Committee D-2 ON PETROLEUM PRODUCTS AND LUBRICANTS

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Reply to: Michael S. Griggs
The Lubrizol Corporation
29400 Lakeland Boulevard
Wickliffe, OH 44092-2298

May 20, 2000

To: Members of the Single Cylinder Oil Test Engine (SCOTE) Surveillance Panel and guest attending the April 13, 2000 meeting.

Enclosed are the minutes of the SCOTE Surveillance panel meeting held in San Antonio, Texas. Please forward any corrections or additions to my attention.

Michael S. Griggs
Secretary, SCOTE Surveillance Panel

MEETING MINUTES

SINGLE CYLINDER DIESEL SURVEILLANCE PANEL

HELD APRIL 13, 2000
PERKINELMER
SAN ANTONIO, TEXAS

ACTION ITEMS

Ensure that two 1Y4021 gaskets are used with the 1Y3661 oil pump as shown in attachment 4- Cat 1P/1Q labs

2. Ensure that adjustments to the EGR rate in the 1Q test are based on inlet CO_2 (1.55% spec)- 1Q EGR labs

3. Utilize the 10.5 gpm EGR coolant flow spec for the 1Q test- 1Q labs

4. Utilize the 65 liter/min EGR coolant flow spec for the 1Q test- 1Q labs

5. Write short procedure for flushing 1Q engine through holes drilled in side cover- Stacy Bond

6. Supply part numbers for filters/filter boss for Caterpillar's engine flushing rig- Al Hahn

7 Ensure that 1Y parts are used for the pre-matrix and discrimination matrix- 1Q labs

8. Ensure that any returned parts are accompanied with a letter of explanation for the reason they are being returned (as per warranty claim procedures specified in the procedures)- Test labs

9. E-mail Al Hahn with 1M-PC liner inventory and estimation of when supply will be depleted- 1M-PC labs

1.0 CALL TO ORDER AND MEMBERSHIP CHANGES

1.1 Chairman Stacy Bond opened the meeting at 8:30 am. The agenda is attachment 1.

1.2 'homas Hitchner replaced Bruce Hillyer for ExxonMobile.

2.0 MEETING MINUTES

2. The meeting minutes for the February 10, 2000 meeting were approved with the following correction: Add start/stop times to the report forms (Scott Parke).

2.2 The attendance list is attachment

Stacy Bond offered to provide the Secretary, Mike Griggs, with his notes from the panel's conference calls for inclusion in the minutes of this meeting. Al Hahn expressed his desire for all stand configuration data to be available in a single document. This information currently exists only in collected meeting minutes. Attachment 3 summarizes the minutes from the February 23rd and May 5th teleconferences.

Greg Hillman participated in this meeting via teleconference.

3.0 TEST DEVELOPER'S REPORT ON 1Q

3.1 Al Hahn clarified which numbers should be reported on form 3 of the test report to identify the ECM EPROM. Attachment 4 shows the current ECM EPROM part number and date code as well as where to enter this information on form 3.

3.2 Mike Griggs described a problem he had recently trying to "flash" (reprogram) his EPROM using Cat ET software. An early version of the software would not allow flashing. Numerous different versions of the ET software exists in the various labs. The current version of the ET software is ver 3.1. Mike Griggs plans to upgrade the ET software and attempt reflashing the EPROM. Following this meeting, he was unsuccessful with the upgraded software, however, he learned from David Redfield at Caterpillar that the most likely reason for a reflash failure was not having the correct communications cable. The problem was solved with a speedy deliver of a 154-8352 EPROM.

3.3 Al Hahn reemphasized the importance of using gaskets on the 1Y3661 oil pump bypass. He presented attachment 5 and pointed out that a gasket is required on each side of the lock nut. Also, the tip of the regulator adjusting screw needs to be 43.7 mm from the housing to give the right relief pressure with the Johnson valve. The gaskets serve to prevent oil aeration.

3.4 Al Hahn presented attachment 6 which is a review of the operational data reported by the various labs running 1Q shakedowns. To date, runs have been completed at PerkinElmer, Caterpillar, Ethyl and 2 at ExxonMobile.

4.0 1Q INSTALLATION/OPERATIONAL REQUIREMENTS

4. There was considerable discussion regarding observations on air, exhaust and EGR gas temperatures. Several labs commented that it takes 15-20 hours to reach stabilization. Tom Hitchner commented that it is necessary to continuously decrease exhaust back pressure until stabilization occurs.

4.2 Stacy Bond asked for clarification on which was the controlled parameter, inlet CO_2% or %EGR. Al Hahn replied that inlet CO_2% should be controlled and %EGR will float. Stacy Bond asked Al Hahn how often he expected inlet CO_2% to be measured. Currently, he is measuring it once per day. Al Hahn would like to see it measured every 2 hours until the test is further developed. Stacy Bond and several other panel members felt that every 2 hours was excessive and maybe even impractical because the engine needs up to an hour to stabilize after hooking up the exhaust analyzer to the engine. All labs concurred that the best way to control EGR flow was by changing the exhaust back pressure set point. The engine seems to stabilize in 30-40 minutes after an adjustment.

4.3 Several labs have been having problems with the Teel pump previously agreed to by the panel. PerkinElmer had a housing gasket leak, Ethyl burned up a motor and others have had seal leaks. Stacy Bond proposed specifying only a flow rate for the pump and allowing lab discretion for selecting the pump. Al Hahn commented that the panel needs to settle on a common pump. Bob Weissmann presented data on a 1/3 hp stainless steel pump he has tried successfully. After some discussions on EGR coolant flow rates and EGR temperature changes, the panel settled on a 10.5 gpm EGR coolant flow spec and the ½ hp version of the pump Ethyl is using (see attachment 7 for pump model 4320K33).

4.4 Some of the labs have had trouble controlling engine coolant flow due to the need to back out the flow adjuster an excessive amount. The panel agreed to lower the spec to 65 liters/min (see attachment 8).

4.5 Tom Hitchner reported that for the increased temperature of the 1Q, the exhaust barrel does not meet ASME pressure vessel code. He has had Gaspar (an original, approved supplier) modify the barrel to meet code. Mike Griggs, who is also having exhaust barrels modified, explained that Gaspar's calculation showed that the elevated 1Q exhaust temperature makes the barrel marginal. The code calls for a safety factor of 3 which limits the existing 1P barrel to 700° F at 40 psi. The modified barrel will be rated at 1150° F at 35 psi. He also presented attachment 9 which summarizes the modifications. Al Hahn agreed to allow such modifications as long as no internal dimensions of the barrel change (Secretary's note- the 5/5/2000 SCOTE teleconference subsequently allowed for the volume increase of the modified barrels).

4.6 The current 1P flushing procedure seems to be inadequate with the increased soot EGR creates. Stacy Bond has found that it helps to begin the flushing while the engine is still warm. He has also modified the engine side covers to allow insertion of the 1K flushing wand to facilitate cleaning the oil pan region. At Al Hahn's request, Stacy Bond agreed to put together a procedure for flushing through the side cover. Bob Weissman found that the flush cart in general use doesn't provide enough flow to the engine's flush nozzles when all valves are opened simultaneously. Even if the nozzles are charged sequentially, pressure to them is still marginal. He suspected that the problem might be in the plumbing used on the suction side of the pump. He noted that the engine oil pan has an opening in the back that is much larger than the actual drain opening so he has devised plumbing that will join this opening with the regular drain opening using a couple of valves and a tee (attachment 10). This configuration brought his flush nozzle pressure from 2 psi to 25 psi (even with all nozzles open). Most of the other labs claimed to have been using the rear oil pan opening for some time but that they might be interested in joining the front and rear openings like Bob described. Al Hahn asked if everyone was using the Cat spin-on filters on their flush cart. Stacy Bond said that his lab has been using a pancake filter arrangement (Raycor) because they couldn't get sufficient flow using the Cat filters. Al Hahn explained that Caterpillar uses 2 big engine filters which fit on a regular filter base. He also explained that frequent filter changes are need to prevent solvent contamination. Al Hahn agreed to provide the necessary part numbers for his flushing arrangement.

4.7 There was a brief discussion on the various methods used to fill the coolant system. The coolant system can be filled from the drain for labs that can supply coolant under pressure. Tom Hitchner commented that coolant can be added at the fill cap as long as the EGR coolant pump is running. He also noted that any air in the system seems to be eliminated within the first 30 hours of the test.

Stacy Bond showed panel members one of his 1Q installations. The was quite a bit of discussion regarding the locations of CO_2 tap, thermocouples and pressure taps. Mike Griggs pointed out that the bolt pattern on the EGR heat exchanger flanges prohibits installation as shown in any of the drawings provided to date. The pattern is such that the flanges can only be rotated 180°, not 90° as would be required to match the drawings. This will actually turn out to be a good thing since the two inward (barrel) facing taps were proving devilishly difficult to access as shown in the drawings. All labs must install pressure taps, thermocouples and CO_2 taps as shown in attachment 11.

5.0 PHILLIPS RD9 FUEL

5.1 Brian Lawrence asked about use of RD9 fuel for the Cat tests. The panel reiterated that it is planned for use in the 1Q test. Al Hahn commented that RD9 is definitely required for the precision matrix and highly desirable for the discrimination matrix.

5.2 There was considerable discussion regarding how labs would changeover to RD9. The major issue is that most lab fuel storage capabilities generally preclude having adequate supplies of both LSRD-4 and RD9. Brian Lawrence informed the panel that a task force has been set up with Jeff Clark as chairman to define the rules for introducing RD9. He encouraged interested parties to ensure that they had representation on this task force.

6.0 1Q DEMONSTRATION MATRIX DESIGN

6.1 Al Hahn showed the results obtained to date on two runs; one on 1005 and one on "oil A" (attachment 12). He commented that the results were similar and that he would have liked to see more separation. Brian Lawrence expressed concern that development was being done on what other surveillance panels have labeled as a poor oil. He asked if Cat considers 1005's performance poor or marginal or if Cat has given consideration to other panels' opinion of 1005. Al Hahn seems to feel that 1005 is a middle-of-the-road type of performer.

Discussion turned to the requirements for a demonstration matrix. All labs plan to complete at least one run on oil 1005-1 for stand development. This should result in 6 runs on 1005-1. Phil Scinto added that CMA expects any lab wishing to participate in the precision matrix to also take part in the demonstration matrix. The question then turned to what oil might be used to show discrimination. Several options were discussed including Cat's "oil A". Phil Scinto mentioned that EMA might have an oil in mind that they'd like to see used. The panel agreed to wait to see what developed from EMA and if no candidate was presented, the panel

will request that a "down-treated" blend of 1005-1 be made for use as the discrimination oil.

7.0 IR O_2 MEASUREMENT

7.1 Ben Weber recommended that the panel specify the "peak area" method for IR O_2 as opposed to "peak value" since "peak area" is a more precise method.

Stacy Bond suggested that labs could do a round robin study on the proposed IR O_2 method. This should be coordinated by the appropriate lab representatives.

8.0 1Q CMA TEMPLATE

Phil Scinto reviewed the CMA template (attachment 13) for the 1Q without much discussion apart from his emphasis on item D.5.3- "Is each pass/fail parameter unique and have a significant purpose for judging engine oil performance?". He emphasized that single parameter fails become more of a problem on an oil that generally exhibits pass characteristics.

9.0 1Q TIMELINE

9.1 Stacy Bond reviewed the 1Q timeline and made changes (attachment 14). The earliest completion date for the demonstration matrix is now July 1, 2000.

Phil Scinto commented that 1005-1 is highly suggested as the first oil to run. Al Hahn expressed his desire that 1005-1 be run once in every lab.

10.0 1P STANDARD

Ben Weber presented the 1P Standard draft to the panel for its approval. He also showed the panel a list of concerns from Lyle Bowman (attachment 15). The panel did not find these objectionable and voted unanimously to go forward with the 1P Standard.

11.0 NEW 1M-PC LINER

At current usage rates, Al Hahn expects the new source 1M-PC liners to come online around June 1, 2000. The part number will be 1Y3995.

Al Hahn requested that labs e-mail him with their 1M-PC liner inventory and when the inventory is expected to be depleted.

12.0 DEFECTIVE PARTS RETURN

Al Hahn asked that all returned parts be accompanied with a reason for their return (as per the warranty claim procedures listed in the test procedure). Parts have been coming to Cat from Holt recently with no explanation.

RATING WORKSHOP UPDATE

13.1 Scott Parke briefed the panel on the latest developments from the recent rating workshop. Most importantly, CRC intends to eliminate the spring rating workshop. Ultimately, CRC would like to combine all workshops into two yearly workshops; one for distress rating and one for deposit rating.

13.2 CRC desires to move away from test specific rating and will no longer be responsible for test specific details. Rater certification must come from ASTM and not CRC since CRC only provides the measuring instrument.

NEXT MEETING/TELECONFERENCE

A teleconference was held 5/5/00. The next teleconference is scheduled for the week June 12, 2000. The next meeting is scheduled for July 12, 2000. On July 11, 2000 the 1Q lab visitation team will review test stand installations at the San Antonio labs.

MISCELLANEOUS

Brian Lawrence took the opportunity to bid the panel a fond farewell. His replacement will be Mark Stevens and/or Pat Fetterman.

FROM: Stacy Bond
Surveillance Panel Chairman

PLACE: PerkinElmer
5404 Bandera Road
San Antonio, TX 78238
DATE: April 13, 2000
TIME: 8:30 pm to 5:00 pm

I. Approve minutes from Jan 12, 2000 meeting

II. Membership Changes

III. 1K/1N/1P/1MPC Actions
- a. 1M-PC Liner Change
- b. Approve 1P Standard (12:30)
- c. Update from Rating Workshop – Scott Parke

IV. 1Q DEVELOPMENT
- a. Test Developer's Report
- b. 1Q Installation Requirements
- d. 1Q Operational Requirements
- e. Fuel Specification
- f. Demonstration Matrix Design
  Be prepared to recommend oils for the demonstration matrix and volunteer resources for the demonstration matrix
- f. 1Q Template
- e. Update timeline

V. REVIEW ACTION ITEMS

VI. SET NEXT MEETING

Please forward any additional agenda items to me.

SCOTE SURVEILLANCE PANEL
Attendance Roster

*** Please indicate any corrections that should be made to members name, address, etc ***

Member	Status	Indicate Presence with Signature	Alternate
Name: Bond, Stacy Company: PerkinElmer Address: 5404 Bandera Road San Antonio, TX 78238 Phone: 210-523-4604 Fax: 210-523-4607	✓	Stacy Bond	
Name: Carlson, Jon Company: Lubrizol Corporation Address: 4801 N.W. Loop 410, Ste. 430 San Antonio, TX 78229 Phone: 210-520-8013 Fax: 210-520-1983			
Name: Clark, Gil Company: Specified Fuels & Chemicals (Howell) Address: 7 W. Square Lake Road, Ste 106 Bloomfield Hills, MI 48302 Phone: 248-452-5659 Fax: 248-333-7999			
Name: Cooper, Mark Company: Oronite Technology Group Address: Chevron Chemical Company 4502 Centerview Ste. 210 San Antonio, TX 78228 Phone: 210-731-5606 Fax: 210-731-5699	✓	Mark	
Name: Foerster, Ed Company: EG&G Automotive Research Address: 5404 Bandera Road San Antonio, TX 78238 Phone: 210-523-4607 Fax: 210-694-0892			
Name: Griggs, Mike Company: The Lubrizol Corporation Address: 29400 Lakeland Blvd. Wickliffe, OH 44092 Phone: 440-943-1200 Ext. 2905 Fax: 440-943-9013	✓	Mike Griggs	
Name: Gutzwiller, Jim Company: Exxon Chemical Co./Paramins Address: 4335 Piedras Dr., W. Suite 101 San Antonio, TX 78228 Phone: 210-732-8123 EXT 13 Fax: 210-732-8480	✓	Al Hahn	
Name: Hahn, Al Company: Caterpillar, Inc./Tech Center Address: Bldg. L/P.O. 1875 Peoria, IL 61656-1875 Phone: 309-578-3617 Fax: 309-578-4232	✓	Jim Gutzwiller	

SCOTE SURVEILLANCE PANEL
Attendance Roster

*** Please indicate any corrections that should be made to members name, address, etc ***

Member	Status	Indicate Presence with Signature	Alternate
Name: Hillman, Gregory E. Company: AutoResearch Lab Inc. Address: 6735 S. Old Harlem Ave. Chicago, IL 60638 Phone: (708) 963-4262 Fax: (708) 563-0087		By Telecon	
Name: Hillyer, Bruce Company: Mobil Technology Co. Address: 600 Billingsport Road Paulsboro, NJ 08066 Phone: 609-224-2414 Fax: 609-224-3628		REPLACE AS MEMBER →	TOM HITCHCOCK EXXONMOBIL R&E 600 BILLINGSPORT RD PAULSBORO, NJ 08066 PHONE 856-224-3012 FAX 856-224-3628
Name: Lewis, John Company: Shell Research Limited Address: P.O. Box 1 Poole Lane INCE (Nr. Chester) Chester CH1 3 SH United Kingdom Phone: Fax: 011-44-151-373-5888			
Name: Knight, John Company: Test Engineering, Inc. Address: 12718 Cimarron Path San Antonio, TX 78249-3417 Phone: 210-690-1958 Fax: 210-690-1959			
Name: Lawrence, Brian Company: Infineum Address: 4335 West Piedras Dr., Suite 101 San Antonio, TX 78228 Phone: (210) 732-8123 Fax: (210) 732-8480			
Name: Nycz, David S. Company: Caterpillar, Inc. Address: Box 610 Mossville, IL 61552-0610 Phone: 309-578-3003 Fax: 309-578-6457			
Name: Parke, Scott Company: ASTM/TMC Address: 6555 Penn Avenue Pittsbugh, PA 15206-4489 Phone: 412-365-1036 Fax: 412-365-1047		Scott R. Parke	
Name: Schaus, Jerry Company: AutoResearch Laboratories, Inc. Address: 6735 S. Old Harlem Avenue Chicago, IL 60638 Phone: 708-563-4263 Fax: 708-563-0087			

SCOTE SURVEILLANCE PANEL
Attendance Roster

*** Please indicate any corrections that should be made to members name, address, etc ***

Member		Status	Indicate Presence with Signature	Alternate
Name:	Steinke, Richard E.			
Company	R.E. Steinke Association			
Address:	P.O. Box 2103			
	Sausalito, CA 94966			
Phone:	415-331-2930			
Fax:	415-332-7757			
	Stephen, Carl			
	Ashland, Inc.			
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	Ashland, KY 41101			
Phone:	606-329-5198			
Fax:	606-329-3009			
Name:	Sutherland, Mark			
Company:	Ethyl Petroleum Additives, Inc			
Address:	9901 IH 10 West Suite 800			
	San Antonio, TX 78230			
Phone:	210-558-2818			
Fax:	210-694-0892			
	Strigner, Paul			
	31 Sequin Street			
	Ottawa, Ontario K1J6P2			
	CANADA			
Phone:				
Fax:	MAIL			
Name:	Stockwell, Robert			
Company:	Southwest Research Institute			
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Fax:	210-523-6919			
	Weissman, Bob			
	Ethyl Petroleum Additives, Inc.			
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	P.O. Box 2158			
	Richmond, VA 23219			
Phone:	804-788-5340			
Fax:	804-788-6358			

SCOTE SURVEILLANCE PANEL
Attendance Roster

(Visitors Page)

Member	Status	Indicate Presence with Signature	Alternate
Name: Philip R. Scinto Company: Lubrizol Address: 29400 Lakeland Blvd. Phone: 440-943-1200 x2161 Fax: 440-943-9053 PRS@LUBRIZOL.com	✓	Philip R Scinto	
Name: DALLAS RODGERS Company: THE LUBRIZOL CORP. Address: 29400 LAKELAND BLVD. WICKLIFFE, OH 44092 Phone: (440) 943-1200 X1836 Fax:	V	Dallas H. Rodgers	
Name: Chapman James Company: Perkin Elmer Address: 5404 Barbara Rd. Phone: (310) 523-4649 Fax:			
Name: JIM GUTZWILLER Company: INFINEUM Address: 4335 PIEDRAS WEST SUITE 101 SAN ANTONIO, TX. 78228 Phone: (210) ~~224~~ 732-8123 EXT. 13 Fax: 210 732-8480	V	Jim Gutzwiller	
Name: PAT FETTERMAN Company: INFINEUM USA L.P. Address: P.O. BOX 735 LINDEN, NJ 07036 Phone: (908) 474-3099 Fax: (908) 474-3363	V		
Name: Company: Address: Phone: Fax:			
Name: Company: Address: Phone: Fax:			
Name: Company: Address: Phone: Fax:			

Att 3, pg 1/3

Griggs, Michael
From: Bond, Stacy [Stacy_Bond%AR.EGGINC.COM@interlockp.lubrizol.com]
Sent: Friday, May 05, 2000 5:44 PM
To: Al Hahn (E-mail); Cooper (E-mail); Mark Sutherland (E-mail); Mike Griggs (E-mail); Parke (E-mail); Stockwell (E-mail); Stephens (E-mail); Thomas Hitchner (E-mail); Bob Weissmann (E-mail); Greg Hillman (E-mail); JWG Jim Gutzwiller
Cc: Shoffner, Brent
Subject: 1Q Test Development - Teleconference Notes From 5/5/2000

Installation

EGR Coolant Pump
The Teel pump from Grainger has a history of leakage and over-temp shutdown. The unit from McMaster- Carr part number 4320K33 has been performing well.

Coolant Seal
PerkinElmer had a coolant seal fail. This seal is located between the head and jug. A part number 3H0107 was used. The updated part is 112-3132.

Exhaust Barrel
Exxon-Mobil, Ethyl, and Lubrizol are updating their exhaust barrels to increase the safety factor. The volume of the barrel will be increased. It was agreed to establish a tolerance on the barrel height to allow this modification.

1Q/1P/1R Interchangeability
We need to discuss interchangeability between these tests at the next meeting

Oil Heating System
All labs should be using the oil heating system that was used on the 1P. The heating oil may require tempering with a small heat exchanger to get good control

Operational

EGR Heat Exchanger Orifice
PerkinElmer has installed a .50" ID orifice at the heat exchanger outlet to increase the pressure drop. A nominal exhaust backpressure of 302 kPa is required to obtain a 1.55% CO2 in the intake. This modification results is better control, improved resolution and less stand to stand interaction. Labs may install a 2.125 OD by .50 ID orifice until a permanent orifice is fabricated. PerkinElmer will design and fabricate a permanent orifice with CAT's approval.

Ramps
Labs should ramp the EBP and IAP during the first three minutes of stage 5 and ramp the load during the first 5 minutes of stage 5. We need to determine the IAT ramps at our next meeting.

I have attached some operational data from a1Q EGR stand with a .50 inch orifice.
<<SAMPLE.xls>>

Next Meeting
We will schedule another teleconference for the week of May 22. We will discuss operational issues, installation issues and begin a procedure review.


SAMPLE.xls

Griggs, Michael
From: Bond, Stacy [Stacy_Bond%AR.EGGINC.COM@interlockp.lubrizol.com]
Sent: Wednesday, February 23, 2000 5:18 PM
To: Al Hahn (E-mail); Scotte Parke (E-mail); Robert Stockwell (E-mail); Mike Griggs (E-mail); Thomas Hitchner (E-mail); Bob Weissmann (E-mail); Greg Hillman (E-mail)
Subject: Meeting Minutes

Minutes from 2/23 conference call

Inlet Air System

Adopted Mike Grigg's specification for the inlet air piping. There should be 3 each ¼ taps upstream of flowmeter.

Air flowmeter will be required at the beginning of each matrix and reference test. Full time use is not required.

Alignment and positioning of barrels may be changed to get proper alignment. The o-ring should be positioned midway in the bore.

The correct O-ring is 5P8211

A straight emissions probe will be installed in the forward facing 3/8 inch tap of the inlet air elbow. The probe is similar to the one used in the 1K/1N procedure except there is no bend.

Exhaust System

An emissions probe (identical to the 1K/1N) will be inserted into the bottom tap of the exhaust flange.

Thermocouple will be inserted in the rear tap of the exhaust flange.

Install a boss on top of the exhaust tee to accomodate the T10 oxygen sensor. (This should not delay stand installation). Mike Griggs will gather some info on the boss required.

Follow the gas in/gas out orientation on the heat exchanger.

Coolant System

Agreed to specify general requirements

Use a ¾ inch hose with an approximate 5/8 inch ID. Areoquip FC350-12 is an option

Position pump to minimize hose lenght. Pump should be positioned under the barrels

Use a 90 degree fitting arrangement at the coolant pump. Tap is #8 SAE o-ring. Aeroquip does not list a 90 deg elbow. You may use a straight fitting and a hose with an elbow end.

5% accuracy on coolant flow meter

Use a ½ inch globe valve in bypass to adjust coolant flow

As an option, you may fit a compression fitting on the heat exchanger.

Coolant in/coolant out markings on heat exchanger are incorrect.

Operational

EBP and IAP control must be re-tuned
CAT is currently running:
60 C Pre-EGR inlet air temp
74 C post EGR inlet into engine
195 C EGR temp out of cooler
It is unlikely that inlet air heaters will be required.

<<Intake CO2 Probe-side.jpg>> <<Intake CO2 Probe.jpg>> <<Exhaust Tee - side.jpg>> <<Intake Pipe Drawing>> <<LZ Intake Pipe 2>> <<LZ Intake Pipe 3>> <<LZ Intake piping 1>> <<1Q Photos.ppt>>


Intake CO2 Probe-side.jpg


Intake CO2 Probe.jpg


Exhaust Tee - side.jpg


Intake Pipe Drawing


LZ Intake Pipe 2


LZ Intake Pipe 3


LZ Intake piping


1Q Photos.ppt

Att 4 pg 1/2

ECM EPROM

Q ECM EPROM From ET Computer Screen

Part No 04 8352

Date Code Jan 00

1Q - EGR SCOTE TEST PROCEDURE

Att 4, pg 2/2

FORM 3

ASSEMBLY MEASUREMENTS AND PARTS RECORD

LAB: *LAB*	EOT DATE: *DTCOMP*	END TIME: *EOTTIME*	METHOD: *METHOD*
STAND: *STAND*	RUN NUMBER: *ENRUN*		
FORMULATION/STAND CODE: *FORM*			
OILCODE: *OILCODE/CMIR*			

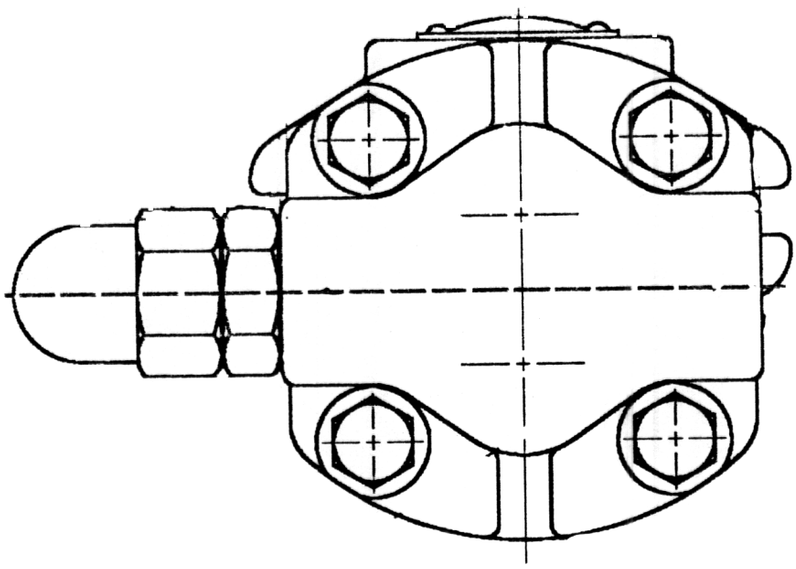
ASSEMBLY MEASUREMENTS AND PARTS RECORD	
INJECTOR SETTING (GO / NO-GO)	*INJSET*
WAS TIMING INITIALIZED? (YES/NO)	*TINIT*
PISTON/HEAD CLEARANCE mm	*PISTONCL*
CAM GEAR BACKLASH mm	*CAMLASH*
DESIRED FUEL TIMING °BTC	*FUELTIM*
INTAKE VALVE OPEN °ATC	*INVALOPN*
INJECTOR PLUNGER LIFT mm @ 72°	*PLUNLIFT*
INTAKE VALVE LIFT mm @ 456°	*INLIFT*
EXHAUST VALVE LIFT mm @ 247°	*EXLIFT*

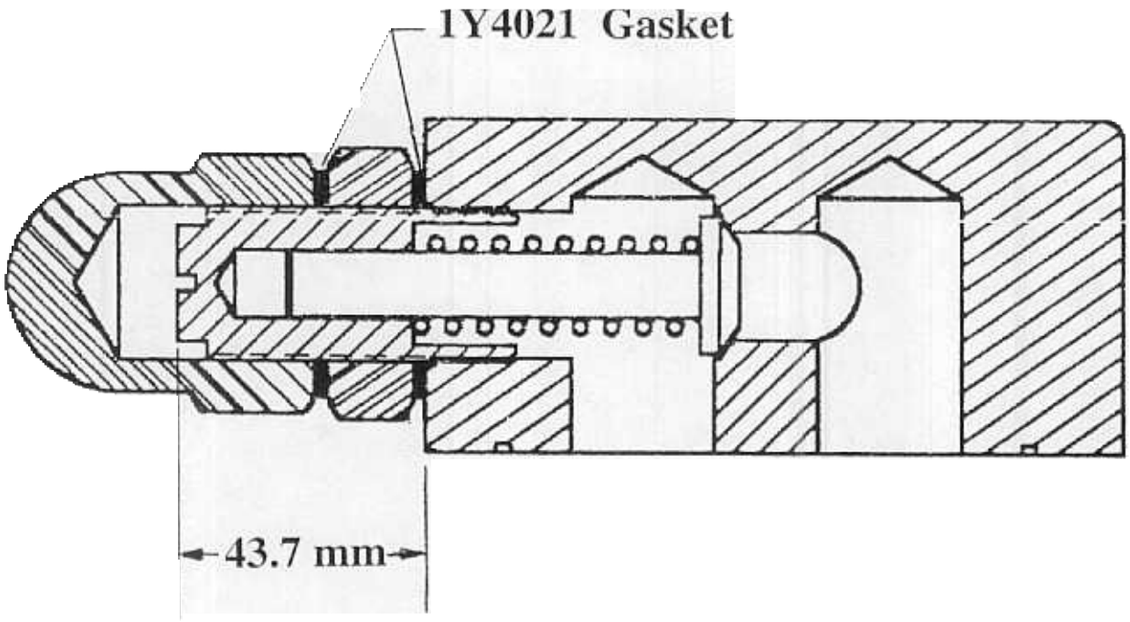
	PART NUMBER		SERIAL NUMBER		DATE CODE		INSPECTION CODE	
LINER	*LINERPN*	A	*LINERSN*	A	*LINERDC*	B		
TOP RING	*TOPPN*	C	*TOPSN*	E				
INTERMEDIATE RING	*INTPN*	C	*INTSN*	E				
OIL RING	*OILPN*	C	*OILSN*	E				
PISTON CROWN	*CROWNPN*	D	*CROWNSN*	D	*CROWNDC*	F	*CROWNIC*	G
PISTON SKIRT	*SKIRTPN*	H	*SKIRTSN*	I				
FUEL INJECTOR	*NOZZLEPN*	J	*NOZZLESN*	K				
ECM EPROM	*ECMPN*				*ECMDC*			
PISTON COOLING JET	*PTUBEPN*		*PTUBESN*					

A On liner O.D.
B On liner O.D. (NNAN)
C On box label
D On top of piston
E On paper envelope containing the ring
F Number below "E" located on piston top
G Number above "E" located on piston top
H On bottom surface of skirt rim
I On bottom surface under pin bore
J On top surface of plunger
K On top surface of plunger -6 digits

A S pg 1/1

1Y3661 SCOTE Oil Pump





1Q SCOTE DATA - INITIAL TESTING

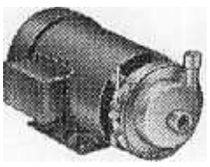
Parameter	PerkinElmer	ExxonMobil	ExxonMobil	Ethyl	CAT
Speed	1800	1800	1800	1800	1800
Torque	367	355	354.2	345	351
Power	69	66.9	66.7	65	66
Fuel Rate	240	240.3	239.9	240	240
Temps					
Fuel	42	42	42	42	42
Coolant In	101	96	96	100	100
Coolant out	105	104.8	105	105	104
Oil to cooler	122.5	121	121.5	123	121
Oil manifold	120	119.9	120.9	120	120
Oil from Ext Heater	98			88	97
Air to Orifice	60	59.6	59.1	60	60
Inlet air manifold	67	72.8	72	73.9	73
Exhaust manifold	611	622.4	618.6	624	610
EGR HX Exhaust in	493	535	531.4	515	499
EGR HX Exhaust out	136	170	167	167	180
EGR HX coolant in	101	100	99.8	100	98
EGR HX coolant out	99.7	103.8	103.6	102	101
Pressures					
Fuel	275	274	273	274	276
Coolant	65	70.4	71.7	78	70
Oil	415	416.5	412.4	415	415
Air to Orifice	na				296
Inlet Air barrel	292	292	292	292	292
Exhaust barrel	294	295	294.5	294.5	295
Crankcase	0.13	0.055	0.061	0.45	0.2
EGR Flow	14.4		15.4	10 Liquid	
Coolant	66.8	66.3	66.5	70	67
Blowby	25.6		16.7	33.4	28
Air to Orifice	na			345	325
EGR HX Coolant flow	15 in h20 across Barco		9.2 gpm with turbine flow meter		
Inlet CO2%	1.47	55	1.54	1.58	1.53
Exhaust CO2%	10.2		10.02	10.6	10.4

Att 7, pg 1/1

Transfer Pumps

For information about centrifugal transfer pumps, see page 176.

Type 316 Stainless Steel Centrifugal Pumps

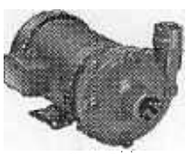


Extremely resistant to corrosion, these close-coupled pumps are built to handle water as well as many acids, caustics, and chemicals. Impeller is Type 316 stainless steel. Motor is totally enclosed fan cooled and generates 3450 rpm. Maximum temperature is 300° F. Materials in contact with solution are Type 316 stainless steel and Viton.

	Pump Performance								Connections, NPT female			
	gpm @ head, ft.			Shutoff,	VAC		Full Load					
hp	10	20	30	ft.	@ 60 Hz	ph.	Amps	Intake	Discharge		Each
1/3	28	22	14	40	115/230	1	6.4/3.2	3/4"	1/2"	4320K32	~~$419.64~~
1/2	30	27	20	46	115/230	1	7.2/3.6	3/4"	1/2"	~~4320K33~~	~~430.69~~
3/4	35	29	25	56	115/230	1	10/5	3/4"	1/2"	4320K34	452.78
3/4	48	45	40	55	115/230	1	10/5	1 1/4"	3/4"	4320K35	599.81
1	91	85	64	58	115/230	1	12/6	1 1/2"	1 1/4"	4320K36	653.59
1 1/2	120	108	90	70	230/460	3	8.4/4.2	1 1/2"	1 1/4"	4320K37	710.97
	30	40	50								
1	38	34	30	46	230/460	3	6.4/3.2	1 1/2"	1 1/4"	4320K61	599.81
1 1/2	46	43	38	66	230/460	3	8.4/4.2	1 1/2"	1 1/4"	4320K62	661.74
2	56	54	50	58	230/460	3	11.2/5.6	2"	1 1/2"	4320K63	743.78
	50	60	70								
2	70	88	38	78	230/460	3	5.6/2.8	2"	1 1/2"	4320K38	798.47
	60	70	80								
3	150	105	60	92	230/460	3	8/4	2"	1 1/2"	4320K39	896.91
3	68	63	56	86	230/460	3	8/4	2"	1 1/2"	4320K64	836.76

Cast Type 316 Stainless Steel Centrifugal Pumps

1/3- to 1 1/2-hp



2- to 3-hp

Investment cast Type 316 stainless steel provides the ultimate in durability and corrosion resistance. Pumps are unaffected by acids, caustics, and chemicals. In addition, because they are cast, the housing has thicker, stronger walls. Discharge can be oriented to four different positions. Impeller is made of Type 316 stainless steel. Motor is totally enclosed fan cooled, generates 3450 rpm, and is close coupled to the pump. Maximum temperature is 212° F. Materials in contact with solution are Type 316 stainless steel, carbon/ceramic, and Viton.

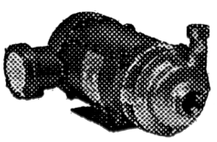
	Pump Performance									Connections, NPT female			
	gpm @ head, ft.					Shutoff,	VAC		Full Load				
hp	10	20	30	50	70	ft.	@ 60 Hz	ph.	Amps	Intake	Discharge		Each
1/3	29	24	17	—	—	45	115/230	1	5.6/2.8	3/4"	1/2"	8124K11	$407.67
1/2	42	35	25	—	—	45	115/230	1	6.2/3.1	1"	3/4"	8124K13	457.89
3/4	47	40	31	—	—	48	115/230	1	8.8/4.4	1"	3/4"	8124K17	480.40
1	68	60	47	—	—	49	115/230	1	11.6/5.8	1 1/4"	1"	8124K21	511.79
1 1/2	72	63	53	6	—	53	115/230	1	16.2/8.1	1 1/4"	1"	8124K23	523.51
1 1/2	72	63	53	6	—	53	230/460	3	4.8/2.4	1 1/4"	1"	8124K25	589.49
2	94	90	85	71	54	110	115/230	1	20.8/10.4	1 1/2"	1 1/4"	8124K51	757.85
2	94	90	85	71	54	110	230/460	3	5.4/2.7	1 1/2"	1 1/4"	8124K53	793.79
3	108	106	103	92	88	131	230	1	15	1 1/2"	1 1/4"	8124K55	834.35
3	108	106	103	92	88	131	230/460	3	7.8/3.9	1 1/2"	1 1/4"	8124K57	870.25

Type 316 Stainless Steel Multistage High-Head Centrifugal Pumps

Not only are these pumps highly corrosion resistant, their multistage design boosts pressure to pump liquids to high heads at medium flows. They have a maintenance-free, bellows-style shaft seal made of Viton and silicon carbide. Motor is totally enclosed fan cooled; operates at 115/230 VAC, 60 Hz, 1 ph.; and generates 3450 rpm. Maximum temperature is 230° F. Materials in contact with solution are Type 316 stainless steel, carbon, ceramic, and Viton. UL listed and CSA certified.

	Pump Performance						Connections, NPT female		
	gpm @ head, ft.				Shutoff,	Full Load			
hp	25	50	100	150	ft.	Amps	Intake	Discharge	Each
1/2	24	19	11	—	135	7/3.6	1"	1"	8134K13 $705.49
1/2	38	30	—	—	88	9/4.5	1 1/4"	1 1/4"	8134K16 693.15
3/4	26	22	18	8	180	9.4/4.7	1"	1"	8134K14 780.45
3/4	45	37	24	—	135	11.5/5.7	1 1/4"	1 1/4"	8134K17 826.81
3/4	50	45	—	—	89	10.6/5.3	1 1/2"	1 1/2"	8134K21 965.91
1	30	26	20	16	265	13/5.5	1"	1"	8134K15 856.96
1	48	40	32	19	185	15/7.5	1 1/4"	1 1/4"	8134K18 839.18
1	60	55	—	—	100	14.6/7.3	1 1/2"	1 1/2"	8134K22 984.45
1 1/2	50	42	35	27	227	19.3/9.7	1 1/4"	1 1/4"	8134K19 914.55
1 1/2	75	55	43	20	172	21.5/10.7	1 1/2"	1 1/2"	8134K23 1220.91

Hazardous-Location Type 316 Stainless Steel Centrifugal Pumps



Designed for pumping chemicals and corrosives in hazardous locations, these Type 316 stainless steel pumps have a motor that's UL listed and CSA certified for use in Class I, Groups C & D and Class II, Groups F & G locations. They have a mechanical seal made of carbon and Viton elastomers. Motor generates 3450 rpm. Maximum temperature is 250° F (or, if lower, the boiling point of the liquid being pumped). Materials in contact with solution are Type 316 stainless steel, carbon, and Viton.

	Pump Performance						Full Load	Connections, NPT female			
	gpm @ head, ft.			Shutoff,	VAC						
hp	20	40	60	ft.	@ 60 Hz	ph.	Amps	Intake	Discharge		Each
1/2	22	13	1	62	115/208-230	1	7.2/4-3.6	3/4"	1/2"	8205K11	$822.43
3/4	30	21	10	76	115/208-230	1	10/6-5	3/4"	1/2"	8205K13	895.33
1	78	48	10	64	115/208-230	1	12/7-6	1 1/2"	1"	8205K17	934.58
1 1/2	108	90	60	81	208-230/460	3	4.4-4/2	1 1/2"	1"	8205K31	1097.20
2	110	100	50	76	208-230/460	3	6.2-5.6/2.8	2"	1 1/2"	8205K37	1119.63
3	140	120	50	76	208-230/460	3	7.9-7.2/3.6	2"	1 1/2"	8205K39	1278.50

Att 8, pg 1/1

1Q/ EGR SCOTE Warm- Up And Operating Conditions

PARAMETER	UNITS	TOL	STEP 1 5 Min	STEP 2 5 Min	STEP 3 5 Min	STEP 4 10 Min	STEP 5 60 Min
Speed	RPM	+/- 3	1000	1000	1400	1800	1800
Power	kW		Idle	10	28	51	67
Torque	Nm	(a) +/- 5	-	100	175	270	355
Fuel Rate	g/ min	(b) +/- 1	-	45	95	192	240
B.S.F.C.	g/ kW-hr		-	-	220	220	215
Fuel Timing	BTC		13	13	13	13	13
Fuel Rack Pos.	mm		2.6	3.8	6	8.6	10.3
Humidity	g/kg	+/- 1.7		-	-	-	17.8
TEMPERATURES	DEG C						
Fuel Into Head		+/- 3	~31	~32	~33	~36	42
Coolant Into Jug				~55	101	101	101
Coolant From Head		+/- 3		57	105	105	105
Oil To Cooler				-	93	102	124
Oil Manifold		+/- 3		-	92	101	120
Oil Fr Extern. Heater				-	97	104	~110
Air To Orifice		+/- 3		55	60	60	60
Inlet Air Manifold		+/- 3		40	45	68	72
Exhaust Manifold			~120	300	430	590	615
EGR H/E - Exh To				48	249	390	510
- Exh From		+/- 10		45	80	135	180
- Coolant In				57	98	99	100
- Coolant Out				57	101	102	103
PRESSURES	kPa						
Fuel From Head		+/- 20	275	275	275	275	275
Coolant Into Jug		(c)	~44	~44	90	100	70
Oil Manifold		+/- 20	415	415	415	415	415
Air To Orifice (abs)				120	155	250	295
Inlet Air Barrel (abs)		+/- 1	120	120	155	250	292
Exhaust Barrel (abs)		+/- 3	120	~~100~~ 120	~~145~~ 155	250	295
EGR H/E - Exh From (abs)							289
- Water Out						150	100
Oil Filter Delta Pressure					30	36	44
Crankcase							~.2
FLOWS							
% EGR Flow							
Coolant	L/ min	+/- 3	~40	40	~55	65	65
Blowby	L/ min					~30	~30
Air	kg/ hr				165	230	325
EGR H/E Coolant Flow	GPM				10.1	10.7	~~10.7~~ 10.5
Oil Scale Cart Reading	Grams						
EMISSONS							
CO2 % Inlet Manif	%	+/- .05		-	-	-	1.55
CO2 % Exh Stack							

Note:
(a) Engine controlled to Torque Spec for Steps #2, #3, #4 and 5 minutes of Step #5
(b) Engine controlled to Fuel Rate for last 55 minutes of Step #5
(c) Air Pressure at coolant tower controlled to 35 kPa

Ramp Up Conditions Between Warm- Up Steps

Torque	At 5 minutes (beginning at step #2)	20 Nm/ min
Speed	At 10 minutes (beginning at step #3)	100 rpm/ min
Inlet Air Press	At 10 minutes (beginning at step #3)	12 kPa/ min
Exhaust Press	At 10 minutes (beginning at step #3)	12 kPa/ min
Inlet Air Temp	At 0 minutes (at start of test)	5 deg C/ min

Cat 1Q Exhaust Barrel Modification

- Lubrizol and Exxon/Mobile have contracted with Gaspar, Inc. to modify the Cat 1P exhaust barrel to be ASME Section VIII, Division 1 rated for 35 psig @ 1150°F.

- Gaspar has confirmed that there will not be a change in the internal volume of the barrel

- Modifications are:

  Lid thickness is increased from 5/8" to ¾"

  Top flange thickness is increased from 5/8" to 1 /8"

  Bottom plate thickness is increased from 5/8" to 7/8"

- Barrel design incorporates a 3:1 safety factor.

- Most likely failure mode of cylindrical pressure vessel is rupture of the longitudinal seam weld.

- Bob Roseman (Gaspar Sales Engineer) recommends periodic inspection of the longitudinal seam weld in non-coded vessels. Labs should look for signs of corrosion and general weld integrity.

- Existing barrels can be modified to meet code.

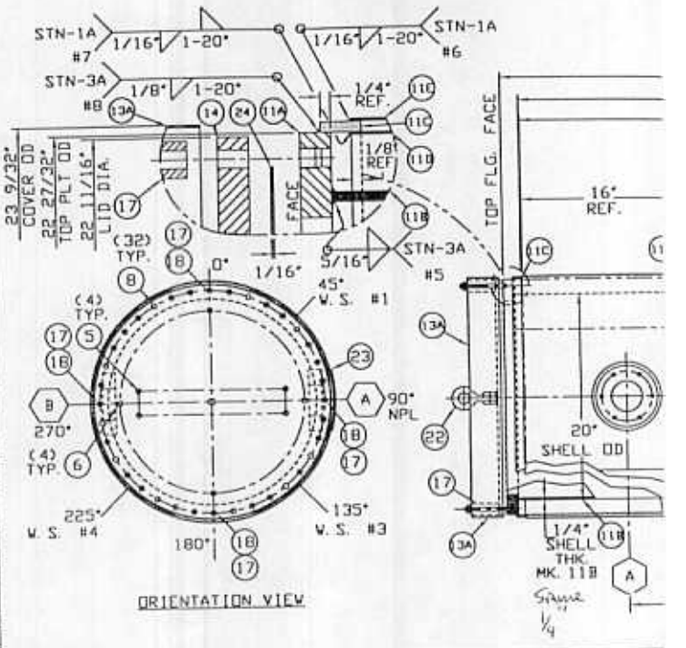
- Point of contact:

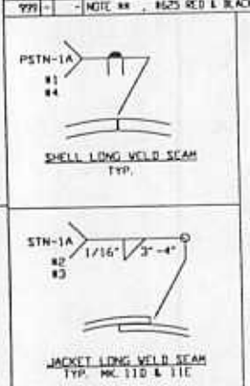
  Bob Roseman
  Gaspar, Inc.
  Welding & Fabrications
  4106 Mahoning Road NE
  Canton, OH 44705-4897
  (330) 453-7735 ext. 123

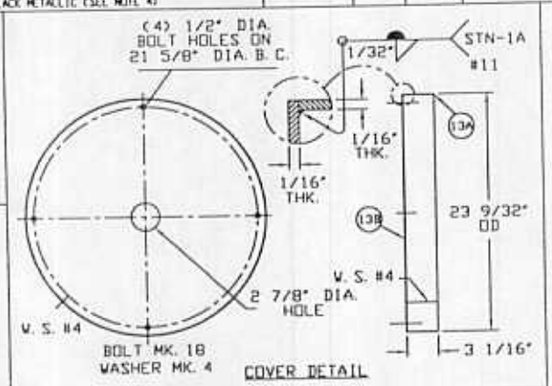
Att 9, PG 2/3

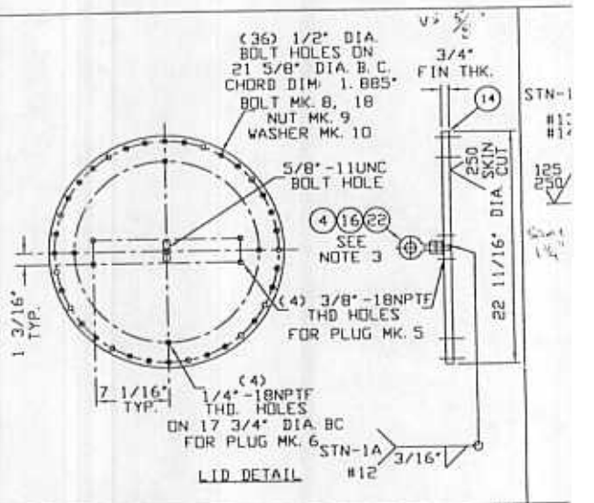
GASPAR JOB# : 620031
CUSTOMER NAME : MOBIL TECH
DESCRIPTION : PV/SS/20x48 FLAT LEG JCKT JOB / PROJECT# : -
PURCHASE ORDER# : L00-30024
PRINTING DATE : KLR 03/22/00
GASPAR QUOTE# : -, C1416 A/O
EQUIPMENT/TAG# : 699086

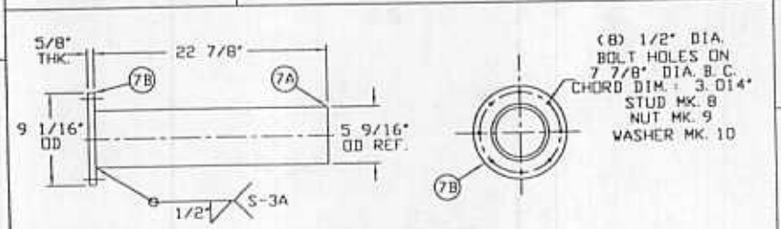
1	1A	-	1	PLATE , 5/8" THK X 15 3/4" WD X 15 3/4" LG, SPRT BASE	SA-36
	1B	-	1	PIPE , 6" SML X S/80 X 22 7/8" LG, OUTER SPRT LEG	SA-53/SA-106B
	2	-	9	BOLTING , 3/8" BOLT-CATERPILLAR PART# 0S-1594, OUT/INN SPRT LEG	-
	3	-	-	, DELETED	-
	4	-	1	BOLTING , 5/8" WASHER-CATERPILLAR PART# 8T-4122, BTM & EYE BOLT	-
	5	-	8	PLUG , CATERPILLAR PART# 8T-6767, BTM & TOP PLT	-
	6	-	8	PLUG , CATERPILLAR PART# 8T-6765, BTM & TOP PLT	-
	7A	-	1	PIPE , 5" SML X S/80 X 22 7/8" LG, INNER SPRT LEG	SA-53/SA-106B
	7B	-	1	PLATE , 5/8" THK X 9 1/16" OD, SPRT TOP	SA-36
	8	-	44	BOLTING , STUD-CATERPILLAR PART# 1J-8668, MAIN	-
	9	-	54	BOLTING , NUT -CATERPILLAR PART# 2N-2766, MAIN	-
	10	-	54	BOLTING , WASHER-CATERPILLAR PART# 9X-6458, MAIN	-
	11A	-	1	PLATE , 1 1/8" FIN THK X 22 27/32" FIN OD X 18 3/4" FIN ID, TOP	SA-240-304L
	11B	-	1	PIPE , 20" WLD X S/10 X 48" LG, SHELL	SA-312-TP304L
	11C	-	4	PLATE , 1/4" THK X 1" WD X 72 5/8" B/L (22 27/32" ID), BAR	SA-240-304L
2	11D	-	1	PLATE , 1/16" THK X 48" LG X 73" B/L (22 27/32" OD), INN JCKT	SA-240-304L
	11E	-	1	PLATE , 1/16" THK X 48" LG X 75" B/L (23 3/8" ID), OUTER JCKT	SA-240-304L
	11F	-	2	PLATE , 1 1/4" THK X 6" FIN OD X 3" FIN ID, NOZ A & STUD PAD	SA-240-304L
	11G	-	1	PLATE , 7/8" THK X 22 11/16" (+0", -1/16") OD, BTM PLT	SA-240-304L
	12	-	6	BOLTING , STUD-CATERPILLAR PART# 9X-1658, NOZ A	-
	13A	-	1	PLATE , 1/16" THK X 3" WD X 74 3/4" B/L(23 9/32" OD), CVR SIDE	SA-240-304L
	13B	-	1	PLATE , 1/16" THK X 23 9/32" FIN OD, COVER PLT	SA-240-304L
	14	-	1	PLATE , 3/4" FIN THK X 22 11/16" FIN OD, LID PLT	SA-240-304L
	15	-	-	-	-
	16	-	2	BOLTING , NUT -CATERPILLAR PART# 7X-0448, LID HANDLE	-
	17	-	4	SPACER , CATERPILLAR PART# 7C-9560, COVER / LID	-
	18	-	4	BOLTING , STUD-CATERPILLAR PART# 6L-4429, COVER TO LID	-
	19	-	-	-	-
	20	-	-	-	-
	21	-	-	-	-
3	22	-	1	BOLTING , EYE BOLT 5/8"-11NC X 2" LG, LID HANDLE	304L STN STL
	23	-	1	PLATE , 1/16" THK X 4 3/4" WD X 5" LG (REF), STD GASPAR MPL	SA-240-304L
	24	-	3	GASKET , 1/16" THK X 21 1/4" OD X 20" ID (SHIP 2 LOOSE), TOP	GARLOCK ##
	999	-	-	NOTE ## , #625 RED & BLACK METALLIC (SEE NOTE 4)	

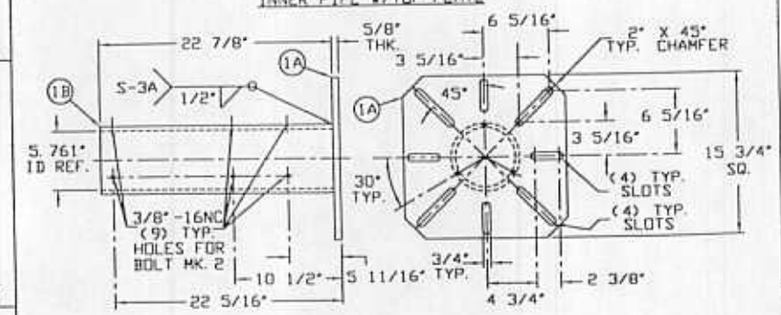


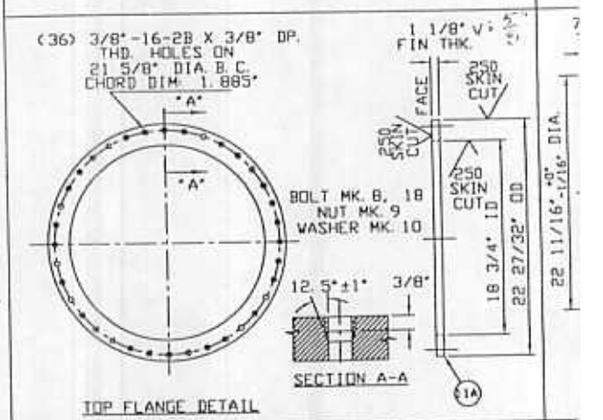












± 1/8"	FACE OF NOZZLE TO CENTERLINE OF EQUIPMENT.
± 1/8"	C.L. OF NOZZLE TO BASELINE OR DATUM REFERENCE.
1°	NOZ. FLNG FACE ALIGNMENT, C.L. TO EDGE, IN DEGREES #/SC
± 1/8"	PLAN LOCATION OF NOZ. OR SUPPORT LUGS FROM EQUIP. C.L. OR DATUM REF.
± 1/8"	FACE OF BOTTOM NOZZLE TO BASELINE OR DATUM REFERENCE.

CERTIFIED DIMENSIONAL
GASPAR I
BY: DATE:

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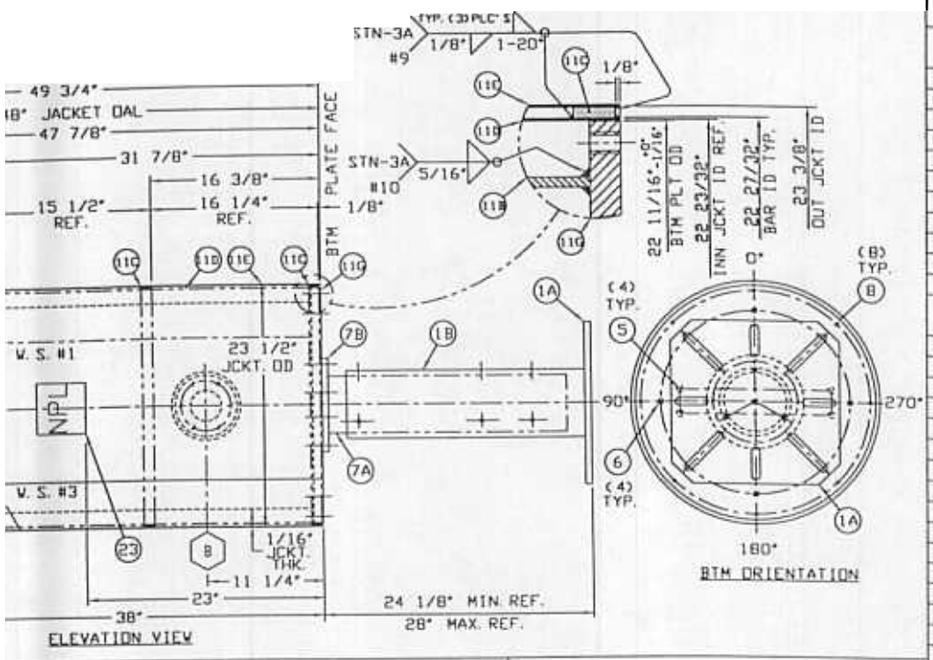

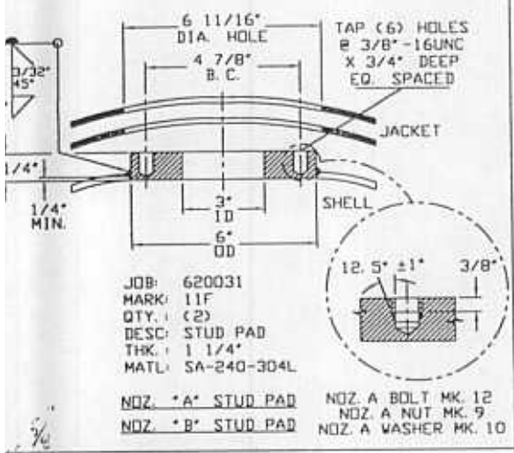

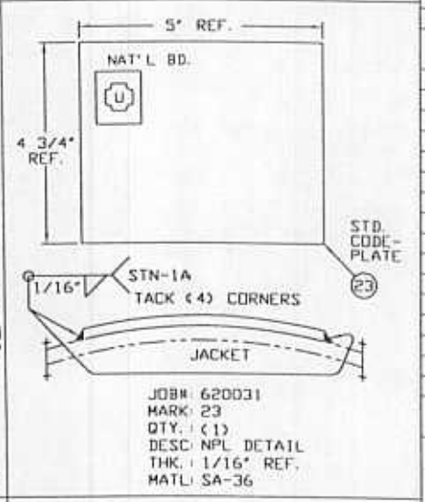

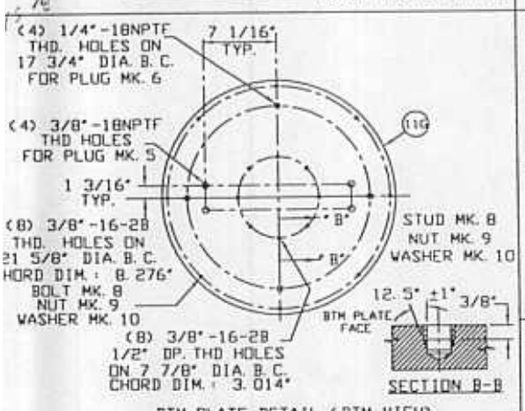

NAT'L BD. –
NATIONAL BOARD NO.

CERTIFIED BY GASPAR, INC.
CANTON, OHIO

SHELL SIDE
MAWP 37 PSI AT 1150 °F
MDMT -20 °F AT 37 PSI

TUBE SIDE
MAWP – PSI AT – °F
MDMT – °F AT – PSI

620031 MFG. SERIAL NO. 2000 YEAR BUILT

NO.	BY DATE	DESCRIPTION
4	–	–
3	–	–
2	–	–
1	–	–

REVISION

CONSTRUCTION MATERIALS

	VESSEL/SHELL SIDE	JACKET/TUBE SIDE
SHELL	SA-312-TP304L	SA-240-304L
HEAD	–	–
NOZZLE NECK	–	–
FLANGE	SA-240-304L	–
SUPPORTS	SA-36/SA-106B	
GASKET	*GARLOCK #625 RED & BLACK MET.	
BOLTING	CS	
NUT	CS	
TUBESHEET	–	
TUBES	–	
	* SEE NOTE 4.	

DESIGN CONDITIONS

			2
DESIGN PRES.	(+) 35 PSIG – VAC	– PSIG – VAC	
DESIGN TEMP.	760 1150 °F	– °F	
OPERATING PRES.	– PSIG – VAC	– PSIG – VAC	
OPERATING TEMP.	– °F	– °F	
MDMT	-20 °F	-20 °F	
HYDRO TEST	117.6 PSIG	– PSIG	
CORROSION ALLW.	0"		
CODE	ASME SECTION VIII DIV. 1 LATEST ADDENDUM	ASME SECTION VIII DIV. 1	
CODE STAMP	YES	–	
STRESS RELIEF	NONE	–	
RADIOGRAPH	NONE	–	
JOINT EFF.	.7	–	
SP. GR. PROD'T	–	–	3
SHIPPING SIZE	26" WD X 26" H X 81" LG		
EMPTY WEIGHT	1,000 LBS.		
FULL WT. (H_2O)	1,600 LBS.		
OPERATING WT.	– LBS.		

NOZZLE SCHEDULE

NOZ.	QTY.	SIZE-RATING	FLANGE	SCHED.	DESCRIPTION
A	1	6" OD	STUD PAD	–	–
B	1	6" OD	STUD PAD	–	–
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4

GENERAL NOTES

5

1) –
2) LUBRICATE ALL THREADS AND BEARING SURFACES BEFORE ASSEMBLY.
3) INSTALL EYE BOLT WITH THREAD END MOUNTED FLUSH WITH INSIDE SURFACE OF COVER.
4) #625 IS RATED FOR 450°F. HIGHER TEMPERATURES REQUIRE ASBESTOS GASKET MATERIAL.
5) SURFACE PREP SPEC: NONE
6) PAINT SPEC: NONE

GASPAR JOB #: 620031

CLIENT: [redacted]

P.O. NO.: [redacted] NUMBER OF UNITS: 1

INQUIRY #: – REFERENCE NUMBER: 699086

6

Gaspar, Inc.
CANTON, OHIO

DRAWING TITLE:
SS EXHAUST BARREL
PV/SS/20x48 FLAT LEG JCKT

7

DRAWN BY:	DRAWING NUMBER	REVISION
KLR 3-21-00	C-1416	A/0
CHECKED BY: –	SHEET 1 OF 1	