 791 psi)

6(a). Thickness Calculations: (ISO 9809–2: 2000)

$$a = 0.5xD\left(1-\sqrt{\frac{(10FRe-\sqrt{3}\ Ph)}{(10FRe)}}\right)$$

Where:

Ph= Test Pressure (bar) = 465 bar (6744psi)

D = External diameter of container =ø231.3mm Max

F = Lesser of 0.65/(Re/Rg) or 0.77; Re/Rg ≤0.9

= Lesser of 0.65/0.85 or 0.77 = 0.765 (for Re/Rg = 0.85)

$$a = 0.5x231.3\left(1-\sqrt{\frac{(10x0.765x935-\sqrt{3}x465)}{(10x0.765x935)}}\right) = 6.71mm\ (0.264")$$

NOTE: a', the guaranteed min thickness = 6.73 mm (0.265") exceeds calculated min thickness, a.

MODEL	LENGTH 'L'		Min WATER CAPACITY		APPROX. WGT. W/O FITTINGS	
	MM	IN	LITERS	IN³	KG	LBS
8HP457C	1295	51	42.0	2563	63.5	140
8HP531C	1519	59.8	50.0	3051	73.5	162
*Vmin	698	27.5	20.2	1233	37.2	82
*Vmax	2121	83.5	72.1	4404	98.0	216

*Note: Model 8HP531 was the design qualification test cylinder. Vmin and Vmax represent the range covered by the same design family. (Vmin per standard, Vmax per Norris manufacturing constraints.) For maximum ovality, maximum verticality deviation, and maximum straightness deviation see Norris' document number 363.

NORRIS CYLINDER COMPANY
4818 WEST LOOP 281 LONGVIEW, TEXAS 75603 USA

REFILLABLE SEAMLESS STEEL CYLINDER FOR PERMANENT GASES EXCEPT EMBRITTLING GASES PER ISO 11114–1

SCALE	NOT TO SCALE		DRAWING NO.	REV.
DWN. BY	SAM	6/3/08	901A–A–9730	04
CHK'D BY	F.G.	6/3/08		
APP'D BY	SAM	6/3/08	SHEET NO. 1 OF 1 SHEETS	